STUDY OF THE A+ 13C INTERACTION AT HEAVY ION ACCELERATOR DC-60

N.A.Mynbayev*[1], V.Z.Goldberg[2], A.K.Nurmukhanbetova[1], G.V.Rogachev[2], M.S.Golovkov[3], V.Dzubin[1], M.V.Zdoroves[4], M.Koloberdin[4], I.Ivanov[4]

[1]NURIS, Nazarbayev University Astana, Kazakhstan; [2]Texas A&M University, Cyclotron Institute, USA; [3]Flerov Laboratory of Nuclear Reactions, Russia; [4]Institute of Nuclear Physics, Kazakhstan

INTRODUCTION.

In astrophysics, nuclear reactions play a great role in understanding the formation of our universe. The reaction $^{13}C(\alpha,n)^{16}O$ is considered to be the main source of neutrons for the *s* process at low temperatures in low mass stars in the asymptotic giant branch. Many problems exist in analyzing this reaction using conventional experimental methods; therefore, we aimed to obtain and analyze data from the a +^{13}C resonance elastic scattering reaction at small angles and low energies using Thick Target Inverse Kinematic method (TTIK) at heavy ion accelerator DC-60.

METHODS.

TTIK method: A beam of heavy ions (^{13}C in this case) enters the scattering chamber through a thin foil. The chamber is filled with target gas, helium, and the pressure of the gas is adjusted so that the beam stops completely in front of detectors which are placed at the back side of the chamber. Recoils from reaction are detected by silicon detectors. We constructed a new Data Acquisition System (DAQ) which allows registering alpha particles, produce numbers proportional to energies of detected particles, and store these numbers in a computer.

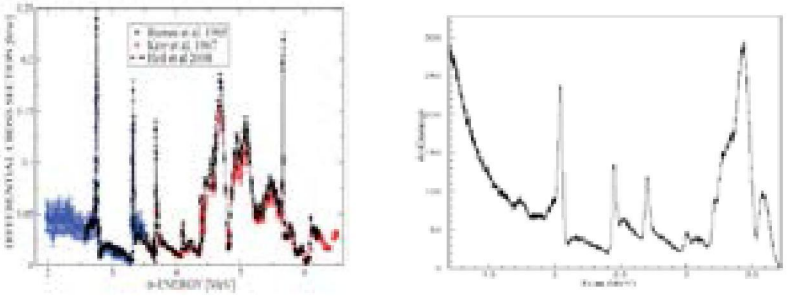

Figure 1. *Left: the excitation function of 12C(α,α)12C obtained in current work. The registration angle is 180° in c.m. frame; Right: the excitation 13C(α,α)13C obtained in previous studies [1]. The registration angle is 165.9° in c.m. frame.*

RESULTS AND DISCUSSION.

The excitation function of $^{12}C(a,a)^{12}C$ reaction was obtained in current work for testing and calibration of the new DAQ system. The main part of the experiment was an elastic scattering interaction a+^{13}C. Excitation function of elastic scattering reaction at 0 degree relative to beam direction in center of mass system is shown in Fig. 1 (Left). Previous studies of the same reaction were done at the linear tandem accelerator can be seen in Fig. 1 (Right). We succeeded in observing resonances in the a+^{13}C interaction at low energies and 0 degree where resonances dominate over the potential scattering. As a result we have found new structures in the region in question. Our experimental data will be analyzed further by the R-matrix method to understand this structure. ^{13}C and air interaction was obtained in the current work. As a result, the air background in the He target can be neglected.

CONCLUSION.

The new DAQ system was installed. Preliminary measurements to study resonances of elastic scattering reaction $^{13}C(\alpha,\alpha)^{13}C$, including calibration with ^{12}C on Helium gas, were performed. Air background in the He target was tested by ^{13}C+air interaction. Excitation functions of elastic scattering reaction $^{13}C(\alpha,\alpha)^{13}C$ at low energies in center of mass frame were obtained. At low energies of excitation function, we found a new structure which needs further experimental and theoretical analysis.

REFERENCES.

1. M.Heil, *et al.* (2008). The C-13 (alpha, n) reaction and its role as a neutron source for the s process. Phys. Rev. C, 78: 025803.