Contribution ID: 31 Type: Poster

Cryogenic hydrogen gas target for a measurement of neutron inelastic scattering in $^{12}\mathrm{C}$

Thursday, 31 August 2023 14:30 (5 minutes)

The triple alpha process is an essential reaction in nucleosynthesis. In a hot and dense environment, the reaction rate can be enhanced by neutron upscattering process. In that process, the Hoyle state in 12 C decays into the bound states by giving the excitation energy to neutrons instead of radiation decay. We plan to measure a cross section of the inverse reaction in order to determine the enhancement factor. For the measurement, we developed a cryogenic hydrogen gas target to produce a high-intensity monoenergetic neutron beam. The hydrogen gas is cooled to below 77 K by a GM refrigerator and approximately 10 MeV neutron beam is produced by 1 H(13 C, n) 13 N reaction at $E_{^{13}C} = 72.7$ MeV. We performed a thermal test of the cryogenic target with heaters to simulate the primary beam energy loss. In addition, we also conduct a performance test of the target using an actual beam. I will report the development of the gas target and results of two performance tests.

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Session Classification: Poster Session