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Studies of Superallowed Fermi Beta Emitters Using the IBE Decay Station

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The study of superallowed Fermi β transitions between nuclear isobaric analog states of spin Jπ = 0+ provides demanding, and fundamental, tests of the properties of the electroweak interaction. In particular, high-precision measurements of the β-decay ft values for superallowed Fermi β emitters with isospin T = 1 have been used to validate the conserved vector current (CVC) hypothesis to better than 12 parts in 10^5 and provide the most precise determination of Vud, by far the most precisely determined element of the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix.

Much current interest lies in the set of superallowed decays with Tz =−1 parents, as the isospin symmetry breaking corrections are, in general, larger than those for the Tz = 0 parents of the same mass due to an increased radial-overlap mismatch between the proton and neutron wave functions in the parent and daughter nuclei. However, high-precision measurements of the ft values for these decays are, in general, more challenging than for the Tz = 0 parents, due both to the fact that they are further from stability, and their daughter nuclei are in general also β unstable and give rise to unwanted but unavoidable time-dependent β-decay backgrounds. Recent experimental efforts, in combination with extensive simulation work, have, however, demonstrated that these challenges can be overcome.

At the IBE low-energy decay station, a program to investigation Tz=−1 superallowed Fermi β emitters has been previously established. The setup uses a moving tape collection system and couples a plastic scintillator with a precisely calibrated HPGe to perform both half-life and branching ratio experiments simultaneously. Possible experiments for those superallowed emitters that are, or are expected to be, available at SPIRAL1 with sufficient intensity and purity will be discussed. This talk will highlight the complementarity of this program with similar studies performed at LISE, ISOLDE, and TRIUMF as well as the decays of T=1/2 mirror nuclei at LPCTrap.

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