

# The physics and engineering of total-body PET

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Total-body imaging with positron emission tomography (PET) was recently developed through a large, international collaboration (EXPLORER), that has so far resulted in the construction of several prototype and preclinical total-body PET systems for research purposes, along with the FDA-approved uEXPLORER total-body PET/CT system. Here, total-body PET imaging is achieved by extending the cylindrical scanner length to 194 cm compared to the ~20-30 cm axial lengths of all other clinical PET systems. A longer scanner allows for the detection of 511 keV photons generated from positron-electron annihilation across the entire body simultaneously, along with detecting a greater number of coincident 511 keV photon pairs due to the increased solid angle of detection. While this general principle of total-body PET is relatively straightforward, the physics and engineering involved in total-body PET are not. I will describe the physics considerations of total-body PET from the detectors to data corrections, elaborate on the engineering challenges associated and encountered with the development of the first 2-meter long uEXPLORER PET/CT system at UC Davis, and give my outlook for the opportunities and current innovations in instrumentation for total-body imaging.

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