^{17}F elastic scattering and total reaction cross section on ^{58}Ni target around Coulomb barrier

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The reaction mechanisms of weakly bound nuclear systems have attracted much attention lately[1)]. Because of the small binding energy, the weakly bound projectiles can easily break up into smaller fragments when they interact with the target[2)]. Moreover, the consequence of the breakup channel on the fusion process is still controversial[3)]. Therefore, a detailed knowledge on the breakup process is important for a deep understanding of the reaction mechanism of weakly bound systems.

In view of this fact, ^{17}F[4)] was chosen to study the breakup mechanism of the ^{17}F+^{58}Ni system. For this purpose, a new detector array has been designed, to perform a complete-kinematics measurement. The array consists of ten detector units, each of which contains one ion chamber (IC), followed by one double-side silicon detector (DSSD), and two thick quartered silicon detectors (QSDs). Based on this array, the energy and angle correlations between the breakup fragments can be measured to reconstruct the intermediate state of the breakup process. The elastic scattering and other reaction channels can also be measured to investigate the total reaction cross-section. The resolution of single detector unit is around 4%. Thus, the inelastic channel may not be distinguished. However, the influence can be estimated because there is only one excited state below the breakup threshold of ^{17}F.

The experiment was performed at the CRIB (CNS Radio Isotope Beam) separator from Dec.10 to 19, 2015. The radioactive ^{17}F was produced by the ^{2}H(^{16}O,^{17}F) reaction using a 6.6 MeV/u ^{16}O primary beam impinging on a H_2 gas target. Four different ^{17}F secondary beam energies were obtained. The former, 59.7 MeV, was achieved with a gas pressure of 254 torr and a Al degrader with a thickness of 5 μm. By increasing the gas pressure and Al degrader up to 262 torr and 12 μm, as well as 316 torr and 17 μm, the beam energies of 49.7 MeV and 46 MeV were obtained, respectively. The latter, 65 MeV, was achieved with a gas pressure of 250 torr and without a degrader. After selection by the WF and tracked by two PPACs, the secondary beam, with an intensity of 6-10×10^5 pps, was then impinged on the secondary target, ^{58}Ni, with a thickness of 1 mg/cm^2. The identification of particles obtained using the first detector unit ($\theta_{\rm lab}$ from 15.2° to 30.5°) is shown in Fig. 1. It can be seen that ^{17}F, ^{16}O, and p can be distinguished clearly.

The data analysis is in progress now.

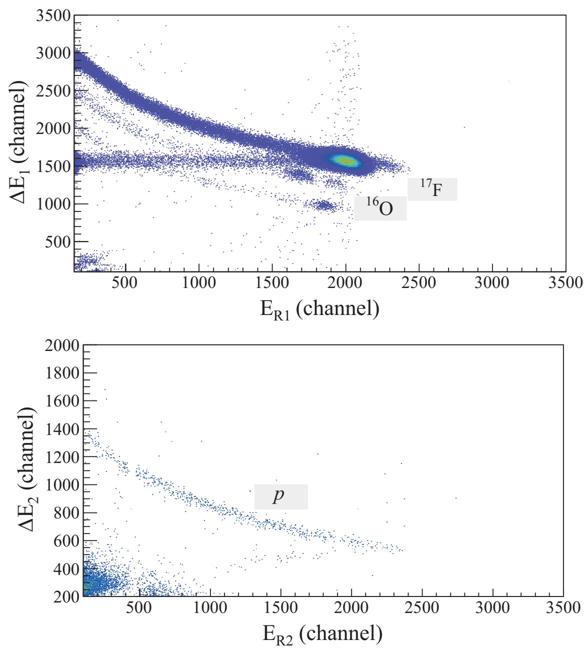

Fig. 1. Identification of particles yielding from ^{17}F+^{58}Ni at $E_{\rm lab}$(^{17}F)=59.7 MeV. Symbols ΔE$_1$ and E$_{\rm R1}$ represent the IC and DSSD, respectively, and ΔE$_2$ and E$_{\rm R2}$ are the two QSDs. The horizontal tail of ^{17}F arises from the radiation damage and/or channeling effect of the solid detector.

References
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