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Search for Octupole Correlations in Odd-Mass Radium and Radon Isotopes

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Higher order collective degrees of freedom are well-established in the composition of excited quantum states of the atomic nucleus. Octupole collectivity, associated with pear-shaped nuclei, has been the subject of intense theoretical and experimental study. Regions of octupole deformation are found above all the major shell gaps — the so-called octupole magic numbers — $Z, N = 34, 56, 88, 134$. Effects attributed to octupole collectivity are particularly prominent in the light-actinide region, confirmed by numerous studies on even-even isotopes of the U, Th, Ra, Rn, isotopic chains. However, experimental information on odd-mass isotopes in this mass region are sorely lacking. The odd-mass candidates are of particular interest due to the enhancement of octupole effects arising from the interaction of the unpaired nucleon with the deformed core. These systems also play a central role in atomic electric dipole moment (EDM) searches, where the static octupole deformation and presence of low-lying parity doublets significantly enhance the nuclear Schiff moment. **We request 7 days of beam time bombarding a 2 mg/cm^2 ^{232}Th target with an 833 MeV ^{136}Xe beam, with the objective of populating odd-mass radon and radium isotopes via multinucleon transfer reactions. A particular focus is placed on ^{223}Rn which is expected to exhibit a higher degree of octupole collectivity compared to its neighbours. Measurements of experimental observables easily derived from energy level schemes $(\Delta i_x,\ |D_0/Q_0|)$ will provide immediate insight into the strength and type of octupole collectivity in these nuclei.** The precise atomic mass and charge selectivity offered by PRISMA is expected to overcome previous experimental shortcomings in being unable to identify γ rays belonging to the odd mass candidates.

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