

WEDNESDAY

NOVEMBER 4

4:00 P.M.

RM 118 NSH

Refreshments
in Rm 202 NSH
@ 3:30 pm

Nuclear Tests of the Standard Model: Vector Current Conservation and CKM Unitarity

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Very precise measurements in nuclei can offer demanding tests of the Standard Model of particle physics. In particular, “superallowed” nuclear beta-decay between 0^+ analogue states is a sensitive probe of the vector part of the weak interaction, and the measured strength (i.e. ft -value) of each such transition yields a direct measure of the vector coupling constant, G_V . To date, the ft -values for fourteen $0^+ \rightarrow 0^+$ transitions have been measured with $\sim 0.1\%$ precision or better, and these results yield fully consistent values for G_V , thus confirming the conservation of the vector current to a part in ten thousand.

The resultant G_V in turn yields an experimental value for V_{ud} , the leading diagonal element of the quark mixing matrix, the Cabibbo-Kobayashi-Maskawa (CKM) matrix. Not only is this the most precise determination of V_{ud} , it is the most precise result for any element in the CKM matrix. The CKM matrix is a central pillar of the Standard Model and, although the model does not predict values for the matrix elements, it demands that the matrix itself be unitary. The experimental value for V_{ud} obtained from superallowed beta-decay leads to the most demanding test available of CKM unitarity, a test which it passes with flying colors: the unitarity sum of the top-row elements as determined from experiment is 0.9998 ± 0.0006 .

The determination of a transition’s ft -value requires the measurement of three quantities: its Q -value, branching ratio and parent half-life. To achieve the 0.1% precision obtained for the superallowed transitions, each of these quantities had to be measured to substantially better precision, a challenging standard which has led to special techniques being developed. I will describe some current experiments in the field, and overview the up-to-date results from a new 2015 survey of world data.