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From Shell Gaps to Shape Coexistence: Probing the Island of Inversion N=40 through the decay of 67Mn

One of the best-known divergences from the independent-particle shell model description of the atomic nucleus is the existence of islands of inversion (IoI) [1]. The N=40 IoI draws particular interest, as 40 was postulated as a non-traditional “magic”number, however, later experimental measurements of B(E2) values and E(2+) energies indicated enhanced collectivity through the N= 40 shell gap, with the clear exception of 68Ni [2,3]. In addition, LNPS shell model calculations predict triple shape coexistence for 67Co (N=40), with three rotational bands [4] and recent experiments on 67Fe (N=41) propose a spin-parity of 5/2+ or 1/2– for its ground state [5], which indicates significant deformation. In addition, shape coexistence is also expected for 67Fe.
To get a better understanding of this region, given the limited experimental data, an experiment was conducted at the TRIUMF-ISAC facility using the GRIFFIN spectrometer [6]. The β and βn decay of 67Mn populated the 67,66Fe, 67,66Co, and 67,66Ni isotopes. This data set contains orders of magnitude more statistics than previous studies, allowing us to build a complete level scheme of 67Fe and 67Ni for the first time and to improve upon the known β- decay level schemes of 67Co. In addition, measurements of level lifetimes down to the picosecond range will allow us to investigate the band structure in these nuclei.
For the 67Fe isotope, a good level of statistics will allow us to measure the energy of the identified isomeric state and improve the lifetime measurement.

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