Final Report

U.S. Department of Energy University Reactor Sharing Program

Grant No. DE-FG02-95NE38121
(September 16, 1995 through May 31, 2002)

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TECHICAL REPORT

UNIVERSITY REACTOR SHARING PROGRAM

GRANT DE-FG02-95NE38121

(SEPTEMBER 16, 1995 THROUGH MAY 31, 2002)

Overview

During the past three decades, the Massachusetts Institute of Technology Nuclear Reactor Laboratory (MIT-NRL) along with other university research reactors (URRs) have benefited by programs initiated by the U. S. Department of Energy (U.S. DOE) that promote educational and research activities within the field of nuclear science and engineering. These programs have in the past supported and will in the future ensure that the U.S. retains its standing as the world's scientific and technological leader in fission and radiological research, development, and application. One of these programs is the Reactor Sharing Program. This program has made it possible for URRs to share their resources with individuals from other educational and private institutions that generally do not have access to the unique educational, scientific, and research opportunities offered by a nuclear research laboratory. Further, during the past few years, a certain percentage of the reactor sharing funds have also been made available to the faculty and students of the grantee university. These funds have supported many research projects that otherwise would not have been funded and therefore never pursued.

For the period September 16, 1995 through May 31, 2002, the MIT-NRL received \$349K under Grant DE-FG02-95NE38121. As a result of these funds, the MIT-NRL assisted countless research projects as well as promoted hundreds of educational endeavors. Because of the funds received through the U.S. DOE Reactor Sharing Program, the MIT-NRL was able to offer: beam time, neutron activation analysis, educational outreach programs to middle and high school teachers and students, laboratory experiments, hands-on reactor training, as well as lectures and tours for students and the general public. By the end of this grant period approximately 75 educational institutions visited the MIT Research Reactor for tours, demonstrations, and experiments on one to three occasions each and/or performed many irradiations. Approximately 3,000 students and 200 faculty and staff were involved in the combined programs. The research made possible by these DOE funds supports graduate level theses and resulted in scientific publications, principally in the areas of earth science and nuclear medicine. Activities supported at MIT under the DOE University Reactor Sharing Program are summarized in the MIT Reactor Sharing Program Reports that were submitted to the U.S. DOE on a yearly basis during this grant period. These reports are included in Appendix A to this report.

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Description of the MIT-NRL Reactor Sharing Program

Reactor Availability

All of the resources of the 5-MWt MIT Research Reactor were available to non-MIT users including the beam ports, neutron activation facilities and analysis equipment, the fission spectrum facilities, gamma irradiation facility, the neutron chopper experiment, and the irradiation thimbles. Except for occasional shutdowns for maintenance and equipment upgrades, the reactor operated seven days per week to support major experiments. Hence, there was ample opportunity for non-MIT personnel, even ones who must drive a considerable distance to reach MIT, to use the facilities.

In addition to making both equipment and reactor time available to non-MIT users, senior members of the reactor staff have been assigned specific responsibilities to assist non-MIT users. Mr. Edward S. Lau, who is the Reactor Superintendent for Operations is responsible for scheduling tours and for allocating reactor time for regular non-MIT users including those performing laboratory exercises at the MIT Research Reactor; Dr. Lin-Wen Hu, who is the Reactor Utilization Engineer, is responsible for assisting those who wish to perform major experiments; and Ms. Jainmei Che is responsible for conducting experiments conducted at the MIT NRL's neutron activation analysis facility.

The following is a description of the activities conducted at the MIT-NRL that were supported by this grant. These activities are divided into four subcategories:

1. Support for Research at Thesis or Post-Doctoral Level

This activity was the sole focus of the MIT Reactor Sharing Program when DOE support was first made available many years ago. It continues to be a major component of the overall program, and is the activity to which the major portion of the available funds are committed. Activities representative of those supported under this subprogram include:

- Preparation of Os-191 by neutron irradiation of enriched Os-190. This radionuclide was used to test new designs for the Os-191/IR-191m generator. Iridium-191m, an ultrashort-lived radionuclide, was used in clinical testing for the early detection of cardiac abnormalities in young adults who were long-term survivors of childhood Hodgkin's Disease. This study was conducted by Alan B. Packard, Ph.D., Children's Hospital, Boston, MA.
- Atmospheric particle samples were collected using cascade impactors and were analyzed for ionic species and carbonaceous species for the purpose of determining of the size and chemical composition distribution of

airborne fine particles and ultrafine particles. This study was conducted by Glen Cass, Ph.D., California Institute of Technology.

- Joint research project using NAA between Professor P. Karabinos (Williams College) and Professor J. C. Hepburn (Boston College) to determine the tectonic environments in which the Barnard Volcanics of eastern Vermont formed. Using the trace elements as powerful indicators of past processes, they were able to prove that an ancient volcanic arc formed some 480 million years ago and then collided with North America to generate the Taconic Orogeny. In addition, Professor J. C. Hepburn and Professor R. Hon have utilized the irradiation facilities at the MIT Research Reactor in connection with research projects that include:
 - Magmatic and tectonic evolution of Southeastern New England.
 - Acadian magmatism of the Northern Appalachians, and its tectonic significance.
 - Magmatism and its correlations in the Circum-Atlantic Paleozoic Orogens;
 - Geochronology of Precambrian and Paleozoic igneous suites of Eastern Massachusetts;
 - Enthalpy constraints on the formation of magmas within the continental crusts;
 - Crustal thermal properties and their bearing on geothermal gradients;
 - Radon bulk rock and soil emanations;
 - Origin of Igneous rocks as a guide to Terrane analysis in southeastern New England;
 - Geochemistry of Meta-igneous rocks in New England;
 - Geochemistry of Paleozoic and Late Precambrian igneous rocks in Northwestern Iberia, Spain.
- ^{64}Cu was prepared by neutron irradiation of natural-abundance copper metal as a means to evaluate new copper complexes for testing as possible PET imaging agents for multidrug resistance. This study was conducted by Alan B. Packard, Ph.D., Children's Hospital, Boston, MA.

- Neutron activation analysis of GaN, fly ash, tin and aluminum to investigate some new possibilities of improving the response characteristics of scintillation detectors of electrons which are to be used in experiments devoted to the study of free neutron decay process was provided to Professor Boris Yerozolinski of Harvard University, Cambridge, MA.
- Studies of the chemical composition of deep seawater by Professor Alan Fler, Woods Hole Oceanographic Institute, Woods Hole, MA.
- Neutron activation analysis of trace elements in subsurface water supplies for Professor Jack Beal, Fairfield University, Fairfield, CT.
- Research on boron neutron capture therapy by the Beth Israel/Deaconess Medical Center, Boston, MA.
- Irradiation of coal ash samples for research being conducted by Professor JoAnne Lighty of University of Utah
- Irradiation of NaOH that was used for a contamination and control exercise by Professor Clayton French of UMass-Lowell.
- Use of neutron activation analysis for Bromine measurements was provided to Professor Joseph Kehayias (Tufts) and Senior Research Scientist Richard Lanza (MIT NED) to evaluate intra/extra-cellular water as an indicator of overall human health.
- Irradiation of scandium particles for Professor Muthanna Al-Dahhan, Washington University.
- NAA analysis of autism and control brain tissue for Dr. Margaret Lang Bauman, Massachusetts General Hospital

Funds provided for these activities enabled the research needed for 18 theses and thirty scientific papers during the past year. A list of theses and publications is shown in Appendix B.

2. Support for College-Level Laboratory Exercises

College students at both the undergraduate and graduate level should have the opportunity to perform experiments with state-of-the-art equipment. Many students learn by doing and, without proper laboratory experiences, many have difficulty making sense of otherwise abstract academic concepts. Decreases in such opportunities are currently recognized by many leading educators, including those at MIT, as a growing deficiency in the American educational system. Accordingly, we are pleased that several area universities have used and continue to use the MIT Research Reactor for laboratory exercises. Professor Martin

Posner, University of Massachusetts – Boston, utilizes the reactor facilities for reactor operation exercises and for student experiments, such as experiments with the beam chopper. The MIT Research Reactor's time-of-flight/Bragg diffraction experiment is quite popular. In addition, because of the decision by DOE to allow a portion of the University Reactor Sharing Program funds to be used by MIT faculty and students, the MIT Junior Physics Laboratory now takes advantage of these funds in order to study neutron detectors as well as to conduct laboratory exercises.

Table One lists the topics offered at the MIT Research Reactor for laboratory exercises.

3. Support for Reactor Tours/Lectures on Nuclear Energy

Over 2,000 people toured the MIT Research Reactor during this reporting period. Each tour group of five or more was given an introductory lecture on nuclear energy and radiation. These tours include high school and college student as well as individuals from the general public. As in past years, this continued to be our most popular activity in terms of the number of participants. MIT feels that much of the public uneasiness about the use of nuclear energy for the generation of electricity is the result of the public's not being allowed access to nuclear power plants, and tours of research reactors are currently the only means by which the general public can actually see a nuclear reactor in the United States.

4. Support for Science Fair Participants

Federal regulations on radiation exposure make it impractical for high school students to participate in laboratory exercises at any research reactor. However, we can and do provide external support to high school students. For example, we receive a number of requests each year for irradiated seeds for studies on the effect of gamma rays on plant germination. The reactor has also assisted middle and high school students with their science fair projects. Some of these include: neutron activation analysis of sediment along the Mystic River; irradiation of topaz; and the irradiation of strawberries.

Table One

**Available Topics and Experiments at the MIT Research Reactor
for Reactor Sharing Program Activities**

<u>Topic No.</u>	<u>Title</u>
1.1	Radiation Protection Lecture
1.2	Introduction to the MIT Reactor
1.3	MIT Reactor Fuel & Fuel Utilization
1.4	Reactivity Control System
1.5	MITR Cooling Systems
1.6	MITR Nuclear Safety Systems
1.7	MITR Non-Nuclear Systems
1.8	MITR Containment & Effluent Monitors
2.1	Neutron Detection & Measurement
2.2	Foil Measurement of Neutron Energy Spectrum
2.3	Chopper Measurement of Neutron Energy Spectrum
2.4	Types of Radiation in Reactors
2.5	Health Physics Measurements in Reactors
2.6	Radiation Effect on Plant Growth
2.7	Industrial Pollutant Dispersion Analysis
3.1	Reactor Startup
3.2	Reactor Operation by Students
3.3	Control Rod Calibration
3.4	Temperature Coefficient Measurement
3.5	Xenon Transient
3.6	Reactivity Measurements
4.1	Chopper Measurement of Neutron Cross Sections
4.2	Crystal Diffraction of Neutrons
4.3	DeBroglie Wavelength Study
4.4	Determination of Half-Lives
4.5	Neutron Activation Analysis
4.6	Neutron Radiography
4.7	Particle Detection by Track Etch Method
4.8	Radiochemistry

USER BASE

The potential user base for the MIT Reactor Sharing Program consists of the educational institutions in the Eastern Massachusetts area as well as some in the neighboring New England States and several from other sections of the country. Table Two lists 70 institutions, several with multiple departments, that have used the MIT Research Reactor during the 29 years (1972-2001) that MIT has participated in this DOE program. (Not included in this list are institutions that only requested reactor tours.) In addition to the colleges and hospitals listed in Table Two, MIT annually receives requests for school-sponsored tours of the reactor from about 25 high schools.

The MIT Reactor Sharing Program has now grown to the point where many prospective users are referred to us by their colleagues. However, we do not rely solely on such referrals to publicize the program. Specifically, we periodically make other institutions aware of the program through either telephone contact or half-day visits in which we explain the resources that are available at the MIT Research Reactor. Once a potential user is identified, he or she is assigned to one of the three individuals responsible for providing assistance. These are the Superintendent for Operations, the Reactor Utilization Engineer, and the Activation Analyst. It is their job to make the reactor facility 'user-friendly.' Two modes of interaction are typical:

- a) If the user possesses his or her own equipment (e.g., HPGe detectors) and an NRC byproduct material license, their use of the reactor will largely entail the production of activated samples. The MITR Staff does a standard safety analysis of the proposed specimens, irradiates them, and ships them in Dept. of Transportation approved containers.
- b) Users who lack their own equipment, or who wish to do laboratory exercises, are first given a standard indoctrination on radiation and industrial safety. They are then issued the necessary radiation-dosimetry devices and, following a safety analysis of any proposed experiment, allowed to use the reactor facility.

Table Two

Colleges/Hospitals Participating in 1971-1998
U.S. DOE/MIT Reactor Sharing Program

Appalachian State University	Exposure Assessment and Engineering Program
Bates College	Harvard-Smithsonian Center for Astrophysics
Department of Physics and Astronomy	Harvard University
Department of Geology	- Department of Chemistry
Beth Israel-Deaconess Medical Center	- Department of Physics
Boston College	- Division of Applied Sciences
Department of Geology and Geophysics	- Art Museums
Boston University	Massachusetts General Hospital
- Department of Physics	Neuromuscular Research Center
Boston University School of Medicine	Department of Neurology
Bowdoin College	Physics Research Laboratory
- Physics Department	Pulmonary and Critical Care Unit
Brandeis University	Middlebury College
Brigham & Women's Hospital	Middlesex Community College
Bunker Hill Community College	New England Deaconess Hospital
California Institute of Technology	Joint Center for Radiation Therapy
Children's Hospital Med. Center - Boston	Northeastern University
- Division of Nuclear Medicine	Department of Chemistry
Clark University	Department of Earth Sciences
Cornell University	Department of Geology
Dartmouth College	Mechanical Engineering Department
- Department of Physics and Astronomy	Department of Physics
Fairfield University	Northwestern University
Forsyth Dental Center	Department of Materials Science and Engineering
Bioengineering Department	Oregon State University
Franklin Institute of Boston	Pennsylvania State University
Georgetown University Hospital	Purdue University
Gordon College	Rensselaer Polytechnic Institute
Hampden-Sydney College	Royal Institute of Technology
Department of Physics	State University of Rutgers
Hampshire College	Saint Mary's University (Halifax, NS)
Department of Geology	Geology Department
Harvard Medical School	Salem State College
Department of Radiology	
Harvard School of Public Health	
Department of Environmental Health	

Table Two

Colleges/Hospitals Participating in 1971-1998
U.S. DOE/MIT Reactor Sharing Program
(Continued)

Geosciences Department	Fitchburg Family Practice Residency Program
Sloan-Kettering Institute	University of Michigan School of Public Health
Stanford University	Department of Environmental and Industrial Health
State University of New York at Albany	University of Pittsburg
State University of New York at Buffalo	University of Utah
Department of Geology	- Center for Excellence in Nuclear Technology, Engineering, and Research
Syracuse University (Syracuse, NY)	University of Washington
Department of Geology	University of Western Kentucky
Taste and Smell Clinic (Washington, DC)	University of Wisconsin
Tufts University	Department of Chemistry
Department of Archaeology	Washington State University
Department of Chemistry	Wheaton College (Wheaton, IL)
School of Medicine and New England Medical Center Hospitals	Washington University School of Medicine (St. Louis, MO)
Department of Radiation Oncology	Wayne State University School of Medicine
University of Connecticut	Wellesley College
University of Leeds	Department of Biological Sciences
University of Lowell	Wentworth Institute of Technology
University of Maryland	Electrical/Electronics Department
Chemistry Department	Williams College
University of Massachusetts-Amherst	Woods Hole Oceanographic Institute
Department of Physics and Astronomy	- Chemistry Department
University of Massachusetts-Boston	Worcester Polytechnic Institute
Biology Department	Mechanical Engineering Department
Civil Engineering Department	Yale University School of Medicine
Chemistry Department	
Environmental Sciences Program	
Physics Department	
UMass. Medical Center	

Notes: (1) Additional institutions have benefited from research at the MITR by virtue of collaboration activities with faculty and staff of some of the above institutions.

(2) Not listed are facilities that only requested tours of the reactor.

Report No. DOE/ER/10770-17
(MITNRL-066)

REACTOR SHARING PROGRAM REPORT
(September 1, 1995 - August 31, 1996)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts
02139

Program Directors: John A. Bernard, Director

Telephone No.: 617/253-4201
617/253-4202

Grant Number: DE-FG02-95NE38121.M007

Reactor Type: Tank
Light water moderator
Heavy water reflector

I. Reactor Sharing Activities

Power Level: 5 MW

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support (\$)</u>
1.	Andover HS Andover, MA	Mr. E. Johnson	42/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	830.00
2.	Baker High School Brookline, MA	Mr. Paul Masi	51/4	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	650.00
3.	Belchertown HS Belchertown, MA	Mr. Skorupski	3/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	200.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support (\$)</u>
4.	Boston College Chestnut Hill, MA	Prof. J. C. Hepburn and Prof. R. Hon Geology and Geophysics Dept.	6/2	Rock powder and iron wire neutron activation analysis for geological materials 162 specimens in eighteen irradiation series) in studies of the geologic development of the Northeastern United States. All irradiations done as student thesis research. (GS/F)	12,800.00
5.	Boston Safety & Health Council Boston, MA	—	14/0	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	440.00
6.	Boy Scouts of America	P. Czachorowski	15/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	616.00
7.	Brandeis University	Prof. Lowenstein	1/1	Neutron activation analysis of binding of zinc in protein. (GS/F)	4,000.00
8.	Brookhaven Nat'l Laboratory	Dr. Walter Kato	0/2	Tour/demonstration of reactor safety features for international program.	730.00
9.	Brookline High School Brookline, MA	a) Mr. Kelly Loughman	15/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	560.00
10.	California Technical Institute	Prof. G. Cass	1/1	Neutron activation analysis studies of trace elements in aerosols. (GS/F)	8,000.00
11.	Children's Hospital Boston, MA	Dr. Alan Packard	0/1	Irradiation of copper powder (four series). (F)	1,303.00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support (\$)</u>
12. Fairfield College Fairfield, CT	Prof. J. Beal Dept. of Physics	a) 2/1	Neutron activation of subsurface water supply specimens for trace element analysis. (GS/F)	N/A
		b) 2/1	Neutron activation analysis of water samples. (GS/F)	N/A
13. Governor Dummer Academy, Ipswich	Mr. Jorge Flores		Tour, overview of BNCT.	183.00
14. Greater Boston Youth Program Boston, MA	Ms. Laura Lattanzi	40/2	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	1,070.00
15. Harvard University Cambridge, MA	Prof. Spengler School of Public Health	1/1	Neutron activation analysis to evaluate air quality. (GS/F)	N/A
16. Harvard University Cambridge, MA	Dr. Huffman	3/1	Tour, overview of neutron beam facilities.	553.00
17. Health Physics Society	Mr. Gary Troyer	26/3	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	484.00
	Ms. Rowe Theriaque	18/2	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	680.00
18. Long Fellow HS Cambridge, MA		4/0	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	183.00
19. Los Alamos National Laboratory	Dr. R. Little	2/2	Tour, discussion of BNCT.	380.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support (\$)</u>
20.	Lowell University Lowell, MA	Dr. Ryan Dept. of Chemistry	2/1	Neutron activation analysis studies of sediments and sewage sludge. (GS/F)	N/A
21.	Massachusetts College of Pharmacy, Boston, MA	Dr. P. Cobb	8/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	N/A
22.	Massachusetts Maritime Academy			Neutron activation analysis of plastics. (GS/F)	4,000.00
23.	NIST		3/1	Tour, overview of BNCT.	310.00
24.	National Tech Univ. Athens, Greece	Dr. Kostopoulos	33/1	Tour, overview of BNCT.	760.00
25.	New England Deaconess Hospital Boston, MA	Dr. E. Fischer	1/1	Tour, overview of BNCT.	190.00
26.	Northeastern University Boston, MA	Dr. W. Reiff Dept. of Chemistry	1/1	Neutron Activation of samples for prompt gamma spectroscopy. (GS/F)	N/A
27.	RPI	Dr. David Geirga	2/1	Tour, overview of BNCT.	183.00
28.	SUNY, New York	—	2/0	Tour, overview of BNCT.	250.00
29.	Thayer Academy Braintree, MA	Ms. Khalili	14/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	500.00
30.	Tohonen University	Dr. Watanabe	2/1	Tour, overview of BNCT.	183.00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support (\$)</u>
31. Tsinghua University China	Dr. Dang Duo	4/1	Tour, overview of BNCT.	1,205.00
32. University of Birmingham	Dr. M. Cawley	2/1	Tour, overview of BNCT.	183.00
33. Univ. of Mass. Boston, MA	Dr. M. Posner Dept. of Physics	a) 6/1	Lecture and neutron detector demonstration. Time of flight experiment. (GS/F)	N/A
		b) 6/1	Neutron activation analysis demonstration. (GS/F)	N/A
		c) 6/1	Neutron detection. (GS/F)	N/A
34. University of Tokyo	Prof. K. Nomura	3/1	Tour, overview of BNCT.	200.00
35. University of Utah	David Slaughter	1/1	Irradiation of gold foils (two sets).	1,004.00
36. University of Western Kentucky	—	1/1	Gamma-ray spectroscopy.	400.00
37. Watertown High School Watertown, MA	Mr. T. Wittenhagen	21/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	570.00
38. Weston High School	Ms. Selinga	1/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	183.00
39. High School Group	Misc.	14/0	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	435.00

Total Reactor Usage Charges
Salaries and benefits

\$44,218.00
\$33,095.89

<u>Participating Institution</u>	<u>Principal Investigator.</u>	<u>Number of Student / Faculty</u>	<u>Description of Project / Program</u>	<u>Reactor Sharing Support_(\$)</u>
			<u>Total expended</u>	<u>\$77,313.89</u>
<u>N o t e :</u>				
Total number of students participating:		379		
Total number of faculty/teachers participating:		47		

Report No. DOE/ER/10770-18
(MITNRL-069)

REACTOR SHARING PROGRAM REPORT
(September 1, 1996 - August 31, 1997)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4201
617/253-4202

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

I. Reactor Sharing Activities

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
1	Acton-Boxboro High School Acton, MA	Ms.Kristoff	80/2	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	1,402.00
2.	Bigelow Middle School Bigelow, MA	Mr. Simonovic	2/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	183.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
3.	Boston College Chestnut Hill, MA	Prof. J. C. Hepburn and Prof. R. Hon Geology and Geophysics Dept.	6/2	Rock powder and iron wire neutron activation analysis for geological materials 27 specimens in eighteen irradiation series) in studies of the geologic development of the Northeastern United States. All irradiations done as student thesis research. (GS/F)	3,740.00
4	Boston Latin School Boston, MA	Ms. A. Montes	9/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	310.00
5.	Brandeis University	Prof. Lowenstein	1/1	Neutron activation analysis of binding of zinc in protein. (GS/F)	N/A
6.	Bronx HS of Science NY	Ms. R. Cohen	47/2	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	589.00
7.	Brookline High School Brookline, MA	a) Mr. Lantos	a) 23/1 b) 47/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	408.00 588.00
9.	Children's Hospital Boston, MA	Dr. Alan Packard	0/1	Irradiation of copper powder (eleven series). (F)	4,517.00
10.	Colby College Waterville, ME	Prof. C. Conover	13/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	254.00
11	Dover-Sherborn High School Dover, MA	Ms. C. Conway	14/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	375.00
12.	Fairfield College Fairfield, CT	Prof. J. Beal Dept. of Physics	a) 2/1 b) 2/1	Neutron activation of subsurface water supply specimens for trace element analysis. (GS/F) Neutron activation analysis of water samples. (GS/F)	N/A N/A

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
13	Foxboro High School Foxbory, MA	Mr. Marcussen	12/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	255.00
14	Framingham High School Framingham, MA	Ms. S. Lee	93/3	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	2,256.00
15	Harvard University Cambridge, MA	Prof. Spengler School of Public Health	1/1	Neutron activation analysis to evaluate air quality. (GS/F)	N/A
16	Israel-Olympeyda Science Program	M. Rosenblum	12/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	316.00
17	Korean-American Math Club	Ms. R. Lee	1/11	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	262.00
18	Lowell University Lowell, MA	Dr. Ryan Dept. of Chemistry	2/1	Neutron activation analysis studies of Hg in sediments (GS/F)	500.00
19	Massachusetts College of Pharmacy, Boston, MA	Dr. P. Cobb	8/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor (PCS)	N/A
20	Massachusetts State Science Fair Cambridge, MA		5/0	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	125.00
21	Matignon High School Cambridge, MA	Mr. R. Bombari	16/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	377.00
22	Matignon High School Cambridge, MA	Mr. L. Larres	1/1	Seed irradiations for science fair project (PES)	740.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
23.	Medford High School Medford, MA	Mr. J. Costrada	6/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	430.00
24.	National Conf. of Black Physics Students	Mr. G. Teklemariam	18/1	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	378.00
25.	Northeastern University Boston, MA	Dr. W. Reiff Dept. of Chemistry	1/1	Neutron Activation of samples for prompt gamma spectroscopy. (GS/F)	N/A
26.	Science Skills Center High School	Ms. B. Bamidee	23/3	Lecture on nuclear energy and tour of MIT Research Reactor (PCS)	446.00
27.	Thayer Academy Braintree, MA	Ms. Kari	14/1	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	449.00
28.	Tufts University Medford, MA	Prof. Durand	1/1	Neutron activation analysis of sediments (GS/F)	1,800.00
29.	Univ. of California at Berkely	—	1/0	Neutron activation analysis of sediments (GS/F)	61.00
30.	Univ. of Mass. Boston, MA	Dr. M. Posner Dept. of Physics	a) 5/1 b) 5/1 c) 5/1	Lecture and neutron detector demonstration. Time of flight experiment on three occasions (GS/F) Neutron activation analysis demonstration. (GS/F) Neutron detection. (GS/F)	2,593.00
31.	University of Miami	Prof. J. Presporo	1/11	Neutron activation analysis of sediments	1,600.00
32.	Watertown High School Watertown, MA	Mr. T. Wittenhagen	28/2	Lecture on nuclear energy and tour of MIT Nuclear Reactor. (PCS)	390.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
33.	Wellesley High School Wellesley, MA	Ms. M. Tufau	11/2	Lecture on nuclear energy and tour of MIT Nuclear Reactor (PCS)	495.00
34.	Woods Hole Oceanographic Inst. Woods Hole, MA	Prof. A. Fler	3/1	Tour of MIT Nuclear Reactor	343.97

Total Reactor Usage Charges

26,182.97

Salaries and benefits

19,581.57

Total expended

45,764.54

Note:

Total number of students participating: 543

Total number of faculty/teachers participating: 56

REACTOR SHARING PROGRAM REPORT
(September 1, 1997 - August 31, 1998)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4202
617/258-8323

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

I. Reactor Sharing Activities

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
1.	Boston College Chestnut Hill, MA	Professor Rudolph Hon	1/1	Rock powder neutron activation analysis to study the geologic development of the Northeastern United States as part of student thesis research.	1,747.50
2.	Boston University Summer Youth Program Boston, MA	Susan Carlson	48/11	Lecture on nuclear energy and tour of MIT Research Reactor	770.00
3.	Boy Scouts of America Billerica, MA	Kenneth Steeves	7/1	Lecture on nuclear energy and tour of MIT Research Reactor	130.00
4.	Brandeis University Waltham, MA	Professor Abeles	1/1	Neutron activation analysis of binding of zinc in protein	500.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
5.	Brookline High School Brookline, MA	Stephen Lantos	64/4	Lecture on nuclear energy and tour of MIT Research Reactor	1040.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
6.	California Technical Institute Pasadena, CA	Professor Glen Cass	4/4	Neutron activation analysis of upper atmospheric aerosols	9,000.00
7.	Children's Hospital Boston, MA	Dr. Alan B. Packard	2/2	Irradiation of copper powder for biodistribution measurement for PET evaluation of multi-drug resistance in humans.	845.00
8.	Educational Talent Search Boston, MA	Kate Glendinning	20/1	Lecture on nuclear energy and tour of MIT Research Reactor	590.00
9.	Franklin Park Zoo Boston, MA	Camille E. Witt	4/1	Lecture on nuclear energy and tour of MIT Research Reactor	125.00
10.	General Public		66/7	Lecture on nuclear energy and tour of MIT Research Reactor	1352.00
11.	Georgetown High School Georgetown, MA		3/0	Lecture on nuclear energy and tour of MIT Research Reactor	130.00
12.	GPU Nuclear	D. W. Ethridge	1/8	Lecture on nuclear energy and tour of MIT Research Reactor	375.00
13.	Harvard University Cambridge, MA	Professor Wilson	1/1	Tin irradiation for archaeological studies	1,000.00
14.	Harvard University Cambridge, MA	Professor Yerozolimsky	2/2	Irradiation of samples for Si-based semiconductor hardening research Positron detection studies	1,500.00
15.	Hollis-Brookline High School Brookline, NH		53/2	Lecture on nuclear energy and tour of MIT Research Reactor	775.00
16.	Israel Science Program - Boston Chapter Boston, MA	Chaplin Miriam Rosenblum	29/1	Lecture on nuclear energy and tour of MIT Research Reactor	330.00
17.	Local High School Students		11/0	Lecture on nuclear energy and tour of MIT Research Reactor	135.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
18.	Lynn High School Lynn, MA		12/2	Lecture on nuclear energy and tour of MIT Research Reactor	254.00
19.	Massachusetts College of Pharmacy Boston, MA	Dr. K. Taylor	10/1	Lecture on nuclear energy and tour of MIT Research Reactor	375.00
20.	Massachusetts General Hospital Boston, MA	Visiting Scientists	0/5	Lecture on nuclear energy and tour of MIT Research Reactor	255.00
21.	Plymouth High School Plymouth, MA	Lauren Gasbarro	3/1	Seed irradiation for science project: 3 lots of 40 green bean seeds 7 lots of 20 lima bean seeds Seed irradiation: 6 lots/sugar snap pea seeds radish seeds	2,840.00
22.	Reactor personnel, family		0/8	Lecture on nuclear energy and tour of MIT Research Reactor	130.00
23.	Reading University NH	Dr. A. Matheson	0/2	Lecture on nuclear energy and tour of MIT Research Reactor	250.00
24.	Sanford High School Sanford, ME	Stuart Weston	9/1	Lecture on nuclear energy and tour of MIT Research Reactor	190.00
25.	Somerville High School Somerville, MA		3/0	Lecture on nuclear energy and tour of MIT Research Reactor	65.00
26.	Spaulding High School Rochester, NH	L. Harrington	18/1	Lecture on nuclear energy and tour of MIT Research Reactor	320.00
27.	Thames River Tech CT	Adam Streckzuk	15/1	Lecture on nuclear energy and tour of MIT Research Reactor	260.00
28.	Thayer Academy Braintree, MA	Ms. Fari Khalili	25/1	Tour of MIT Research Reactor	390.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
29.	Tufts University Medford, MA	Professor Durand	1/1	Neutron activation analysis of sediments	1,500.00
30.	University of Massachusetts - Boston Boston, MA	Professor M. Posner	19/1	Lecture on nuclear energy and tour of MIT Research Reactor 1/M reactor startup plot Calibration of shim blade reactivity worth Neutron detection	4710.00
31.	University of Michigan Ann Arbor, MI		0/1	Lecture on nuclear energy and tour of MIT Research Reactor	190.00
32.	University of Missouri Columbia, MO		0/1	Tour of MIT Research Reactor	65.00
33.	Watertown High School Watertown, MA	Tom Wittenhagen	27/1	Lecture on nuclear energy and tour of MIT Research Reactor	330.00

32,468.50

Salaries and benefits

12,745.00

Total expended

45,213.50

Note:

Total number of students participating: 459

Total number of faculty/teachers participating: 75

REACTOR SHARING PROGRAM REPORT
(September 1, 1998 - August 31, 1999)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4202
617/258-8323

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

I. Reactor Sharing Activities

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
1.	Beth Israel Deaconess Medical Center	Dr. Robert Zamenhof Dr. Mark Wyers	4/1 1/1	Blood and Cancer Cell Irradiation; Au foils, blood, and lung cell irradiation; Irradiation of mouse blood and plasma, human blood and plasma, lung tissue/boron samples, quartz slides, gold foils; Quartz slides, gold foils; Dacron graft Irradiation of mouse blood and plasma, boric acid in H ₂ O, and Lexan slides and cell culture; Irradiation tissue equipment plastic	27,240

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
2.	Boston University (SPLASH) Boston, MA		34/4	Lecture on nuclear energy and tour of MIT Research Reactor	640.00
3.	Brookline High School Brookline, MA	Mr. Steve Lantos	30/5	Lecture on nuclear energy and tour of MIT Research Reactor	455.00
4.	California Technical Institute Pasadena, CA	Professor Glen Cass	12/4	Analysis of 359 atmospheric particulate samples	10,040.00
5.	Cambridge High School HSSP Cambridge, MA		15/0	Lecture on nuclear energy and tour of MIT Research Reactor	320.00
6.	Certco, Inc. Lyons Society of Engineers	Mr. David Weisman	6/1	Lecture on nuclear energy and tour of MIT Research Reactor	190.00
7.	Conference Attendees		71/0	Tour of the MIT Research Reactor	1,350.00
8.	General Public		21/0	Tour of MIT Research Reactor	639.00
9.	Health Physics Society	Mr. R. Broseus/Mr. G. P. Skillman	50/2	Lecture on nuclear energy and tour of MIT Research Reactor	595.00
10.	Hollis-Brookline High School Brookline, MA	Mr. Brian Maynard	34/1	Lecture on nuclear energy and tour of MIT Research Reactor	395.00
10.	IQS	Mr. Mark Pruesert	3/1	Lecture on nuclear energy and tour of MIT Research Reactor	65.00
11.	Johns Hopkins School of Medicine	Charles Lowenstein	2/0	Trace Zn analysis of protein samples	1,000.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
12.	Karolinska Institute		2/0	Lecture on nuclear energy and tour of MIT Research Reactor	63.00
13.	Lincoln Sudbury Rites High School	Mr. M. Sobkowics	19/1	Lecture on nuclear energy and tour of MIT Research Reactor	260.00
14.	Mass College of Pharmacy	Ms. Cone	8/2	Lecture on nuclear energy and tour of MIT Research Reactor	192.00
15.	Massabesic High School	Mr. Ann Cutten	30/3	Lecture on nuclear energy and tour of MIT Research Reactor	525.00
16.	Matignon High School Cambridge, MA		1/1	Irradiation of radish and bean seeds	615.00
17.	Medford High School Medford, MA		1/1	Neutron Activation Analysis of Mystic River Sediment	605.00
18.	Mt. Ararat High School	Mr. D. Pelletier	7/0	Lecture on nuclear energy and tour of MIT Research Reactor	190.00
19.	Plymouth North High School Plymouth, MA	Lauren Gasbarro	1/1	Seed irradiation (gamma - spent fuel pool)	535.00
20.	Roberts School Medford, MA		1/1	Irradiation of strawberries (8 samples)	1,505.00
21.	Rush University		1/0	Tour of MIT Research Reactor	63.00
22.	Science Group		2/0	Tour of MIT Research Reactor	65.00
23.	Thayer Academy Braintree, MA	Ms. Kalik	18/1	Lecture on nuclear energy and tour of MIT Research Reactor	265.00
24.	Tufts University Medford, MA	Professor John Durant	1/1	Analysis of 51 Sediment Samples	4,080.00
25.	University of CA - Davis	Professor J. Stubbins	1/1	Tour of MIT Research Reactor	62.00

	<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number of Student/Faculty</u>	<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
26.	University of Connecticut Storrs, CT	Professor Joseph J. Helble	1/1	Rare earth analysis of Zircon ia powder samples	500.00
27.	University of Massachusetts Boston, MA		2/1	Tour of MIT Research Reactor	65.00
28.	University of Massachusetts, University of Mobile, North Western University		7/1	Lecture on nuclear energy and tour of MIT Research Reactor	196.00
29.	University of New Hampshire		2/0	Tour of MIT Research Reactor	185.00
30.	Watertown High School Watertown High	Mr. D. Morgan	29/2	Lecture on nuclear energy and tour of MIT Research Reactor	330.00
31.	Weston High School	Mr. T. Reese	62/4	Lecture on nuclear energy and tour of MIT Research Reactor	670.00
				<u>Total expended</u>	\$53,900.00

Note:

Total number of students participating: 497
Total number of faculty/teachers participating: 48

REACTOR SHARING PROGRAM REPORT

(September 1, 1999- May 31, 2000)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4202
617/258-8323

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
		<u>Faculty</u>	<u>Students</u>		
American Nuclear Society			15	Lecture on nuclear energy and tour of MIT Research Reactor	195.00
Beth Israel Deaconess Medical Center	Dr. Stead Kiger	1		Irradiation of Quartz Slides	1,455.00
Boston Children's Hospital	Alan Packard	1		Copper metal irradiation	337.00
Boston Latin School				Strawberry, Green Beans, and Asparagus Irradiations	1,450.00
Boston Refugee Youth Enrichment	Mr. Truong/Mr. Hill	2	37	Lecture on nuclear energy and tour of MIT Research Reactor	410.00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
		<u>Faculty</u>	<u>Students</u>		
Boston University			1	Demonstration and lecture on nuclear energy and tour of MIT Research Reactor	190.00
Brookline High School Brookline, MA	Mr. Stephen Lantos	2	52	Lecture on nuclear energy and tour of MIT Research Reactor	880.00
Bulkely High* School Farmington, CT	Michael Cunha	3	10	Lecture on nuclear energy and tour of MIT Research Reactor	315.00
California Technical Institute Pasadena, CA	Professor Glen Cass	1		Analysis of 359 atmospheric particulate samples	1,800.00
Cambridgeport School Cambridge, MA	Mr. Monahan Mr. Hans	2	33	Lecture on nuclear energy and tour of MIT Research Reactor	905.00
Chelsea High School	Mr. Devolto T. Chen	1	29	Lecture on nuclear energy and tour of MIT Research Reactor	485.00
Cornell University	F. Ka	1		Lecture on nuclear energy and tour of MIT Research Reactor	61.00
General Public	(Newton Family)	6	64	Lectures on nuclear energy and tours of MIT Research Reactor	2,930
Harvard Summer Program	B. Summner	1	36	Lecture on nuclear energy and tour of MIT Research Reactor	487.00
Harvard University Physics Departmetn	Professor Yerozolinsky	1		Tin and aluminum irradiations	1,460.00

4-7-00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
		<u>Faculty</u>	<u>Students</u>		
John Hopkins School of Medicine	Charles Lowenstein	1	1	Preparation and irradiation of protein samples for trace Zn analysis Preparation and irradiation for 2 nd Phase of analysis of protein samples for trace Zn	2,000.00
King Open Elementary School		1	12	Lecture on nuclear energy and tour of MIT Research Reactor	305.00
Medford High School	Devin Mack Mr. Contrada	1	7	Topaz irradiation Lecture on nuclear energy and tour of MIT Research Reactor	3,070.00
MIT/Nuclear Engineering Department	Professor Kenneth Czerwinski	1	2	Irradiation and Preparation: $\text{UO}_2(\text{NO}_3)_2$ Irradiation and Preparation: Bi Shots	4,183.00
MIT/Nuclear Engineering Department	Professor Kenneth Czerwinski and Professor Jacqueline Yanch	2	26	Lecture on nuclear energy and tour of MIT Research Reactor	60.00
MIT Nuclear Engineering Department	Professor Jacquelyn Yanch	1	4	Irradiation and Preparation: $\text{K}_2\text{B}_2\text{H}_{12}$ solution Irradiation and Preparation of gold foils Irradiation and Preparation: 3 samples of resin Irradiation and Preparation: 2 samples $\text{UO}_2(\text{NO}_3)$	4,813.00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
		<u>Faculty</u>	<u>Student</u>		
MIT Nuclear Engineering Department	Professor Otto K. Harling	1	1	Irradiation and Preparation: Gold Foils/Cd Foils	3,000.00
MIT/ Junior Physics Lab	Jordan. Kirsch	1	5	Neutron Detectors	10,980.00
National ANS	Mr. Siantar	1	7	Lecture on nuclear energy and tour of MIT Research Reactor	90.00
Nettle Middle School, Haverill, MA	Mr. Bernie Nagle	1	69	Lecture on nuclear energy and tour of MIT Research Reactor	760.00
Newton High School	Amy Lien	1		Lecture on nuclear energy and tour of MIT Research Reactor	65.00
North Andover High School Andover, MA	(Mr. Luz)	1	48	Lecture on nuclear energy and tour of MIT Research Reactor	845.00
Presentation of Mary High School Methuen, MA	(J. Diaciaccio)			Tour of MIT Research Reactor	65.00
Quabban High School	Elaine Hall	1	11	Demonstration, lecture on nuclear energy and tour of MIT Research Reactor	400.00
Smith University				Lecture on nuclear energy and tour of MIT Research Reactor	140.00
SUNY	Professor Reinstein	1		Tour of MIT Research Reactor	65.00
Thayer Academy Milton, MA 1/29	Ms. Kalik	1	13	Lecture on nuclear energy and tour of MIT Research Reactor	310.00

<u>Participating Institution</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support</u> <u>(\$)</u>
		<u>Faculty</u>	<u>Students</u>		
Tobin Elementary School Boston, MA		1	14	Lecture on nuclear energy and tour of MIT Research Reactor	315.00
U.S. Naval Academy Annapolis, MD			2	Lecture on nuclear energy and tour of MIT Research Reactor	130.00
UMASS		1		Neutron detector irradiations	1,040.00
UMass-Boston			4	Demonstration, lecture on nuclear energy and tour of MIT Research Reactor	200.00
UMass-Lowell	Nelson Eby	1	3	Soil Sample Irradiations Lecture on nuclear energy and tour of MIT Research Reactor	2,490
University of Cal @ Berkley	Professor E. Morse	1		Lecture on nuclear energy and tour of MIT Research Reactor	125.00
University of Cincinnati			1	Lecture on nuclear energy and tour of MIT Research Reactor	125.00
University of Miami		1	1	Special analysis of 8 wood ash samples	1,600.00
University of Tennessee Knoxville, TN			1	Lecture on nuclear energy and tour of MIT Research Reactor	125.00
		43	511		50,661.00

REACTOR SHARING PROGRAM REPORT
(JUNE 1, 2000 – MAY 31, 2001)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4202
617/258-8323

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
Agassi II High School Cambridge, MA	4/25/01		34	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
The Big Brother Program of Boston Boston, MA	1/14/01	Mr. W. Holland	20	1	Lecture on nuclear energy and tour of MIT Research Reactor	450.00
Boston Children's Hospital Boston, MA	6/00	Alan Packard		1	Copper metal irradiations	3,739.00
Brookline High School Brookline, MA	5/17/01		59	2	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
East Boston High School East Boston, MA	2/8/01	D. Gregorio	27	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
General Public		Various	73			2,505.00

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
Harvard Business School Cambridge, MA	4/05/01		25	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Harvard University Cambridge, MA	3/31/01	Professor Yerozolinsky		1	GaN, fly ash irradiations Tin and aluminum irradiations	2,029.00
	8/5/00	Hee Young Ahn	2		Lecture on nuclear energy and tour of MIT Research Reactor, demonstration and data taking.	
Masconomet Regional High School Topsfield, MA	5/15/01		47	3	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Medford High School Medford, MA	9/22/00	Joseph Contrada	19	1	Lecture on nuclear energy and tour of MIT Research Reactor	510.00
MIT Cambridge, MA	11/30/00	Professor Jacquelyn Yanch (Nuclear Eng. Dept.)	1	1	Irradiation and Preparation of gold foils	12,640.00
	12/31/00	Jordan Kirsch (Junior Physics Lab.)	1	2	Neutron Detectors	(N/C)
	2/9/01	Jordan Kirsch (Junior Physics Lab.)	8		Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
	4/06/01	MIT Pre-Frosh	50	2	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
MIT Cambridge, MA Continued.	1/16/01	John Bernard Reactor Dynamics Course	7	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
	2/16/01	Richard Lanza Nuclear Engineering Laboratory	11		Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Normandin Junior High School New Bedford, MA	11/17/00	Mr. Queiro	27	1	Lecture on nuclear energy and tour of MIT Research Reactor	580.00
Ohio State University Columbus, OH	7/03/00	Professor Rolf Barth		1	Lecture on nuclear energy and tour of MIT Research Reactor	65.00
Poland Regional High School Poland, ME	2/13/01	Town	20	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Quincy High School Quincy, MA	4/02/01		23	2	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Revere High School Revere, MA	2/01/01			1	Irradiations of Green Bean Seeds	915.00
Sanford High School Sanford, ME3	4/26/01		2	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Stoneham High School Stoneham, MA	12/3/00	Mr. Callahan	52	4	Lecture on nuclear energy and tour of MIT Research Reactor	995.00

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
Thayer Academy Milton, MA	1-26-01	Ms. Kalik	18	1	Lecture on nuclear energy and tour of MIT Research Reactor	450.00
Tufts University Medford, MA	3/01 – 5/01	Dr. Joseph Kehayias		1	Blood Sample Testing	6,893.00
	10/9/00	Mr. Lang	1	1	Lecture on nuclear energy and tour of MIT Research Reactor	
U Mass Lowell Lowell, MA		Professor Clayton French		1	NA OH Irradiation	830.00
	9/18/00	Mr. Regan		1	Lecture on nuclear energy and tour of MIT Research Reactor	
University of CA – Davis Davis, CA	7/12/00	Susan Autrey Conwell		3	Lecture on nuclear energy and tour of MIT Research Reactor	75.00
University of Michigan Ann Arbor, MI	7/17/00 and 12/21/00	Professor John S. King		1	Lectures on nuclear energy and tours of MIT Research Reactor	130.00
University of Tennessee Knoxville, TN	12/15/00	Mr. Nichols		2	Lecture on nuclear energy and tour of MIT Research Reactor	70.00
University of Utah Salt Lake City, UT	12/31/00 to 3/31/01	Sheree Swenson		1	Irradiations and analyses of coal ash samples	38,816.00
Waldorf School Lexington, MA	3/19/01	Jan Zemba	12	1	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)
Wrentham High School	3/30/01	Emily Poon	30	2	Lecture on nuclear energy and tour of MIT Research Reactor	(N/C)

REACTOR SHARING PROGRAM REPORT
(JUNE 1, 2001 – MAY 31, 2002)

University: Massachusetts Institute of Technology

Location: Nuclear Reactor Laboratory
138 Albany Street
Cambridge, Massachusetts 02139

Program Director: John A. Bernard, Director

Telephone No.: 617/253-4202
617/258-8323

Grant Number: DE-FG02-95NE38121.M007

Light water moderator
Heavy water reflector

Power Level: 5 MW

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
Agassi II High School Cambridge, MA	4/25/01		34	1	Lecture on nuclear energy and tour of MIT Research Reactor	275.00
Brookline High School Brookline, MA	5/17/01		59	2	Lecture on nuclear energy and tour of MIT Research Reactor	721.00
East Boston High School East Boston, MA	2/8/01	D. Gregorio	27	1	Lecture on nuclear energy and tour of MIT Research Reactor	185.00
Harvard Business School Cambridge, MA	4/05/01		25	1	Lecture on nuclear energy and tour of MIT Research Reactor	384.00
Masconomet Regional High School Topsfield, MA	5/15/01		47	3	Lecture on nuclear energy and tour of MIT Research Reactor	350.00

<u>Participating Institution</u>	<u>Date of Tour, etc</u>	<u>Principal Investigator</u>	<u>Number Student/ Faculty</u>		<u>Description of Project Program</u>	<u>Reactor Sharing Support (\$)</u>
Poland Regional High School Poland, ME	2/13/01	Town	20	1	Lecture on nuclear energy and tour of MIT Research Reactor	251.00
Quincy High School Quincy, MA	4/02/01		23	2	Lecture on nuclear energy and tour of MIT Research Reactor	503.00
Sanford High School Sanford, ME3	4/26/01		2	1	Lecture on nuclear energy and tour of MIT Research Reactor	183.00
Waldorf School Lexington, MA	3/19/01	Jan Zemba	12	1	Lecture on nuclear energy and tour of MIT Research Reactor	193.00
Wrentham High School	3/30/01	Emily Poon	30	2	Lecture on nuclear energy and tour of MIT Research Reactor	540.00
Total			279	15		3,585.00

Students: 279/Faculty: 15

II. Theses and Publications

a) Theses in progress during the year:

McKenna, Chris, "Geochemistry and Petrogenesis of the Nahant Gabbro and Mafic Dikes, Nahant, Eastern Massachusetts," Boston College. (M.S. Thesis); GS

Schwartz, William, "Geochemistry and Petrology of the Silurian Bimodal Five Mile Brook Volcanics, Northern Maine," Boston College. (M.S. Thesis); GS

Unnamed, "Sediments of Marine and Riverine Origin," University of Massachusetts-Lowell. (Ph.D. Thesis); GS

Wilson, Donald, "Geochemistry and Tectonic Significance of Siluro-Devonian Volcanics in the Coastal Volcanic Belt, Eastern Maine," Boston College. (M.S. Thesis); GS

b) Theses completed during the year:

Frisch, Joel, "Geochemistry, Provenance and Evolution of Eolian Paleosoles in Bermuda," Boston College (M.S. Thesis); GS

Gallinelli, Keith, "Geochemistry and Petrology of the Quaternary Volcanics of the Galleras Volcano in Southern Columbia," Boston College. (M.S. Thesis); GS

Haysom, Steven, "A Geochemical Study of the Boston Blue Clay and Comparison with Selected Cambridge Argillite, Boston Massachusetts," Boston College (M.S. Thesis); GS

c) Published papers and papers in preparation:

(NOTE: All papers are category GS/F)

Busse, P. et al., "Long-Term Clinical Follow-up of Four Subjects with Melanoma in the Extremities who underwent a Phase-I Boron Neutron Capture Therapy Protocol," Paper No. N-5, Seventh International Symposium on Neutron Capture Therapy, Sept. 1996.

- Francois, R., Altabet, M.A., Yu, Ein-Fen, Sigman, D.M., Bacon, M.P., Frank, M., Bohrmann, G., Bareille, G., and Labeyrie, L.D., "Contribution of Southern Ocean Upper Water Column Stratification to the Glacial Decrease in Atmospheric CO₂," *Nature*, 1997.
- Hepburn, J. C., Dunning, G. R., and Hon, R., "The Nashoba Terrane in Eastern Massachusetts: Geochronology, Geochemistry, and Tectonic Implications," 30th Annual Meeting of the NE Geological Society of America, Hartford, CT: Abstracts with Programs, Vol. 27, No. 1, p. 53.
- Hepburn, J. C., Dunning, G. R., and Hon, R., "Geochronology and Regional Tectonic Implications of Silurian Deformation in the Nashoba Terrane, SE New England," in *Current Perspectives in the Appalachian Caledonian Orogen: Geological Association of Canada, Special Paper 41*, p. 349-366.
- Hon, R., Dunning, G. R., and Hepburn, J. C., "Geochronology, Geochemistry, and Tectonic Significance of Mafic Magnetism within the Avalon Terrane, SE New England," 30th Annual Meeting of the NE Geological Society of America, Hartford, CT: Abstracts with Programs, Vol. 27, No. 1, p. 55.
- Karabinos, P., Samson, S.D., Hepburn, J.S., Stoll, H.M., and Aleinikoff, J.N., "The Taconic Orogeny in New England: Collision Between Laurentia and the Shelburne Falls Arc," *Geological Society of America: Abstracts with Programs*, Vol. 28, No. 3, p. 70.
- Madoc-Jones, H., Zamenhof, R., Solares, G., Harling, O., Yam, C-S., Riley, K., Kiger, S., Wazer, D., Rogers, G., and Atkins, M., "A Phase-I Dose-Escalation Trial of Boron Neutron Capture Therapy for Subjects with Metastatic Subcutaneous Melanoma of the Extremities," in Cancer Neutron Capture Therapy, Mishima, Y., (ed.), p. 707-716, (1996).
- Oakes-Coyne, L., Hepburn, J.C., and Hon, R., "Geochemistry of Meta-Volcanic Rocks from the Putnam - Nashoba Terrane, Southeastern New England; 31st Annual Meeting of the NE Geological Society of America; Abstracts with programs, Vol. 78, No. 3, p. 70.
- Solares, G., et al., "B-10 Quantification and Microdosimetric Studies in a Phase-I Dose-Escalation Trial of Boron Neutron Capture Therapy for Subjects with Metastatic Subcutaneous Melanoma of the Extremities," Paper No. F-6, Seventh International Symposium of Neutron Capture Therapy, Sept. 1996.
- Solares, G., et al., "On-Line Dosimetry for Boron Neutron Capture Therapy at the MIT Research Reactor," Paper No. G-6, Seventh International Symposium of Neutron Capture Therapy, Sept. 1996.

- Solares, G. and Zamenhof, R., "A Novel Approach to the Microdosimetry of Neutron Capture Therapy: Part I – High Resolution Quantitative Autoradiography Applied to the Microdosimetry of Neutron Capture Therapy," *Radiation Research*, Vol. 144, No. 1, p. 50-58 (1995).
- Valverde-Vaquero, P. and Hepburn, J.C., "Pre- and Post-Variscan Magmatism in the Northern Iberian Massif (Cantabrian Zone): Geochemical Signatures and Tectonic Implications," *Annual Meeting of the European Union of Geosciences*, Strasbourg, France, Vol. 8, p. 76, April 1995.
- Yu, E.F., Francois, R., and Bacon, M.P., "Similar Rates of Modern and Last-Glacial Ocean Thermohaline Circulation Inferred from Radiochemical Data," *Nature*, Vol. 379, pp. 689-694, Feb. 1996.
- Zamenhof, R.G., et al., "Clinical Treatment Planning of Subjects Undergoing Boron Neutron Capture Therapy," Paper No. C-10, *Seventh International Symposium of Neutron Capture Therapy*, Sept. 1996.
- Zamenhof, R.G., et al., "Mac NCTPLAN: An Improved Macintosh Based Version of the Boron Neutron Capture Therapy Treatment Planning Program NCTPLAN," Paper No. J-34, *Seventh International Symposium of Neutron Capture Therapy*, Sept. 1996.

II. Theses and Publications

a) Theses in progress during the year:

Frisch, Joel, "Bermuda Paleosol Geochemistry: Evidence for Pleistocene Paleoclimates, Boston College, (M.S. Thesis);

Schwartz, William, "Geochemistry and Petrology of the Silurian Bimodal Five Mile Brook Volcanics, Northern Maine, Boston College (M.S. Thesis)

Wilson, Don, "Geochemistry and Tectonic Significance of Siluro-Devonian Volcanics in the Coastal Volcanic Belt, Eastern Maine, Boston College, (M.S. Thesis)

Zeman, Christopher, "A Geochemical Study of Sedimentary Formations of the Connecticut Valley-Gaspé Synclinorium, Northern Maine, Boston College, (M.S. Thesis)

b) Published papers and papers in preparation:

Busse, P. et al, "Clinical Follow-up of Patients with Melanoma of the Extremity Treated in a Phase I Boron Neutron Capture Therapy Protocol, Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 100-105, Amsterdam, 1997.

Busse, P., et al., "Complete Response of Cutaneous and Intracranial Melanoma to BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Busse, P., et al, "Harvard-MIT BNCT Program: Overview of the Clinical Trials and Translational Research," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

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Francois, R., Altabet, M. A., Yu, Ein-Fen, Sigman, D. M., Bacon, M. P., Frank, M., Bohrmann, G., Bareille, G., and Labeyrie, L. D., "Contribution of Southern Ocean Surface Water Stratification to Low Atmospheric CO₂ Concentrations during the Last Glacial Period," *Nature*, Vol. 389, pp. 929-935, 1997.

Francois, R., Altabet, M. A., Yu, Ein-Fen, Sigman, D. M., Bacon, M. P., Frank, M., Bohrmann, G., Bareille, G., and Labeyrie, L. D., "Contribution of Southern Ocean Upper Water Column Stratification to the Glacial Decrease in Atmospheric CO₂," *Nature*, 1997.

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Hon, R., and Haysom, S., "Origin and Geochemistry of Boston Blue Clay, Eastern Massachusetts; Association of Engineering Geologists, Boston 2000-Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.

Hon, R. and Jewell, P., "Geochemistry and Cause of Soft Rock Alteration in Boston Bay Group, Boston, Massachusetts; Association of Engineering Geologists, Boston 2000 - Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.

Hughes, L., et al, "Physical and Chemical Characterization of Atmospheric Ultrafine Particles in the Los Angeles Area," *Environmental Science and Technology*, in press.

- Karabinos, P., and Hepburn, J. C., "The Life Span of Iapetus Along the New England Segment of Laurentia, Geological Society of America, Abstracts with Programs, National Meeting, in Special Symposium on the Iapetus Ocean, its Birth, Life and Death: The Wilson Cycle, 1997, Vol. 29, # 6, p. A-378, 1997.
- Kiger, W.S. III and R. G. Zamenhof, "Application of Realistic Microdosimetry Techniques to the Radiobiology of BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III , et al., "Demonstration of MACNCTPLAN, the Harvard-MIT BNCT Treatment Planning Software," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III , et al., "Effects of Neutron Collimation, Beam Size, and Spectrum on In-Phantom Performance of Realistic Epithermal Neutron Beams for BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
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- Packard, A. B., et al., "Copper (II) Diiminedioxime Complexes for Imaging Multidrug Resistance," American Chemical Society, Dallas, March, 1998.
- Packard, A. B., Day, P. J., S. T. Treves, "A High-Yield $^{191}\text{Os}/^{191\text{m}}\text{Ir}$ Generator," presented at the XII International Conference on Radiopharmaceutical Chemistry, Sweden, 1997.

- Packard, A. B., et al., "Lipophilic Cationic Copper Complexes as PET Radiopharmaceuticals," presented at the XII International Conference on Radiopharmaceutical Chemistry, Sweden, 1997
- Packard, A. B., et al., "Synthesis and Biodistribution of Monocationic Diiminedioxime Copper Complexes," Submitted to *Nuclear Medicine and Biology*
- Packard, A.B., "Synthesis and Biodistribution of ^{64}Cu -Labeled Monocationic Diiminedioxime Copper(II) Complexes, Elsevier, (1998).
- Palmer, M.R., et al., Integrated Medical Image Registration, Patient Positioning and Patient Monitoring for Cranial BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Palmer, M.R., et al., Predicting Boron-10 Concentrations in Normal Brain and Glioblastoma from Blood Measurements," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Solares, G., et al., "Microdosimetric Studies at the Harvard/MIT Phase I Clinical Trial of Boron Neutron Capture Therapy," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 171-176, Amsterdam, Sept. 1997.
- Solares, G., et al., "On-Line Dosimetry for Boron Neutron Capture Therapy at the MIT Research Reactor," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 147-152, Amsterdam, Sept. 1997.
- Walter, H.-J., "Reliability of the $^{231}\text{Pa}/^{230}\text{Th}$ Activity Ratio as a Tracer for Bioproductivity of the Ocean," in Proxies in Paleoceanography, G. Fisher and G. Wever, eds. University of Bremen, (1998).
- Zamenhof, R.G., et al., "Clinical Treatment Planning of Subjects Undergoing Boron Neutron Capture Therapy," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 2, pp. 614-620, Amsterdam, Sept. 1997.
- Zamenhof, R.G, et al, "Monte Carlo Based Treatment Planning for Boron Neutron Capture Therapy Using Custom Designed Models Automatically Generated from CT Data," *Int. J. Rad. Oncol. Biol. Phys.*, Vol. 32, pp. 383-397, 1996

Zamenhof, R.G., "Microdosimetry for Boron Neutron Capture Therapy: A Review," *J. of Neuro-Oncology*, Vol. 33, pp. 81-92, 1997.

Zamenhof, R.G., "Is There a Future for Neutron Capture Therapy," *Int. J. Rad. Onc. Biol. Phys.*, 38(5): 1139, 1997

II. Theses and Publications

a) Theses in progress during the year:

Frisch, Joel A., "Bermuda Paleosol Geochemistry: Evidence for Pleistocene Paleoclimate Variations," Boston College (M.S. Thesis)

Haysom, Steven, "Geochemical Study of the Boston Blue-Clay and Selected Cambridge Argillite," Boston College (M.S. Thesis)

McKenna, Christian, "Geochemistry and Petrogenesis of the Nahant Gabbro and Mafic Dikes on Nahant, Nahant, Eastern Massachusetts," Boston College (M.S. Thesis)

Oakes-Coyne, Laurie, "Meta Volcanic Rocks from the Putnam-Nashoba Terrane, Southeastern new England: Geochemistry and Tectonic Implications," Boston College (M.S. Thesis)

Schwartz, William, "Geochemistry and Petrology of the Silurian Bimodal Five Mile Brook Volcanics, Northern Maine," Boston College (M.S. Thesis)

Zeman, Christopher, "Geochemical Study of the Frontenac Formation within the Connecticut-Gaspe Synclinorium, Northern Maine," Boston College (M.S. Thesis)

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Busse, P. et al., "BNCT for Glioblastoma Multiforme and Intracranial Melanoma: Clinical Results of the Harvard-MIT Phase-I Trial," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Busse, P., et al., "Complete Response of Cutaneous and Intracranial Melanoma to BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Busse, P., et al., "Harvard-MIT BNCT Program: Overview of the Clinical Trials and Translational Research," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

- Chuang, C., et al., "Selective Tumor Uptake of Boronophenylalanine-Fructose (BPA-F) in an Animal Model of Hepatic Colorectal Metastasis," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Chuang, C., et al., "Time-Dependent Biodistribution of BPA-F in Normal and Tumor Brain Tissues in Mice," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Francois, R., Altabet, M.A., Yu, Ein-Fen, Sigman, D.M., Bacon, M.P., Frank, M., Bohrmann, G., Bareille, G., and L.D. Labeyrie, , "Contribution of Southern Ocean Surface Water Stratification to Low Atmospheric CO₂ Concentrations during the Last Glacial Period," Nature, Vol. 389, pp. 929-935, 1997.
- Harling, O.K., Kohse, G., and K.J. Riley, "The Use of Polytetrafluoroethylene (Teflon (R)) Containing Filter/Moderators for Epithermal Neutron Beam Production," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Hepburn, J.C., Dunning, G.R., and R. Hon, "Mafic Alkalic Plutonism of Paleozoic Age, Avalon Terrane Northwest of Boston, Massachusetts," Geological Society of America, Abstracts with Programs, Vol. 30, No. 1, p. 24, 1998.
- Hon, R., and S. Haysom, "Origin and Geochemistry of Boston Blue Clay, Boston, Massachusetts," Association of Engineering Geologists, Boston 2000 - Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.
- Hon, R. and P. Jewell, "Geochemistry and Cause of Soft Rock Alteration in the Boston Bay Group, Boston, Massachusetts," Association of Engineering Geologists, Boston 2000 - Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.
- Hon, R., Frisch, J., and S. Herwitz, "Geochemistry of Bermudan Paleosols: Are Glacial - Interglacial Cycles Recurrent Climatic Events?" Geological Society of America, Abstracts with Programs, Vol., 30, No. 1, p. 26, 1998.
- Hon, R. and K.A. Doherty, "Beneficial Reuse of Construction and Demolition Debris as Daily Cover in Landfill Operations," 4th International Environmental Geotechnology Symposium, Boston, MA 1998.
- Hughes, L., et al., "Physical and Chemical Characterization of Atmospheric Ultrafine Particles in the Los Angeles Area," *Environmental Science and Technology*, 1998.

- Karabinos, P., and J.C. Hepburn, "The Life Span of Iapetus Along the New England Segment of Laurentia," Geological Society of America, Abstracts with Programs, National Meeting, in Special Symposium on the Iapetus Ocean, its Birth, Life and Death: The Wilson Cycle, 1997, Vol. 29, #6, p. A-378, 1997.
- Karabinos, P., Samson, S., Hepburn, J.C., and H. Stoll, "The Taconian Orogeny in Western New England, U.S.A.: Collision Between Laurentia and the Shelburne Falls Arc," Geology, Geological Society of America, 1997.
- Kiger, W.S. III, Sakamoto, S., and O.K. Harling, "Application of Realistic Microdosimetry Techniques to the Radiobiology of BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III, et al., "Demonstration of MacNCTPLAN, the Harvard-MIT BNCT Treatment Planning Software," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III, Sakamoto, S., and O.K. Harling, "Effects of Neutron Collimation, Beam Size, and Spectrum on In-Phantom Performance of Realistic Epithermal Neutron Beams for BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III and R.G. Zamenhof, "A Validated Pharmacokinetic Model for the Concentration of Boron-10 in Blood Following BPA-F Administration in Humans," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Packard, A.B., et al., "Copper (II) Diiminedioxime Complexes for Imaging Multidrug Resistance," American Chemical Society, Dallas, March, 1998.
- Packard, A.B., et al., "Synthesis and Biodistribution of Monocationic Diiminedioxime Copper Complexes," Submitted to *Nuclear Medicine and Biology*
- Packard, A.B., et al., "Synthesis and Biodistribution of ^{64}Cu -Labeled Monocationic Diiminedioxime Copper(II) Complexes, Elsevier, 1998.
- Palmer, M.R., et al., "Integrated Medical Image Registration, Patient Positioning and Patient Monitoring for Cranial BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Palmer, M.R., et al., "Predicting Boron-10 Concentrations in Normal Brain and Glioblastoma from Blood Measurements," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Walter, H.-J., et al., "Reliability of the $^{231}\text{Pa}/^{230}\text{Th}$ Activity Ratio as a Tracer for Bioproductivity of the Ocean," in Proxies in Paleoceanography, G. Fisher and G. Wever, eds., University of Bremen, 1998.

Wazer, D., et al., "Boron Neutron Capture Therapy," Chapter XII in: Cancer of the Nervous System, eds. P. Black and J. Loeffler, Blackwell Science, Cambridge, MA 1997.

Zamenhof, R.G., et al., "MacNCTPLAN: An Improved Macintosh Based Version of the Boron Neutron Capture Therapy Treatment Planning Program NCTPLAN," in press: Medical Physics.

Zamenhof, R.G., "Microdosimetry for Boron Neutron Capture Therapy: A Review," *J. of Neuro-Oncology*, Vol. 33, pp. 81-92, 1997.

Zamenhof, R.G., "Is There a Future for Neutron Capture Therapy," *Int. J. Rad. Onc. Biol. Phys.*, 38(5): 1139, 1997.

Zuo, C., et al., "Proton NMR Spectroscopic Measurement of p,Boronophenylalanine (BPA): a Preliminary Study," in press: *Medical Physics*

II. Theses and Publications

a) Theses in progress during the year:

Chowdhury, Zohir, "Advection of Airborne Particles from the Indian Subcontinent," California Institute of Technology (Ph.D. Thesis)

Frisch, Joel A., "Bermuda Paleosol Geochemistry: Evidence for Pleistocene Paleoclimate Variations," Boston College (M.S. Thesis)

Haysom, Steven, "Geochemical Study of the Boston Blue-Clay and Selected Cambridge Argillite," Boston College (M.S. Thesis)

Hughes, Lara, "Effect on Global Climate of Airborne Particles Advected over the Indian Ocean," California Institute of Technology (Ph.D. Thesis)

Llamas, Arancha Pinan, "The Origin of the Coastal Volcanic Belt, Eastern Maine." Boston College (M.S. Thesis)

b) Theses completed during the year:

MacKinnon, Kevin, "Manganese, Iron and Trace Elements in Overburden to Public Water Supplies Norwell, Massachusetts." Boston College (M.S. Thesis)

McKenna, Christian, "Geochemistry and Petrogenesis of the Nahant Gabbro and Mafic Dikes on Nahant, Nahant, Eastern Massachusetts," Boston College (M.S. Thesis)

Schwartz, William, "Geochemistry and Petrology of the Silurian Bimodal Five Mile Brook Volcanics, Northern Maine," Boston College (M.S. Thesis)

Zeman, Christopher, "Geochemical Study of the Frontenac Formation within the Connecticut-Gaspe Synclinorium, Northern Maine," Boston College (M.S. Thesis)

c) Published papers and papers in preparation:

Busse, P. et al., "Clinical Response and Normal Tissue Tolerance following Boron Neutron Capture Therapy for Melanoma, (to be published).

Busse, P. et al., "BNCT for Glioblastoma Multiforme and Intracranial Melanoma: Clinical Results of the Harvard-MIT Phase-I Trial," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

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- Hughes, L.S., et al., "Size and Composition distribution of Atmospheric Particles in Southern California," *Environmental Science and Technology*, Vol. 33, No. 20, pp. 3506-3515, 1999.
- Hughes, L., et al., "Physical and Chemical Characterization of Atmospheric Ultrafine Particles in the Los Angeles Area," *Environmental Science and Technology*, 1998.
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- Kiger, W.S. III, Sakamoto, S., and O.K. Harling, "Effects of Neutron Collimation, Beam Size, and Spectrum on In-Phantom Performance of Realistic Epithermal Neutron Beams for BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III and R.G. Zamenhof, "A Validated Pharmacokinetic Model for the Concentration of Boron-10 in Blood Following BPA-F Administration in Humans," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kleeman, M.J., et al., "Size and Composition Distribution of Fine Particulate Matter Emitted from Wood Burning, Meat Charbroiling, and Cigarettes," *Environmental Science & Technology*, Vol. 33, No. 20, pp. 3516-3523, 1999.
- Packard, A.B., et al., "Copper (II) Diiminedioxime Complexes for Imaging Multidrug Resistance," American Chemical Society, Dallas, March, 1998.
- Packard, A.B., et al., "Synthesis and Biodistribution of Monocationic Diiminedioxime Copper Complexes," Submitted to *Nuclear Medicine and Biology*
- Packard, A.B., et al., "Synthesis and Biodistribution of ^{64}Cu -Labeled Monocationic Diiminedioxime Copper(II) Complexes, Elsevier, 1998.

Palmer, M.R., et al., "Integrated Medical Image Registration, Patient Positioning and Patient Monitoring for Cranial BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Palmer, M.R., et al., "Predicting Boron-10 Concentrations in Normal Brain and Glioblastoma from Blood Measurements," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Prospero, J.M., "Al and Fe in PM 2.5 and PM 10 Suspended Particles in South-Central Florida: The Impact of the Long Range Transport of African Mineral Dust," to be published: *Water Air and Soil Pollution*.

Walter, H.-J., et al., "Reliability of the $^{231}\text{Pa}/^{230}\text{Th}$ Activity Ratio as a Tracer for Bioproductivity of the Ocean," in Proxies in Paleoceanography, G. Fisher and G. Wever, eds., University of Bremen, 1998.

Zamenhof, R.G., et al., "MacNCTPLAN: An Improved Macintosh Based Version of the Boron Neutron Capture Therapy Treatment Planning Program NCTPLAN," in press: *Medical Physics*.

Zamenhof, R.G., "Is There a Future for Neutron Capture Therapy," *Int. J. Rad. Onc. Biol. Phys.*, 38(5): 1139, 1997.

Zuo, C., et al., "Proton NMR Spectroscopic Measurement of p,Boronophenylalanine (BPA): a Preliminary Study," in press: *Medical Physics*

II. Theses and Publications

a) Theses in progress during the year:

Beal, J.W., "Comparative Analysis of Surface and Subsurface Waters," Fairfield University, (Senior Independent Study Project)

Connolly, Megan, "Geochemistry of Arsenic Bearing Rocks in Central Massachusetts," (Boston College), (Senior Honors Research),

Frisch, Joel A., "Bermuda Paleosol Geochemistry: Evidence for Pleistocene Paleoclimate Variations," Boston College (M.S. Thesis)

Llamas, Arancha Pinan, "The Origin of the Coastal Volcanic Belt, Eastern Maine." Boston College (M.S. Thesis)

Martinova, Lubomira, "Geochemical Characteristics of Bedrock Beneath an Aquifer, Norwell, Massachusetts, Boston College, (M.S. Thesis)

Sijgers, Rachael, "Trace Elements in Plant Tissues from a Natural Wetland," Boston College, (Senior Honors Research)

b) Theses completed during the year:

Chowdhury, Zohir, "Advection of Airborne Particles from the Indian Subcontinent," California Institute of Technology (Ph.D. Thesis)

Haysom, Steven, "Geochemical Study of the Boston Blue-Clay and Selected Cambridge Argillite," Boston College (M.S. Thesis)

Hughes, Lara, "Effect on Global Climate of Airborne Particles Advected over the Indian Ocean," California Institute of Technology (Ph.D. Thesis)

c) Published papers and papers in preparation:

Bernard, J.A., et al., "License Requirements for the MITR Fission Converter," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.

- Binello, et al, "B Uptake by Cells for Boron Neutron Capture Synovectomy," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Binns, P.J., et al, "Shielding and Beam Performance of the New Epithermal Neutron Irradiation Facility at the MITR-II, Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Busse, P.M., "A Phase-1 Clinical Trial for Cranial BNCT at Harvard-MIT, Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Busse, P.M., et al., "Clinical Response and Normal Tissue Tolerance following Boron Neutron Capture Therapy for Melanoma, (to be published).
- Goldstein, A. and J. C. Hepburn, "Possible Correlations of the Norumbega Fault System with Faults in Southeastern New England," in Ludman, A. and West, D. P., Jr., eds., Norumbega Fault system in the Northern Appalachians: Geological Society of America, Special Paper No. 331, pp. 73-83, 1999
- Goorley, T., et al, "Reference Dosimetry Calculations for NCT with Comparison of Analytical and Voxel Models, "Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Hepburn, J.C., et al., "Mafic Alkalic Plutonism of Paleozoic Age, Avalon Terrane Northwest of Boston, Massachusetts," Geological Society of America , Abstracts with Programs, Vol. 30, No. 1, pp. 24-25 , 1998. (Invited presentation for Symposium on the Tectonic History of the Eastern Margin of the Appalachians: New England and Atlantic Canada.)
- Hughes, L.S., et al., "Size and Composition distribution of Atmospheric Particles in Southern California," *Environmental Science and Technology*, Vol. 33, No. 20, pp. 3506-3515, 1999.
- Karabinos, P., et al, "Taconian Orogeny in the New England Appalachians: Collision Between Laurentia and the Shelburn Falls Arc, Discussion and Reply," Geological Society of America, *Geology*, Vol. 27, No. 4, pp. 281-382, 1999
- Kiger, W.S., et al, "Boron Uptake by Erythrocytes following Boronophenylalanine-Fructose Infusion in Humans, Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Kleeman, M.J., et al., "Size and Composition Distribution of Fine Particulate Matter Emitted from Wood Burning, Meat Charbroiling, and Cigarettes," *Environmental Science & Technology*, Vol. 33, No. 20, pp. 3516-3523, 1999.

- Kohut, E. and J. C. Hepburn, "Mylonite Zones Near the Avalon Terrane Boundary, West and Northwest of Boston, Massachusetts," Geological Society of America, Abstracts with Programs," vol. 31, No. 2, p. 28, 1999
- Newton, T.H., et al, "Modeling and Optimization of Tissue ^{10}B Concentration and Dosimetry for Arbitrary BPA-F Infusion Schedules in Humans," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Palmer, M.R. et al, "Treatment Planning and Dosimetry for the Harvard-MIT Phase-1 Clinical Trial for Cranial BNCT," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Pinan Llamas, A., "The Coastal Volcanic Belt (CVB), Easternmost Maine: Geochemistry and Tectonic Implications, submitted to the Geological Society of America, Northeastern Section, Dec. 2000.
- Riley, K.J., et al, "Collimator Optimization Studies for the New MIT Epithermal Neutron Beam," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Thompson, J.B., Jr., et al, "The Erving Formation revisited," Transactions of the American Geophysical Union, EOS, p. S359, 1999. (Invited presentation for symposium entitled "A matter of Scale-From Chain Silicate Crystal Chemistry to Paleo Plate Tectonics of the Northern Appalachians and Scandinavia: A special Session in Celebration of the Career of Peter Robinson).
- Wilson, B. A., et al, "Automatic Control and Monitoring of the MIT Fission Converter Beam," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Yu, E. F., et al., "Trapping Efficiency of Bottom-Tethered Sediment Traps Estimated from the Intercepted Fluxes Th-230 and Pa-231," in Deep-Sea Research: Part I, Vol 48, pp. 865-889, 2001
- Zamenhof, R.G., et al, "A Core Laboratory Offering Full Evaluation of New Boron Compounds: A Service to the BNCT Community," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Zamenhof, R.G., et al., "MacNCTPLAN: An Improved Macintosh Based Version of the Boron Neutron Capture Therapy Treatment Planning Program NCTPLAN," in press: *Medical Physics*.
- Zuo, C., et al., "Proton NMR Spectroscopic Measurement of p-Boronophenylalanine (BPA): a Preliminary Study," in press: *Medical Physics*

II. Theses and Publications

a) Theses in progress during the year:

Frisch, Joel, "Bermuda Paleosol Geochemistry: Evidence for Pleistocene Paleoclimates, Boston College, (M.S. Thesis);

Schwartz, William, "Geochemistry and Petrology of the Silurian Bimodal Five Mile Brook Volcanics, Northern Maine, Boston College (M.S. Thesis)

Wilson, Don, "Geochemistry and Tectonic Significance of Siluro-Devonian Volcanics in the Coastal Volcanic Belt, Eastern Maine, Boston College, (M.S. Thesis)

Zeman, Christopher, "A Geochemical Study of Sedimentary Formations of the Connecticut Valley-Gaspé Synclinorium, Northern Maine, Boston College, (M.S. Thesis)

b) Published papers and papers in preparation:

Busse, P. et al, "Clinical Follow-up of Patients with Melanoma of the Extremity Treated in a Phase I Boron Neutron Capture Therapy Protocol, Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 100-105, Amsterdam, 1997.

Busse, P., et al., "Complete Response of Cutaneous and Intracranial Melanoma to BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Busse, P., et al, "Harvard-MIT BNCT Program: Overview of the Clinical Trials and Translational Research," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Chuang, C., et al., "Selective Tumor Uptake of Boronophenylalanine-Fructose (BPA-F) in an Animal Model of Hepatic Colorectal Metastasis," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

Chuang, C., et al, "Time-Dependent Biodistribution of BPA-F in Normal and Tumor Brain Tissues in Mice," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.

- Francois, R., Altabet, M. A., Yu, Ein-Fen, Sigman, D. M., Bacon, M. P., Frank, M., Bohrmann, G., Bareille, G., and Labeyrie, L. D., "Contribution of Southern Ocean Surface Water Stratification to Low Atmospheric CO₂ Concentrations during the Last Glacial Period," *Nature*, Vol. 389, pp. 929-935, 1997.
- Francois, R., Altabet, M. A., Yu, Ein-Fen, Sigman, D. M., Bacon, M. P., Frank, M., Bohrmann, G., Bareille, G., and Labeyrie, L. D., "Contribution of Southern Ocean Upper Water Column Stratification to the Glacial Decrease in Atmospheric CO₂," *Nature*, 1997.
- Harling, OK, Kohse, G., and K. J. Riley, "the Use of Polytetrafluoroethylene (Teflon (R)) Containing Filter/Moderators for Epithermal Neutron Beam Production," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Hepburn, J. C., Dunning, G. R., and Hon, R., "The Nashoba Terrane in Eastern Massachusetts: Geochronology, Geochemistry, and Tectonic Implications," 30th Annual Meeting of the NE Geological Society of America, Hartford, CT: Abstracts with Programs, Vol. 27, No. 1, p. 53.
- Hepburn, J. C., Dunning, G. R., and Hon, R., "Geochronology and Regional Tectonic Implications of Silurian Deformation in the Nashoba Terrane, SE New England," in Current Perspectives in the Appalachian Caledonian Orogen: Geological Association of Canada, Special Paper 41, p. 349-366.
- Hon, R., Dunning, G. R., and Hepburn, J. C., "Geochronology, Geochemistry, and Tectonic Significance of Mafic Magnetism within the Avalon Terrane, SE New England," 30th Annual Meeting of the NE Geological Society of America, Hartford, CT: Abstracts with Programs, Vol. 27, No. 1, p. 55.
- Hon, R., and Haysom, S., "Origin and Geochemistry of Boston Blue Clay, Eastern Massachusetts; Association of Engineering Geologists, Boston 2000-Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.
- Hon, R. and Jewell, P., "Geochemistry and Cause of Soft Rock Alteration in Boston Bay Group, Boston, Massachusetts; Association of Engineering Geologists, Boston 2000 - Geology and Construction Symposium, March 1997 - invited paper for symposium, 1997.
- Hughes, L., et al, "Physical and Chemical Characterization of Atmospheric Ultrafine Particles in the Los Angeles Area," *Environmental Science and Technology*, in press.

- Karabinos, P., and Hepburn, J. C., "The Life Span of Iapetus Along the New England Segment of Laurentia, Geological Society of America, Abstracts with Programs, National Meeting, in Special Symposium on the Iapetus Ocean, its Birth, Life and Death: The Wilson Cycle, 1997, Vol. 29, # 6, p. A-378, 1997.
- Kiger, W.S. III and R. G. Zamenhof, "Application of Realistic Microdosimetry Techniques to the Radiobiology of BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III, et al., "Demonstration of MACNCTPLAN, the Harvard-MIT BNCT Treatment Planning Software," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III, et al., "Effects of Neutron Collimation, Beam Size, and Spectrum on In-Phantom Performance of Realistic Epithermal Neutron Beams for BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Kiger, W.S. III, et al., "A Validated Pharmacokinetic Model for the Concentration of Boron-10 in Blood Following BPA-F Administration in Humans," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Madoc-Jones, H., Zamenhof, R., Solares, G., Harling, O., Yam, C-S., Riley, K., Kiger, S., Wazer, D., Rogers, G., and Atkins, M., "A Phase-I Dose-Escalation Trial of Boron Neutron Capture Therapy for Subjects with Metastatic Subcutaneous Melanoma of the Extremities," in Cancer Neutron Capture Therapy, Mishima, Y., (ed.), p. 707-716, (1996).
- Oakes-Coyne, L., Hepburn, J.C., and Hon, R., "Geochemistry of Meta-Volcanic Rocks from the Putnam - Nashoba Terrane, Southeastern New England; 31st Annual Meeting of the NE Geological Society of America; Abstracts with programs, Vol. 78, No. 3, p. 70.
- Packard, A. B., et al., "Copper (II) Diiminodioxime Complexes for Imaging Multidrug Resistance," American Chemical Society, Dallas, March, 1998.
- Packard, A. B., Day, P. J., S. T. Treves, "A High-Yield $^{191}\text{Os}/^{191\text{m}}\text{Ir}$ Generator," presented at the XII International Conference on Radiopharmaceutical Chemistry, Sweden, 1997.

- Packard, A. B., et al., "Lipophilic Cationic Copper Complexes as PET Radiopharmaceuticals," presented at the XII International Conference on Radiopharmaceutical Chemistry, Sweden, 1997
- Packard, A. B., et al., "Synthesis and Biodistribution of Monocationic Diiminedioxime Copper Complexes," Submitted to *Nuclear Medicine and Biology*
- Packard, A.B., "Synthesis and Biodistribution of ^{64}Cu -Labeled Monocationic Diiminedioxime Copper(II) Complexes, Elsevier, (1998).
- Palmer, M.R., et al., Integrated Medical Image Registration, Patient Positioning and Patient Monitoring for Cranial BNCT," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Palmer, M.R., et al., Predicting Boron-10 Concentrations in Normal Brain and Glioblastoma from Blood Measurements," presented at the Eighth International Symposium on Neutron Capture Therapy for Cancer, La Jolla, California, 1998.
- Solares, G., et al., "Microdosimetric Studies at the Harvard/MIT Phase I Clinical Trial of Boron Neutron Capture Therapy," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 171-176, Amsterdam, Sept. 1997.
- Solares, G., et al., "On-Line Dosimetry for Boron Neutron Capture Therapy at the MIT Research Reactor," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 1, pp. 147-152, Amsterdam, Sept. 1997.
- Walter, H.-J., "Reliability of the $^{231}\text{Pa}/^{230}\text{Th}$ Activity Ratio as a Tracer for Bioproductivity of the Ocean," in Proxies in Paleoceanography, G. Fisher and G. Wever, eds. University of Bremen, (1998).
- Zamenhof, R.G., et al., "Clinical Treatment Planning of Subjects Undergoing Boron Neutron Capture Therapy," Advances in Neutron Capture Therapy, Seventh International Symposium of Neutron Capture Therapy, Vol. 2, pp. 614-620, Amsterdam, Sept. 1997.
- Zamenhof, R.G, et al, "Monte Carlo Based Treatment Planning for Boron Neutron Capture Therapy Using Custom Designed Models Automatically Generated from CT Data," *Int. J. Rad. Oncol. Biol. Phys.*, Vol. 32, pp. 383-397, 1996

Zamenhof, R.G., "Microdosimetry for Boron **Neutron** Capture Therapy: A Review," *J. of Neuro-Oncology*, Vol. 33, pp. 81-92, 1997.

Zamenhof, R.G., "Is There a Future for Neutron Capture Therapy," *Int. J. Rad. Onc. Biol. Phys.*, 38(5): 1139,. 1997

II. Theses and Publications

a) Theses in progress during the year:

Llamas, Arancha Pinan, "The Origin of the Coastal Volcanic Belt, Easternmost Maine: A Petrological and Geochemical Study, M.S. Thesis, in Progress 2001 (Advisor, R. Hon).

Martinova, Lubomira, "Geochemical Characteristics of Bedrock Beneath an Aquifer, Norwell, Massachusetts, Boston College, M.S. Thesis, in Progress (Advisor, R. Hon)

Sijgers, Rachael, "Biohydrochemistry of Principle Cations within a Mixed Westland Aquifer in SE Massachusetts," Boston College, (Scholar of the College Senior Honors Thesis), May, 2001, p. 97 (Advisor, J. C. Hepburn).

b) Theses completed during the year:

Kiger, III, William S., "Developments in Micro- and Macro- Dosimetry of Boron Neutron Capture Therapy," Massachusetts Institute of Technology, Ph.D. Thesis, 2000.

Lewis, Matthew R., "The Behavior of Uranium in the Environment: Bacterial Reduction of an Aqueous Uranium Species," Massachusetts Institute of Technology, M.S. Thesis, 2000.

Kletskova, Tatyana, "Atomistic Modeling of Cation Exchange in Zeolitic Nuclear Waste Form," Massachusetts Institute of Technology, M.S. Thesis, 2000.

Fauchon, Celine, "Development and Testing of an Electrochemical Model for PWR Steam Generators Crevice Environment," Massachusetts Institute of Technology, M.S. Thesis, 2000.

Caputo, Daniel F., "Characterizing Actinide Transport and Speciation Using Nuclear Magnetic Resonance Tracer Technique," Massachusetts Institute of Technology, M.S. Thesis, 2000.

White, Susan Marie, "Biological Dosimetry of Neutron Beams for Neutron Capture Therapies," Massachusetts Institute of Technology, Ph.D. Thesis, 2001.

Cohen, Randi J., "Bacterial Reduction of Uranium and Plutonium," Massachusetts Institute of Technology, M.S. Thesis, 2001.

Min, Seung K., "Effect of Chemistry Modifications on the Oxygen-Induced Embrittlement of Incoloy Alloy 908," Massachusetts Institute of Technology, Ph.D. Thesis, 2001.

Riley, Kent J., "Construction and Characterization of a Fission converter Based Epithermal Neutron Beam for BNCT," Massachusetts Institute of Technology, Ph.D. Thesis, 2001.

Li, Qing, "Model-Based Fault Detection for a Nuclear Reactor," Massachusetts Institute of Technology, Ph.D. Thesis, 2001.

Buongiorno, Jacopo, "Conceptual Design of a Lead-Bismuth Cooled Fast Reactor with In-Vessel Direct-Contact Steam Generation," Massachusetts Institute of Technology, Ph.D. Thesis, 2001.

Curran, Virginia L., "Thorium Oxide Dissolution Kinetics for Hydroxide and Carbonate Complexation," Massachusetts Institute of Technology, M.S. Thesis, 2001.

Chowdhury, Zohir, "Advection of Airborne Particles from the Indian Subcontinent," California Institute of Technology (Ph.D. Thesis)

Haysom, Steven, "Geochemical Study of the Boston Blue-Clay and Selected Cambridge Argillite," Boston College (M.S. Thesis)

Hughes, Lara, "Effect on Global Climate of Airborne Particles Advected over the Indian Ocean," California Institute of Technology (Ph.D. Thesis)

c) Published papers and papers in preparation:

Bernard, J.A., et al., "License Requirements for the MITR Fission Converter," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.

Binello, et al, "B Uptake by Cells for Boron Neutron Capture Synovectomy," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.

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- Busse, P.M., et al., "Clinical Response and Normal Tissue Tolerance following Boron Neutron Capture Therapy for Melanoma, (to be published).
- Gonzalez, S.J., G. A. Santa Cruz, and C.-S. Yam, "NCTPlan, the New PC Version of MacNCT Plan Improvements and Validation of the Treatment Planning System, Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- Goorley, T., et al, "Reference Dosimetry Calculations for NCT with Comparison of Analytical and Voxel Models, "Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Goorley, T., R. Zamenhof, and H. Nikjoo, "DNA Damage from Incorporated Auger Emitting Radionuclides ^{157}Gd , ^{159}Gd , and ^{125}I ," Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- Harling, O.K, K.J. Riley, T.H. Newton, B.A. Wilson, S. Sakamoto and B. Sutharshan, "The New Fission Converter Based Epithermal Neutron Irradiation Facility for Neutron Capture Therapy," *Neutron News*, 12, No. 1, 24-26 (2001).
- Hsu, F.Y, C. J. Tun, D. E. Watt, R. R. Palmer, and R. G. Zamenhof, "Microdosimetry for Clinical BNCT Beams," Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- Kang, Haejin, C. S. Melhus, J. F. Copeland, R. G. Zamenhof, "Characteristics and Beam Modeling of a Mammography X-Ray Unit, "Characteristics and Beam Modeling of a Mammography X-Ray Unit" Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- Karabinos, P., et al, "Taconian Orogeny in the in Western New England," submitted to Geological Society of America, Field Trip Guidebook for 2001 Annual Meeting, Boston, MA, in press, 2001
- Kiger, W.S., et al, "Boron Uptake by Erythrocytes following Boronophenylalanine-Fructose Infusion in Humans, Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Kiger, W.S., et al, "Boron Microquantification in Oral Muscosa and Skin Following Administration of a Neutron Capture Therapy Agent," Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- Melhus, C. S., D.M. Cooper, and J. F. Copeland, "Too Light, Too Dark, Too Bad for Words to Describe; An Analysis of Retake Rates in Computed Radiography," Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.

- Newton, T.H., et al, "Modeling and Optimization of Tissue ^{10}B Concentration and Dosimetry for Arbitrary BPA-F Infusion Schedules in Humans," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
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- Riley, K.J., et al, "Collimator Optimization Studies for the New MIT Epithermal Neutron Beam," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Thompson, J.B., Jr., et al, "The Erving Formation revisited," Transactions of the American Geophysical Union, EOS, p. S359, 1999. (Invited presentation for symposium entitled "A matter of Scale-From Chain Silicate Crystal Chemistry to Paleo Plate Tectonics of the Northern Appalachians and Scandinavia: A special Session in Celebration of the Career of Peter Robinson).
- Shibata, Y., et al, "The Prediction of Boron Concentrations in Blood from Low Dose Infusions for Patients of Boron Neutron Capture Therapy," Presented at the Beth Israel Deaconess Medical Center Research Day, October 12, 2001.
- White, S.M., K. Held, M.R. Palmer and J.C. Yanch, "Biological Dosimetry for Epithermal Neutron Beams, Radiation Research, Vol. 155(6), pp. 778-784, 2001
- Wilson, B. A., et al, "Automatic Control and Monitoring of the MIT Fission Converter Beam," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Yu, E. F., et al., "Trapping Efficiency of Bottom-Tethered Sediment Traps Estimated from the Intercepted Fluxes Th-230 and Pa-231," in Deep-Sea Research: Part I, Vol 48, pp. 865-889, 2001
- Zamenhof, R.G., et al, "A Core Laboratory Offering Full Evaluation of New Boron Compounds: A Service to the BNCT Community," Presented at the Ninth International Symposium on Neutron Capture Therapy for Cancer, Osaka, Japan, 2000.
- Zamenhof, R.G., et al., "MacNCTPLAN: An Improved Macintosh Based Version of the Boron Neutron Capture Therapy Treatment Planning Program NCTPLAN," in press: *Medical Physics*.

Zuo, C., et al., "Proton NMR Spectroscopic Measurement of p,Boronophenylalanine (BPA): a Preliminary Study," in press: *Medical Physics*