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Proposed research topic

Study of symmetry violation between matter and antimatter in positronium decays.

Short description (< 1000 characters)

The aim of the research is to test the symmetry between matter and antimatter in the decays of the positronium atom, which is a system consisting of an electron and a positron. The positronium atom occurs in 2 quantum states - a pair of positronium (p-Ps) and ortho positronium (o-Ps), which decay into even and odd numbers of gamma quanta, respectively. As part of the practice, the level of charge symmetry breaking (related to the conversion of an electron to a positron) will be examined by measuring the positronium decay prohibited by the Standard Model, e.g. the p-Ps decay into 3 photons. Measurements will be made with the use of a J-PET detector (Fig. 1).

During the practice, the student will have the opportunity to acquire knowledge about the conducted research (theoretical basis, statistics), learn about the J-PET detection system unique in the world (Fig. 1) (learning how to use the device, conduct measurements), and then perform the experiment prepared by him in which the emission of photons from the decay of positronium will be investigated. The collected data will then be analyzed for testing charge symmetry.

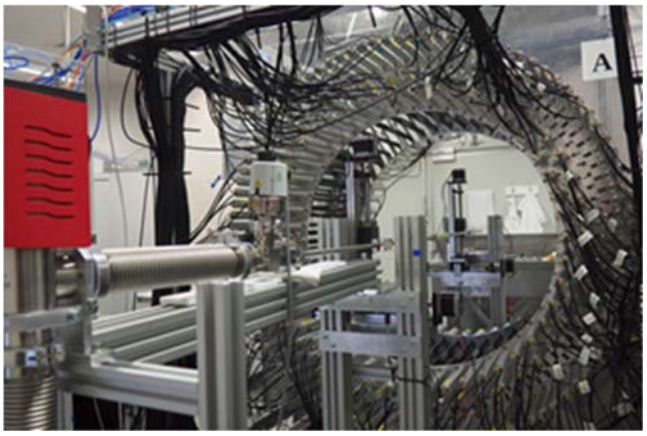

Fig. 1 J-PET detector used to perform measurements, with a small annihilation chamber inside.

The level of research will be adapted to the degree of study. Each step of the experimental work and data analysis will be explained on an ongoing basis and according to individual needs.

Main research tool

J-PET detector, oscilloscope, C++/python, ROOT library

Additional requirements to the candidate

Students of physics, experimental physics and particle physics. Nice to have: willingness to learn, research enthusiasm, diligence and punctuality.

Possibility to continue student internship in the form of:

Diploma thesis (master's or bachelor's degree)	X
PhD study	X