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Please not that the abstract format is limited to 500 words (main text, not including title, authors, affiliation, and references). Up to 3 supplementary tables and/or figures are allowed.

Title:Verification of applicability of silicon detector technology for PET-MR and SPECT-MR imaging

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Aim: Evaluate performance of silicon sensors and associated electronics in presence of MR field and confirm absence of interference between the systems during data taking procedures

Methods and materials: Imaging module under test consisted of

- High resistivity silicon sensors with thickness of 650 micrometers segmented to 1 mm2 square diodes with p+nn+ doping profile. Radioactivity from the object is directly detected in the sensors without converters such as scintillators.
- Flexible circuit boards connecting the readout pads to the first stage electronics. Flexibility of the circuits allows for strategic placement of amplifier boards and seamless contact to the sensor electrodes.
- A set of 128 channel VATAGP7.1 ASIC by IDEAS provides low noise amplification of moderate (5 to 15 fC) signals. The chips were housed on a dedicated PCB and connected via long (1.5 m) cables to a customized data acquisition board (MADDAQ) housed outside of MR Faraday enclosure.

The MR used is a small animal MRI scanner consisting of a 2.35 T (100 MHz proton NMR resonance frequency) horizontal bore superconducting magnet (Oxford instruments, Abingdon, United Kingdom) and an Apollo NMR spectrometer (TecMag, Houston TX, USA). Two stage evaluation algorithm was used to verify viability of the sensor technology:

- A populated module without the sensor was placed inside the magnet and a test readout sequence was initiated to evaluate interference of electronics alone, with and without the running of the MR readout sequence. On top of that, MR performance with the inserted and running bare module was recorded.
- The test was superseded with insertion of the complete module exposed to simple point like radioactive sources (Am-241, Na-22). Again, interference both ways was evaluated.

Results: The tests confirmed minimum interference between the systems. There was no degradation in energy spectrum of recorded interactions in silicon either outside of magnetic field, inside of the MR magnet or during MR operation. With proper shielding of the module, interference to the MR was minimized to tolerable levels.

Discussion – Conclusion: Silicon and similar solid state sensors offer great potential in some areas of emission imaging. Because of direct detection they can operate at significantly better spatial resolution (0.35 micrometers or less) compared to the scintillator-SiPM assemblies. Because of that they can offer gains in specific setups like PET probes [1], Compton cameras [2] or high precision SPECT collimated systems [3]. Although such systems are in principle compatible with MR level magnetic fields, interference of the readout electronics may cause inadvertent effects to either of the data set and verification of the setup is required. Our final aim is to develop a MR insertable imaging ring dedicated to imaging of animal models composed of tightly packed silicon sensors.

[1] Studen, A. Et al. A silicon PET probe. Nucl Inst Meth A, 648(1) 2011 pp. S255-S258.
[2] K. Vetter, D. Chivers, B. Plimley, A. Coffer, T, Aucott, Q. Looker," First demonstration of electron-tracking based Compton imaging in solid-state detectors", Nucl. Instr. Meth. A 652 (2011) 599
[3] L. J. Meng, G. Fu, E. J. Roy, B. Suppe and C. T. Chen, "An ultrahigh resolution SPECT system for I-125 mouse brain imaging studies," *Nucl Instrum Meth A,* vol. 600, pp. 498-505, Mar 1 2009.