The structure of neutron-rich rhenium isotopes and the impact of triaxiality

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Heavy neutron-rich isotopes, centred around ^{192}Os, are predicted to exhibit nuclear shape transitions [1]. This has been supported by experimental results on even-even isotopes in the region (^{188,190}W [2] and ^{192}Os [3]), that show corresponding signatures of a move from prolate to triaxial deformation. However, the presence of an odd particle can distort and change this transition by filling deformation driving nuclear orbitals. The present focus is on the odd-A neutron-rich rhenium isotopes (^{187}Re, ^{189}Re and ^{191}Re). High-spin studies of these nuclei using conventional fusion-evaporation reactions have not been possible, therefore, our approach has been to access these nuclei via multinucleon transfer or deep inelastic reactions. Using a pulsed or chopped ^{136}Xe beam from the ATLAS accelerator at Argonne National Laboratory, incident on ^{187}Re and ^{192}Os targets in-conjunction with the Gammasphere detector array, emitted γ rays from excited reaction products were measured.

Previous experiments identified delayed γ rays from isomeric states in ^{187}Re [4] and ^{191}Re [5], although a partial decay scheme is only known for ^{187}Re [4]. In addition to γ-ray spectroscopic studies, low spin states in ^{187}Re,^{189}Re and ^{191}Re have also been the subject of particle transfer experiments [6]. In the current measurement, the $9/2^{-}[514]$ proton orbital and its associated rotational band were observed, populated in the decay of 3-quasiparticle isomers, in all three isotopes and for the first time in ^{189}Re and ^{191}Re. Progression towards higher neutron numbers shows a decrease in K-hindrances for the isomeric decays, and an increase in the signature splitting of the $9/2^{-}[514]$ rotational band. These properties suggest the development of triaxiality which will be explored within different theoretical approaches: potential energy-surface, triaxial particle-rotor and total Routhian surface calculations.

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