Feasibility study of nn-resonance state search using $^2\mathrm{H}(n,p)nn$ reaction at $E_n = 12\mathrm{MeV}$

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Possibility of existence of a neutron-neutron (nn) resonance state was discussed by H. Witala and W. Glöckle in 2011 [1] to explain the anomalous enhancement of nn quasi-free scattering (QFS) cross section in nd breakup at $E_n = 26\mathrm{MeV}$ [2] and 25MeV [3].

To search for the state, we have prepared an experiment using $^2\mathrm{H}(n,p)nn$ reaction. Secondary neutron beam produced by $^2\mathrm{H}(d,n)^3\mathrm{He}$ reaction at 0 degree is injected on a CD_2 foil to induce nd breakup reaction. We detect only protons from the $^2\mathrm{H}(n,p)nn$ reaction with Si-SSDs. If the nn-resonance exists, an isolated peak may be observed in the proton energy spectrum.

To verify whether the resonance state exists by the above experiment, three kinds of improvements are needed: (A) reduction of backgrounds caused by neutrons, (B) improvement of the energy resolution and (C) increase in proton counts.

(A) reduction of backgrounds is now in progress. Neutrons from $^2\mathrm{H}(d,n)^3\mathrm{He}$ reaction cause $\mathrm{Si}(n,\alpha)$ reaction in the Si- detectors which make harmful backgrounds. First, n-flux was reduced with shields of paraffin and lead, and (n,α) backgrounds were eliminated with a ΔE-E detector system to detect protons above 5MeV. Remaining p-background was supposed to be from $\mathrm{X}(n,p)$ reactions on surfaces of slits and walls surrounding the detectors. Therefore, we replaced them with ones made of Carbon because $^{12}\mathrm{C}, ^{13}\mathrm{C}(n,p)$ reactions have large negative Q-values. The experimental results will be reported in the conference. After (A) is finished, we will consider (B) and (C).

[1] H. Witala and W. Glöckle, Phys. Rev. C **83**, 034004 (2011)

[2] A. Siepe *et al.*, Phys. Rev. C **65**, 034010 (2002)

[3] X. C. Ruan *et al.*, Phys. Rev. C **75**, 057001 (2007)

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