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Comparing Nuclear Level Densities: Particle Evaporation vs. Neutron Resonance Data

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All level density models currently used in nuclear reaction codes are based on experimental data on absolute values of nuclear level density which are basically coming from two data sets: discrete level scheme at low excitation energies and the s-wave neutron resonance spacing (D0) at the neutron separation energy. These data are known in very limited ranges of excitation energies and spins. This restriction poses a challenge in effectively constraining level density models, resulting in significant uncertainties when modeling reaction cross-sections for various applications.

The experimental technique based on measuring the shape of emitted particle spectra from compound nuclear reactions (also referred to as evaporation spectra) allows for obtaining independent absolute level density information at higher excitation energies (up to the neutron separation energies) using only known discrete level scheme for the absolute normalization. This allows for independent cross-check of level densities obtained from particle evaporation technique and neutron resonances for their consistency, which will help with understanding the cause of possible difference. Understanding this difference is very important for constraining level density models and improving accuracy of reaction cross-section calculations. Also, it is critical for understanding systematical uncertainties of the experimental techniques based on the Oslo method of extracting level densities and gamma-strength functions, which uses D0 data for absolute normalization.

In this presentation, experimental information on level densities from particle evaporation and neutron resonance data will be compared for the range of nuclei and the difference and possible causes will be discussed.

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