

## Constraining CP Violation in Ortho-Positronium Decays at 7 Tesla with NeuroSphere PET Modules

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The decay properties of ortho-positronium (o-Ps), a bound state of a positron and an electron that can form prior to annihilation, serve as a probe of material properties (e.g., differentiating porosity or tissue pathology) and fundamental physics (e.g., testing quantum electrodynamic theory or constraining fundamental symmetry violation). In this work, we demonstrate the capability of the NeuroSphere MR-compatible PET modules to measure the  $\text{o-Ps} \rightarrow 3\text{g}$  decay lifetime and kinematics under an applied 7-T magnetic field and report preliminary results. A target comprised a Na-22 positron source was placed between two slabs of polyvinyltoluene (PVT), which serve both as the formation region for o-Ps and positron emission time trigger. The target was positioned at the center of a ring of 20 PET detectors (pixelated LSO arrays coupled to silicon photomultipliers), and the system was mounted on a motorized turntable at isocenter of the 7-T MRI base field for data acquisition. The long-lived component of the o-Ps decay lifetime in PVT was measured to be 31.2 ns. The measured asymmetry in o-Ps decays under the effective reversal of the magnetic field direction, as a function of the angle between the most energetic decay photon and o-Ps spin polarization axis, was measured to be  $0.0102 \pm 0.0100$ , consistent with zero asymmetry (no CP violation).

**Presenter(s) :** ALLEN, Magdelena S. (Department of Physics, Massachusetts Institute of Technology and A. A. Martinos Center, Department of Radiology, Massachusetts General Hospital)