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The EXPLORER Project: Total-Body Positron Emission Tomography

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Positron emission tomography (PET) scanners generate in vivo images of radiolabeled pharmaceutical distribution and kinetics, providing a powerful window into metabolism and physiology. However, current PET scanners for humans cover only 20-25 cm of the body axially at any one time, which leads to long scan times, relatively high radiation dose, poor signal quality and largely limits their ability to kinetically model radiotracer distribution to single organs of the body. The goal of the EXPLORER project, which was first conceived of in 2005, was to develop the world's first total-body PET/CT scanner that covers the entire body at once and offers the promise of a step-change in molecular imaging research and clinical practice.

Construction of the EXPLORER scanner, consisting of over 500,000 individual detector elements and more than 50,000 photosensors and channels of electronics, was recently completed. The scanner has a total axial field of view of 194 cm, and a bore diameter of 76 cm with a reconstructed spatial resolution better than 3 mm, a time-of-flight resolution of 430 psecs and also incorporates a high-performance CT scanner (80 detector-row, 160 slice) for anatomic registration.

First human applications of the scanner have already demonstrated the ability to acquire extremely high-quality images with standard acquisition protocols, the ability to image very fast (tomographic images of the entire human body in as little as 1 second), and the ability to acquire diagnostic quality images with less than 1/10th the standard radiation dose. The first total-body dynamic studies in which the distribution of a radiolabeled compound is followed in every tissue and organ of the body from the time of injection also will be presented. The world's first EXPLORER scanner has been installed at UC Davis where it will be used both for biomedical research and clinical studies.

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