The progression into triaxiality in neutron-rich rhenium isotopes

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The region with $Z \sim 76$ and $N \sim 116$ has been predicted to exhibit changes in nuclear deformation [1], our recent results on heavy neutron-rich isotopes in the region, ^{188,190}W [2] and ^{192}Os [3], show corresponding signatures of a transition to triaxial shapes. However, the presents of an odd particle can distort and change the transition from prolate to triaxial shapes 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). Since these nuclei cannot be produced by conventional fusion-evaporation reactions, our approach has been to access these nuclei via multinucleon transfer or deep inelastic reactions, specifically using a pulsed or chopped ^{136}Xe beam from the ATLAS accelerator at Argonne National Laboratory, incident on gold-backed ^{187}Re and ^{192}Os targets. The γ rays from excited reaction products were measured using the Gammasphere detector array.

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 two theoretical approaches: potential energy-surface, triaxial particle-rotor and total Routhian surface calculations.

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