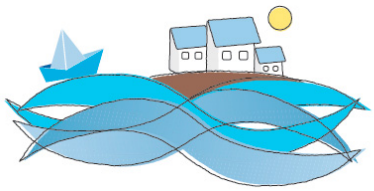

Mediterranean Thematic Workshops in Advanced Molecular Imaging

Contribution ID: **75** Type: **Poster**

PET scanners based on pure Cherenkov detectors: a Monte Carlo Study

Monday 5 September 2022 18:15 (2 hours)

Dense Cherenkov radiators provide an opportunity for high gamma detection efficiency - due to their high stopping power and photofraction - and excellent coincidence time resolution (CTR). However, because only a few tens of Cherenkov photons follow a gamma interaction in the radiator, the detection efficiency and the energy resolution of a pure Cherenkov detector are an issue. We study gamma detection efficiency and CTR of PbF_2 based detectors with different surface treatments and photo-detectors (SiPMs with realistic PDE and 70 ps FWHM SPTR) covering one or two crystal faces (two-sided readout). We investigate the potential performance of a full-size Cherenkov PET scanner using the NEMA NU 2-2018 standard and compare image quality with a reference scanner - Siemens Biograph Vision PET scanner. The geometry of Cherenkov scanners was based on that of the reference scanner. Monte Carlo simulations were performed on a super-computing network using GATE, and CASToR was used for TOF-OSEM image reconstruction. Normalization, scatter, random, and attenuation correction factors were included in the reconstruction. Cherenkov scanner with 1-sided readout had similar TOF performance (225 ps CTR-FWHM) and achieved very similar image quality as the reference scanner. Superior image quality was achieved by using a 2-sided readout detector design (SiPMs at the sides of the crystal), thanks to the improved coincidence detection efficiency and CTR (128 ps FWHM). We demonstrate that even though pure Cherenkov scanners have basically no energy resolution, the scatter fraction of around 50\% is not prohibitively large, and images comparable to the state-of-the-art clinical PET scanner can be achieved due to improved efficiency and CTR attainable with PbF_2. Cherenkov detectors are expected to perform even better in preclinical or brain imaging studies where the scatter fraction is significantly smaller compared to the torso imaging.

Topic Selection

Technical Advances in brain imaging

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