STRUCTURE OF ^{24}MG EXCITED STATES AND THEIR INFLUENCE ON NUCLEOSYNTHESIS

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Experimental studies of the $^{12}C+^{12}C$ system started in 1960 which showed that the excitation functions for the elastic [1] and reaction [2] channels have unique and prominent resonant structure. These resonances are observed in every reaction channel and independently of the angle of detection. Since then, a lot of experimental and theoretical work has been done in order to understand this phenomenon. Study of the $^{12}C+^{12}C$ system is still interesting today because of the cluster structure of these resonances and important role that they have on carbon-rich stellar systems, such as super AGB stars, supernovae Type Ia and superbursts. Relevant energy range of cross section measurements for these stellar systems is between 1.5 and 3.3 MeV in E_{CM} of the $^{12}C+^{12}C$ system, equivalent to 15.4-17.2 MeV in energy of excited ^{24}Mg. Current cross section measurements of $^{12}C+^{12}C$ system extend down to 2.10 MeV [3]. This region of astrophysical interest is far below the Coulomb barrier, which makes measurements quite difficult and due to high number of resonances, extrapolation to the lower energies is unreliable and model dependent.

Due to these obstacles, instead of direct measurement [1], [2], [3], we decided to measure the $^{12}C(^{16}O,\alpha)^{24}Mg^*$ reaction using resonant particle spectroscopy technique and to observe the $\alpha+^{20}Ne$, $^{12}C+^{12}C$ and $^{8}Be+^{16}O$ ^{24}Mg decay channels. The main idea was to study the resonance structures of ^{24}Mg, with strong emphasis on resonances in astrophysical region of interest. Experiment was performed at INFN-LNS, Catania, using Tandem accelerator beam of $E(^{16}O)$=94 MeV and experimental setup consisted of 6 silicon detector telescopes, each of them had a thin ΔE detector (thickness of 19 or 20 μm), and a thick Position-Sensitive Silicon Strip Detector (PSSSD) or a Double-Sided Silicon Strip Detector (DSSSD) (thickness 500 or 1000 μm).

Analysis of resonances observed in different decay channels, including determination of their spins and branching ratios, has been performed in order to understand the structure of ^{24}Mg excited states. Results of this analysis will be presented.

Since in the $\alpha+^{20}Ne$ decay channel of ^{24}Mg, many resonances in 15.4-17.2 MeV energy region were detected, we decided to measure an experiment that concentrates only on this decay channel. By using resonant elastic scattering method, we measured the $^{4}He(^{20}Ne, ^{4}He)^{20}Ne$ reaction, using PIAVE-ALPI accelerator system at INFN-LNL, Legnaro. Some preliminary results of this analysis will be presented too.

REFERENCES

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