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A thin time-of-flight PET scanner based on novel pixel silicon detectors

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The TT-PET project aims at developing a compact Time-of-flight PET scanner with 30ps time resolution, capable of withstanding high magnetic fields and allowing for integration in a traditional MRI scanner, providing complimentary real-time PET images. The very high timing resolution of the TT-PET scanner is achieved thanks to a new generation of Silicon-Germanium (Si-Ge) amplifiers, which are embedded in monolithic pixel sensors. The scanner is composed of 16 detection towers as well as cooling blocks, arranged in a ring structure. The towers are composed of multiple ultra-thin pixel modules stacked on top of each other. Making it possible to perform depth of interaction measurements and maximize the spatial resolution along the line of flight of the two photons emitted within a patient. This will result in improved image quality, contrast, and uniformity while drastically reducing backgrounds within the scanner. Allowing for a reduction in the amount of radioactivity delivered to the patient. Due to an expected data rate of about 250 MB/s a custom readout system for high data throughput has been developed, which includes noise filtering and reduced data pressure. The realization of a first scanner prototype for small animals is foreseen by 2019. A general overview of the scanner will be given including, technical details concerning the detection elements, mechanics, DAQ readout, simulation and results.

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