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Systematic measurement project of ISGMR in nuclear chart including unstable nuclei using CNS Active Target (CAT-M)

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The equation of state of nuclear matter (EOS) plays an important role not only in nucleus but also in extreme quantum systems such as neutron stars. Incompressibility of symmetric nuclear matter (K_0) and isospin dependence (K_τ) are the parameters of EOS, and they can be extracted from the nuclear incompressibility K_A measured from the isoscalar giant monopole resonance (ISGMR).

Previous studies have reported $K_0 = 240 \pm 20$ MeV and $K_\tau = -550 \pm 100$ MeV. The larger error in the K_τ arises from the limited asymmetry parameter in the stable isotopes and also from the uncertainty in the assumption of the surface term in the expansion of nuclear incompressibilities. Systematic ISGMR measurements including unstable nuclei enable quantitative evaluation of surface effects.

An active target CAT-M has been developed for the systematic measurement including unstable nuclei. The CAT-M consists of a time projection chamber (TPC) with an active volume of $300 \times 300 \times 200$ mm^3 and a dipole magnetic field inside the TPC and an array of twelve strip silicon detectors with a sensitive area of 96×96 mm^2 for measuring recoil particles, and a small TPC with an active volume of $30 \times 30 \times 10$ mm^3 for beam particle measurement. The dipole magnet was introduced recently to eliminate the delta-rays, which induce the noise in the recoil region. The signal-to-noise ratio was improved by 100 times under high-intensity heavy ion beam irradiation.

The systematic measurement for various isotopes including ^{132}Xe, ^{136}Xe, and ^{80}Kr, ^{84}Kr, ^{86}Kr was performed in these years at an accelerator facility HIMAC in Chiba. We will report an overview of the project and the ISGMR measurement using the ^{86}Kr (d, d') reaction.

Experimental study on nuclear physics

Primary author: ENDO, Fumitaka (Tohoku Univ)

Co-authors: OTA, Shinsuke (RCNP, Osaka University); DOZONO, Masanori (Kyoto University); KOJIMA, Reiko; IMAI, Nobu (CNS); YOKOYAMA, Rin; MICHIMASA, Shin'ichiro (Center for Nuclear Study, the Univ. of Tokyo); HANAI, Shutaro (CNS,the university of Tokyo); Dr SUZUKI, Daisuke (RIKEN Nishina Center); Dr ISOBE, Tadaaki (RIKEN Nishina Center); HIJIKATA, Yuto (Dept. of Phys., Kyoto Univ.); Mr FRACASSETTI, Stefano (KU Leuven); Prof. RAABE, Riccardo (KU Leuven); SAKAUE, Akane (CNS); LI, Jiatai (Center for Nuclear Study, University of Tokyo); KAWATA, Keita (Center for Nuclear Study, University of Tokyo); YAKO, Kentaro; HAYAKAWA, Seiya; Mr MASUOKA, Shoichiro (Center for Nuclear Study, the University of Tokyo); Mr CAI, Jiawei (Institute of Modern Physics, Chinese Academy of Sciences); Dr ZHANG, Ningtao (Institute of Modern Physics, Chinese Academy of Sciences); Dr UESAKA, Tomohiro (RIKEN Nishina Center); HARADA, Tomoya (Toho univ. / RIKEN); Dr TAKADA, Eiichi (National Institute of Radiological Sciences); Prof. NOUMI, Hiroyuki (Research Center for Nuclear Physics, Osaka University & Institute of Particle and Nuclear Studies, High Energy Accelerator Research Organization); Mr MIYAMOTO, Kenshin (Research Center for Nuclear Physics, Osaka University); Dr SHIROTORI, Kotaro (Research Center for Nuclear Physics, Osaka University); Dr KOBAYASHI, Nobuyuki (Research Center for Nuclear Physics, Osaka University); Mr YAMAMOTO, Yuji (Research Center for Nuclear Physics, Osaka University)

Presenter: ENDO, Fumitaka (Tohoku Univ)

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