Contribution ID: **46** Type: **Poster**

Development of a tracking detector to study the 12C(α,γ)16O reaction

Tuesday, 15 November 2016 14:41 (2 minutes)

Summary

Stellar model calculations are extremely sensitive to the rate of 12C(α,γ)16O. Although great efforts were devoted to decrease the uncertainty in the extrapolations, more precise data are needed to provide a good input to the stellar models. The required precision for the rate of 12C(α,γ)16O is about 10% [Woosley, 2003]. The available data indicate that the cross section of 12C(α,γ)16O at E0 = 300 keV is dominated by E1 and E2 radiative capture processes into the 16O ground state, where the main contribution to the capture cross section is given by two subthreshold states with Jπ = 1− and 2+ at Elevel = 7.12 and 6.92 MeV, respectively. Since the measurement of Dyer and Barnes in 1974 [Dyer, 1974], the E1 and E2 contributions have been determined by measuring the γ-rays from the 16O-recoils. Some of the experiments conducted to date performed coincidence between γ-rays and 16O-recoils to reduce background. In one case [Schürmann, 2005] it was possible to measure the total cross section by the detection of recoils using the RMS (Recoil Mass Separator) ERNA (European Recoil mass separator for Nuclear Astrophysics). In the case of a RMS, an additional constrain to the γ-ray data can be the measurement of the angular distribution of the recoils. Monte Carlo simulations together with the simulation of the beam transport through ERNA have shown that it could be possible to determine the E1 and E2 contributions by the analyses of the angular distribution of the recoils at the end of the RMS. In order to achieve that, a two stage tracking detector is being developed. The first stage is a modification of the existing MCP detector [Di Leva, 2008], that will be made position sensitive. The second stage is a parallel grid position sensitive detector that will be placed inside of the existing Ionization Chamber Telescope [Rogalla, 1999]. The detector development will be described and the expected physics outcome presented.

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Primary author: GARCIA DUARTE, Jeremias (NA)

Co-author: COLLABORATION, ERNA (INFN)

Presenter: GARCIA DUARTE, Jeremias (NA)

Session Classification: Posters