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Design of the Cherenkov Full-body PET Scanner with GATE Simulation

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Positron emission tomography (PET) is a powerful nuclear imaging technique used widely nowadays in oncology, cardiology and neuropsychiatry. The PET technology consists in injecting the patient with a radioactive tracer. The decay of the tracer emits a positron which annihilate with an electron. As a result of the annihilation, two 511 keV gamma quanta are emitted back-to-back and registered by the dedicated detectors.
The individual detector of the proposed scanner consists in the lead fluoride crystal (PbF2) assembled with MCP-PMT. Scanner diameter is 800 mm and axial size is 53 mm. 43 detectors compound in the ring. Crystal size is 6.5 mm x 6.5 mm x 10...20 mm. Matrix consists of 1 x 8 x 8 PbF2 crystals. As the MCP-PMT we envisage to use the
Photonis Planacon detector XP85112. Detector size is 59 mm x 59 mm with an
active area of 53 mm x 53 mm (64 anodes). We will use a modified version of this detector, with the sapphire window. First results show good TOF resolution (140 ps). We will calculate NECR taking into account TOF potential, evaluate gain of the scanner due to the TOF technique, optimize the configuration, image reconstruction for a realistic tracer distribution.

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