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Neutron-proton correlations in macro- and microscopic nuclear models

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We review the systematics of various local mass relations (LMR) used for description of neutron-proton pairing. The shell model interpretations of several LMR are verified on the latest compilation of nuclear masses AME2020. Several theoretical approaches, such as the liquid drop model with Strutinsky corrections, finite-range droplet model, Duflo-Zucker model and the Hartree-Fock-Bogolyubov approach (HFB), are tested on their ability to reproduce the LMR related to the general mean field part of neutron-proton interaction as well as the odd neutron –odd proton interaction. We demonstrate that LMR such as $_{np}$ denoting the pairing between an odd neutron and proton require explicit introduction of neutron-proton residual interaction in microscopic approaches such as HFB, as blocking effects arising from pairing of like nucleons in odd-odd nuclei are not sufficient to reproduce the LMR.

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