| | Category:<br><br>**B. Particle characterization**<br><br><br>**Institute: CIC biomaGUNE**<br>**Location:** Paseo Miramón<br>          Parque Tecnológico de San Sebastian<br>          20009 San Sebastian<br>          Guipúzcoa, SPAIN<br><br>**Contact Details of Technology Expert:**<br>**Jordi Llop Roig**<br>**+34 943 00 53 33**<br>**jllop@cicbiomagune.es** |
|---|---|
| **PET camera (eXplore Vista CT, GE Healthcare)** | |

**Short technology description/Overview**:

Positron emission tomography (PET) is the most sensitive and specific technique for imaging molecular pathways in vivo and in a non-invasive way. It is based on the administration of compounds labelled with short-lived positron-emitting radionuclides to obtain three-dimensional images of functional processes in animals and/or humans. Typical isotopes used as radionuclides in PET are fluorine-18, carbon-11, nitrogen-13 and oxygen-15. These radionuclides are incorporated into biological compounds that play a specific role in living organisms.

The spontaneous decay of a positron emitter produces a positron, which travels a certain distance (depending on its energy) to finally react with one electron of a surrounding atom. This process is called annihilation; as a result, two gamma photons are emitted (511 keV each, emitted at 180 ºC to each other). The generation of these gamma rays is the basis of positron emission tomography. When a tracer containing a positron emitter is administered to an organism, the high-energy gamma rays produced, which have a high penetration power, escape from the body and are detected by an external ring of detectors as a coincident event. The detection of hundreds of thousands of such coincident events permits the reconstruction of a 3D image that contains information about the distribution of the radiolabeled tracer within the organism.

The most commonly used PET detection system consists of an array of scintillation crystals. These crystals are usually made of high density materials to enhance interaction with gamma rays and are optically coupled to several photomultipliers. The intrinsic resolution is determined by the number of detectors on the array and the size of the individual detectors. Hence, resolution can be enhanced by reducing the dimension of the detector crystals.

**Main Features (Equipment Capabilities):**

GE's eXplore Vista-CT small animal positron emission tomography (PET) - CT (Computed Tomography) scanner is designed to accurately quantify and visualize regional, time-varying distributions of positron emitter labeled radiopharmaceuticals in murines, mice and rats with the anatomical information in order to allow the localization of the molecular signal.

The eXplore Vista-CT scanner is based on an advanced, high spatial resolution, dual scintillator, depth-of-interaction detector technology that provides extremely high sensitivity, while achieving consistent high resolution across the=field of view.

- Ring diameter: 11.8 cm
- Aperture: 8 cm
- Effective transverse field-of-view: 6.7 cm
- Axial FOV: 4.7cm
- Number of depth-of interaction detector modules: 36 position-sensitive PMTS
- Number of dual-scintillator depth-of-interaction elements: 6,084
- Depth identification method: pulse shape discrimination
- Crystal array pitch: 1.55 mm
- Crystal size: 1.45 x 1.45 mm
- Crystal depth 15 mm
- Total number of crystals: 12,168
- 3D acquisition
- Total number of coincidence lines: 28.8 M

SYSTEM PERFORMANCE:
- Central spatial resolution: 1.4 mm (FWHM); 1.0 mm w/3D OSEM
- Spatial resolution off-axis: 1.7 mm @ 1.0 cm, 2.0 mm @ 2.0 cm, both FWHM-FBP
- Absolute central point source sensitivity: 6.5% @ 100-700 keV energy window
- Timing resolution: 1.5 ns
- Energy resolution uniformity: <25%

**Typical Samples & Images:**
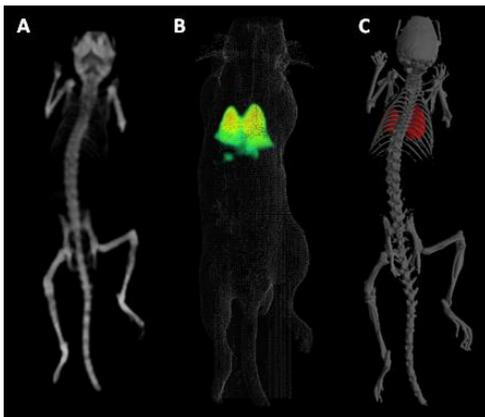


Whole Body PET-CT images for the determination of biodistribution of labelled aluminum oxide NPs in mouse after IV administration: (A) CT scan, (B) PET scan, (C) PET-CT rendering
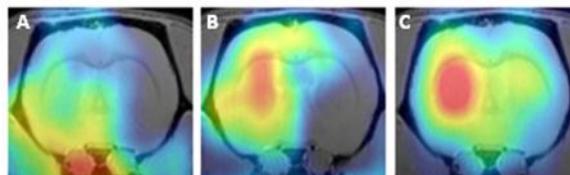


PET images of rat brain after transient ischemia (MCAO model) performed with: (A) [13N]ammonia (perfusion marker), (B) [18F]FDG (metabolism marker) and (C) [11C]Raclopride ($D_2$ receptor antagonist). MRI corregistration is included.

*Any further Information*: