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**Precise test of the unitarity of the CKM matrix via superallowed nuclear beta decay**

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Superallowed $0^+ \rightarrow 0^+$ nuclear beta decay between isospin T = 1 analogue states is a sensitive probe for studying the fundamental properties of the weak interaction. Today, the most precise measurements of the decay strengths (or $ft$ values) of fourteen superallowed transitions, ranging from $^{10}$C to $^{74}$Rb, provide a direct determination of the vector coupling constant $G_V$, and lead to the most precise value of $V_{ud}$, the up-down quark-mixing element of the Cabbibo-Kobayashi-Maskawa (CKM) matrix. When $V_{ud}$ is combined with the other top-row elements, $V_{us}$ and $V_{ub}$, the sum of squares of the top-row elements of the CKM matrix satisfies the unitarity condition at the level of $\pm 0.06\%$.[1] The impact of this result on searches for new physics beyond the Standard Model motivates further work to improve even further the precision of the CKM-matrix unitarity sum. Our current focus is on measurements to constrain the uncertainty in calculations of the isospin-symmetry-breaking corrections needed to determine $V_{ud}$ from the experimental data. This can be achieved with high-precision comparisons of the $ft$ values from four pairs of accessible mirror superallowed decays with $A \leq 42$. This presentation reports our results for the mass-38 pair, $^{38}$Ca $\rightarrow$ $^{38m}$K and $^{38m}$K $\rightarrow$ $^{38}$Ar, and our progress on measuring $^{42}$Ti decay. The measured ratio of the mirror $ft$ values for $A = 38$ agrees well with the corrections currently used, and points the way to even tighter constraints on the unitarity of the CKM matrix. If the three mirror pairs, with $A = 26, A = 34$ and $A = 42$ confirm and strengthen our present conclusion, it will become possible to shrink the systematic uncertainty on $V_{ud}$, reduce the uncertainty on the CKM-matrix unitarity sum, and further constrain the scope for possible extensions to the Standard Model.

[1]J.C. Hardy and I.S. Towner, Phys. Rev. C **91**, 025501 (2015).