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The nature of seniority symmetry breaking in the semi magic nucleus 94Ru

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For any fermionic system, seniority, ν, is defined as the number of particles not in pairs coupled to angular momentum J=0. It is a conserved quantum number for a system with n identical particles, each with angular momentum j, interacting through a pairing force [1]. Nuclei such as 9444Ru50 with valence particles situated in the upper half of the N/Z=28-50 major shell are influenced by the relative isolation of the g9/2 subshell. The j=9/2 system has received particular recent interest with respect to the exotic partial conservation of seniority [2].

Direct lifetime measurements via γ- γ coincidences using a FAst Timing Detector Array (FATIMA) [3] has been applied to determine the half-lives of low-lying states in the semimagic 94Ru nucleus. The experiment was carried out as the first of a series of commissioning "FAIR-0"experiments with the DESPEC experimental setup at the Facility for Antiproton and Ion Research (FAIR) [4]. Excited states in 94Ru were populated primarily via the β-delayed proton emission of 95Pd nuclei, produced in the projectile fragmentation of a 850 MeV/nucleon 124Xe beam impinging on a 4 g/cm2 9Be target. While the deduced E2 strength for the 2+ ⟶ 0+ transition in the yrast cascade well follow the expected behavior for conserved seniority symmetry, the intermediate 4+ ⟶ 2+ transition
exhibits a drastic enhancement of transition strength in comparison with pure-seniority model predictions as well as standard shell model predictions in the fpg proton hole space with respect to doubly-magic 100Sn. The anomalous behavior is ascribed to a subtle interference between the wave function of the lowest seniority ν=2, Iπ = 4+ state and that of a close-lying ν =4 state that exhibits partial dynamic symmetry. In addition, the observed strongly prohibitive 6+ ⟶ 4+ transition can be attributed to the same mechanism but with a destructive interference. It is noted that such effects may provide stringent tests of the nucleon-nucleon interactions employed in state-of-the-art theoretical model calculations.

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Presenter: DAS, Biswarup (GSI Helmholtz Centre for Heavy Ion Research)

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