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Time Over Threshold as a measure of energy response of plastic scintillators used in the J-PET detector

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Collaboration

J-PET

Abstract content

Discrete symmetries C (charge conjugation), P (parity) and T (time reversal) have been studied for decades in order to answer the question of inequality between matter and antimatter. So far most of such studies were focused on the mesons and nuclei [1,2]. But studies on discrete symmetries in the leptonic system is very scarce. Jagiellonian-Positron Emission Tomograph (J-PET) is the first of its kind constitutes of 192 plastic scintillators arranged in three layers which are positioned in a cylindrical shape [3]. Characteristic features of the plastic scintillators (small light attenuation, high angular, and excellent time resolution) and optimized locally developed data acquisition based on FPGA, justify the JPET utilization in measuring the expectation values of the symmetry-odd operators which eventually can be used to test the discrete symmetries in positronium atom decays [3-7]. In the frame of J-PET, the charge collection is replaced with time over threshold (TOT) measurements [8,9]. In plastics due to the nonlinearity between energy deposition by incident gamma quanta and TOT values, there is a strong necessity to develop a relationship between these two quantities in order to exhaust the utilities of J-PET detector to study the discrete symmetries [5]. The geometrical acceptance of J-PET allows studying the scattering of incident gamma. By knowing the incident gamma energy and its scattering angle, the energy deposition in the scintillator can be estimated. Thus for a gamma quanta hitting the plastic scintillator one can know its scattering angle, energy deposition, and corresponding TOT values. Results obtained from the data analysis aiming to develop the relationship between energy loss by incident gamma quanta and TOT values in pursuit to study the discrete symmetries will be presented.

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Primary author(s) : SHARMA, Sushil K. (Jagiellonian University)

Presenter(s) : SHARMA, Sushil K. (Jagiellonian University)

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