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Study of reaction mechanisms induced by exotic nuclei and weakly bound nuclei at energies around Coulomb barrier as well as related nuclear structure

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In the reactions induced by exotic and weakly bound nuclei at energies around coulomb barrier, breakup is an important reaction channel. It can provide rich information for nuclear reaction mechanisms and nuclear structure at energies around coulomb barrier. For breakup researches, the elastic scattering and fusion were used. The elastic scattering angular distributions were measured for 50 and 59 MeV 17F radioactive ion beam on a 89Y target. The experimental data were analyzed by means of the optical model with the double-folding Sao Paulo potential for both real and imaginary parts. The theoretical calculations reproduced the experimental data reasonably well. It is shown that the method of the data analysis is correct. Continuum-Discretized Coupled-Channels (CDCC) calculations were performed to consider the breakup coupling effect. It is found that the experimental data show the Coulomb rainbow peak and that the effect of the coupling to the continuum states is not very significant, producing only a small hindrance of the Coulomb rainbow peak and a very small enhancement of the elastic scattering angular distribution at backward angles, suggesting that the multipole response of the neutron halo projectiles is stronger than that of the proton halo systems.
The beam intensities of stable weakly bound nuclei such as 6,7Li and 9Be, which have significant breakup probability, are orders of magnitude higher. Precise fusion measurements induced by these nuclei have already been performed. However, the conclusion of reaction dynamics was not clear and has the contradiction. In order to have a proper understanding of the influence of breakup and transfer of weakly bound projectiles on the fusion process, the 6Li+89Y and 6Li+209Bi experiments were performed on Galileo array in combination with Si-ball EUCLIDES at Legnaro National Laboratory (LNL) in Italy. Using the coincidence by the charged particles and γ-rays, the different reaction channels can be clearly identified. Also the new energy levels of some nuclei were founded, and then the nuclear structure is explored.

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