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ABSTRACT

Extraction of the Nuclear Level Density 68Cu and 65Ni using the LANSCE/WNR neutron beams and the evaporation technique

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Nuclear reactions involved in stellar evolution generally occur at energies much lower than the Coulomb barrier, making neutron induced reactions vital in the synthesis of chemical elements, particularly those heavier than iron. Reactions of the (n,a) and (n,p) types can be utilized to extract nuclear level densities (NLD) of unstable isotopes, essential for accurate reaction rate calculations, using the evaporation technique. To probe nuclear level densities in the Ni region, cross sections measurements for 68Zn(n,p)68Cu and 68Zn(n,a)65Ni were carried out at WNR facility at LANSCE. Neutron beam ranging between 0.1 to 100 MeV impinged on a highly enriched 68Zn target located in the center of LENZ detection system. The reaction products were detected using annular S1 DSSD telescopes upstream and downstream of the target, and the discrimination between protons and alpha particles was accomplished by a pulse shape discrimination technique. The experimental data in the energy range of 10 to 13 MeV will also be used to extract level densities for the neutron-rich isotopes of 68Cu and 65Ni using the evaporation technique. The major energy-selection criterion was the minimization of direct and non-primary contributions that distort the evaporation spectra. The main idea of the evaporation technique is that the differential cross section for the emission of a particle from a compound nucleus is proportional to the appropriate transmission coefficient and NLD. Therefore, the detailed shape of the particle spectrum is determined by the energy dependence of the level density. Further improvement of the experimental level density can be achieved by comparing the experimental spectra to those calculated with the Hauser-Feshbach theory and adjusting the theory parameters to reproduce the experimental spectra. In this talk/poster, we present details on the experimental setup, analysis, and preliminary results for the measurement of 68Zn(n,a)65Ni and 68Zn(n,p)68Cu reaction cross section and the extraction of the nuclear level density of 68Cu and 65Ni.

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