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Improved Search for CP Violation in Ortho-Positronium Decay

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Symmetry under the combined charge and parity (CP) transformations is only known to be violated through mixing matrices in the Standard Model. This leads to vanishingly small effects in many low energy processes. Positronium (Ps) is a purely leptonic bound state that decays to photons. Any observation of CP violation in Ps would indicate beyond Standard Model physics. We are designing an apparatus to search for CP violation in Ps decay to three photons, to be run at the Facility for Rare Isotope Beams. Positronium is formed by surrounding a positron emitting source with low density powder. The apparatus consists of three rings of photon detectors with the Ps source at the center. The entire apparatus sits inside the warm bore of a superconducting solenoid to induce a tensor polarization in the Ps system. With this we can measure a 5-fold correlation between the photon momenta and the Ps spin. Here we present progress on detector design and testing, Ps formation, and simulations of the detector apparatus. With our design we expect to reach our target sensitivity of 10^{-4} with 35 days of continuous running – a 10 x improvement over existing limits.

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