Polarization Effects on the ^{3}He$(d,p)^4$He Fusion Reaction in the $3/2^+$ Resonance Region

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The nearest resonance region above the ^{3}He-d threshold is investigated by using the three-body Faddeev formalism in the n-p-^{3}He system for the ^{3}He$(d,p)^4$He, and ^{3}He$(d,d)^3$He reactions. The AV14-NN potential with the $^1S_0$, $^3S_1$-$^3D_1$ partial waves is adopted, while the p-^{3}He, and n-^{3}He effective interactions are constructed by using the well known Resonating Group Method (RGM) in which only the ^{1}S$_0$ interaction is used in our first trial. There is a well known $3/2^+$ resonance state of ^{5}Li which appears at around E$_{lab}$= 450keV above the d-^{3}He threshold. However, we do not care about the $3/2^+$ resonance because we adopted only the ^{1}S$_0$ state for the p-^{3}He and the n-^{3}He effective interactions. These states are given by the rank=1 EST expansion method. Our present aim is to clarify the evidence of the three-body effects in the $3/2^+$ resonance region. For this purpose, we compared the polarized $^3\overrightarrow{\text{He}}(\overrightarrow{d},p)^4$He reaction cross section with unpolarized ^{3}He$(d,p)^4$He one in the resonance energy region. The two-cluster RGM results are also referred in the ^{3}He$(d,d)^3$He reaction. The total spins and parities are adopted from J$^\pi$ =1/2$^\pm$, to 9/2$^\pm$. It is found that the polarization cross section is enhanced as much as twice of the unpolarized one at 90 degree. In the comparison with the two-cluster result, this fact may suggest that the three-body treatment in the fusion energy region is very important.

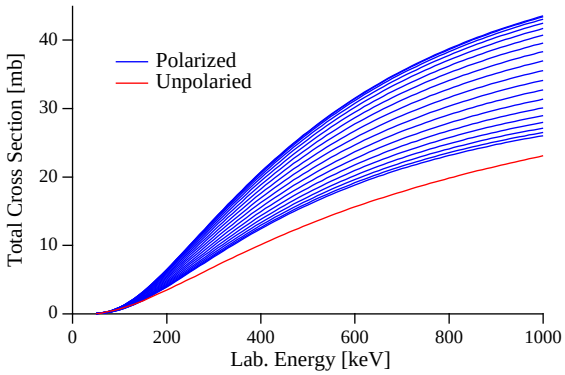

Figure 1: The total cross sections of the ^{3}He$(d,p)^4$He reaction. The lowest doted line is the unpolarized total cross section, while a set of the upper lines illustrates the polarized cross sections in which the scattering angles are changed from 0 degree (the lowest) to 90 degree (the highest).

[1] R. B. Wiringa *et al.*, Phys. Rev. **C29** ,1207 (1984).
[2] S. Gojuki, S. Oryu, and S. A. Sofianos, available from the Los Alamos e-print archive as **nucl-th/0112020**
[3] S. Gojuki, S. Oryu, Modern Physics Letters **A-18** 302-305 (2003)