TRIUMF Advanced Rare Isotope Laboratory (ARIEL)

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Testing Static Octupole Deformation in Radium Isotopes via Collinear Laser Spectroscopy at ARIEL

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Radium isotopes near A =220-230 exhibit strong octupole correlations, evidenced by low-lying negative-parity states and enhanced E3 transition strengths in even-even nuclei [1,2]. However, whether the underlying octupole deformation is static (a genuine ground-state symmetry breaking) or dynamic (a collective shape vibration) remains an open question.

In this contribution, the possibility of addressing this question through collinear laser spectroscopy of odd-A radium isotopes is discussed. I will outline a roadmap toward next-generation collinear laser spectroscopy of radium isotopes aimed at testing static octupole deformation via hyperfine spectroscopy at TRIUMF ARIEL. While previous laser spectroscopy measurements in radium at ISOLDE have focused on isotope shifts and the extraction of magnetic dipole and electric quadrupole moments [3], future measurements involving higher-J atomic states enable sensitivity to rank-3 hyperfine interactions associated with the nuclear magnetic octupole moment.

The proposed approach relies on multi-state hyperfine spectroscopy and global analysis of hyperfine patterns to test whether dipole–quadrupole interactions are sufficient to describe the spectra, or whether a rank-3 contribution is required. This effectively turns the search for octupole deformation into a statistical hypothesis test rather than a direct measurement of a single small parameter.

In this talk, I introduce the physics motivation and discuss experimental requirements and feasibility at ARIEL, and invite community discussion on beam availability and infrastructure.

[1] L. P. Gaffney *et al.*, Nature **497**, 199 (2013).
[2] P. A. Butler *et al.*, Phys. Rev. Lett. **124**, 042503 (2020).
[3] K. M. Lynch *et al.*, Phys. Rev. C **97**, 024309 (2018).

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