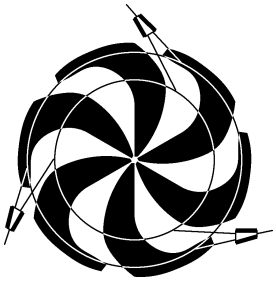
TRIUMF



ANNUAL REPORT
SCIENTIFIC ACTIVITIES
1998

CANADA'S NATIONAL MESON FACILITY
OPERATED AS A JOINT VENTURE BY:

MEMBERS:

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SIMON FRASER UNIVERSITY
UNIVERSITY OF VICTORIA
UNIVERSITY OF BRITISH COLUMBIA

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UNIVERSITÉ DE MONTRÉAL
UNIVERSITY OF TORONTO
UNIVERSITY OF REGINA
CARLETON UNIVERSITY
QUEEN'S UNIVERSITY

UNDER A CONTRIBUTION FROM THE
NATIONAL RESEARCH COUNCIL OF CANADA

APRIL 1999

The contributions on individual experiments in this report are outlines intended to demonstrate the extent of scientific activity at TRIUMF during the past year. The outlines are not publications and often contain preliminary results not intended, or not yet ready, for publication. Material from these reports should not be reproduced or quoted without permission from the authors.

LIFE SCIENCES RESEARCH

Introduction

The Life Sciences program exploits the powerful radioisotope production capabilities at TRIUMF. The four cyclotrons that provide proton beams with energy between 13 and 520 MeV having beam currents up to 500 μA makes TRIUMF the most versatile and powerful radioisotope producing facility in the world.

PET continued to be the major focus of the efforts in the Life Sciences program. The Medical Research Council of Canada awarded five major grants that make use of the PET technique as their primary research tool. Four of these projects are related to the Neurodegenerative Disorder Centre at UBC and the fifth was from the Department of Psychiatry also at UBC to study endogenous serotonin in patients diagnosed with mania.

We have developed tracers for many aspects of the dopaminergic system and the serotonin receptors labelled with ^{18}F and ^{11}C. Using these tracers we have begun a major study to follow the progression of Parkinson's disease by scanning patients who have early disease and their symptoms are asymmetric, and a group of subjects who have had the disease for an extended period. These same subjects will have repeat scans after a period of 4 years. One of the questions to answer is related to the changes in the unaffected side and how the measures change in relation to the affected side over the period between scans.

The following sections provide a brief description of the progress made during 1998 for the experiments approved by the Life Sciences Project Evaluation Committee (LSPEC).

Experiment LS0
PET facilities

(K.R. Buckley, TRIUMF)

The PET facilities comprise the TR13 13 MeV H^- cyclotron, the ECAT 953B/31 tomograph, and ancillary equipment such as counting and data acquisition systems.

TR13 cyclotron

The TR13 cyclotron continues to be the backbone of the PET program, conveniently and reliably supplying isotopes throughout the day for radiochemical synthesis. Usage of the cyclotron increased 57% (by delivered beam) this year over 1997, reflecting an increased demand for PET radiopharmaceuticals (LS3) and FDG (LS13, LS24), experimentation in precursor synthesis, and the irradiation of several lithium targets for the production of ^{7}Be nuclear physics targets.

Downtime this year was minimal and was again caused primarily by the cyropumping system and target window failures. A faulty component was found on the cryopump controller circuit board and replaced with the help of the TRIUMF Electronics group. Unusually warm weather this summer caused some difficulties with temperature interlocks but these subsided with a return to cooler weather.

The ion source filament was replaced once this year due to routine wear. In addition to this, the ion source was opened and cleaned twice following failure of the ^{18}F-F_2 target during the Ar/F_2 recovery run. It was found that F_2 contamination in the ion source severely affected performance. The fix is as simple as opening the ion source and cleaning the surfaces lightly with scotchbrite followed by acetone.

We performed several extraction foil changes, mostly as a result of target window failures.

Presently there are five target locations occupied of the available eight. These consist of

- one ^{18}O-O_2 gas target
- one ^{18}O water target
- two CH_4 gas targets
- one lithium metal target

The lithium target (LS8) has a reserved location and is installed and removed for each production. A mobile shield with remote manipulator, which has been constructed by the Lithium group, can be placed in the TR13 target shield opening to remove the target and place it in a lead pig. This assembly has been tested and is now used routinely for runs exceeding 2 hours at 50 μA.

The concrete blocks for shielding the ion source/injection line area of the cyclotron were installed in the spring and have reduced ambient fields around the cyclotron and simplified access to the ion source for servicing.

A talk was given at the Canadian chapter meeting of the International Isotope Society in Toronto on the in-target production of PET precursors. A talk and a poster were presented at the Workshop on Accelerator Operations in Vancouver.

ECAT tomograph

The ECAT has had a typical year with several detector block failures. An external laser for patient alignment was mounted on the front of the camera to aid the positioning of less flexible patients.

Statistics

Table XIII. TR13 run data.

Total runs conducted	837	
Total runs lost	7	
Integrated charge delivered	485300	μA-mins
delivered to – LS3	327995	
– LS4	3610	
– LS7	637	
– LS8	99606	
– LS13	41588	
– LS24	11864	

Table XIV. ECAT run data.

Total scans conducted	488
Total scans lost	41
lost to – patient	31
– cyclotron	7
– chemistry	2
– rabbit	1

Experiment LS2
Synthesis of radiohalogenated carbohydrates
(M.J. Adam, TRIUMF)

The use of 2-deoxy-2-[^{18}F]fluoro-D-glucose (FDG) to study glucose metabolism has seen extensive clinical applications especially in cardiology and oncology. Because of the growing importance of FDG/PET for clinical use, we have decided to study close analogs of FDG, 2,2-dihalo sugars, and see how they compare.

During this year we have synthesized 2-deoxy-2,2-[^{18}F]difluoro-glucose and have carried out biodistribution studies. Briefly, this compound behaves in a similar fashion in the brain to FDG (see Fig. 94).

The details of this work have been presented at the Society of Nuclear Medicine meeting in Toronto in June. Further studies on this compound and the synthesis of other dihalo sugars are currently under investigation.

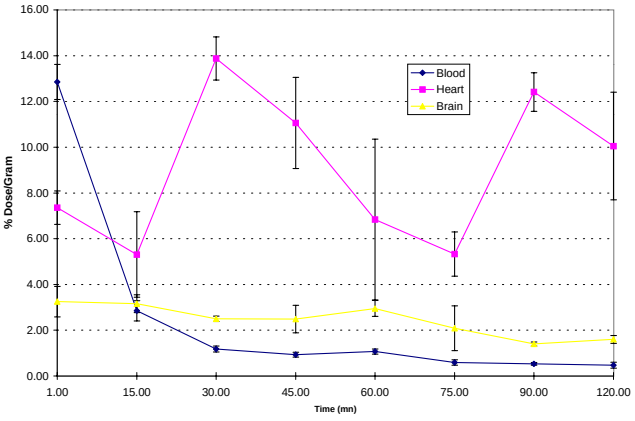

Fig. 94. Biodistribution of DFDG in mice.

Experiment LS3
PET radiopharmaceuticals
(M.J. Adam, TRIUMF)

PET radiopharmaceutical production deliveries continued to increase in 1998 to a total of 443 (see Fig. 95). There are a total of 7 radiopharmaceuticals used in the program: FDG, fluorodopa, raclopride, SCH23390, dihydrotetrabenazine, setoperone, and methylphenidate. In addition there were also 44 shipments of FDG to Vancouver and Lions Gate Hospitals and 54 shipments of N-13 sent to the Department of Botany in 1998. While most of the production runs are for use by the Neurodegenerative Disorders Program at UBC there is an increasing number (total of 44 FDG) of deliveries to other researchers such as Vancouver Hospital and Lions Gate Hospital.

One major project undertaken this year was to reduce the amount of precursor used in the C-11 preparations. This is important since the synthesis of precursors is very labour intensive and some of the component chemicals are difficult to obtain. This has been accomplished by the use of Al/KF as the base in some of the reactions and the development of methyl triflate to replace methyl iodide as the methylating agent.

A new PET radiopharmaceutical that is currently under development by the group is PK 11195, a peripheral benzodiazapine receptor drug that has shown promise as an anti-inflammatory drug. This new agent, when labelled with C-11, will be used as a possible imaging agent for arthritis and for the study of Parkinson's disease.

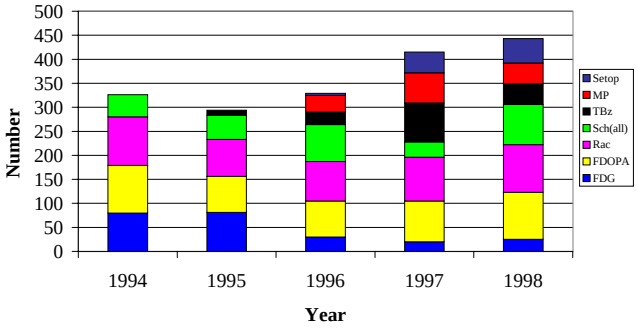

Fig. 95. PET radiopharmaceutical deliveries.

Experiment LS4
TR13 targets for PET radioisotope production
(T.J. Ruth, TRIUMF)

The development of targets for the production of the neutron deficient isotopes ^{18}F (T 1/2 = 109.8 min), ^{11}C (T 1/2 = 20.4 min), ^{13}N (T 1/2 = 10.0 min) and ^{15}O (T 1/2 = 2.05 min) on the TR13 has been a major task for the TRIUMF PET group during the last several years and is still in progress.

Thus far we have installed targets for the production of ^{18}F both as fluoride and fluorine (F_2) and ^{11}C targets producing CO_2 and ^{11}C-CH_4. In order to meet the clinical research demands of the UBC Movement Disorders Program we have continued to use the prototype targets. These designs have worked well but we have determined that there are a number of improvements that can be incorporated to improve performance. Efforts in the past year have centered at increasing the yield of the $^{11}CH_4$ target. The yields from this target are substantially lower than the identical target for producing CO_2. A number of experiments to determine the exact cause of this difference have been performed, including the determination of the quantity of ammonia formed in situ which could be a sink for the hydrogen in the target gas mixture. The ammonia production reaches equilibrium quickly and is not affected by alterations in beam current or length of bombardment. Further studies using a nickel plated target point towards the possibility that the hot atom products, namely CN, may be adhering to the walls of the target. Further studies are planned.

Both of the ^{18}F targets are performing well. We ran the water target for nearly 2 hours at 18 μA and maintained a production rate of 115 mCi/μA at saturation. The gas target using the double shoot method yields about 70 mCi/μA and a follow up irradiation results in another 28 mCi/μA at saturation.

Experiment LS8
Radiotracers for the physical and biosciences
(T.J. Ruth, TRIUMF)

This project provides radiotracers to a number of collaborators both on the UBC campus as well as elsewhere when the half-life is sufficiently long that it can be transported. The radioisotopes are used as probes for fundamental research in other disciplines in the physical and biological sciences. Listed below are brief reports on the progress of the active experiments.

The production of ^{7}Be is in collaboration with the Beryl group at TRIUMF as part of their effort to measure the cross section for the $^7\mathrm{Be}(p,\gamma)^8\mathrm{B}$ reaction to address anomalies in the international solar neutrino measurements. Irradiations have been performed up to the 50 μA required for full production and yields of 10 mCi have also been processed. Optimization of the separation chemistry is under way.

^{13}N tracers have been used extensively at UBC to study the kinetics of nitrogen incorporation by plants. This program attempts to integrate research at the ecophysiological level, through physiology to molecular biology. During 1997/98 we have compared the absorption rates for NO_3^- and NH_4^+ by rice. There is evidence that in the superficial paddy soil, aeration by O_2 transport from leaf tissues (produced by photosynthesis) may generate localized oxidative conditions leading to NO_3^- production. Thus, roots localized in this region of the soil may be able to acquire NO_3^- as effectively as NH_4^+. Our studies demonstrate that $^{13}NO_3^-$ uptake by these seminal roots is as large and even larger than rates of NH_4^+ uptake.

It appears that conifers from climax forests, as well as salal (a shrub species common to evergreen forests), prefer reduced N (NH_4^+, amino acids) to NO_3^-. Tissue N and N uptake rates may be $\sim$6 times greater for reduced N than nitrate. Clearcuts, fires and other disturbances result in a conversion of soil N from reduced to oxidized form so that replanting of climax species in this altered soil environment disadvantages these species, reducing replanting success. We have examined NO_3^-/NH_4^+ preferences of lodgepole pine, aspen and spruce in comparative experiments.

We have been examining the expression of the AMT1 gene which codes for the NH_4^+ transporter in Arabidopsis while undertaking correlated studies of NH_4^+ uptake by use of ^{13}N. It appears that the gene is only expressed when N supply is limited. At high available N a second transport system is adequate to deliver sufficient N. We have demonstrated by the use of parallel $^{13}NH_4^+$ flux studies and Northern analysis of AMT1 expression that the gene is regulated by glutamine accumulation and not by NH_4^+ itself. At the same time, it appears that accumulated NH_4^+ is capable of reducing the influx of $^{13}NH_4^+$ through the transporter.

Based on results from the nitrogen studies, the researchers in Dr. Glass' lab wish to explore the kinetics of K uptake in plants as a function of nitrogen concentration. In order to perform these experiments they will need access to ^{42}K.

One of the major uses of kinetic isotope effects (KIEs) is to help chemists model the transition states of organic reactions so they can understand how and why reactions occur. KIEs are the major tool used in these investigations because they give both qualitative and semi-quantitative information about the structure of the transition state. Dr. Westaway from Laurentian University wishes to measure KIEs for iodine. We are proposing using ^{120}I and ^{135}I as the isotopes of iodine that have half lives sufficiently long for this study.

Researchers at Children's Hospital are implementing a near infrared system for the monitoring of blood flow in infants. They are using immature pigs as the model for this development. They wish to calibrate their NIR system against blood flow as measured via PET with $H_2{}^{15}O$ as tracer.

Use of the $^{122}Xe/^{122}I$ system has as its major objective the development of brain and myocardial perfusion methods using PET. Such a generator system could

alleviate the need to have an on-site accelerator for the generic clinical PET centre. Miniature NaI targets suitable for irradiation on the TRIUMF BL2C solid target facility have been constructed and preliminary irradiations have been initiated to determine production and shipping parameters. Preliminary shipments of radioxenon have been supplied to the LBL group as part of LS14.

Experiment LS6/LS21
Accelerator mass spectrometry for trace element analysis in living organisms
(R.R. Johnson, UBC)

LS6, the experiment on the resorption and release of ^{41}Ca from a single subject, is in its seventh year. Over this time period the subject has gone through pre-, peri- and menopause.

In Expt. LS21, the uptake and release of Al is being monitored by using ^{26}Al as a tracer. The data are collected over several days and indicate that aluminum is retained in the plants. There appear to be several compartments in the release process.

A Wein filter has been constructed and installed at the Weizmann Institute where some of the AMS measurements are performed.

Experiment LS10
Aptamer imaging agents
(H. Dougan, TRIUMF)

Research is progressing with radiolabeled ^{123}I short DNA molecules (aptamers), in this example with an affinity for blood clot components. The goals are to master the use of DNA radiopharmaceuticals and obtain an imaging agent for thrombus. The aptamers function readily in simple test-tube experiments but encounter pitfalls in-vivo. This year's progress attempts to master the science required to extend activity to in-vivo conditions. (1) Aptamer interaction with clots is better understood, revealing aspects which were not anticipated: One class of aptamers binds thrombin in-vitro, but access is blocked by fibrin (the major protein in clots) in-vivo. A second class of aptamers binds thrombin in-vitro and in-vivo, but unexpectedly binds also to fibrin; this complicates the in-vivo behaviour. The latter aptamers are suited for in-vivo imaging studies. (2) Destruction of aptamers in-vivo has limited the availability of the aptamer to the clot, and has limited the lifetime of aptamer bound to the clot. I have been able to extend the lifetime of the aptamer in blood to several hours by modifying the aptamer with a small molecule. Attaching a larger molecule to the aptamer allows aptamer to be transferred from the site of injection to the thrombus with improved efficiency. Dr. Can Vo worked with the project nine months developing animal assays.

Experiment LS23/LS34
Radioisotope production targets
(R.R. Johnson, UBC)

These two projects aim to produce ^{94m}Tc and ^{103}Pd. These are two radioisotopes that may have research or clinical utility. Principally, the technetium isotope can be used in PET to derive quantitative kinetic information which may not be available from using the standard ^{99m}Tc and SPECT.

Experiment LS24
PET of breast cancer in a community hospital: a study of advanced disease using a coincidence gamma camera
(P.F. Cohen, Lions Gate Hospital)

Lions Gate Hospital is unique in having the only coincidence PET system in Canada at the moment, and one of the few sites doing clinical PET studies in oncology. This year at Lions Gate Hospital involved further characterization of our ADAC coincidence PET camera doing phantom studies. Clinical studies were begun, initially on a normal volunteer, and then followed by two patients with extensive bone metastatic breast cancer lesions previously detected on bone scan. There was a good agreement between the coincidence PET and Tc-99m MDP bone scans, but some lesions were seen on PET and not on bone scan, and vice-versa. It was felt that this might make a good initial clinical study, as the discordance between bone scan and PET scan has not been reported on very extensively. One of the clinical difficulties facing our site has been that the closest dedicated PET system capable of performing whole-body oncology studies for comparison is at the University of Washington Medical Center. It was thought that bone metastases at least could be verified in comparison with regular nuclear medicine bone scans.

Our clinical directions were changed, however, by growing awareness of our system by the Vancouver community, and growing use of our system by the Lions Gate Hospital oncologist. Two patients presented themselves to our department, one who had previously had a dedicated PET scan in Seattle, showing extensive breast cancer metastases, and another with recurrent lymphoma which could not be detected by the usual radiology modalities (CT, gallium scan, and chest x-ray). The patient with extensive breast cancer disease was confirmed on our coincidence system, with detection of most of the lesions seen at the University of Washington. The other patient with recurrent lymphoma showed multiple lesions on our system, and was sent to Seattle for confirmation (both scans are included in Fig. 96). At this point it was decided to do PET scans on patients with recurrent cancers referred by our

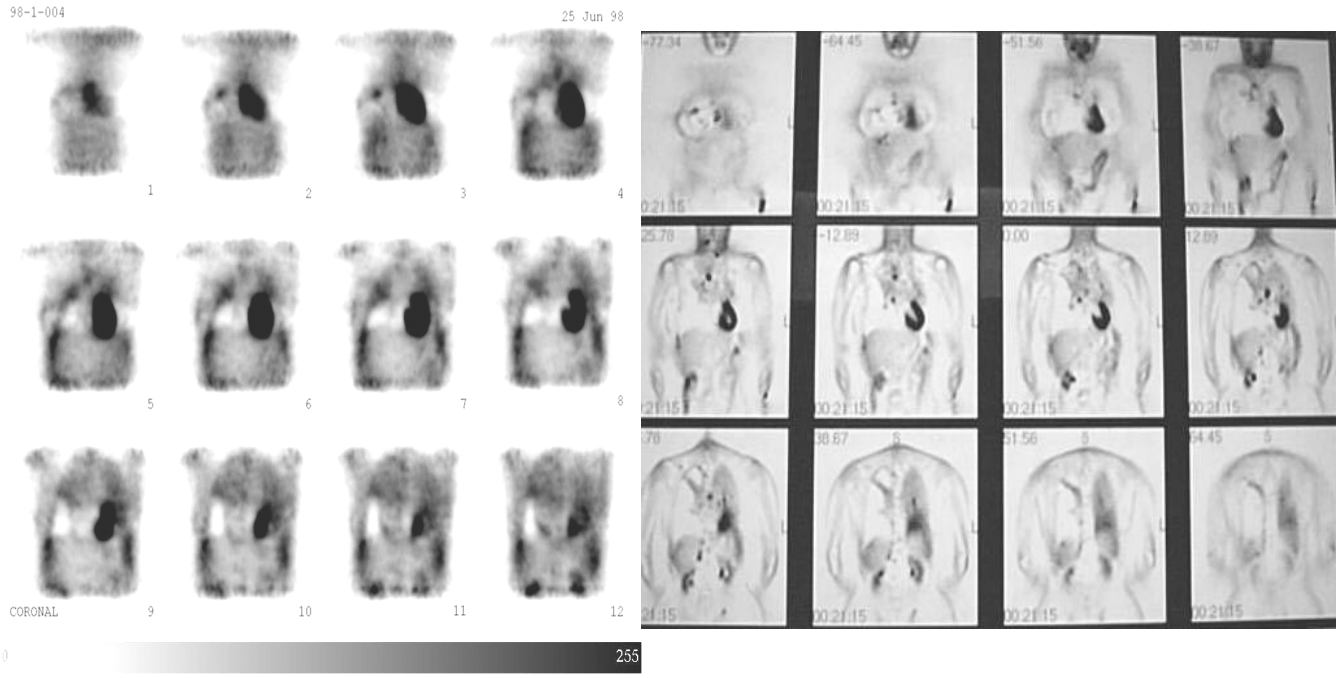

Fig. 96. Female age 41; metastatic breast cancer.

oncologist, with concentration on recurrent breast cancer and recurrent lymphomas. The rationale was that we were still attempting to do initial clinical studies with the ADAC coincidence camera, and rather than attempt to dictate to clinicians which patients should be referred for PET, we would have greater success in attempting to see if PET could answer clinical questions for our clinicians. At the same time we have been optimizing our parameters based on phantom studies for image acquisition times, methods of display, and reconstruction algorithms. It appears we are now producing images whose clinical appearance is starting to approximate images produced at other PET centres with dedicated PET systems. It appears likely there will be further improvements with the acquisition by our department of commercially available attenuation correction packages, as well as further random and scatter correction algorithms. We have now done a further five patients with breast cancers, showing lesions which were not apparent on other standard radiology tests.

Experiment LS25
3D PET in human neuroreceptor studies: quantification and reconstruction
(V. Sossi, UBC/TRIUMF)

We had previously developed the quantitative aspect of 3D PET (see 1997 Annual Report). In this last year we solved the last outstanding problem associated with 3D PET, the reduction of the time required to reconstruct a 3D data set. Up to now we have been using the 3D FBP algorithm developed by Kinahan and Rogers [IEEE Trans. Nucl. Sci. **36**, 964 (1989)], which requires approximately 20 minutes of processing time/frame. Since we have on-going studies, a new reconstruction method had to produce identical reconstructed images to 3D FBP. We have implemented and tested the Fourier rebinning method [Kinahan and Townsend, Proc. 1995 Int. Meeting on Fully 3D Image Reconstruction in Radiology and Nuclear Medicine, p.235] to reduce 3D sinograms to 2D ones, followed by several 2D reconstruction methods. We found that FORE followed by 2DFPB produced identical images (within approximately 1%) compared to 3DFBP and the reconstruction time decreased by approximately a factor of 10. Tests were performed on phantom and human data. This study was part of a thesis project of a M.Sc. physics student who thus completed his degree. The results were presented at the 1998 IEEE/MIC conference in Toronto and submitted for refereed publication to the IEEE Trans. Nucl. Sci. This project is thus completed.

Experiment LS26
A gaseous planar positron source for routine 3D PET normalization
(T.R. Oakes, TRIUMF)

A plane-source containing a β^+ emitting gas was constructed which approaches the theoretical lower limit for contribution of scattered photons. The scattering properties of a gas plane-source are defined by the housing thickness, which for a β^+ emitting medium is in turn defined by the maximum energy of the β^+; the housing must be thick enough to stop the most energetic β^+.

The location of a positron emission in a gaseous medium is partially decoupled from the site of the positron decay, which can reduce the effect of some non-uniformities while creating others. A plane-source containing a gaseous positron emitter can produce good uniformity over the width of the plane-source, except within 3 cm from the sides. Such a source is useful for normalization in 3D PET. By optimizing a gas plane-source so the housing is just thick enough to contain the most energetic positron for a given isotope, the lowest possible scatter fraction may be achieved. Our plane-source optimized for ^{18}F CH_3F yields a scatter fraction of 2.09%.

Experiment LS28
Evaluation of potentially viable myocardium with dobutamine myocardial SPECT imaging
(D. Worsley, VHHSC)

The purpose of this project is to evaluate whether combined perfusion and functional imaging with Tc-99m sestamibi (MIBI) augmented by low dose dobutamine is a useful technique for detecting viable myocardium.

In patients with chronic coronary artery disease, regional myocardial contraction dysfunction may be due to severe tissue hypoperfusion (hibernation), rather than infarcted myocardium. The differentiation between infarcted and hibernating myocardium can be clinically important. Patients with myocardium contraction dysfunction, secondary to infarction, have little recovery following successful revascularization. In contrast, patients with hibernating myocardium are likely to improve left ventricular function following revascularization. The development of a readily available, non-invasive technique that would permit an accurate pre-operative assessment of hibernating (viable) myocardium would clearly be beneficial.

Using FDG SPECT as the gold standard for defining viable myocardium, this study will compare the diagnostic accuracy of dobutamine augmented gated SPECT imaging and perfusion imaging with MIBI.

Currently we have performed and analyzed scans and dobutamine gated SPECT plus FDG SPECT in 45 patients. Another 15 patients have been imaged but the data have not been analyzed.

Of the 405 segments evaluated, perfusion/metabolism mismatch was present in 18.8% (77 of 405 segments). The sensitivity, specificity and accuracy of perfusion imaging and dobutamine augmented gated SPECT imaging are presented in Table XV.

Table XV. Change in perfusion without and with dobutamine SPECT as compared to FDG viability.

Change in perfusion	Sensitivity	Specificity	Accuracy
<80%	100%	50%	51%
<60%	46%	67%	59%
<40%	18%	88%	75%
⋮	⋮	⋮	

Experiment LS29
Production and distribution of FDG for clinical studies
(T.J. Ruth, TRIUMF)

Following the Workshop on the Distribution of FDG held at the LSPEC Review of 1996/97, discussions ensued as to how best to provide FDG to the local community for clinical utility. There is no mechanism established for the real-cost reimbursement. However, there continues to be interest in access to FDG, both for research purposes and for clinical applications. While the research uses for FDG can continue to be supplied under existing protocols, we will have to find out from the Canadian Health Protection Branch (HPB) what is required for approval before FDG can be used clinically by the local user community.

The aim of this proposal is to determine the level of involvement TRIUMF is willing to have in meeting the local needs for FDG prepared for clinical applications. The primary effort will consist of contacting HPB in Ottawa and determining the scope of work of a regulatory nature. In addition, based on the outcome of our discussions with HPB we will derive a cost estimate for establishing an independent (chemistry/delivery system different from existing PET group chemistry systems) supply of FDG.

Experiment LS30
Life Sciences five year plan
(T.J. Ruth, TRIUMF)

A Workshop was held at TRIUMF in September, 1997 to determine the possible research directions of the Life Sciences User community during TRIUMF's next five year funding period (2000–2005). While what was presented reflected ongoing research, much of this effort has a long term component associated with it

and from the presentations it was possible to create a program which would form the basis of the future research programs in the Life Sciences into the next century.

There are two large projects that will seek major funding from new initiatives from the Canadian Federal Government. One is for the construction of a radiochemistry laboratory in existing space in the Meson Hall Annex basement. This area would have hot labs, sterile labs and shipping facilities. Funding for this project was sought from a number of sources including the Canadian Foundation for Innovation (CFI), MDS Nordion and the Provincial Government. By the end of the year we had learned that our proposal to the CFI was not successful.

The second project is the establishment of a Network of Centres of Excellence (NCE) based on PET Methodologies. There is a movement within Canada for the establishment of such a Network. In response to this initial effort a Special Interest Group on Clinical PET has been established. Funding for this project would be through the Federal Government program on NCE.

The review of the TRIUMF five year plan took place in the fall. Preliminary feedback from the review is very positive for the Life Sciences Program.

Experiment LS33
Evaluation and improvement of a dual head coincidence camera
(V. Sossi, UBC/TRIUMF)

The ADAC molecular coincidence dual head camera had been installed at Lions Gate Hospital in North Vancouver in August/September, 1997. The physics aspect of the research performed during the first year was mostly focused toward establishing an optimum scanning protocol for oncology imaging. To accomplish this we have:

- Determined the basic characteristics of the camera, such as sensitivity and scatter fraction.
- Determined the count rate performance of the camera both following NEMA guidelines and in a clinically meaningful situation.
- Determined the optimum acquisition mode and optimum count rate range.
- Determined an empirical formula for an optimum radiotracer dose to be injected to the patient, which was verified with patient studies.
- Examined contrast evaluation as a function of count rate.
- Performed a NEMA-NU2 evaluation test in collaboration with ADAC at Milpitas, CA, USA.

Results of studies 1–4 were presented at the 1998 Society of Nuclear Medicine meeting [Sossi *et al.*, J. Nucl. Med. **39**, 5 (1998)]. Particular emphasis was placed on defining and using scanning conditions that would mimic real patient scanning, such as the use of an extended phantom and clinically realistic scanning times. As a consequence of the phantom studies an empirical formula for an optimum tracer dose to be injected to the patient was determined: 1.88 MBq/kg at time of scanning. Nine patients have been scanned to date using this formula and in each case the single event rate fell in the optimum count range as defined from the noise equivalent count rate (NECR) curve. Since maximizing the scan length was found to be crucial to image quality, patients are now scanned in two bed positions covering the area of interest, 37 min/bed position as opposed to the initially recommended 20 minutes. Data are acquired in list mode and p-p and p-C images are reconstructed separately. Images obtained from p-p data have to date proven to yield sharper contrast, confirming the results of phantom studies

Results from study 5 were presented at the 1998 IEEE/MIC meeting in Toronto. In a situation where random events are not subtracted prior to reconstruction, the measured radioactivity contrast will be altered compared to the contrast actually present in the object. Since the random event fraction is a function of single event count rate it is to be expected such alteration would be count rate dependent thus potentially leading to inaccurate and artificially varying estimates of contrast. Such an effect would invalidate therapy efficacy assessment investigations. We have examined the magnitude of this effect. Results showed that it is very important to maintain similar count rate conditions when a repeat scan needs to be compared to a baseline scan. Photopeak-photopeak (p-p) only was found to be the acquisition mode that yields higher contrast compared to the photopeak-photopeak + photopeak-Compton (p-C).

Measurements at Milpitas defined the image characteristics of the camera according to a preliminary version of the NEMA-NU2 standards. The purpose of the NEMA-NU2 standards is to define the camera properties in a clinically meaningful setting in terms of count rate, concentration and scan duration. The measurements themselves were a test of the feasibility of the NEMA-NU2 protocol and as a result minor modifications to the protocol were suggested.

Experiment LS35
^{18}F-nitroimidazole hypoxia agents
(M.J. Adam, TRIUMF)

Labelled nitroimidazoles have been used as markers for hypoxic tissue for some time. The compounds are retained in hypoxic tissue and serve as "hot spot" markers for tissue that is oxygen deficient but still viable. Knowing if a tumour is hypoxic is important to treatment since the tumours are more likely to survive radiation and chemotherapy.

Recently, a new agent, EF5, has received clinical trial approval in the U.S. We have begun a collaboration with this group (Cameron Koch's group at the University of Pennsylvania, Radiation Oncology) and with Kirsten Skov at the B.C. Cancer Research Centre to try to synthesize ^{18}F labelled EF5 and its analogs.