Precision Branching Ratio Measurement of ^{62}Ga

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Superallowed Fermi β decays test the Standard Model of particle physics by providing a precise measurement of the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix element V_{ud}. The current accepted value of V_{ud} from superallowed Fermi decays is 0.9738 ± 0.0004 [1], leading to a unitarity sum for the first row of the CKM matrix of 0.9966 ± 0.0014, where the world average values for V_{us} and V_{ub} [2] have been used. Due to this 2.4 σ discrepancy there has been interest in reducing the error on V_{ud} and V_{us}. Recent measurements of V_{us} [3, 4, 5, 6] may suggest a revised value but currently remain inconclusive, motivating further refinement in our knowledge of V_{ud}. For a superallowed Fermi beta decay the experimental parameters needed to determine V_{ud} are the half life, branching ratio, and Q-value. The current world average for the half life of ^{62}Ga is 116.17 ± 0.04 ms [7, 8]. A precision Q-value has not yet been determined. In addition to the experimental limits the precision of V_{ud} is currently limited by knowledge of the isospin symmetry breaking correction, δ_C. This parameter is predicted to be large in the case of ^{62}Ga, providing further motivation to measure the branching ratio of this decay.

A measurement of the branching ratio of ^{62}Ga was conducted at TRIUMF (TRI-University Meson Facility) located in Vancouver, Canada. The 8π array of 20 HPGe detectors was used to detect the gamma rays emitted in the decay of ^{62}Ga, and SCEPTAR (SCintillating Electron-Positron Tagging ARray) was used to detect the β^+ particles in coincidence. In this work at least eight levels with excitation energies up to 5.2 MeV were observed to be populated in the decay of ^{62}Ga either directly in the beta decay of ^{62}Ga or via the subsequent gamma-decay cascade. The results for the branching ratio analysis will be presented, and a comparison with theoretical shell model predictions for the branching ratios will be made.

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