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POS-K #108 – Time-reversal test in radiative beta decay: progress

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We are developing a time-reversal breaking test in radiative β decay, using just the momenta of three outgoing particles. This type of time reversal is independent of nuclear spin, so explores time reversal-breaking physics unrelated to electric dipole moments (though there are model-dependent constraints at 1-loop order from null measurements of the neutron EDM). The scalar triple product of three momenta $\vec{p_1} \cdot \vec{p_2} \times \vec{p_3}$ provides a unique time-reversal odd observable, but trivially vanishes in ordinary β decay when the three momenta sum to zero. So we need the fourth outgoing particle in radiative β decay, considering the correlation between β, ν, and γ. We add γ-ray detectors (GAGG scintillator with SiPM readout) to TRIUMF's magneto-optical trap for beta decay (TRINAT), which includes a uniform electrostatic field for efficient recoil ion detection. Explicit models produce this observable with an antisymmetric Chern-Simons term from QCD-like new interactions, interfering with the standard model vector electroweak interaction within the nucleon [S. Gardner and D. He, Phys. Rev. D 87 116012 (2013)], and among the predicted features are a quite different gamma-ray spectrum than normal bremsstrahlung. We will show initial data from the decay of 92Rb, a case without vector interactions not yet testing the explicit models.

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