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Theoretical uncertainty of nuclear mass models

It's becoming increasingly important to understand the uncertainties and extrapolation power of nuclear mass model calculations when being extrapolated to driplines. In this contribution we evaluate the uncertainties of the parameters and model predictions of both the liquid drop model and three different Duflo-Zuker shell model mass formulas through a fractional sampling method. We optimize those nuclear mass models by fitting to large sets of randomly selected nuclei. Only a small fraction of data is chosen each time. We study the behaviour of the model predictions as a function of the size of the training data. It shows that one can construct an optimized model from a tiny portion of available data that can exhibit equal performance as those fitted to all data. However, the best trained model does not always lead to the best extrapolation. We determine the mean values and uncertainties of the model parameters and model predictions by fitting all calculated values to normal distributions. The parameter deviations increase as the complexity of the model increases which can deteriorate the extrapolation power of the model. The mean values of masses from all model predictions show a rather stable behaviour. However, the uncertainties can increase significantly as one goes towards the driplines. We hope that, within this framework, a minimal model with as few parameters as possible and good extrapolation power can be established for a given mass model or nuclear functional.

Primary author: Prof. QI, Chong

Presenter: Prof. QI, Chong

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