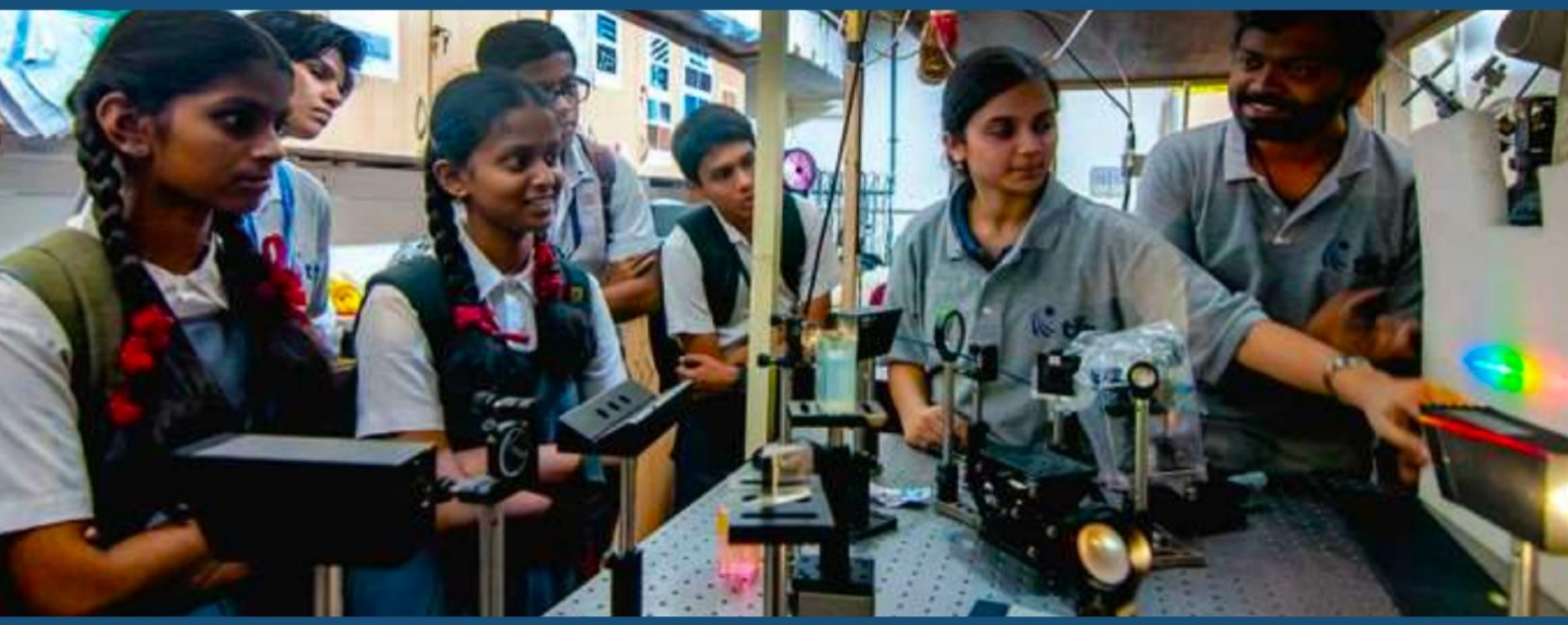

GENDER IN PHYSICS WORKING GROUP • INDIAN PHYSICS ASSOCIATION
& TATA INSTITUTE OF FUNDAMENTAL RESEARCH

10-14 JULY 2023

INTERNATIONAL CONFERENCE ON WOMEN IN PHYSICS

Section-A

Agnes Pockel Hall

8th International Conference on Women in Physics

Existence and formation of small amplitude electrostatic double-layer structure in superthermal plasma

Adnan, Muhammad

Department of Physics, Kohat University of Science and Technology (KUST), 26000, Kohat, Pakistan.

In the present work the effect of superthermal electrons on the formation and existence of double-layer structures in three-species plasma; inertial positive ions, superthermal electrons, and immobile negative dust-charged grains is studied. A modified Korteweg-de Vries equation is derived, following the reductive perturbation method for the wave propagation features of dust-ion-acoustic waves bearing superthermality aspects of the electrons. It is found that the superthermality index of electrons affects the properties of the formed double-layer structures in the configured plasma. The results are relevant to the shock/double layer structures observed in Q-machine experiments and the ionospheric regime of the earth.

ID-024

Title: Steep potentials in Warm Inflation

Speaker: Dr. Suratna Das

Abstract: Steep potentials in cold inflation leads to power-law type inflation where inflation does not exit gracefully as long as one considers standard general relativity. Warm inflation, a variant inflationary paradigm to the standard cold inflation scenario, can accommodate steep potentials very easily. Not only inflation gracefully exits in these Warm Inflationary scenarios, but they also lead to observationally viable models. Warm inflation with steep potentials can also be on par with the recently proposed Swampland Conjectures in String Theory, which makes them viable model of inflation which can be constructed within String Landscapes. In this talk we will discuss such aspects of Warm Inflation with steep potentials.

arXiv no: 2005.01122 [gr-qc], 2007.15268 [hep-th], 2212.13914 [astro-ph.CO]

8th International Conference on Women in Physics

Depth profile of natural gamma-emitting radionuclides in the soils between Kathmandu and Makawanpur

Mishra Anita, Khanal Raju

Central Department of Physics, Tribhuvan University, Kirtipur, Kathmandu 44613, Nepal.

The natural radiation emitted by gamma-emitting radionuclides in Earth's crust poses a potential threat to human health. Therefore, it is crucial to assess the vertical distribution of radionuclides in soil to understand their mobility and transfer in the environment. In this study, we used in-situ gamma ray spectrometry to measure the concentrations of natural radionuclides (^{40}K, ^{238}U and ^{232}Th) in soil at eight selected locations between Kathmandu and Makawanpur. The measurements were taken at 10 cm intervals up to a depth of 50 cm. Our results show that the average dose rates and average concentrations of ^{40}K, ^{238}U and ^{232}Th in the soil profiles range from 84.4 to 246.0 nGy/h, 1.4 to 9.2 %, 4.7 to 10.6 ppm, and 12.6 to 43.3 ppm, respectively. These values are higher than the world average. We also observed a homogeneous depth distribution of natural radionuclides. To understand the behaviour of radionuclides, we calculated activity ratios. The Th/U, Th/K, and U/K ratios of the studied soil depth profiles suggest that they are environmental profiles. Furthermore, we found that the activity ratios were approximately constant in the soil profiles, indicating that the radionuclides have the same geochemical origin. In conclusion, our study provides insights into the vertical distribution of natural radionuclides in soil between Kathmandu and Makawanpur Nepal. Our findings highlight the importance of monitoring and managing natural radiation sources to protect human health and the environment.

Keywords: primordial radionuclides, vertical distribution, gamma spectrometry, Nepal

Resolving hierarchy problem with dimension-six effective operators and Naturalness

Biswas Ambalika[1], Kundu Anirban[2], Mondal Poulami[2]

[1] Department of Physics, Banwarilal Bhalotia College, GT Road, Ushagram, Asansol, West Bengal, 713303, India

[2] Department of Physics, University of Calcutta,92 Acharya Prafulla Chandra Road, Kolkata, West Bengal, 700009, India

Without any mechanism to protect its mass, the self-energy of the Higgs boson diverges quadratically, leading to the hierarchy or fine-tuning problem. One bottom-up solution is to postulate some yet-to-be-discovered symmetry which forces the sum of the quadratic divergences to be zero, or almost negligible; this is known as the Veltman Condition. Even if one assumes the existence of some new physics at a high scale, the fine-tuning problem is not eradicated, although it is softer than what it would have been with a Planck scale momentum cut-off. We study such divergences in an effective theory framework, and construct the Veltman Condition with dimension-6 operators. We show that there are two classes of diagrams, the one-loop and the two-loop ones, that contribute to quadratic divergences, but the contribution of the latter is suppressed by a loop factor of $1/16\pi^2$. The Wilson coefficients of these higher-dimensional operators that contribute to the former class play an important role towards softening the fine-tuning problem. We find the parameter space for the Wilson coefficients that satisfies the extended Veltman Condition. The parameter space is consistent with the theoretical and experimental bounds of the Wilson coefficients, and should act as a guide to the model builders.

The effective field theory Lagrangian is,

$$\mathcal{L} = c_{4i} O_i^{d=4} + \frac{1}{\Lambda^2} c_{6i} O_i^{d=6} \,, \tag{1}$$

where c_{4i} and c_{6i} are dimensionless constants. The VC now takes the form $F\left(c_{4i}, c_{6i}\right) \approx 0$. Our aim will be to find out the parameter space for the c_{6i} coefficients. The relevant operators in the SMEFT are,

$$O_{WW} = \Phi^\dagger \widehat{W_{\mu\nu}}\, \widehat{W^{\mu\nu}} \Phi \,, \quad O_{BB} = \Phi^\dagger \widehat{B_{\mu\nu}}\, \widehat{B^{\mu\nu}} \Phi \,, \quad *O_{GG} = \Phi^\dagger \Phi \widehat{G_{\mu\nu}}\, \widehat{G^{\mu\nu}} \,, \tag{2}$$

$$O_W = (D_\mu \Phi)^\dagger \widehat{W^{\mu\nu}} (D_\nu \Phi) \,, \quad O_B = (D_\mu \Phi)^\dagger \widehat{B^{\mu\nu}} (D_\nu \Phi) \,, \quad O_{\phi,1} = (D_\mu \Phi)^\dagger \Phi\, \Phi^\dagger (D^\mu \Phi) \,, \tag{3}$$

$$O_{\phi,2} = \tfrac{1}{2}\, \partial^\mu (\Phi^\dagger \Phi)\, \partial_\mu (\Phi^\dagger \Phi) \,, \quad O_{\phi,3} = \tfrac{1}{3}\, (\Phi^\dagger \Phi)^3 \,, \quad O_{\phi,4} = (D_\mu \Phi)^\dagger (D^\mu \Phi)\, \Phi^\dagger \Phi \,, \tag{4}$$

where

$$\widehat{B_{\mu\nu}} = \frac{i g'}{2} B_{\mu\nu} \,, \quad \widehat{W_{\mu\nu}} = \frac{i g}{2} \sigma^a W^a_{\mu\nu} \,, \widehat{G_{\mu\nu}} = \frac{i g_s}{2} \lambda^a G^a_{\mu\nu} \,, \tag{5}$$

g, g' being the $SU(2)_L$ and $U(1)_Y$ gauge couplings respectively, and λ^a, σ^a are the Gell-Mann and Pauli matrices. The modified VC reads $\frac{1}{16\pi^2}\left[\left(6\lambda + \frac{3}{4} g_1^2 + \frac{9}{4} g_2^2 - 6 g_t^2\right) + \sum_i f_i\right] \leq \frac{\delta m_h^2}{\Lambda^2}$

Our results for exact cancellation of the quadratic divergences for $\Lambda = 100$ TeV and 10^6 TeV are,

$\Lambda = 100$ TeV $\mid$ $c_{\phi,1} = c_{\phi,4} = 2c_{\phi,2} = -1.15 \,, c_{BB} = c_B = -21.5 \,, c_{WW} = c_W = -4.13 \,, c_{GG} = -0.78 \,,$

$\Lambda = 10^6$ TeV $\mid$ $c_{\phi,1} = c_{\phi,4} = 2c_{\phi,2} = -1.03 \,, c_{BB} = c_B = -17.3 \,,\ c_{WW} = c_W = -4.20 \,, c_{GG} = -1.11 \,.$

We find that there are only eight operators that contribute to the Veltman condition. It turns out that at least one of the WCs has to be negative, but they are all consistent with a high-scale perturbative theory. The parameter space that we find is compatible with other theoretical and experimental constraints. Thus, this study should set a benchmark for the model builders.

8th International Conference on Women in Physics

Proton structure function and parton distributions at small and large *x*

Jahan, Akbari[1]

[1]*Department of Physics, North Eastern Regional Institute of Science and Technology, Nirjuli - 791109, Arunachal Pradesh, India.*

The dynamics of the interaction of partons inside the proton result in their momenta distribution, that is expressed in terms of parton distribution functions (PDFs). The hard scale scattering in quantum chromodynamics (QCD) is usually associated with the assay of PDFs. The proton structure function and its partonic structure have been better apprehended following the studies of PDFs in deep inelastic scattering (DIS) [1]. Also, with the advent of the Large Hadron Collider (LHC), the knowledge of PDFs has become more significant. As PDFs are inestimable from the first principles, they are evaluated by making appropriate theoretical assumptions [2]. In the present work, three main global PDF sets, viz. CT10, MSTW2008 and NNPDF30, have been discussed and the plots of different quark flavours and gluons have been obtained for these PDFs in a wide range of energy scale Q and momentum fraction x [3]. A comparative study of the proton structure function and the corresponding parton distributions apropos these global PDFs have been done at small and large x. While both the distributions decline sharply, the gluon distribution functions are found to be more vast as compared to the sea quark distribution functions at large Q as well as at large x.

References:

1. R. Devenish, and A. Cooper-Sarkar (2004), Deep Inelastic Scattering, *Oxford University Press*, Oxford, ISBN: 9780198506713
2. Jacob J. Ethier and Emanuele R. Nocera, Parton distributions in nucleons and nuclei, *Annu. Rev. Nucl. Part. Sci.* **70**, 43 (2020)
3. V. Bertone, S. Carrazza and J. Rojo, APFEL: A PDF Evolution Library with QED corrections, *Comput. Phys. Commun.* **185**, 1647 (2014)

8th International Conference on Women in Physics

The torsion of stellar streams and the shape of galactic gravity's source

Bariego-Quintana, Adriana[1], *Llanes-Estrada Felipe J.*[2]

[1]*IFIC, Universidad de Valencia, c/ Catedrático José Beltrán, 2, E-46980 Paterna, Valencia, Spain.*
[2] *IPARCOS & Dept. Física Teórica, Universidad Complutense de Madrid, Plaza de las Ciencias 1, 28040 Madrid, Spain*

Flat rotation curves v(r) are naturally explained by elongated (prolate) Dark Matter (DM) distributions [1], and we have provided competitive fits to the SPARC database [2]. To further probe the geometry of the halo, or the equivalent source of gravity in other formulations, one needs out-of-plane observables.

Stellar streams, poetically analogous to airplane contrails, but caused by tidal dispersion of massive substructures such as satellite dwarf galaxies, would lie on a plane (consistently with angular momentum conservation) should the DM-halo gravitational field be spherically symmetric. Entire orbits are seldom available because their periods are commensurable with Hubble time, with streams often presenting themselves as short segments.

Therefore, we aim at establishing stellar stream torsion, a local observable that measures the deviation from planarity in differential curve geometry, as a diagnostic providing sensitivity to aspherical DM distributions which ensures the use of even relatively short streams.

We perform small-scale simulations of tidally distorted star clusters to check that indeed a central force center produces negligible torsion. Turning to observational data [3], we identify among the known streams those that are at largest distance from the galactic center and likely not affected by the Magellanic clouds, as most promising for the study, and by means of polynomial fits we extract their differential torsion.

We find that the torsion of the few known streams that should be sensitive to most of the Milky Way's DM Halo is much larger than expected for a central spherical bulb alone. This is consistent with nonsphericity of the halo.

Future studies of stellar stream torsion with larger samples and further out of the galactic plane should be able to extract the ellipticity of the halo to see whether it is just a slight distortion of a spherical shape or rather ressembles a more elongated cigar

References:

1. F. J. Llanes-Estrada. Elongated Gravity Sources as an Analytical Limit for Flat Galaxy Rotation Curves, Universe, 7, 346 (2021).
2. A. Bariego-Quintana, F. J. Llanes-Estrada, O. Manzanilla Carretero. Galaxy rotation favors prolate dark matter haloes (2023), ArXiv e-prints, arXiv: 2204.06384, to appear in Phys.Rev.D *in press*
3. C. Mateu. galstreams: A library of Milky Way stellar stream footprints and tracks, Monthly Notices of the Royal Astronomical Society, 520, 5225 (2023).

8th International Conference on Women in Physics

Development of Neutron Interrogation System for Illicit material

Bishnoi Saroj

Technical Physics Division, Bhabha Atomic Research Centre, Mumbai, India.

Neutron interrogation techniques offer unique capabilities towards non-intrusive and non-destructive imaging and detection of low Z materials in comparison to X-ray/gamma-based techniques due to unique interaction properties of neutrons. Low Z materials, particularly if composed of carbon (C), oxygen (O), nitrogen (N) elements, are of interest because most of the threat materials including chemical explosive, narcotics chemical weapons are primarily composed of these elements. X-ray based scanning systems provide information related to shape, size and relative density of the interrogated object and are ideally suitable for detection of metallic objects with distinctive shapes and sizes. However, most of the current potential threats composed of low Z elements (such as narcotics and explosives), do not pose unique or specific discernible shapes and these systems fails to differentiate them from benign materials. These challenges can overcome and material identification can be improved with the use of neutron-based techniques. In neutron interrogation, the methodology rests on the principle of detecting elemental composition of the inspected volume and elemental ratios of C, N, O (such as C/O, N/O, C/N etc) can be used for discrimination between threat and commonly used material.

In this direction, an advanced neutron imaging techniques "Associated Particle Imaging Technique (API)" has been investigated and implemented successfully with in-house developed D-T neutron generator [1,2]. API based system provides improved signal-to- noise ratio and can reconstruct the 3D location of the suspect inside a large volume such as cargo, truck etc (Fig1). Proof-of-concept experiments performed at lab scale with various benign and illicit material simulants (RDX, C4 etc) and has validated the efficacy of the developed API system toward illicit material detection. The simulation, data analysis methodology, software tools for the data acquisition, unfolding and image reconstruction and material classification have been developed indigenously for performing relevant experiments and analysis. In the conference, research work performed on API interrogation technique towards system development and its performance highlighting experimental work guided by simulations will be presented as well as challenges associated with its implementations for field applications will be discussed.

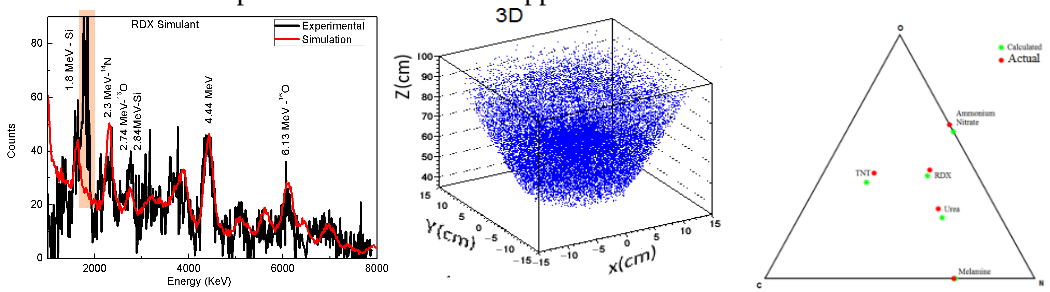

Fig1: (Right) Energy spectrum of a simulant obtained with API system, (Middle) reconstructed 3D location of the suspect, (Left) material identification using C, N, O elemental ratios.

References

1. V. Valkovic et al., Neutron-charged particle coincidence measurement from 14.4 MeV neutron induced reactions. *Nucl. Instrum. Methods 76, 29–34 (1969)*
2. Saroj Bishnoi, T. Patel, R. G. Thomas, R. Jilju, P. S. Sarkar, B. K. Nayak, Study of tagged neutron method with laboratory D-T neutron generator for explosive detection, *Eur. Phys. J. Plus (2020) 135:428.*

New physics sensitivities of some $b \to c(u)l\bar{\nu}_l$ decay modes

Mawlong Barilang, Jain Karthik
School of Physics, University of Hyderabad, Hyderabad 500046, Telangana, India

Neutrino oscillations, dark matter, baryon asymmetry in the Universe are just some of the phenomena that the standard model of particle physics cannot explain and these suggest the need for new physics beyond the SM. The existence of new physics has also been strongly indicated by the high precision measurement of the muon anomalous magnetic moment. In the flavor sector, the anomalies observed in the B meson modes, such as those mediated by the $b \to c\tau\bar{\nu}_\tau$ transitions, additionally provide hints to probe for new physics. Motivated by these observations, in this work, we analyze some decay modes mediated by the $b \to cl\bar{\nu}_l$ transitions, as well as the $b \to ul\bar{\nu}_l$ transitions, and explore their sensitivities to various NP interactions.

8th International Conference on Women in Physics

Comparison of Daily Ground Measurement and Satellite-based Solar Radiation – Nepal Experience

Usha Joshi[1,2*], *N. P. Chapagain*[3], *I. B. Karki*[1], *K. N. Poudyal*[4]

[1]*Department of Physics, Patan Multiple Campus, Tribhuvan University, Patan, Nepal*

[2]*Central Department of Physics, Tribhuvan University, Kirtipur, Nepal*

[3]*Department of Physics, Amrit Campus, Tribhuvan University, Kathmandu, Nepal*

[4]*Department of Applied Sciences and Chemical Engineering Pulchowk Campus, IOE, Tribhuvan University, Patan, Nepal*

**Email: ushajoshik1967@gmail.com,*

Precise estimation of global solar radiation (GSR) is essential to the design and assessment of solar energy utilization systems. Ground measurement solar radiation data are unsatisfactory in developing countries both qualitatively and quantitatively. Satellite estimated data can effectively fulfill this void of solar radiation data. This study aimed to compare and assess daily global solar radiation measured on the ground and satellites using data from NASA-POWER for 24 meteorological stations over Nepal with differing levels clearness index and daily data directly. This makes it possible to determine the applicability of approximated satellite data in locations without access to weather data. On comparison of daily data of solar radiation, the ranges of statistical tools were obtained as the coefficient of determination (0.3 – 0.82), Root Mean Square Error (2.4 – 5.5 MJ/m^2/day), Mean Bias Error (-2,87 – 4.14 MJ/m^2/day and PRMSE (16.23-43%). For cloudy days and partially cloudy days, the maximum solar ground measured radiation was underestimated by satellite data, whereas the overestimation of ground-based data for clear days was observed. For high altitude stations, solar radiation by satellite data is underestimated. Over all, ground-measured GSR data is lowered by approx.—7.25% than the Satellite data of GSR. Vitality of solar radiation in harnessing the sun as a renewable resource highlight the value of obtained results.

Key Words: Global solar radiation, satellite data, meteorological stations, statistical tools.

8th International Conference on Women in Physics

Neutron Imaging: Basics and Applications

Shukla Shefali[1,2] , *Roy Tushar*[1], *More M.R.*[1], *Kashyap Y.S.*[1,2], *Singh Prashant*[1,2] , *Shukla Mayank*[1,2]

[1]*Bhabha Atomic Research Centre, Mumbai, India.*
[2]*Homi Bhabha National Institute, Mumbai, India*

Neutron Imaging is a non-destructive technique used for visualising the internal structures of materials. The basic principle is similar to X-ray radiography: a beam of neutrons passes through the sample and is attenuated because of neutron matter interaction; the transmitted beam is then recorded on 2D detector. The interaction of neutron and X-rays differ as the former interacts with the nucleus while the latter with the electron cloud. The neutrons have an advantage that they are highly attenuated by light elements like C, H, B, Li and can penetrate heavy materials like Pb and Ti. Thus neutron imaging has an edge over X-ray imaging when it comes to low Z materials shielded in high Z materials [1].

The neutrons are a versatile probe and with state of imaging beamlines being established this technique now finds usage in various domains ranging from archaeology to material science and from reactor applications to biological applications. Figure1 shows a schematic of a neutron imaging set-up which includes a neutron source, collimator, sample manipulator set-up and a 2D detector. A thermal neutron imaging beamline has been set up at Dhruva reactor, India. In this paper we present the basics of neutron imaging, details of the facility along with the various studies currently being pursued in India [2-4].

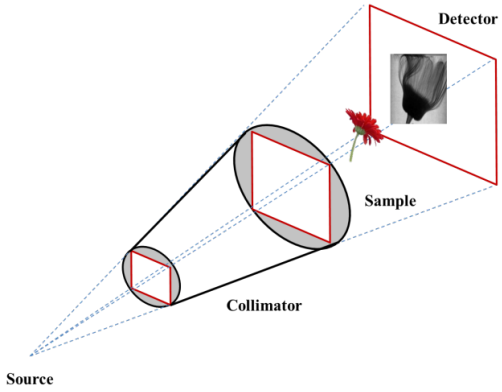

Figure 1: Schematic of Neutron Imaging set-up

References:

1. D.K. Aswal, P.S.Sarkar, Y.S.Kashyap, Neutron Imaging:Basics, Techniques and Applications: Springer Book. (2022)
2. M. Shukla, T. Roy, Y.S. Kashyap, S. Shukla, P. Singh, R. Baribaddala, T. Patel, S. C. Gadkari; Development of neutron imaging beamline for NDT applications at Dhruva India.: Nuclear Instruments & Methods-A 889, 63-68 (2018)
3. S. Shukla, P. Singh, T.Roy, Y.S.Kashyap, M.Shukla, R.N.Singh; Investigation of hydrogen diffusivity in Zr-2.5%Nb alloy pressure tube material using metallography and neutron radiography.: Journal of Nuclear Materials, volume 544, 152679.(2021)
4. S.Shukla, R.N.Singh, Y.S.KAshyap, T.N.Murty, N.Keskar, T.Roy, P.Singh, M.Shukla; Anisotropy study of Hydrogen diffusion along different directions of Zr-2.5%Nb alloy pressure tube using Neutron Imaging: Journal of Nuclear Materials, volume 580, 154414.(2023)

8th International Conference on Women in Physics

Low energy phase shift and cross-section analysis of p-He^3 system

Swain Biswanath[1], *Laha Ujjwal*[2]

[1]*Department of Physics, National Institute of Technology, Jamshedpur, 831014, India.*
[2]*Department of Physics, National Institute of Technology, Jamshedpur, 831014, India*

The phase function method (PFM) is an efficient tool for evaluating scattering phase shifts and is mostly useful for those potential for which the Schrödinger equation does not have exact analytical solution. In the said method, the radial Schrödinger equation is converted into a first order non-linear differential equation of Riccati type known as phase equation. The function that satisfies the Riccati equation/phase equation termed as the phase function and has at each point the meaning of the phase shift of the wave function for scattering by potential at that point. This helps in investigation of different regions of the potential in producing the phase shift. Following this method one can directly determine the scattering phase shift for local potential. But the case is not obvious for non-local or local plus non-local interaction and PFM needs some modification for such type of interactions. A non-local potential is a function of two variables namely r and its neighbouring point r^{δ} and is used to consider the recoil effect of the target. Laha et al. [1] generalized the traditional PFM to study the system involving local plus nonlocal separable potential and advocated the usefulness of this new approach to potential scattering. In the current text, following the approach of [1] we derive a closed form expression for scattering phase shifts for Deng-Fan [2] plus Graz [1] separable potential. Deng-Fan potential, a molecular potential, proposed to describe the vibrational spectra of a diatomic molecule. As Deng-Fan potential satisfies correct physical boundary conditions at $r = 0$ and $r = \infty$, it is consistent with the quantum needs and can be a good choice for studying quantum physical systems. Here we consider Deng-Fan potential as a short range electromagnetic potential adding to Graz separable potential to study scattering phase parameters for p-He^3 system. By exploiting the phase shifts we also calculate the differential cross-section for the concerned system. We notice that our result is in close conformity with the previous works [3, 4].

References:

1. G. C Sett, U. Laha and B. Talukdar, Phase function method for Coulomb-distorted nuclear scattering, J. Phys. A:Math. Gen. **21**, 3643 (1988)
2. Z. H. Deng and Y. P. Fan, A Potential Function of Diatomic Molecules, J. Shandong Univ. (Natural Sci.) **1**, 162 (1957)
3. T. V. Daniels, C. W. Arnold, J. M. Cesaratto, T. B. Clegg, A. H. Couture, H. J. Karwowski, and T. Katabuchi, Spin-correlation coefficients and phase-shift analysis for p + ^{3}He elastic scattering, Phys. Rev. C **82**, 034002 (2010)
4. M. Viviani , L. Girlanda, A. Kievsky and L. E. Marcucci, n + ^{3}H, p + ^{3}He, p + ^{3}H, and n + ^{3}He scattering with the hyperspherical harmonic method, Phy. Rev. C **102**, 034007 (2020)

Determination of ^{58}Co(γ,xp)cross section via the surrogate ratio method

Akbar, Shaima[1], M.M Musthafa[1], C.V Midhun[1], S.V Suryanarayana[2,3],Jyoti Pandey[4,5]

[1] Department of Physics, University of Calicut, Malappuram - 673635, Kerala, India

[2] Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai - 400085, India

[3] Manipal Centre for Natural Sciences, MAHE, Manipal - 576014, India

[4] Department of Physics, G.B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand - 263145, India

[5] Inter University Accelerator Centre, New Delhi - 110067, India

A significant level of high-energy photons is produced inside the fusion reactors as a result of neutron interaction with the structural materials and during the tritium breeding stage. The energetic photons also contribute to gas formation through the photonuclear reactions and result in swelling and stress formation[1]. Hydrogen gas is one such product formed via (γ,xp) reaction channel. ^{58}Co(γ,xp) is one of the major reaction channels as we consider the production of hydrogen isotopes. ^{58}Co is an important radioisotope produced inside the nuclear reactor due to the continuous exposure of neutrons on the reactor structural materials. ^{58}Ni(n,p), ^{59}Co(n,2n),^{60}Ni(n,t), etc., are the major pathways leading to the production of ^{58}Co. This ^{58}Co will undergo photon-induced reactions by the prompt gamma rays produced inside the reactor itself. Considering the ^{58}Co target which is highly unstable, the direct measurement of this reaction is not feasible. In the present work, the photonuclear cross sections of ^{58}Co(γ,xp) reaction have been studied via the surrogate ratio technique [2].

To determine the photon-induced nuclear reaction cross-section, the neutron-induced reaction is selected as a reference reaction. In a compound nuclear reaction, the decay probability does not depend on the formation of the compound. Hence in the surrogate reaction method, which is a two-step process, we can choose neutron induced reaction as the reference reaction to determine the photonuclear cross section. The compound nuclei ^{58}Co and ^{61}Ni was populated through the transfer reactions ^{56}Fe(^{6}Li,α) at E_{lab} = 35.9 MeV and ^{59}Co(^{6}Li,α) at E_{lab} = 40.5 MeV respectively. The projectile-like fragments (α) and evaporated protons are measured in coincidence to obtain the decay probabilities of the compound nuclei. The reference reaction data of ^{60}Ni(n,xp) reaction is taken from the JENDL-4.0 data library[3]. Theoretical model calculations are performed using the nuclear reaction code Talys 1.96[4].

References:

1. B. Pandey, V. V. Desai, S. V. Suryanarayana, B. K. Nayak, A. Saxena, E. T. Mirgule, S. Santra, K. Mahata, R. Makawana, M. Abhangi, T. K. Basu, C. V. S. Rao, S. Jakhar, S. Vala, B. Sarkar, H. M. Agrawal, G. Kaur, P. M. Prajapati, A. Pal, D. Sarkar, and A. Kundu. Phys. Rev. C vol.**93**, 021602(R) (2016)
2. Escher, J. E. and Burke, J. T. and Dietrich, F. S. and Scielzo, N. D.and Thompson, I. J. and Younes W. Rev. Mod. Phys. vol.**84**, pages 353-397,(2012)
3. K. Shibata, O. Iwamoto, T. Nakagawa, N. Iwamoto, A. Ichihara, S. Kunieda, S. Chiba, K. Furutaka, N. Otuka, T. Ohsawa et al. J. Nucl. Sci. Technol. vol.**48**, 1 (2011)
4. A. J. Koning and S. Hilaire and S. Goriely, G A Nuclear Reaction Program, User Manual, NRG, Petten, Netherlands, (2021)

8th International Conference on Women in Physics

The dark matter direct search at JUSL : the present status

Das Mala[1,2], *Ali Suraj*[3] , *Kumar Vimal*[1,2]

[1]*HENPP Division, Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Kolkata-700064, India*
[2]*Homi Bhabha National Institute, Training School Complex, Anushakti Nagar, Mumbai 400094, India*
[3]*Physics Department, Jadavpur University, 188, Raja S.C. Mallick Rd, Kolkata - 700032, India*

The Jaduguda Underground Science Laboratory is situated at the 555m deep underground at the Jaduguda mine at UCIL, India. One of the main experiments at JUSL is the dark matter direct search experiment with superheated liquid detector [1]. Dark matter (DM) consists of about 27% of the mass energy budget of the Universe and the detecting and exploring the nature of DM is an important topic of research in Astro-particle Physics. Among the several candidates, the WIMPs (Weakly Interacting Massive Particles) are the most favourable candidates of DM. The DM does not emit or reflect electromagnetic radiation and it can be inferred through the gravitational interaction only. Therefore it is very challenging to detect the dark matter by the usual particle detection method and the events are dominated by the backgrounds. The backgrounds can be of intrinsic contaminations of the detector material or can be external sources of radioactive material and cosmic rays. The radiation backgrounds like, neutrons, gamma-rays, cosmic muons, radon etc have been measured and/or simulated at JUSL [2] and more advanced measurements are under-way. The detector for DM search has been fabricated at the laboratory in a small scale, 500ml with active superheated liquid and coupled to the acoustic sensor and FPGA-based DAQ system [3]. The system ran at the underground lab for about 4 months at 5.8 keV threshold and few kg-days of exposure were obtained. The calibration run was carried out with ^{241}Am-Be neutron source and with neutrons from Li(p,n) reaction at the cyclotron. Event by event analysis has been carried out. The preliminary results on the upper limit on WIMP-nucleon cross section for a WIMP mass of this run will be presented in this conference. The R & D for the larger exposure for the near future run is going on.

References:

1. S. Seth, S. Sahoo, P. Bhattacharjee and M. Das, Probing low-mass WIMP candidates of dark matter with tetrafluoroethane superheated liquid detectors, Phys. Rev. D **101**, 103005 (2020).
2. S. Ghosh, S. Dutta, N. K. Mondal, S. Saha, Measurements of gamma ray, cosmic muon and residual neutron background fluxes for rare event search experiments at an underground laboratory, Astropart. Phys. **139**, 102700 (2022).
3. S. Sahoo, N. Chaddha, S. Sahoo, N. Biswas, A. Roy, M. Das, S. Pal, FPGA-based multi-channel data acquisition system for Superheated Emulsion Detectors, Nucl. Instrum. Meth. A **1009,** 165457 (2021).

8th International Conference on Women in Physics

Fast timing characteristics with 1.5″ × 1.5″ $CeBr_3$ detectors

(Das, Sneha) [1,2], (Bhattacharyya, S)[1,2], (Bhattacharya, Soumik)[1]
[1] Variable Energy Cyclotron Centre, Kolkata-700064, India
[2] Homi Bhabha National Institute, Anushaktinagar, Mumbai-400094, India

The lifetime of the nuclear excited states is an important parameter which can be measured by $\gamma - \gamma$ electronic coincidence method depending on the time and energy resolution of the detector system. With the availability of new generation scintillator detectors with reasonably good energy resolution, the precise measurement of lifetime in sub nanosecond ranges have been possible. At Variable Energy Cyclotron Centre (VECC), Kolkata, 1.5″× 1.5″ $CeBr_3$ detectors coupled with a new Photo-Multiplier tube Hamamatsu R13089-100 has been characterized [1]. The typical energy and time resolution obtained with 1.5″ × 1.5″ $CeBr_3$ detectors are 4.1% (at 662 keV of ^{137}Cs source) and 199(2) ps (for 1173 -1332 keV cascade of ^{60}Co source). The systematic variation of the time-resolution for different PMT bias voltages and external CFD delays has also been studied. It has been observed that the time resolution improves with shorter CFD delays and higher PMT bias voltages. With the knowledge of the basic characteristics of two detector set-up, time-walk response for this set-up has been determined using Mirror Symmetric Centroid Difference (MSCD) method [2]. In order to calibrate the Prompt Response Function (PRF) of the experimental set-up for the energy range of interest, Prompt Response Difference (PRD) calibration curve [3] has been determined for two 1.5″ × 1.5″ $CeBr_3$ detectors with ^{152}Eu source. To investigate the effect of the PMT bias voltage and the external CFD delays on the PRD curves, the variation of the PRD curve has been studied at different PMT bias voltages and CFD external delays.

The nuclei in the close proximity of double magic shell closure of ^{208}Pb are expected to have spherical structure at lower spin and collective structure at higher spin and excitation energies. For even-even Po (Z=84) isotopes, the variation of $R_{4/2}$ ratio approaches towards vibrational limit as neutron holes increase whereas, E2 transition strength increases from ^{210}Po to ^{206}Po [4]. The low-lying states of neighbouring odd-A nuclei in this region are mainly described by the coupling of one neutron hole with the nearest even-even core. The lifetime measurement of low-lying states of Po isotopes will be of great importance to understand how the collectivity arises for the lower and the higher spin states. In this regard, the lifetime of $11/2^-$ state of ^{209}Po, has been measured with two 1.5″ × 1.5″ $CeBr_3$ detectors in MSCD method. The ^{209}Po has been populated via electron capture decay of ^{209}At, which has been produced using the reaction ^{209}Bi (α,4n)^{209}At at VECC, Kolkata with 52 MeV α beam from K-130 cyclotron. The lifetime of $11/2^-$ state at 1521.85 keV of ^{209}Po has been obtained as 98(6) ps using 239-195 keV cascade [5], which is found to be in good agreement with a recently reported value [6].

References:

1. Soumik Bhattacharya, et al., NIM A 1014, 165737(2021)
2. J.-M.Regis, et al., NIM A 622 (2010) 83-92
3. J.-M.Regis, et al., NIM A 684 (2012) 36-45
4. M. Stoyanova, et al., PRC 100, 064304 (2019)
5. Sneha Das, et al., JINST 17 (2022) P09012
6. V. Karayonchev, et al., PRC 103, 044309 (2021)

8th International Conference on Women in Physics

Predicting solar wind using reservoir computing

Ibiyinka A. Fuwape [1,2,a] , Samuel T. Ogunjo[1] , Babatunde Rabiu [3,4] and Aderonke Obafaye [3]

1 Department of Physics, Federal University of Technology, P.M.B. 704, Akure, Ondo State, Nigeria

2 Office of the Vice Chancellor, Michael and Cecilia Ibru University, Ibru Village, Agbarha-Otor, Ughelli North, Delta State

3 United Nations African Regional Centre for Space Science Technology and Education – English (UN-ARCSSTE-E), Obafemi Awolowo University Campus, Ile Ife, Nigeria

4 Institute for Space Science and Engineering, African University of Science and Technology, Abuja, Nigeria

a) Corresponding author: iafuwape@futa.edu.ng

The sun is the main driver of solar activity and determinant of space weather. Space weather has significant impact on terrestrial infrastructure and weather including but not limited to satellite-to-earth signal attenuation and destruction of pipelines. It is not enough to understand space variables and their variability, there is the need to predict their trajectory. Several work has been done in this regard [1], [2]. Long term prediction will help in mitigating, adapting, and preparing for their impact. In this study, an attempt has been made to predict solar wind using reservoir computing algorithm – echo state network. Using past states of solar wind and 100 reservoirs, the prediction of solar wind yield errors within the ±5 band. Our results also revealed the role of reservoir size and lag on the efficiency of the predictions. The results obtained in this study will help in making efficient step-ahead predictions that will help in preparing for their impact.

References:

1. Weimer, D. and T. Edwards (2021), Testing the electrodynamic method to derive height integrated ionospheric conductances, Ann. Geophys., 39, 31-51, https://doi.org/10.5194/angeo-39-31-2021
2. Nakano, S. and R. Kataoka (2022), Echo state network model for analyzing solar-wind effects on the AU and AL indices, Ann. Geophys., 40, 11-22, https://doi.org/10.5194/angeo-40-11- 2022

Intermittency analysis to understand multiparticle production in the heavy-ion collisions

Gupta Ramni, Sharma Sheetal
Department of Physics, University of Jammu, Jammu and Kashmir, India

A fundamental characteristic of the critical behaviour of a system undergoing phase transition is that it exhibits fluctuations of all scales. A hot and dense system formed in heavy-ion collisions can be characterized by studying the scaling behavior of the spatial distributions of the produced particles. Quantum chromodynamics predicts, close to the line separating deconfined state of quarks and gluons at high temperatures and the hadronic matter, significant fluctuations are associated with the quark-hadron PT. Thus, of the various methodologies proposed, the study of multiplicity fluctuations of hadrons produced in these collision experiments might reveal some of the features of quark-hadron PT[1,2].

Intermittency, a power law behaviour of the normalized factorial moments (F_q) as function of number of bins[3], is one of the signatures of density fluctuations (characteristic of the critical behaviour). For a system with scale-invariant dynamical fluctuations due to the characteristic critical behavior near the phase transition, the F_q would exhibit power-law growth with increasing phase-space resolution. Further by relating the q^{th}-order F_q to the normalized second-order factorial moment (F_2), the scaling exponent [4] (ν) is extracted, which provides information about the order of the phase transition in the framework of the Ginzburg-Landau theory. A two dimensional factorial moment analysis performed on high multiplicity events generated using Toy Monte Carlo, to understand the efficacy and applicability of intermittency analysis to gauge the fluctuations in the scenerio of events produced in the recent collider experiments, will be presented.

References:

1. R. C. Hwa and C. B. Yang, Phys. Rev. C **85**, 044914(2012).
2. I. M. Dremin, E. A. De Wolf and W. Kittel Phys. Rep. **270**, 1 (1996); W. Kittle and E.A. De Wolf, *S*oft Multihadron Dynamics. (World Scientific, Singapore, 2005).
3. R. C. Hwa and M. T. Nazirov, Physical Review Letters, **69**, no. 5, 741 (1992).
4. R.C. Hwa and C. B. Yang, Acta Physica Polonica B, **48**, 23 (2016).

8th International Conference on Women in Physics

Finite volume effects on the QCD chiral phase transition using NJL model

Shaikh, Adiba[1], *Datta, Saumen*[2], *Mohapatra, Ranjita*[3]
[1] *Department of Physics, Indian Institute of Technology Bombay, Powai, Mumbai-400076, India*
[2] *Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400005, India*
[3] *Rajdhani College, Bhubaneswar - 751003, India*

The deconfined phase of QCD called quark-gluon plasma (QGP) created in the relativistic heavy-ion collision experiments is of the size of a few fermi, which is comparable to the characteristic interaction scale. Hence, understanding the effect of the finite-system geometry with a suitable boundary condition is necessary for its theoretical understanding. Since the questions of interest are in the non-perturbative regime of QCD, we use the Nambu−Jona-Lasinio (NJL) model with two-flavour for the study of dynamical chiral symmetry breaking. Chiral quark condensate is the order parameter for chiral phase transition connected to the chiral symmetry breaking (restoring) which is a feature of an infinite (finite) volume system. Susceptibility is a measure of the system's response to variation of an intrinsic quantity, which for QGP is quark chemical potential, isospin chemical potential, etc. and their corresponding susceptibilities are quark number susceptibilities and isospin number susceptibilities i.e. c_2, c_4, etc. These thermodynamic susceptibilities are related to higher order fluctuations or moments i.e. variance, skewness and kurtosis of conserved quantities such as net-baryon, net-charge and net-strangeness distribution. So, susceptibilities are connected to experiments where one can study the finite volume effects.

We have studied finite volume effects on the QCD chiral phase transition using different boundary conditions (anti-periodic/APBC, periodic/PBC, stationary wave/SWC and MIT) and different geometries of the fireball (cubic, cylinder and sphere). APBC and PBC show smaller finite volume effects compared to SWC with the variation of the QGP system size. NJL model with PBC shows deviation from lattice results towards smaller volumes ($L < 4\ fm$) which indicates the inability to properly incorporate zero-mode in the model (proper removal of the zero-mode improves the situation). Cylindrical geometry with MIT boundary condition along the transverse direction is further constrained by SWC and APBC along the length. We also studied quark number susceptibilities (c_2, c_4) and chiral limit extrapolation ($\lim_{[m\to 0]} M_{[\text{finite L}]} \longrightarrow 0$) for cubic geometry with different boundary conditions.

Non-Destructive Evaluation of Static Objects using Cosmic-Ray Muons

Prof. MAJUMDAR, Nayana

Non-destructive evaluation (NDE) using the cosmic-ray muons as the source of radiation has evolved through many impressive developments during last couple of decades with the advent of science and technology. It has found applications in many different fields requiring penetrating probes for investigation of composition and structural issues of static objects which are often not feasible using artificial radiation sources. For such cases, cosmic muons can offer a practical solution for their capability of deep penetration due to large mass and high energy with added advantages of natural abundance and no radiation hazard. Being charged particles, cosmic-ray muons interact electromagnetically with atoms of the matter they pass through, resulting in a loss of energy and a change of direction due to multiple Coulomb scattering. Based on these interaction processes, two different means of imaging have been developed depending upon the area of applications. At SINP, our research group has been pursuing an R&D work to develop a prototype setup implementing the NDE technique based on the scattering phenomenon of the cosmic-ray muons. In the presentation, different aspects of the R&D including both the hardware and software activities that have been undertaken for the progress toward building the radiographic imaging setup will be discussed.

---

*Retired

8th International Conference on Women in Physics

Finite-Time Behaviour of Vacuum Instability: Electron-Positron Creation in Strong Electric Fields

Deepak(Sah, Deepak)[1,2], *Manoranjan P.Singh (Singh, Manoranjan P.)*[1,2]

[1]*Theory and Simulations Lab, Raja Ramanna Centre for Advanced Technology, Indore-452013, India*

[2]*Homi Bhabha National Institute, Training School Complex, Anushakti Nagar, Mumbai-400094, India*

The phenomenon of particle-antiparticle generation from the vacuum in the presence of intense electric fields has recently garnered significant attention in the field of high-energy particle physics, particularly within the realm of early cosmology. While the theoretical concept of vacuum particle creation under the influence of strong electric fields was proposed many years ago[1-3], experimental validation of this phenomenon is still pending. Theoretical investigations rooted in kinetic theory[4-6] have revealed the existence of a dense quasi-particle plasma, even in electric fields below the critical Schwinger threshold. However, this quasi-particle plasma is intrinsically unstable and dissipates once the external field is deactivated, in contrast to the sustained plasma observed when a strong field pulse surpasses the critical threshold. Several proposals have been presented to detect the quasi-particle Electron-Positron Plasma (EPP) generated within the focal region of counter-propagating laser beams, and ongoing efforts are underway to approach electric fields nearing the Schwinger limit through the utilization of advanced X-ray laser facilities and other research facilities worldwide[7-8]. Traditionally, investigations in the field of vacuum particle production have primarily focused on elucidating the characteristics of the out-state, which represents the system's state after the external field has ceased. This research emphasis arises from the objective of identifying and observing free real particles in experimental settings. However, there is a growing interest in exploring the properties of intermediate states, also known as mid-states or non-asymptotic states[9]. These intermediate states correspond to the system during the interaction of quasi-particles in the presence of the external field, prior to reaching the final out-state. Exploring these intermediate states holds significant importance as it provides valuable insights into the dynamics and behavior of quasi-particles under the influence of the external field, thereby deepening our understanding of their interactions and potential experimental manifestations. In this study, we specifically investigate the electron-positron plasma (EPP) generated from the vacuum, which undergoes three distinct stages of evolution: the quasi-particle stage during the action of the electric field pulse, the transient period of EPP transmutation, and the final residual EPP (REPP) in the out-state, where particles exist on their respective mass shells. By thoroughly examining the particle distribution function, we provide a comprehensive description of the pair production process throughout all three stages. Notably, we scrutinize the momentum spectra of particles during non-asymptotic time intervals. This detailed analysis of particle numbers and spectra significantly enhances our understanding of designing laser pulses that effectively lower the critical electric field threshold. Moreover, it offers valuable insights into the time-dependent processes of pair recombination and the back-reaction of pairs. By shedding light on these fundamental aspects, our research expands the frontiers of vacuum particle production and establishes a solid foundation for future experimental endeavors investigating EPP created in strong electric fields.

8th International Conference on Women in Physics

DETECTION OF ATMOSPHERIC TIDES AT LAKE TANGANYIKA ANALYSIS BY FOURIER

ELVIRE BANZA LING(1)

(1) : Department de Physics (Prof. Assistant)
Faculty of Sciences / UNIKIN
P.O. Box 190 Kinshasa-XI / D.R.CONGO

The gravitational attraction of the Sun, the Moon, and other planets affects the Earth, resulting in various natural phenomena known as oceanic, atmospheric, and terrestrial tides. Atmospheric tides, observed in the atmosphere, are not solely influenced by the gravitational effects of the Sun and the Moon but also by radiation forcing, which causes variations in wind speed. Notably, tides with larger amplitudes have oscillation periods of 24 and 12 hours, while tides with smaller amplitudes occur every 8 and 6 hours.

To detect these atmospheric tides, we analyzed fluctuations in ambient air temperature, the horizontal component of wind speed, and air temperature at the Lake Tanganyika tower. Data was collected in Mpulungu, Zambia, at three-hour intervals over the course of one year. Using the Fourier transform in MATLAB, we analyzed these fluctuations and obtained a graphical representation of pulsation as a function of period.

Our analysis revealed diurnal components at 8, 12, and midnight in the recorded fluctuations, which we associated with the oscillation periods of atmospheric tides. Moreover, we proposed the presence of atmospheric tides around Lake Tanganyika.

Considering that these atmospheric tides exist within the air we breathe and the Earth's wind flow, they have the potential to interact with various natural phenomena, including diseases, plant growth, living beings in general, and climate change, among other factors.

8th International Conference on Women in Physics

Dark matter in Two-singlet extension of Standard Model

Basak Tanushree [1], *Coleppa Baradhwaj* [2], *Loho Kousik* [3]

[1]*Department of Physics, M. B. Patel Science College, Anand 388 001, India.*
[2,3]*Indian Institute of Technology Gandhinagar, Gandhinagar 382 355, India*

In the beyond Standard Model (BSM) scenarios, the real singlet extension of the Standard Model (SM) has been extensively studied [1], where the imposed Z_2-symmetry ensures the stability of the viable Dark Matter (DM) candidate. We revisit the next to minimal approach which is the two real singlet extension of the SM with a $Z_2 \times Z'_2$ symmetry [2]. We analyse the entire parameter space using constraints from vacuum stability and collider to put bounds on the couplings [3]. In this model, the destructive interference between the two t-channel scalar mediators alleviates the stringent constraints from the Xenon1T experiment. Due to the Breit-Wigner resonance, an enhancement in the velocity averaged cross section of DM-DM annihilation is obtained and the measured relic abundance can be realized at only the narrow mass regions where the dark matter mass is around half of the mass of either of the two Higgs bosons. This also ensures the scope for explaining the observed gamma-ray excess in the galactic centre.

References:

1. Cline J M, Kainulainen K, Scott P and Weniger C 2013 Phys. Rev. D 88 055025 [Erratum: Phys.Rev.D 92, 039906 (2015)] (Preprint 1306.4710)
2. Abada A, Ghaffor D and Nasri S 2011 Phys. Rev. D 83 095021 (Preprint 1101.0365)
3. Basak T, Coleppa B and Loho K 2021 JHEP 06 104 (Preprint 2105.09044)

8th International Conference on Women in Physics

Development of New-Generation Gaseous Detectors for Nuclear Physics

Bhattacharya Purba[1], Sen Arijit[2,4], Ghosh Tilak Kumar[2,4], Majumdar Nayana[3,4], Mukhopadhyay Supratik[3,4]

[1]Department of Physics, School of Basic and Applied Sciences, Adamas University, Barasat-Barrackpore Road, Kolkata 700126, India.
[2]Physics Group, Variable Energy Cyclotron Centre, Bidhannagar, Kolkata 700064, India.
[3]Applied Nuclear Physics Division, Saha Institute of Nuclear Physics, Bidhannagar, Kolkata 700064, India
[4]Homi Bhaba National Institute, BARC Training School Complex, Anushaktinagar, Mumbai 400094, India.

One of the major and frontiers of today's current nuclear physics research programs is the investigation of heavy ion induced fission reactions. Apart from fundamental interest to study the dynamics of heavy ion nuclear reactions, these studies will be helpful to find out the proper target and projectile combination for the synthesis of super heavy elements (SHE). To have an insight into the dynamics, one requires the study of fission fragment mass and angular distribution at near barrier energies for heavy-ion induced fission reactions. The detection of fission fragments is particularly suitable with gaseous detectors [1]. Conventionally, Multi wire proportional counter (MWPC) [2], are more favourable in such are preferred in experiments to detect fission fragments because of the flexibility it offers. However, the central anode plane of MWPC detectors, which is the main charge multiplication region, is made of 10 μm thin wires and, therefore, makes the detectors highly fragile, and prone to tear. The present work is motivated towards overcoming fragility of this kind of detector, maintaining all the advantages of the older design as much as possible. In particular, time of arrival, position and energy loss information should be of a similar quality, as obtained from the older detector. In particular, the proposed design should provide time of arrival, position and energy loss information of a quality similar to the earlier design. During recent times, Micro-Pattern Gaseous Detector (MPGD) [3] design and applications have made significant progress towards achieving excellent time, position and energy resolution. Semiconductor fabrication technologies used in the production of many of these detectors lead to very robust designs, as well. The present activities encompass a detailed evaluation of the operational conditions of different MPGDs operated in low-pressure isobutane gas with a view to optimizing their use in the detection of charged particles and fission fragments [4]. In the presentation, numerical demonstration of such hybrid detector technologies as possible candidates for new generation low energy fission studies and their evaluation as a function of different possible geometric and electric configurations will be discussed.

References:

1. T. K. Ghosh, Detectors for Nuclear Physics, Springer Proc. Physics **201**, 15 (2018)
2. G. Charpak and F. Sauli, Multiwire Proportional Chambers and Drift Chambers, Nuclear Instruments and Methods **162**, 405(1979)
3. F. Sauli, Micro-Pattern Gaseous Detectors: Principles of Operation and Applications, , https://doi.org/10.1142/11882
4. P. Bhattacharya, A. Sen, T. K. Ghosh, N. Majumdar and S. Mukhopadhyay, Development of Micro-Pattern Gaseous Detectors for Nuclear Reaction Studies, Journal of Physics: Conference Series **2349** 012017(2022)

Section-B

Carolyn Parker Hall

8th International Conference on Women in Physics

Generation of scalar beams fully manipulated in amplitude and wavefront

*Mansi Baliyan and Naveen K. Nishchal**
Department of Physics, Indian Institute of Technology Patna, Bihta, Patna-801 106, Bihar, India

Abstract: Controlling light in amplitude and wavefront is prerequisite for various optical applications [1-3]. In this study, we aim to achieve complex scalar field modulation using a compact and flexible optical set-up employing single phase-only liquid crystal spatial light modulator (SLM). An approach of dual-pass modulation has been applied in which two cascaded phase holograms are encoded side-by-side on a single SLM. The two holograms displayed on SLM enable encoding of desired amplitude and phase in incoming light one-by-one. The first hologram is responsible for sculpting desired amplitude in light due to interference in the second hologram plane and finally the second hologram shapes the required wavefront in light. Commonly known scalar beams such as Laguerre-Gaussian and Bessel mode can be generated using the proposed experimental set-up.

Principle:

The principle of manipulating complex light fields fully in amplitude and phase with single SLM is illustrated in Figure 1. In Eq. (1), the *cos* term determines the amplitude distribution while phase is determined by the term $\frac{(\varphi_1 + 2\varphi_2)}{2}$. Hence, we can structure light in desired amplitude and phase independently at the same time by controlling of phase profiles displayed on SLM [4].

$$E(x,y) = \frac{1}{2} A_0 (\exp(i\varphi_1(x,y)) + 1) \exp(i\varphi_2(x,y)) \tag{1}$$

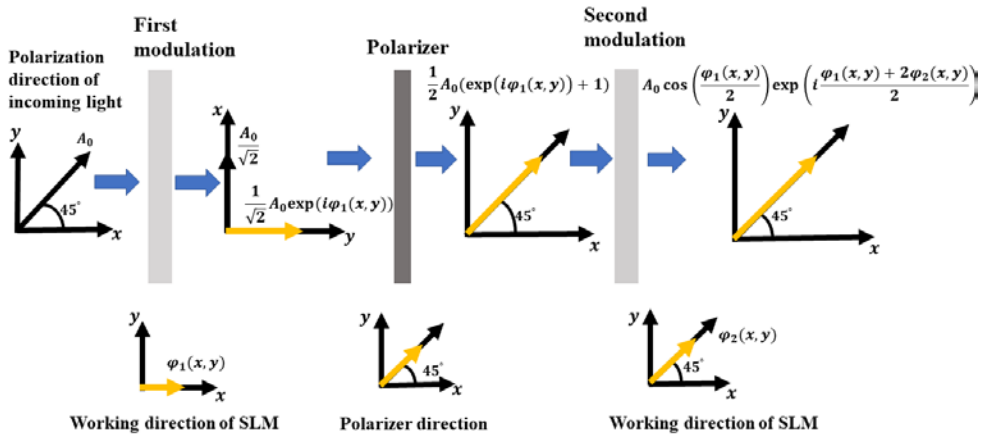

Fig. 2 Principle of manipulating light beam in both amplitude and phase employing dual modulation approach using single SLM

Acknowledgement

The authors acknowledge the financial support from the SERB, DST, Govt. of India (CRG/2021/001763).

References:

1. Y. Shen *et al.*, Light Sci. Appl. 8, 90 (2019).
2. P. G. Martinez *et al.*, Opt. Laser Eng. 125, 105859 (2020).
3. P. Kumar *et al.*, J. Opt. Soc. Am. A 37, 1043-1052 (2020).
4. L. Zhu and J. Wang, Sci. Rep. 95, 7441 (2014).

Defects in Natural Fluorite Crystals Caused by Radiation and Elemental Substitutions

Rumu H. Banerjee[a,*] and Pranesh Sengupta[a,b]
[a]*Materials Science Division, Bhabha Atomic Research Centre, Mumbai, India-400085*
[b]*Homi Bhabha National Institute, Anushakti Nagar, Mumbai, India-400094*
** email: rumu@barc.gov.in, Tel:+91-022-25592678*

Understanding the response of fluorite structure under prolonged exposure to radiation is essential for its potential applications such as containment of radioactive waste, spent fuel and applications in accidental dosimetry [1]. Naturally occurring fluorites have been used in environmental radiation monitoring since many decades and hence can be a potential candidate for accidental dosimeter. For such applications, it is essential to understand the nature of cationic and anionic defects in the material under irradiation. In the present study, naturally occurring fluorites, CaF_2, having different colours were studied and compared with the literature reports available on the defect studies in halides [1]. Such a colour variation in fluorites indicates that the cubic crystal structure can host a variety of lattice defects, namely, colour centres which are formed when the crystal is subjected to ionizing radiations from the associated host rock and/or has elemental substitutions. Use of multi characterization spectroscopic tools provide insights on the identification of stable cationic and anionic defects in differently coloured fluorite crystals. A suitable methodology was proposed to delineate the effect of radiation from the elemental substitutions. Based on the observations, a suitable mechanism for defect production by radiation is proposed.

References

1. Rumu H. Banerjee *et al*., *Journal of Luminescence*, 254 **(2023)** 119540.

ID-018

8th IUPAP International Conference on Women in Physics (ICWIP 2023)

Adélaïde Lareba OUEDRAOGO, Sié KAM , Dieudonné Joseph BATHIEBO, Florent Pèlèga KIENO.

Joseph KI-ZERBO University, Thermal and Renewable Energies Laboratory (LETRE)

Courriel : adeo62@yahoo.fr

Theme of the poster: Thermal comfort: Temperature and relative humidity of a habitable cell in foamed concrete in Burkina Faso.

Abstract : Burkina Faso is a country with a hot and dry tropical climate which is not immune to the energy problem. We notice that in Burkina Faso, the construction of habitats with cinder block bricks is increasing because of its high mechanical properties despite its discomfort. In the context of sustainable development, new regulations on thermal insulation in the building sector are leading researchers to design new materials for energy-saving systems and ensuring comfort in the home. We highlight the use of foamed concrete (FC, made in Burkina Faso) in construction in order to reduce energy consumption and ensure thermal comfort in the habitat. A calculation model developed under the comsol Multiphysics 5.3a software is used to simulate the thermal behavior of foamed concrete. The aim is to numerically study the thermal comfort of buildings constructed with foamed concrete. A comparison of the hygrothermal behavior of different materials was carried out with three typical climates (January, April and August) under climatic conditions of Ouagadougou in Burkina Faso. The results showed that for the months of January, April and August the temperatures of the foamed concrete room (BM-930, e = 17.5 cm) having respectively values of 296 K, 304 K, and 298 K are always lower to those of cinder block, compressed earth blocks (CEB), adobe and cut laterite brick (CLB). The relative humidity of the foamed concrete cell (BM-930, e = 17.5 cm) in the months of January, April and August has values of 18.9%, 31% and 63.7% respectively, which are also superior to those of cells built with several local materials. Whatever the month of the year, the temperatures of the room made of foamed concrete are lower compared to other materials. In addition, the relative humidity values of the foamed concrete room are more in the thermal comfort zone than those of the other materials. This high relative humidity with low temperature is generally an advantage for hot and dry Sahelian countries. Thus, a building constructed with foamed concrete has better thermal comfort than those of the other materials studied.

Keywords: Foamed concrete, Materials, Thermal comfort, Temperature, Relative humidity.

ID-025

Analysis of turbulence moments and turbulent intensities of wind speed and temperature above a non-uniform terrain in unstable conditions

Ossénatou Mamadou[1,2*], Armand Mariscal[3], Djidjoho Renaud Roméo Koukoui[1,2] and Miriam Hounsinou[1,2]

*corresponding author : ossenatou.mamadou@imsp-uac.org

1- Institut de Mathématiques et de Sciences Physiques (IMSP), Dangbo, Bénin
2- Laboratoire de Physique du Rayonnement (LPR), Université d'Abomey-Calavi, Bénin
3- Institut de Recherche pour le Développement (IRD), Bénin

Abstract: Since the work of Monin and Obukhov, a description of turbulent processes in the Atmospheric Boundary Layer (ABL) is possible through similarity relationships such as flux-variance similarity. From this, the normalized standard deviations of wind velocity and temperature, as a function of the stability parameter (z/L) are used to characterize the state of turbulence at all frequencies. However, due to the non-universality of turbulence moments models, more investigations are necessary, especially in tropical regions where low wind conditions frequently occur. This study aims at (i) investigating whether the turbulence moments of wind speed components and temperature obey to the Monin-Obukhov Similarity Theory (MOST) above a non-uniform terrain located in the south of Benin, West Africa; and (ii) identifying the appropriated models for this ecosystem. The data used have been collected from a tower equipped with an eddy covariance system placed at 2.7m of height from the ground, above the a mixed crop at Dangbo's village, Benin, West Africa. The turbulence intensity parameters calculated were analyzed according to wind speed and stability conditions and various seasons (dry and wet seasons) in the study site. From their relationships with the stability parameter, some data driven models have been then proposed. They were finally assessed by using a statistical tool such as the Root Mean Squared Error (RMSE), the Mean Absolute Error (MAE) and the coefficient of determination (R^2). The results showed that, σ_u/u_* and σ_v/u_* in both stability conditions; σ_w/u_* in stable and σ_T/T_* in unstable conditions respectively, follow the MOST with a 1/3 power law.

Key words: Stability parameter, Turbulence, Monin-Obukhov Similarity, turbulence moments, turbulence intensities.

ID-069

Measurement Of Radon And Radon Exhalation Rates In Soil Samples From The Traditional Main Halls In The University Of Ghana Campus Using The Sealed-Can Technique

Irene Opoku-Ntim[1], Darkwa Charles Aboagye[2], Aba Bentil Adam [3]

[1]Ghana Atomic Energy Commission,mailto:ina82ma@gmail.com
[2]University of Ghana
[3]School of Nuclear and Allied Sciences

ABSTRACT

Radon has been recognized as one of the health hazards for mankind because long-term exposure to radon increases the risk of developing lung cancer. This study aimed at determining the radon exhalation rates, the concentration levels of radon in soil samples, evaluating the contribution factors of radon concentration of soil samples and evaluating the health risks associated with soil radon concentration of the traditional main halls in the University of Ghana. In this study, the sealed-can technique was used to determine the radon exhalation rates in fifty (50) soil samples collected from different sites around the five (5) traditional main halls in the University of Ghana. The average soil radon concentration ranged from 166.26 - 222.20 Bqm^{-3} with a mean of (189.96 ± 23.12) Bqm^{-3}. The average surface exhalation rate ranged from 10.94 - 14.62 $\mu Bqm^{-2}h^{-1}$ with a mean of (12.50 ± 1.52) $\mu Bqm^{-2}h^{-1}$. The average mass exhalation rate was (3.17 ± 0.39) $\mu Bqkg^{-1}h^{-1}$. A good positive correlation has been observed between the soil radon concentration and exhalation rates of soil samples.

Keywords: Radon, exhalation rate, University of Ghana, sealed-can, traditional

8th International Conference on Women in Physics

An homemade Solar Tracking system

Gaëlle Kafira Ko [1], Kokouvi Edem N'Tsoukpoe[2], Aboubakar Gomna[2]

[1]Laboratoire d'Energies Thermiques REnouvelables (LETRE), Ecole Normal Supérieure (ENS), 01 BP 1757 Ouagadougou 01, Ouagadougou, Burkina Faso.
[2]Laboratoire Energies Renouvelables et Efficacité Energétique (LabEREE), Institut International d'Ingénierie de l'Eau et de l'Environnement (2iE), Ouagadougou, Burkina Faso.

Sub-Saharan Africa is endowed with abundant solar resources, of over 5.5 kWh·m^{-2} [1][1]. However, the region also has a low level of energy access. We can harness this solar potential to meet the energy needs. Concentrated solar thermal power (CSP) plants can provide both heat and electricity, while photovoltaic systems can generate only electricity. CSP requires one or two-axis solar tracking, and the photovoltaic plant can be optimized using a solar tracking system. Although there are several commercial solar tracking systems available, they are often expensive and subject to planned obsolescence. The objective of our study is to design a sun tracking system for CSPs that is adapted to the socio-economic reality of sub-Saharan Africa, which means a system that is low cost, accurate, and easy to update. In order to achieve this goal, the sun tracking system must be built largely with locally available instruments and materials and it must be controlled by an open source program that uses an algorithm to calculate the position of the sun. Three different solar position algorithms: Astronomical Almanac's algorithm [2,3], Astronomical Algorithms [4], Solar position algorithm (SPA) [5] have been compared in order to determine the most suitable. The solar tracking system operates in an open loop and comprises a microcontroller board (Arduino UNO) and a motor driver. Sun azimuth and elevation, are calculated using a solar position algorithm and a stepper motor is used as the operating component. The stepper motor is coupled with a threaded rod to refine the accuracy of the solar tracking.

Key word: Solar tracking system; Appropriate design; Concentrated solar power plant; Photovoltaics

References[1] Ademola A. A. Assessment of solar energy technologies in Africa-opportunities and challenges in meeting the 2030 agenda and sustainable development goals. Energy Policy 137(2020) 111180. https://doi.org/10.1016/j.enpol.2019.111180

[2] J.J. Michalsky, The Astronomical Almanac's algorithm for approximate solar position (1950–2050), Solar Energy. 40 (1988) 227–235. https://doi.org/10.1016/0038-092X(88)90045-X.

[3] J.W. Spencer, Comments on The Astronomical Almanac's Algorithm for Approximate Solar Position (1950–2050), Solar Energy. 42 (1989) 353. https://doi.org/10.1016/0038-092X(89)90039-X.

[4] J. Meeus, Astronomical Algorithms, 1st English ed edition, Willmann-Bell, Richmond, Va, 1991.

[5] I. Reda, A. Andreas, Solar position algorithm for solar radiation applications, Solar Energy. 76 (2004) 577–589. https://doi.org/10.1016/j.solener.2003.12.003.

8th International Conference on Women in Physics

Machine Learning in Atmospheric Sciences - How are we catching up?

Uma Das[1], Oishila Bandyopadhyay[1], Soumyajit Pal[1,2]
[1] Indian Institute of Information Technology Kalyani, Kalyani - 741235, West Bengal, India
[2] Computer Science, St. Xavier's College (Autonomous), Kolkata - 700016, West Bengal, India

Climate change is gaining upon the human civilization. Its effects are being most felt through extreme weather events. Statistically, cyclonic storms are known to cause maximum damage to lives and infrastructure. In the Indian Ocean, this weather phenomenon is known as tropical cyclone (TC). For many decades, research on numerical weather prediction (NWP) models have led to their deployment across all regions. However, the warnings provided by these systems are still found to have low accuracy. This hampers timely rescue operations and irreversible losses are incurred. Machine learning (ML) is proving highly capable in understanding and predicting such complicated phenomena. With the growing number of satellite launches, quality image data are now being freely available for research, as with the Meteorolgical & Oceanographic Satellite Data Archival Centre (MOSDAC) portal maintained by the Indian Space Research Organization (ISRO) under the aegis of the Government of India. The authors are investigating these data with ML techniques for better near real time predictions. Firstly, a convolutional neural network (CNN) is used to predict whether an incoming satellite image is cyclonic or not. If the image is cyclonic, it is fed to another CNN to predict its intensity stage by way of multi class classification. Lastly, if the intensity of the TC is at the higher end, its track is predicted over the next few days by way of a recurrent neural network (RNN). This work shows that ML is capable of providing good predictions in addition to standard NWP models and forecasts. Such techniques are being applied to other problems in atmospheric sciences like fog prediction and forecasts of other extreme events.

8th International Conference on Women in Physics

Graphene Hybrid Scaffolds for Laser Stimulated Neuro-regeneration

A. Dhanusha[1] and T C. Sabari Girisun[1]

[1]Nanophotonics Laboratory, Department of Physics, Bharathidasan University, Tiruchirappalli, India – 620 024.

The versatile study of graphene scaffolds has a resurgence of interest on developing effective neuro-regenerative medicine. Graphene hybrids promotes the proportion rate of proliferation and differentiation of neural stem cells into neurons by rational modification of the chemical structure and through functionalization of appropriate materials. Inclusive of fine strategical approach like laser induction could control selective spatial resolution via ion channel distribution in the nerve cell as well tuning the physicochemical properties of the nanomaterial. α-MnO_2 surface functionalized reduced graphene oxide nanohybrid was prepared by reduction method. XRD and Raman spectra confirms the formation of tetragonal phase α-MnO_2 and reduced graphene oxide. The panoramic view of FESEM and HRTEM vividly shows a high tangled 1D MnO_2 nanowires of length ranging from tens of nanometers to several micrometers interpenetrating on the 2D sheets of rGO. Initial assessment of the material laser interaction for the safe stimulation of the cultured cells was preliminarily refined under standard Z-scan technique. The hydrophilicity of the prepared scaffolds was analyzed using contact angle measurements and were found to be 36°, 47° and 27° for rGO, MnO_2 and MnO_2: rGO respectively. The prepared scaffolds' cytotoxicity and laser conditions were assessed by MTT assay and at the optimized concentration of the scaffolds and laser parameters, the proliferation and differentiation of neuronal cell culture were investigated. Immunocytochemistry measurements were done using fluorescence imaging for the estimation of total number of Nestin positive and DAPI positive neural cells. The obtained results could excite the imperative development for the progress of non-invasive neural stem cell therapies.

References:

[1]. A. Dhanusha and T C. Sabari Girisun, Implications of morphology on excited state absorption of α-MnO_2 nanostructures, Optical Materials, 134, 113214, (2022)

[2]. S. Y. Park, J. Park, S. H Sim, M. G. Sung, K. S Kim, B. H. Hong, & S. Hong, Enhanced differentiation of human neural stem cells into neurons on graphene, Advanced materials, 23: 36, 263-267, (2011)

[3]. O. Akhavan and E. Ghaderi, Differentiation of human neural stem cells into neural networks on graphene nanogrids, Journal of Materials Chemistry B, 1(45), 6291-301, (2013)

8th International Conference on Women in Physics

Molecular properties studies of Choline chloride, Glucose and water-based NADES

Thongam Gomti Devi

Department of Physics, Manipur University, Canchipur-795003, India
Email: tgd@manipuruniv.ac.in

Natural deep Eutectic solvents (NADES) have wide applications in the pharmaceutical and cosmetic industries. We need to study various types of NADES to understand their structure and thermodynamic properties and the effect of solvents on these properties to screen the large-scale application of these materials in the industry. In the present work, NADES is designed using choline chloride, Glucose and water and characterizes the compound using DFT study and experimental techniques. The optimize structure of the NADES is calculated using B3LYP/6311+G(d,p) level of theory and electronic and molecular behaviour of the compound are examined under MEP surface study, frontier molecular orbital analysis, NBO analysis, and AIM analysis to investigate the type of interactions between them. The drug-likeness properties and bioactivity score of the liquids are studied to understand their bioactivity and pharmacokinetics. The molecular and vibrational properties of the compound shall help in finding out its application in different fields.

References:

1. Th.Gomti Devi, Study of vibrational relaxation and molecular reorientation in liquids: a Raman spectroscopic study, J.Raman Spectrosc. **1216**, 41(2010)
2. G. Upadhayay, Th.Gomti Devi, Raman spectroscopic study of polar aprotic molecule and its molecular associations with chemical and isotopic solvents: Comparative study with quantum-chemical calculations, J. Mol. Liquids. **263**, 197 (2014).
3. T.Jeliński, M. Przybyłek, P.Cysewski, Natural Deep Eutectic Solvents as Agents for Improving Solubility, Stability and Delivery of Curcumin, Pharm Res.**116**, 36(2019).

Phase-induced current in thermally driven topological Josephson junction

Dutta, Paramita[1]

[1] *Theoretical Physics Division, Physical Research Laboratory, Navrangpura, Ahmedabad-380009, India*

The possibility of generating large thermoelectric currents in superconducting junctions boosted the research in this direction last decade. Among various superconducting junctions, Josephson junction has drawn special attention since the usage of external materials can be avoided here. It has been shown in the literature that the phase difference between two superconductors in a Josephson junction can be used to control the behavior of the junction in different ways. In the present work, we study how the superconducting phase difference controls the current in a topological Josephson junction when biased by temperature gradient. To minimize the loss, the junction is placed at spin quantum Hall edges so that the normal reflection of electrons/holes is prohibited. By tuning the phase, an asymmetry in the behavior of the transmission amplitudes with the phase appears and thus can induce a charge current in the junction. The amplitude of the charge current is sensitive to the size of two superconductors. The amplitude is higher for smaller sizes. For a given phase difference, the charge current can change its sign for a longer junction. The heat current carried by the transmitted electrons is also controllable by the phase difference and the size of the junction. Thermal conductivity will be lower for smaller superconductors and lower base temperatures. Our topological Josephson junction provides further insights into the study of thermal transport in the Josephson junctions.

8th International Conference on Women in Physics

Flexible Phase Change Materials for Electrically-Tuned Active Absorbers

Yu Liu, Jia-Nan Wang, Ru-Wen Peng, and Mu Wang*

National Laboratory of Solid State Microstructures, School of Physics, and Collaborative Innovation Center of Advanced Microstructures, Nanjing University, Nanjing 210093, China.

Phase change materials (PCMs), such as GeSbTe (GST) alloys and vanadium dioxide (VO2), play an important role in dynamically tunable optical metadevices. However, the PCMs usually require high thermal annealing temperatures above 700 K, but most flexible metadevices can only work below 500 K owing to the thermal instability of polymer substrates. This contradiction limits the integration of PCMs into flexible metadevices. Here, a mica sheet is chosen as the chemosynthetic support for VO2 and a smooth and uniformly flexible phase change material (FPCM) is realized[1]. Such FPCMs can withstand high temperatures while remaining mechanically flexible. As an example, a metal-FPCM-metal infrared meta-absorber with mechanical flexibility and electrical tunability is demonstrated. Based on the electrically-tuned phase transition of FPCMs, the infrared absorption of the metadevice is continuously tuned from 20% to 90% as the applied current changes, and it remains quite stable at bending states. The metadevice is bent up to 1500 times, while no visible deterioration is detected. For the first time, the FPCM metastructures are significantly added to the flexible material family, and the FPCM-based metadevices show various application prospects in electrically-tunable conformal metadevices, dynamic flexible photodetectors, and active wearable devices.

References:

1. J.-N. Wang, B. Xiong, R.-W. Peng, C.-Y. Li, B.-Q. Hou, C.-W. Chen, Y. Liu, and M. Wang, “Flexible phase change materials for electrically-tuned active absorbers”. *Small* **17**, 2101282 (2021)

8th International Conference on Women in Physics

Machine Learning accelerated Prediction of Bandgap of Cubic Perovskites

Ponkiya Zarna D. [1], *Sattigeri Raghottam M.* [2], *Jha Prafulla K.* [1]

[1]*Department of Physics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India-390002.*
[2]*International Research Centre MagTop, Institute of Physics, Polish Academy of Sciences, aleja/Lotnikow 32/46, Warsaw, Poland 02-668*

Machine Learning (ML) methods for screening and predicting materials properties with various applications has boosted the research in condensed matter physics. Compared to the high computational costs associated with the conventional first-principles calculations, ML based on statistical methods have established promising avenues to predict material properties such as electronic bandgap, optical properties, etc. In this work, we have applied five different neural network-based ML models to predict the bandgap of perovskites wherein the crystal structures are the input features and electronic bandgap are the associated properties. These ML methods were implemented alongside material screening techniques using the existing database of Castelli perovskites [1,2]. The prediction performance is evaluated and analysed using metrics such as, comparison of the predicted vs literature values (for calibration purposes), root mean square error (RMSE) and correlation coefficient (R^2). We found that the crystal graph convolutional neural network (CGCNN) [3] is most effective out of the applied models in predicting bandgaps of cubic perovskites with the average RMSE of ~ 0.39 eV (Fig. 1 (a)) and R^2-value > 0.90 (Fig. 1 (b)) for both training and test datasets. These results show that the bandgap of perovskite materials can be predicted reliably and with decent precision using only the crystal structures as a feature to train the ML model. Using such training models, huge libraries of perovskites can be scanned for photocatalytic and photovoltaic applications due to the correlation between the crystal structure and the electronic bandgap.

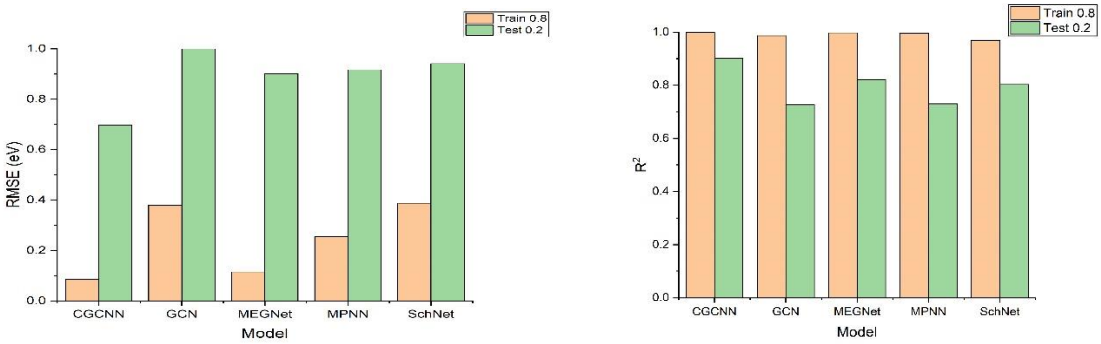

Fig 1. (a) RMSE (eV) (b) R^2

References:

1. I. E. Castelli, D. D Landis, K. S Thygesen, S. Dahl, I. Chorkendorff, T. F. Jaramillo and K. W. Jacobsen, New cubic perovskites for one-and two-photon water splitting using the computational materials repository. *Energy & Environmental Science*, ***5***(10), 9034 (2012)
2. Computational Materials Repository, https://wiki.fysik.dtu.dk/cmr/(Documentation) and https://cmr.fysik.dtu.dk/(Database)
3. T. Xie and J. C. Grossman, Crystal graph convolutional neural networks for an accurate and interpretable prediction of material properties. *Physical Review Letters*, ***120***(14), 145301 (2018)

8th International Conference on Women in Physics

Tailoring magnetic properties of ferromagnetic film on ion irradiated Si

Jafri, Yasmeen[1,2], Vasdev, Aastha[3], Sheet, Goutam[3], Sharma, Kavita[1,2], Sharma, Gagan[1,2], Gupta, Ajay[4]

[1]Amity Center for Spintronic Materials, Amity University, Sector-125, Noida – 201313, India
[2]Amity Institute of Applied Sciences, Amity University, Sector-125, Noida – 201313, India
[3]Department of Physical Sciences, Indian Institute of Science Education and Research, Sector – 81, Mohali – 140306, India
[4] Department of Physics, University of Petroleum and Energy Studies, Dehradun – 248007, India

Surface nanostructures produced by low energy ion beam irradiation has attracted immense attention in recent times owing to their broad range of applications in different technological areas [1, 2]. Ion beam irradiation, emerged as a simple, fast, efficient and cost-effective technique for producing large area surface nanopatterns on variety of materials [2 - 4]. These nanostructured surfaces also observed to act as templates for thin film growth and modifying their magnetic characteristics in controlled manner. In particular, uniaxial magnetic anisotropy generated by the periodic surface nanopatterns has been the subject of immense research interest for magnetic and spintronic applications.

In the present work, optimization of ion beam parameters for surface nanopatterning of Si substrates and influence of the same on the magnetic properties of ferromagnetic film i.e., Fe, has been carried out. Preparation of ion irradiated Si was done using low energy Ar ion beam for varying ion beam incidence angle (θ) and irradiation time (t). Formation of periodic nanopatterns on Si upon ion irradiation was confirmed by atomic force microscopy (AFM) measurements. Structural properties' investigation of the irradiated Si surface was done using X- ray reflectivity (XRR). AFM and XRR measurements provided variation in Si surface roughness as a function of ion beam incidence angle and irradiation time. Magneto-optical Kerr effect (MOKE) measurements were carried out for the magnetic characteristics' investigation of Fe film. MOKE suggested the variation in magnetic coercivity and magnetic anisotropy in Fe with respect to the Si surface treated at varying θ and t. Fe film on patterned Si showed presence of uniaxial magnetic anisotropy in contrast to Fe film on polished/unirradiated Si substrate. Further, enhanced magnetic coercivity was seen for the Fe film on irradiated Si, as a function of ion beam incidence angle.

References:

1. M.A. Garcia, R. Gago, M. Arroyo-Hernández, E.H. de Laorden, M. Iglesias, D. Esteban-Mendoza, R. Cuerno, and J. Rickards, Texturization of polycrystalline titanium surfaces after low-energy ion-beam irradiation: Impact on biocompatibility, Surface and Coatings Technology, **458**, 129363 (2023).
2. S. Hans, B.K. Parida, V. Pachchigar, S. Augustine, M. Saini, K.P. Sooraj, and M. Ranjan, Temperature influence on the formation of triangular features superimposed on nanoripples produced by low-energy ion beam, Surfaces and Interfaces, **28**, 101619 (2022).
3. A.R. Cubero, F.J. Palomares, K. Lorenz, J. Rubio-Zuazo, R. Hübner, F.J. Mompeán, M. García-Hernández, G.R. Castro and L. Vázquez, Role of the metal supply pathway on silicon patterning by oblique ion beam sputtering, Applied Surface Science, **580**, 152267 (2022).
4. L.V. Burgos, A.R. Cubero, K. Lorenz, F.J.P. Simon and R. Cuerno, Surface nanopatterning by ion beam irradiation: compositional effects, Journal of Physics: Condensed Matter, **34**, 333002 (2022).

8th International Conference on Women in Physics

Hydrophobic silica/water interface studied by sum-frequency vibrational spectroscopy (SFVS)

Lu, Fanjin [1], Chen, Huiling [1], Liu, Weitao [1]

[1] Physics Department, State Key Laboratory of Surface Physics, Key Laboratory of Micro and Nano Photonic Structures [Ministry of Education (MOE)], Fudan University, Shanghai 200433, China.

Hydrophobic and hydrophilic interactions are ubiquitous at metal, protein, and mineral oxide/water interfaces [1, 2]. The essential physical and chemical reactions involved are affected by the microscopic hydrophobic and hydrophilic interactions that are not easily extracted by macroscopic measurements such as the contact angle. For example, the heat-treated SiO_2 exposes extended hydrophobic Si-O-Si patches despite its macroscopic hydrophilicity [3]. Density functional theory-molecular dynamics (DFT-MD) coupled SFVS shows that when hydrophobic patches exist, the interfacial water is organized into the two-dimensional hydrogen-bonding (HB) network, which typically presents at macroscopic hydrophobic interfaces [4]. Here, we used the surface-sensitive SFVS to study the microscopic hydrophobic SiO_2/H_2O interface in situ. The spectra show that most of the Si-OHs are dehydroxylated after heating and converted to metastable Si-O-Si rings. When the heat-treated SiO_2 is immersed in the water, the spectral evolution showcases the hydrolysis of Si-O-Si and the formation of SiOH bonds. Furthermore, a ~1060cm^{-1} peak appears consistently in the protonation/deprotonation gap (neither Si-OH nor SiO^-) during the pH cycle, which is not observed at the hydrophilic SiO_2/H_2O interface.

References:

1. A. Serva, M. Salanne, M. Havenith, S. Pezzotti, Size dependence of hydrophobic hydration at electrified gold/water interfaces. *Proceedings of the National Academy of Sciences* **118**, e2023867118 (2021).
2. E. Xi, V. Venkateshwaran, L. Li, N. Rego, A. J. Patel, S. Garde, Hydrophobicity of proteins and nanostructured solutes is governed by topographical and chemical context. *Proceedings of the National Academy of Sciences* **114**, 13345-13350 (2017).
3. J. D. Cyran, M. A. Donovan, D. Vollmer, B. F. Siro, S. Pezzotti, D. R. Galimberti, M. Gaigeot, M. Bonn, E. H. G. Backus, Molecular hydrophobicity at a macroscopically hydrophilic surface. *Proc. Natl. Acad. Sci* **116**, 1520-1525 (2019).
4. S. Pezzotti, A. Serva, F. Sebastiani, F. S. Brigiano, D. R. Galimberti, L. Potier, S. Alfarano, G. Schwaab, M. Havenith, M. Gaigeot, Molecular Fingerprints of Hydrophobicity at Aqueous Interfaces from Theory and Vibrational Spectroscopies. *J. Phys. Chem. Lett* **12**, 3827-3836 (2021).

8th International Conference on Women in Physics

Breaking the Limitation of Polarization Multiplexing in Optical Metasurfaces with Engineered Noise

Ruwen Peng[1], *Bo Xiong*[1], *Yu Liu*[1], *Yihao Xu*[2], *Yongmin Liu*[2], *and Mu Wang*[1,3]

[1]*National Laboratory of Solid State Microstructures, School of Physics, and Collaborative Innovation Center of Advanced Microstructures, Nanjing University, Nanjing 210093, China.*
[2]*Department of Mechanical and Industrial Engineering, Northeastern University; Boston, Massachusetts 02115, USA.*
[3]*American Physical Society, 100 Motor Pkwy, Hauppauge, New York 11788, USA.*

Noise is usually undesired yet inevitable in science and engineering. However, by introducing the engineered noise to the precise solution of Jones matrix elements, we can break the fundamental limit of polarization multiplexing capacity of metasurfaces that roots from the dimension constraints of the Jones matrix. We experimentally demonstrate up to 11 independent holographic images using a single metasurface illuminated by visible light with different polarizations. To the best of our knowledge, it is the highest capacity reported for polarization multiplexing. Combining the position multiplexing scheme, the metasurface can generate 36 independent images, forming a holographic keyboard pattern. This discovery implies a new paradigm for high-capacity optical display, information encryption, and data storage.

References:

1. Bo Xiong, Yu Liu, Yihao Xu, Lin Deng, Chao-Wei Chen, Jia-Nan Wang, Ruwen Peng, Yun Lai, Yongmin Liu, Mu Wang, “Breaking the limitation of polarization multiplexing in optical metasurfaces with engineered noise”, *Science* **379**, 294-299 (2023)

8th International Conference on Women in Physics

Development of an External Cavity Diode Laser (ECDL) to use as an injection seeding for OPOs

P. S. Ardra[1], *A. Kumar*[1], *S. K. Singh*[1], *P. R. Shirhatti*[1]
[1] *Tata Institute of Fundamental Research Hyderabad, 36/P Gopanpally, Hyderabad 500046, Telangana, India*

It is important to investigate the process of energy transfer in collisions between molecules and surfaces, as well as the fundamental reactions taking place on metal surfaces. To accomplish this, we employ state-selectively excited molecules in the form of molecular beam and metal surfaces as our model system. In our experiment, we excite CO molecules from their vibration state v = 0 to v = 2 by using a radiation source operating in the infrared (IR) region at a wavelength of 2346.25 nm. The excitation is achieved by a pulsed Optical Parametric Oscillator (OPO) system developed in our lab, which is versatile and has a wide range of wavelength tunability in the IR region. However, without an intracavity element as a filter, the OPO has a broader linewidth and is challenging to control its mode stability.

Having a molecular beam with residual Doppler broadened absorption profile of 5-6 MHz, to optimize molecular excitation efficiency, we require a narrow linewidth radiation source. Therefore, I am currently developing an External Cavity Diode Laser (ECDL) based on the Littrow configuration[1] to use as an injection seeding element for the OPO. The ECDL needs to be actively locked to ensure a frequency- stabilized, single-mode laser system with a narrow linewidth. By employing a pump at 532 nm and seeding at 688 nm, the Difference Frequency Generation (DFG) process within the OPO can produce radiation at 2346.25 nm, which matches the specific transition for CO, as mentioned earlier. The passive stability of the ECDL system is achieved by constructing a PID-based temperature controller using a cost-effective microcontroller. The active stabilization component is yet to be built. We characterized the passive stability of the diode laser using a Fizeau[2] wedge-based interferometer, which was calibrated for temperature variation using an actively locked He-Ne laser with a part- per-billion stability[3].

References:

1. A. Arnold, J. Wilson, and M. Boshier. A simple extended-cavity diode laser. *Review of ScientificInstruments*, **69**, 1236-1239 (1998).
2. W. Demtröder. *Laser spectroscopy: basic concepts and instrumentation*, Third Edition. Springer, 2003.
3. S. K. Singh, A. Kumar, and P. R. Shirhatti. A wavemeter for measuring wavelengths with ppm- level accuracy and better than 0.1 ppm-level precision, based on thermal drift compensated cross fringe Fizeau interferometer design. *Under consideration for patent (Indian)*, 2023.

8th International Conference on Women in Physics

Stochastic Dynamics of a Feshbach-coupled Atomic-Molecular Bose-Einstein Condensate

Dasgupta Raka[1], *Mukherjee Avinaba* [2]

Department of Physics, University of Calcutta, 92 A.P.C. Road, Kolkata, India .

We study a two-channel model of resonant ultracold Bose gas, consisting of both atomic and molecular Bose-Einstein Condensates (BEC). The system shows Josephson oscillations. The Feshbach assisted transition from atomic BEC to molecular BEC plays the role of the tunneling here. Depending on the value of the Feshbach detuning, the system shows (I) a particle localization crossover, and (II) a transition from oscillatory mode to running mode in terms of the relative phase between the two condensates. We consider a stochastic dynamics where both the Feshbach coupling and the Feshbach detuning have Gaussian noise components. Considering small deviataion from the fixed points of the dynamics, we study the relaxation process. We also study how the particle localization crossover and the transition in relative phase are affected by these noise components.

References:

1. Avinaba Mukherjee and Raka Dasgupta, Stochastic Josephson oscillation dynamics of a Feshbach-coupled atomic-molecular Bose-Einstein condensate, *manuscript under preparation*.

8th International Conference on Women in Physics

Verification of pairwise non-locality trade-off in pure symmetric 3-qubit states using the IBM open access quantum computer ibmq_lima

Humera Talat[1], A. R. Usha Devi[1], Sudha[2], B. P. Govindaraja[2]

[1]Department of Physics, Bangalore University, Jnanabharathi, Bengaluru-560056, India.
[2]Department of Physics, Kuvempu University, Shankaraghatta-577129, India.

Violation of Bell inequality reveals inherent non-locality in quantum entangled systems [1]. In particular, the Clauser-Horne-Shimony-Holt (CHSH) inequality [2] may be used to verify pairwise non-locality of constituent two-qubits of multiqubit systems. Yet another essential feature of entangled multiparty systems is monogamy i.e., restriction placed on the shareability of entanglement [3]. Non-local correlations recorded by the violation of CHSH inequalities obey monogamy trade-off relations. Monogamy trade-off relation in the case of 3-qubit states ρ_{ABC} is given by [4]:

$$\mathfrak{M}_{ABC} \equiv \langle CHSH\rangle_{AB}^2 + \langle CHSH\rangle_{BC}^2 + \langle CHSH\rangle_{AC}^2 \leq 12$$

where $\langle CHSH\rangle_{AB} = \langle A_1 \otimes B_1\rangle + \langle A_1 \otimes B_2\rangle + \langle A_2 \otimes B_1\rangle - \langle A_2 \otimes B_2\rangle$; $\langle A_i \otimes B_j\rangle = Tr[\rho_{AB} A_i \otimes B_j]$ and $A_i = \vec{\sigma}.\vec{a}_i, B_j = \vec{\sigma}.\vec{b}_j, i,j = 1,2$ are Pauli observables with orientation directions $\vec{a}_i, \vec{b}_j$ of qubits A, B respectively. While violation of the CHSH inequality $|\langle CHSH\rangle_{AB}| < 2$ reveals non-locality, monogamy constraint imposes the trade-off relation $\mathfrak{M}_{ABC} \leq 12$ on 3-qubit states. In the special case of 3-qubit permutation symmetric states for which $\langle CHSH\rangle_{AB} = \langle CHSH\rangle_{BC} = \langle CHSH\rangle_{AC}$, one obtains $\mathfrak{M}_{ABC} = 3\langle CHSH\rangle_{AB}^2 \leq 12$, in turn indicating that $|\langle CHSH\rangle_{AB}| < 2$. Hence one ends up with the monogamy restriction on non-locality: Any arbitrary 2-qubit state extracted from 3-qubit permutation symmetric system cannot violate CHSH inequality, even though the constituent qubits are entangled.

In this work, we verify monogamy relations obeyed by one parameter family of symmetric 3-qubit states[5]: $|\Psi_\beta\rangle = \frac{1}{\sqrt{2+\cos\beta}}\,(|0\rangle \otimes |0\rangle \otimes |\beta\rangle + |\beta\rangle \otimes |0\rangle \otimes |0\rangle + |0\rangle \otimes |\beta\rangle \otimes |0\rangle)$, $|\beta\rangle = \cos\frac{\beta}{2}|0\rangle + \sin\frac{\beta}{2}|1\rangle$, $0 < \beta \leq \pi$ (known as W-class states) using open access IBM quantum computer ibmq_belem. A scheme of of the paper is outlined here:

- Building quantum circuit using the IBM open-source software kit Qiskit to prepare the 3-qubit state $|\Psi_\beta\rangle$ for $\beta = \pi/6, \pi/4, 3\pi/8, 9\pi/16, \pi$.
- Preparation the quantum state using ibmq_belem
- Collecting measurement data (based on 8192 statistical trials) and constructing 2-qubit correlation matrices.
- Verification of monogamy relation $\mathfrak{M}_{ABC} \leq 12$

Our results agree with theoretical predictions and establish how shareability places restrictions on CHSH non-locality.

References:

1. J. S. Bell, On the Einstein–Podolsky–Rosen paradox, Physics **1**, 195 (1964)
2. J. F. Clauser, M. A. Horne, A. Shimony, R. A. Holt, Proposed experiment to test local hidden-variable theories. Phys. Rev. Lett. **23**, 880 (1969)
3. H. -H. Qin, S. -M. Fei, X. Li-Jost, Trade-off relations of Bell violations among pairwise qubit systems. Phys. Rev. A **92**, 062339 (2015)
4. K. Anjali, S. H. Akshata, H. S. Karthik, S. Sahu, Sudha, A. R. Usha Devi, Characterizing nonlocality of pure symmetric three-qubit states. Quantum Inform. Process. **20**, 18 (2021)
5. IBM quantum computing platform (2019). https://quantum-computing.ibm.com/

8th International Conference on Women in Physics

Mineralogical Characterization of the Serra Pelada Meteorite by Energy Dispersive X Ray Fluorescence and X Ray Diffractometry

Cerón Loayza, María L., Bravo Cabrejos, Jorge A., Montoya Burga, Jenny A., Mori Escobar Fanny E., Tesillo Quispe Mabel E.
Laboratorio de Análisis de Suelo, Facultad de Ciencias Físicas, Universidad Nacional Mayor de San Marcos Ap. Postal 14-0149, Lima 14, Perú.

Abstract

We report the preliminary results about the elemental composition and structural phases of a Serra Pelada meteorite. The Serra Pelada meteorite fell on June 29, 2017 that impacted at Serra Pelada Village (a famous gold mining location) (5º 57.135'S, 49º 39.238'W), located in the State of Pará, northern Brazil. Serra Pelada is a monomict basaltic eucritic breccia and is a normal member of the howardite-eucrite-diogenite (HED) are from the crust asteroid 4 Vesta [1]. We show result by X Ray Fluorescence Energy Dispersive (EDXRF) and X Ray Difractometry (XRD). The elemental composition analysis shows Si (28%), S (1.2%), Ca (15.8%), Ti (1.7%), Cr (0.8%), Mn (1.7%), Fe (48%), Cu (0.8%), Zn (0.05%), Ga (0.08%), Ge (0.06%), and Au (0.8%); this was performed with a portable EDXRF AMPTEK instrument. This instrument uses an X-ray tube with a Ag anode, that operated at 30 kV and about 30 μA, and allows the identification of elements with Z > 12 (magnesium). This was done by fitting the experimental EDXRF spectrum with a program that simulates EDXRF spectra based on the fundamental parameters model; this program is written in FORTRAN and simulates all the physical processes that affect the X-rays: energy distribution of the primary radiation, propagation, scattering, absorption and photoelectric production, that take place in an EDXRF measurement with the used experimental geometry. It uses X-ray cross sections data provided by NIST and atomic characteristic X ray parameters provided by IAEA. The X-ray distribution function, which includes continuous and discrete components, has been calibrated performing scattering of these primary X-rays by known samples. The performance of the program has been checked using reference samples. The estimated uncertainty in these measurements of the elemental concentrations is about 10%, depending on the atomic number of the element (Dr. J.A. Bravo C., private communication) [2]. For the structural analysis of the minerals present in the sample, the XRD technique was applied using a BRUKER diffractometer, model D8-Focus, using CuKα (1.5406 Å) radiation (40 kV, 40 mA) with a vertical goniometer, the scanned angle interval was 4º < 2θ < 70º and the 2θ advance was 0.02°/step with a time interval of 3 s per step. The results obtained through these techniques allow us to find information about a large extraterrestrial impact. We observe the presence of the element gold (Au); Au was probably produced by supernova nucleosynthesis or colliding neutron stars, and has been present as dust as other materials merged and differentiated to form the asteroid Vesta.

References:

1. Zucolotto, M. I. et al. Serra Pelada: the first Amazonian Meteorite fall is a Eucrite (basalt) from Asteroid 4-Vesta. Earth Sciences • An. Acad. Bras. Ciênc. 90(1): 3-16. (2018). •

2. Cerón Loayza, M.L., & Bravo Cabrejos, J.A. Characterization of the Carancas–Puno meteorite by energy dispersive X-ray fluorescence, X-ray diffractometry and transmission Mössbauer spectroscopy. *Hyperfine Interactions, 203*, 17-23. (2011).

ID-213

SOLAR QUIET (SQ) DAILY CURRENT VARIATIONS CONTRIBUTIONS TO THE EARTH CONDUCTIVITY WITHIN SOME SOUTHERN AFRICAN COUNTRIES

Okwesili Ngozi Agatha[1] *and Okeke Francisca Nneka*[2]

[(1,2)]*Department of Physics and Astronomy, University of Nigeria, Nsukka, Enugu State, Nigeria.*

Abstract:

These data used in the study were obtained from geomagnetic stations across Hermanus, Maputo, Tsumeb and Hartebeesthoek within the Southern African countries for the year 2011. Matlab software with Gauss spherical harmonic analysis (SHA) method were employed to separate the internal and external field contributions to Solar queit current (Sq) variations after which, the transfer function was used to compute the electrical conductivity-depth profile of the region. The result showed that the Sq patterns are the same in all the stations with daily and seasonal variations observed. Highest seasonal solar quiet current (Sq) variations was recorded during the months of June for Hartebeesthoek, Hermanus and Tsumeb regions across all the stations, with an exception of Maputo region which has nearly triple peaks in the months of March, June and December having its highest during the December solstice. The evaluated seasonal solar quiet current (Sq) variation maximum values for Hartebeesthoek, Hermanus, Maputo and Tsumeb are approximately 16nT, 12.5nT, 12nT and 14.8nT respectively. An equinoxial maximum with a value of 2.1 x 10^3 A was observed in the separated seasonal external current variations in March within the Maputo region and a solsticial minimum in June with a value of 0.75 x 10^3 A in the Hartebeesthoek region. The separated seasonal external variations pattern is seen to be same to that of the seasonal solar quiet current (Sq) variations proving that the source of Sq current system is external to the earth. The highest electrical conductivity value of 0.498 Sm^{-1} was obtained in Hartebeesthoek with the Hermanus station having the highest penetration depth of about 1467.0 Km. These findings could be attributed to the mantle compositions, the closer to the equator and the oceanic effect of that area. The Southern African region conductivity had a downward increase which agreed with the global model.

Keywords: Southern African regions, conductivity-depth structure, solar quiet (Sq) daily current variations, Gauss spherical harmonic analysis (SHA)

Section-C

Deborah S Jin Hall

ID-015

Photoelectrochemical response of non-enzymatic glucose Biosensing for $BiVO_4$ nanocomposites

SHABBIR, Syeda Ammara

Abstract

Diabetes mellitus is a worldwide disease which affects the vital organs of human body. The approach executed in this project is to fabricate the nanocomposites of $BiVO_4$ by incorporating reduced graphene oxide (RGO) and carbon nanotubes (CNT) for photoelectrochemical non-enzymatic glucose detection. These different composites were prepared using electrochemical deposition method. X-ray Diffraction (XRD) and scanning electron microscope (SEM) analysis confirmed the structural details and surface morphology of these nanostructures, graphene sheet, $BiVO_4$ nanoparticles and of carbon nanotubes. UV–Vis analysis revealed the increasing trend in absorption of light and absorption edge, for $BiVO_4$, $CNT/BiVO_4$, $RGO/BiVO_4$ and $CNT/RGO/BiVO_4$ electrodes, respectively. The photoelectrochemical response was measured through Linear Sweep voltammetry and increase in current density was observed from pure $BiVO_4$nanoparticles to $CNT/BiVO_4$ to $RGO/BiVO_4$ and to $CNT/RGO/BiVO_4$, due to incorporation of graphene and carbon nanotubes. The increasing glucose oxidation current was measured through cyclic voltammetry. It was observed that glucose oxidation peak was maximum for $CNT/RGO/BiVO_4$ electrode, as the incorporation of extremely conductive CNTs specifies several routes for the transportation of electrons and act as an impressive conductive binders to restrict the agglomeration of graphene nanosheets, thus enhancing the rate of electrons exchange. This study shows that $CNT/RGO/BiVO_4$ electrode is the best photoelectrochemical electrode for non-enzymatic glucose detection for providing maximum sensitivity of 501.5 mA cm^{-2} mM^{-1} and good stability with negligible current response from interference species.

8th International Conference on Women in Physics

ID-021

Hyperthermia response of graphene-magnetite nanohybrids in AC magnetic field for cancer treatment

Khush Bakhat Akram[1]

[1]*khushbakhat@nutech.edu.pk||National University of Technology (NUTECH), Main IJP Road, Sector I-12, Islamabad, Pakistan*

Abstract

As per factsheet of world health organization (WHO) published in February 2018, cancer is the cause of almost 8.8 million deaths annually. Conventionally adopted approaches of cancer treatment including radiation therapy, chemotherapy, and surgery cause severe side effects such as damage to healthy tissues, fatigue, alopecia and multidrug resistance (MDR). Magnetic hyperthermia (HT) is a promising non-invasive alternative approach for the treatment of cancer. Biologically prepared Graphene-magnetite (G-Fe_3O_4) nanohybrids (graphene/magnetite wt. ratio varies 0-100 %) have been investigated for radio-frequency hyperthermia therapy. The samples were exposed to an alternating current (AC) magnetic field of 734.1 kHz and of strength 16.9 mT. A significant heating effect was observed in prepared nanohybrids. The hyperthermia potential of graphene-magnetite nanohybrids was evaluated by calculating specific absorption rate (SAR) from time varying magnetic hyperthermia curves (0-90 seconds). Graphene in the nanohybrid reduces the dipolar interactions between Fe_3O_4 nanoparticles to enhance their heating effect. Decoration of Fe_3O_4 nanoparticles onto the graphene sheets surface also gives the advantage of biocompatibility and large surface area for homogeneous heat dispersal for effective magnetic hyperthermia activity. The biocompatible graphene-magnetite nanohybrids have been found useful for localized hyperthermia applications for cancer treatment.

Keywords: Graphene, Magnetite, Dipolar interactions. Magnetic Hyperthermia, Specific absorption rate (SAR),

8th International Conference on Women in Physics

Photoelectrochemical response of non-enzymatic glucose biosensing for $BiVO_4$ nanocomposites

Shabbir, Syeda Ammara[1],

[1]*Department of Physics, Forman Christian College (A Chartered University, Lahore, Pakistan*

Diabetes mellitus is a worldwide disease which affects the vital organs of human body [1]. The approach executed in this project is to fabricate the nanocomposites of $BiVO_4$ by incorporating reduced graphene oxide (RGO) and carbon nanotubes (CNT) for photoelectrochemical non-enzymatic glucose detection [2]. These different composites were prepared using electrochemical deposition method. X-ray Diffraction (XRD) and scanning electron microscope (SEM) analysis confirmed the structural details and surface morphology of these nanostructures, graphene sheet, BiVO4 nanoparticles and of carbon nanotubes. UV–Vis analysis revealed the increasing trend in absorption of light and absorption edge, for $BiVO_4$, $CNT/BiVO_4$, $RGO/BiVO_4$ and $CNT/RGO/BiVO_4$ electrodes, respectively. The photoelectrochemical response was measured through Linear Sweep voltammetry and increase in current density was observed from pure BiVO4nanoparticles to $CNT/BiVO_4$ to $RGO/BiVO_4$ and to $CNT/RGO/BiVO_4$, due to incorporation of graphene and carbon nanotubes. The increasing glucose oxidation current was measured through cyclic voltammetry. It was observed that glucose oxidation peak was maximum for $CNT/RGO/BiVO_4$ electrode, as the incorporation of extremely conductive CNTs specifies several routes for the transportation of electrons and act as an impressive conductive binder to restrict the agglomeration of graphene nanosheets, thus enhancing the rate of electrons exchange. This study shows that $CNT/RGO/BiVO_4$ electrode is the best photoelectrochemical electrode for non-enzymatic glucose detection for providing maximum sensitivity of 501.5 mA cm-2 mM-1 and good stability with negligible current response from interference species.

References:

1. K.E. Toghill, R.G. Compton, Electrochemical non-enzymatic glucose sensors: a perspective and an evaluation. Int. J. Electrochem. Sci 5(9), 1246–1301 (2010)
2. N. Arora, Recent advances in biosensors technology: a review. Octa J. Biosci. 1(2), 147–150 (2013)

8th International Conference on Women in Physics (ICWIP 2023)
9-14 July 2023
ONLINE (Homi Bhabha Centre for Science Education (HBCSE), Mumbai, INDIA)
Asia/Kolkata timezone

Hybrid photodetectors of triple perovskite with graphene

Mei-Hsin Chen*, Pei-Hong Xie, Rong-Sheng Xu
Department of Electro-Optical Engineering, National Taipei University of Technology, Taipei 106, Taiwan

Organic-inorganic hybrid perovskites have attracted significant attention for optoelectronic applications due to their strong light absorption and long carrier lifetime in the past few years. However, the problem that perovskites are easily affected by environment still needs to overcome, resulting in the decrease of device performance and stability. Here, a hybrid photodetector composed of the multi heterojunction of graphene/Poly(3-hexylthiophene) (P3HT)/triple cation perovskite Cs0.05MA0.14FA0.81Pb(I0.85Br0.15)3 is proposed. And this multiheterojunction is shown to greatly improve the performance of graphene-based photodetector, where in triple cation perovskite serves as light absorbing layer with regard to its high light harvesting property, adding P3HT layer can effectively separate the photoexcited electrons and holes, and graphene functions as the transport layer with regard to its excellent electrical properties. As a result, the hybrid photodetector exhibits an impressively high responsivity of 1.35x 107 A/W with response time shortened to ms. In addition, this hybrid photodetector exhibits excellent stability over long-term measurements due to the stable triple cation perovskite.

ID-028

Breath Figure Formation Using PDMS

*Swathi P V, V Madhurima**

Department of Physics, School of Basic and Applied Sciences,
Central University of Tamil Nadu, Thiruvarur, 610005, Tamil Nadu, India.
**EMail: madhurima.cutn@gmail.com*

Highly ordered porous polymer films are in great demand due to their variety of applications as superhydrophobic surfaces, self-cleaning templates etc., and are also useful in studying the underlying physics of self-assembly of droplets on surfaces. A simple, cost effective, single stage method for the fabrication of porous polymer films is breath-figure approach. This method utilizes the condensation of droplets from a vapor medium onto a polymer in a liquid state, in a controlled environment. The droplets evaporate as the polymer solidifies, leaving behind a porous substrate. In this work, Polydimethylsiloxane (PDMS) is drop casted on the smooth and grooved surface in saturated vapor atmosphere of water, ethanol and propanol to study the effect of alcohol vapors in the pore sizes.The pore sizes on the smooth surfaces are 2.53, 3.45 and 3.07 μm for water, ethanol and propanol vapours respectively and for grooved surfaces are 7.18, 2.94 and 3.54 μm for water, ethanol and propanol vapours respectively. The grooved surfaces show distorted patterns from the ideal hexagonal structure whereas the smooth surfaces show more ordered patterns. Voronoi tessellations are calculated for the grooved and smooth surfaces and the voronoi entropy is calculated only for smooth surfaces since the grooved surfaces show high distortion. Also, Aboavs law, Desch law and Lewis law are verified to study the topological properies of the voronoi diagram.

8th International Conference on Women in Physics

Pressure induced superconductivity in topological quantum materials

Malavi Pallavi[1]

[1]*HP&SRPD, Bhabha Atomic Research Centre, Trombay, Mumbai 400085, India*

Topological materials are new quantum state of matter and has attracted considerable attention from the condensed matter physics community [1,2]. They are characterized by surface states induced by the topology of the bulk band structure. The search for superconductivity in various types of topological quantum materials has been of immense current research interest for the possible exploration of Majorana quasiparticles in condensed matter physics and for potential applications in topological quantum computation. We have recently investigated two prototype systems using pressure as a tuning parameter to tune the lattice structure and manipulate the electronic states.

First compound is a layered trigonal BiSe, a weak topological insulator. It is found to exhibit rich phase diagram with the emergence of pressure induced superconductivity. Sequential structural transitions into energetically tangled orthorhombic and cubic structures having distinct superconducting properties are identified. Superconductivity is preserved and system transforms back to trigonal phase upon release of pressure [3]. Secondly, a Dirac semimetal Ir_2In_8S shows large magneto-resistance at ambient pressure which is dramatically suppressed with increasing pressure, without showing any pressure-induced superconductivity. Surprisingly, superconducting onset below ~4 K has been detected with partially regained magneto-resistance upon pressure release. Ir_2In_8S thus becomes a unique system exhibiting large magneto-resistance above the superconducting transition [4]. Onset of superconductivity in presence of Dirac like surface states makes both these systems suitable candidates for topological superconductor. Our research on these quantum materials under pressure provide novel route to explore the possibility of achieving topological superconductivity by pressure-cycling and will help improve our understanding of their exotic properties, making it easier to unlock their potential for practical applications in future quantum technologies.

References:

1. X.-L Qi & S.-C Zhang, Topological insulators and superconductors. Rev. Mod. Phys. **83**, 1057–1110 (2011).
2. S. M. Young, et al. Dirac semimetal in three dimensions. Phys. Rev. Lett. **108**, 140405 (2012).
3. P. Malavi, P. Kumar, N. Jakhar, S. Singh and S. Karmakar, Signature of superconducting onset in presence of large magnetoresistance in type-II Dirac semimetal candidate Ir2In8S, New J. of Physics, **24**,102002, (2022).
4. P. Malavi, A. Paul, A. Bera, D. V. S. Muthu, K. Mazhi, P S Anil Kumar, U. V. Waghmare, A. K. Sood, and S. Karmakar, Pressure-induced superconductivity in the weak topological insulator BiSe, Phys. Rev. B **107**, 024506 (2023).

ID-040

Molecular Interactions of Zinc Finger Protein Kaiso with p120 Catenin

Bidhya Thapa[1,2], Narayan P. Adhikari[1], Purushottam B. Tiwari[3], Prem P. Chapagain[4,5]

[1]Central Department of Physics, Tribhuvan University, Kirtipur, Kathmandu, Nepal

[2]Padma Kanya Multiple Campus, Tribhuvan University, Bagbazar, Kathmandu, Nepal

[3]Department of Oncology, Georgetown University, Washington, D.C., USA

[4]Department of Physics, Florida International University, Miami, FL, USA

[5]Biomolecular Sciences Institute, Florida International University, FL, USA

Abstract

Molecular level insights into protein-protein interactions are crucial for the deeper understanding of various cellular and biological processes. Interactions of zinc finger (ZF) protein Kaiso with its binding partner p120 catenin are implicated in several biological processes, especially in tumorigenesis, through the the regulation of the genes involved in development and cancers. Despite their important biological role, there is no structural characterization of the interactions of Kaiso with p120 catenin and their complex formation. In this work, we employed molecular modeling, docking and molecular dynamics (MD) simulations to model the optimum complex of Kaiso and p120 catenin as well as to investigate the interactions between these two proteins in molecular level. Our results show that, non contiguous regions flanking to the ZF domains in Kaiso bind with the 1-7 arms repeat domains of p120 catenin. We identified the major residues in both proteins and their interactions involved in the complex formation and stabilization. Various non-covalent interactions such as; salt bridge, hydrogen bonding as well as hydrophobic interactions are involved in formation of stable complex between these two proteins. Our results show that the Kaiso residues adjacent to ZF domains in the C-terminal side are involved in the hydrophobic interactions with p120 catenin 1-3 arms, whereas, the residues in the N-terminal side interact with p120 catenin 3-7 arms repeats mainly through hydrogen bonds and salt bridge interactions.

ID-041

Uphill Diffusion through Point Contact Reaction during Nanoscale Silicide Formation

Yi-Chia Chou[1*], Lih-Juann Chen[2], King-Ning Tu[3]

[1]*Department of Materials Science and Engineering, National Taiwan University, Taiwan*

[2] *Department of Materials Science and Engineering, National Tsing Hua University, Taiwan*

[3] *Department of Materials Science and Engineering, City University of Hong Kong, China*

[*]Presenter

Abstract

Many electronic devices, such as field-effect transistors, depend on achieving precise control of both a semiconductor nanostructure and its contact with the larger scale circuit. The control of the contact between nanowire and circuit is a key step that involves integrating different types of materials and bridging between length scales. In Si nanowires, we show that silicide formation can occur through a point contact reaction and we demonstrate that the reaction shows different kinetics from those already known in thin film silicide technology. We discuss the strain effect on the nucleation and growth of silicides in nanowires. Such nanowires have an oxidized surface and this controls the reaction pathway and kinetics. To follow up the present model, the gradient of stress potential is treated as the driving force for "uphill diffusion" of metal atoms in Si to migrate to the epitaxial interface. Additionally, the strain effect is taken as a reason that an extremely high degree of supersaturation of Ni, over a factor of 1000 needed for NiSi formation, can take place near the interface. The need of an extremely high super-saturation, about a factor of 1000, of Ni interstitials for the nucleation is because of the extremely low equilibrium solubility of Ni in Si.

8th International Conference on Women in Physics

Growth of Cobalt Doped β-Ga_2O_3 Crystal for Saturable Absorber Application

Mantri Priyanshi[1], Soharab M.[2], Bhatt Rajeev[2,3], Karn Ratna [2], and Bhaumik Indranil[2,3]

[1]Intern at Laser and Functional Materials Division, RRCAT, Indore, India.
[2] Laser and Functional Materials Division, RRCAT, Indore, India.
[3] Homi Bhabha National Institute, Training School Complex, Mumbai, 400094, India.

Recently, ultra-wide band gap (UWBG) transparent semiconductors have attracted attention for the development of solar-blind UV detectors, flame detectors, light emitting diodes, gas sensors, and electronic and optoelectronics devices [1-5]. β-Ga_2O_3 has been identified as a potential material in this category and being explored for the development of next-generation electronic and photonic devices. It is a wideband gap (4.8 eV) material with unique combination of properties like an insulator or conductor depending on the growth conditions [3-6]. The excellent thermal conductivity of 27 $Wm^{-1}K^{-1}$[7] along the b-axes makes Ga_2O_3 a promising material for laser and related optical applications. Recently, Cobalt doped β-Ga_2O_3 has attracted attention as a potential laser material for saturable absorber application to generate passively Q-switched pulsed near IR lasers [8]. Numerous applications, including range finding, material processing, medical, communication, micro-machining, defence, and others, use near-infrared pulsed lasers. In view of the above, there is a lot of interest to develop β-Ga_2O_3 crystal for efficient, compact, and high beam quality pulsed laser system.

In the present work, single crystals of Co-doped β-Ga_2O_3 with varied doping concentrations of 0.025, 0.05, 0.15 and 0.3 at.% Co have been grown by Optical Floating Zone technique. The chemicals were synthesized by solid state reaction route. The growth parameters were optimised to have flaw free crystals. Good quality crack-free single crystals having light to dark green colour depending on the Co concentration in the lattice were grown. The crystals were cleaved along [100] direction and polished for optical measurements. The grown crystals were investigated for structural, optical absorption, and saturable absorption characteristics. Powder X-ray diffraction analysis shows no significant variation in the lattice parameters on Co doping. The broad absorption band observed at 950-1700 nm due to Co ions is used to obtain self Q-switched pulsed lasing near IR using saturable absorption phenomenon. The FTIR spectra depict the presence of OH^{-1} ions in the lattice. The details of the investigation will be presented at the conference.

References:

1. Zbigniew Galazka, Semicond. Sci. Technol. **33**, 113001 (2018)
2. I. Bhaumik, M. Soharab, R. Bhatt, A. Saxena, S. Sah, A.K. Karnal, Optical Materials **109**, 110351 (2020).
3. I. Bhaumik, R. Bhatt , S. Ganesamoorthy, A. Saxena, A.K. Karnal, P.K. Gupta, A.K. Sinha, S.K. Deb, Appl. Optics, **50**, 6006 (2011).
4. S.I. Stepanov, V.I. Nikolaev, V.E. Bougrov and A.E. Romanov, Rev. Adv. Mater. Sci. **44**, 63 (2016).
5. R. Jangir, Tapas Ganguli, S. Porwal, Pragya Tiwari, S. K. Rai, I. Bhaumik, L.M. Kukreja, P.K. Gupta, S.K. Deb, J. Appl. Phys.**114**, 074309 (2013)
6. Single Crystals of Electronic- Materials Growth and Properties; Woodhead Publishing Series in Electronic and Optical Materials; Elsevier 487-521 (2018).
7. Z. Guo, A. Verma, X. Wu, F. Sun, A. Hickman, T. Masui, A. Kuramata, M. Higashiwaki, D. Jena and T. Luo, Appl.Phys. Lett. **106**, 111909 (2015).
8. Jin Zhang, Yiran Wang, Wenxiang Mu, Zhitai Jia, Baitao Zhang, Jingliang He, and Xutang Tao, Optical Materials Express **11**, 442 (2021).

Light induced thermal and electrical transport in graphene-silver nanoparticle nanocomposites for thermoelectric applications

Sweta Gurung[1], Nimmala Arun[2], Anand P Pathak[2], Srinivasa R Nelamarri[3], Ajay Tripathi[1], Archana Tiwari[4,*]

[1]*Department of Physics, School of Physical Sciences, Sikkim University, Gangtok, 737102, India*
[2]*School of Physics University of Hyderabad, Hyderabad, 5000046, India*
[3]*Department of Physics, Malaviya National Institute of Technology,Jaipur, 302017, India*
[4]*Department of Physics, Institute of Science, Banaras Hindu University, Varanasi 221005, India*
**Email id : archana.tiwari@bhu.ac.in*

In this work, we report synthesis of nanocomposite of silver nanoparticles with reduced graphene oxide (Ag-rGO) using one-step, one-pot method where polyvinylpyrrolidone and ethylene glycol are used as capping and reducing agents respectively. The average particle size of Ag NP has been reduced by 16-fold after composite formation with rGO. Intensity ratio of D and G peaks (I_D/I_G) present in rGO has been used to determine crystallite size for rGO and Ag-rGO at various temperature. The change in Raman frequency with increasing temperature and power has been related to increasing phonon anharmonicity, lattice expansion and has been further used to determine thermal conductivities of rGO and Ag-rGO [1,2]. Thermal conductivities (κ) at ~ _300 K have been found to be 2.86(1) $Wm^{-1}K^{-1}$ for rGO and 1.69(1) $Wm^{-1}K^{-1}$ for Ag-rGO. The decrease in κ with nanocomposite formation has been associated with the presence of small sized Ag NP which acts as scattering centers for phonons and also restricts the flow of heat [3]. To the best of our knowledge, thermal conductivity for thin films of Ag-rGO nanocomposite is reported here for the first time. I-V hysteresis loops have been obtained for rGO and Ag-rGO. Ag-rGO presents higher electrical resistance as compared to rGO due to the presence of Ag NP which acts as scattering centers for conducting electrons. Unlike Ag-rGO, the space charges and electrical resistance vary proportionately in rGO owing to its capacitive behavior with no significant decrease in resistance upon illumination with 532 nm. While in Ag-rGO a significant drop in the resistance upon illuminating with 532 nm is observed due LSPR mediated charge transfer from Ag NP to rGO surface. Through this work we have been able to synthesize Ag-rGO with low thermal conductivity and photo tunable electrical conductance which might find suitable applications in photo-thermoelectric devices [4].

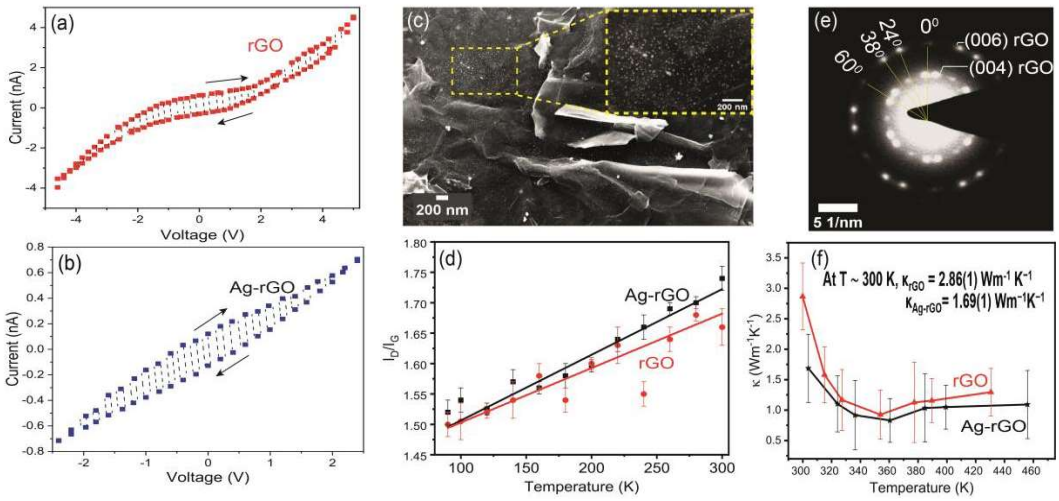

Fig.1 I-V curves obtained upon illumination with 532 nm for (a) rGO and (b) Ag-rGO. (c) FESEM micrograph of Ag-rGO nanocomposite. (d) Variation of ID/IG ratio with temperature for rGO and Ag-rGO. (e) SAED pattern where angle between the spots corresponding to rGO plane is shown. (f) Variation of κ with temperature for rGO and Ag-rGO.

References

[1] I. Calizo, A.A. Balandin, W.Bao, F. Miao, C.N. Lao "Temperature dependence of the Raman spectra of graphene and graphene multilayers," Nano Lett.**7,** 2645-2649 (2007).
[2] M. Sharma, S. Rani, D.K. Pathak, R. Bhatia, R. Kumar, I. Sameera "Temperature dependent Raman modes of reduced graphene oxide: Effect of anharmonicity, crystallite size and defects," Carbon. **184**, 437-444 (2021).
[3] A. Minnich, G. Chen "Modified effective medium formulation for the thermal conductivity of nanocomposites," Appl. Phys. **91**, 073105 (2007).
[4] W. Kubo, M. Kondo, K. Miwa "Quantitative Analysis of the Plasmonic Photo-Thermoelectric Phenomenon," J. Phys. Chem. C. **123**, 21670-21675 (2019).

ID-066

Revealing deformation phonons of graphene on various substrates by polarized Raman spectroscopy

Yu-Chen Chang[1], Wen-Cheng Ke[2], Yann-Wen Lan[1], and Ting-Hua Lu[1*]

[1]Department of Physics, National Taiwan Normal University, Taipei, Taiwan
[2]Department of Materials Science and Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan

[*]Email: thlu@ntnu.edu.tw

Polarized micro-Raman spectroscopy is a versatile technique that enables the study of the optical coupling between graphene and substrates. In this report, we investigated the exchange of optical helicity between graphene and different substrates by analyzing the degree of polarization using Raman spectroscopy. This study helps to deepen our understanding of the coupling strengths of phonon modes in graphene on different substrates. We calculated the degree of polarization of the G-band on Si (100), SiC, and patterned sapphire substrates using linearly and circularly polarized incident light. Our analysis revealed that the degree of polarization of phonon modes for linearly and circularly polarized incident light is higher for monolayer graphene on Si (100) compared to SiC and patterned sapphire substrate. We also observed changes in Raman intensity by varying polarized excitation light. The experimental results were accurately fitted using the Raman tensors.

8th International Conference on Women in Physics

A Case Study on the Non-Isothermal Reaction Kinetic Calculations for Thermal Decomposition leading to Iron Oxide Nanoparticles

Chakraborty, Manisha and Bhattacharjee, Ashis

Department of Physics, Institute of Science, Visva-Bharati University, Santiniketan-731235, India.

Among many different methods, thermal decomposition of organoiron solid precursors leads to a popular way to synthesize nanosized iron oxides with controllable morphology and quality of varying phases. Solid state thermal decomposition is a process of redistribution of bonds in the solid upon heating and subsequent formation of new products different from the reactant(s) [1]. Further, a kinetic modelling for a solid-state thermal decomposition [2] is a pertinent way to investigate the thermal conversion of solid precursors into materials with application potential. Nature of thermal decomposition reaction as well as the decomposed products significantly depend on the reaction environment, presence of co-precursor and reaction temperature.

Ferrocene and its derivatives are good sources of iron for the formation of iron oxide nanoparticles through thermal decomposition [3,4]. Non-isothermal decomposition of 1-ferrocenyl ethanol ($C_{12}H_{14}FeO$), a ferrocene derivative, under O_2 atmosphere exhibits a three-step process, while the decomposed material is a mixture of hematite and maghemite. On the other hand, non-isothermal decomposition of 1-ferrocenyl ethanol in presence of malonic acid ($C_3H_4O_4$) in O_2 atmosphere affects the thermal decomposition significantly (a five-step process) while the decomposed product is characterized as hematite with spherical nanostructures. Using the thermogravimetric data, the reaction kinetics of the decomposition has been studied, the kinetic triplets (i.e., activation energy, mechanism function and reaction rate) of each step are estimated and the effect of the presence of co-precursor on these parameters has been explored.

References:

1. M. E. Brown, *Introduction to Thermal Analysis: Techniques and Applications* (Springer Science & Business Media, 2001).
2. Koga et al., Thermochimica Acta 179384 (2022).
3. Rooj et al., International Journal of Chemical Kinetics **49**, 319 (2017).
4. Das et al., International Journal of Chemical Kinetics **50**, 259 (2018).

8th International Conference on Women in Physics

Impact of the Thicknesses of the p and p+ Regions on the Electrical Parameters of a Bifacial PV Cell

Konate Ramatou[1], Zouma Bernard[1], Ouedraogo Adama[2], Korgo Bruno[1], Zoungrana Martial[1], Kam Sié[1]

[1]Laboratoire d'Energies Thermiques REnouvelables (L.E.T.RE), Departement de Physique, Unite de Recherche et de Formation en Sciences Exactes et Appliquees, Universite Joseph KI-ZERBO, Ouagadougou, Burkina Faso.

[2]Laboratoire d'Energies Thermiques REnouvelables (L.E.T.RE), Departement de Physique, Centre Universitaire Polytechnique de Kaya (CUP-Kaya), Kaya, Burkina Faso.

The present paper is about a contribution to the bifacial PV cell performances improvement. The PV cell efficiency is weak compared to the strong energy demand. In this study, the base thickness impacts and the p+ zone size influence are evaluated on the rear face of the polycrystalline back surface field bifacial silicon PV cell. The photocurrent density and photovoltage behaviors versus thickness of these regions are studied. From a three-dimensional grain of the polycrystalline bifacial PV cell, the magneto-transport and continuity equations of excess minority carriers are solved to find the expression of the density of excess minority carriers and the related electrical parameters, such as the photocurrent density, the photovoltage and the electric power for simultaneous illumination on both sides. The photocurrent density, the photovoltage and electric power versus junction dynamic velocity decrease for different thicknesses of base and the p+ region increases for simultaneous illumination on both sides. It is found that the thickness of the p+ region at 0.1 µm and the base size at 100 µm allow reaching the best bifacial PV cell performances. Consequently, it is imperative to consider the reduction in thethickness of the bifacial PV cell for exhibition of better performance. This reduced the costs and increase production speed while increasing conversion efficiency.

Keywords : Doped p+ Region, Bifacial PV Cell, Photocurrent Density, Photovoltage, Polycrystalline Solar Cell

8th International Conference on Women in Physics

Insolation Based Models for solar radiation estimation in three Localities of Burkina -Faso

Ladifata Mogmenga[1], *Gilbert.G Nana*[1], *Nebon Bado*[1], *Thierry Sikoudouin Maurice Ky*[1], *Sié Kam*[1] *Bouchaib Hartiti*[2] *and Philippe Thevenin*[3]

[1]*University Joseph KI-ZERBO, Laboratory of REnewable Thermal Energies, 03 BP 7021 Ouaga 03, Burkina Faso.*
[2]*University Hassan II of Casablanca, ERDyS Laboratory GMEEM and DD Group, BP 146, 20800, Mohammedia, Morocco*
[3]*Department of Physics, LMOPS Laboratory, University of Lorraine, BP57070, Metz, France*

Abstract
The solar data used to size installations for energy needs are most often oversized. The data used are either old or suffer from the effects of climate change or from data extrapolated to a whole region. For a country with a strong sunshine all year round, it is good to compare the many models that exist to find the most suitable for the country. The distribution of solar radiation on a territory is not uniform, it depends on several geographical, meteorological and astrological parameters. In addition, solar radiation data is often not available due to the high cost of measuring equipment. To address this issue, we propose models based on easily measurable meteorological data.
In this study the models are proposed for localities of Dori in the North, Ouagadougou in the center and Bobo-Dioulasso in the South of Burkina Faso. Regression models based on insolation duration for estimating global solar radiation on a horizontal surface in these localities have been proposed. The results obtained are satisfactory with the coefficient of determination between “0.9745 - 0.9977” and a statistical test t between “0 - 0.09”.

8th International Conference on Women in Physics

SPECTRAL EFFECT OF A MONOCHROMATIC LIGHT ON THE PERFORMANCE OF A SILICON SOLAR CELL

R. Saré[1], I. Sourabié[2], M. Zoungrana[1] and I. Zerbo[1]

[1]Laboratory of Thermal and Renewable Energies, Department of Physics, Faculty of Pure and Applied Sciences, University Joseph KI-ZERBO, Ouagadougou, Burkina Faso

[2]Laboratory of Research in Energetic and Space Metrology, Department of Physics, Faculty of Pure and Applied Sciences, University Nobert ZONGO, Koudougou, Burkina Faso

ABSTRACT

The aim of this work is to show the effect of the incident light wavelength on the electrical parameters of a silicon solar cell. The photo-current density and the photovoltage are derived from the density of excess minority carriers which is, in turn, obtained by solving the continuity equation in a one dimensional model. The J-V and P-V curves are plotted in the same axes system and that allows us to find, according to incident light wavelength, the maximum electric power, the photocurrent density and the photovoltage at the maximum power point, the short circuit photocurrent density and the open circuit photovoltage. Then, the conversion efficiency, the series and shunt resistance of the equivalent circuit of the solar cell are calculated using the electrical parameters previously determined.

The results have shown that the best performance of the silicon PV cell are obtained in wavelengths ranges from 0.62 µm to 0.8 µm corresponding to the red region of the solar spectrum.

Keywords: Conversion efficiency; Monochromatic illumination; Series Resistance; Shunt Resistance, Solar cell.

8th International Conference on Women in Physics

Magneto-electronic properties of graphene nanoribbons in different electric field under QHE regime

Akansha Thakur (Thakur, Akansha)[1], *Niladri Sarkar (Sarkar, Niladri)*[1]

[1]*Department of Physics, Birla Institute of technology and Science Pilani, Pilani-Campus, Rajasthan,India.*

We investigate the electronic properties of Graphene Nanoribbons (GNRs), which are sensitive to the geometry of their edges and the number of carbon atoms N across the ribbon. Depending on it we have two structures, namely Armchair GNR (AGNR) for which confinement mixes Dirac points, K and K' valleys whereas for Zig-Zag GNR (ZGNR) does not mix the valleys. Near the K and K' Dirac points for infinite graphene, the electrons are massless and chiral so we are using Dirac formulation to calculate their energy eigenvalue and energy eigenstates [1]. The electron confinement in GNRs causes their properties to be quite sensitive to an applied uniform and non-uniform electromagnetic field and its corresponding changes are reflected in conductance, local density of state and transmission which we are determining using a mathematical formulation named as Non-Equilibrium Green's function (NEGF)[2]. Depending upon the even or odd number of ribbon width we can make these metallic or semiconducting GNRs applicative in tunable Field-effect Transistors (FETs) [3].

References:

1. Lukose, Vinu, R. Shankar, and G. Baskaran, *Physical review letters* 98.116802 (2007).
2. S. Datta, Quantum transport: atom to transistor (Cambridge university press, 2005)
3. Chen, S. C., et al *Physics Letters A* 372.38 (2008): 5999-6002

8th International Conference on Women in Physics

Biomineralization behavior of 58S, 70S and 82S ternary mesoporous bioactive glasses stabilized through ethanol extraction process

Kandari, Sudipta[1, 2], *Murugavel, Sevi*[2]
[1]*Department of Physics, Govt. P. G. College Gopeshwar (Chamoli) Uttarakhand-246401, India*
[2] *Department of Physics and Astrophysics, University of Delhi, Delhi-110007, India*

The investigations on bioactive glass materials with multi-functional properties like tissue regeneration, tumor annihilation, anti-bacterial growth and angiogenesis advancement is of great importance. In this context, mesoporous bioactive glasses (MBGs) are gaining tremendous interest in designing the next generation of biomaterials for the bone defect treatment. The current research trend to enhance their biological activity is the inclusion of appropriate textural characteristics by adopting newer synthesis procedure. In this work, ternary SiO_2-CaO-P_2O_5 mesoporous bioactive glasses with three different compositions have been synthesized by using the acid assisted sol-gel process with Pluronic P123 template as a structure-directing agent followed by evaporation induced self-assembly process. In contrast to the conventional process, we adopted an ethanol extraction process to remove surfactant, leading to superior textual properties and high Si-OH group density in resultant MBGs. The textural study reveals that as-synthesized MBGs possess the superior textural properties such as high specific surface area, high pore volume with the narrow mesopore size (2-50 nm) distribution which is highly beneficial for the glass degradation upon soaking in physiological solution. The textural parameters of the investigated glass samples strongly depend on chemical compositions and stabilization step. Additionally, the different anionics species present in the silica network structure, density of Si-OH group, role of the CaO and P_2O_5 contents in the glass structure of all samples have been revealed by using the magic angle spinning nuclear magnetic resonance (MAS-NMR) technique. The vibrational spectroscopy reveals the presence of high concentration of Si-OH group over the surface of pristine glass samples, which effectively accelerates the formation of hydroxyl carbonate apatite (HCA) layer. The MBG specimens show a good cell viability behavior without toxicity up to the concentration of 20 µg ml^{-1}. In the present results we observed that pore size along with surface area and Si-OH group density play an effective role in the growth of HCA layer.

Keywords: Mesoporous bioactive glass, Apatite phase, High surface area, Biomineralization

8th International Conference on Women in Physics

Synthesis and characterization of Ag_3PO_4 /SnS_2 composite for hydrogen evolution reaction

***S. Divyadharshini*[1]**, *B. Leena*[1], *Rekha Pachaiappan*[2], *D. Paul Joseph*[3], *M. Kovendhan*[1*]

[1]*Department of Physics and Nanotechnology, SRM Institute of Science and Technology, Kattankulathur, 603203, Tamilnadu - India*

[2]*Department of Physical Sciences, SIMATS School of Engineering, Thandalam, Chennai-602105 - India*

[3]*Department of Physics, National Institute of Technology, Warangal, Telangana – 506004-India*

The photocatalytic behaviour of transition metal oxides (TMO's) is improved effectively by making it as a heterojunction with transition metal dichalcogenides (TMDC's) [1]. In this work, a simple hydrothermal method is used to prepare Ag_3PO_4 / SnS_2 composite. The prepared photocatalyst is studied using various characterization techniques such as XRD, UV, TEM, SEM, and degradation using industrial dyes. The bandgap value of both Ag_3PO_4 and SnS_2 are estimated and values are closely matches with the previous reported work [2]. XRD result confirms the presence of both Ag_3PO_4 and SnS_2 peaks without any secondary phases. UV-vis spectroscopy reveals the absorption capacity of Ag_3PO_4 is improved significantly after the addition of SnS_2. SEM and EDX confirms the morphology and percentile of element present in the prepared samples. We have also carried out degradation studies based on the samples prepared and found that this composite has wide range of applications in wastewater treatment, and environmental related applications.

Key words: Wastewater treatment, Hydrothermal synthesis, Ag_3PO_4 composite, Photocatalytic activity, Heterojunction.

References:

[1] M. You *et al.*, "The visible light hydrogen production of the Z-Scheme Ag3PO4/Ag/g-C3N4 nanosheets composites," *J. Mater. Sci.*, vol. 53, no. 3, pp. 1978–1986, 2018, doi: 10.1007/s10853-017-1612-6.

[2] J. Liu and E. Hua, "High Photocatalytic Activity of Heptazine-Based g-C3N4/SnS2 Heterojunction and Its Origin: Insights from Hybrid DFT," *J. Phys. Chem. C*, vol. 121, no. 46, pp. 25827–25835, 2017, doi: 10.1021/acs.jpcc.7b07914.

8th International Conference on Women in Physics

SPECTRAL EFFECT OF A MONOCHROMATIC LIGHT ON THE PERFORMANCE OF A SILICON SOLAR CELL

R. Saré[1], I. Sourabié[2], M. Zoungrana[1] and I. Zerbo[1]

[1]Laboratory of Thermal and Renewable Energies, Department of Physics, Faculty of Pure and Applied Sciences, University Joseph KI-ZERBO, Ouagadougou, Burkina Faso

[2]Laboratory of Research in Energetic and Space Metrology, Department of Physics, Faculty of Pure and Applied Sciences, University Nobert ZONGO, Koudougou, Burkina Faso

ABSTRACT

The aim of this work is to show the effect of the incident light wavelength on the electrical parameters of a silicon solar cell. The photo-current density and the photovoltage are derived from the density of excess minority carriers which is, in turn, obtained by solving the continuity equation in a one dimensional model. The J-V and P-V curves are plotted in the same axes system and that allows us to find, according to incident light wavelength, the maximum electric power, the photocurrent density and the photovoltage at the maximum power point, the short circuit photocurrent density and the open circuit photovoltage. Then, the conversion efficiency, the series and shunt resistance of the equivalent circuit of the solar cell are calculated using the electrical parameters previously determined.

The results have shown that the best performance of the silicon PV cell are obtained in wavelengths ranges from 0.62 µm to 0.8 µm corresponding to the red region of the solar spectrum.

Keywords: Conversion efficiency; Monochromatic illumination; Series Resistance; Shunt Resistance, Solar cell.

8th International Conference on Women in Physics

Space charge contributions to the dielectric response and breakdown strength of high-temperature polyetherimide/polyimide blends

Jurečič Vida[1,2], Novak Nikola[1], Fulanović Lovro[3], Bobnar Vid[1,2]

[1]Condensed Matter Physics Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia.
[2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia.
[3]Department of Materials and Earth Sciences, Nonmetallic Inorganic Materials, Technical University of Darmstadt, Alarich-Weiss-Straße 2, 64287 Darmstadt, Germany.

Capacitors are an indispensable part of modern electronics and electrical power systems. Compared to ceramics, polymer-film capacitors are inexpensive and can be produced in a variety of shapes. One of the major challenges in developing dielectric polymers is realizing high energy density while maintaining low dielectric losses. The composite approach, in which conductive particles are dispersed in the dielectric matrix, effectively increases the dielectric permittivity but also boosts the losses [1]. An alternative approach is operation under higher electric fields, i.e. increasing the electrical breakdown strength without increasing the dielectric permittivity.

Phenyl groups are fundamental chain components of many high-temperature polymers and, depending on the polymer's molecular structure, delocalized electrons in these groups may exhibit a partially positive or negative charge. Blending of appropriately matched polymers can thus result in high chain packing density and a reduction of accumulated space charges that initiate breakdown at lower electric fields. Indeed, an enhancement of the breakdown strength in blends of polyetherimide (PEI) with polyimide (PI) has been reported [2].

To further investigate the influence of the interchain interactions on the dielectric response, we prepared several PEI/PI blends by solution casting method and performed high-resolution dielectric measurements over broad frequency and temperature ranges. While the dielectric permittivity of the blends is almost identical to that of pristine PEI and PI, their electrical conductivity is significantly (up to 40%) lower. Additional low-frequency measurements corroborated that blends with lower intrinsic electrical conductivity accumulate less space charges. Moreover, the temperature-dependent measurements of both annealed and non-annealed samples revealed the influence of aging processes and, particularly, absorbed water on the dielectric response of PEI/PI blends. Therefore, the impact of high-temperature annealing on the dielectric breakdown strength was also examined. Annealing before the measurement significantly increased the breakdown strength of pristine polymers, while values in blend systems remained almost unchanged. Furthermore, unannealed blends exhibited ≈2.5 times higher values of breakdown strength than pristine PEI and PI [3].

Our results confirm that molecular engineering of high-temperature polymers can reduce the amount of accumulated space charges and consequently enhance the electrical breakdown strength, making polymer-film capacitors even more attractive for further development.

References:

1. C. Huang, Q.M. Zhang and J. Su, High-dielectric-constant all-polymer percolative composites, *Appl. Phys. Lett*. **82**(20), 3502–3504 (2003)
2. Q. Zhang, X. Chen, B. Zhang, T. Zhang, W. Lu, Z. Chen, Z. Liu, S.H. Kim, B. Donovan, R.J. Warzoha, E.D. Gomez, J. Bernholc and Q.M. Zhang, High-temperature polymers with record-high breakdown strength enabled by rationally designed chain-packing behavior in blends, *Matter* **4**(7), 2448–2459 (2021)
3. V. Jurečič, N. Novak, L. Fulanović and V. Bobnar, Space Charge Contributions to the Dielectric Response and Breakdown Strength of High-Temperature Poly(ether imide)/Polyimide Blends, *Macromolecules* **56**(3), 1097–1104 (2023)

8th International Conference on Women in Physics

Charge-Transfer Complex Formation in Organic Semiconductor Films: role in Surface Doping

Babuji Adara[1], *Cazorla Alba*[1], *Solano Eduardo*[2], *Ocal Carmen*[1], *Barrena Esther*[1]

[1]*Institut de Ciència de Materials de Barcelona (ICMAB-CSIC), 08193 Bellaterra, Barcelona, Spain.*

[2]*ALBA Synchrotron, 08290 Cerdanyola del Vallès, Barcelona, Spain*

Among the vast number of organic semiconductors (OSCs) developed in the last decades, [1]benzothieno [3,2-b]benzothiophene (BTBT) derivatives have emerged as one of the best performing materials for p-type organic field-effect transistors (OFETS). Understanding and controlling molecular doping as a versatile platform for tuning the optoelectric properties of OSCs, still remain a challenge for further advancements in organic electronics. Contact and channel doping, generally referred as surface doping, are two general approaches used to improve OFETs operation, which rely on integer electron charge transfer between the OSC and the dopant. In this work, we address the structural properties of BTBT films during the deposition of a p-type dopant, 2,3,5,6-tetrafluoro-7,7,8,8-tetracyanoquinodimethane (F6TCNNQ), with special attention to the comparison of two BTBT derivatives, namely 2,7-dioctyl-BTBT (C8-BTBT-C8) and 2,7-diphenyl-BTBT (DPh-BTBT). Grazing incidence wide-angle X-ray scattering (GIWAXS) was performed in the course of thermal annealing of the films. Although both BTBT-based films are isostructural, we find important structural differences upon the deposition of F6TCNNQ. The deposition of F6TCNNQ on C8-BTBT-C8 results on the formation of a co-crystalline mixed phase at the interface with charge-transfer complex (CTC) properties, which is further promoted by thermal annealing [1]. We demonstrate the key role of the formed charge transfer complex in surface doping for improving channel field-effect mobility and reducing the threshold voltage in organic field-effect transistors. In contrast, F6TCNNQ on DPh-BTBT results in a planar heterostructure, without intermixing of both molecules.

References:

1. Adara Babuji, Alba Cazorla, Eduardo Solano, Carsten Habenicht, Hans Kleemann, Carmen Ocal, Karl Leo, Esther Barrena, ACS Appl. Mater. Interfaces, 14, 44632–44641 (2022)

8th International Conference on Women in Physics

Simulation of successive Cascades in Fe-Ni-Cr Model Alloy using Molecular Dynamics for studying Defect Microstructure during ion irradiation

(Chakraborty,Soumita),(Dutta,Argha),(Dey,Santu),(N.,Gayathri),(Mukherjee,Paramita)

Department of Atomic Energy, Variable Energy Cyclotron Centre, Kolkata-700064,India.

Nuclear/thermonuclear facilities use high chromium and nickel containing alloys of iron for various applications including fuel clad tubes. Ion irradiation is well established as a surrogate for neutrons to perform experimental studies on new candidate materials for future advanced reactor systems. Formation of various defects such as vacancy/interstitial clusters, dislocation loops, stacking fault tetrahedra etc. plays a vital in controlling the microstructure and mechanical properties of the material after irradiation, as response of the material to particle irradiation. MD simulation has been used in this work to follow the development of these defects during successive irradiation. The study has been carried out to correlate with earlier experimentally observed results of ion irradiated SS316 alloy and its Ti modified version. 3 different PKA energies were chosen as the average energy of the PKA's produced due to 3 different ion beams incident on the model alloy. To calculate the PKA energy spectra, Stopping and Range of Ions in Matter (SRIM) Program was used. MD simulation was carried out using Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS)[1]. OVITO software was used for visualisation and extraction of necessary information from LAMMPS output files.5000 successive cascades were used in the simulation to achieve a dpa range of ~ 0.46-2.5. Interstitial clusters, cluster composition, stacking faults and various dislocation loop evolution with dpa have been studied. To find out average of the mentioned parameters, multiple sets of simulation were carried out. Defect clusters were identified and compositional analysis was carried out to find the % of Ni and Cr (in clusters) as function of dpa. Stacking fault counts evolution was also followed. Changes in these parameters were observed and correlated to the PKA energy and hence its damage cascade

References:

1. S. Plimpton, Fast Parallel Algorithms for Short-Range Molecular Dynamics, J. Comput. Phys. 117 (1995) 1–19

8th International Conference on Women in Physics

Plasmon-Exciton Interactions in Bilayers of Core-Shell Au-SiO_2 Nanoparticles and $FAPbI_3$ Perovskite Nanocrystals

Souzou Aliki[1,2], *Athanasiou Modestos*[1], *Manoli Andreas*[1], *Bodnarchuk Maryna I.*[4], *Kovalenko Maksym V.*[3,4], *Andreou Chrysafis*[2] *and Itskos Grigorios*[1]

[1]*Experimental Condensed Matter Physics Laboratory, Department of Physics, University of Cyprus, Nicosia 1678, Cyprus*

[2]*Nanotechnology Imaging and Detection Laboratory, Department of Electrical and Computer Engineering, University of Cyprus, Nicosia 2112, Cyprus*

[3]*Institute of Inorganic Chemistry, Department of Chemistry and Applied Biosciences, ETH Zürich, CH-8093 Zürich, Switzerland*

[4]*Laboratory for Thin Films and Photovoltaics, Empa – Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH-8600 Dübendorf, Switzerland*

In recent years, hybrid metal – semiconductor nanostructures have received extensive attention, due to their ability to improve the performance of optoelectronic devices via plasmon-exciton interactions. The inter-component coupling in such structures is tuneable by controlling the metal and/or semiconductor nanoparticle composition, size, shape and their interparticle distance. This offers extraordinary potential for high-performing optoelectronic devices in a diverse range of applications, including photodetectors, solar cells, laser diodes and light emitting diodes. In this work, core-shell Au-SiO_2 nanoparticles (NPs) with various core and shell sizes were synthesized and silicated via the Turkevich and Stöber methods, respectively. Bilayers of the Au-SiO_2 NPs with $FAPbI_3$ perovskite nanocrystals (NCs) have been fabricated. By tuning the core and shell size of the NPs, an enhancement of the light absorption and of the photoluminescence intensity and decay rate of the NCs is observed in the presence of the plasmonic NPs compared to control, pristine NC films. The enhanced absorption and emission of the bilayers is attributed to a combination of effects which include re-absorption of light scattered by the NPs, near-field plasmon-exciton coupling and plasmon-induced resonance energy transfer.

8th International Conference on Women in Physics

Bulk Heterojunctions of Cesium Lead Halide Nanocrystals with Fullerene Derivatives for Light Harvesting Applications

Charalambous, Eleftheria[1], *Papagiorgis Paris*[1], *Polycarpou, Nefeli*[2], *Christodoulou, Sotirios*[2], *Itskos, Grigorios*[1]

[1]*Department of Physics, University of Cyprus, Nicosia 1678, Cyprus.*
[2]*Department of Chemistry, University of Cyprus, Nicosia 1678, Cyprus.*

Lead halide perovskite nanocrystals (LHP NCs) combine facile fabrication, compositional bandgap tuning through the visible and excellent optoelectronic properties as a result of their defect-tolerant nature.Light-harvesting devices based on LHP NCs mostly rely on ligand washing protocols to produce electronic active NC arrays, but these methods are complex, lack reproducibility, and have issues related to the ambient and long-term stability of the treated NC electronic solids. An alternative approach that has received significantly less attention is to fabricate heterojunctions of LHP NCs with other conductive materials, similar to the concept of polymer-fullerene bulk heterojunctions. Blending LHP NCs with other conductive materials, such as carbon nanotubes, graphene, or conducting polymers, can result in efficient exciton quenching at the interface between the donor and acceptor materials, and potentially enable efficient charge extraction via conductive pathways. [1-4]

In this study, we investigate the electronic functionalization of green-emitting $CsPbBr_3$ and red-emitting $CsPb(Br/I)_3$ nanocrystals (NCs) [5] by mixing them with the fullerene derivative $PC_{70}BM$. The NCs are capped with short octylamine/octanoic-acid ligands, treated using a ligand washing protocol, and then mixed with fullerenes to produce conductive solids. Spectroscopic analysis of the resulting samples indicates efficient exciton dissociation at the NC-fullerene heterointerface. To probe charge extraction and long-range transport, we fabricate simple hole and electron photoconductive lateral devices using ITO and gold electrodes, respectively. After optimizing the fullerene component and subjecting the samples to thermal annealing post-processing, we observe a significant improvement in photoconductance in blend devices compared to pristine NC devices. [6] The improvement is more pronounced in gold-based devices, indicating that $PC_{70}BM$ acts as an efficient electron acceptor and transporter in such hybrid composites.

References:

1. Yao, E. P. et al., Exciton Diffusion Lengths and Dissociation Rates in $CsPbBr_3$ Nanocrystal–Fullerene Composites: Layer-by-Layer versus Blend Structures., Adv. Opt. Mater. **7**, 1–8 (2019)
2. Hu, L. et al., Flexible and efficient perovskite quantum dot solar cells via hybrid interfacial architecture. Nat. Commun., **12**, 466 (2021)
3. Zhao, Q. et al., High efficiency perovskite quantum dot solar cells with charge separating heterostructure. Nat. Commun. **10**, (2019).
4. Yuan, J. et al. Metal Halide Perovskites in Quantum Dot Solar Cells: Progress and Prospects. Joule **4**, 1160–1185 (2020).
5. Christodoulou, S., et al., High-Open-Circuit-Voltage Solar Cells Based on Bright Mixed-Halide $CsPbBrI_2$ Perovskite Nanocrystals Synthesized under Ambient Air Conditions. J. Phys. Chem. C **122**, 7621–7626 (2018).
6. Manoli, A. et al. Surface Functionalization of CsPbBr3Nanocrystals for Photonic Applications. ACS Appl. Nano Mater. **4**, 5084–5097 (2021)

Section-D

Purnima Sinha Hall

ID-014

The activities of the Women in Astronomy Working Group of the International Astronomical Union

Priya Hasan, Co-Chair WiA WG-IAU

The WiA WG set up in August 2022 organizes activities following there four point workplan on (i) Awareness & Sustainability, (ii) Training and Skill Building, (iii) Fundraising and career retention & (iv) Dissemination and communication of results via conferences, newsletters, etc. laid by its OC members since September 2021. These efforts of the WG has contributed to create awareness on the difficulties (bias, reduced career prospects, leaky pipeline and lacking role models, childcare issues, harassment, discrimination, unfair working conditions) faced by Women Astronomers and helped the careers of young women Ph.D. students worldwide.

8th International Conference on Women in Physics

Women in Physics

Siddique, Rizwana[1], *Hasnain, Aziz Fatima* [2]

[1]*Department of Physics, University of Karachi, Pakistan*
[2]*Center for Physics Education, Karachi, Pakistan*

In this paper, we will explore the underlying causes for the underrepresentation of women in physics. We have observed that the number of female enrollees is higher than that of male students, yet this number significantly reduces when it comes to postgraduate studies or faculty positions. After gathering input from various groups of girls and career women, we concluded that certain factors, including cultural impact, hinder the women to grow as scientists and make it hard for them to manage work-life balance.

To combat these irrational cultural parameters, Steps are required to be taken to change mindsets and popularize science among the masses. Paucity of female role models in physics and lack of encouragement for girls to opt physics are the reasons for having low enrollment of girls in postgraduate physics

In order to reduce gender disparity in sciences, a sense of belonging must be nourished for women scientists to feel empowered. While a little progress has been made in recent years to support women in physics in Pakistan, there is still much work to be done to address the structural and cultural barriers. Awareness is essential, but steps must be taken to provide more scholarships, grants, and financial aid, such as fee waivers (e.g., for GRE).

Activities like ICWIP2023, we have more stories to share with our young girls to encourage them to pursue a career in physics.

References:

1. Houle, F., Kirby, K.P., & Marder, M.P. (2023). Ethics in physics: The need for culture change. Physics Today.

2. Avolio, B., Chavez, J., & Vílchez-Román, C. (2020). Factors that contribute to the underrepresentation of women in science careers worldwide: a literature review. Social Psychology of Education, 23, 773 - 794.

3. Doucette, D., & Singh, C. (2020). Why Are There So Few Women in Physics? Reflections on the Experiences of Two Women

8th International Conference on Women in Physics

Participation of women in physics in the Dominican Republic: An initial approach

Encarnación, Emma[1,4], Samson, Inna[2,4], Álvarez, Moises[3,4], Caba, Thara[1], Santos, Laura[1]
[1]Physics Department, Universidad Autónoma de Santo Domingo, Alma Máter, Santo Domingo 10103, Dominican Republic.
[2] Physics Department, Instituto Tecnológico de Santo Domingo, Av. de Los Próceres 49, Santo Domingo 10602, Dominican Republic.
[3] Physics Department, Universidad Nacional Pedro Henríquez Ureña, Av. John F. Kennedy Km 7 1/2, Santo Domingo 1423, Dominican Republic.
[4] Physics Education Division, Dominican Physical Society, José Contreras Ave., 11-B, Ens. La Julia, P.O. Box 1528, Santo Domingo, Santo Domingo 1423, Dominican Republic.

Currently, the scientific and technological training of women in different fields of knowledge is important due to the continuous development of these areas and the need for people trained to perform research. Factors related to health and environmental problems have favored a greater interest in science careers in general and specifically in Physics. Therefore, it is necessary to promote the active participation of women in applied sciences. In Dominican Republic, the participation of women in the STEAM movement (Science, Technology, Engineering, Arts and Mathematics) is currently being timidly promote; however, when reviewing in different media we did not find related publications or research with the participation of women in physics in our country. The main goal of this work is to present the main activities that women in physics in the Dominican Republic are currently involved. To carry it out, we based ourselves on a survey that was apply to women who are specifically relate to physics in our country. This survey was apply through the Dominican Physical Society (SoDoFi). Within the questions, the age range was inquired, the academic degrees obtained in physics, the research field currently working on, how many years they have actively performing research, if they have received funding for research projects, the lines of research in which they work, the number of publications on peer review journals, the number of theses advised. The poster will present the results and within the conclusions, the need to carry out research that study the role and participation of women in physics in the Dominican Republic is evident.

ID-115

Natasha Sharma

Study of women representation in the field of relativistic heavy-ion collisions

It is observed that the females are underrepresented in the physics major graduate course. The 2010 Global Survey of Physicists found that men are more likely to be invited speakers at conference [1]. In 2019, women made up only 22.4% of the work-force in nuclear science [2]. Recently, scholars have begun investigating gender representation in several subdisciplines of physics, such as plasma physics, particle physics etc. In this work, we turn our gaze to women in the field of relativistic heavy-ion collisions, a subfield of nuclear physics.

We will present a study of the demographics of major conferences in heavy ion physics. We look at the distribution of talks by gender between 2011–2022 in some of the most prestigious international conferences of the field such as Quark Matter, Strangeness in Quark Matter, Initial Stages, Hard Probes etc.. We find that women are often underrepresented among plenary speakers and usually underrepresented among parallel speakers. At Quark Matter, women are more likely to be given a poster presentation in lieu of an oral presentation. We will discuss the collection of data and possible approaches to make the field more equitable and, therefore, more scientifically productive.

We have investigated the representation of women in the heavy-ion community.

[1] American Institute of Physics (2019), found here
https://www.aip.org/statistics/reports/women-physics-and-astronomy-2019

[2] “Toward closing the gender gap in nu- clear science,” (2019), found here
https://www.iaea.org/newscenter/news/toward-closing-the-gender-gap-in-nuclear-science

8th International Conference on Women in Physics

Institutional Racism and Sexism in Science

Brown, Nathanial[1]

[1]*Department of Mathematics, Penn State University, State College, PA 16801, USA.*

I'll discuss a representative sample of the vast body of research demonstrating institutional racism and sexism in science. We will look at ways inequity impacts women, particularly women of color, and spend time critically analyzing some institutional structures that enable inequity and the institutional inertia that prevents change.

8th International Conference on Women in Physics

Towards achieving Gender Equity: Activities of the Gender Group in Condensed Matter Physics

Bhattacharjee, Kuntala[1], Kalita, Bulumoni[2], Jaiswal-Nagar, Deepshikha[3], Rath, Shyama[4], Das, Sourin[5], Gupte, Neelima[6], Saha-Dasgupta, Tanusri[7], Narasimhan, Shobhana[8], Kulkarni, Sulabha[9], Varma, Shikha[10]

[1.] *IIST, Dept. of Space, Valiamala, Thiruvananthapuram, Kerala- 695547, India*

[2.] *Department of Physics, Dibrugarh University, Dibrugarh, Assam-786004, India*

[3.] *School of Physics, IISER - Thiruvanthapuram, Thiruvananthapuram, Kerala-695551, India.*

[4.] *Department of Physics and Astrophysics, University of Delhi, Delhi-110007, India*

[5.] *Department of Physical Sciences, IISER- Kolkata, Mohanpur, West Bengal-741246, India*

[6.] *Department Of Physics, IIT-Madras, Tharamani, Chennai, Tamil Nadu-600113, India*

[7.] *S. N. Bose National Centre for Basic Sciences, Salt Lake, Kolkata, West Bengal-700106, India*

[8.] *Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, Karnataka-560064, India*

[9.] *Centre for Materials for Electronics Technology (CMET), Pune, Mahrashtra-411008, India*

[10.] *Institute of Physics, Sachivalaya Marg, Bhubaneswar, Odisha- 751005, India*

Despite numerous efforts to promote the presence and participation of women in the field of Science, women still encounter systemic inequities and difficulties while pursuing research in physics. Even in most conferences, only a very small number of women scientists are invited as speakers or chairpersons. Gender Group in Condensed Matter Physics (GGCMP) is working towards understanding the factors that contribute to these inequities and underrepresentation of women in the physical sciences in general, with a special focus on the areas of condensed mater physics. The group also strives to gain insight into the challenges experienced by women researchers in their research endeavours.

GGCMP is a newly formed group (in 2022). However, many of its members have been very active in promoting gender related activities at various fronts and conferences for long time. Some of the activities of the group consist of carrying out a detailed survey on various aspects of the women in Physics in India, conducting workshop featuring panel discussions, etc. Survey aims to assess the representation of women faculty in universities and institutes, and comprehend the nuanced challenges faced by them. These challenges encompass the availability of childcare facilities on campuses, the "two-body problem," flexible working hours, career breaks, the presence of internal complaint committees, government funding, and more. The workshop and panel discussions provide a platform to deliberate on the aforementioned issues and the related obstacles. Looking ahead, the group plans to initiate several endeavours, including workshops dedicated to raising awareness about gender-related issues for both women students, post docs, and faculty. By spearheading these initiatives, the group aims to drive positive change and foster a more inclusive and equitable environment in the field of Condensed Matter Physics, where women researchers are able to freely communicate with each other about their problems and challenges.

8th International Conference on Women in Physics

Women in Physics: Argentina 2023

Claudia Montanari[1,2,], Laura C. Estrada[1,3,*], Tomás Cicchini[1,4,*], Fabiana Laguna[1,5], Victoria Ferreyra[1,6], Marisa A. Frechero[1,7], Lucila Álvarez Zuzek[1,8], Luciana Bruno[1,4], Cecilia Cormick[1,9], Natalia Giovenale[1,9], Daniela Lioren Suárez[1,5,10], Agustina Magnoni[1,11]*

[1]*Subcomisión de Género – Asociación de Física Argentina, Argentina,* genero.afa@gmail.com.
[2]*Instituto de Astronomía y Física del Espacio, CONICET – UBA, Buenos Aires, Argentina.*
[3]*Instituto de Física de Buenos Aires, CONICET – UBA, Buenos Aires, Argentina.*
[4]*Instituto de Cálculo, CONICET – UBA, Buenos Aires, Argentina.*
[5]*Centro Atómico Bariloche, CONICET – CNEA, Río Negro, Argentina.*
[6]*Universidad Nacional de La Pampa, La Pampa, Argentina.*
[7]*Dpto. De Química, Universidad Nacional del Sur and INQUISUR, Buenos Aires, Argentina.*
[8]*Fondazione Bruno Kessler, Italia.*
[9]*IFEG, CONICET- Universidad Nacional Córdoba, Córdoba, Argentina.*
[10]*Universidad Nacional de La Plata, La Plata, Buenos Aires, Argentina.*
[11]*Unidad de Investigación y Desarrollo Estratégico para la Defensa, CONICET, Buenos Aires, Argentina.*
[*]*corresponding authors*

Since 2017, the Gender Committee (GC) of the Argentine Physical Society (AFA) has been actively engaged in providing a gender perspective into the Physical community, striving to promote actions that foster a community characterized by gender equity and equal opportunities. To ensure comprehensive and inclusive participation, the constitution of the GC places particular emphasis on diversity, including representation from various geographical regions and individuals at different career stages. The GC has undertaken initiatives such as fostering a network of women in physics to facilitate collaboration, actively working to ensure the representation of women in plenary sessions and awards during the AFA's annual meeting and establishing safe spaces for victims of gender-based violence. In this article we provide an overview of the current state of Women in Physics in Argentina, focusing on 3 primary aspects: the main activities undertaken by the GC, a review of the national recent legislative framework aimed to prevent gender bias and violence, and a 5-years study of the relationship between the gender of Ph.D. candidates and their thesis advisors. Notably, while nearly 30% of physics researchers in Argentina are women, the proportion of female Ph.D. advisors stands at a mere 17%. Preliminary findings reveal gender homophilic tendency in the selection of thesis advisors. Specifically, female candidates are more likely to choose female advisors, while male candidates tend to have male advisors. These findings underscore the potential presence of gender bias within the advisor selection process, potentially impacting the diversity and representation within academic mentorship. Further research is needed to explore the underlying factors contributing to these patterns and to promote equal opportunities for students in selecting their thesis advisors.

Science Academies of India: Contributions towards Women in Science

Deore Dhanashree[1], Kumar Richa Prashant[2], Goswami Srubabati[2], Sharma Manju[3], Godbole Rohini[4], Sharma Shobhona[5]

[1]Institute of Bioinformatics and Biotechnology, Savitribai Phule Pune University, Pune 411007, Maharashtra, India.
[2]Physical Research Laboratory, Navrangpura, Ahmedabad-380009, Gujarat, India.
[3]Distinguished Women Scientist Chair, NASI, Allahabad, Residence:B-9 Extn. House No. - 6476(FF), Vasant Kunj, New Delhi – 110070, India.
[4]Centre for High Energy Physics, Indian Institute of Science, Bengaluru 560012, Karnataka, India.
[5]Institute of Chemical Technology, Mumbai 400019, Maharashtra, India.

Currently the three mainstream Science Academies of India, Indian Academy of Sciences (IAS), Indian National Science Academy (INSA) and National Academy of Sciences (NASI), have dedicated committees and activities towards Women in STEM. Several reports and books on 'Women in Science' have been published directly under the banner of- or in collaboration with- these academies. In recent years an Inter-Academy Panel for Women in STEM (IAPWiSTEM) has also been set up to coordinate the activities and promote synergy. Each Academy has been striving for improving the nomination and election of women fellows. This has resulted in a considerable increase in the numbers of women fellows in the last decade. The web-pages of the academies now document separately 'Women Fellows' as well as certain new initiatives towards Women in Science. Amongst various tasks of IAPWiSTEM, science outreach for rural women, and workshops have played a major role. An ambitious project of a comprehensive database of Women in Science in India - 'Science for Women: A Technology and Innovation (SWATI)' has taken off recently. It has been launched by the Department of Biotechnology and is a current important activity of IAPWiSTEM. At present it is hosted and maintained at the National Institute of Plant Genome Research. Details of the various activities will be presented in the poster.

8th International Conference on Women in Physics

The GATI Pilot: Influencing Policies, Organizational Culture and Strategic Vision

Jolly, Pratibha, Nupur, Priyanka, Rawal, Roja

[1]*National Assessment and Accreditation Council, Bengaluru, India.*

Gender Advancement for Transforming Institutions (GATI) is a novel intervention program launched by the Department of Science and Technology for women in STEMM disciplines. The strategic intent is to nudge institutions of higher education and research towards supporting diversity, inclusion and the full spectrum of talent for their own success and progression. The underpinning objective is to create evidence-based interventions to increase gender parity and reduce gender inequity across the whole institution for faculty, staff and students at all levels.

GATI pilots a sustainable evidence-based self-assessment and accreditation model based on a carefully crafted *Gender Equity Indicator Framework* (GEIF) [1]. At the core are ten key principles that articulate a commitment towards overcoming systemic and cultural barriers to academic and professional advancement across the pipeline. Going beyond quantitative data and gender statistics, the focus is on unravelling challenges and opportunities; on connecting the dots to create the bigger picture. This entails understanding the gender climate and organizational culture that plays an important role in the overall performance of individuals across the gender spectrum.

GATI has catalyzed a systematic and comprehensive relook at functioning of institutions in science domains. The focus has been on analysis, review and reflection on policies, processes, and practices based on intensive stakeholder feedback. Based on the insight gleaned, institutions are expected to create specific, relevant, achievable and time bound action plans, incorporating these in their strategic vision.

With GATI, India joins other international gender equality charters. Although inspired by Athena Swan (UK), it has developed an indigenous self-assessment framework. Thirty premiere institutions were selected to participate in the pilot over a duration of 18 months. The presentation will provide a multifaceted view on the unfolding dynamics of transformative change. It will also include important baseline data and a comparative study to understand sectoral and discipline-based differences for a wide range of institutions across the country. This perspective is important for understanding the task ahead for enhancing women's participation in physics education and research.

References:

1. Pratibha Jolly and Priyanka Nupur, Catalyzing change for gender advancement in science, Seminar **760,** 33 (2022).

8th IUPAP International Conference on Women in Physics

A study of vertical exclusion in a profession with a higher percentage of women in the labor market.

Parisoto, Mara Fernanda, M. F. P.[1], Santos, Juliana da Silva, J. S. S. [2], Villwock, Lara Eduarda L.E.V. [3], da Silva, Lillyan Kelly Sales L. K. S. S.[4], Valerão, Manuela M.V. [5]

[1] Department of Engineering and Exact, Federal University from Paraná, Palotina, Paraná, Brazil.

[2] Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

[3] Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

[4] Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

[5] Bioprocess Engineering and Biotechnology student, Federal University from Paraná, Palotina, Paraná, Brazil.

Abstract

The term vertical exclusion has been used to define the underrepresentation of women as they advance in their careers and in prestigious positions (SAITOVITCH et. al. 2015). In 2002, a research was conducted in Paris at the First IUPAP International Conference on Women in Physics (IUPAP CONFERENCE-I, 2002, BARBOSA, 2003) and demonstrated the reduction in female participation as the advancement of the career in physics, the study corroborated for the visibility of the theme and raised the vertical exclusion of women in the area of exact sciences. However, the question arises whether the vertical exclusion continues to occur in professions with a higher or equal percentage of men and women in the labor market. Currently, in Brazil, women in veterinary medicine account for 54% of the professionals registered in regional councils and the Federal Council of Veterinary Medicine (CFMV, 2022). For this, bibliographic research and documentary research will be carried out, analysis of the data found and conclusion of the study. The dropout of women throughout their careers is an issue that should be carefully discussed and paid attention to, so we can better identify the barriers created, and thus have the development of policies and strategies that seek to eliminate such barriers at all stages and sectors of many different careers that a female might pursue, contributing to a greater and more qualified presence of women in the job market.

Initiatives and Progress for Women in Physics: A Status Update from Ethiopia

Meti Desalegn-Tadesse[1,a)] *and Tsega Berhane Teklu*[2,b)]

[1]*Department of Physics, Adama Science and Technology University, Adama, Ethiopia*
[2]*Department of Physics, Mekelle University, Mekelle, Ethiopia*
Corresponding author: [a)]*meti.desalegn7@gmail.com*
[b)]*tsega.teklu29@gmail.com*

Abstract: This paper provides a comprehensive overview of the initiatives, progress, and current status of issues pertaining to women in physics in Ethiopia. The representation and participation of women in physics have historically been lower compared to their male counterparts, highlighting the need for targeted interventions to promote gender equity in the field. The participation of women in physics in Ethiopia is still low, with no women or holding a PhD in physics faculty, and only few women holding an MS degree. However, there are initiatives in place to increase the participation of women in physics and other like science, tech, engineering, and math (STEM) fields in Ethiopia. For example, the Physics in Ethiopia community has a specific goal to provide support to women in physics. The African Network of Women in Astronomy and STEM for GIRLS in Ethiopia initiatives has been established to strengthen the participation of girls and women in astronomy and science in Africa and Ethiopia. It highlights the increasing number of women pursuing physics education at various levels, including undergraduate and graduate programs. Efforts have also been directed towards increasing the visibility of women physicists through conferences, seminars, and public outreach activities. Moreover, the establishment of support networks and professional associations for women in physics has facilitated collaboration and knowledge sharing, further enhancing their career development prospects.

The initiatives outlined in this report encompass a range of activities, including mentorship programs, networking opportunities, awareness campaigns, and policy advocacy. These programs aim to address systemic barriers and biases that impede the progress of women in physics and create a supportive environment for their professional growth. Additionally, efforts have been made to enhance educational opportunities, scholarships, and research grants specifically targeted at women in physics. The education of females contributes to various aspects of their lives, such as increased longevity, family health, and nutrition. However, women's education in Ethiopia is strongly influenced by socio-cultural norms and attitudes, leading to a minimum share of women in higher education and STEM fields. To increase female students' participation in physics class, studies have suggested analyzing the factors affecting their academic performance and providing support to female students. International organizations can also play a crucial role in supporting the development of female physics role models in Ethiopia by providing funding for mentorship and role model programs, collaborating with Ethiopian universities and communities, and establishing initiatives to increase the visibility of female physics role models. While there is still work to be done to promote gender equality and empower women in STEM fields in Ethiopia, these initiatives are a step in the right direction towards creating a more diverse and inclusive physics community in Ethiopia. It emphasizes the importance of sustained efforts and collaboration among academia, industry, and policymakers to create a more diverse and inclusive physics community. By addressing existing challenges and promoting equal opportunities, Ethiopia can unlock the full potential of women in physics and harness their contributions to scientific advancement and societal development.

8th International Conference on Women in Physics

Strategies to encourage young females to pursue Physics in South Africa: Achievements and Challenges

***Shinqange, Katekani*[1]**, *Mhlongo Rebecca*[2], *Mdhluli Joyful*[3], *Modiba Rosinah* [4]

[1]*DSI/Mintek Nanotechnology Innovation Centre, Advanced Materials Division, Randburg, Johannesburg 2125, South Africa*

[2]*Sefako Makgatho Health Sciences University, Physics Department, PO Box 94, Medunsa 0204, South Africa*

[3] *University of the Witwatersrand, 1 Jan Smuts Avenue Braamfontein, Johannesburg 2001, South Africa*

[4] *Council for Scientific and Industrial Research, Manufacturing Cluster, Advanced Materials Engineering, Meiring Naude Road, PO Box 395 Pretoria, South Africa*

For a developing country such as South Africa, Physics is still seen as a male discipline as the number of women and girls participating in this specific area of study is relatively low. Additionally, the support structure for women and girls is still unsatisfactory given the extremely low number of females retained in the field of physics and its related careers. The Women in Physics in South Africa (WiPiSA), a forum under the South African Institute of Physics (SAIP), has begun several activities in various South African locations, particularly in the most disadvantaged locations, as part of a drive to promote and attract women and girls to careers in physics and fields related to it. Here, we provide a report on the WiPiSA activities conducted during the period of April 2022–April 2023. The pursuit of Physics awareness by WiPiSA includes science-related initiatives such as role modelling, mentorships, Physics departmental lunches, science outreaches, science competitions, webinars and media communications such as articles and radio interviews. These activities as well as the audience reach are discussed in detail. The planned actions moving forward are also covered in detail along with the triumphs and difficulties the activities present.

8th International Conference on Women in Physics

"Science for Women: A Technology and Innovation" Portal

Yadav, Gitanjali[1], Ranjan Aashish[1], Sharma Dhananjay[1], Venkatasubramanian Rishi[1], Chakraborty, Subhra[1],

[1]National Institute of Plant Genome Research, Aruna Asaf Ali Marg, New Delhi, India.

Recognising the wide-ranging scientific contributions by Indian Women in 75 years of Independence, the Govt of India jointly with National Science Academies, launched the SWATI portal for Indian Women and Girls in STEM. Envisaged as a gateway to view expertise and contributions of Indian Women in Science, the portal is being developed and housed at National Institute of Plant Genome Research (NIPGR), New Delhi and contains sections not just for Iconic Women in Science, but also faculty, research fellows, science communicators, entrepreneurs and girl students. Our Goal is to scale up this effort exponentially, to include and recognise each and every Indian woman and girl in science, across all career stages and subjects, spanning both Academia and Industry, enabling reliable and statistically significant long-term research on the issue of equality, diversity and inclusivity in India. We hope to reach out to each of the colleges and academic organisations within India, so that SWATI may represent a nation-wide interactive and searchable repository, the first of its kind in India. In future, we would like to link SWATI with similar efforts across nations.

Lab Hopping: A Journey to Find Indian Women in Science is a book published this year by Penguin India. The well-received book is a distillation of a beloved feminist science media project thelifeofscience.com which has been running for 7 years chronicling the gender gap in Indian science by collecting the stories of success and struggle of marginalised people in the community. The book takes the reader through the many issues of women and other marginalised people in science as it travels through laboratories in India -- a place where the popular imagination expects to find only a cis-male ‘genius’ scientist. Lived experiences of Indian women scientists from different disciplines, geographies, and professional levels are sewn together with existing data and analysis on the gender gap as well as the current policy scenario.

Conversations that took place while touring labs big and small, spread across the country - from Aligarh to Aluva, from Bhopal to Bhubaneswar, from Ajmer to Kalimpong, and many more - will rearticulate science and also gender in India today. The data gathered might be statistically significant but even more revealing are the stories of the invisible Indian women scientist. The face of STEM in India remains upper-caste/class and male-dominated, which is contradictory to the essence of science being diverse and open.

Authors: Aashima Dogra and Nandita Jayaraj, Co-founders of TheLifeofScience.com aka Labhopping

Media mentions of the book as of May 2023: https://www.gettoby.com/p/r43b59ybh6yf

8th International Conference on Women in Physics

Progress of Women Physicists in Egypt Supported by Legislations

Kahil [1], Ebraheem H[1],S El-Din Nermeen[2],M. Abd-Elkereem Reem[1], Mohsen M [1]

[1]Physics, Ain Shams University, Cairo, Egypt.
[2]Physics, German University, Cairo, Egypt.

The study highlights the legislations concerning working females in general, mothers and children. The texts of the laws reflect the legislator's appreciation for the status of women and their pioneering role in society [1]. The laws also explicitly stipulate that there is no discrimination between women and men in employment, except in matters that endanger women or any form of disrespect or human trafficking. The laws also grant women the right to maternity leave and childcare, in addition to obliging employers to provide suitable nurseries for children. All this creates a suitable working environment that is free from discrimination. The study also sheds the light on the extent to which high school girls are interested in studying physics compared to biology. The statistics represent one of the schools in the capital, Cairo. The provided high school educational system allows the student to select the qualifying subjects for university study. Numbers reveal no variation in the gender distribution in the enrolment of students in the ordinary level of physics, but female students significantly exceed their male counterparts in biology. Whereas, in the advanced level, girls exceed boys in biology, the case is reversed in physics. In addition, the number of female staff members of physics and biophysics specializations in Mansoura university [2], as an example, shows that biophysics attracts females more than physics. Nevertheless, it can be inferred that interest in physics is increasing among female scholars by time which.

References:

1. court of cassation: https://www.cc.gov.eg/legislation_single?id=417919
2. Physics Department, Faculty of Science, Mansoura University: https://scifac.mans.edu.eg/index.php/about-the-department-50

8th International Conference on Women in Physics

Empowering Women to Excel and Lead in all Sectors for Sustainable and Better Future

Sonawane Kavita[1], Deshpande Anjali[2], Jolly Lochan[3]

[1] Chair- Women In Engineering Affinity Group- IEEE Bombay Section, Mumbai India.
[2]Chair-Section Awards Committee, IEEE Bombay Section, Mumbai, India
[3]Chair-Education Activity Committee, IEEE Bombay Section, Mumbai, India

Progress of a Nation and Society is measured by status of its women. In the 2020-21 academic year, colleges approved by the All-India Council for Technical Education (AICTE) enrolled 658,191 undergraduate students. According to Society of Women Engineers research, 30.2% were female students. IEEE Women in Engineering (WIE) is the largest international professional organization dedicated to promoting women engineers and scientists and inspiring girls around the world to follow their academic interests to a career in engineering [1]. The Affinity Group, WIE-AG IEEE Bombay section, conducts various activities aiming at providing a platform to encourage women's participation and contribution in variety of sectors of science, engineering, physics and related domains [2].

Expert talks, workshops, training and mentoring Sessions that are organized by the WIE-AG for engineering students have equipped them with the skills and knowledge of latest developments in the technologies that are necessary for their careers. Participation in networking events such as Leadership Programs have facilitated meaningful connections, collaborations and knowledge exchange among women professionals, students, and industry leaders. The policies designed by section for scholarships and grants provide financial support to women pursuing education and research, enabling women to access quality opportunities in all domains. The WIE members are encouraged and supported for participation in conferences, which helps them to grow in their research career. Awards are given to encourage them for impacting the community through dedication and involvement in initiatives fulfilling WIE objectives.

These initiatives are strongly supporting the involvement of women and inspiring the younger generation to pursue STEM education and are leading to transformative changes in gender dynamics and the achievement of a more equitable society at broad. These also help empowering them to overcome barriers and continue a long and successful career, utilize their full potential and emerge as an impactful leader.

REFERENCES

1. https://r10.ieee.org/bombay-wie/
2. https://swe.org/research/2022/india-undergraduate-education/

8th International Conference on Women in Physics

Comparative Analysis of the Situation of Female Students in the Physical Sciences at the Universidad Nacional Mayor de San Marcos

Cerón Loayza, María Luisa[1]; Tesillo Quispe, Mabel Erlinda[1]; Montoya Burga, Jenny Aleida[1]; Mori Escobar, Fanny E.[1]; Mejía Santillán, Mirian E.[1]; Michuy Suyo, Regina[2]; Rimachi Gálvez, Karin[2], Silva Vidal De Millones, Fey Yamina[3]; Quispe Quispe, Adita[4]; Torres Guillen, Roxan[5]; Hanampa Roque, Hermelinda[6]; Quispe Crisolo, Tifany[7]; Ortíz Rojas, Senayda[7]

[1]*Soils Analysis Laboratory, Faculty of Physical Sciences. Universidad Nacional Mayor de San Marcos Av. Amézaga. Cercado de Lima, Perú.*
[2]*Graduated of Faculty of Physical Sciences. Universidad Nacional Mayor de San Marcos*
[3]*Instituto Geofísico del Perú*
[4]*Master's student policies and management of science, technology and innovation. Peruvian University Cayetano Heredia*
[5]*Universidad Nacional de San Agustín de Arequipa-Arequipa*
[6]*Universidad Nacional San Antonio Abad del Cusco. UNSAAC-Cusco*
[7]*Undergraduated of Faculty of Physical Sciences. Universidad Nacional Mayor de San Marcos*

We present the comparative results of the statistical study on the number of women entering the Faculty of Physical Sciences study programs at the Universidad Nacional Mayor de San Marcos (UNMSM) in Peru. Our previous studies showed that the population of female students in the Department of Physics at the undergraduate level was disproportionately low compared to the number of male students [1, 2]. Many female students registered in the physical sciences majors transferred to other areas of study for various reasons: work, family problems, or simply because physics did not seem to be the career they liked. We have the statistics of admission of female students for several years with a very variable number: in 1992, 1993, 1997, 1998, 2000, 2003 to 2005, only one female student entered per year. In 1995 and 2002 only two female students per year entered; in the years 1996 and 2001 there was no female students admitted to the Faculty of Physical Sciences; and in 1999 only five female students entered. This was the highest number of women admitted during these fourteen years (1993 to 2005).

In the last thirteen years, the statistical data shows that the number of women that were admitted to the Faculty of Physical Sciences had increased proportionally over the years from 2010 to 2020; it is an average between 6 and 7 students per year that represent a percentage between 6 - 7% of all the students entering the undergraduate study program. Pleasantly, in the years 2021, 2022 and 2023 there is an exponential increase of 13.6 %; 19.62% and 30.16% respectively; this percentage is very important and interesting. It is important to continue with this work about the statistical data, because it allows us to visualize how the female population has increased considerably, this data is relevant. Surveys should continue to be carried out to discuss and analyze the situation of that population that decided to pursue a career in physical sciences. How many graduated? How to continue postgraduate studies? And above all, stimulate and continue with the different activities that have been carried out for more than 10 years.

References:

8th International Conference on Women in Physics

Vigyan Vidushi – a unique initiative for mentoring aspiring young women

Dighe Amol[1], Mazumdar Anwesh[2], Nanal Vandana[3]

[1] *Dept. of Theoretical Physics, Tata Institute of Fundamental Research, Mumbai 400005, India*
2 Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, Mumbai 400088, India
3Dept. of Nuclear and Atomic Physics, Tata Institute of Fundamental Research, Mumbai 400005, India

As a step towards gender equity in the STEM (science, technology, engineering, mathematics) disciplines, Tata Institute of Fundamental Research (TIFR), a premier research institute in India, started an initiative named "Vigyan Vidushi" (literally: a learned woman scientist) in 2020 (https://vv.hbcse.tifr.res.in/). Originally started as an advanced summer school in Physics, it has also been later adopted by the disciplines of Mathematics and Computer Science. The programme has already received an excellent response and positive feedback, and has been acclaimed as an important initiative by TIFR.

The three-week programme, which includes lectures, tutorials, lab sessions, and mentoring sessions, focusses on women students from a wide spectrum of Indian universities, who are about to complete their first-year Masters in Physics. These students are at the threshold of deciding whether to engage in research towards their Ph.D., look for other opportunities based on their education, or leave their academic pursuits altogether. It is the right time to provide them an exposure to advanced physics topics and research opportunities, and encourage them to take up research in physics as a career option. Importantly, this programme enables young women research aspirants to interact with established women scientists, learn about their journeys, and be mentored in a unique gender-sensitised fashion – experiences which may not be available in their respective university learning environments. This is a unique initiative for women in physics, aimed at providing opportunities to level the playing field as well as increasing awareness.

The programme has been running successfully for 4 years in a row, although the first two years it was entirely in an online mode. It may be pointed out that the interactive sessions led the way for PAWS (Program for Aspiring Women Scientists) of Gender in Physics Working Group of India Physics Association (GIPWG-IPA) and subsequently to some of the satellite workshops of this conference. This paper will present the details of the programme, impact of the programme, feedback of students and future prospects.

8th International Conference on Women in Physics

Activity of AAPPS-WIP

Prof. Nojiri Mihoko

ID NO. 226

8th International Conference on Women in Physics

Analyzing implicit gender bias in Optics and Photonics

De Las Heras, Alba, Tomas, Maria

ID NO. 228

ID-237

Activities of the Working Group for Gender Equity (WGGE) of the Astronomical Society of India (ASI)

In September 2015, the Executive Council, Astronomical Society of India (ASI) approved the formation of a Working Group for Gender Equity (WGGE) to address issues related to gender equity within the Astronomy & Astrophysics community of India. Ever since the WGGE has been actively organising 1) lecture series for increasing gender sensitisation in the astronomy community in India, 2) mentoring sessions for young scientists 3) interviews of former members and 4) collection of gender statistics in academic institutions in India, among others. In this poster, we will present the activities of the WGGE for 2022-23.

Section-E

Laura Bassi Hall

ID-027

Regulated Infantilization: protection or roadblock?

V Madhurima

Department of Physics, School of Basic and Applied Sciences,
Central University of Tamil Nadu, Thiruvarur, 610005, Tamil Nadu, India.
Email: madhurima.cutn@gmail.com

Infantilization is the prolonged treatment of one who is no longer a child as one and usually comes in two main shades. The first is the hyper-sexualization of the female body through infantilization, mostly in media and will not be discussed further. The second is the infantilization of women in the name of protectionism, usually enforced through regulatory mechanisms, both social and institutional, and is referred to as paternalism. These are evidenced in the differential rules for women and men on higher education campuses, such as different timings for women and men's hostels, library hours, dress codes etc. Such regulatory mechanisms usually come into action when instead of augmenting resources, such as street-lights, late-night transportation etc., to ensure safety, differential rules for the women's and men's hostels are created. This often leads to a further decline in the engagement of women with STEM, especially those with laboratory-based work. Even when women continue to engage, such regulation can lead to lower academic productivity, and hence a lesser chance to continue to work in STEM fields. In this paper, I will discuss some case studies, and how regulated infantilization, or paternalization, is more of a roadblock than protection, and how as a concept, it goes against the guidelines of University Grants Commission's (UGC) SAKSHAM [1].

Reference:

1. UGC SAKSHAM guidelines:

   https://www.ugc.gov.in/pdfnews/5873997_saksham-book.pdf

ID-044

Challenges in Choosing Physics as a Career

Sarmistha Das[a], Moon Moon Devi[b], and Rupjyoti Gogoi[b]

[a]Department of Sociology, Tezpur University, Sonitpur, Assam-784028, INDIA
[b]Department of Physics, Tezpur University, Sonitpur, Assam-784028, INDIA
Email: sarmistha@tezu.ernet.in, devimm@tezu.ernet.in, rgogoi@tezu.ernet.in

Abstract:

Over the years participation of women in paid professions has increased in manifolds. With more women in professional spaces there are new hurdles and challenges for them. Academia is not an exception to women's increased participation and experiences. While the GER (gross enrolment ratio) in India, indicates a surge in the rates of enrolment with an increase from 53.8% in 2020-2021 to 57.6% in 2021-2022 there are studies which indicate a steady decline in representation of women in STEM (Science, Technology, Engineering and Mathematics) fields in higher educational institutions and universities. In India, the struggle for women's entry in higher education has been steady. Beginning with the colonial interventions on women's education to mid19th century women's reform movements including the nationalist movement women's education always occupied a center stage. This marked its way into the post-independent Indian state and the promises of the new nation towards women's education. Notwithstanding the efforts, there is a subsequent gap in underrepresentation of women in STEM fields of research despite the increase in overall enrolment rates. While there are numerous studies indicating the data on underrepresentation of women, there is a dearth of data when it comes to the states in Northeast India.

This proposed study is conducted upon the students of Physics in Tezpur University in the age group of 18-35 years. The study seeks to explore the pervasiveness of gender segregation, academic choices of the researchers and the challenges that they face in terms of making those choices. Are these choices reflective of their gender socialisation, social responsibilities towards the family, and care? Is there a rural urban divide when it comes to the choices of women and their enrolment?

8th International Conference on Women in Physics

"Fascinating Science! STEM Role Models": Building bridges for the next generation of scientists

Angelica Zacarias[1,2], Agnes Sandner[1], Iris Traulsen[3], Ruzin Aganoglu[1].

[1]German Physical Society, Working Group on Equal Opportunities, Hauptstr. 5, 53604 Bad Honnef, Germany.

[2]Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle, Germany.

[3]Leibniz-Institut für Astrophysik Potsdam (AIP), An der Sternwarte 16, 14482 Potsdam, Germany

Extra-curricular activities and exposure to STEM role models, such as experienced scientists and industry professionals, can significantly motivate younger generations, especially schoolgirls, to pursue a career in physics and other STEM fields. The rapidly changing society and job market require new key competencies, and developing appropriate teaching and learning concepts is necessary to keep up with these changes. To promote physics education, the Working Group on Equal Opportunities of the German Physical Society initiated the school outreach program "Faszination Wissenschaft! MINT-Role-Models" (Fascinating Science! STEM Role Models)[1]. In collaboration with the German Chemical Society (GDCh), Halles Schülerlabor für Physik, Martin Luther University Halle-Wittenberg (MLU), and Max Planck Institute for Microstructure Physics, activities for 6th-13th grade school pupils are organized, including seminars and webinar series that provide access to experienced scientists and their work. These webinars[2] are available online. The program also aims to help bridge the gender gap in the STEM workforce by showcasing successful female scientists and their achievements in traditionally male-dominated fields. Furthermore, the program enables collecting direct feedback from the school pupils through a questionnaire distributed at the end of the webinar. Based on the survey results, 64% of school pupils believe that they have the same opportunities as their peers to pursue a STEM education or career. However, 22% of pupils believe that they do not have the same opportunities as others, with 60% of those citing gender-based prejudices as the reason. These indicative results highlight the importance of addressing and combating gender-based prejudices in education to ensure that all students have equal access to pursue their interests and reach their full potential. It is also essential to educate and inform students about the opportunities available to them and the resources they can utilize to overcome any challenges they may face in pursuing their chosen paths.

References:

1. Ruzin Ağanoğlu und Agnes Sandner, „Für den Nachwuchs in Physik", Physik Journal 19 (2020) Nr. 6, 2020 Wiley-VCH
2. Available at the DPG YouTube Channel https://www.youtube.com/playlist?list=PLjr7Q7aXcJtieIWhC9BAPj0t5yb6RHhBZ

8th International Conference on Women in Physics

Reasons for the persisting underrepresentation of women in physics: insights from research on disciplinary cultures

Bossmann, Andrea B.[1,2,3], Erlemann, Martina[1,2] and Sandner, Agnes[1]

[1]German Physical Society, Working Group on Equal Opportunities, Hauptstr. 5, 53604 Bad Honnef, Germany.

[2]Department of Physics, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany.

[3]Department of Humanities and Educational Sciences, Center for Interdisciplinary Women's and Gender Studies, Technische Universität Berlin, Fraunhoferstr. 33-36, 10587 Berlin, Germany.

Vertical segregation, i.e. the decreasing share of women in academia with each career rank, and horizontal segregation, i.e. the underrepresentation of women in certain academic fields, are still widespread phenomena in academia.

Vertical segregation affects all academic fields. Women experience career disadvantages due to family care responsibilities [1]. Men are better integrated into informal networks than women and thus benefit more from networking [2]. Gender biases to the detriment of women result in poorer assessment results such as in application processes [3], in peer review procedures for publication and proposals [4] and in selection processes for awards [5].

Horizontal segregation refers to discipline-specific effects. Physics in Germany is highly affected by horizontal segregation. In 2022 women received only 22% of Bachelor's and 23% of Master's degrees [6].

A powerful tool to analyze the origins for these phenomena is the concept of disciplinary cultures. They are characterized by unconsciously shared values and norms, the Dos and Don'ts of a community. In physics the strong belief to be objective, a "culture of no culture" [7], makes it difficult to even address these issues and their resulting gender imbalances. Nevertheless, research from Gender Studies shows that gender is made relevant both implicitly and explicitly by physicists at the workplace.

In order to improve gender equity in physics a cultural shift is needed. Strategies to support these cultural shifts are proposed. To inform about the lack of diversity, especially the lack of women in physics, the AKC (Working Group on Equal Opportunities) organizes sessions/lectures at the major physics conferences in Germany. Also there is a Women in Physics-Lunch after the sessions, so that the female physicists can get together, network, exchange ideas and make plans. A parallel quiz about the status of equal opportunities in Germany shows the lack of knowledge on these topics.

References:

1. Beaufaÿs, A., Engels, A. and H. Kahlert, H. (2012), Einfach Spitze? Neue Geschlechterperspektiven auf Karrieren in der Wissenschaft. Frankfurt a.M.
2. Dautzenberg, K., Fay, D. and P. Graf (2011), Frauen in den Naturwissenschaften. Ansprüche und Widersprüche, Wiesbaden.
3. Moss-Racusin, C. et al. (2012), Science faculty's subtle gender biases favor male students, Proceedings of the National Academy of Sciences 109 (41): p. 16474-16479.
4. Wennerås, C. and A. Wold (1997), Nepotism and Sexism in Peer-Review, Nature 387 (22 May): p. 341-343.
5. Rossiter, M. (1993), The Matthew Matilda Effect in Science, Social Studies of Science 23 (2): 325-341.
6. Düchs, G. and K. Mecke (2022), Physik Journal 21, Nr. 8/9.
7. Traweek, S. (1988): Beamtimes and Lifetimes, Harvard University Press, Cambridge MA.

8th International Conference on Women in Physics

Concept inventories in physics: Multiple-choice or free-text?

Jordan, Sally[1], *Hedgeland, Holly*[2], *Nylk, Jonathan*[1], *Parker, Mark*[1], *Pathak, Ashutosh Kumar*[1]

[1]*School of Physical Sciences, The Open University, Milton Keynes, MK7 6AA, United Kingdom.*
[2]*Clare Hall, University of Cambridge, Hershel Road, Cambridge, CB3 9AL, United Kingdom.*

Concept inventories, of which the most well-known is the Force Concept Inventory (FCI), are generally multiple-choice instruments designed to test students' conceptual understanding, usually pre- and post-instruction. The use of multiple-choice questions enables easy marking of students' responses and is considered to provide a direct link between a student's response and a particular conceptualization. However, concerns have been expressed about the appropriateness of multiple-choice instruments, both when used for concept inventories [1] and when used in assessment more generally [2].

One consideration worthy of attention is the finding that women perform less well than men on the FCI [3], even in countries where women's outcomes on physics qualifications are better than men's. The possibility that this may, at least in part, be explained by the more general result that men are more likely than women to prefer multiple-choice questions over ones in which they give free text answers.

Until recently, the potential for free-text concept inventories was limited by the fact that this required resource-intense manual marking of responses. However, following extensive work by the lead author into the potential of automatic marking of assessment questions requiring a free-text answer of up to 20 words [4, 5], a PhD project has developed and evaluated a free-text version of the Force Concept Inventory [6]. In a subsequent PhD project, free-text responses have been further evaluated and compared with the distractors used in the conventional FCI. Free-text sub-questions are being developed, for use with the multiple-choice FCI, to further explore the conceptualizations which lead students to pick each distractor.

References:

1. N. Rebello and D. Zollman, The effect of distractors on student performance on the Force Concept Inventory, *American Journal of Physics*, **72**, 116 (2004)
2. C. Sangwin (2013) Computer-Aided Assessment of Mathematics. *Oxford: Oxford University Press.* ISBN 9780199660353
3. S. Bates, R. Donnelly, C. MacPhee, D. Sands, M. Birch and R. Walet, Gender differences in conceptual understanding of Newtonian mechanics, *European Journal of Physics*, **34**, 421(2013)
4. S. Jordan and T. Mitchell, eAssessment for learning?: The potential of short-answer free-text questions with tailored feedback, *British Journal of Educational Technology*, **40**, 371 (2009)
5. P. Butcher and S. Jordan, A comparison of human and computer marking of short free-text student responses, *Computers and Education*, **55**, 489 (2010)
6. M. Parker, H. Hedgeland, S. Jordan and N. Braithwaite, Establishing a physics concept inventory using computer marked free-response questions, *European Journal of Science and Mathematics Education*, **11**, 1 (2023)

ID-074

Education of the girl students from marginalized tribal regions of Maharashtra

Asmita Redij
Visiting Fellow, Homi Bhabha Centre for Science Education, TIFR

A journey into an invisible world, which began a year before the covid lockdown and continues. A journey that eventually culminated in starting two distinct projects while at HBCSE,

- ***Anandi Newsletter,*** a channel for direct communication with students addressing their fears related to education.
- ***Culturally Responsive Teaching,*** working with teachers to make science classrooms responsive to the needs and relevant for the life of our students.

This poster will give an overview of the status of education, in particular Science Education of girl students, in the marginalized tribal regions of Maharashtra. It will unfold some engaging stories from the ground, bringing out the concerns of the girl students and the challenges they face, calling upon attention from the wider Science Community.

8th International Conference on Women in Physics

Belarusian experience in reducing gender gap in Natural Science using heuristic learning approach in physics education in university

Tashlykova-Bushkevich Iya, Bobryk Aliaksei, Rusetskaya Tatiana

Physics Department, Belarusian State University of Informatics and Radioelectronics (BSUIR), 6 Browka St., 220013, Minsk, Belarus

Digital technologies, having become an essential attribute of modern life, have caused changes in many fields, including education. Implementation of modern teaching methods and approaches in the field of physics makes it possible to train competitive specialists with skills required to solve practical problems, establish a constructive dialogue "teacher-student" and can thus reduce the gender gap in Natural Science, see Fig. 1. In Belarus, one of the nation's oldest universities – Belarusian State University – conducts training of lecturers and professors on technologies of heuristic learning in order to develop heuristic qualities of the teacher who will be capable to individualize the teaching process, improving students' curiosity and creativity.

This work aims at demonstrating how the implementation of problem-heuristic approach can be used effectively to encourage girls' achievements and interest in Natural Science. Based on outcomes of the voluntary educational project "Heuristics in Physics" ("HiP") created for IT students by I.I. Tashlykova-Bushkevich in 2018 at the BSUIR the goal of this study is to reveal the effect of the author's technology of physics lectures organization with elements of heuristic learning on involving girls as well as boys in creative activities to make their own educational content on physics in the study of general physics course.

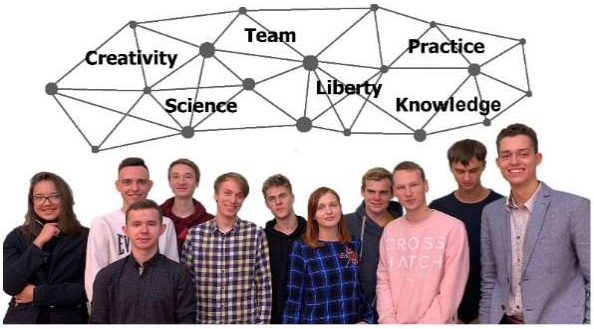

Figure 1. "Heuristics in Physics" project is a place where female and male students are involved into Natural Science and develop hard and soft skills in the study of general physics course

Engineering and IT students are more often male, which makes it important to create a healthy atmosphere for the educational training of female students. This is particularly true of the BSUIR that is the leading university in Belarus in the field of computer engineering and telecommunications. To illustrate the results of 5-year implementing heuristic learning approach in the physics educational process, the topics investigated were the analysis of students participating in the project, purpose of their participation, and impact of the project activities on their academic performance and development of hard-skills and soft-skills in the process of studying physics. Students were analyzed by gender, and among the group of female students the most popular sector of the project was determined. In summary, the gender evaluation' findings revealed a high level of participation of girls in the production of creative works and showed the benefits of applied approach for girls studying physics. The facts above indicate the effectiveness and reveal the prospects of the given heuristic educational approach in universities to increase the involvement of girls in physics and reduce the gender gap in Natural Science.

8th International Conference on Women in Physics

Activities for Diversity and Inclusion in the Japan Society of Applied Physics

CHIKUMOTO, Noriko[1,2,3], SHOJI, Ichiro[1,4], MATSUKI, Nobuyuki[1,5]
[1] The Japan Society of Applied Physics, 1-21-5 Nezu, Bunkyo-ku, Tokyo, Japan
[2] Chubu University, 1200 Matsumoto-cho, Kasugai-shi, Aichi, Japan
[3] Osaka University, 2-6 Yamadaoka, Suita, Osaka, Japan
[4] Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, Japan
[5] Kanagawa University, 3-27-1 Rokkakubashi, Yokohama, Kanagawa, Japan

The Japan Society of Applied Physics (JSAP) [1] established the Gender Equality Committee in July 2001, and has been working to raise awareness of gender equality among members and to create an environment in which both men and women can exercise their abilities in the society. In April 2022, the committee changed its name to the Diversity & Inclusion Committee, because the perception of gender has been diversifying in recent years and we should consider how to include not only men and women but also various nationalities, ages, and other diversities in our academic activities. The committee's mission is to promote diversity and inclusion in order to realize a society where individuals are respected and can fully demonstrate their talents. Our recent activities include the following.

- Establishment of the Diversity & Inclusion Award
  We established the "Outstanding Female Researchers Award" and "Young Female Researchers Award" (for researchers under 40 years old) to promote gender diversity by honoring female researchers and engineers who have achieved remarkable research and development results in the field of applied physics, and to foster female researchers and engineers who will lead the future of this field. Furthermore, the "Diversity & Inclusion Contribution Award" was also established to honor researchers, engineers, organizations, and groups that have conducted research and activities that significantly contribute to diversity and inclusion, and to activate the field of applied physics.
- Holding symposiums
  In 2022, we held a symposium entitled "Discussion of gender equality in applied physics fields through gendered innovation" to discuss how gendered innovation has become increasingly important in research and development, and how it can lead to an increase in the number of female researchers working in applied physics fields. Four lecturers from a newspaper and an automobile company, JAXA, and a university introduced case studies and participated in a panel discussion. The 2023 symposium was entitled "Diversity & inclusion with various distinct perspectives," in which the inclusion of not only gender diversity but also the inclusion of a wider range of diversity were discussed. Two external lecturers introduced cross-cultural understanding and the possibility of new work styles using avatar robots, and two female member researchers introduced their perspectives on D&I based on their own research experiences, followed by a panel discussion.
- Support for female junior high and high school students to choose science-related career paths
  We participate in the "Summer School for Junior and Senior High School Girls (Natsugaku) [2]" every year in the hope that the appeal of applied physics to junior and senior high school girls will increase the number of students who enter science-related fields, especially applied physics. We interact with many female junior and senior high school students through career counseling, hands-on experiments, poster exhibitions, and other activities.

References:

[1] https://www.jsap.or.jp/english.
[2] https://natsugaku.jp/en/.

8th International Conference on Women in Physics

The Gender Group in High Energy Physics in India: Efforts and Initiatives towards Gender Equity

Banerjee Nabamita[1], Dahiya Harleen[2], Devi Moon Moon[3], Goswami, Srubabati[4], Mohanta Rukmani[5], Shah Neha[6], Srivastava Ajit M.[7]

[1]Department of Physics, Indian Institute of Science Education and Research Bhopal, Bhopal 462066, India.
[2]Department of Physics, Dr. B.R. Ambedkar National Institute of Technology, Jalandhar 144027, India.

[3]Department of Physics, Tezpur University, Assam-784028, India.

[4]Physical Research Laboratory, Ahmedabad, Gujarat 380009, India.

[5]School of Physics, University of Hyderabad, Hyderabad 500046, India.
[6]Department of Physics, Indian Institute of Technology Patna, Patna 801106, India.

[7]Institute of Physics, Sachivalaya Marg, Bhubaneswar 751005, India.

Although the scientific aptitude is not dependent on gender, the overall scenario in Physics shows a very significant under-representation of women globally. Although, there has been a significant increase in the number of women pursuing Physics over the past decades, the high drop in the fraction of women remaining in the Physics profession demonstrates a strong "leaky pipeline syndrome". The situation in the Indian context is no exception in the physics disciplines including the High Energy Physics section. A notable effort to establish gender equity in the Indian High Energy Physics discipline is the formation of the "Gender Parity in HEP" (GePHEP) group in 2020, as a part of the initiatives by the Gender in Physics Working Group (GIPWG). The GePHEP group is actively working towards pin-pointing the challenges and exploring possible remedies through which gender equity may be achieved. We summarize here the efforts and initiatives taken up by this group since its formation.

Since 2020, the group has been actively organizing dedicated gender sessions during the National DAE-BRNS Symposium on High Energy Physics. The first ever session in 2020 included a plenary session in which the motivation behind the formation of the group, challenges faced by women at different levels in their career and the ongoing activities in raising an awareness were widely discussed. In the session in the 2022 meeting, a panel discussion on "Two Body Problem in Academia and Possible Ways to Overcome it", was held. The two body problem is identified as a major cause of the leaky pipeline syndrome, and the panel discussed various issues related to this. It may be noted that this group organized the first-ever gender session in a string theory meeting, including a panel discussion on "Gender Imbalance in String Theory: Focus on India" at the Indian String meet 2021. The emphasis was given at the imbalance at the root level of education till higher level of employment for women researchers in String Theory. The group also performed a detailed survey on the exact fraction of women in the Physics profession in various Indian institutes and initiated the probe into the cause and challenges. The study was presented in the 30th International Symposium on Lepton Photon Interactions at High Energies in January 2022. In the coming days, the group looks forward to a more intense role in spreading awareness to gender issues as well as in reducing the gender gap in high energy physics.

8th International Conference on Women in Physics

Proyecto Equis: Gender inequalities in the trajectory of the Bachelor 's degree in Physics.

Bessonart, Magdalena[1], *Sedofeito, Camila* [2], *Pelaez, Marcela*[3],

Anzibar, Maximiliano [2,3], *Rinderknecht, Felipe*[2], *Stari, Cecilia*[2]

[1] *Programa de historia económica, Facultad de Ciencias Sociales, Universidad de la República Constituyente 1502, Montevideo, Uruguay.*
[2]*Instituto de Física, Facultad de Cencias, Universidad de la República, Iguá 4225, Montevideo, Uruguay*

[2]*Instituto de Física, Facultad de Ingeniería, Universidad de la República, Av. Julio Herrera y Reissig 565, Montevideo, Uruguay*

Presentation of the results of a survey on the academic trajectories of physics students at the Faculty of Sciences, Universidad de la República.

In the previous edition of this congress, figures were presented regarding the situation of women in Uruguay in the field of physics and physics research. This data revealed a clear disparity between gender, although no thorough analysis had been conducted up until that moment. The analysis of these disparities became a catalyst to undertake a survey in order to delve deeper into the underlying causes of these inequalities.

In 2022, a survey was conducted with the aim of gathering the information on the trajectory of students, graduates, and individuals who discontinued their studies in the Bachelor of Physics program. The survey was completed by a total of 206 participants, spanning various generations and age groups.

Through the analysis of the collected data, several significant findings have been identified. When conducting a gender-based analysis, structural inequalities in academic performance between men and women have become evident. These inequalities manifest themselves in both the initial interest in choosing the profession and in the persistence in the program, as well as academic and professional achievements.

The survey included open-ended questions that allow for an analysis of how these gender inequalities have manifested and continue to manifest, along with the perceptions regarding them. Furthermore, potential strategies, mechanisms, and policies that could contribute to the eradication of these inequalities were explored.

8th International Conference on Women in Physics

Moving from ‘interest’ to ‘identity’: changing girls’ attitudes to careers in space science

Sadler, Wendy[1], *Bartlett, Sophie*[2], *Leverment, Shaaron*[3]

[1]*School of Physics & Astronomy, Cardiff University, UK.*
[2]*School of Social Sciences, Cardiff University, UK.*
[3]*Explorerdome, Bristol, UK.*

Astronomy and space science is a strong and growing industry. However, across Europe, the pool of qualified personnel with the skills, expertise, and, more importantly, desire to enter this workforce, is struggling to keep pace.

Although school students often enjoy topics of science, astronomy and space, they do not regard them as realistic or aspirational careers for their future [1]. ‘Our Space Our Future’ was an EU Horizon 2020 programme with a vision to enable and empower all young people, regardless of gender, ethnicity, disability, and socio-economic status to consider a career in astronomy and space science as an attainable and exciting aspiration. To fulfil this vision, the project delivered multiple interventions with the same groups of students (age 11-14yrs) to deliver experiences bringing together industry role models, students, families, and teachers. The experiences were designed to embed a culture of empowerment and belonging, that built students’ science capital.

Research was conducted across the five partner countries; Denmark, England, Italy, Portugal and Wales and pre- and post-intervention data was collected about attitudes to careers in space science and the perceived diversity of the types of people who work in this sector.

Students responded to statements about their views around space and astronomy, in terms of their interest, its relevance to society, diversity of the workforce, their sense of competence and their future aspirations. They participated in group discussions with their peers about their experiences in the project and their experiences in school. Students drew pictures of themselves engaging in astronomy, space, and science, that gave indications towards their feelings and identity in such an environment. This data can be disaggregated by gender and by country to explore differences connected to both country culture and gender stereotyping.

This poster will focus on the differences that were found between genders and countries in terms of aspirations in space science, and discuss what was most effective for turning a student's ‘interest’ into a possible future self. We will highlight the inclusive measures and indicators of impact and engagement that can be implemented in other outreach and education projects and provide a series of recommendations for future endeavours.

References

1. Ametller and Ryder, 2014; Archer et al., 2013; Jenkins and Nelson, 2005

8th International Conference on Women in Physics

Understanding Huygens principle & verifying laws of light propagation: a mathematical approach

Parakkal, Raziya[1], Parmar, AmisH[2], Chari, Deepa[2]

[1]Kendriya Vidyalaya, Kendriya Vidyalaya Sangathan, Mumbai, India.
[2]Homi Bhabha Centre for Science Education, TIFR, Mumbai, India.

deepa@hbcse.tifr.res.in

Concepts of wave optics are introduced to students of class XII in Indian schools following the CBSE curricula. Usually, CBSE schools adapt NCERT textbooks in class, one of its physics textbook chapters is "wave optics". Through this chapter, students explore the original formulation of the Huygens principle, and apply this principle to construct reflected and refracted wavefronts and further verify the laws of light propagation.

In the derivation discourse, the geometrical representation is introduced in textbooks at the beginning as a readymade construction. Students following the derivations can simply check the relation between angle of incidence and reflection formed by the incident wavefront and the constructed reflected wavefront in this static representation. The static nature of textbooks puts a limit to help students visualise the wavefront growing at a later instant of time. In contrast, building the same geometric representation step by step (as they follow derivation discourse) can be much richer experience for students.

In this work, we explain how students were facilitated to use GeoGebra as a mathematical tool to develop step by step construction of light propagation phenomenon. Using GeoGebra's dynamic capabilities, students readily observe different angles (incidence, reflection, refraction), identify connections between them, and observe wave propagation in some interval. This hands-on activity of geometrical construction is developed for students to build a deeper understanding of Huygens construction and how it is coherent with the laws of reflection and refraction. We present the analysis of 2 such sessions conducted with ~ 50 students in the poster.

Acknowledgements: This work is carried out under Vigyan Pratibha Project. We acknowledge the support of the Govt. Of India, Department of Atomic Energy, under the Vigyan Pratibha Project (No. R&D-TFR-0650).

8th International Conference on Women in Physics

Choosing Between Physics and Engineering, by Gender: A Canadian Study of Socio-Cultural Factors

Barkanova, Svetlana[1], *Sundly, Amit*[2], *Rosales, Janna*[3], *Moloney, Cecilia*[4]

[1]*School of Science and Environment, Memorial University, Corner Brook, Canada.*
[2]*Division of Community Health, Faculty of Medicine, Memorial University, St. John's, Canada.*
[3]*Faculty of Engineering and Applied Science, Memorial University, St. John's, Canada.*
[4]*Department of Electrical and Computer Engineering, Memorial University, St. John's, Canada.*

How do students choose between physics and engineering for university study, given the substantial overlap of skill sets and knowledge in these fields? Does gender play a role? Choosing a university program is a potentially significant life decision [1], and our team is interested in exploring the motivations and influences that factor into these choices. As STEM educators and practitioners, we believe that exploring the sociocultural factors influencing students' decisions can: a) yield an understanding that can better equip students to make more informed choices; and b) help high-school teachers, guidance counsellors, and university faculty to support students more effectively.

We present findings from our recent study that aims to understand the factors influencing the decisions of first-year students interested in or studying physics or physical oceanography, electrical engineering or mechanical engineering. The data were collected in Fall 2022 at a comprehensive university in Canada using an ethically approved online questionnaire. Women are still under-represented in physics and engineering in Canada [2]. Specifically, our analysis focuses on the gender factor across these disciplines in terms of the social and cultural context. We present and discuss the similarities and differences between students who identify as female or male and how their responses differ across and within these disciplines.

A student's decision about first-year university study may have longer-term financial, emotional and professional implications for their life and career. Our findings have the potential to inform future outreach and educational structures to improve support for incoming first-year students in physics and engineering to choose the field of study or profession that best aligns with their goals and motivations.

References:

1. K. Galotti and V. Umschied, Students choosing courses: Real-life academic decision making, *American Journal of Psychology,* **132**, no. 2, pp. 149-159 (2019).
2. D. Hango, Gender differences in science, technology, engineering, mathematics and computer science (STEM) programs at university, Statistics Canada (2013) [Online] Available https://www150.statcan.gc.ca/n1/pub/75-006-x/2013001/article/11874-eng.pdf [Accessed May 23, 2023]

8th IUPAP International Conference on Women in Physics

Rocket Girls

Valerão, Manuela M.V. [1], Parisoto, Mara Fernanda, M. F. P.[2], Santos, Juliana da Silva, J. S. S. [3], Villwock, Lara Eduarda L.E.V. [4], Silva, Lillyan Kelly Sales L. K. S. S.[5]

[1] Bioprocess Engineering and Biotechnology student, Federal University from Paraná, Palotina, Paraná, Brazil..

[2] Department of Engineering and Exact, Federal University from Paraná, Palotina, Paraná, Brazil

[3]Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

[4]Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

[5]Veterinary Medicine student, Federal University from Paraná, Palotina, Paraná, Brazil.

Abstract

Historically and culturally, especially within capitalist society, it has always been up to women to take responsibility for the care of the house and family, regardless of their age, occupation condition and income level. Domestic work fell on women based on the discourse, alive to this day, of the female naturalness for care. This social attribution of care to the feminine, first, limited the lives of women to the private space, and later, with the socioeconomic transformations and the search for female independence, marked disadvantages in relation to men in economic and social performance. With this in view of this work aims to identify the pattern of reasoning and decision of choices regarding the choice of gender for the realization of daily and scientific activities, With this we hope to compare the results of a survey conducted by the magazine " -Decipher the code: education of girls and women in science, technology, engineering and mathematics-" where a similar survey was carried out. Therefore, a survey will be carried out with students from a school in the year 2023, from different periods, from elementary school, high school and graduation. Through a didactic questionnaire the answers will be computed. Students will answer who they consider most apt to perform some activities. The objective is to analyze the pattern of choice for two groups of tasks: domestic and scientific, and whether this pattern changes proportionally with age and academic level.

Keyword: Stereotype, woman, science, gender equality

ID 138

Efforts for gender equality in Chinese higher education institutions.

Limei Xu

Abstract

The talk mainly discusses the series of efforts and measures taken by higher education institutions in China to promote gender equality. These efforts include raising awareness of gender equality issues, recognizing the impact of family responsibilities on women's career development in academia, implementing measures to encourage women's participation in social and professional development, and promoting actions for gender equality. Particularly in the fields of science, technology, engineering, and mathematics, measures have been taken to address gender equality issues, increase women's representation in leadership positions, and overcome age-related limitations in women's career development. These efforts have achieved certain results and have promoted progress in gender equality in higher education institutions, increasing women's participation and equality. These efforts have had a positive impact on improving women's participation and equality in fields such as science, technology, engineering, and mathematics.

8th International Conference on Women in Physics

Beginning and development of the physics in Nicaragua: the role of women in this history

Mairena Elba[1], *García Yasser*[2], Montes Marcela[2], Torrez Katherine[2], Vega Shelvis[1]
[1] *Enseñanza de las Ciencias, UNAN-Managua, elba.mairena@unan.edu.ni, Nicaragua*
[2] *Departamento de Física, UNI-Nicaragua, yasser.garcia@fcys.uni.edu.ni, Nicaragua*
[2] *Departamento de Física, UNI-Nicaragua, katherine.torrez@fcys.uni.edu.ni, Nicaragua*
[2] *Departamento de Física, UNI-Nicaragua, marcela.montes@fcys.uni.edu.ni, Nicaragua*
[1] *Enseñanza de las Ciencias, UNAN-Managua,shelvaortega@gmail.com, Nicaragua*

Physics as a discipline throughout history has been led by men, and although there is no pre-established role in science according to gender, women have contributed significantly in the development of this science. In Nicaragua, the training of physicists began in the 70s at the National Autonomous University of Nicaragua, León, where women began their leading role [1]. Then, the degree was opened with two approaches (theoretical and educational) at the National Autonomous University of Nicaragua, Managua, being here where women acquired more prominence, and once trained, they later dedicated their lives to teach this science in the different educational subsystems of the country. Due to the different political and economic contexts that the country has faced, Physics has had little progress.

The objective of this work is to show a general picture from the beginning of the training of physicists in Nicaragua to the current state of this science, highlighting the role of women in this entire process, indicating the different successes and failures that have been presented with the purpose of promoting the training of physicists so that girls and women get interested in this wonderful science. It is worth mentioning that in a country with economic problems such as Nicaragua (the second poorest country in Latin America) very little attention is given to the development of scientists in the area of physics. This research group intends to promote science activities at different educational levels where women stand out with their contributions to the scientific development of the country, but support is needed and that is what we intend to get with the participation in different national and international events. **References:**

1. Taller Iberoamericano de Enseñanza de la Física Universitaria: libro de actas: Facultad de Física, Universidad de La Habana. Ciudad de La Habana (Cuba), 20-24 (enero de 1997).

8th International Conference on Women in Physics

Designing a teaching grade phase contrast microscope on an optical bench

Vishwakarma Abha[1], *Kashyap R. Vasanth*[1], *Prusty Sudakshina*[1]

[1] *School of Physical Sciences, National Institute of Science Education and Research, Po- Jatni, Dist-Khurda, Odisha-752050, INDIA*

In this piece of work, we demonstrate design of a simple Phase Contrast Microscope (PCM) on an optical bench, which can be used in undergraduate optics laboratories to teach the underlying principles. Prof. F Zernike was awarded the Nobel Prize in 1953 for his discovery of the phase contrast principles [1]. Although the PCM imaging technique is quite popular for research studies of transparent biological samples, its working principle is quite interesting for students of optics.

The basic principle of a PCM is to convert the phase changes produced by any transparent object, which differs only slightly from its surrounding, into amplitude changes in the final image [2]. Instead of the usual upright microscope, we have built a PCM test set up on an optical bench. We have used a 10X phase contrast objective (NIKON make) which includes λ/4 phase ring, a matching phase annulus and some other standard laboratory equipment. The test set up is shown in Fig.1. We have used a red laser as the light source. One can also use a suitably collimated white light source. The test set up was used to image typical biological samples (an onion peel) and the preliminary results are reported here as shown in Fig. 2. The image was taken by a smartphone camera placed close to the eyepiece. The internal cell structures with membranes can be seen. The inset in Fig. 2 is an image taken for the same sample using a commercial PCM with 10X objective, just for comparison.

We are currently trying to improvise the set up and image physical samples like single and multimode fibres, transparent thin films etc. and use it as an undergraduate optics experiment.

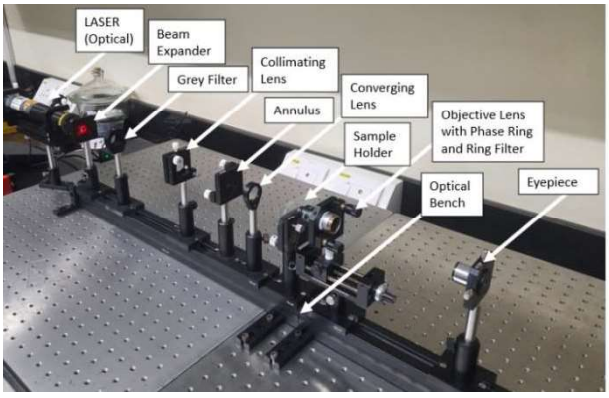

Figure 1: Experimental set up for PCM

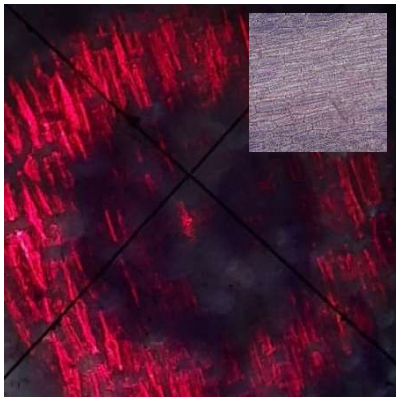

Figure 2: Image of an onion peel using our set up. Inset shows image of the same sample using a commercial PCM with a white light source

References:

1. F. Zernike, Phase contrast, a new method for the microscopic observation of transparent objects, Physica, **9**, Issue 7, 686 (1942)
2. F. A. Jenkins & H. E. White (1981). Fundamentals of Optics. McGraw-Hill, Inc. ISBN 0-07-085346-0.

8th International Conference on Women in Physics

Exploring the Single Slit Diffraction Experiment

S. Deepa[1], R. Jasmine, G. Divya

[1]Department of Physics, Sri Sathya Sai Institute of Higher Learning, Anantapur Campus, Anantapur, Andhra Pradesh, India.

Fraunhofer diffraction by a single slit is a popular experiment in undergraduate practical curricula. In this experiment, a long slit is illuminated by laser light and the diffraction pattern is observed on a distant screen. Measurement of the distances between the central maximum and the minima leads to the wavelength of the light source [1]. With the availability of low cost photodetectors, the intensity profile of the diffraction pattern is also being easily studied. This paper describes some other extensions to this simple experiment which were carried out as an undergraduate project.

In Fraunhofer diffraction theory, the electric field of light is assumed to be uniform across the width of the slit [2]. However, lasers used in laboratories emit beams whose transverse electric field and irradiance are Gaussian functions. In our first exploration, the diffraction intensity profile due a uniform electric field at the slit was compared to that of a Gaussian profile using a computer program that employed numerical techniques of integration [3] to solve the corresponding diffraction integrals. The beam width was varied from a chosen slit width b to $10b$. The results showed that as the beam width approached the width of the slit, the features of the diffraction pattern get altered - both the positions of the minima and the intensities of the maxima changed considerably from the expected values.

Fraunhofer diffraction limit is often studied only by varying the slit-screen distance, and the source-slit distance is largely neglected. In our second exploration, the intensity profile of the diffraction pattern was obtained for various distances between the laser and the slit. The experiments were conducted in a dark room. Although the patterns looked completely alike to the eye, the patterns generated using a photodetector clearly indicated that when the laser was placed close to the slit, the minima of the diffraction pattern did not go to zero indicating Fresnel diffraction. The same was also verified by photographing the pattern and analysing it using Tracker – a video analysis and modelling tool based on the OSP Java framework [4]. The exercise emphasized the importance of source-slit distance in Fraunhofer diffraction experiments.

The above investigations which involved a combination of methods like hands-on experimentation, modelling using numerical techniques and computer based experiments using Tracker, will definitely help to generate interest and enthusiasm in the students, develop conceptual clarity, and also expose them to a variety of techniques used in Physics research.

References:

1. Sirohi R. S. *(1989)* A Course of Experiments with He-Ne Lasers. *New Age International.* ISBN 978-0470202500.
2. Frank L. Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti *(2017)* Introduction to Optics. *Cambridge University Press*. ISBN: 978-1108428262
3. Chapra S. and Canale R *(2021)* Numerical Methods for Engineers*, McGraw Hill Company.* ISBN: 978-1260232073
4. Tracker Video Analysis and Modeling Tool for Physics Education (physlets.org)

8th International Conference on Women in Physics

Contribution of women researchers in physics in scientific fields at the Faculty of Sciences of the University Mohammed the first

Maaroufi, Fatiha[1]

[1]*Department of Physics, Faculty of Sciences, University Mohammed the First Bd Mohamed VI B.P. 717, 60000 - Oujda, Morocco.*

Despite efforts deployed by Moroccan government to combat gender discrimination such as the family code reform, and the institutionalization of gender parity in the country's 2011 constitutional reforms [1], women were under represented in key sectors such as education particularly in scientific fields, health and justice.

The number of female students and teachers in Moroccan universities is increasing, but there are still fewer women than men, especially at the highest levels of responsibility in these professions. Annual statistics for the various academic years show that women researchers are still less numerous and less represented at the decisional level than their male colleagues in almost all fields of science and engineering, and in some of them, such as physics, engineering and computer science [2].

At University Mohammed the first, 54% of students are girls, 22,8% of teachers are female and women represent 40% of the administrative staff. The Faculty of Science at the same university has 274 teachers, of which only 50 are women and 7 are physics researchers. Currently, no female physicist holds a decision-making position in the institution.

In this study, we examine the causes of the absence of female teachers in the leadership of the physics department, in the faculty and university councils, and in various research responsibilities [3].

References:

1. S. Boutkhil. The Cost of Women's Absence in Decision-making Positions in Moroccan Rice University's Baker Institute for Public Policy, Houston, Texas. Issue brief 06/23 (2020). https://www.bakerinstitute.org/sites/default/files/2022-10/cme-pub-grassroots-063019.pdf
2. A. Bettachy, F. Maaroufi, A. Nouira, M. Baitoul, Women Researchers in Physics in Morocco; Contribution and Evolution, AIP Conference Proceedings, **1119,** 141 (2009).
3. F. Maaroufi, Women Researchers in Theoretical Physics, Particles physics and Modelling (LPTPM) laboratory at Oujda University, AIP Conference Proceedings **1119**, 209 (2009).

The current status for women in physics in Zambia

Nyirongo Racheal [1] *, Chama Tombozi Clemens* [2] *, Munkombwe Obedience* [3] *, Sawila Perseverance* [4]
nyirongoracheal98@gmail.com , tomchama17@gmail.com , obediencemunkom3@gmail.com , perseverancesawila@gmail.com

[1]Physics Department, University of Zambia, Lusaka, Zambia.

Abstract
Since the university of Zambia's inception, it took 38 years for it to produce its first female physics graduate. In 1966, the first physics department in Zambia was established in Lusaka together with the University of Zambia. At the time, it was the only institution offering a physics degree. Today there are about 58 private universities and 6 public institutions from which a physics degree is offered, additionally the country recently registered its first Physics Society of Zambia (PSZ) in 2022 which is responsible for promoting the study of physics in Zambia, organize seminars, workshops and conferences to disseminate knowledge and exchange ideas among physicists, plus many more. As a result, there has been an increase in the number of physics graduates, including women, compared to the previous decade, when only two universities existed; the University of Zambia (UNZA) in Lusaka and Copperbelt University (CBU) in Kitwe which offered a physics degree. This paper looks at the current status of Zambian women in physics, the obstacles they face on their way to becoming physicists and the initiatives taken to make their career path easy as they advance in the field.