High Resolution (^{3}He,t) Charge-Exchange Reaction and Analogous β-decay for the Study of Gamow-Teller Strengths

Y. Fujita, RCNP High Resolution (^{3}He,t) Collaboration, and Valencia-Surrey-Osaka-Leuven β-decay Collaboration

Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan

Gamow-Teller (GT) transition is the most popular nuclear weak process with the nature of spin-isospin excitation. GT transitions in pf-shell nuclei, including those starting from unstable nuclei, are of interest, due to their importance in astrophysics, for example, at the core collapse stage of type II supernovas. Accurate determination of "absolute" values and the distribution of GT transition strength B(GT) are requested.

Direct information on B(GT)s can be derived from β-decay measurements. Several far-from-stability pf-shell nuclei were studied, but the obtained B(GT) values are only for a few low-lying states and ambiguous. Note that the feeding to a higher excited state in β decay is hindered by the phase-space factor. On the other hand, charge-exchange reactions at 0° and intermediate beam energies do not suffer from such restriction and can access the B(GT) values to the higher excitations. However, they have to rely on the β decays for standard B(GT) values.

Isospin symmetry is expected for the $T_z = \pm 1 \rightarrow 0$ analogous transitions in isobars with mass A, where T_z is the z component of isospin T. We present a new method to determine absolute B(GT) values starting from $T = 1$ (and 2) pf-shell nuclei by making a merged analysis of isospin mirror transitions. This method was first applied to the $A = 50$ system. The strength distribution is derived from the high resolution ^{50}Cr(^{3}He, t)^{50}Mn reaction precisely, while strengths are normalized to the absolute B(GT) values by using the half-life $T_{1/2}$ of the analogous ^{50}Fe$\rightarrow^{50}$Mn β decay [1]. In order to get accurate $T_{1/2}$s and branching ratios, we extend the study of β decay to other A pf-shell system [2].

[1] Y. Fujita et al., Phys. Rev. Lett. 95, 212501 (2005).

[2] B. Rubio et al., Experimental proposals at Louvain la Neuve and GSI.

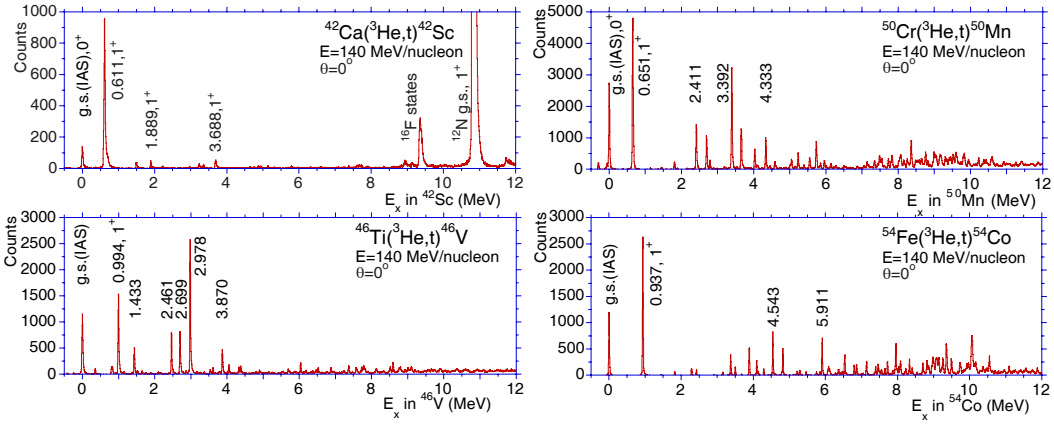

Figure 1: High resolution (^{3}He, t) spectra for $T = 1$, $A = 42 - 54$ target nuclei in fp-shell. All prominent states are GT states. Absolute B(GT) values are determined by the merged analysis for these A isobar systems.