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Collinear resonance ionization spectroscopy of francium and radium

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The propensity to adopt different shapes to minimize energy is a remarkable property of atomic nuclei. Nuclei around the $Z = 82$ shell closure exhibit a wide variety of these shapes. Low-lying excited states with different shape configurations to the ground state lead to shape-coexistence below the $N = 126$ shell closure. Additionally, octupole-deformed nuclei are found above the $N = 126$ shell closure. Model-independent measurements of nuclear spins, magnetic dipole moments, electric quadrupole moments and relative charge radii obtained through laser spectroscopy have played a key role in understanding the mechanisms driving these phenomena.

This work presents results from two experimental campaigns on neutron-deficient francium and neutron-rich radium exploring both sides of the $N = 126$ shell closure. By using collinear resonance ionization spectroscopy (CRIS), the quadrupole moment of ^{203}Fr was measured for the first time in addition to the ground-state properties of ^{231,233}Ra. These results allow an insight into the evolution of nuclear structure in two transitional regions: the approach of the $N = 104$ mid-shell from the $N = 126$ shell closure and the transition between octupole- and quadrupole-deformed nuclei above $N = 136$.

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