Nuclear Forecasting as Pattern Recognition: Can we predict Nuclear Masses?

A. Frank,[1] J. Lopez Vieyra,[1] V. Velazquez,[2] J. Barea ,[1] J. Hirsch,[1] and P. Van Isacker [3].

[1]Instituto de Ciencias Nucleares, UNAM, México.
[2]Facultad de Ciencias, UNAM, México.
[3]GANIL, France.

We analyze different approaches to predict nuclear masses and propose a new method which converts this question into a pattern recognition problem on the N-Z plane. We can maximize the observed pattern by examining the liquid-drop mass deviations from experimentally measured masses. By interpreting these data as an ordered arrangement seen through a window, we can then use a convolution of Fourier transforms which is able to separate the pattern from the window form. The inverse Fourier transformation then leads to opening the window and to our nuclear mass forecasts. The obtained frequencies carry information of more than 2000 nuclei predicting, for example, the occurrence of larger magic numbers and thus of more stable heavy nuclei. This technique does not attempt to minimize the measured global mass deviations or a priori restrict the calculation to be consistent with particular nuclear models. Preliminary calculations already show a competitive predictive power compared to sophisticated methods. We also discuss the possibility of pattern recognition-constrained calculations, incorporating further conditions and additional physical input, such as the Garvey-Kelson relations. Possible generalization of this method to other nuclear properties is briefly discussed.