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First Identification of the 0^+_4 and 0^+_5 levels in 100Zr at ANL-ATLAS

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An abrupt shape change from spherical to deformed ground states has been observed between 98Zr (N = 58) and 100Zr (N = 60) [1]. Monte Carlo shell model (MCSM) cal- culations suggest that the rapid change in the relative excitation energy of spherical and prolate structures fulfills the requirements of a first-order phase transition, and predict an excitation energy of the 0+4 spherical state at ≈ 1.5 MeV in 100Zr [2]. In contrast, interacting boson model calculations with configuration mixing (IBM-CM) predict a con- figuration exchange between 0+1 and 0+2 states from 98Zr to 100Zr, with the spherical 0+2 level located at ≈ 300 keV in 100Zr [3]. Thus, to test the two distinct predictions experi- mentally requires the determination of the excitation energy of the spherical 0+ bandhead in 100Zr and, more generally, more extensive knowledge of 0+ excitations in this nucleus. In this talk, we report on the observation of two new excited 0+ states in 100Zr, where spin and parity quantum numbers were unambiguously determined using the unique an- gular correlation pattern provided by 0+ ⟶ 2+ ⟶ 0+ cascades, as measured with the high-granularity Gammasphere spectrometer. In addition, the analysis has allowed for the identification of new excited states relative to the previously known level scheme, as well as for the determination of their spins and parities. The new data, recently published in Physical Review C [4], provide a stringent test of the MCSM calculations.
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