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Semi-empirical model for fission product yields

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Accurate fission product yield (FPY) data are essential for various applications, including reactor antineutrino spectrum calculations. However, experimental FPY data remain incomplete due to the difficulty of measuring short-lived fission fragments. Meanwhile, theoretical models have provided qualitative insights into the fission process but still lack sufficient accuracy for quantitative predictions. To address these limitations, we developed a semi-empirical model to improve FPY predictions.
Our study treats the compound nucleus as a microcanonical ensemble, assuming that FPYs are proportional to the level density at the fission barrier. The potential energy at the fission barrier is modeled as a combination of a macroscopic component following the liquid drop model and a microscopic component arising from shell effects, represented as a parabola and a Gaussian function, respectively. The parameters for these components were determined using experimental data.
To properly describe the fission process, we devised a method where the pre-neutron emission FPY is reproduced using the semi-empirical model, followed by the construction of a probability distribution for neutron emission from fission fragments based on neutron multiplicity, ultimately allowing us to calculate the post-neutron emission FPY.

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