

Frontiers in Gamma Ray Spectroscopy

FIG18

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Measurement of gamma rays from both hadronic and electromagnetic decay of giant resonance of ^{12}C and ^{16}O

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Content :

We have carried out an experiment E398 at RCNP (Osaka) to measure gamma rays from both hadronic decay and direct electromagnetic decay of giant resonance of ^{12}C and ^{16}O using 392-MeV proton beam, high-resolution magnetic spectrometer Grand-Raiden and an array of NaI(Tl) counters. We first confirmed the consistency of our cross section of the known levels (12.71MeV, 15.11MeV) with the previous measurements. Then, we measure the gamma emission probability $\Gamma_{\gamma}/\Gamma_{\text{total}}$ at each 2 MeV step for $16 < E_x < 34$ MeV. The gamma emission probability for the giant resonance of ^{12}C increases from 0 at $E_x=16$ MeV to 0.7 at $E_x=27$ MeV and then begins to decrease. The measurement is compared to the statistical model calculation. We also observe the direct electromagnetic decay from the giant resonance of ^{12}C to be about $0.28 \pm 0.04(\text{stat})\%$ for $22 < E_x < 26$ MeV, where GDR resonances are known to be there, while we observe no significant direct decays for $16 < E_x < 22$ MeV, where there are higher multipole resonances ($J^P=2^-, 3^-$). This is the first systematic measurement of gamma rays from both hadronic decay and electromagnetic (direct) decay of the giant resonance of ^{12}C (and ^{16}O) over the excitation energy $16 \text{ MeV} < E_x < 34 \text{ MeV}$. We apply our measurement for the estimation of gamma rays induced by neutrino bursts from supernova explosion.

Primary authors : Dr. SAKUDA, Makoto (Physics Department, Okayama University, Japan)

Co-authors :

Presenter : Dr. SAKUDA, Makoto (Physics Department, Okayama University, Japan)

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