

Tests of discrete symmetries in positronium decays with the J-PET detector

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Collaboration

J-PET

Abstract content

Positronium is a unique laboratory to study discrete symmetries with precision limited, in principle, only by the effects due to the weak interactions expected at the level of 10^{-14} [1] and photon-photon interactions expected at the level of 10^{-9} [2]. Violation of T or CP invariance in purely leptonic systems has never been seen so far [3] and the experimental limits on CP and CPT symmetry violation in the decays of positronium are set at the level of 10^{-3} [4,5] and limits on charge conjugation violation are set at the level of 10^{-7} [6-8]. Thus, there is still a range of six orders of magnitude as regards T and CP, and two orders of magnitude as regards the C symmetry, where the phenomena beyond the Standard Model can be sought for by improving the experimental precision in investigations of decays of positronium atoms.

The newly constructed Jagiellonian Positron Emission Tomograph (J-PET) is a first PET tomograph built from plastic scintillators [9-14] and was optimized for the registration of photons from the electron-positron annihilations. It enables tests of discrete symmetries in decays of positronium atoms via the determination of the expectation values of the discrete-symmetries-odd operators [15-17].

In the talk, we will present the capability of the J-PET detector to improve the current precision of testing CP, T and CPT symmetries in the decays of positronium atoms and report on results from the first data-taking campaigns.

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