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Gamow-Teller Transitions in Nuclei: An Overview

Spin and isospin are unique quantum numbers in nuclei defined as "Finite Many-body System consisting of Two Fermions." Therefore, Gamow-Teller (GT) excitations caused by the spin-isospin (\sigma \tau) operator are unique in the sense that they can reflect the critical part of nuclear structure as well as nuclear interactions. In addition, they are the most common nuclear weak process in the Universe.
GT transitions can be studied in \beta decays as well as charge-exchange (CE) reactions. From the \beta-decay studies absolute values of GT transition strength *B*(GT)s can be derived. However, they can access only the low excitation-energy region due to the limitation coming form finite decay *Q*-values. On the other hand, it was found that the CE reactions performed at intermediate incoming energies (*E*_in > 100 MeV/nucleon) and 0-degrees can access the GT strengths up in the highly excited region. Thus, CE reactions, in particular (*p,n*) reactions, gave an overview of the GT response of nuclei [1]. The well-known GT excitation carrying the main part of the available GT strength is the GT Resonance (GTR) that has been systematically observed as a broad bump at excitation energies *Ex* ~ 9 - 15 MeV.
The (3He,*t*) reactions at RCNP preformed at 140 MeV/nucleon have achieved one-order-of-magnitude better resolutions compared to (*p,n*) reactions (~30 keV) [2]. They have shown that the main part of the GT strength can also be concentrated in a low-lying discrete GT state called the "Low-energy Super Gamow-Teller (LeSGT) state" [3]. Largely different features of GT responses are discussed for various nuclei with a large mass range and from them we try to deduce the overview of GT strength distributions. In addition, the "isospin symmetry" is introduced to make connections between beta-decay and CE-reaction studies[2].

References:
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