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Looking Through Double Charge Exchange Reactions

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So far, double charge exchange reactions have been less explored than single charge exchange reactions. We have revisited double charge exchange reactions and found their discovery potentials in two cases: one is production of a tetra-neutron state and the other is a search for double Gamow-Teller Giant resonances. In the both cases, new techniques which exploit properties of exotic nuclei have been used[1].

The first case is a production of tetra-neutron state via the double charge exchange $4\text{He}(8\text{He}; 8\text{Be})$ reaction. This reaction with a large positive Q -value (exothermic) is particularly efficient in producing the fragile tetra-neutron state with a recoilless manner. We have identified a (narrow) peak that can be a candidate of the tetra-neutron state[2]. The existence of the state close to the threshold may indicate necessity of force(s) that is attractive among neutrons.

The second case is a search for double Gamow-Teller giant resonances (DGTGR). DGTGR has been kept yet-to-be-discovered since the first theoretical prediction in 1989[3]. We have started an experimental program to search for DGTGR with a newly-invented method based on use of the heavy-ion double charge exchange ($^{12}\text{C}; ^{12}\text{Be}(0+2)$)[4].

This reaction has strong points that are missing in previously employed reactions and is quite efficient in populating DGTGR. In the workshop, results of the first experiment performed for a ^{48}Ca target with a 100-MeV ^{12}C

beam at RCNP, Osaka University are presented.

References

- [1] T. Uesaka et al., Progress of Theoretical Physics 196, 150 (2012).
- [2] K. Kisamori, S. Shimoura et al., Physical Review Letters 116, 052501 (2016).
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- [4] M. Takaki, T. Uesaka et al., presentation in INPC2016, Adelaide, Australia, September, 2016.

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