The mesurment of cross section of 3He(3He,2p)4He at Ecm=30keV,28keV – Instruction –

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To understand the biginning of the universe, we have to understand the astrophysical nuclear reaction. The knowledge of nuclear reaction rates at the Gamow energy is important to understand the energy generation and the nuclear synthesis in the star. This is the hint of understanding of the nuclear reaction in the universe.

The main part of the nuclear reaction in the light star, as the sun, is p-p chain reaction. The components of the p-p chain reaction is d(p,gamma)3He, 3He(3He,2p)4He, 3He(4He,gamma)7He, We have forcused on the cross section measurment of the 3He+3He reaction at the energy $Ecm \leq 45keV$[1] ,[2].The cross section for the 3He(3He,2p)4He reaction have been observed by various group[3],[4],[5].

This measurments can be used to verify the standard solar model, and provide the effective potential Ue in the astrophysicalnuclear reaction[6].Therefore, successive and precise data from around 50 keV to 20keV center of mass energy have been needed.

We already measured the cross section of 3He(3He,2p)4He from 45keV to 31keV center of mass energy, so our thema of experiment is to measure the cross section of 3He(3He,2p)4He at the energy $Ecm \leq 30keV$.In this energy, the cross section will be expected to be nano-barn or pico-barn.

We expected that the event rate of 3He(3He,2p)4He acceptable region in the dE-E scatter plot will be 45 events per day (at $Ecm = 30keV$), 4 events per day (at $Ecm = 25keV$), with the 150μA 3He beam and 0.1 Torr 3He gas terget. We have to supress the background rate in the 3He(3He,2p)4He acceptable region to be less than several events per day. For this purpose, we connect the ground level of pre-Amprifire to the scattering chamber. Then, the 10mV amplitude, 10μs period components of the signal of pre-Amprifire was removed, and the resolution of detector was improved to be about 50keV(E-detector), 80keV(dE-detector). We measured the background rate for 4 days in Janualy 2003, and culculated that the background rate in the 3He(3He,2p)4He acceptable region was 2 events per day.

We also established the new pressure control device to the gas circulation system, and checked that this device could control the target pressure at 2 or 3 percent accuracy.

Using the GEANT program, we also simulated the change of the detection efficiency when the beam axis was shift from the center. There are three colimeters before the target chamber in the differential pumping system. Due to the arrengement of the colimeters, the beam axis could be 18mm shift from the center. We simulated that the detection efficiency will be changed less than 1

The cross section of 3He(3He,2p)4He at $Ecm = 30keV, 28keV$ were measured in April-

June 2003 by using 3He doubly ionized beam at a low-energy high current accelerator facility OCEAN. This is the preliminary data for the measurrements of the 3He(3He,2p)4He reaction.

Table:Summary for measurrements of the 3He(3He,2p)4He reaction

Ecm(keV)	30.26	28.09
live time(s)	1233966	1746821
beam current(μA)	143.7	154.9
target pressure(Torr)	0.0752	0.0689
target tempreture($\circ C$)	30.03	30.03
3He+3He(counts)	625	365
3He+d(counts)	33.4	28.2
other B.G(counts)	5.89	2.38
cross section(nano barn)	0.175	0.0743
S(Meb barn)	6.73	7.58

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