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Odd-even mass staggering, shell effects, and pairing correlation in neutron-rich nuclei

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The empirical pairing gaps derived from four different odd-even mass staggering formulae are compared. By performing single-j shell and multi-shell seniority model calculations as well as by using the standard HFB approach with Skryme force we show that the three-point formula $\Delta_C^{(3)}(N) = \frac{1}{2}\left[B(N,Z) + B(N-2,Z) - 2B(N-1,Z)\right]$ provides a good measure of the neutron pairing gap in even-N nuclei. It removes to the largest extent the contribution from the nuclear mean field as well as contributions from shell structure details. It is also free from the Wigner effect for nuclei around $N = Z$. We also show that the strength of $\Delta_C^{(3)}(N)$ can serve as a good indication of the two-particle correlation in the nucleus of concern and that the weakening of $\Delta_C^{(3)}(N)$ in some neutron-rich nuclei indicates that the di-neutron correlation itself is weak in these nuclei.

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