Algebraic nuclear mass formulas

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The nuclear mass is a ground state observable of atomic nuclei, whose measured value reflects a subtle interplay of nuclear forces. Different models have been proposed to describe them, ranging from the semi-empirical liquid drop model to full shell model calculations, and including local and global methods [1].

In this contribution we analyze the ability of three different Liquid Drop Mass (LDM) formulas [2,3,4] to describe nuclear masses for nuclei in various deformation regions. Separating the 2149 measured nuclear species into eight sets with similar quadrupole deformations, we show that the masses of prolate deformed nuclei are better described than those of spherical ones [5]. In fact, the prolate deformed nuclei are fitted with an RMS smaller than 750 keV, while for spherical and semi-magic species the RMS is always larger than 2000 keV. These results are found to be independent of pairing [5].

It is also shown that the macroscopic sector of the Duflo–Zuker (DZ) [6,7] mass model reproduces shell effects, while most of the deformation dependence is lost and the RMS is larger than in any LDM [5]. Adding to the LDM the microscopically motivated DZ master terms introduces the shell effects [6,7,8], allowing for a significant reduction in the RMS of the fit but still exhibiting a better description of prolate deformed nuclei [5]. The inclusion of shell effects following the Interacting Boson Model's ideas [3,9] produces similar results[5].

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