HAW14-2014-020287

Abstract for an Invited Paper
for the HAW14 Meeting of
the American Physical Society

Charge Exchange Reaction: a powerful tool to study the "Weak Response" of nuclei[1]

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Weak-interaction processes, for example, Gamow-Teller (GT) transitions, play important roles in the stellar evolution and nucleosynthesis. β-decay studies provide the most direct information on the transition strengths caused by these processes, but the accessible E_x range is limited by the decay Q values. On the other hand, Charge-Exchange (CE) reactions can access the transitions to higher excited states. Pioneering (p,n) reactions at intermediate incident energies ($E_{\rm beam} > 100$ MeV/nucleon) found the main part of the GT transition strength expected by the GT sum rule in GT resonances (GTRs) situated in the $E_x = 10-15$ MeV region, and detailed studies in combination with (n,p) studies provide further knowledge on the GT sum rule. Recent development of CE reactions toward higher resolution and sensitivity is impressive. The (p,n)-type (^{3}He,t) reaction achieved a $\Delta E \sim 30$ keV and GTRs were resolved into individual states. The (d,^{2}He) reaction also provides much better resolution in the (n,p)-type study and recent (t,^{3}He) reaction in coincidence with γ decay could detect weakly excited states. We can also see future in the CE reactions using unstable incident beams.

[1]Partially supported by MEXT, Japan under Grant No. 22540310.