Reaction of ^{44}Ca with Gd targets

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In a series of publications [1-4], our group has studied the survival of nearly spherical compound nuclei near ^{208}Pb that are produced in reactions of medium-mass projectiles with lanthanide targets. This work showed that compound nucleus survival is heavily dependent on the difference in the fission barrier and the neutron separation energy of the compound nucleus as well as the influence of collective effects. In the most recent of these publications [2], we studied the reactions of ^{44}Ca with ^{158}Gd, ^{159}Tb, and ^{162}Dy. These targets all have N = 94 or N = 96. In the current work, we have expanded our study to include the reactions of ^{44}Ca with $^{154, 156, 157, 160}$Gd to study the influence of neutron number while also verifying the ^{158}Gd measurement. We measured excitation functions for production of *xn* evaporation residue products by measuring the known alpha decays of the products, and preliminary results are given here.

Beams were provided by the K500 cyclotron to the MARS spectrometer [5, 6], which acted as a separator. Reaction products were spatially separated from transfer reaction products and unreacted beam using MARS (see [7] for details). A 25 mm x 25 mm 16-strip position-sensitive Si detector was used to detect implantations and subsequent alpha decays, while a microchannel plate detector was mounted upstream of the Si detector to provide discrimination of implantation events. The beam dose was monitored by two collimated Coulomb scattering detectors mounted in the target chamber with an angle of ±30° to the beam axis. The beam energy was varied using a series of Al degraders mounted upstream of the targets.

The primary results for maximum cross sections are shown in Fig. 1 with our previously published data for comparison. Although the general trend of decreasing cross section with decreasing difference in fission barrier and neutron separation energy is maintained, the change is not as pronounced as with other reactions, and the ^{44}Ca + ^{157}Gd maximum cross section is surprisingly large. The analysis of these data is ongoing.

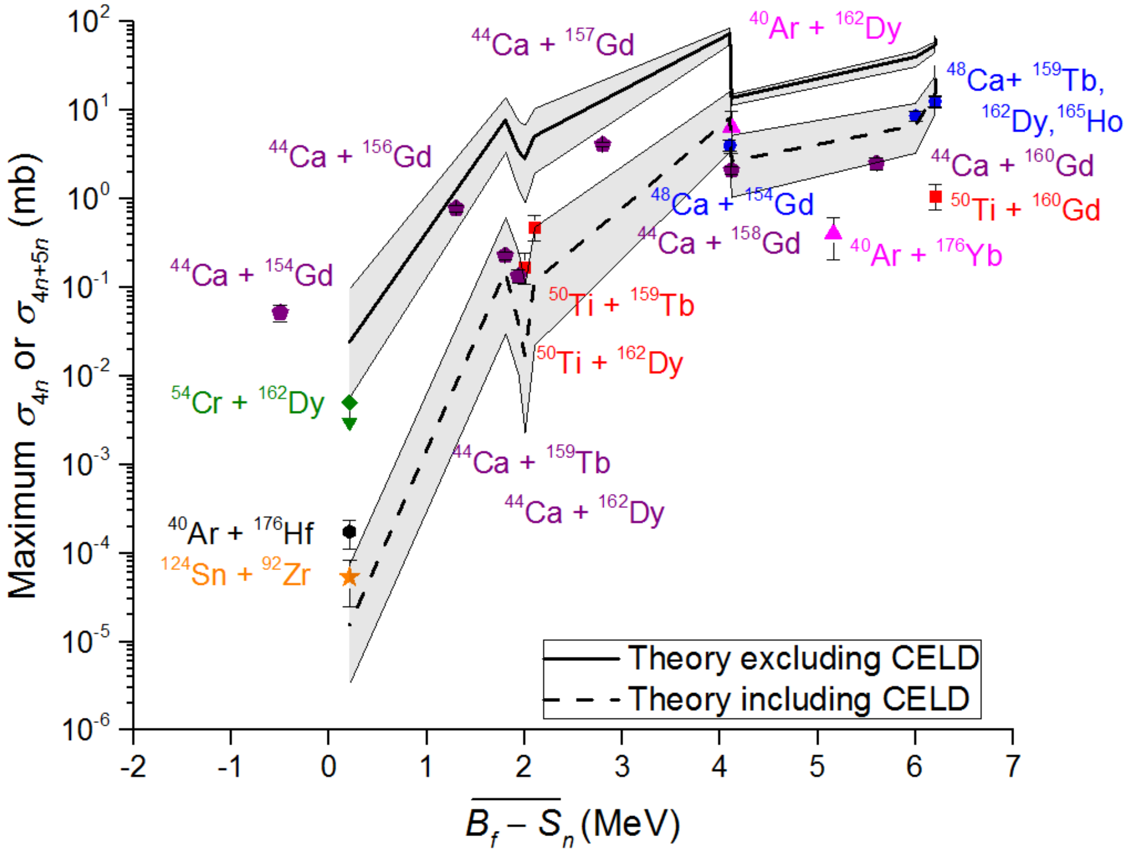

FIG. 1. Maximum measured 4*n* cross sections as a function of average difference in fission barrier and neutron separation energy. Points represented measured values for the indicated reactions, and lines represent theoretical calculations described in [2]. The heavy black line excludes the influence of collective effects, while the dashed line includes these effects. The shaded gray areas indicate the influence of changing the fission barrier by ±0.5 MeV. The data for ^{40}Ar projectiles are preliminary, as are the data for ^{44}Ca projectiles except ^{158}Gd.

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