Alpha cluster resonance structure of light nuclei close to coulomb barrier

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The aim of this experimental study is to investigate the structure of the ^{19}F nuclei at energies representing astrophysical interest. Here we study the resonant interaction ^{15}N+^{4}He in the cyclotron DC-60 in Astana.

Important astrophysical processes which are taking place during the formation of new stars can be analyzed studying γ-radiation of the stars [1]. While the main source of γ-radiation within the first few hours of life of a novae is the annihilation of positrons following the β + decay of ^{18}F [2], it turns out that the data on the synthesis and decay of ^{18}F is crucial for the understanding of this emission. However, the study of ^{19}Ne is experimentally difficult to implement [3], and therefore instead of a direct study of the structure ^{19}Ne it is suggested to investigate it through the mirror nucleus ^{19}F.

Structure of ^{19}F we studied utilizing the method of thick target inverse kinematics [4,5]. Following this approach the ion beam (^{15}N, q=+3e) with an energy of 26.25 MeV enters the scattering chamber through the titanium film (Ti 2 μm) losing in it 3.64 MeV. Scattering chamber is filled with a gas target (^{4}He) with pressure of 276 Torr chosen so that the beam is stopped before the detectors (10x10 mm Si, 375 μm), located along the far wall of the chamber at a distance of 445 mm from the input window, at 0° in the lab frame. The advantage of this method is that we exclude the impurities in the target and in the beam. The energy resolution of the detector is 15-20 keV measured for the α-source (^{226}Ra) with energy 4.8-7.7 MeV.

Here we present our early experimental results. Figure 1 shows the 180^{0} excitation function in comparison with the data of [6]. Figure 1 shows that our data support the absolute cross section measurements of [6]. Our data (blue curve) has the advantage of the better energy peaks positioning and widths for narrow states. However, the quality of the results is quite comparable at cm energies above 3 MeV. Also it is important to note that our experimental methodology allows measuring larger energy interval at much shorter time.

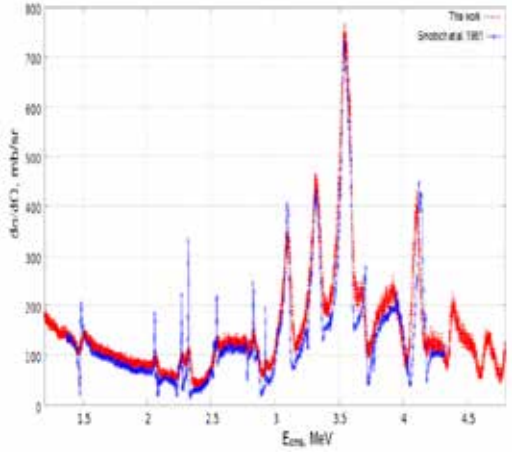

Figure 1. Excitation functions for elastic scattering of α particles on ^{15}N in c. m. frame at angle 180° vs the previous data at angle 169° [6]

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