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Exploring nuclear structure by double charge exchange reactions in Japan

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Variety of spin and isospin responses is among the most interesting features in atomic nuclei. For the spin-isospin response, the Gamow-Teller (GT) transition is the simplest within one-phonon excitations, and it has been well studied. In contrast, data on multi-phonon excitations have been scarce. The double GT giant resonance (DGTGR) is the simplest two-phonon excitation mode in spin-isospin excitation, but DGTGRs have not been observed so far. The discovery of the DGTGR is an essential step in extending the research of the spin-isospin responses to multi-phonon space. Another important incentive for studying DGTGRs is its relevance in neutrino physics; the DGT transition is induced by the same transition operator as the double beta decay, i.e. $\sigma\tau\sigma$. In general the double beta decay carries a tiny fraction of DGT strength while the majority lies in highly excited states in the DGTGR. An experimental attempt to search for DGTGRs is heavy-ion double charge exchange (HIDCX) reactions, which can induce two-phonon excitations with spin and isospin transfer by two units. Also an exotic system of tetra-neutron was studied by HIDCX reaction [1]. Experimental studies by HIDCX reactions at RCNP Osaka, and RIBF RIKEN will be introduced.

[1] K. Kisamori et al., PRL 116, 052501 (2016).

Primary author: Prof. YAKO, Kentaro (CNS, University of Tokyo)

Presenter: Prof. YAKO, Kentaro (CNS, University of Tokyo)

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