^{100}Tc electron capture branching ratio

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The motivation to measure the electron-capture (EC) branch of ^{100}Tc is two-fold: ^{100}Mo is a neutrinoless double-β decay (0νββ) candidate [1, 2] for which the ^{100}Tc EC branch is needed for matrix element calculations; and inverse EC on ^{100}Mo has been proposed [2] as a potential detector for observing charged-current neutrinos from the pp chain. The main motivation at this time, however, is 0νββ because there is no concrete plans to develop ^{100}Mo as a neutrino detector due to the large mass (≃ 3 tons) which would be required. To date, only one measurement of the EC branching ratio has been published which has a 50% uncertainty on its value: $(1.8\pm0.9)\times10^{-5}$ [3].

A schematic diagram of the setup we used at the IGISOL facility in Jyväskylä, Finland is shown in Fig. 1. Using the Penning-trap system JYFLTRAP, contaminants in the beam (most notably ^{99}Tc and ^{100}Ru) were removed. The purified ^{100}Tc beam was collimated before entering a cylindrical cavity bored into a cube of plastic scintillator to ensure all the activity was implanted onto a foil near the opposite end of the cube. Imposing a veto from signals in the scintillator allowed us to suppress the dominant (≃ 99.999%) β^- decay branch to ^{100}Ru by >90%. A planar Ge detector observed the x-rays following the EC of ^{100}Tc with very little attenuating material between it and the activity (3 mm of scintillator and 120 μm of Be). A preliminary x-ray spectrum from the experiment is shown in Fig. 2. The dominant peak at 19.2 keV originates from K_α x-rays following the decay to ^{100}Ru; without the β veto, this peak would overwhelm the small ^{100}Mo x-ray peak at 17.4 keV. We calculate the EC branching ratio based on the ratio of the area of this small – but clearly resolved – peak to that of the 540 keV γ ray which follows the β^- decay. Although analysis of the data continues, preliminary results indicate a branch of 1×10^{-5} with an uncertainty of ≃ 20%. The dominant sources of

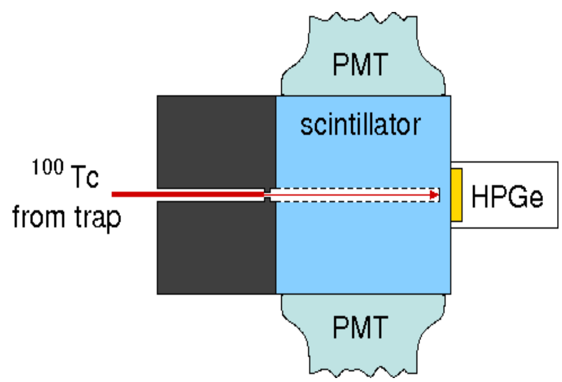

Figure 1. Schematic diagram of the detector setup at the end of the IGISOL/JYFLTRAP beamline.

uncertainty are expected to be statistics in the ^{100}Mo peak and our understanding of the relative efficiency of the Ge detector between 17 keV and 540 keV.

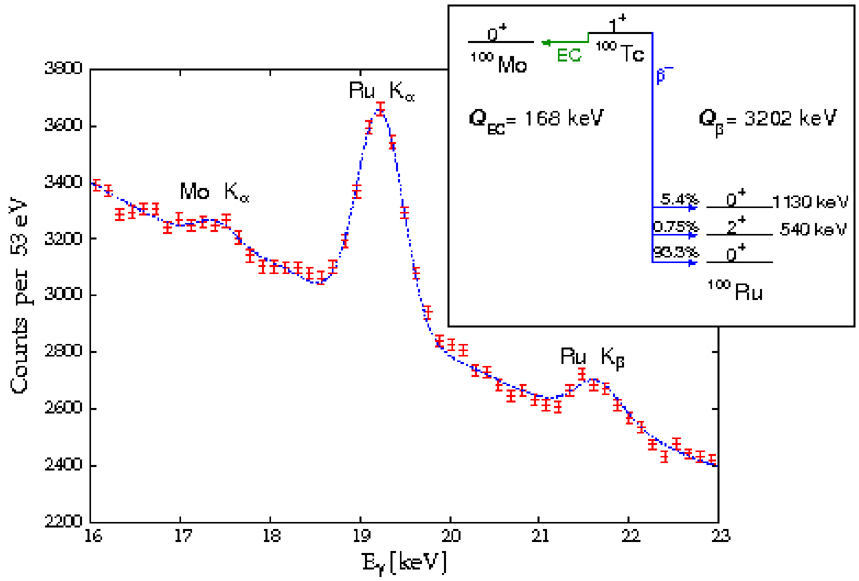

Figure 2. Simplified decay scheme (inset) and x-ray spectrum from ^{100}Tc decay.

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