



Contribution ID: 468

Type: **Contributed Oral Presentation**

Isospin breaking in isospin-hindered ^{47}K beta decay: enhanced sensitivity to time-reversal

Friday, 30 May 2025 08:55 (15 minutes)

Isospin is not an exact symmetry of QCD. Though in most nuclear systems the Coulomb interaction is thought to dominate isospin symmetry breaking (ISB), strong interaction ISB has implications for several nuclear physics puzzles, ranging from the Nolen-Schiffer anomaly in mirror nuclear masses to the extraction of V_{ud} from Fermi beta decay.

The main result of TRIUMF's atom trap for beta decay (TRINAT) in the 3 years since INPC2022 is not a standard model test, but rather a measurement of isospin breaking in the ^{47}Ca nucleus fed by $I^\pi=1/2^+$ ^{47}K beta decay. The nonzero asymmetry in direction of the nuclear recoils wrt the ^{47}K spin directly implies that the 80% $1/2^+$ decay branch has a small Fermi component to interfere with the dominant Gamow-Teller piece. We have extracted from this measured recoil asymmetry a ratio of Fermi and Gamow-Teller matrix elements 0.098 ± 0.037 and a Coulomb matrix element 101 ± 37 keV [Kootte et al. PRCL 2024].

Unlike most previous existing beta decay measurements, our ^{47}K result exhausts a large fraction of expected analog-antianalog mixing, calculable by schematic analytic expressions backed by RPA [Auerbach and Loc NPA 2022]. We attribute the relatively large measured Coulomb matrix element to the existence of only one $1/2^+$ state in nearly doubly-closed ^{47}Ca , so the antianalog configuration is not spread over many final states. We will review a number of measurements with analog-antianalog mixing in mind, including the recent measurement in ^{26}P decay done at Lanzhou [Liu et al. PRL 2022].

The relatively large M_F/M_{GT} will be helpful to our planned test of time-reversal symmetry by measuring the correlation $\hat{I} \cdot v_\beta \times v_\nu$ in spin-polarized ^{47}K decay. Sensitivity to parity-even time-reversal odd isospin-breaking interactions in the final nucleus is enhanced because the small T-breaking matrix element is referenced to the Coulomb interaction matrix element, which is naturally much smaller than strong interactions [Barroso and Blin-Stoyle PLB 1973]. We need backing for these simple assertions from nuclear theory calculations of matrix elements of time-reversal breaking effective operators [Herczeg NP 1966].

Our measurement of the β asymmetry in ^{37}K decay [Fenker PRL 2018] can also be interpreted as a benchmark of ISB theory relevant to measurements of V_{ud} . DFT-based calculations of ISB in mirror decay, including strong interaction ISB fit to the Nolen-Schiffer anomaly [Konieczka PRC 2022] produce quite different ISB in ^{37}K than shell-model calculations with Coulomb matrix elements matched to IMME [Severijns and Towner 2008]. We hope by improved β decay correlation experiments with TRINAT to distinguish these calculations.

Primary author: BEHR, John (TRIUMF)

Presenter: BEHR, John (TRIUMF)

Session Classification: Parallel Session

Track Classification: Fundamental Symmetries and Interactions in Nuclei