Study of the resonant elastic scattering of the first cyclotron institute light ion guide cocktail beam (A=105) on hydrogen

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We performed a first commissioning experiment using a cocktail beam of ^{105}Cd, ^{105}In, and ^{105}Ag provided by the Cyclotron Institute Light Ion Guide (LIG) [1]. The beam intensity was about 100 particles per second. A 7-um plastic scintillator upstream of the reaction chamber measured the incoming beam during the experiment. The beam composition was measured periodically during the run using the beam diagnostics upstream of the scattering chamber. The^{105}In was about 35% of the total beam intensity. The In/Cd ratio was about 50%. The ^{105}Ag was accumulating in the LIG gas cell as a decay product of ^{105}Cd. The beam also contained a 2% contamination of mass 94. The initial energy of the beam was 12 MeV/nucleon.

We measured the resonant elastic scattering of the provided beam on Hydrogen in inverse kinematics. We wanted to investigate the existence of low-lying resonances in ^{106}In/^{106}Sn and test our capability to reproduce the observed cross-section using a Koning-Delaroche (KD) nuclear potential [2].

Fig. 1 shows a picture of the experimental setup. The scattering chamber was filled with pure H_2

FIG. 1. Picture of the experimental setup. The picture shows the scattering chamber and the three Si-CsI(Tl) telescopes (labeled as 1, 2, 3) at the end of the gas volume. A PCB board used for the signals read out is also visible.

gas at an average pressure of 1725 mbar, sufficient to stop the beam a few centimeters before the silicon detectors. A 4-um-Havar window isolated the scattering chamber from the beam line under vacuum. We measured the scattered protons with three Si-CsI(Tl) telescopes placed at the end of the chamber at a minimum distance of 44.5 cm from the window. The silicon detectors had an active area of 5x5 cm^2 (divided into four quadrants) and a thickness of 500 um. The CsI(Tl) had the same surface and a thickness of 4 cm.

Figure 2 shows the preliminary excitation function measured in the angular ranges covered by our silicon detectors. Since ^{105}Cd was the dominant isotope in the cocktail beam, we reconstructed the center-of-mass energy using the kinematics of the elastic scattering ^{105}Cd+p.

The Figure also shows ^{105}Cd+p Rutherford cross-sections and the cross-sections from the KD potential. The insert in Figure 2 shows the cross-sections corresponding to the protons that punched through the silicon detector.

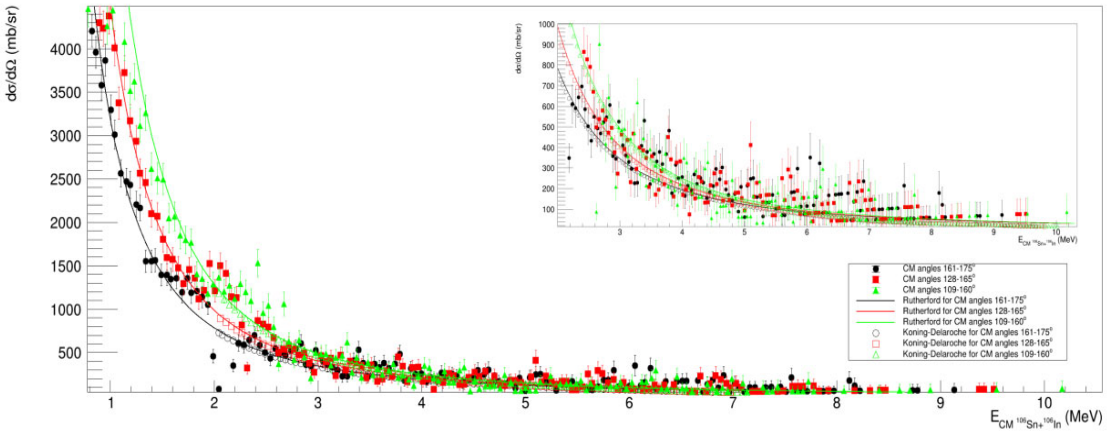

FIG. 2. Excitation function for the resonant elastic scattering on Hydrogen. See the text for details.

At center-of-mass energies from 2 to 5.5 MeV, the cross-sections from the KD potential agree well with the Rutherford cross-sections; at energies higher than 5.5 MeV, the KD cross-sections are slightly smaller than the Rutherford cross-sections.

The experimental data agree well with the Rutherford cross-sections at center-of-mass energies lower than 2 MeV. The data in the insert of Figure 2 show some possible structures with cross-sections exceeding the Rutherford cross-section by at least one sigma. This excess of cross-section suggests the presence of resonances. Larger statistics are required to investigate these structures further. Moreover, the limited statistics accumulated with a beam composition without ^{105}In are insufficient, at this time, to disentangle the contribution to the cross-section due to ^{105}Cd and ^{105}Ag from that due to ^{105}In.

[1] G. Tabacaru et al. Proceedings of ECRIS2010, Grenoble, France (2010) and
https://cyclotron.tamu.edu/facilities/light-ion-guide/
[2] A.J. Koning and J.P. Delaroche, Nucl. Phys. **A713**, 231 (2003).