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New frontiers in fundamental physics and medical imaging with J-PET

Monday, 24 February 2025 13:00 (1 hour)

The Jagiellonian Positron Emission Tomograph (J-PET), a flagship project of the University, is the first PET scanner made of plastic scintillators. It goes beyond the standard PET imaging and enables novel investigations in both fundamental physics and medical imaging. J-PET research is currently focused on the study of positronium (Ps) decays. Positronium, a hydrogen-like bound state consisting of an electron and a positron, is an ideal laboratory for the study of quantum electrodynamics (QED). The annihilation dynamics of positronium is precisely determined by QED and allows to pursue several interesting physics problems, e.g. measurements of decay rates, tests on discrete symmetries, investigations of quantum entanglement of annihilation photons and the search for new physics beyond the Standard Model. Thanks to the modular design of the new prototype and its multiphoton detection capabilities, J-PET proves to be a multipurpose device for various applications. The modular J-PET will be used for investigations on various anti-matter objects, including experiments with positronium beams at the Anti-Matter Laboratory in Trento and with anti-hydrogen beam in the AEgIS experiment at CERN. J-PET has also demonstrated its key role in the development of a new imaging modality, namely positronium imaging (both ex vivo and in vivo), where the analysis of positronium properties offers new diagnostic parameters that go beyond conventional PET. This observation can lead to significant advances in medical imaging, especially in oncology and cancer tissue detection. In this seminar, I will discuss the dual role of J-PET as a detector for fundamental physics studies and as a scanner for clinical applications, followed by the latest scientific results.

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