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## Single- and double-charge exchange excitations of spin-isospin mode

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Double charge exchange excitations (DCX) induced by heavy ion beams at intermediate energies [1],[2] attract a lot of interest in relations with new collective excitations such as double isobaric analog states (DIAS) and double Gamow-Teller giant resonance (DGTR). This reaction is also closely linked with double beta decay matrix elements. In 1980s, the double charge exchange reactions (DCX) were performed by using pion beams, i.e.,  $(\pi^+, \pi^-)$  and  $(\pi^-, \pi^+)$  reactions. Through these experimental studies, the double isobaric analog states (DIAS), and the double dipole resonance states (DGDR) are identified. However, DGTR were not found in the pion double charge exchange spectra.

A new research program based on a new DCX reaction ( $^{12}\text{C}, ^{12}\text{Be}(0_2^+)$ ) is planned at RIKEN RIBF facility with high intensity heavy ion beams at the optimal energy of  $E_{lab} = 250\text{MeV/u}$  to excite the spin-isospin response [1]. A big advantage of this reaction is based on the fact that it is a  $(2p, 2n)$  type DCX reaction and one can use neutron-rich target to excite DGT strength.

In this talk, I will present a microscopic study of DGTR within a framework of microscopic Hartree-Fock+BCS (or Bogolyubov) and QRPA. The results of QRPA will be also examined by analytic formulas to calculate the excitation energies of the DIAS and DGT strength using commutator relations for the double isospin  $(t_-)^2$  and spin-isospin operator  $(\sigma t_-)^2$ . I will give formulas to estimate energies of the DIAS state and DGT states with separable interactions [3].

[References]

- [1] M. Takaki, T. Uesaka et al., Proposal for experiment at RCNP, "Search for double Gamow Teller giant resonances in  $^{48}\text{Ti}$  via the heavy-ion double charge exchange reaction" (2015).
- [2] F. Cappuzzello et al., Journal of Physics: Conference Series 630, 012018 (2015).
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