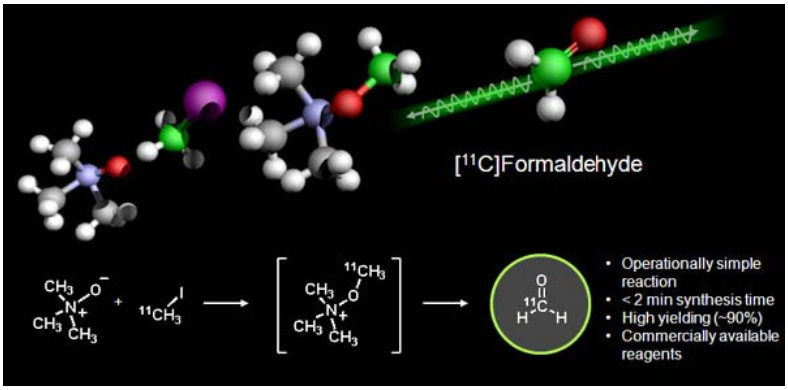
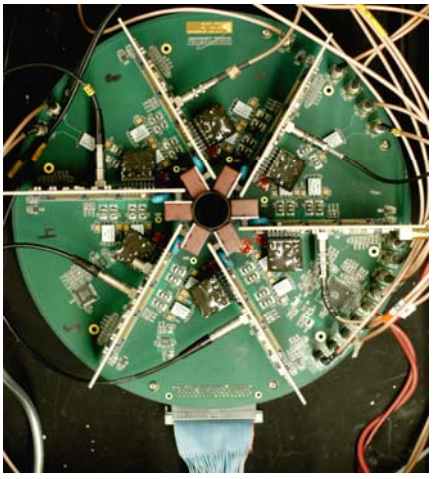
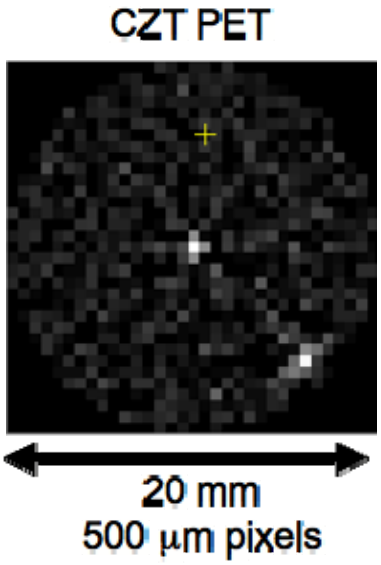
New Carbon-11-Formaldehyde Radiolabeling Reagent Developed: This transformational new radiochemical methodology utilizes commercially available, inexpensive trimethylamine-N-oxide for highly effective conversion of carbon-11-labeled methyl iodide to carbon-11-labeled formaldehyde, a useful reagent central to synthesis of a variety of radiolabeled compounds. The reactions require no special equipment and produce high yields of carbon-11-labeled formaldehyde after only few minutes under mild conditions. The labeled formaldehyde has two major applications: scientists can now use this as a precursor to synthesize a whole new class of radiotracers, compounds that can be tracked by positron emission tomography (PET) scanners to monitor the movement and interactions of a wide range of chemicals in biological systems, and secondly, scientists now have a means to study and track formaldehyde itself in research on medical and environmental effects of this chemical. The study appeared in the July 4, 2008, issue of *Angewandte Chemie International Edition;* and was highlighted in *July 14, 2008, C&EN; and in July 18, 2008, Nature Chemistry.*



Above: Trimethylamine N-oxide reacts with [^{11}C]methyliodide to form [^{11}C]formaldehyde.

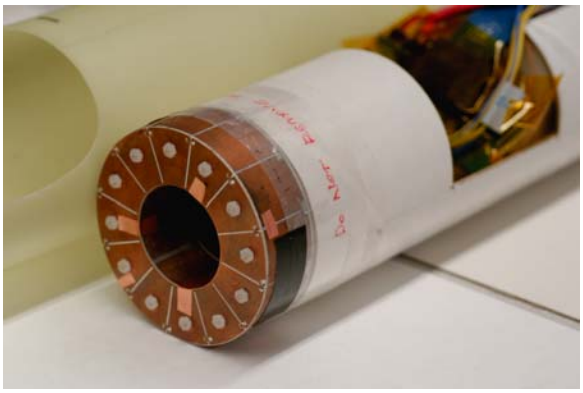
Ultra-high Resolution PET Imager: The Radiochemistry and Instrumentation program at Brookhaven National Laboratory has designed and built an ultra-high resolution prototype PET imager using fully solid-state cadmium zinc telluride (CZT) detectors in a novel configuration. The system has achieved the best resolution ever demonstrated in a complete PET system - about 600 microns which is almost a factor of 2 improvement over the best available devices. Sub-mm resolution PET allows to visualize biological systems and processes at a size scale never before possible, which will greatly facilitate research in areas ranging from visualizing cancer micrometastases to plant molecular biology.

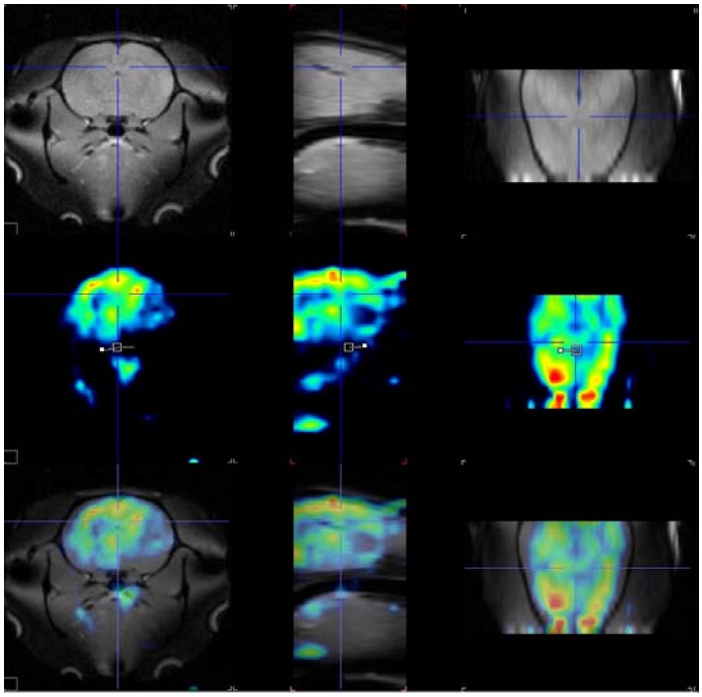




Left: Top view of ultra-high resolution PET scanner designed and built by Brookhaven National Laboratory showing CZT detectors (brown) and front-end electronics. Right: Reconstructed image of 2 point sources (at center and edge of field of view in a warm background), demonstrating ~600 micron resolution and lack of parallax distortions at edge.

Simultaneous PET/MRI Instrument Development: A truly simultaneous hybrid PET/MRI scanner has been developed based on solid state photodetectors contained in the Positron Emission Tomography (PET) insert. This novel BER-funded PET/MRI imaging instrumentation technology provides simultaneous quantitative functional information (from PET) and high resolution structural/ anatomical data (from MRI) to study biological processes in living systems. This significant advance in multimodality imaging grew out of a BER-supported effort to miniaturize scanning technologies, a device known as the "RatCAP" used to assess rat brain biochemistry and function in un-restrained animals. Basic research applications may include obtaining MRI derived structural information together with PET- derived cellular receptor occupancy or enzyme concentration information, both at the highest possible resolution. This technology will allow researchers to study the distribution of nutrients and radiotracers, for example to characterize and quantify specific enzymatic reactions and metabolism related to normal and abnormal biological processes in the living organism in real time.





Above left: PET insert based on RatCAP modular design ready for insertion into the MRI Scanner.
Above right: PET and MRI images of the rat brain taken simultaneously. Lower image is the overlay of the two images showing the correspondence of the MRI anatomical detail with the PET functional information.