Beta Decay of ^{37}S†

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New measurements of the energies and the intensity ratio of the two γ rays which are emitted following the β decay of ^{37}S to ^{37}Cl are reported. The more accurate energies are 3102.7 (±0.3) keV and 3706(±2) keV, and the revised intensity of the 3706-keV radiation relative to the 3102.7-keV radiation is 0.012(±0.003). The revised logft value for the β transition to the 3706-keV level of ^{37}Cl is now in better agreement with a recent shell-model calculation.

An earlier report[1] from this laboratory described the β decay of ^{37}S as consisting of decay to the ground energy level and to two excited levels of ^{37}Cl followed by the emission of two γ rays with an intensity ratio of 0.004. The ^{37}S was produced through the $^{37}Cl(n,p)^{37}S$ reaction with fast neutrons. Libert[2] has since reported the detection of only the lower-energy γ ray.

The purpose of this note is to report a recent, more accurate measurement of the γ-ray energies and of their intensity ratio. The reaction which produced the radioactivity was $^{40}Ar(n,\alpha)^{37}S$. A 35-cc Ge(Li) crystal detector was used with a dispersion of 0.98 keV/channel. The results were obtained in connection with a study of the β decay of ^{40}Cl, and other experimental details are described elsewhere.[3] The triplet of peaks associated with the more intense γ ray, now given the energy of 3102.7(±0.3) keV, and the full-energy peak of the other γ ray, now given the energy of 3706(±2) keV, were observed. The intensity of the 3706-keV radiation relative to the 3102.7-keV radiation was 0.012(±0.003). In the earlier work,[1] the smaller ratio was evidently due to overestimation of the background and of the NaI(Tl) crystal's efficiency for the higher-energy γ ray.

A more accurate $^{37}S-^{37}Cl$ atomic mass difference of 4.855(±0.040) MeV is now available from the $^{37}Cl(t,{}^3He)^{37}S$ reaction[4]; with this mass difference and the present γ-ray energies the deduced β-ray end-point energies are 4.86, 1.76, and 1.15 MeV (each ±0.04 MeV). The revised β-group relative intensities are 5.5, 93.3, and 1.2%, respectively, and the corresponding logf_1t is 8.05 and logf_0t are 4.48 and 5.34. Recently, a shell-model calculation[5] has yielded logft = 4.50 for the β transition to the 3103-keV level, in excellent agreement with the experimental result of 4.48. However, for the β transition to the 3706-keV level the calculation yielded logft = 4.94, which is much smaller than the present experimental result of 5.34. That is, the calculation[5] predicts a γ-ray intensity ratio which would be 2.5 times larger than the present experimental result.

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