The dark matter direct search at JUSL : the present status

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Dark matter

- No electromagnetic interaction with ordinary matter.
- Inferred through its gravitational interactions.

Evidence:

Obtain from rotational curve of galaxy.

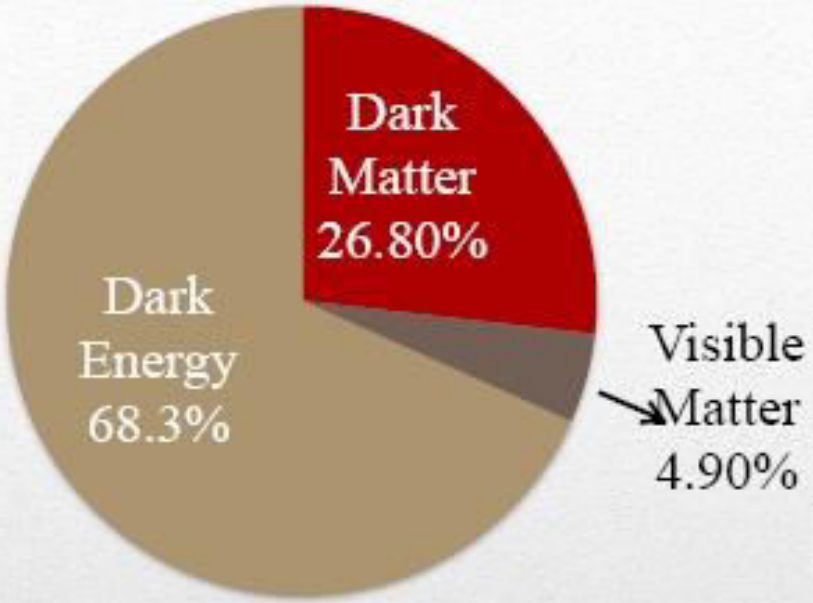
$$v_c^2 = \frac{GM(r)}{r}$$

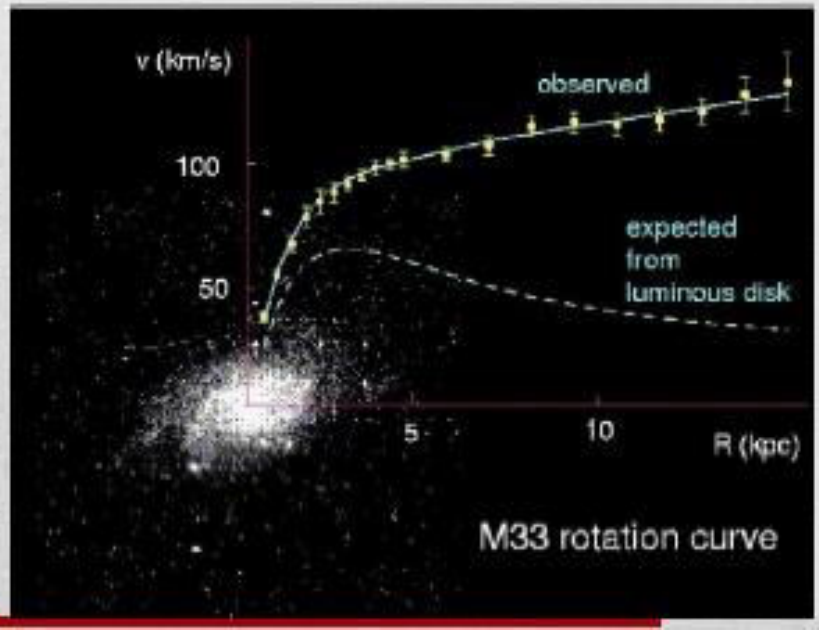
For $r > r_{visible}$, we expect

$$v_c \propto r^{-1/2}$$

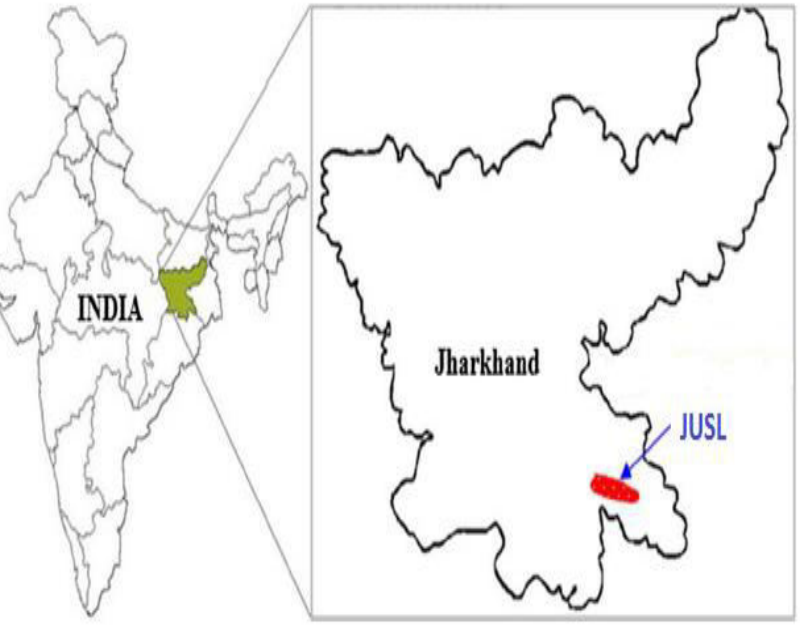
Weakly interacting massive particles (WIMPs) are the favoured candidates of dark matter.

Composition of Universe

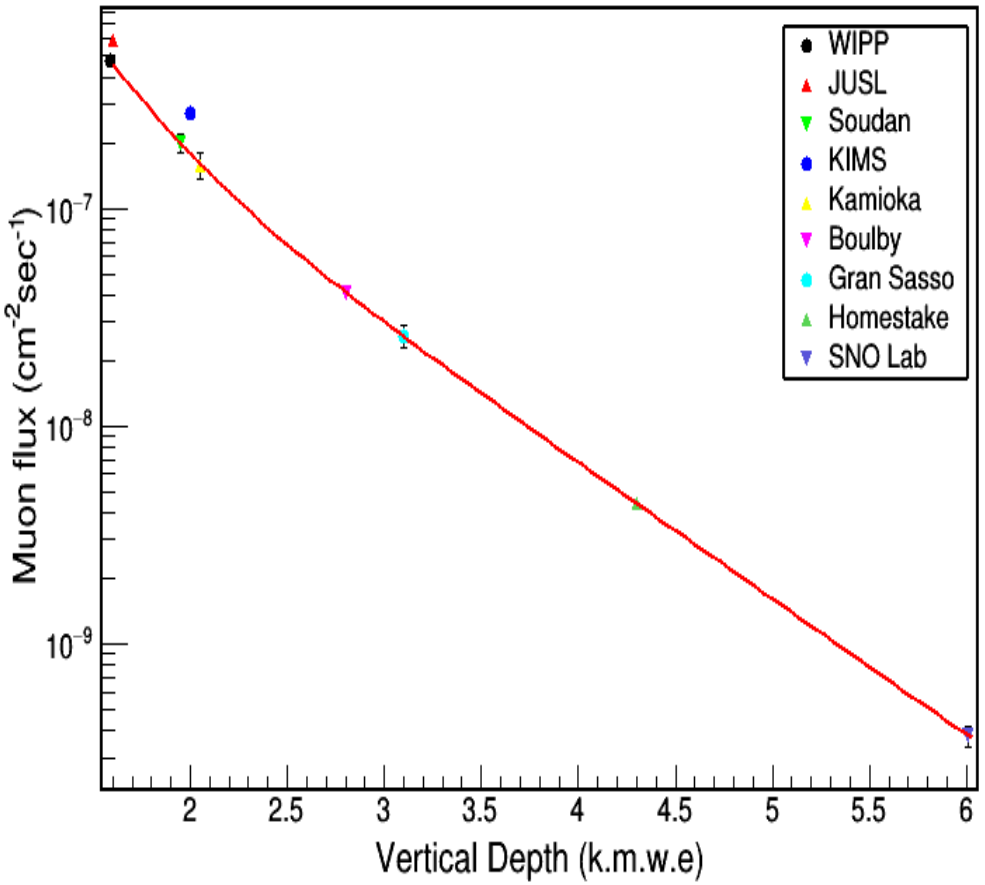


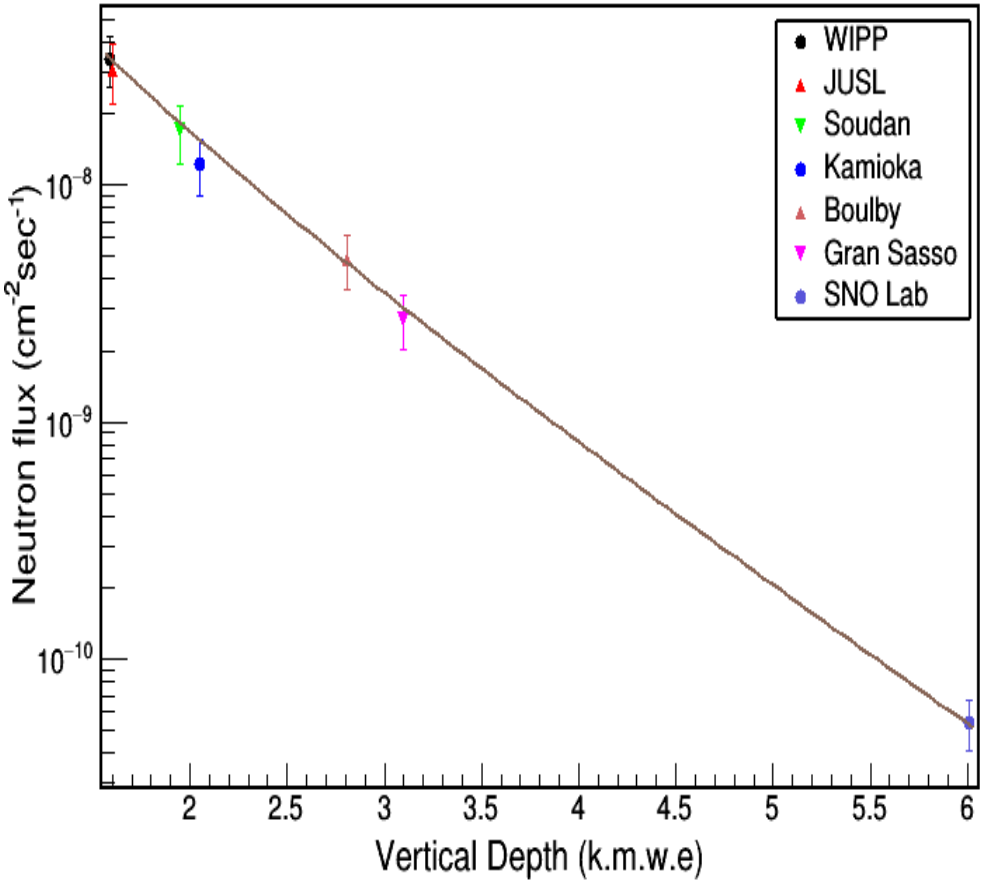


Jaduguda Underground Science Laboratory (JUSL), Jaduguda Mine, UCIL



Global fit : neutrons and muons at the underground labs worldwide





- Global Fit functions :- D. Mei, A. Hime, Phys. Rev. D 73 (2006) 053004.
- Simulation results from both the cosmic ray muon flux and cosmogenic neutron fluxes match well with data from other underground sites.

S Ghosh et al, Astro. Phys. 139, 102700 (2022)

Low mass DM search at JUSL

- Superheated droplet detector (SDD type) / /Geyser type
- SDD (1-8), Geyser type (1-2)

Active liquid : $C_2H_2F_4$, Exposure : 2 kg-days-1000 kg-days

2019 -2020 : Initial R & D, Exploratory run

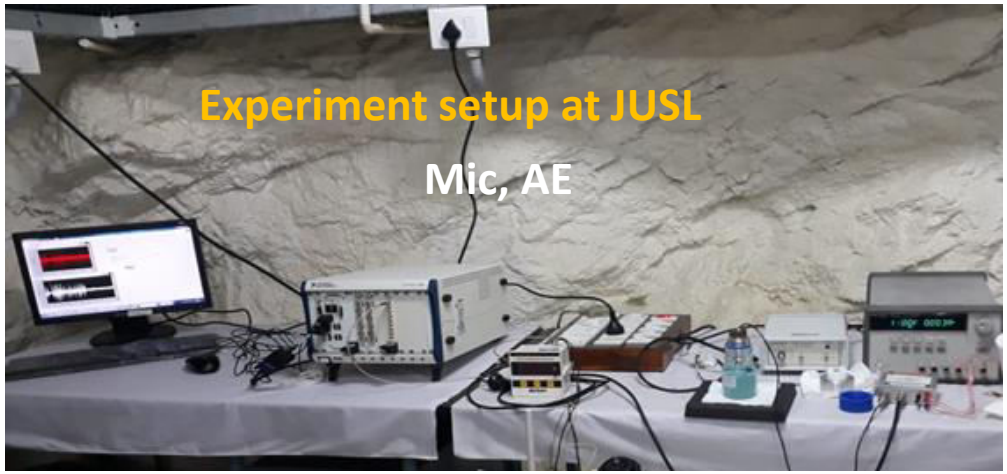
2021 : R & D, calibration

2022-24 : WIMP run in several steps (5.87 keV ; 1.92 keV) &

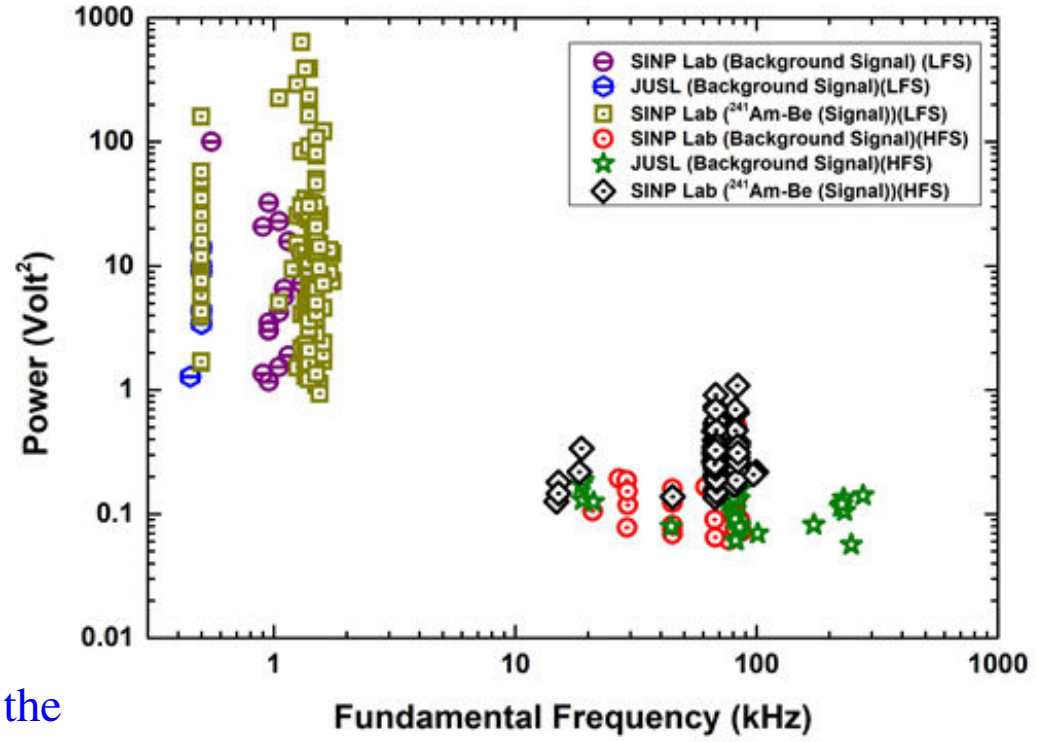
next generation R &D

Test run at JUSL with $C_2H_2F_4$ SED

- Operating temperature of SED: 24.3 ^{0}C ± 0.5 ^{0}C (Lab temperature).



100ml detector
4.8 gm active liquid
101.2 gm-hr exposure

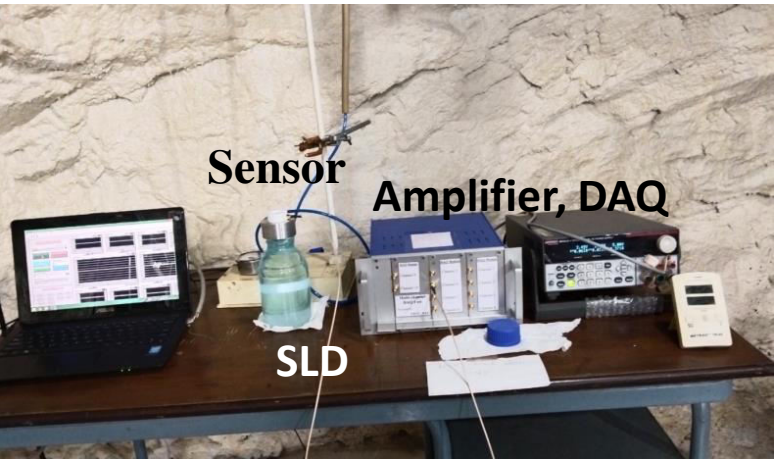


About 24% of JUSL background events appear in the 150-300 kHz fundamental frequency region which are absent at SINP lab measurement but present in Li(p.n) experiment

- ^{241}Am-Be neutron source (10mCi) for neutron calibration

- Low frequency noise at JUSL
- Background event rate at JUSL reduces by a factor of 2 than surface Lab

Projected sensitivity : Present & where to go ……

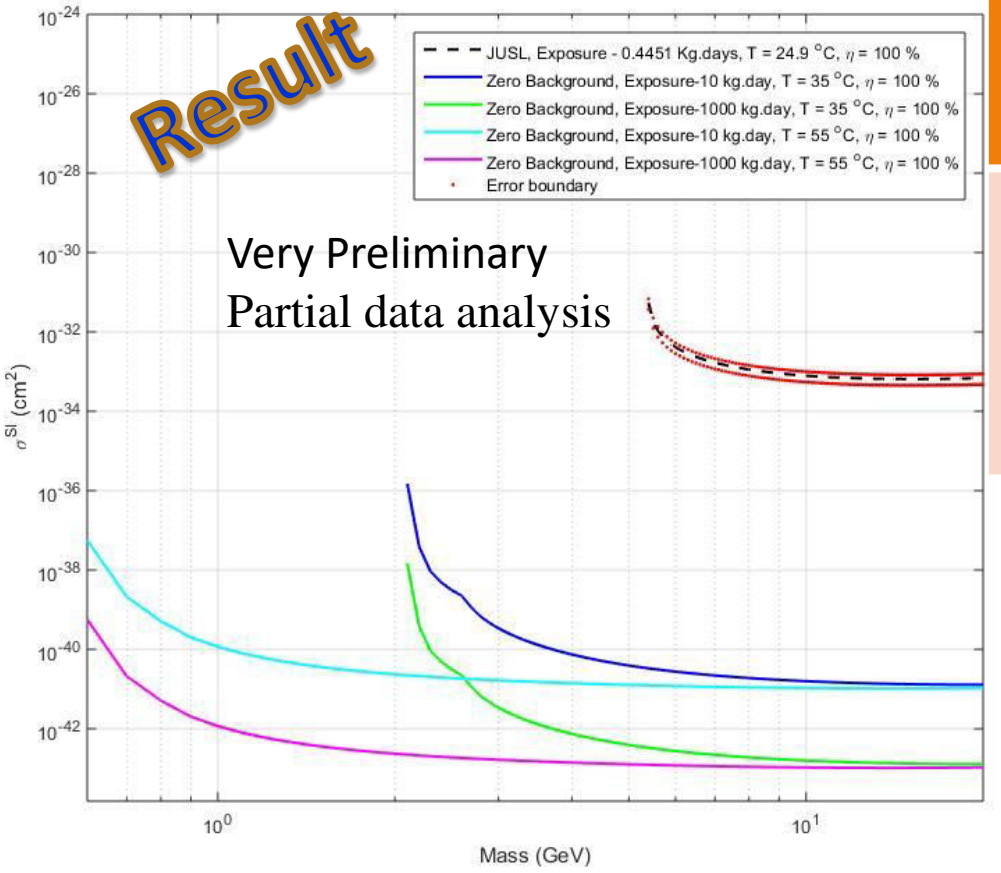


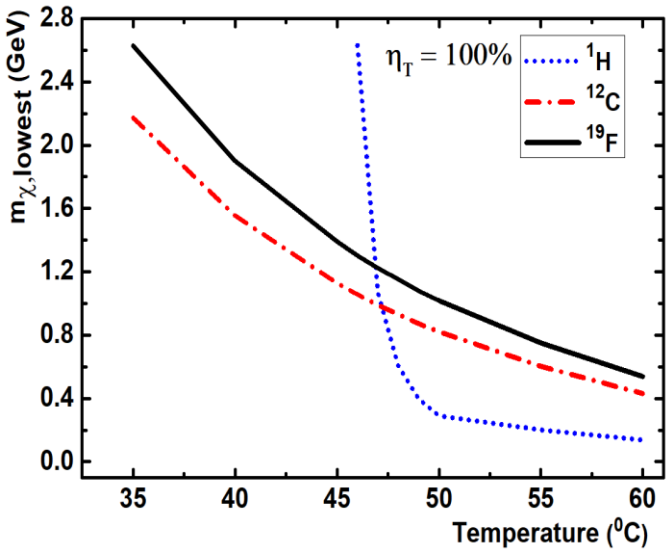
Experimental set up at JUSL

First run at JUSL

500ml SED (1+1) ; ~50 days of run
Exposure ~2.46 kg-days
Operating threshold ~ 5.87keV
run start date: 27/07/2022; end date : 16/12/2022

Minimum Cross-section (SI) cm^2 $x10^{-34}$
6.51 (+1.76) (-2.0) at 14.6 GeV





Lowest WIMP mass possible to explore

Future run : larger detector mass & exposure, lower threshold, shieldings for n,γ etc.

Acknowledgements

- UCIL, Jaduguda
- HPU, BARC Jaduguda
- JUSL collaboration

Invite you all to participate to this experiment

Thank you