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Precision tests with the J-Pet detector.

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The J-PET [1, 2, 3] is a high-acceptance multi-purpose detector optimized for the detection of photons from positron-electron annihilation and can be used in a broad scope of interdisciplinary investigation, e.g. medical imaging, fundamental symmetry tests, and quantum entanglement studies, etc. For this purpose, the Positronium system, which consists of a bound state of an electron and a positron, is used in experiments where we can test the predictions of quantum electrodynamics (QED). In particular, we look for new physics studying the Ps triple state, the ortho-positronium (o-Ps), which mainly decays to three photons.

We look for the so-called Alice or Mirror Matter (MM), a new type of matter and a suitable candidate for Dark Matter, performing a high-precision measurement of the lifetime of the o-Ps state, to achieve the needed accuracy for testing the present QED calculations. A discrepancy with the expectation from theory could indicate the presence of Physics Beyond the SM, i.e. a signal for MM. In addition, profiting from the triggerless acquisition mode of the J-PET detector, we are searching for decays of the o-Ps into 4γ and 5γ , the former C-violating decay and the latter never observed. Present limits in these forbidden and rare decays can be improved thanks to the large acceptance and high angular resolution of the J-PET detector.

References

- [1] P. Moskal et al. In: Science Advances 7 (2021), eabh4394.
- [2] P. Moskal et al. In: Nature Communications 12 (2021), p. 5658.
- [3] P. Moskal et al. In: Nature Communications 15 (2024), p. 78.

session

K. Precision and New Physics

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