# Study of Gamow-Teller transitions in unstable nuclei

**Masaki Sasano, RIKEN Nishina Center**

The Gamow-Teller (GT) transition is one of the basic excitation modes in nuclei. The transition changes both the spin and isospin quantum numbers of the nuclear wave function by one unit at the same time and appears as a weak process such as allowed beta decays or electron captures (EC). In medium or heavier mass region, the collectivity in this mode exhibits the GT giant resonance (GTGR), which gives information critically important for understanding the isovector part of effective nucleon-nucleon interaction [1] and the symmetry term of the equation of state [2]. The most direct source of the GT transition strength is provided by measuring half-life of beta decays or ECs. In such measurements, the final states that can be accessed are limited to low energy region within the decay Q-value window. For accessing high excitation energy regions where GTGR is included and obtaining an entire picture of the collectivity existing in the GT transition mode, charge-exchange (CE) reactions at intermediate energies, e.g., the (p,n) reaction, have been used.

With the advent of facilities providing RI beams at intermediate energies, it is becoming an important experimental challenge to extend CE reactions to regions of unstable nuclei far from the stability line. There have been several attempts but all of them are limited to the studies of light nuclei and their low-lying excited states, because of the experimental difficulties to measure the CE reactions in inverse kinematics with RI beams.

Recently, an experimental technique to measure the (p,n) reaction on unstable nuclei has been developed at the NSCL, Michigan State University. This experimental technique can be applied to any region of the nuclear chart as long as the nuclei of interest are available as an RI beam at intermediate energies. The choice of the (p,n) reaction as the probe reaction among many CE reactions allows one to achieve a high luminosity, thereby boosting the extension of our knowledge on the GT transitions.

In this talk, the physics cases this technique has been applied to will be presented. The technique was first applied to study the GT transitions from $^{56}$Ni [3], which plays an important role in astrophysical processes. After the experiment, the same experimental technique was applied to light nuclei, $^{8}$He and $^{12}$Be, using the SHARAQ spectrometer at the RIKEN RIBF [4]. Recently, the GT transitions from $^{132}$Sn, the most important doubly magic and neutron rich nuclei situated between $^{78}$Ni and $^{208}$Pb, have been studied using the SAMURAI spectrometer [5] at the RIBF. Last, the future plan to measure the GT transitions and isovector spin dipole transitions in exotic nuclei such as $^{11}$Li will be presented.

REFERENCES

[1] S. Fracasso and G. Colo, Phys. Rev. C 72, 064310 (2005).
[2] P. Danielewicz, Nucl. Phys. A 727, 233 (2003).
[3] M. Sasano et al., Phys. Rev. C 86, 034324 (2012).
[4] K. Yako et al., RIKEN Accel. Prog. Rep 45, 137 (2012).
[5] T. Kobayashi et al., Nucl. Instr. Meth. B317, 294 (2013).