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# Delineating the kink: laser spectroscopy and theoretical calculations of mercury isotopes across the N = 126 shell closure

Neutron rich mercury isotopes have been studied at CERN-ISOLDE by in-source resonance ionization spectroscopy, determining the change in the mean-square charge radii of 207, 208Hg and magnetic dipole moment of 207Hg. These results reveal a doubling of the growth rate of the mean-square charge radii of mercury isotopes across the N = 126 neutron shell closure. Kinks in charge radii systematics at the crossing of neutron shell closures have been found to be universal, indicating an origin that is general and independent of the local microscopic phenomena in the nuclear chart. The location and gradient of experimentally measured kinks provide an excellent benchmark for testing nuclear theory: facilitating the comparison of different theoretical approaches. This work provides a complementary benchmark for the validation of theoretical calculations in addition to the commonly used lead isotope chain.
In order to investigate the mechanisms driving these results, theoretical calculations of the ground states of 200–210Hg and 198–214Pb have been performed. This has included both nonrelativistic Hartree-Fock-Bogolyubov (HFB) calculations with energy density functionals (EDF) M3Y-P6 and M3Y-P6a and relativistic calculations within the framework of covariant energy density functional theory (CDFT) and employing a range of EDFs (NL3*, DD-PC1, DD-ME2 and DD-ME2). Of the approaches considered, the CDFT approach with the DD-ME2 forces was found to agree best with experimental data. There is a strong dependence of calculated values on the choice of the EDF. Thus, the experimentally determined kink parameter appears a good candidate for optimization of the EDF parametrization. Crucially the CDFT approach is also demonstrated to reproduce the kink and odd-even staggering (OES) independent of pairing effects, suggesting for the first time an approach that could be capable of reproducing all aspects of the kink and OES at N = 126. Based on the experimental measurements and the theoretical results, our interpretation of the kinks and odd-even staggering in charge radii is in contradiction to that suggested in [1], where pairing is the dominant contributor to both these effects.

[1] C.Gorges et al., Phys. Rev. Lett., 122, 192502 (2019).

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