



Department of Nuclear Medicine

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***micro*PET: Positron Emission Tomography Imaging for Small Animals**

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[Department of Nuclear Medicine](#) has a high resolution dedicated positron emission tomography scanner for studying small animal models of human diseases ([*micro*PET](#)). We welcome the researchers at UB and its affiliated institutes to use this state-of-the-art research tool in their research. Department would ensure delivery of radiotracers and provide necessary expertise and support for any collaborative research involving *micro*PET. Department operates a cyclotron, a radiochemistry laboratory, a radiopharmacy and a medical physics division. In addition to the routinely used short-lived tracers, like *F-18*, *C-11*, *N-13*, *O-15*, department has systems to synthesize long-lived positron emitter, *I-124*. This will enable to develop and characterize novel molecular imaging probes with longer biological half-lives. Please [contact us](#) or consult [the procedures](#) if you are interested in using *micro*PET in research.

***micro*PET APPLICATIONS**

*micro*PET offers the unique opportunity to image small animal models of diseases, including genetically engineered animals. It is a functional imaging modality at molecular level and provides valuable insights into biochemical, physiological, pathological or pharmacological process *in vivo*. Data can be obtained noninvasively, repeatedly, and quantitatively in the same animal. Current applications include a diverse field including perfusion, metabolism and substrate utilization in various vital organs including heart and brain, gene expression and stem cell tracking, neurotransmitter and receptors, neural activation and plasticity, targeting tumor antigens and elucidating tumor biology such as angiogenesis, hypoxia and apoptosis. Recent research efforts find its application in a wide area ranging from basic insights into the normal physiology and disease processes to drug development and early response to anticancer and gene therapy. Research can also be conducted in the field of imaging physics and scanner development, image and data analysis, attenuation correction and reconstruction techniques, and tracer kinetics and modeling. Several links to current *micro*PET research are available [here](#).

microPET SPECIFICATIONS



MICROPET FOCUS 120 ®

Manufacturer: Concorde Microsystems, Inc, Knoxville, TN

Year of installation: 2004

Location: Room 202 A, Lab Animal Facility, BEB , South Campus

Detector material: Lutetium oxyortho-silicate (LSO)

Number of detectors: 96

Axial field of view: 7.6 cm

Resolution at the center of FOV: <1.3 mm

Volumetric resolution at the center of FOV: 2.5 μ L

Timing resolution: 3 nsec

Peak NEC: 580 kcps

Data acquisition: List mode

Acquisition PC and OS: PC/win XP

Attenuation correction: yes

Bed motion: automated

ECG and respiratory gated acquisition: yes

Serial and multiple point imaging: yes

Reconstruction algorithm: FBP, OSEM, MAP

Data analysis and display options: static, dynamic, time-activity curve
kinetic modeling and many others

Open data format : yes

Data format supported by 3rd party analysis software: yes

Reference: Concorde Microsystems, Inc

A. Application procedure

Department of Nuclear Medicine ([website](#)), Institutional Animal Care and Use Committee (IACUC, [website](#)), Environmental health and Safety Services (EH&S, [website](#)) and Laboratory Animal Facilities (LAF, [website](#)) recommend the following application procedure for the use of *microPET* in any research project.

1. Submit a summary research proposal to the Department of Nuclear Medicine
 - a. Submit the proposal describing the background, objectives and methods (not exceeding 3 pages) to Dr. Hani Nabi hha@buffalo.edu, or Debbie Erb deberb@buffalo.edu
 - b. The proposal will be reviewed for scientific merit and feasibility for *microPET* imaging
2. After approval from Nuclear Medicine, apply to IACUC (animal use) and EH&S (radiation use and safety)
 - a. IACUC application forms are available at:
<http://wings.buffalo.edu/smb/iacuc/#IACUC/FORMS>
Submit completed application to **Darlene Campanella** (IACUC, 150 Parker Hall, South Campus).
 - b. Fill the RMA-29 form : “[Request to Use Radioactive Materials in Animals](#)” (form is available at <http://wings.buffalo.edu/services/fac/ehs/radsafety/forms/RMA-29.pdf>) and submit to EH&S (14 Parker Hall, South Campus).
 - c. **Dr. M Sajjad** of the department of Nuclear Medicine is currently the authorized person for the use of positron emitting isotopes. Please contact Dr. Sajjad (838-5889, msajjad@buffalo.edu) for his signature in the RMA-29 form.
 - d. Refer and follow the [dose schedule](#) in the application for commonly used positron emitting radiopharmaceuticals
 - e. For handling radioactive animals or attending *microPET* scans, researchers without radiation safety training must contact EH&S for training and authorization. For details on UB policies on the use of radioactive materials and radiation safety, visit <http://www.ehs.buffalo.edu>
3. Schedule use of the *microPET* scanner:
 - a. Contact Debbie Erb (838-5889 extn 139; derb@buffalo.edu) to book time.
 - b. Schedule Veterinary Technical Assistance. Call 829-2919 at least 1 week ahead of the scheduled date and ask to speak to a veterinary technician. Visit LAF website for additional information on services and fees, if applicable: <http://cm-laf.buffalo.edu/technical-services.asp>
 - c. Notify Lab Animal Facility Manager, David Niederbuhl (829-6826)
4. If animals are obtained from non-commercial sources or other research facilities,
 - a. Arrange to have animal health reports from source facility sent to:
Dr. Leslie Curtin, Clinical Veterinarian, BEB 116 CM-LAF, SUNY at Buffalo, 3435 Main St. Buffalo, NY, 14214-3013 or fax to 716-829-3249
 - b. Once Health reports are approved, arrangements for shipment will be made by Import/Export Manager, Kathy Thaler 716-829-2340

B. Dose schedule for *micro*PET imaging of rodents

The following dose schedule is based on the information currently available in the [literature](#) (July 2004) and is approved by the EH&S.

Investigators should follow and refer this dose schedule in IACUC and EH&S applications as follows: **as per standard operating procedure for *micro*PET imaging**.

Please note, this schedule is applicable to [static imaging](#) only. For [dynamic imaging](#), imaging with specialized technique such as [ECG gating](#), and imaging with other positron tracers not included in this document and for some other specific applications, dose schedule may vary. The protocol in such cases can be developed in consultation with the Department of Nuclear Medicine.

For further information, please contact: Debbie Erb (derb@buffalo.edu).

		Positron emitter				
		C-11	N-13	O-15	F-18	I-124
Pharmaceutical/ Compound (common indications)		Acetate (oxidative metabolism, tumor fatty acid synthesis) , Choline (tumor cell membrane synthesis), Raclopride (dopaminergic system), HED (sympathetic neurotransmission)	Ammonia (myocardial perfusion)	O ₂ ,H ₂ O, (cerebral perfusion)	FDG (glucose uptake), FLT (tumor proliferation), FMISO (tumor hypoxia), FHBG (reporter gene probe), annexin (apoptosis)	Antibody, other long acting compounds
Half life		20.3 min	9.97 min	122 sec	110 min	4.2 days
Route of administration		IV	IV	IV	IV	IV
<u>Dose</u>	mouse	150-300 μCi	300-500 μCi	Protocol specific	150-300 μCi	100-300 μCi
	Rat, Rabbit	300-500 μCi	500μCi-1 mCi		300-500 μCi	300-500 μCi
Static image acquisition		20 min postinjection	4-20 min postinjection	immediately	30-60 min postinjection	Protocol specific
Acquisition		Protocol specific				
Anesthesia		Isoflurane gas (1-3%)				
Euthanasia		As per IACUC guidelines				

Animal disposal	Storage, decay and disposal after at least 10 half-lives (as per EH&S guideline)
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1. **Static imaging** indicates single image acquisition for a predefined time period or until a predefined number of counts are obtained. In **dynamic imaging**, multiple sequential frames are acquired over a period of time. In **ECG gated acquisition**, one cardiac cycle is divided into multiple frames. Since each frame, in dynamic and gated acquisitions, is typically of shorter duration or acquires less counts compared to a static acquisition, higher doses may be required.
2. Because of the larger size and weight, higher dose is required for a rat compared to a mouse.

References: (for doses)

1. Oyama N. *Nucl Med Biol* 2002; 29:783-790. (Washington University, C-11 acetate)
2. Inubushi M. *Eur J Nucl Med Mol Imaging* 2004; 31:110-116 (UCLA, N-13 NH3)
3. Green LA. *J Nucl Med* 1998; 39:729-734 (UCLA, F-18 FDG)
4. Zingone A. *Life Sciences* 2002; 71:1293-1301 (NICHD, F-18 FDG)
5. Croteau E. *J Nucl Med* 2003; 44:1655-1666 (Sherbrooke, Gated PET, rat heart)
6. Zanzoko P. *Eur J Nucl Med* 2004; 31: 117-128 (Sloan Katterring, I-124)
7. Kornblum JI. *Nat Biotechnol.* 2000;18:655-660. (UCLA, rat brain, FDG)

C. Related UB Websites:

1. [Office of the Vice President for Research](#)
2. [Department of Nuclear Medicine](#)
3. [Institutional Animal Care and Use Committee \(IACUC\)](#)
4. [Environmental Health and Safety Services \(EH&S\)](#)
5. [Laboratory Animal Facilities \(LAF\)](#)

CONTACT PERSONS

Research, collaboration and supervision : Dr. Hani A Nabi (hha@buffalo.edu)
Imaging physics : Dr. Ruitao Yao (rutaoyao@buffalo.edu)
Radiochemistry : Dr. Munawwar Sajjad (msajjad@buffalo.edu),
microPET operation and scheduling : Debbie Erb (derb@buffalo.edu)
Health Physics and radiation safety : Egon Fast fast@buffalo.edu
microPET imaging : Michael Meal (mdmeal@buffalo.edu)

SMALL ANIMAL PET RESOURCES

WebLinks

1. UCLA Crump Institute for Molecular Imaging
<http://www.crump.ucla.edu/research/>

2. UCLA Crump MicroPET website
<http://www.crump.ucla.edu/user-files/resprojects/microPET>
3. National Cancer Institute: Small Animal Imaging Resource Program
http://www3.cancer.gov/bip/sairp_abs.htm
4. Department of Energy: Nuclear Imaging of Gene Expression (NIGE)
<http://vision.lbl.gov/Projects/NIGE/>
5. Academy of Molecular Imaging: Molecular Imaging Central
<http://www.mi-central.org/>
6. Molecular Imaging Program at Stanford University
<http://mips.stanford.edu/>
7. Concorde Microsystems
<http://www.cms-asic.com/>

Reviews

1. Phelps ME: Positron emission tomography provides molecular imaging of biological processes. *Proc Natl Acad Sci USA*. 2000;97:9226-9233 [[Full text](#)][[Pubmed](#)]
2. Myers R. The biological application of small animal PET imaging. *Nucl Med Biol*. 2001;28:585-593 [[Pubmed](#)]
3. Chatziioannou AF. Molecular imaging of small animals with dedicated PET tomographs. *Eur J Nucl Med*. 2002;29:98-114 [[Pubmed](#)]
4. Herschman HR. Molecular imaging: looking at problems, seeing solutions. *Science*. 2003;302: 605-608 [[Full text](#)][[Pubmed](#)]
5. Massoud TF, Gambhir SS. Molecular imaging in living subjects: seeing fundamental biological processes in a new light. *Genes Dev*. 2003;17:545-580. [[Full text](#)][[Pubmed](#)]
6. Gambhir SS, Herschman SR, Cherry SR, et al. Imaging transgene expression with radionuclide imaging technologies. *Neoplasia*. 2000;2:118-38. [[Pubmed](#)]
7. Gambhir SS. Molecular imaging of cancer with positron emission tomography. *Nat Rev Cancer*. 2002;2:683-693.[[Full text](#)] [[Pubmed](#)]
8. Eckelman WC. The use of PET and knockout mice in the drug discovery process. *Drug Discov Today*. 2003;8:404-410.[[Pubmed](#)]
9. Luker GD, Sharma V, Piwnica-Worms D. Visualizing protein-protein interactions in living animals. *Methods*. 2003;29:110-122. [[Pubmed](#)]
10. Eckelman WC. The use of gene-manipulated mice in the validation of receptor binding radiotracer. *Nucl Med Biol*. 2003;30:851-860.[[Pubmed](#)]
11. Hildebrandt IJ, Gambhir SS. Molecular imaging applications for immunology. *Clin Immunol*. 2004;111:210-224. [[Pubmed](#)]
12. Min JJ, Gambhir SS. Gene therapy progress and prospects: noninvasive imaging of gene therapy in living subjects. *Gene Ther*. 2004;11:115-125. [[Pubmed](#)]
13. Eckelman WC, Rice KC, Contoreggi C. New Tools to Monitor Stress Using Non-Invasive PET Imaging. *Ann N Y Acad Sci*. 2004;1018:487-494.[[Full text](#)] [[Pubmed](#)]