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Investigation of ground-state symmetry in the ^{71}Kr/^{71}Br mirror pair

Properties of proton-emitting nuclei along the $N \sim Z$ line in the vicinity of the proton dripline, can be a useful probe of nuclear structure. In particular, the ground-state spins of the ^{71}Kr/^{71}Br mirror pair have been under debate for several decades driven primarily by the closely spaced (E_x = 10 keV) first-excited state in the ^{71}Br mirror partner [1,2]. Additionally, a significant enhancement in the β-decay branching to excited states in ^{71}Br had been suggested [3]. This should not be the case, however, if this system was a perfect mirror where the decay is expected to be dominated by a ground-state to ground-state transitions.

To explore these ground-state structures and the mirror symmetry in the ^{71}Kr/^{71}Br system, we have performed detailed $\beta\gamma$ and βp decay spectroscopy of ^{71}Kr. A cocktail beam of heavy-ions, including ^{71}Kr, was produced through projectile fragmentation of a 140-MeV/nucleon ^{92}Mo primary beam, accelerated by the Coupled Cyclotron Facility at the National Superconducting Cyclotron Laboratory (NSCL), and impinged upon a 152.2-mg/cm^2 Be target. The secondary beam was analyzed by passing the ions through the A1900 fragment separator and further purified using the Radio Frequency Fragment Separator (RFFS). These ions were implanted into a DSSSD in the Beta-Counting Station (BCS) coupled to the Segmented Germanium Array (SeGA), enabling β and β-delayed proton spectroscopy to be performed using implant-ion correlations. Branching to the $5/2^-$ 407-keV state in ^{71}Br and a delayed-proton branch feeding the first-excited 2^+ 945-keV state in ^{70}Se were observed. A detailed analysis of the β response of the setup was performed using ^{70}Br ions that were simultaneously implanted. From this analysis we were able to determine absolute β intensities as well as quantify an important source of systematic uncertainty in these types of decay experiments. Intensities of the measured γ transitions were used to build the low lying β-decay scheme of ^{71}Kr. Consequently, we find the observed delayed-proton decay to 2^+ state in ^{70}Se provides firm evidence that the ground-state spin of ^{71}Kr must be $J > 3/2$, consistent with mirror symmetry of the ^{71}Kr and ^{71}Br ground-state pair both having $J^\pi = 5/2^-$.

[1] M. Oinonen et al., Phys. Rev. C 56, 745 (1997).
[2] P. Urkedal and I. Hamamoto, Phys. Rev. C 58, R1889 (1998).
[3] S. M. Fischer et al., Phys. Rev. C 72, 024321 (2005).

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