EQUIPMENT

PET

Cyclotron:
- A 16 MeV GE PetTrace 800 series cyclotron, configured for producing $[^{13}N]NH_3$, $[^{11}C]CO_2$, $[^{11}C]HCN$, $[^{11}C]CH_4$, $[^{18}F]$fluoride and $[^{68}Ga]GaCl_3$

Research Radiochemistry Laboratory. This laboratory contains:
- 4 Comecer MIP 1100 hot cells
- Chemical fume hood
- ScanSys TracerMaker chemistry systems for ^{11}C chemistry
- GE Tracerlab FXC pro ^{11}C chemistry system
- GE Tracerlab FXN pro ^{18}F chemistry systems
- GE FastLab ^{68}Ga chemistry system
- RadioHPLC systems

cGMP Radiosynthesis Laboratory. This ISO class 7 laboratory contains:
- 2 Comecer MIP 1100 hot cells
- 2 Comecer MMP mini hot cells
- ISO Class 5 dispensing hot cell with master/slave manipulators.
- GE Tracerlab FXN pro ^{18}F chemistry systems
- ScanSys TracerMaker chemistry systems
- Direct pass through connecting to the QC laboratory
- Direct pass through connecting to the packaging and dispatch area
- ISO Class 7 ante room

QC Laboratory. This laboratory contains:
Gas chromatography system for residual solvent testing
- Two HPLC systems with autoinjectors and in line UV and gamma detectors for radiochemical/chemical purity testing
- Depyrogenation oven
- Multichannel analyzer
- Endotoxin testing equipment
- Pharmacy 4˚C refrigerator,
- -20˚C freezer
- 0.01 mg readable balance
- 2 kg capacity, top loading balance
- 22.5˚C incubators for assessing fungal contaminants.
- 32.5˚C incubators for assessing bacterial contaminants.
- Class 2A biological safety cabinet for aseptic work
- Chemical fume hood
- Direct pass through connecting to the cGMP manufacturing laboratory

Scanners:
MiE Scintronic PET Scanner. This is a dedicated research PET scanner that is a redesigned and updated Siemens HR+. The scanner rings and detection hardware are from an HR+, restored or replaced with new components as appropriate. The digital processing hardware and software have been modernized to acquire list mode data.

United Imaging uMI 550 Digital High-Resolution PET/CT:.This is a 100% research-dedicated combined PET/CT scanner. This scanner consists of a high-resolution digital PET with 2.9 mm NEMA resolution and 2.76 mm LYSO detectors. The CT is an 80-slice ultra-low noise CT with 0.55 mm individual elements. The PET/CT has a 24 cm axial field of view (FOV) and can acquire a whole-body scan within 8 minutes. This FOV lends to

high system sensitivity to boost data acquisition and enable low dose PET scans. Additionally, this system offers advanced technologies such as time-of-flight, point spread function, HYPER iterative (ROSEM), HYPER focus, deep learning (AI) PET reconstructions, deviceless gating, metal artifact correction, and more.

Stony Brook University has a unique collaboration with United Imaging. We hold biweekly meetings with the company's Physics team to discuss and address the research goals of both our team and the field as a whole.

Metabolite Analysis Laboratory. This laboratory contains a HIDEX gamma counter, additional HPLC systems for radiometabolite analysis and systems for cell culture analysis.

Positron Emission Tomography (PET)/Magnetic Resonance Imaging (MRI) Scanner:
In addition to the 100% research-dedicated PET scanners, SBU has a Siemens Biograph mMR (molecular MR), a shared resource that is 50% research dedicated. This scanner consists of MRI-compatible LSO PET detectors that are inserted into the bore of the 3T MRI scanner and that allow simultaneous acquisition of MRI and list-mode PET data. PET axial and transaxial fields of view are 25.8 cm and 59.4 cm, respectively. The diameter of the scanner bore is 60 cm, with a magnet length of 163 cm and system length of 199 cm. The whole-body gradient coil system is actively shielded with a length of 159 cm. The MRI gradient strength is 45 mT/m @ 200 T/m/s (MQ Gradients). The helium capacity of the magnet is 1,500 L. The unique TrueForm RF design provides uniform RF distribution in all body regions, optimized amplitude and phase transmission settings, and homogeneous B1 distribution. The unique mMR block detector architecture includes integrated cooling features to provide optimal PET performance as well as specialized shielding to virtually eliminate magnetic field interference in the PET data processing chain. The optimized design for Biograph mMR and low-attenuation materials in Tim mMR coils and the mMR Tim Table minimize attenuation of the PET signals. This helps to improve the consistency of PET data results. PET detector crystal material is 4 x 4 x 20 mm with 64 crystal elements per block, providing the NEMA 2007 transverse spatial resolution of 4.4 mm in full width at half maximum, with sensitivity of 13.2 cps/kBq and a peak NEC rate of 175 kcps.

Through a Master Research Agreement with Siemens and their Works in Progress program, MRI sequences are available on the mMR that are not available on commercial MRI scanners. Techniques that are available include: high resolution anatomical images (used for anatomical delineation in PET studies), EPI (Echo-planar imaging) for resting state functional MRI, diffusion-weighted MRI (diffusion tensor imaging [DTI] and diffusion spectrum imaging [DSI]), pseudoContinuous Arterial Spin Labeling (pCASL) for cerebral blood flow quantification, Point RESolved Spectroscopy (PRESS) for single-voxel magnetic resonance spectroscopy and spectroscopy images, and a MEGA-PRESS (MEshcher-GArwood PRESS, the authors who first developed the MEGA suppression scheme), spectroscopy sequence for GABA quantification. Any of these sequences can be acquired simultaneously with the PET imaging.

To accommodate task-based functional MRI scans, the PET/MRI suite is equipped with: a projector (Psychology Software Tools' Hyperion, Sharpburg, PA) connected to a PC for visual stimulation using E-Prime (Psychology Software Tools, Sharpburg, PA) and MATLAB (MathWorks, Natick, MA); two 5-button MRI-compatible response pads to accommodate each hand (Celeritas Fiberoptic Response System of PST); an audio stimulation device (Serene Sound from Resonance Technology) with external noise attenuating MRI-compatible headphones; and MRI-compatible corrective lenses.

MRI
A research-dedicated 3T MRI scanner housed in the SCAN Center.
In July 2015, the MR scanner in the SCAN Center was upgraded to a Siemens MAGNETOM Prisma scanner with 3T PowerPack technology. The 3T PowerPack combines a new, unmatched 3T magnet with 80 mT/m @ 200 T/m/s gradients, the most powerful gradient in clinical MR scanners. For comparison, the scanner specifically designed for the human CONNECTOME project is using a 100 mT/m gradient, and the maximum gradient is 45 mT/m in the Siemens Skyra system. This improvement in gradient has been shown to be advantageous in brain imaging, especially for diffusion and functional MRI. The latest parallel transmit technology in PRISMA, TimTX TrueShape, enables zooming into specific brain regions for enhanced imaging and spectroscopy quality.
The MRI scanner at the SCAN Center has the following techniques available for brain research: anatomical images, EPI for fMRI and resting-state fMRI, diffusion-weighted MRI (DTI, DSI), pseudoContinuous Arterial Spin

Labeling (pCASL) for cerebral blood flow quantification, PRESS for single-voxel spectroscopy and spectroscopy image, and an GABA spectroscopy sequence for GABA quantification. Other instruments associated with the SCAN Center include a projector (BrainLogics MR) connected to a PC for visual stimulation using the E-Prime and Experiment builder as the paradigm software, a response pad used to record the participant response during fMRI tasks, an audio stimulation device (SereneSound - Resonance Technology Inc.) with external noise attenuating MRI-compatible headphones, an MRI-compatible eye-tracking system, an MRI-compatible TMS coil for noninvasive transcranial magnetic stimulation of the brain, and BIOPAC physiological monitoring system for pulse, respiration, and galvanic skin response measurements.

microPET Scanner:

Stony Brook's small-animal PET imaging facilities include a trimodality PET/SPECT/CT (Siemens Inveon installed in 2013). The Inveon is a top-tier small-animal imaging platform located in a spacious lab in the main animal facility in the Health Sciences Center. All 3 modalities can be accessed in a sequential manner, without removing the animal from the bed, thus providing a high degree of image registration. The PET component features a large field of view (9.9 cm transaxial x 12.7 cm axial), high spatial resolution (1.5 mm FWHM), and high sensitivity (6.8% coincidence). The CT component provides anatomical information as well as attenuation correction for the PET. It also has fully developed data processing software with all necessary quantitative corrections and multiple image reconstruction options (FBP, OSEM, MAP) as well as gating functions. Animal handling equipment includes isoflurane anesthesia machine, rectal temperature probe with closed-loop heating pad, MouseOX physiological monitoring (real-time display and recording of arterial oxygenation, heart and respiratory rates from a single clip-on probe). For quantitative radioactivity measurements of radiotracers/blood/plasma, the lab includes a Biodex Atomlab 500 dose calibrator integrated with a calibrated well counter as well as standard equipment for handling blood samples.