BRANCHING RATIOS FOLLOWING THE BETA DECAY OF $^{69}Ni^{m}$

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In the 1998 NSCL annual report [1] we discussed the identification of a 3.4(7) s isomeric state in ^{69}Ni which was directly populated following the fragmentation of a 70 MeV/nucleon ^{76}Ge beam in a ^{9}Be target. The identification of this isomeric state was based on a newly discovered 1296 keV beta delayed gamma ray. From the experimental data, we concluded that the decay of the 1/2$^-$ isomer in ^{69}Ni proceeds mainly through the excited 3/2$^-$ state at 1296 keV in ^{69}Cu, see figure 1. No other excited state in ^{69}Cu has been observed following the β decay of this isomer, neither in this study [2] nor in a study of the β decay of ^{69}Co and its subsequent daughters [3]. Since [1], we have extracted an upper limited for the β branch of the 1/2$^-$ isomeric state in ^{69}Ni to the ground state of ^{69}Cu of 36%. This value was arrived at by comparing the total number of ^{69}Ni nuclei implanted within our 300 μm silicon PIN detector with the intensities of the γ rays following the β decay of the 1/2$^-$ isomeric state and the ground state of ^{69}Ni. Using the measured half-life and branching for the $^{69}Ni^{m1}$ β decay to the two 3/2$^-$ states in ^{69}Cu, as well as the β-decay Q value from Ref. [4], log ft values of 4.48 (upper limit) and 5.24 (lower limit) to the $3/2_2^-$ and $3/2_1^-$ states in ^{69}Cu, respectively, have been deduced.

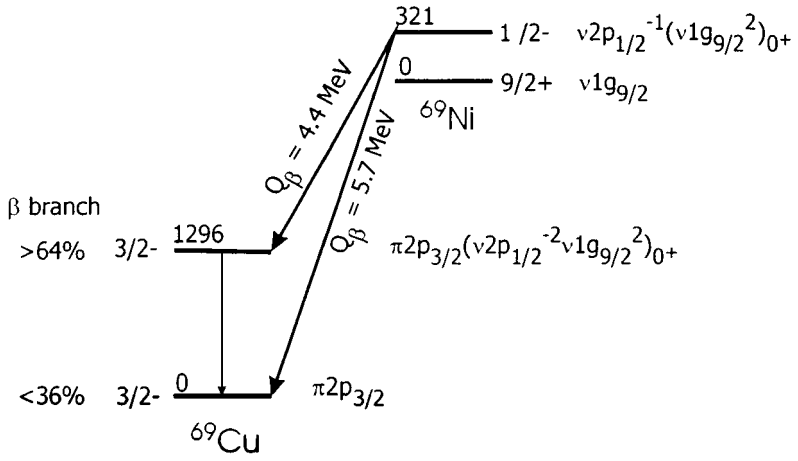

Fig. 1. Schematic of the β decay of ^{69}Ni along with the proposed configurations.

The beta decaying $\nu p_{1/2}^{-1}$ isomeric state at 321 keV was first proposed by Grzywacz *et al.* [5] following a study of microsecond isomeric states in neutron-rich nuclides near ^{68}Ni. Since that time, this isomeric state has been identified both via the study of the A = 69 β decay chain $^{69}Co \rightarrow {}^{69}Ni \rightarrow {}^{69}Cu$ by Mueller *et al.* [3] and also by the direct production of the isomer via projectile fragmentation as observed in this work. Based on these studies it has been concluded that the β decay of this 1/2$^-$ isomer predominately follows through the excited 3/2$^-$ state at 1296 keV in ^{69}Cu. If we consider the excited 3/2$^-$ state with a pure configuration, then the resulting matrix elements for the Gamow-Teller decay would look as follows:

$$< 3/2_2^- \,||T(GT)||\, 1/2^- > = < \pi 2p_{3/2} ||T(GT)|| \nu 2p_{1/2} > \quad (1)$$

$$< 3/2_1^- \,||T(GT)||\, 1/2^- > \approx 0 \quad (2)$$

Therefore, the β-decay of the $1/2^-$ isomer of ^{69}Ni would proceed only to the excited $3/2^-$ state at 1296 keV in ^{69}Cu. Some configuration mixing, resulting in a fragment of the $\pi 2p_{3/2} \otimes \nu(1g_{9/2}^{2}\, 2p_{1/2}^{-2})$ configuration in the ground state of ^{69}Cu, can produce a branch to the ground state in the decay of ^{69}Ni^{m1}. Using the upper limit of 36% obtained for this β branch, a 15% 2p-2h (two particle-two hole) mixing within the ground state of ^{69}Cu may be deduced [2].

References

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