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Preliminary Studies of a Simultaneous PET/MRI Scanner Based on the RatCAP Small Animal Tomograph

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We are developing a scanner that will allow the simultaneous acquisition of high resolution anatomical data using Magnetic Resonance Imaging (MRI) and quantitative physiological data using Positron Emission Tomography (PET). The approach is based on the technology used for the RatCAP conscious small animal PET tomograph which utilizes block detectors consisting of pixelated arrays of LSO crystals read out with matching arrays of avalanche photodiodes (APDs) and a custom-designed ASIC. The version of this detector used for simultaneous PET/MRI imaging will be constructed out of all non-magnetic materials and will be situated inside the MRI field. We have demonstrated that the PET detector can be operated inside the MRI field using 511 keV gamma rays, and have obtained MRI images with its detector components located around various objects being imaged with MRI. The MRI images show minimal distortion in this configuration in which some components still contain traces of certain magnetic materials, and we plan to improve on the image quality in the future using completely non-magnetic components and by tuning the MRI pulse sequences. The combined result will be a highly compact, low mass PET scanner that can operate inside an MRI magnet without distorting the MRI image, and can be retrofitted into existing MRI instruments.

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