



KONWERSATORIUM INSTYTUTU FIZYKI UMCS

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„Jagiellonian Positron Emission Tomography: A novel technology for multi-photon medical imaging”

The Jagiellonian Positron Emission Tomograph (J-PET) is the first PET built from plastic scintillators. It consists of detection modules arranged axially in three layers forming a cylindrical diagnostic chamber. An axial arrangement of long strips of plastic scintillators, their small light attenuation, superior timing properties, and relative ease of the increase of the axial field-of-view opens promising perspectives for the cost effective construction of the whole-body PET scanner, as well as construction of MR and CT compatible PET inserts.

As a detector optimized for the registration of photons from the electron-positron annihilations, J-PET also enables tests of discrete symmetries in decays of positronium atoms via the determination of the expectation values of the discrete-symmetries-odd operators, which may be constructed from the spin of ortho-positronium atom and the momenta and polarization vectors of photons originating from its annihilation. These features makes J-PET capable of improving present experimental limits in tests of discrete symmetries in decays of positronium atom (a purely leptonic system) and makes it a unique facility to study the entanglement of photons originating from positronium annihilations.

Status of the commissioning of the first J-PET prototype as well as status of the development of the second fully modular and transportable J-PET tomograph and their possibilities for multi-photon and positronium imaging will be presented and discussed. In the talk we will present the method of photon registration, fully digital signal processing and data acquisition, as well as methods of event selection and image reconstruction. We will also present results of feasibility studies of multi-photon imaging of the properties of positronium inside the human body showing that it may deliver new diagnostic informations, additional to the presently available standardised uptake value indicator.

Moreover, 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 will be presented and discussed.

P. Moskal et al., Phys. Med. Biol. **61**, 2025 (2016)

A. Gajos et al., Nucl. Instrum. Meth. **A 819**, 54 (2016)

D. Kamińska et al., Eur. Phys. J. **C 76**, 445 (2016)

B. Jasinska et al., Acta Phys. Polon. **B 48**, 1731 (2017)

J. Smyrski et al., Nucl. Instrum. Meth. **A 851**, 39 (2017)

L. Raczyński et al., Phys. Med. Biol. **62**, 5076 (2017)

B. Hiesmayr, P. Moskal, Scientific Reports **7**, 15349 (2017).

Uprzejmie zapraszam wszystkich pracowników, doktorantów i studentów Instytutu Fizyki.

Dr hab. Ryszard Zdyb, prof. nadzw.
Dyrektor IF UMCS