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#09-235 The Wearable PET project for a compact clinical exam for an early diagnosis

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The Wearable PET (WPET) project was successfully supported by EU-ATTRACT (https://attract-eu.com). Its objective is to demonstrate the feasibility of a light PET systems for cancer preventive screening which can be hosted by wearable vest.
Positron Emission Tomography or PET is a very precise imaging modality commonly used in hospital oncology units to test patients with cancer to establish possible metastasis or other complex diseases difficult to diagnose with traditional methodologies. In PET a radioactive positron emitter is injected into the patient's body. Sugar is attracted by infected human cells and cancer cells, which therefore accumulate the positron emitter. The emitted positrons annihilate producing two high energy gamma rays back to back that can be detected outside the human body.
Traditional PET systems detect the two emitted gammas and reconstruct the emission point. These devices produce a 3D image of the full body reconstructing the cancer location with spatial resolution of the millimetre. The disadvantages of these systems are that are expensive, massive and can only be used for a limited number of tests daily.
On the contrary, the WPET, that performs a similar, but less detailed, measurement for a longer time, would allow one to use this modality for routine screening for a large fraction of the population at risk, improving early stage detection.
The WPET project aims at building a wearable PET scanner with a modular, flexible design, able to image different body parts according to specific needs, as well as to track detector motion and correct its effects in real-time. This is made possible not only by lighter and compact LYSO-SiPM detector modules, but also by accompanying developments in miniaturized readout electronics, battery technology, wearable sensors, wireless data transmission and fast PET image reconstruction algorithms. WPET requires a novel system design to combine wearable electronics with novel materials, controls, batteries and data transmission components to be hosted in a comfortable wearable support. Storage, handling and visualization are also part of the package on the medical side for an easy diagnosis of the collected data.
Within the project Geant4 MonteCarlo simulations were performed to optimize the jacket design and evaluate the feasibility. Reconstruction algorithms were used to demonstrate the proof of concept performances. With this paper we would like to present the WPET concept and the early results obtained. Using simulation and tests with single modules we can conclude that the fabrication and use of a WPET system is feasible. The key to feasibility is scalability, miniaturization, data storage and handling and precise position monitoring. With current technology, WPET can detect tumours as small as 2 mm with 10 kg crystal weight in 6 hours, using the same tracer dose as conventional clinical PET.

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