Department of Energy
Brookhaven Site Office
P.O. Box 5000
Upton, New York 11973

APR 2 2010

Mr. Ian Smith, M.A.
Research Associate, Laboratory Investigations Division
People for the Ethical Treatment of Animals
501 Front Street
Norfolk, VA 23510

Dear Mr. Smith:

SUBJECT: U.S. DEPARTMENT OF ENERGY (DOE) FREEDOM OF INFORMATION ACT (FOIA) REQUEST NUMBER CH-2010-00884-F

I am the authorizing official responsible for making the determination required by Section 1004.5(b) of DOE regulations found at 10 CFR Part 1004, which implements the FOIA, 5 U.S.C. 552.

In your original FOIA request you were seeking, "copies of all internal and external documents -- including memos, letters, reports, emails and IACUC meeting minutes (including subcommittees) -- pertaining to radiation experiments on nonhuman primates at Brookhaven National Laboratory (BNL) (January 13, 2010 - present, including 2/4/10 IACUC meeting minutes)."

On March 16, 2010, in a phone conversation with DOE FOIA Officer, Ms. Miriam Legan, of the DOE Office of Science-Chicago Office (SC-CH), you narrowed your subject FOIA request to exclude the following records/information:

1. All records related to BNL spam e-mail/fax incident in February 2010 involving 5000+ emails and faxes received by BNL personnel containing a recurring message from In Defense of Animals voicing opposition to proposed study on monkeys.

2. All documents generated by the Physicians Committee for Responsible Medicine (PCRM)

3. All transmittal documents that relayed news articles on the proposed NASA monkey experiments.

4. All records related to PCRM and PETA FOIA requests.

5. 1/28/10 Brookhaven Site Office (BHSO) internal e-mail with contact information for NASA employee.

6. All information contained in BHSO Manager Updates to DOE Office of Science that relate to other activities unrelated to the proposed NASA monkey experiments.

On March 17, 2010, in your email response to Ms. Legan, you confirmed this narrowing in writing. Subsequently, on March 30, 2010, in a phone conversation with DOE FOIA Counsel, Megan Mikhail of SC-CH, you narrowed your request to exclude personally identifiable information including "the names of individuals and vendors, signatures, and initials, as well as contact information such as phone numbers, fax numbers, mailing addresses, and email addresses." On March 31, 2010, in your email response to Ms. Mikhail, you confirmed this narrowing in writing.

Be advised that the DOE Brookhaven Site Office and the Brookhaven Science Associates, LLC, the DOE management and operating contractor at the Brookhaven National Laboratory, searched the Brookhaven National Laboratory for records responsive to your narrowed request and located the enclosed responsive documents. Any additional redactions made are reflective of nonresponsive material. Therefore, this response represents our full release of DOE's responsive documents.

Copies of four other responsive documents were found that were parts of the subject original grant submittal to NASA: two documents are entitled "Research Statement," one document is entitled "Support," and one is a letter dated January 13, 2010, with subject line entitled, "Title of Application: Preclinical pharmacology of CNS drugs: Master Protocol #09-5/2-18." These documents are more appropriately considered NASA agency records. A copy of your FOIA request along with copies of these four documents has been referred to NASA for their action. A copy of our referral letter, without enclosures, is attached. Please note, the January 13th letter has been found to have been made publicly available by NASA at the following link: http://www.nasa.gov/centers/johnson/pdf/435686main_info_nonhuman_primates_space.pdf.

You would be categorized as an "Other" requester, and as such related costs for search and duplication of records would normally be charged. However, after review of the criteria you supplied in your request to support a fee waiver, on February 8, 2010, DOE SC-CH granted your fee waiver request, and accordingly, there are no fees associated with your request at this time.

If you have questions regarding this response, please contact DOE SC-CH FOIA Officer Miriam Legan at (630) 252-2041 or via e-mail at miriam.legan@ch.doe.gov.

Sincerely,

Michael D. Holland
Site Manager

Enclosure:
As Stated

PROPOSAL# _____

USER PROPOSAL AND REQUEST FOR BEAM TIME

DATE_____

Proposal Type: (check one) Animals X☐ Cell ☐ Physics ☐ Other ☐

Regular Proposals

__X__New Proposal

_____Replacement Proposal for Proposal #_____; Original proposal will become inactive.

_____Renewal Proposal

_____Request for Deferral

"Parasitic" Proposals (see Guidelines for Submission). Apply for beam in ONE run only.

_____New Proposal

_____Replacement proposal for proposal #_____; Original proposal will become inactive.

2. **Title of Experiment:** Ground-Based Studies in Neurobehavioral Biology
   Funding Source NASA
   Grant Title and Number Ground-Based Studies in Space Radiobiology; SK-09-278

3. **Principal Investigator** [redacted]
   Department [redacted]
   Institution [redacted]
   Mailing Address [redacted]
   Telephone [redacted]
   Fax [redacted]
   Computer Mail [redacted]

4. **BNL Account Number:** _____ **(See guidelines p iii)**

5. **Beam Time Request:**

   A. Requested period Fall 2010 NSRL-10C; Spring 2011 NSRL-11A; Summer 2011 NSRL-11B

   B. Requested ions & energies (for available ion/energy list, see Att.9; for beam information, see Att.6)

Fall 2010 NSRL-10C: Fe at 600 MeV/u

Spring 2011 NSRL-11A: Protons

Summer 2011 NSRL-11B: Si at 600 MeV/u

6. **Signature**

As Principal Investigator/Spokesperson for this proposal, I certify that everything in this proposal is accurate to the best of my knowledge and that my research team will abide by the rules and regulations at Brookhaven National Laboratory. I also certify that the worked described in the proposal is not proprietary and upon completion of research will be published in the open literature.

PI/Spokesperson Signature

[redacted]

Date 01/14/2010

7. Detailed Beam Request: SEE NSRL Beam Info Information, attachment # 6, and memo-NSRL Beams, attachment # 9.
Year: 2010 Cycle: ☐ Spring ☐Summer X Fall

Ion Species	Energy (MeV/amu)	Beam Time Requested (hr) ‡	Dose Rate Required¶ (Gy/min) MIN	MAX	Beam Diameter Required¶ (cm)	Beam Uniformity Required¶ (+/- %)	Dose Range
Fe	600	0.4	0.1	0.1	25	n.a.	0.1 Gy
Fe	600	0.66	0.1	0.1	25	n.a.	0.5 Gy

‡ From Beam Time Calculation Table or other calculation
¶ Enter "n.a." if not an applicable requirement (i.e., any available can be used) or a range of values if a particular value is not required.

Year: 2011 Cycle: X Spring ☐Summer ☐Fall

Ion Species	Energy (MeV/amu)	Beam Time Requested (hr) ‡	Dose Rate Required¶ (Gy/min) MIN	MAX	Beam Diameter Required¶ (cm)	Beam Uniformity Required¶ (+/- %)	Dose Range
Protons	1000	0.46	0.25	0.25	25	n.a.	0.5 Gy
Protons	1000	0.6	0.25	0.25	25	n.a.	1.0 Gy

‡ From Beam Time Calculation Table or other calculation
¶ Enter "n.a." if not an applicable requirement (i.e., any available can be used) or a range of values if a particular value is not required.

Year: 2011 Cycle: ☐ Spring X Summer ☐Fall

Ion Species	Energy (MeV/amu)	Beam Time Requested (hr) ‡	Dose Rate Required¶ (Gy/min) MIN	MAX	Beam Diameter Required¶ (cm)	Beam Uniformity Required¶ (+/- %)	Dose Range
Si	600	0.4	0.1	0.1	25	n.a.	0.1 Gy
Si	600	0.66	0.1	0.1	25	n.a.	0.5 Gy
Controls	n.a.	1.0	n.a.	n.a.	n.a.	n.a.	n.a.

‡ From Beam Time Calculation Table or other calculation
¶ Enter "n.a." if not an applicable requirement (i.e., any available can be used) or a range of values if a particular value is not required.

D. List equipment and materials to be provided by beamline.

No equipment or materials are needed from the beamline.

E. List materials and equipment that you will bring.

Monkeys temporarily residing in the BNLF will be brought to the experimental room for exposure. Each subject will be placed in a customized, well-ventilated plastic chamber (25 x 25 x 25 cm) that will be positioned inside the radiation field. We have constructed the chamber to meet the requirements of the radiation field.

F. Indicate requirements for special equipment or facilities.

No special equipment or facilities are required. Our laboratory will provide BNLF with all the equipment and facilities necessary for the proper care of our animals.

8. Personnel (PROVIDE INFORMATION FOR ALL PERSONNEL WHO WILL PARTICIPATE IN EXPERIMENTS AT THE NSRL or AGS; use additional sheet(s) if necessary)

Role	Name	Citizenship(s)	Address	Phone	Email	FAX
PI	[redacted]	US	[redacted]	[redacted]	[redacted]	[redacted]
Spokesperson	[redacted]	UK	[redacted]	[redacted]	[redacted]	[redacted]
Coworker	Research Assistant	US	[redacted]	[redacted]		[redacted]
Coworker	Research Assistant	US	[redacted]	[redacted]		[redacted]

9. Controlled Research Issues/Hazardous Materials

PLEASE REVIEW NEW SBMS FOR RESEARCH INVOLVING ANIMALS AT LINK BELOW: (https://sbms.bnl.gov/sbmsearch/subjarea/149/149_SA.cfm)

A. Will you use **ANIMAL SUBJECTS**? Y
Species: *Saimiri sciureus* – Squirrel Monkeys
Number of Subjects: 30
Current Home Institution IACUC Status: Approved Y Date 01/13/10 Protocol #: 09-5/2-18
Application Submitted: Y/N Date_____
Current BNL IACUC Status: Approved: Y/N Conditioned Approval Date 01/11/10 Protocol #: 405
Application Submitted: Y/N Date

B. Will you use **HUMAN TISSUES OR CELLS**? No.
Tissue/Cell Line
Name(s)_____
Current Home Institution IRB Status: Approved Y/N Date_____ Protocol #:_____
Or Application Submitted: Y/N Date_____
Current BNL IRB Status: Approved: Y/N Date _____ Protocol # _____
Or Application Submitted: Y/N Date _____

C. Will you use **RECOMBINANT DNA**? No
Current BNL RAC Status: Approved: Y/N Date _____ Protocol# _____
OR Application Submitted: Y/N Date_____

D. Will you generate **MEDICAL WASTE**? No

E. List all RADIOACTIVE MATERIALS, BIO-HAZARDOUS MATERIALS, TOXIC OR EXPLOSIVE SUBSTANCES, HAZARDOUS PROCEDURES you will use.

N/A

10. Are there experimental samples or items that must be transported AWAY FROM BNL?

X Yes ☐ No

(If Yes, check all that apply)

☐ Radioactive Samples or Items (Must arrange transportation via BNL Supply & Materiel Group)
Describe Samples or Items:
N/A

☐ Hazardous Materials (Must arrange transportation via BNL Supply & Materiel Group)
Describe Samples or Items:
N/A

☐ Biological Samples
Which type of transport method will be used:

- ☐ Ground Transportation (Vehicle driven by Researcher)
- X Shipment via Contract Carrier (UPS, FedEx, etc)
- ☐ Hand Carried on Commercial Aircraft

Describe Samples or Items: (Identify any special TSA/Customs handling/inspection requirements, ie; light sensitive, cannot be x-rayed):

30 awake freely moving adult male squirrel monkeys will be transported from McLean Hospital, Belmont, MA, 02478 to BNL and back to McLean Hospital by a contract carrier. We anticipate five separate trips to and from BNL (six monkeys per trip). Prior to each trip, the attending veterinarians at McL ([redacted] and BNL ([redacted]) will conduct pre-transport evaluations of all subjects, including physicals and laboratory tests to establish their pre- and post-radiation clinical profiles, and issue required health certificates. A McL-approved vendor ([redacted]) will transport monkeys to and from McL and BNL. In addition to customized travel crates designed for squirrel monkeys and safe passage, food and water will be provided to monkeys *ad libitum* throughout the shipping process.

11. DESCRIPTION OF RESEARCH:

A. EXPERIMENTAL PROPOSAL

Title of proposal (new). Ground-Based Studies in Neurobehavioral Biology

Overview of Project. NASA has identified the need for studies of long-term effects of exposure to space radiation [galactic cosmic rays (GCRs) and solar particle events (SPEs)] on central nervous system (CNS) function. The present information gap significantly hinders NASA's ability to realistically estimate radiation risk associated with human space exploration and, consequently, impedes the development of future human deep space missions. To begin to address this urgent need, we propose to evaluate the long-term impact of ^{56}Fe, proton, and ^{28}Si radiation on *in vivo* CNS function in nonhuman primates. We plan to employ neurobehavioral procedures to systematically analyze aspects of motivation and cognition over a period of three to four years after irradiation with two different doses of ^{56}Fe, proton, and ^{28}Si. These procedures are thought to involve specific neurochemical systems and will allow us to: 1) monitor changes in overt nonconditioned behavior and changes in performance on motivation-related and cognitive behavioral tasks, and 2) evaluate how irradiation may alter the effects of drugs that act selectively through neurochemical mechanisms implicated in motivational or cognitive processes. Our studies in monkeys will yield, for the first time, information in primates that is essential to estimating long-term risks of space radiation to CNS function in humans. Overall, this research will accelerate NASA's Space Radiation Program in an efficient and easily translational manner.

Background and Significance. The long-term risk of neurobiological damage to humans induced by space radiation during deep space travel is the most poorly explored health risk in ground-based studies of space radiobiology. Future deep space missions require travel beyond the Earth's protective magnetic field. Such continuous exposure leads to different types of space radiation hazards such as GCRs and SPEs, which consist of particles of high energy and charge (HZE) and protons. Exposure to these radiations may pose a significant health risk for astronauts and, notably, low doses of GCRs or proton exposure caused by SPEs may be the primary sources of space radiation hazards on long duration missions. Recent studies suggest that the CNS, like the gastrointestinal tract, may be a radiosensitive organ. Thus, exposure to these types of space radiation, in addition to jeopardizing mission success, may cause considerable and potentially long-term damage to the astronaut's normal CNS functioning and overall health. Although astronauts will be exposed to low doses of HZE particles and protons during deep space travel, studies to date have primarily focused on the short-term CNS effects of high doses of HZE's and protons. Surprisingly little information is available on the long-term CNS consequences of different types of space radiation with exposures that may be more representative of a space radiation environment. This information gap has significantly hindered NASA's ability to realistically estimate radiation risk associated with human space exploration and, consequently, impedes the development of future human deep space missions. The proposed studies will address this information gap with a set of *in vivo* procedures in monkeys developed to examine the long-term effects of GCRs and SPEs on CNS function.

Early work indicated that exposure to radiation can lead to disruption of motor function and schedule-controlled operant behavior, as well as, decreases in non-conditioned activity (i.e., aggressive, defensive, ambulatory, and rearing behaviors). Recent studies have directly evaluated the effects of ground-based models of space radiation on different neurobehavioral processes, e.g. reactivity to stimuli, motivation, cognition, and mood. Generally, these studies have shown that exposure to HZE, but not protons, can produce profound deficits in both simple and complex behaviors that provide a measure of motor and cognitive functioning, and that these changes may be similar to those observed in aging. Several studies have related the behavioral consequences (i.e., DA-mediated behavioral endpoints that are associated with motoric and cognitive functions) of HZE particle and proton radiation exposure to *in vitro* neurochemical (DA) changes within the CNS. These studies have yielded mixed results. For example, previous studies provide some evidence for a relationship between radiation-induced damage to the brain DA neurotransmitter system and deficits in DA-mediated motor and cognitive behavioral measures. They report that the observed behavioral and neurochemical deficits are not dose-related but are evident following a threshold radiation dose below which there are no effects. Additionally, these deficits occur quickly following HZE (^{56}Fe) radiation and fail to dissipate afterward. These investigators also report a lack of association between the LET (linear energy transfer) of HZE particles and their relative effectiveness in disrupting behavior or DA regulation. However, results of other studies are not consistent

with this view. Exposure to ^{56}Fe particles failed to alter the density of brain DA transporters, and altered cocaine-induced effects on locomotor activity but did not alter other DA-mediated behaviors. The paucity of other data on the behavioral and neurochemical effects of space radiation makes it difficult to reconcile these varying findings, which may reflect differences in behavioral and neurochemical procedures.

The above studies clearly indicate that further neurobiological research on the short- and long-term effects of HZE particle and proton radiation is critical to the advancement of NASA's Space Radiation Program. Notably, the above results have mainly been obtained from rodent studies or *in vitro* tissue preparations. These studies provide a strong initial foundation for further work to effectively and efficiently evaluate the long-term effects of exposure to GCR and SPE radiation on neurobehavioral processes and CNS function. Our ground-based studies in monkeys are designed to enhance our understanding of the CNS-mediated behavioral effects of space radiation. This work in primates should significantly advance NASA's mission of estimating and reducing the uncertainties associated with space radiation exposure during deep space missions.

Program Objective. The overall objective of our program is to obtain data from studies in nonhuman primates that help predict long-term deleterious effects of space radiation on CNS function in humans. We propose to undertake this effort with neurobehavioral pharmacological studies in monkeys to evaluate the long-term (4 yrs) effects of exposure to two doses of ^{56}Fe ion (0.1 or 0.5 Gy), protons (0.5 or 1.0 Gy), or ^{28}Si ion (0.1 or 0.5 Gy).

Specific Aims. Specifically, we will determine whether and how exposure to ^{56}Fe, ^{28}Si, and protons alter the effects of receptor-selective drugs that target different brain systems implicated in overt behavior, motivational processes, and cognitive processes. Additionally we will examine changes in lenticular protein aggregation.

Hypotheses. Although the absence of comparable studies in other species does not permit confident prediction, we anticipate that exposure to ^{56}Fe, ^{28}Si, and protons will alter the DA pharmacology associated with overt behavior, motivational, and cognitive processes in monkeys. We expect corresponding increases in lenticular protein aggregation.

Relevance, Significance and Feasibility. Our overall research strategy is based on observations that exposure to high doses of GCR and SPE leads to short- and long-term changes in CNS processes. These findings come mainly from *in vitro* preparations or neurobehavioral assays in rodents, and provide a strong foundation for further assessing the immediate and long-term CNS effects of space radiation. Cognizant of anatomical and functional variations across species that limit extrapolation of laboratory data from rodents to nonhuman primates or humans, our approach will employ well-established procedures in nonhuman primates to study the effects of ^{56}Fe, ^{28}Si, and proton radiation on CNS function.

Relevance. There presently is little understanding of potential long-term neurobehavioral consequences of exposure to space radiation. In this regard, NASA's Space Radiation Program has identified studies of immediate and late (i.e., long-term) effects of space radiation on CNS functions as a major research focus. The relevance of our proposed research is that we will directly address this need with ground-based studies in monkeys to examine the long-term effects of HZE and proton radiation in neurobehavioral assays of motivational and cognitive processes. In addition, our proposed experiments will investigate the utility of non-invasive assessment of molecular pathology in the lens of the eye as a stable quantitative marker of exposure to biologically relevant radiation. In conjunction, this information will help advance NASA's ability to predict the long-term CNS risks of space radiation for astronauts. **Significance.** To our knowledge, the neurobehavioral effects of exposure to space radiation have not been previously examined in nonhuman primates. Overall, a highly significant aspect of our proposal lies in our use of nonhuman primates. Several features of nonhuman primate research facilitate the translation of experimental results to humans with reasonable predictive validity. For example: 1) nonhuman primates and humans are similar in their genetic, physiological, pharmacokinetic, and neurobiological characteristics; 2) within-subject designs similar to those used in human laboratory studies permit meaningful conclusions or inferences to be based on the evaluation of all treatment effects in individuals as well as in groups; and 3) nonhuman primates are reliable subjects in long-term behavioral and pharmacological studies. Considerations such as these suggest that nonhuman primates are especially well-suited for ground-based research to study long-term neurobehavioral effects of space radiation. Previous reports suggest that HZE particle radiation may have deleterious effects on DA function. Thus, we have chosen to first evaluate the long-term consequences of exposure to ^{56}Fe, ^{28}Si, and proton radiation on CNS DA-related systems. Studies of overt behavior outlined in **Specific Aim 1** will enable us to determine whether exposure alters

the effects of DA receptor subtype-selective drugs or of drugs that activate DA receptors indirectly. The significance of these studies is that they will advance NASA's Space Radiation Program in a manner that is logically based on previous findings of DA-related abnormalities and that is highly translational. Under **Specific Aims 2 and 3**, we will employ operant procedures that are widely acknowledged to measure aspects of motivation and cognition. These procedures also have been used to study the effects of receptor-selective drugs that act through CNS systems implicated in these neurobiological processes. Our proposed research will use this pharmacological approach to analyze the long-term effects of exposure to radiation on motivation and cognition by evaluating changes in baseline performance over time, and by comparing pre- and post-exposure effects of receptor-selective drugs. The significance of these studies is that they will provide data in nonhuman primates that will lead to more accurate prediction of long-term effects of space radiation on motivational and cognitive processes. Finally, in **Specific Aim 4** we will test a recently-developed innovative laser-based diagnostic procedure to non-invasively measure molecular pathology (e.g., radiation-induced protein denaturation, aggregation, crosslinking) within the nonhuman primate lens as a function of radiation dose, type, and post-exposure time. The significance of this work is that it will permit meaningful quantitative analyses of cause-effect relationships between radiation dose and effects in neurobehavioral studies in monkeys. Taken together, the results of these studies will provide previously unavailable information on the long-term CNS effects of ^{56}Fe, ^{28}Si, and proton radiation in nonhuman primates. Regardless of study outcomes, such quantitative and qualitative neurobehavioral and neuropharmacological data will be uniquely valuable to two stated goals of NASA's Space Radiation Program: a) significant progress toward estimating space radiation risks to humans and b) development of a strong and clear foundation for NASA to successfully design future human deep space missions. **Feasibility.** Given that similar ground-based studies in space radiobiology have not been previously conducted in nonhuman primates, it is important to recognize the feasibility of our planned research. Our research group includes investigators with as much as 30 years of experience in conducting complex behavioral pharmacology studies in nonhuman primates ([redacted], radiation biology expertise in cellular and molecular CNS effects of space radiation, ([redacted]). With regard to our proposed neurobehavioral studies, we have substantial experience in studying drug effects on overt behavior in squirrel monkeys (**Specific Aim 1**), and we have demonstrated that different types of DA receptor-related drugs exhibit unique and characteristic behavioral profiles. Our laboratory also has extensive experience in training nonhuman primates in complex behavioral tasks that are used to measure both motivational and cognitive processes (**Specific Aims 2** and **3**). For example, we currently are conducting studies in squirrel monkeys using PR performance as an index of motivation and we have recently trained monkeys to leverpress or withhold leverpressing depending on the color of visual stimulus lights as a measure of impulsivity. Based on our extensive experience in training squirrel monkeys to perform these and other complex behavioral tasks, we do not anticipate methodological problems in achieving the goals of this application. Regarding **Specific Aim 4**, our project team has substantial experience in using QLS instrumentation to investigate the molecular architecture of the lens in rats, mice, nonhuman primates, and humans. Finally, to further ensure that the NASA Space Radiation Laboratory (NSRL) at Brookhaven National Laboratory (BNL, NY) can support our planned studies in nonhuman primates, we have visited [redacted] (a consultant on our proposal) and [redacted] (BNL Animal Facility Manager). Following careful inspection of the NSRL and the animal care facility at BNL, and as well, discussion with [redacted] and [redacted], we are highly confident that: 1) the irradiation of squirrel monkeys at NSRL will be conducted without difficulty; and 2) our subjects will be properly housed and maintained at BNL during the irradiation protocol.

List three (3) of your publications, which will assist the Review Committee in evaluating your work.

1) Rosenzweig-Lipson S, Hesterberg P, Bergman J (1994) Observational studies of dopamine D_1 and D_2 agonists in squirrel monkeys. *Psychopharmacology* 116: 9-18

2) Desai RI, Neumeyer JL, Paronis CA, Nguyen P, Bergman J (2007) Behavioral effects of the R-(+)- and S-(-)-enantiomers of the dopamine D(1)-like partial receptor agonist SKF 83959 in monkeys. *European Journal of Pharmacology*. 558:98-106.

3) Goldstein, LE, Muffat JA, Cherny RA, Moir RD, Ericsson MH, Huang X, Mavros C, Coccia JA, Faget KY, Fitch KA, Masters, CL, Tanzi RE, Chylack Jr LT, Bush AI (2003) Cytosolic β-amyloid deposition and suparnuclear cataracts in lenses from people with Alzheimer's Disease. *Lancet* 361:1258-1265

Previous accelerator experience (1 paragraph maximum)

None.

Accelerator experience will be provided by [redacted] and [redacted] at NSRL/BNL.

B. BEAM TIME REQUEST

EXPERIMENTAL PLAN:

This proposal is designed to obtain critical information on the long-term effects of space radiation on the CNS in squirrel monkeys. The intended studies will utilize neurobehavioral pharmacological procedures with which we have extensive (>30 years) experience.[25-27,39,110,113] Using a within-subjects design, data for all studies will be obtained before and after exposure to two different doses of ^{56}Fe, ^{28}Si particles and protons each (n=4/radiation type); a separate control group of squirrel monkeys (n=6) also will be tested but will not be exposed to any radiation particles. During pre-exposure testing, the operant condition will remain constant for each monkey in each of three rounds of testing; in the first round, the effects of drugs on overt behavior will be studied one week and the effects of drugs on motivational performance will be studied the following week, until all drug effects have been determined in both experiments. Subsequently the effects of drugs will be re-determined on the cognitive tasks. In each operant condition, drug test sessions will follow two or more control sessions of stable performance. After initial testing of a drug, its effects will be re-determined in subjects for which data lie outside the 95% confidence interval of grouped values. Based on previous experience, we expect that the effects of each drug will be reproducible in individual subjects over time and repeated testing (i.e., limited, if any, sensitization or tolerance). Following completion of these studies, we will expose subjects to ^{56}Fe ion or proton radiation; the last group of monkeys will be exposed to ^{28}Si ion. After radiation exposure and return of subjects to the vivarium at McL, behavioral experiments will resume and the effects of all drugs on each behavioral endpoint will be periodically re-determined. Data with each drug under all behavioral procedures will be obtained prior to exposure and at least twice during the remainder of the project period (i.e. Years 2-4) following exposure.

UTransportation and Irradiation Procedure.U After pre-radiation studies are completed, monkeys will be transported to NSRL/BNL for irradiation. We anticipate five separate trips to BNL (six monkeys pre trip). Prior to each trip, the attending veterinarian at McL [redacted]) will conduct pre-transport evaluations of all subjects, including physicals and laboratory tests to establish their pre-radiation clinical profiles, and issue required health certificates. A McLean-approved vendor [redacted]) will transport monkeys to BNL. In addition to customized travel crates designed for squirrel monkeys and safe passage, food and water will be provided to monkeys *ad libitum* throughout the shipping process. Upon arrival at BNL, monkeys will be transferred to the BNL animal facility under the oversight of [redacted] Subjects will be allowed to acclimate in the BNL animal facility for at least one week prior to radiation exposure. During that time, they will be under the direct care of BNL staff, headed by [redacted] (Animal Facility Manager) and [redacted] (Attending Veterinarian). Food, enrichment, and all instructions for the proper care of squirrel monkeys will be provided by our laboratory. A BNL IACUC approval for transfer of monkeys and irradiation protocol is currently under review. All irradiations will be performed in accord with BNL safety policies and procedures, and guided by BNL scientists.

In the present proposal, two doses of each radiation type will be studied. Separate groups of monkeys (n = 4) will be exposed to two doses of protons (0.5 and 1.0 Gy) at a dose rate of 0.25 Gy/min and two doses of ^{56}Fe or ^{28}Si particles (0.1 and 0.5 Gy) at a dose rate of 0.1 Gy/min with energy levels of a 1000 (protons) and 600 (HZEs) MeV/u, respectively; a control group (n = 6) will be subjected to identical experimental conditions, except that they will not be exposed to any particle radiation. The total beam time necessary to conduct irradiations in all 30 subjects will be approximately 402-min, assuming a 5-min entry and exit time from the NSRL irradiation facility per subject; beam time calculations are based on the above described doses of each particle and its associated dose rate/min, and are shown in the Table below. The radiation beams and doses have been selected after consultation with NASA and BNL scientists and will provide information needed to fill critical gaps in NASA's deep space travel data base. The 60 x 60 cm^2 radiation field will be used for all irradiation procedures, which are scheduled to begin in year 2 of our protocol. Briefly, monkeys will be placed individually in a custom made plastic chamber (25 x 25 x 25 cm) that will be positioned securely and comfortably inside the radiation field perpendicular to the beam. Freely moving monkeys will receive full body exposure to the different types of particle radiation described above. This is intended to realistically simulate the space radiation environment experienced by astronauts during deep space travel. To accurately calculate the radiation dose absorbed by an internal organ/tissue the position of all subjects will be photographed or video taped during the irradiation procedure. We note that the activation decay times for the highest dose of protons, ^{56}Fe, and

^{28}Si particles to be considered non-dispersible are approximately 140, 36, and 30 min, respectively (see BNL website: HUhttp://www.bnl.govUH for further details on activation decay times). Materials exposed to radiation in the BNL target room will be considered radioactive until surveyed and released by a BNL Radiological Controls Technician. Monkeys will be considered non-dispersible and will require no special radiological handling, after the de-activation time has elapsed following exposure (i.e. after approximately 140 min). Appropriate biological handling techniques including radiological training (Radworker and Radiobiology Users Training) and a radiation work permit will be obtained from BNL by [redacted] and trained technicians as needed. All experimental procedures at BNL and at McL will be carried out by [redacted] and trained technicians. Following radiation exposure, monkeys will remain at BNL for a period of at least one week. During this time, all monkeys will be monitored by BNL veterinary staff, who will issue health certificates for their return to McL. [redacted] will again be present during the transfer of monkeys back to McL, where the attending veterinarian will oversee the re-introduction of monkeys in the vivarium. Once fully re-situated, monkeys will be tested periodically and on a long-term basis, i.e., up to 3–4 years following exposure to ^{56}Fe, ^{28}Si particles and protons.

b. Beam time calculation (include table or other calculation; See page 2.). Also place request on page 1, item 4, of User Proposal.

	Dose (Gy)	Dose rate (Gy/min)	Irrad Time (min)	Cave Access (min)	Access + Irrad (min)	# irrad	Time required (min)	Total Times
^{56}Fe	0.1	0.1	1	5	6	4	24	24
^{56}Fe	0.5	0.1	5	5	10	4	40	40
^{28}Si	0.1	0.1	1	5	6	4	24	24
^{28}Si	0.5	0.1	5	5	10	4	40	40
Protons	0.5	0.25	2	5	7	4	28	28
Protons	1.0	0.25	4	5	9	4	36	36
Controls	0	0	5	5	10	6	60	60
Set Up + Dosimetry						5	150	150
						SUBTOTAL	402	402

^{56}Fe: n = 4 monkeys/dose
^{28}Si: n = 4 monkeys/dose
Protons: n = 4 monkeys/dose
Controls: n = 6 monkeys
Assuming a 5 min entry/exit time per subject.
Assuming 30 min for set up and dosimetry per 5 trips = 150 min

C-A OPERATIONS PROCEDURES MANUAL

ATTACHMENT

9.2.1.g NSRL Users Experimental Safety Approval Form

C-A OPM Procedures in which this Attachment is used		
9.2.1		

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: _____ _____
Collider-Accelerator Department Chairman Date

[redacted]

NSRL USERS EXPERIMENTAL SAFETY APPROVAL FORM

You must complete this form for all work listed on the proposal, not for any individual runs.

1. NSRL PROPOSAL NUMBER: ***Date Submitted:***

Expected Start Date:

2. EXPERIMENT TITLE:

Ground-Based Studies in Neurobehavioral Biology

3. CONTACT PERSON FOR QUESTIONS REGARDING THIS EXPERIMENT:
Name of Person: [redacted]
Phone Number (home institution): [redacted]
Email: [redacted]

4. EXPERIMENTERS *who will be working on this project. Indicate Principal Investigator. All experimenters must satisfy all training requirements for the experiment.*

[redacted]	[redacted] (PI)	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] (Co-I/Science PI)	[redacted]	[redacted]	[redacted]
[redacted]	[redacted] (Consultant)	[redacted]	[redacted]	[redacted]

5. TASK AND HAZARD ANALYSIS: Discuss what you will bring to BNL, how it will be shipped here, what special precautions you will take when using it and transporting it on-site, and how it will be disposed of and/or shipped back to your home institution. Include Radioactive items, materials and samples, hazardous materials, as well as non-radioactive and non-hazardous items and materials.
We will be supplying the BNL animal facility with 2 racks consisting of 6 squirrel monkey home cages each. In addition, we will provide BNL/NSRL with 6 transfer cages to transfer monkeys to and from the BNL and NSRL facilities. We will also provide NSRL with 2 custom-made plastic chambers in which monkeys will receive particle exposure.

6. MATERIALS TO BE USED Please use only the minimum quantity and the least hazardous chemicals available to do your experiment successfully:

6a) CHEMICALS: List all chemicals including toxic and experimental substances, controlled substances, compressed gases, and cryogens: N/A

[redacted]					

6b) BIOLOGICALS: List all animals, cell lines (and note if they are primary or not), blood or body fluids, viruses, viable bacteria, or toxins of biological origin. Please list detailed description of organisms below. You may need Institutional Animal Care and Use Committee (IACUC), Institutional Biosafety Committee (IBC) and/or Institutional Review Board (IRB) Approval:

Saimiri sciureus	Squirrel Monkeys: n = 30	Return to Home Institution- [redacted]	[redacted] IACUC Protocol Approved. BNL-IACUC Protocol is under review.

6c) RADIOACTIVE MATERIALS: List any radioactive materials, include any handling of activated materials:

Squirrel Monkeys	30	NSRL/Medical	NSRL/Medical	Return to Home Institution	
Plastic Experimental Chambers	2	NSRL/Medical	NSRL/Medical	Return to Home Institution	
Transfer Cages	6	NSRL/Medical	NSRL/Medical	Return to Home Institution	

If you are required to handle materials shortly after beam exposure (activated materials) indicate time frame required:

150 min	Squirrel Monkeys; Plastic Experimental chambers and transfer cages.

7. EQUIPMENT: List any equipment you will bring to BNL. Please list where you will use it (NSRL, Medical, Biology). Listing of Potentially Hazardous Equipment Must Include: electric equipment not UL approved or certified to meet National Electrical Code, electronic equipment, detectors with flammable gases and flammable gas targets, flammable-combustible (e.g. plastic detector materials), samples, reactive metals etc, lasers, ovens, pumps, cryostats, pressure devices or pressure vessels, vacuum windows or vacuum vessels, liquid or gas mixing or containment systems, UV lamps, high-temperature devices, material handling devices, solenoids, spectrometer magnets, structures supporting heavy loads, compressed air or gas systems, RF or microwave devices, sound systems or noise greater than 85 dBA, items that emit liquids, gases, or vapors from the experiment, welding or burning tools,

mercury containing devices, or any equipment or activities that require special written procedures by the User.

Description:
Two stainless steel racks with a capacity to house six squirrel monkeys each. Both cages will be located within the Brookhaven National Laboratory Animal Facility. The purpose of these two cages is to house monkeys daily pre- and post-radiation exposure during their time at BNL.

Six stainless steel cages (25 x 25 x 25 cm) that will be stored at the Brookhaven National Laboratory Animal Facility. These cages will be used to transfer monkeys from the animal facility to the NSRL for radiation exposure.

Two plastic chambers (25 x 25 x 25 cm) that will be stored at the NSRL facility. Freely moving squirrel monkeys will be placed in these chambers during exposure to ionizing radiation.

8. WASTES: (including clean waste, hazardous waste, radioactive waste, medical/biohazard waste.)
N/A

9. USER COMMENTS:

10. ***TRAINING: Training requirements for each experiment will be posted on the NASA website. Listed below are the specific training requirements based on the work to be performed.***
For return users, you may check your training status on-line at http://training.bnl.gov **to see which courses you need to complete again.**
All NSRL Users must complete the following 4 courses:

1. **C-A Radiobiology Users Training**
   - Initial training - Classroom training necessary - contact [redacted] for schedule.
   - Renewals- every 24 months, complete Challenge exam at http://training.bnl.gov (study guide is available), or repeat classroom training.

2. **Radiological Worker 1**
   - Part 1 can be done on-line at http://training.bnl.gov
   - Part 2 consists of a challenge exam to be taken at BNL. Study guide is at http://training.bnl.gov

   (Note: If you are from another DOE facility you can apply for DOE Radiation Worker Reciprocity by completing exemption form).
3. **Cyber Security online at** http://training.bnl.gov. Initial training only (no requalification required)
4. **Guest Site Orientation online at** http://training.bnl.gov. Initial training only (no requalification required)

In addition, ALL participants using laboratory facilities in the Medical or Biology Departments must complete the following.
If you are using chemicals, as noted in this experimental safety review, you must complete the following on-line courses

- Laboratory Standard (required every two years)
- Hazardous Waste Generator (required annually)
- Regulated Medical Waste Generator Training (initial training only)

If you are using Human blood, tissues, or primary human cells:

- Bloodborne Pathogens Training (required annually)

If you are using cryogens (liquid nitrogen or helium), you must complete the following on-line course:

- Cryogen Safety Awareness (initial training only)

If you are using compressed gases, you must complete the following on-line course:

- Compressed Gas Safety (initial training only)

If you are using dispersible Radioactive Materials such as tagged cells, or will handle your samples while activated from beam exposure, you must complete the following:

- Radioactive Waste Generator (HP-RADIGEN) available on-line
- Benchtop Dispersibles Training (required every two years) - contact [redacted] to arrange for course)

If you are using Animals:

- Laboratory Animal Training (LAT I): will be administered upon arrival. (Initial training only, no requalification)

If you are using Controlled Substances:

- Controlled Substance Awareness
- DEA Background Check: Contact Medical Chairman's Office at [redacted]

ALL USERS MUST READ AND SIGN THE <u>LOW HAZARD-SKILL OF THE CRAFT WORK PLAN</u> SPECIFIC FOR THE EXPERIMENTAL RUN THEY ARE ATTENDING

[redacted]

SIGNATURE: _____

Life Sciences Experimental Review Committee
Designee Approval:

C-A Experimental Safety Review Committee
Designee Approval:

Environmental Safety &Health Staff Comments and Requirements:

Approval Date

Minutes of the BNL Institutional Animal Care and Use Committee
February 4, 2010

Present: [redacted]

Secretary: [redacted]
Guest: [redacted]
Excused: [redacted]

The meeting was held in the 490D Conference Room in Building 490 and was called to order at 1:05 pm by [redacted] Chair.

[redacted] updated the IACUC regarding two FOIA requests, a request to attend the IACUC meeting by a PETA member and letters of concern regarding [redacted]'s protocol involving squirrel monkeys. The letters referenced gamma irradiation which is not being done at BNL and drugs that are not being used in the BNL portion of the protocol. A discussion was held on the question of whether the IACUC should require IACUC approvals from collaborating institutions. There is no federal requirement to obtain collaborating approvals, it is the PI's responsibility to ensure he has the appropriate approvals for any animal work being done. It was suggested to modify the BNL application form to request the investigator's home institution IACUC protocol number and approval dates.

[redacted] left at 1:20 pm

Animal Care and Use Program for review:

[redacted] – Part I A-K, Part II A.1.a-A.1.c
[redacted] – Part II, A.1.d-A.1.e, A-2, A-3
[redacted] – Part II A.4
[redacted] – Part II B
[redacted] – Part II C
[redacted] – Part II D

All reviewers submitted their comments to [redacted] who will incorporate them into the Program.

Actions Taken Since the Previous IACUC Agenda:

IACUC Protocol [redacted]

Old Business

Minutes of the January 7, 2010 IACUC meeting approved as submitted.

New Business

IACUC Protocol [redacted]

non-responsive

non-responsive

[redacted]

There being no further business, the meeting adjourned 2:20 pm and IACUC members toured the BLAF and NSRL.

Respectfully submitted,

[redacted]

cc: [redacted]

DRAFT

From: [redacted]
Sent: Friday, February 05, 2010 11:42 AM
To: [redacted]
Subject: BHSO Update

[redacted]

NASA Research Protocol Issue – BHSO has prepared a response to the FOIA request from People for the Ethical Treatment of Animals (PETA) seeking copies of documents related to nonhuman primate research protocols conducted at BNL's NASA Space Radiation Laboratory (NSRL). Our response is due by Thursday, February 11th. BHSO is coordinating the response with all stakeholders, including SC and NASA.

[redacted]

BHSO Page 2
2/5/10

[redacted]

[redacted]

From: [redacted]
Sent: Monday, March 01, 2010 2:05 PM
To: [redacted]
Subject: FW: IDA/IPPL Complaint to BNL Review Committees, RE: Primate Irradiation Experiment
Attachments: nasa_complaint_bnl.pdf; ATT350781.txt

From: [redacted]
Sent: Wednesday, February 24, 2010 9:28 AM
To: [redacted]
Subject: FW: IDA/IPPL Complaint to BNL Review Committees, RE: Primate Irradiation Experiment

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From: [redacted]
Sent: Friday, February 12, 2010 8:18 AM
To: [redacted]
Subject: FW: IDA/IPPL Complaint to BNL Review Committees, RE: Primate Irradiation Experiment

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eklein

From: [redacted]@earthlink.net [mailto:eklel@earthlink.net]
Sent: Thursday, January 21, 2010 4:44 PM
To: [redacted]
Subject: IDA/IPPL Complaint to BNL Review Committees, RE: Primate Irradiation Experiment

Dear [redacted]

Below please find the text of the complaint IDA and IPPL are filing with the BNL Institutional Animal Care and Use Committee, Experimental/Science Review Committee, and the Safety Committee. Please provide this complaint to the members of these Committees. We have also attached our complaint in .pdf format. If you have any questions or need any further information, please don't hesitate to contact me at 717-939-3231. Thank you for your consideration.

Sincerely,

Eric Kleiman
IDA Research Director
717-939-3231

In Defense of Animals
International Primate Protection League

January 21, 2010
VIA email

Institutional Animal Care & Use Committee

Experimental/Science Review Committee
Safety Committee
c/o [redacted]
[redacted]
Brookhaven National Laboratory
[redacted]

RE: NASA-Sponsored Irradiation Study on Squirrel Monkeys

Dear BNL Committees:

Please consider this an official complaint filed by In Defense of Animals, a nonprofit animal advocacy and rescue organization based in San Rafael, California, and the International Primate Protection League, a nonprofit grassroots organization based in Summerville, SC dedicated to protecting the world's remaining primates, great and small. Please also consider this a petition to your lab to refuse approval for NASA-sponsored radiation experiments on squirrel monkeys.

We are appalled by and opposed to these experiments. As well as being inherently inhumane, we believe these experiments are scientifically worthless. In light of previous studies, species discrepancies, USDA Policy 12 and research alternatives, the proposed experiments appear to our organizations to be duplicative, flawed, unnecessary, and possibly violate the Animal Welfare Act.

Inherent Inhumanity

The protocol of the proposed experiments involves dosing monkeys with gamma radiation and assessing its behavioral effects by testing task performance. Whether or not the experiments are determined to be acceptable under NASA's Principles for the Ethical Care and Use of Animals, the subjection of sentient beings to radiation can never be conducted humanely. According to the Randolph Air Force Base report titled "Acute Effects of Gamma Radiation in Primates," the pre-lethal effects include "hyperirritability, convulsions, ataxia, debility, vomiting, diarrhea, weight loss, erythema [skin inflammation], purpura [skin hemorrhages], epilation [hair loss], and ulcerations [open sores]." Depending upon the dosage, death is caused by failure of the central nervous system, the gastrointestinal system, or the hematopoietic (blood-forming) system. As stated in the Randolph AFB report, depression and disability usually precede death, as "some 70 percent of all the animals exhibited a symptom complex we have called debility, consisting of an extreme loss of interest in all surroundings, disinclination or inability to move, and a tendency to sit, unmoving and huddled over with a bowed head and ruffled fur, in a remote corner of the cage." When informed about the cruelty inherent to radiation experiments, most members of the public are opposed to them. In fact, the International Primate Protection League's dissemination of information on primate radiation experiments has led to a global public outcry which spurred bans on primate exportation in India in 1978 and Bangladesh in 1979.

Previous Studies (all references contained herein available upon request)

NASA spokesperson [redacted] has stated that the study is "different than any test we've ever done" and one of its researchers, [redacted] of Harvard Medical School, stated that the health risks of radiation have "not been well assessed." However, it appears that [redacted] and [redacted] are unfamiliar with the research literature. Since the 1950s, thousands of monkeys of various species have been given performance tests after being subjected to various dosages and exposure schedules of radio frequency, microwave, X-ray, gamma, electron, proton, neutron, and other particle radiation. Studies have examined the effects of radiation on other measures as well, including but not limited to:

- body weight
- urine volume
- corticoid/creatine/electrolyte concentrations in urine
- cerebral temperature
- blood cell counts
- vascular volume
- bone marrow regeneration
- eye damage
- gastrointestinal damage
- testicular damage
- hemorrhage
- vomiting and retching

Literally hundreds of technical reports on this topic are available online through public databases. In fact, a number of books have been written as well, including Van Cleave's Irradiation and the Nervous System and Ionizing Radiation: Neural Function and Behavior by Hunt and Kimeldorf. As a starting point, we suggest "Behavioral and Neurophysiological Changes with Exposure to Ionizing Radiation," Chapter 7 of the Medical Consequences of Nuclear Warfare volume of the Textbooks of Military Medicine series by the Borden Institute at Walter Reed Army Medical Center.
This chapter summarizes hundreds of studies on the behavioral and neurological effects of radiation, including experimentation on mice, rats, rabbits, cats, dogs, miniature pigs, rhesus monkeys, cynomolgus monkeys, and chimpanzees. Among these studies are many similar to the proposed experiments, studies in which primates were exposed to moderate doses of gamma radiation and then their performance was tested on cognitive and behavioral tasks. Here are a few examples:

- In one "pilot simulation" study, monkeys were given 3 Gy of gamma radiation over 12 hours, then tested on a "discrete response" task – pressing a lever in response to a light.

- In another "pilot simulation" study, monkeys were given 3 Gy of gamma radiation over 72 hours, then tested on a Primate Equilibrium Platform steering task. Although monkeys were vomiting and exhibiting other symptoms of radiation sickness, performance was minimally impaired.

- In a study on the "nuclear survivability/vulnerability of aircrews," "subhuman primates" were given either 3.6 Gy or 14.4 Gy of gamma radiation over 7.5 hours, then tested on a Primate Equilibrium Platform steering task and Multiple Alternative Reaction Time (MART) tasks.

- Chimpanzees were exposed to 4 Gy of gamma radiation, then tested between 2 and 5 years later on an "oddity-discrimination" task. The irradiated chimpanzees showed a decline in performance. Chimps given this dose also showed less motivation to solve puzzles.

Perhaps the single most significant scientific flaw in the proposed study is the fact that a single session of gamma radiation would be equivalent to the radiation absorbed in a three-year voyage to Mars and back. Animals in past radiation experiments have been exposed to tens and hundreds of times that amount and have revealed that a low radiation dose rate - not just a low radiation dose - is one of the most important factors in their successful recovery and survival. In a study in which monkeys were exposed to the same radiation dose (10 Gy) over varying dose rates (0.3-1.8 Gy/minute) and then performed a delayed matching-to-sample task, 7% of the 0.3 Gy/minute group showed a performance decrement, whereas 81% of the 1.8 Gy/minute group showed a performance decrement. A comparison of the two "pilot simulation" studies mentioned above reveals that although both groups of monkeys were exposed to 3 Gy of radiation, those who were exposed over 72 hours exhibited less performance impairment that those exposed 12 hours. The proposed experiment, which

apparently calls for a single dose of approximately 3 Gy of gamma radiation, would give an unrealistic dose of radiation to these tiny monkeys and would give unrealistic results to NASA scientists. It would also be unfeasible to give these monkeys a representative dose around-the-clock over three years, and even if it were possible, the data would still be unreliable due to species discrepancies.

USDA Policy 12

USDA Policy 12, "Alternatives to Painful Procedures" (available online at http://www.aphis.usda.gov/animal_welfare/downloads/policy/policy12.pdf requires that any investigator proposing to use animals in an experiment must perform an adequate and proper literature search and provide the Institutional Animal Care and Use Committee with enough information regarding that search to ensure that non-animal methods are not available and/or could not be used to attain the goals of the experiment. Although IDA has not yet seen the grant application or protocol, we question whether the Principal Investigator has complied with Policy 12 given the copious amount of information already available regarding irradiation in nonhuman primates.

Species Discrepancies

The aforementioned chapter describes many experiments in which rhesus monkeys and chimpanzees are subjected to gamma radiation at a variety of doses and dose rates, after which they are forced to perform tasks in order to study changes in their behavior, cognition, and nervous systems. The reviewers are quick to note that "animal research brings with it problems of extrapolation" and that "different species (even strains within species) may have different responses or sensitivities to radiation exposure." These facts call into question the scientific value of this data, as well as [redacted] suggestion that the proposed study could advance cancer research. In fact, scientists and physicians have found physiological responses to radiation to be highly variable within species as well as between species. In a 1985 paper on animal models of radiation carcinogenesis, Broerse et al. stated that "diversity of dose-response relationships point to different mechanisms involved in the induction of different tumours in various species and even in different strains of the same species." In a 2007 review of the same research, Suit et al. went beyond that, saying "There is great heterogeneity in risk of radiation-associated cancer between species, strains of a species, and organs within a species" and "the heterogeneity between and within patient populations of virtually every parameter considered in risk estimation results in substantial uncertainty in quantification of a general risk factor." If physiological responses are inconsistent within a species, how can we expect them to be consistent across species?

Research Alternatives

NASA is currently conducting research on space radiation using methods that are more humane and scientifically superior to animal experimentation. We support the use of Tissue Equivalent Plastic to simulate human skin and monitor its properties on the Lunar Reconnaissance Orbiter. NASA's anatomical model - Fred the Phantom Torso - is an impressive radiation detector and could be included on Moon and Mars probes as well as the International Space Station. We are also aware that NASA constantly collects data from the radiometric equipment integrated into spaceships and spacesuits. We hope that NASA will use these innovative methods on future lunar flights and planned lunar base - in an atmosphere that more closely resembles deep space. Please continue to research radiation shielding and rapid space travel, so that we can protect our astronauts by not exposing them to dangerous doses of radiation in the first place.

According to a conversation between IDA Research Director Eric Kleiman and [redacted] of BNL's public relations department on January 20, 2010, the experimental proposal for [redacted]'s study of "Long-term effects of space radiation in non-human primates" has not yet started at BNL and is currently undergoing review by your three internal BNL committees.

In light of the overwhelming evidence against these radiation experiments, the inexcusable suffering they cause to sentient beings, and the realistic alternatives that are already in use, please refuse to approve this tudy. The $1.75 million in funding could be spent more wisely elsewhere – and these animals' lives would not be wasted for nothing.

Thank you for your consideration.

Sincerely,

Dr. Shirley McGreal, OBE, IPPL Founder

Elliot M. Katz, DVM, President, IDA

IN DEFENSE OF ANIMALS

January 21, 2010
VIA email

Institutional Animal Care & Use Committee
Experimental/Science Review Committee
Safety Committee
c/o [redacted]
Brookhaven National Laboratory
[redacted]

RE: NASA-Sponsored Irradiation Study on Squirrel Monkeys

Dear BNL Committees:

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- bone marrow regeneration
- eye damage
- gastrointestinal damage
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scientists and physicians have found physiological responses to radiation to be highly variable within species as well as between species. In a 1985 paper on animal models of radiation carcinogenesis, Broerse et al. stated that "diversity of dose-response relationships point to different mechanisms involved in the induction of different tumours in various species and even in different strains of the same species." In a 2007 review of the same research, Suit et al. went beyond that, saying "There is great heterogeneity in risk of radiation-associated cancer between species, strains of a species, and organs within a species" and "the heterogeneity between and within patient populations of virtually every parameter considered in risk estimation results in substantial uncertainty in quantification of a general risk factor." If physiological responses are inconsistent within a species, how can we expect them to be consistent across species?

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Thank you for your consideration.

Sincerely,

Shirley McGreal

Dr. Shirley McGreal, OBE, IPPL Founder

Elliot M. Katz, DVM, President, IDA

[redacted]

From: [redacted]
Sent: Monday, March 01, 2010 2:05 PM
To: [redacted]
Subject: FW: Letter from [redacted] (PCRM) re IACUC protocol "Ground-Based Studies in Neurobehavioral Biology"
Attachments: Brookhaven IACUC Letter 02.03.10.pdf; ATT1383818.htm; PCRM Review of Bergman Protocol.pdf; ATT1383819.htm

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From: [redacted]
Sent: Wednesday, February 24, 2010 9:28 AM
To: [redacted]
Subject: FW: Letter from [redacted] (PCRM) re IACUC protocol "Ground-Based Studies in Neurobehavioral Biology"

From: [redacted]
Sent: Friday, February 12, 2010 8:18 AM
To: [redacted]
Subject: FW: Letter from [redacted] (PCRM) re IACUC protocol "Ground-Based Studies in Neurobehavioral Biology"

From: [redacted]
Sent: Tuesday, February 02, 2010 9:12 PM
To: [redacted]
Subject: Fwd: Letter from [redacted] (PCRM) re IACUC protocol "Ground-Based Studies in Neurobehavioral Biology"

FYI, another letter. I'm not sure how they got my name, I did an extensive Google of myself today and only found one reference to me being on the committee (not Chair) but that would have been hard to find if I had not been looking for my name. Not to be paranoid, but I hope this does not point to someone on the inside.

I am not inclined to respond, but if there is a response, I would point out that the IACUC makes decisions by committee and that the Chair cannot overrule the committee.

[redacted]
Brookhaven National Laboratory
[redacted]

Begin forwarded message:

From: [redacted]@pcrm.org>
Date: February 2, 2010 6:18:18 PM EST

To: [redacted]
Subject: Letter from [redacted] (PCRM) re IACUC protocol "Ground-Based Studies in Neurobehavioral Biology"

[redacted]

Physicians Committee for Responsible Medicine

[redacted]

From: [redacted]
Sent: Friday, January 29, 2010 4:15 PM
To: [redacted]
Cc: [redacted]
Subject: BHSO Update

[redacted],

[redacted]

[redacted]

3. NASA Research Protocol Issue: The Physicians Committee for Responsible Medicine filed a Freedom of Information Act (FOIA) request (December 3, 2009) with DOE seeking copies of all documents/records relating to nonhuman primate research protocols approved, underway, or previously completed at Brookhaven National Laboratory (BNL). They also specifically asked for all documents/records relating to the "Long-term effects of space radiation in human primates" experiment to be funded by a NASA grant and conducted, at least in part, at the NASA Space Radiation Laboratory (NSRL) located at BNL. Our response letter, which included the redacted copy of the protocol (names removed), was released to the requestor on January 8th. The People for the Ethical Treatment of Animals (PETA), on January 13, 2010, also filed a FOIA request for all documents/records pertaining to radiation experiments carried out on nonhuman primates at NSRL (2009-present). We have recently been in contact with NASA FOIA personnel and will coordinate with them regarding our planned release to PETA (redacted protocol, protocol review committee minutes, and memo). NASA has also received FOIA requests and Congressional inquiries regarding this space radiation experiment. We have been advised that copies of the protocol (redacted or not redacted is unclear) have made their way to Capitol Hill and have raised some interest.

[redacted]

BHSC Page 2

1/29/10

[redacted]

Harvard Medical School

Department of Psychiatry

Associate Professor
of Psychobiology

[redacted]

McLean Hospital

An Affiliate of the
Massachusetts General Hospital
Partners HealthCare System, Inc.

Behavioral Pharmacology Program, ADARC
Preclinical Pharmacology Program, MRC

27 January 2009

Institutional Animal Care & Use Committee
Experimental/Science Review Committee
Safety Committee
c/o [redacted]
Brookhaven National Laboratory
[redacted]

Dear members of the Committees,

We are writing in response to the recent complaint filed by IDA/IPPL with regard to our protocol for NASA-sponsored research in squirrel monkeys (**IACUC Protocol # 405** "Ground-Based Studies in Neurobehavioral Biology"). We fully understand and appreciate the concerns and interest on the part of individuals or organizations in protecting the welfare of experimental subjects and, in particular, nonhuman primates. Often, sensitivity to the use of laboratory animals in research can lead to valuable improvements in animal care and welfare, as well as the type of scientific research that is being conducted. However, we strongly believe the authors' accusations in the present complaint, are groundless and without merit.

The core of this complaint letter from IDA/IPPL is that our proposed work is inhumane and scientifically worthless. The charge of 'inhumanity' is an inflammatory accusation that is based on a prejudiced and anti-science outlook. We do not wish to debate the value of hindering research in laboratory animals vs. the value of scientific progress intended to significantly improve the quality of human life and its potential. Nevertheless, it should be noted that IDA/IPPL has misapplied factual matter in constructing their argument. In this complaint letter, the grounds for the claim of 'inhumanity' include biological outcomes that are generally associated with relatively high doses (3 – 20 Gy) of radiation (i.e., X-rays or gamma) or with radiation disasters such as nuclear war. These outcomes are ***not*** associated with the relatively low levels ($\leq$ 1 Gy protons; $\leq$ 0.5 Gy iron/silicon) of space radiation that will be used in our proposed research. As stated in our protocol, the levels of particle radiation exposure were selected following extensive consultations with scientists from NASA and BNL, and are meant to mimic levels of exposure that astronauts are expected to encounter during deep space travel (i.e., Lunar or Mars Missions).

The second contention of the complaint letter is that the work is unnecessary, flawed, and duplicative. The authors make this claim primarily on the basis of previous work that was conducted between 1950 – 1989, and

use a review chapter by Mickley et al. to make their point [Mickley, G.A., Bogo, V., and West, B. Behavioral and Physiological Changes with Exposure to Ionizing Radiation. In, R. Zajtchuk, D.P. Jenkins and R.F. Bellamy (Eds). Textbook of Military Medicine, Part 1, Vol. 2, Medical Consequences of Nuclear Warfare, (R.I. Walker and T.J. Cerveny, Eds. TMM Publications Office of the USA Surgeon General, Falls Church, 1989, pp. 105-151]. Though this information is somewhat useful, the above-mentioned work has typically studied the effects of high doses of either X-rays or gamma radiation in non-human primates. Unfortunately, these radiation types on earth are different from the particle radiation that astronauts are exposed to during deep space missions. As a consequence, these previous studies on X-rays and gamma radiation are not relevant to our proposed research. More importantly, these previous studies do not scientifically address the consequences of exposure to space radiation on neurobehavioral functioning that may be encountered during deep space exploration. It is worth noting that in the very same chapter Mickley et al. write that: "The behavioral effects of ionizing radiations (such as protons and high-Z particles) in space are beginning to be explored. Preliminary indications are that radiations in space may be significantly more disruptive to behavior than are the radiations in the earth's environments" (p. 136). We would like to emphasize that, to date, previous work using the types of radiation we intend to study—protons and high-Z energy particles—has been conducted exclusively in rodents, which is one reason that NASA so strongly supports our proposed studies. It is important to realize that our proposed research only begins to address the clear need for data in primate species regarding the effects of these types of radiation, and will allow us to start to systematically bridge the information gap between rodents and humans. Clearly, the proposed work is novel, necessary, and critical in the advancement of human deep space exploration.

The complaint letter also raises issues of species discrepancies and the desirable use of research alternatives (e.g., tissue equivalent plastics). From our perspective, the value of primate studies is highlighted by their greater translational value—i.e., lesser chance of species discrepancies—for understanding and realistically estimating the risks to astronauts associated with exposure to protons and HZE particles in space. As for the desirable use of research alternatives, there are no known alternatives for the type of behavioral work within this project. We strongly believe that the information generated from our proposed research will be highly beneficial to NASA, and will substantially advance future human deep space travel.

I hope that the above comments are useful to the Committees. Please do not hesitate to call or write should you require further information.

Very sincerely yours,

Harvard Medical School / McLean Hospital

McLean Hospital, Preclinical Pharmacology Program,
Telephone FAX

Harvard Medical School

Department of Psychiatry

Associate Professor
of Psychobiology

[redacted]

McLean Hospital

An Affiliate of the
Massachusetts General Hospital
Partners HealthCare System, Inc.

Behavioral Pharmacology Program, ADARC
Preclinical Pharmacology Program, MRC

January 15, 2010

[redacted]
BNL IACUC, chairman
[redacted]

Dear [redacted],

We would like to thank you and the committee for reviewing our protocol # 405 (Ground-Based Studies in Neurobehavioral Biology). We have now submitted a revised version of the protocol in which each of the points that you raised in your letter dated January 11th, 2010, are addressed. We hope that our protocol is now fully acceptable. Below you will find a detailed response to each of the points that were raised in your letter. Bullets identify the points raised, italics identify our response.

- **The custom made chambers for irradiation must be discussed with NSRL and BLAF staff prior to being sent to BNL.**

  The custom made chambers for irradiation have been constructed following extensive consultation with [redacted] NSRL) and [redacted] (BNL Animal Facility Manager). Prior to sending these chambers to BNL we will again consult with [redacted] and [redacted] to ensure that they are suitable for our irradiation protocol.

- **Section C.1: Should clarify whether or not acute effects from radiation are expected and discuss any previous primate data to support this.**

  To our knowledge, there are no previous primate data that bear on this question (this is the primary goal of our study). However, previous studies in rodents strongly suggest that the low levels of radiation that will be used in these studies will not have acute adverse effects. We have added text to our protocol to highlight this point (see below).

- **Section C.1: Correct spelling in second sentence "six monkeys *per* trip".**

  This text has now been corrected.

- **Section C.1: Clarify whether six monkeys at a time are brought to and from the NSRL or whether they are staggered depending on when they are being irradiated.**

  In our planned experiments all six monkeys will be brought to and from the NSRL at the same time. The protocol text has been modified to indicate that all six monkeys will be transported to and from NSRL at the same time.

  All subjects (i.e., six) will be individually transferred at the same time to NSRL from the BNL animal facility in our standard transfer cages (10" x 10" x 12" high).

- **Section C.1: The radiation dose chosen must be justified in terms of its relevance to space travel.**

  The following text has now been added to our protocol to explain our choice of radiation dose.

  The radiation beams and doses have been selected after consultation with NASA and BNL scientists and will provide information needed to fill critical gaps in NASA's deep space travel data base. These are considered to be low levels of irradiation and, based upon previous studies in rodent species, acute effects are not expected. (To this point, previous studies have suggested that exposure levels greater than 2 Gy are associated with some evidence of acute effect).

- **Section E.1: Should be changed to 36;**

  The text in section E.1 has now been changed to indicate 36.

- **Section H.1: The box for "Radioactivity" should be checked.**

  The box for radioactivity has now been checked.

Very respectfully yours,

[redacted]

Associate Professor, Department of Psychiatry
Harvard Medical School/McLean Hospital

BROOKHAVEN NATIONAL LABORATORY
INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)
ANIMAL USE PROTOCOL

BROOKHAVEN NATIONAL LABORATORY

The protocol must be submitted in typed form and all applicable items must be answered. Answers must be written in English and in terms understandable to all IACUC members.

PROTOCOL #:	

Title:	Ground-Based Studies in Neurobehavioral Biology		
Principal Investigator*:	[redacted]		
Address:	McLean Hospital, [redacted]		
Phone:	[redacted]		
Fax:	[redacted]		
E-mail:	[redacted]		
Key Investigators*:	[redacted]		
	[redacted]		
** Note - if no investigators are BNL employees, please list a BNL employee contact:*			
Funding Source:	NASA	**BNL Account Number:**	
Protocol Type (e.g. Research, Teaching, Other):	Research		

A. OVERVIEW

A.1 Please provide a brief description of the proposed studies in lay terms.

The main goal of our planned studies is to examine the long-term neurobehavioral and neuropharmacological effects of space radiation in nonhuman primates. These are translational studies that are designed to forecast risk associated with human space exploration and, consequently, aid in NASA's development of future human deep space travel. The goals of these studies are based on observations that exposure to high doses of space radiation *may* lead to: 1) *in vitro* molecular and cellular damage in brain systems; 2) *in vitro* alterations in striatal levels of dopamine (DA)]; 3) short-term treatment effects in some rodent neurobehavioral assays; and 4) acceleration of the aging process with increased risk of early onset of neurodegenerative diseases. Notably, however, these findings have come from studies using *in vitro* tissue preparations or *in vivo* assays using rodents. While important first steps, NASA is interested in following this work with translationally-directed studies in primate species for confirmation and further development of its Space Radiation Program. In this work, we aim to evaluate the neurobehavioral and neuropharmacological effects of different types of ionizing radiation encountered during deep space travel. Note that this type of exposure differs from exposure to radioactive materials that may pose health risks resulting from irradiation. The health risks of space radiation at levels of exposure that are planned for these studies currently are unknown and may be trivial.

We plan to use up to 30 squirrel monkeys for the duration of the project (i.e. up to 4 years). In addition, 6 squirrel monkeys will be available as replacement subjects for these studies but will not otherwise participate in this research. In these studies, we will employ four different procedures to characterize the behavioral effects of drugs in squirrel monkeys before and after exposure to ionizing radiation. ***With the***

exception of the irradiation procedure at BNL, all other procedures will be conducted at McLean Hospital. The four procedures include: a) observation assay of non-conditioned behavior; b) operant performance maintained by response-contingent reinforcement [e.g. food (sweetened condensed milk) delivery]; c) Stop Signal Response (SSR) Task; and d) Stimulus Discrimination/Reversal (SD/R) Task. In additional experiments, we will measure changes in the lens of the eye following exposure to ionizing radiation. In our research plan, we aim to examine the long-term neurobehavioral and neuro-pharmacological effects of exposure to two relatively low doses of ^{56}Fe (0.1 and 0.5 Gy), protons (0.5 and 1.0 Gy), and ^{28}Si (0.1 and 0.5 Gy) in squirrel monkeys. Using a within-subjects design, data will be generated in all monkeys before and after exposure to each type of space radiation. A group of 4 squirrel monkeys will be used for each radiation type and 6 squirrel monkeys will serve as controls without radiation exposure. Thus a total of 30 squirrel monkeys (6 radiation types x 4 monkeys = 24 monkeys + 6 control monkeys = 30 monkeys) will serve as subjects in these studies. Additionally, a group of 6 monkeys from our existing colony will be available as replacement subjects for these studies.

B. PERSONNEL AND TRAINING

B.1 In each box, list all personnel working directly with animals and indicate number of years of experience for each procedure for each species. All BNL personnel will be put on the appropriate Occupational Medicine Protocol. *Non-BNL employees working with primates will be put on the appropriate Occupational Medicine Protocol.*

NAME	SPECIES	MONITORING & HANDLING	NONSURGICAL MANIPULATION	ANESTHESIA, SURGERY	BLOOD COLLECTION	EUTHANASIA
[redacted]	Squirrel Monkeys	>25 Years	>25 Years	>25 Years	N/A	>25 Years
[redacted]	Squirrel Monkeys	>5Years	>5Years	>5Years	>5Years	>5Years
Research Assistant 1	Squirrel Monkeys	>1 Year	>1 Year	>1 Year	N/A	>1 Year
Research Assistant 2	Squirrel Monkeys	>1 Year	>1 Year	>1 Year	N/A	>1 Year

Note: Any personnel with less than one year experience in any of the above categories must take the applicable training listed below.

B.2 Indicate which training courses apply to this protocol. Use A to indicate all personnel or put initials of those required to take the training. *All courses are located at http://www.bnl.gov/training*

Required	COURSE TITLE	PROCEDURES COVERED
A	Basic Overview of Laboratory Animal Care and Use	Overview required by all animal users
	Biomethodology of the Mouse	Restraint, handling, identification, sexing, husbandry, behavior of mice
	Biomethodology of the Rat	Restraint, handling, identification, sexing, husbandry, behavior of rats
	Experimental Techniques in Rodents	Injections, blood sampling, oral gavage, euthanasia
	Post-Procedure Care of Mice and Rats: Reducing Pain and Distress	Analgesia, pain & distress recognition and alleviation, post-operative care
	Survival Surgery in Rodents	Anesthesia, aseptic surgical techniques
A	**Primate Safety**	Covers safe handling of non-human primates
	Controlled Substance Awareness and DEA background Check	Required if any controlled substances will be used
	Regulated Medical Waste Management	Required if regulated medical waste (animal carcasses, needles, syringes) will be generated as a result of the work

C. PROCEDURES

C.1 Concisely describe all manipulations and experimental procedures, including surgeries, performed on the animals. *Everything done to the live animal at BNL must be detailed here. A short description of experimental procedures done elsewhere should be included. Include the end point of the experiment and timing of euthanasia, if applicable. Flow diagrams or charts are helpful. Materials and methods portion of grant applications or other detailed descriptions may be attached.*

Subjects. Experimentally naïve adult male squirrel monkeys *(Saimiri sciureus,* approx. 650 to 800g) will serve as subjects (n=4/radiation type; n=6 for control group). Monkeys will be individually housed in stainless steel cages in a climate-controlled vivarium under an automated 12:12 light-dark cycle. Monkeys will have unlimited access to water and will receive a daily allotment of high-protein monkey chow (LabDiet, Brentwood, MA). All monkeys will be weighed daily and their diets will be adjusted to maintain constant body weights. Experimental sessions will be conducted daily (Monday–Friday) between 10 AM and 6 PM. The study protocols have been approved by the McLean Hospital (McL) Institutional Animal Care and Use Committee.

Apparatus. All experimental sessions will be conducted in a specifically constructed ventilated, sound-attenuating chamber provided with white noise to mask extraneous sounds. During all experimental sessions, monkeys will be seated in a customized Lexan chair. The front panel of this chair will differ for each type of experiment depending on the study requirements (see Figure). Please note that all the below procedures will be conducted at McLean Hospital with the exception of the irradiation procedure.

a. *Overt Behavior.* The front wall of the chair will be removed in order to facilitate videotaping with a compact video camera (JVC, GR-AX10). The camera will be located at a distance of approximately 2ft in front of the

seated monkey. All behaviors will be scored from videotape by blinded observers.
b. PR Performance. Monkeys will be seated in a chair similar to that shown in the Figure. While seated, monkeys will face a panel containing colored stimulus lights serving as visual stimuli and two response levers. Reinforced lever presses will activate a syringe pump outside the chamber and deliver 0.2 ml of 30% sweetened condensed milk into a food tray located midway between the two levers.
c. SSR and SD/R Tasks. During experimental sessions, the front panel will incorporate a touch screen (30cm wide x 22.5 cm high, [redacted]) that uses an infrared sensor grid just above the surface to monitor touches. Milk will be used to reinforce behavior and will be delivered by syringe pump into a food tray located on the side wall. E-prime software ([redacted]) will be used for all schedules of stimulus presentation and recording of responses.
d. Non-Invasive QLS Assessment of the Lens. During experimental sessions, monkeys will be seated in a chair similar to that shown in the Figure. While seated, monkeys will face the Slit-lamp Stereophotonmicroscope and images of the lens of the eye will be generated.
e. Irradiation Chamber. During irradiation procedures, freely moving monkeys will be placed individually in a customized, well-ventilated plastic chamber (25 x 25 x 25 cm) that will be positioned inside the radiation field. The chamber will be constructed to meet the requirements of the radiation field.

Transportation and Irradiation Procedure. After pre-radiation studies are completed, monkeys will be transported to NSRL/BNL for irradiation. We anticipate five separate trips to BNL (six monkey's per trip). Prior to each trip, the attending veterinarian at McL ([redacted] will conduct pre-transport evaluations of all subjects, including physicals and laboratory tests to establish their pre-radiation clinical profiles, and issue required health certificates. A McL-approved vendor ([redacted]) will transport monkeys to BNL. In addition to customized travel crates designed for squirrel monkeys and safe passage, food and water will be provided to monkeys *ad libitum* throughout the shipping process. Upon arrival at BNL, monkeys will be transferred to the BNL animal facility under the oversight of [redacted] All subjects will be individually housed in our standard stainless steel cages ([redacted]). We will provide the BNL animal facility with two racks of 6 cages each; one for housing and one for cage washing. Subjects will be allowed to acclimate in the BNL animal facility for at least one week prior to radiation exposure. During that time, they will be under the direct care of BNL staff, headed by [redacted] (Animal Facility Manager) and [redacted] (Attending Veterinarian). Food, enrichment, and all instructions for the proper care of squirrel monkeys will be provided by our laboratory. For ease of handling, monkeys will wear collars and can be leashed when necessary. All irradiations will be performed in accord with BNL safety policies and procedures, and guided by BNL scientists. All subjects (i.e., six) will be individually transferred at the same time to NSRL from the BNL animal facility in our standard transfer cages (10" x 10" x 12" high). We will provide 6 transfer cages for transporting monkeys to and from the BNL animal facility and NSRL irradiation facility. An additional 6 transfer cages will also be provided to the NSRL irradiation facility. Monkeys will remain in these transfer cages at NSRL until they are considered non-dispersible (i.e. approximately 140 min; see below).

In the present proposal, two doses of each radiation type will be studied. Separate groups of monkeys (n = 4) will be exposed to two doses of protons (0.5 and 1.0 Gy) at a dose rate of 0.25 Gy/min, two doses of ^{56}Fe particles (0.1 and 0.5 Gy) at a dose rate of 0.1 Gy/min, and two doses of ^{28}Si (0.1 and 0.5 Gy) at a dose rate of 0.1 Gy/min with energy levels of 1000, 600, and 600, MeV/u, respectively; a control group (n = 6) will be subjected to identical experimental conditions, except that they will not be exposed to any particle radiation. A total of 30 squirrel monkeys will be used for these planned experiments. The total beam time necessary to conduct irradiations in all 24 subjects plus the 6 controls will be approximately 402-min, assuming a 5-min entry and exit time from the NSRL irradiation facility per subject and a 30-min time for set-up and dosimetry per 6 monkeys (i.e. 5 trips x 30 min = 150 min); beam time calculations are based on the above described doses of each particle and its associated dose rate/min. The radiation beams and doses have been selected after consultation with NASA and BNL scientists and will provide information needed to fill critical gaps in NASA's deep space travel data base. These are considered to be low levels of irradiation and, based upon previous studies in rodent species, acute effects are not expected. (To this point, previous studies have suggested that exposure levels greater than 2 Gy are associated with some evidence of acute effect). The larger radiation field of 60 x 60 cm^2 field will be used for our studies. Briefly, monkeys will be placed individually in a custom made plastic chamber that will be positioned securely and comfortably inside the radiation field perpendicular to the beam. Freely moving

monkeys will receive full body exposure to the different types of particle radiation described above. This is intended to realistically simulate the space radiation environment experienced by astronauts during deep space travel. To accurately calculate the radiation dose absorbed by an internal organ/tissue the position of all subjects will be photographed or video taped during the irradiation procedure. Following irradiation, subjects will be re-leashed and returned to the BNL Animal Facility.

We note that the activation decay times for the highest dose of protons, ^{56}Fe, and ^{28}Si particles to be considered non-dispersible are approximately 140 min, 36 min, and 30 min, respectively (see BNL website: http://www.bnl.gov for further details on activation decay times). Materials exposed to radiation in the BNL target room will be considered radioactive until surveyed and released by a BNL Radiological Controls Technician. Monkeys will be considered non-dispersible and will require no special radiological handling, after the de-activation time has elapsed following exposure (i.e. after approximately 140 min). Appropriate biological handling techniques including radiological training (Radworker and Radiobiology Users Training) and a radiation work permit will be obtained from BNL by [redacted] and trained technicians as needed. All experimental procedures at BNL and at McL will be carried out by [redacted] and trained technicians. Following radiation exposure, monkeys will remain at BNL for a period of at least one week. During this time, all monkeys will be monitored by BNL veterinary staff, who will issue health certificates for their return to McL. [redacted] will again be present during the transfer of monkeys back to McL, where the attending veterinarian will oversee the re-introduction of monkeys in the vivarium. Once fully re-situated, monkeys will be tested periodically and on a long-term basis, i.e., up to 3–4 years following exposure to particle radiation.

Experimental End Point and Euthanasia. Upon completion of all studies, subjects will remain in the McL colony under the direct care of the McL staff and the attending veterinarian at McL. No further studies are planned for these subjects. Euthanasia is ***not*** an end point in these experiments.

C.2 Does this work duplicate previous experiments/activities? *If yes, justify.*

No. To our knowledge, long-term effects of ionizing radiation on the CNS functioning of nonhuman primates have not been examined previously.

D. ANIMAL DESCRIPTION	
D.1 Species:	Squirrel Monkeys
D.2 Strain/Breed:	Saimiri sciureus
D.3 Sex:	Male
D.4 Age/Weight:	Adult / Weight = 650 – 800g
D.5 Supplier:	N/A

*If not a commercial vendor, a recent health report (no older than three months) from the animal facility must be submitted to the BLAF Manager **at least six weeks before** the planned experiment or shipment of animals. Please contact the BLAF Manager at [redacted] to make arrangements for the receipt of the animals.*

Health reports for all animals will be submitted to the BLAF Manager 6 weeks prior to planned shipment/ experiment. Health reports for each monkey will be generated by the attending veterinarian at McL [redacted].

D.6 Justify that the work is appropriate to be done in an animal model.
The proposed research is not ethically permissible in human subjects. The work also cannot be conducted in rodent or other lesser species because of the long-term nature of these studies, the use of procedures that are not feasible across species, documented differences in the neurobiological actions of many drugs across species, and the unique translational value of data obtained in nonhuman primates. The research also cannot be conducted using tissue samples or other biological material or computer modeling because the goal of the research is to understand the long-term effects of ionizing radiation on CNS processes in nonhuman primates under conditions predictive of effects in humans. See section D7 for further details.

D.7 Justify species to be used and why a lower phylogenetic species cannot be used.
Under the experimental conditions described in this application, the effects of ionizing radiation-induced changes in the behavioral pharmacology of nonhuman primates can be associated meaningfully to their effects in humans. Squirrel monkeys have been selected for the proposed studies because several features of nonhuman primate research facilitate the translation of experimental results to humans with reasonable predictive validity.[1-6] For example, a) nonhuman primates and humans are similar in their genetic, physiological, pharmacokinetic, and neurobiological characteristics; b) they have been studied previously under experimental conditions similar to those detailed in this application; c) an extensive literature regarding the physiological and pharmacological effects of drugs in this species is available for reference; d) nonhuman primates are reliable subjects in long-term behavioral and pharmacological studies[1-6]; e) they adapt well to laboratory environment and can be handled easily and safely by experienced staff members; and f) within-subject designs similar to those used in human laboratory studies permit meaningful conclusions or inferences to be based on the evaluation of all treatment effects in individuals as well as in groups. Together, this information allows us to conduct our research efficiently and is fundamental to a constructive assessment and interpretation of data. All these considerations suggest that nonhuman primates are especially well-suited for ground-based research to study long-term neurobehavioral effects of space radiation. To date, the effects of space radiation have mainly been examined in *in vitro* preparations or neurobehavioral assays in rodents. These studies provide a strong foundation for further assessing the immediate and long-term CNS effects of space radiation. Cognizant of anatomical and functional variations across species that limit extrapolation of laboratory data from rodents to nonhuman primates or humans, our approach will employ well-established procedures in nonhuman primates to study the effects of ionizing radiation on brain systems that may be involved in CNS processes.

D.8 Animal Numbers:	
D.8.a Total for first three years:	Total: 36 Squirrel Monkeys 24 monkeys exposed to particle radiation; 6 monkeys as controls; 6 as replacement subjects
D.8.b Maximum housed at one time:	6 Squirrel Monkeys

D.9 Justify number of animals. Indicate design of study groups and statistical methods and include power calculations. Include steps taken to minimize the number of animals required.

In the present proposal, two doses of each radiation type will be studied. Separate groups of monkeys (n = 4) will be exposed to two doses of protons (0.5 and 1.0 Gy), ^{56}Fe particles (0.1 and 0.5 Gy), and ^{28}Si (0.1 and 0.5 Gy); a control group (n = 6) will be subjected to identical experimental conditions, except that they will not be exposed to any particle radiation. A total of 30 squirrel monkeys will be used for these planned experiments. Additionally, 6 squirrel monkeys will be available as replacement subjects for these studies. We recognize that non-human primates are a valuable resource, and our research is designed to minimize the number of subjects. The within-subject design used in the proposed research, in which each animal serves as its own control, allows for scientifically meaningful results to be obtained with fewer animals (usually four subjects per experiment) that would be necessary with other experimental designs. **Data Analysis.** Please note that all procedures described below will be conducted at McLean Hospital. In observational studies, the effects of vehicle and each drug dose will be determined by calculating the average group frequency or duration of target behaviors during 5-min observation periods. For cumulative dosing procedures, data from the test component immediately following injection will be used to express the effects of the administered dose, and for single dosing procedures, data from all four test components will be averaged and used to express the effects of the administered dose. For operant performance under a progressive ratio schedule, i.e., PR responding, the measures for each monkey will be: a) the value of the final ratio completed for milk delivery, i.e., the break point; b) the total number of lever presses in each component; and c) the mean response rate. In the SSR Task, impulsivity will be measured by the stop signal response time (SSRT) determined for each session (SSRT = mean Go reaction time – mean SSD). Performance monitoring will be the Post–Stop trial Slowing (PSS) determined as: mean of the individual values of: PSS = Go reaction time of the first Go trial following a Stop trial – Go reaction time of the last Go trial prior to that Stop trial. Data for the SD/R Task will be expressed as the number of stimulus discriminations divided by the total number of trials and the number of trials to criterion following stimulus reversal. *Non-Invasive QLS Assessment of the Lens.* Primary outcome is the total light scattering intensity and autocorrelation function parameters (continuous variable). All results will be presented as group means (± S.E.M.). Where possible, data will be analyzed using analysis of variance followed by *post hoc* tests for specific comparisons (significance will be set at $P < 0.05$). Dose-effect curves will be analyzed with standard parallel-line bioassay techniques.[124] ED_{50} values and their 95% confidence limits will be determined and pairs of ED_{50} values will be considered to be significantly different if their 95% confidence limits do not overlap.

E. PAIN/DISTRESS

E.1 List total number of animals at applicable levels of stress/discomfort

Level A: No pain or distress: Animals will be euthanized without any treatments or manipulations or irradiation with unrestricted movement and without anesthesia and without anticipated subsequent effects at BNL.

Level B: Relived or momentary pain or distress: Momentary pain or potential pain or distress relieved by pharmacologic, behavioral or other means, e.g., injection of any substance including anesthetics, post-procedural analgesics, behavioral conditioning, restraint or minor pain/distress and medical treatment of disease states.

Level C: Unrelieved or sustained pain or distress: Any procedure that would cause more than momentary or slight pain or distress, e.g., chronic untreated disease states, pain research

Species	LEVEL A	LEVEL B	LEVEL C
Saimiri Sciureus – Squirrel Monkeys		36	

E.2 For animals used in Level B or C, perform a literature search for alternatives to pain/distress. *Please note the Research Library Staff is available to assist with literature searches.*

List procedures that may cause pain/distress (e.g. irradiation, imaging, surgery, injection, behavioral testing, food restriction, etc) and perform a search using the procedures and the word "alternative". *Procedures that have pain eliminated by the use of anesthetics and/or analgesics are still considered painful even though the animal is not expected to experience any pain/distress.*

Irradiation Procedure

Date of Search:	10/28/09
Databases Searched:	PubMed
Years Included:	1960 – 2009

No suitable alternative methods exist

Provide a narrative of Search Results *When alternative procedures are discovered, you must identify them and justify why those procedures are not being considered:*

We typically conduct searches on a bi-annual basis with key terms of squirrel monkey, cognitive tasks, motivation, schedule-controlled behavior, alternative methods. We have incorporated the key term of space radiation in our most recent search (10/28/09), and will continue to do so.

E.3 Indicate how procedures have been refined to reduce the amount of potential pain, distress or morbidity.

Laboratory procedures for our planned studies do not involve pain and have been developed over decades to minimize distress to experimental subjects. Briefly, animals are trained by experienced laboratory personnel to perform behavioral tasks while loosely restrained at the waist within customized primate chairs placed within larger ventilated enclosures. Outside of experimental sessions, lab staff members supervise and interact with animals for which they are responsible, providing them with enrichment and care.

E.4 Describe if animals are subjected to food/water deprivation or prolonged and/or unusual restraint and provide justification. *Describe how animal health is monitored during deprivation.*

All animals will have free access to food and water and will not be subjected to prolonged or unusual restraint.

E.5 Is death used as a study endpoint wherein animals must die without intervention such as pain relief and/or euthanasia? *If yes, explain why an earlier end point is not acceptable.*

No

F. ANIMAL CARE

F.1 Please indicate if animals will be housed at BNL in other than in the Brookhaven Laboratory Animal Facility (BLAF). *All singly-housed rodents will be provided with environmental enrichment unless scientifically justified.*

No

F.2 Describe additional requirements for other than routine animal care (e.g. housing, feeding)
Investigative staff must be responsible for feeding all animals, weighing the correct amount of food, logging each feeding and adjusting the ration as needed to maintain the animal at the desired weight. If food, equipment and/or other supplies are to be shipped from another institution's animal facility, a recent health report from the facility must be submitted to the BLAF Manager at least six weeks before the planned experiment.

Food ([redacted], equipment (i.e. housing cages), and all other supplies will be shipped directly from the vendor to BLAF at least six weeks prior to the planned shipment/experiment. Instructions on housing, feeding, and all other routine animal care will be provided to the BLAF Manager by our laboratory.

F.3 List the building and room number(s) in which experimental procedures, surgery, and/or postoperative recovery will be performed on live animals (if known).

With the exception of exposing monkeys to space radiation at NSRL, no other experimental procedures are being conducted at BNL.

G. PROCEDURE SPECIFICS

G.1 List all chemical agents (sedatives, analgesics, anesthetics, paralytics, euthanasia, study drugs, radiotracers) administered to the animals. *For euthanasia involving CO2, please use 100% CO2 at a 20% air replacement per minute rate. For ketamine anesthesia, please use intraperitoneal (ip) injections, not intramuscular (im). Ketamine/xylazine may be stored for up to 28 days after mixture.*

Type	Agent	Dose	Route	Frequency	Controlled Substance (Y/N)
N/A					

G.1.a List the name(s) of the individual(s) administering the above agents:

N/A

G.1.b Indicate building and room numbers where agents are stored and security procedures for controlled substance(s):

N/A

G.1.c If paralytic agents are used in conjunction with surgical manipulations, indicate the means by which absence of pain is monitored and/or determined, and who is responsible:

N/A

G.2 Is surgery involved? *If yes, indicate whether surgery is survival or non-survival.*

N/A

G.2.a Describe monitoring and supportive care provided during surgery *(who, what and how will this be done?)*:

N/A

G.2.b Describe indications for analgesic therapy to be administered before, during, and/or following surgery:

N/A

G.2.c Describe post-operative and/or anesthetic monitoring and supportive care (*who, what and how often*): ***Please use Surgery and Recovery Record***

N/A

G.2.d Who will maintain surgical and post-operative records and where will they be maintained? ***Please note: Records must be accessible for inspection***

N/A

G.3 Is anesthesia involved?

N/A

G.3.a Describe monitoring and supportive care provided during anesthesia *(who, what, and how will this be done?)*: ***Please use Surgery and Recovery Record***

N/A

G.3.b Who will maintain anesthetic records and where will they maintained? ***Please note: Records must be accessible for inspection***

N/A

G.4 Are animals to be used in more than one major surgical procedure from which they are allowed to recover? *If yes, please describe and justify.*

N/A

G.5 By what method and by whom will animals be euthanized and how will death be confirmed? If a chemical agent is used, please list in Section G.1. *For euthanasia involving CO2, please use 100% CO2 at a 20% air replacement per minute rate. Justification must be provided for any physical method, such as decapitation or cervical dislocation, without anesthesia.*

If and when recommended by veterinary staff, monkeys will be euthanised by i.v. pentobarbital (100mg/kg) followed by thoracotomy. McLean veterinarian [redacted], [redacted] (>15 yrs experience) will conduct all euthanasia procedures.

G.6 List criteria for intervention and/or removal of animals from study or early euthanasia.

•Examples are severe ataxia; rapidly increased heartrate or respiratory rates; oral, nasal or vaginal discharge such as pus or blood; wound dehiscense; marked swelling, tumor(s) greater than 2 cm or ulcerating, ulcer greater than 10% of body surface area, inability to eat or drink, loss of weight, great discoloration in an appendage or surgical area; immobility.

• Unless otherwise noted 100% CO2 at a 20% air replacement per minute rate will be used for early euthanasia

for rodents.

Animals will be removed from study in the unlikely event of major organ system failure (e.g., heart, liver, kidney) or if there are signs of persistent behavioral distress evident in dramatic changes in home cage activities (e.g., decrease in activity and response to external stimuli or unexplainable loss of weight or appetite). Such determinations will be made in consultation with veterinary staff.

H. SPECIAL CONSIDERATIONS N/A

H.1 Check hazardous materials being used in this study.

☐ Human cells or fluid	☐ Microorganism	☐ Chemicals including fixatives	☐ Recombinant DNA
☐ Nanoparticles	X Radioactivity	☐ Other (list):	☐

For each agent listed above, please ensure that it is covered under an approved ESR

H.2 Indicate if animals will be shipped from BNL. *If yes, indicate that BNL's preferred shipping procedures will be followed. If other arrangements are necessary, please describe.*

Yes. Both BNL and McL shipping procedures will be followed as described in Section C1, under transportation and irradiation procedure.

H.3 If not shipped from an approved vendor, detail how animals will be transported to BNL.

Animals will be transported to and from BNL and McL as described in Section C1, under transportation and irradiation procedure.

I. INVESTIGATOR ASSURANCE

I affirm to the best of my knowledge that all the above information is complete and accurate and agree to accept responsibility for this project in accordance with applicable Federal and State of New York regulations, USDA guidelines, and established BLAF policies and procedures. No changes will be made without prior approval from the IACUC.

In order to reduce risk to all personnel and laboratory animals, I agree to:

a. Follow BNL procedures for aspects of the animal care and use such as preoperative care, anesthesia, surgical technique, postoperative care, sampling techniques, euthanasia, and disposal of contaminated carcasses and waste.

b. Ensure that my instructions to laboratory personnel are implemented.

c. Ensure that all project personnel comply with the required Occupational Health Program before handling animals.

d. Instruct all personnel in my laboratory that they should inform me if they believe that the treatment of any research animal is inappropriate. If the situation is not resolved, the employee should contact the Attending Veterinarian, or the IACUC Chair and/or Institutional Official.

I am aware that all research outlined under this protocol must be carried out under approved Experimental Safety Review(s) (ESR). I am aware that it is my responsibility to ensure that all individuals working on this protocol have been listed on an appropriate ESR and that their training is up to date. I am aware that work cannot proceed without an approved ESR.

PRINCIPAL INVESTIGATOR	[redacted]	**DATE**	12/22/09

Your Department Safety Coordinator will be notified of your IACUC approval.

J. APPROVALS

I attest that the following issues have been appropriately addressed: Scientific merit of project; Appropriateness of conducting the project at BNL; Adequacy of funding for the project; Appropriateness of the expertise and experience of the PI and project personnel; Appropriateness of training for the PI and project personnel; and; Adequacy of department resources to support this protocol.

BNL DEPARTMENT CHAIR		**DATE**	
PHARMACIST (or designee)		**DATE**	

Required for Schedule I controlled substances

References:

1 Weerts EM, Fantegrossi WE, Goodwin AK (2007) The value of nonhuman primates in drug abuse research. *Experimental Clinical Psychopharmacology.* 15:309-327.

2 Goldman-Rakic PS, Lidow MS, Smiley JF, Williams MS (1992) The anatomy of dopamine in monkey and human prefrontal cortex. *Journal of Neural Transmission.* 36: 163-177.

3 Ward KW, Smith BR (2004) A comprehensive quantitative and qualitative evaluation of extrapolation of intravenous pharmacokinetic parameters from rat, dog, and monkey to humans. I. Clearance. *Drug Metabolism and Disposition.* 32:603-611.

4 Matta SG, Balfour DJ, Benowitz NL, Boyd RT, Buccafusco JJ, Caggiula AR, Craig CR, Collins AC, Damaj MI, Donny EC, Gardiner PS, Grady SR, Heberlein U, Leonard SS, Levin ED, Lukas RJ, Markou A, Marks MJ, McCallum SE, Parameswaran N, Perkins KA, Picciotto MR, Quik M, Rose JE, Rothenfluh A, Schafer WR, Stolerman IP, Tyndale RF, Wehner JM, Zirger JM (2007) Guidelines on nicotine dose selection for in vivo research. *Psychopharmacology (Berl).* 190:269-319.

5 Czoty PW, Makriyannis A, Bergman J (2004) Methamphetamine discrimination and in vivo microdialysis in squirrel monkeys. *Psychopharmacology (Berl).* 175:170-178.

6 Mutschler NH, Bergman J (2002) Effects of chronic administration of the D_1 receptor partial agonist SKF 77434 on cocaine self-administration in rhesus monkeys. *Psychopharmacology.* 160:362-370.

Harvard Medical School

Department of Psychiatry

Associate Professor
of Psychobiology

[redacted]

McLean Hospital

An Affiliate of the
Massachusetts General Hospital
Partners HealthCare System, Inc.

Behavioral Pharmacology Program, ADARC
Preclinical Pharmacology Program, MRC

February 29, 2010

[redacted]
BNL IACUC, chairman
[redacted]

Dear [redacted]

We would like to thank you and the committee for reviewing our protocol # 405 (Ground-Based Studies in Neurobehavioral Biology). We apologize for not providing the committee with a more detailed justification of the chosen doses and dose rates. We have consulted with [redacted] (BNL) and are now submitting a revised version of the protocol in which each of the points that you raised in your letter dated January 15th, 2010, are addressed. We hope that these revisions are sufficient and our protocol is now fully acceptable. Below you will find a detailed response to each of the points that were raised in your letter. Bullets identify the points raised, italics identify our response.

- **How does the proposed dose compare to that expected to be experienced by an astronaut on a Mars mission?**

Based upon estimations from reports by Cucinotta and Durante (2006; 2008) astronauts on a 3 year Mars mission may absorb approximately 1 Gy of ionizing radiation. We plan to study the effects of 0.1 and 0.5 Gy of ^{56}Fe and ^{28}Si which are considered to be low doses. The reason we are studying low doses is to establish baseline data in ground-based studies.

- **Does the different dose rate make an appreciable difference?**

This is a complicated issue that has been repeatedly addressed in studies with a variety of radiation sources, doses, and exposure rates. It may be that extremely high doses of radiation produce biological changes that may be associated with the kinetics of radiation delivery (e.g. Mickley et al., 1989). However, there is no evidence to date suggesting that we would be able to measure rate dependent differences in the effects of protons and GCRs within the range of doses that we are studying.

- **Can you cite relevant data on the acute effects of these doses (e.g. by comparing to LD_{50} values)?**

  There have been previous studies in mice suggesting that exposure to 4 Gy of ^{56}Fe may produce some behavioral and or CNS effects (e.g. Pecaut et al., 2002; 2004; Rola et al., 2008; Huang et al., 2009). Also data from studies by Dr. Albert Fornace at Georgetown University indicate that the LD_{50} for protons and iron are in the range of 7 – 8 Gy. However, these studies were also conducted in mice and it is unclear how to translate these data into primate species.

- **While there may be no literature on heavy ions and primates, please cite any relevant data with other radiation types, or other species and whether species differences are expected to be significant.**

  There has been previous work in non human primates showing some behavioral deficits following exposure to extremely high doses of X-rays or gamma radiation (e.g. Mickley et al., 1989). Unfortunately, this literature does not contribute to our understanding of what might be expected with protons and GCRs. More closely related to our proposed studies, Rabin and coworkers have assessed the effects of space radiation on behavioral endpoints in rodents and generally find limited deficits following exposure to ≥ 2 Gy of heavy ions (e.g. Rabin et al., 1998; 2000; 2001; 2002a; 2002b; 2003; 2004; 2007a; 2007b; 2007c).

  Indeed, species differences likely will be significant in the qualitative and quantitative impact of space radiation. Consequently, studies in primates are needed to provide information to NASA for more accurate risk assessment.

Very respectfully yours,

[redacted]

Associate Professor, Department of Psychiatry
Harvard Medical School/McLean Hospital

McLean Hospital, Preclinical Pharmacology Program, [redacted]
Telephone [redacted], FAX [redacted]

References:

Cucinotta FA, Durante M (2006) Cancer risk from exposure to galactic cosmic rays: implications for space exploration by human beings. *Lancet Oncology*. 7:431–435.

Durante M, Cucinotta FA (2008) Heavy ion carcinogenesis and human space exploration. *Nature Reviews* 8:465–472.

Mickley, G.A., Bogo, V., and West, B. Behavioral and Physiological Changes with Exposure to Ionizing Radiation. In, R. Zajtchuk, D.P. Jenkins and R.F. Bellamy (Eds). Textbook of Military Medicine, Part 1, Vol. 2, Medical Consequences of Nuclear Warfare, (R.I. Walker and T.J. Cerveny, Eds. TMM Publications Office of the USA Surgeon General, Falls Church, 1989, pp. 105-151

Rabin BM, Joseph JA, Erat S (1998) Effects of exposure to different types of radiation on behaviors mediated by peripheral or central systems. *Advances in Space Research*. 22 (2):217-225.

Rabin BM, Joseph JA, Shukitt-Hale B, McEwen J (2000) Effects of exposure to heavy particles on a behavior mediated by the dopaminergic system. *Advances in Space Research*. 25(10):2065-2074.

Rabin BM, Shukitt-Hale B, Joseph JA, Denissova N (2001) Effects of exposure to ^{56}Fe particles on the acquisition of a conditioned place preference in rats. *Physica Medica*. 17(1):196-197.

Rabin BM, Shukitt-Hale B, Szprengiel A, Joseph JA (2002a) Effects of heavy particle irradiation and diet on amphetamine-lithium chloride-induced taste avoidance learning in rats. *Brain Research*. 953:31–36.

Rabin BM, Buhler LL, Joseph JA, Shukitt-Hale B, Jenkins DG (2002b) Effects of exposure to ^{56}Fe particles or protons on fixed-ratio operant responding in rats. *Journal of Radiation Research*. 43:S225-S228.

Rabin BM, Joseph JA, Shukitt-Hale B (2003) Long-term changes in amphetamine induced reinforcement and aversion in rats following exposure to ^{56}Fe particle. *Advances in Space Research*. 31(1):127-133.

Rabin BM, Joseph JA, Shukitt-Hale B (2004) Heavy particle irradiation, neurochemistry and behavior: thresholds, dose–response curves and recovery of function. *Advances in Space Research*. 33:1330–1333.

Rabin BM, Joseph JA, Shukitt-Hale B, Carey AN (2007a) Dietary modulation of the effects of exposure to ^{56}Fe particles. *Advances in Space Research*. 40:576–580.

Rabin BM, Carrihill-Knoll KL, Carey AN, Shukitt-Hale B, Joseph JA, Foster BC (2007b) Elevated plus-maze performance of Fisher-344 rats as a function of age and of exposure to ^{56}Fe particles. *Advances in Space Research*. 39:981-986.

Rabin BM, Shukitt-Hale B, Joseph JA, Carrihill-Knoll KL, Carey AN, Cheng V (2007c) Relative effectiveness of different particles and energies in disrupting behavioral performance. *Radiation and Environmental Biophysics*. 46:173-177.

McLean Hospital, Preclinical Pharmacology Program, [redacted]
Telephone [redacted] FAX [redacted]

Office of Research Administration

BROOKHAVEN
NATIONAL LABORATORY

[redacted]
Phone [redacted]
Fax [redacted]
[redacted]@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

Memo

* * *

DATE: January 15, 2010

TO: [redacted] [redacted] [redacted] 2010.01.19 08:03:36 -05'00'

FROM: [redacted] Chair, Institutional Animal Care and Use Committee (IACUC)

SUBJECT: **IACUC Protocol 405** "Ground-Based Studies in Neurobehavioral Biology"

Thank you for your response. However, we do request a more detailed justification of the chosen doses and dose rates with respect to potential acute effects and relevance to human space travel, including answers to the following questions:

1. How does the proposed dose compare to that expected to be experienced by an astronaut on a Mars mission?;
2. Does the different dose *rate* make an appreciable difference?;
3. Can you cite relevant data on the acute effects of these doses (e.g. by comparing to LD50 values)?;
4. While there may be no literature on heavy ions and primates, please cite any relevant data with other radiation types, or other species and whether species differences are expected to be significant.

Please respond to [redacted]

[redacted]

[redacted]

From: [redacted]
Sent: Monday, March 01, 2010 2:09 PM
To: [redacted]
Subject: FW: Notes from NSRL Mtg (Revised)
Attachments: NSRL Animal Research_Final(2).doc

This is one to look at.

From: [redacted]
Sent: Tuesday, February 09, 2010 9:28 AM
To: [redacted]
Subject: FW: Notes from NSRL Mtg (Revised)

fyi

[redacted]
DOE/BHSO
[redacted] (office)
[redacted] (cell)

From: [redacted]
Sent: Tuesday, February 09, 2010 9:21 AM
To: [redacted]
Subject: Notes from NSRL Mtg (Revised)

Attached are the notes of the NSRL animal research meeting that include the revisions made by [redacted] and a change moving [redacted] from attendee to absent.

[redacted]

<<NSRL Animal Research_Final(2).doc>>

[redacted]

[redacted]

[redacted]

Brookhaven National Laboratory

[redacted]

[redacted]

phone: [redacted] *fax* [redacted]

email: [redacted]

NSRL Animal Research Meeting
February 5, 2010

Attendees: [redacted]

Absent: [redacted]

Introduction:

- [redacted] stated that the purpose of bringing this group together is to update and discuss a plan for communications for the NASA animal research proposal.
- [redacted] stated that many requests have been received from outside organizations regarding the proposal and recommended CEGPA help in the coordination of requests. There was a consensus agreement on this recommendation.

Update:

- [redacted] presented a brief chronology of activities regarding the NASA proposal:
- [redacted] met with [redacted] at Brookhaven in order to prepare a grant application which was submitted to NASA.
- November – [redacted] received approval from NASA of their grant and NASA published the abstract on their website as required by Congressional statute. Discover News web-published an article based on the abstract.
- December – talks emerged about an 'animal use' proposal although BNL had not received the formal proposal
- January – Brookhaven's Institutional Animal Care & Use Committee (IACUC) received [redacted]'s proposed protocol for the experiment and conducts initial review.
- February – BNL received the official NASA proposal regarding squirrel monkey research during the first week of February 2010. The Scientific Advisory Committee for Radiation Research (SACRR) will be sent the proposal for their revue.
- [redacted] explained that once a proposal is received, a formal review process is conducted by SACRR. IACUC receives a separate proposal addressing animal issues. Both committees are independent of each other and have separate schedules to meet once a month to review all the proposals and make recommendations. [redacted] added that two other reviews also occur: an experimental safety/worker safety review predicated on the IACUC review and a medical department review that looks at the care and feeding of the animals.
- [redacted] advised [redacted] that [redacted] would like a senior management point of contact at BNL to discuss matters of mutual interest concerning NSRL. **Action Item:** [redacted] will plan to contact [redacted] or designate someone else to do so.

Issues overview:

- [redacted] asked [redacted] to arrange for herself and [redacted] to be added to the IACUC e-mail address to receive inquires from the public pertaining to animal research. It was decided the coordination of all queries from the public (with the exception of FOIA requests) will be coordinated by [redacted] and [redacted]. A

comment and review process for responses will include all appropriate members of the team including managers and subject matter experts.

- [redacted] mentioned that FOIA requests undergo a specific process between the BNL legal department and DOE/BHSO. [redacted] gave a short overview of the process. [redacted] requested that BNL Legal keep CEGPA informed of FOIAs. BNL Legal agreed.
- [redacted] asked that the NSRL and medical websites be reviewed for consolidation and security issues. **Action Item:** [redacted] will meet with members of ITD and security.
- [redacted] asked when the SACRR and IACUC reviews of the NASA proposal would be completed.
  - [redacted] chair of the IACUC, responded that the IACUC has unanswered questions that need more research and justification before a recommendation can be made.
  - [redacted] reported that the SACCR is scheduled to meet in mid-March to review all proposals.
  - [redacted] requested that the review process continue but would like the process to be expedited.

  Action Item: [redacted] will schedule a teleconference with the SACRR as soon as possible to discuss this proposal, singularly. [redacted] will participate in the teleconference for information that may help guide the IACUC decision.
- [redacted] asked the committee for identification of spokespersons for this topic.
  - [redacted] will be spokesperson for questions on animal care and use.
  - [redacted] will be spokesperson for questions on the NSRL facility.
  - NASA will respond to questions on the science behind the experiment.
- [redacted] stated that CEGPA will coordinate the development of Q&As to prepare spokespersons and staff for community and media queries.
- [redacted] sought the opinion of the committee about responding to [redacted] to let him know that we are in the middle of a review process. The group responded in favor of such a response and added that maybe some of the inaccuracies contained in his letter can also be addressed. **Action Item:** [redacted] and [redacted] will coordinate a response for review by [redacted], and [redacted]
- [redacted] stated that she and [redacted] will review other queries that have been received and work with [redacted] and [redacted] to prepare responses.

Action Items repeated from above:

- [redacted] will plan to contact [redacted] or designate someone else to do so.
- [redacted] will meet with members of ITD and security.
- [redacted] will schedule a teleconference with the SACRR as soon as possible to discuss this proposal, singularly. [redacted] will participate in the teleconference for information that may help guide the IACUC decision.
- [redacted] and [redacted] will coordinate a response for review by [redacted], and [redacted]

[redacted]

From: [redacted]
Sent: Monday, March 01, 2010 2:10 PM
To: [redacted]
Subject: FW: Feb 4 IACUC meeting

From: [redacted]
Sent: Tuesday, February 02, 2010 3:11 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Feb 4 IACUC meeting

Thanks.

From: [redacted]
Sent: Tuesday, February 02, 2010 3:09 PM
To: [redacted]
Cc: [redacted]; [redacted]
Subject: RE: Feb 4 IACUC meeting

To the best of my knowledge they are not open to the public, but we have never had anyone ask before so I am trying to find if there is a written policy anywhere that says one thing or the other

---

From: [redacted]
Sent: Tuesday, February 02, 2010 3:07 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Feb 4 IACUC meeting

Peter,

Does BSA have a position on access to IACUC meetings? These aren't open to the public...

Maria

From: [redacted]
Sent: Tuesday, February 02, 2010 2:22 PM
To: [redacted]
Subject: Feb 4 IACUC meeting
Importance: High

Here is an interesting issue !!

From: Justin Goodman [mailto:JustinG@peta.org]
Sent: Tuesday, February 02, 2010 2:09 PM
To: IACUC@bnl.gov
Cc: [redacted]
Subject: Feb 4 IACUC meeting

To Whom It May Concern:

A representative from People for the Ethical Treatment of Animals would like to attend the BNL IACUC meeting on February 4, 2010. Can you please send me the time and location of the meeting?

Thank you.

Sincerely,

Justin Goodman, M.A.
Research Associate Supervisor
Laboratory Investigations Department
People for the Ethical Treatment of Animals
JustinG@peta.org
860-882-2492 (phone)
860-812-2280 (fax)

www.stopanimaltests.com
Please support our efforts to get animals out of laboratories.


Please consider the environment before printing this e-mail

[redacted]

From: [redacted]
Sent: Monday, March 01, 2010 2:11 PM
To: [redacted]
Subject: FW: Feb 4 IACUC meeting

From: [redacted]
Sent: Tuesday, February 02, 2010 2:51 PM
To: [redacted]
Cc: [redacted]
Subject: RE: Feb 4 IACUC meeting

I don't believe it has ever been either DOE or BNL policy to permit 3rd parties to attend operational meetings.

From: [redacted]
Sent: Tuesday, February 02, 2010 2:25 PM
To: [redacted]
Subject: FW: Feb 4 IACUC meeting
Importance: High

Did you see this?

From: [redacted]
Sent: Tuesday, February 02, 2010 2:22 PM
To: [redacted]
Subject: Feb 4 IACUC meeting
Importance: High

Here is an interesting issue !!

From: Justin Goodman [mailto:JustinG@peta.org]
Sent: Tuesday, February 02, 2010 2:09 PM
To: IACUC@bnl.gov
Cc: [redacted]
Subject: Feb 4 IACUC meeting

To Whom It May Concern:

A representative from People for the Ethical Treatment of Animals would like to attend the BNL IACUC meeting on February 4, 2010. Can you please send me the time and location of the meeting?

Thank you.

Sincerely,

Justin Goodman, M.A.
Research Associate Supervisor
Laboratory Investigations Department
People for the Ethical Treatment of Animals
JustinG@peta.org
860-882-2492 (phone)

860-812-2280 (fax)

www.stopanimaltests.com
Please support our efforts to get animals out of laboratories.


Please consider the environment before printing this e-mail

[redacted]

From: [redacted]
Sent: Thursday, February 04, 2010 4:02 PM
To: [redacted]

Subject: FW: NASA - NASA Awards Space Radiobiology Research Grants

FYI

-----Original Message-----
From: [redacted]
Sent: Thursday, February 04, 2010 4:50 PM
To: [redacted]
Subject: Re: NASA - NASA Awards Space Radiobiology Research Grants

Yes

----- Original Message -----
From: [redacted]
To: [redacted]
Sent: Thu Feb 04 15:44:29 2010
Subject: RE: NASA - NASA Awards Space Radiobiology Research Grants

Didn't NASA have the proposal posted on their webpage and then removed it?

-----Original Message-----
From: [redacted]
Sent: Tuesday, February 02, 2010 2:09 PM
To: [redacted]
Subject: NASA - NASA Awards Space Radiobiology Research Grants

http://www.nasa.gov/exploration/acd/radiobology_research_grants.html

[redacted]

From: [redacted]
Sent: Tuesday, February 02, 2010 3:53 PM
To: [redacted]
Subject: FW: PETA Request for attendance at IACUC meeting

Importance: High

The PETA request is copied below and [redacted]'s response is also below. [redacted]

To Whom It May Concern:

A representative from People for the Ethical Treatment of Animals would like to attend the BNL IACUC meeting on February 4, 2010. Can you please send me the time and location of the meeting?

Thank you.

Sincerely,

Justin Goodman, M.A.
Research Associate Supervisor
Laboratory Investigations Department
People for the Ethical Treatment of Animals
JustinG@peta.org
860-882-2492 (phone)
860-812-2280 (fax)

www.stopanimaltests.com
Please support our efforts to get animals out of laboratories.

From: [redacted]
Sent: Tuesday, February 02, 2010 4:03 PM
To: JustinG@peta.org
Subject: PETA Request for attendance at IACUC meeting

Dear Mr. Goodman:

We must decline your request to attend an IACUC meeting. First, there is no regulatory requirement that the meetings of the Brookhaven National Laboratory IACUC be open to the public. Additionally, opening them to the public would be detrimental to the kind of forthright deliberations that the regulations envision take place between the members of the committee as well as between the committee and the investigators who are seeking approval of their protocols. The responsibilities of the committee to document its deliberations and actions are set forth in the regulations and the BNL IACUC complies with these requirements.

Very truly yours,

[redacted]
Brookhaven Science Associates, LLC
[redacted]
Brookhaven National Laboratory
[redacted] Fax: [redacted]

DISCLAIMER
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From: [redacted]
Sent: Wednesday, January 27, 2010 9:03 AM
To: [redacted]
Cc: [redacted]
Subject: FW: NSRL Review
Attachments: Agenda for NASA review on January 28,2010.pdf

[redacted]

Agenda is attached

[redacted]
U.S.Department of Energy
Brookhaven Site Office
[redacted]
Phone: [redacted]
Fax [redacted]
E-mail [redacted]

From: [redacted]
Sent: Wednesday, January 27, 2010 9:35 AM
To: [redacted]
Subject: NSRL Review

[redacted]

Do you have an electronic copy of the review agenda?

[redacted]

12/18/09

- DRAFT Agenda -

NASA Review of NSRL

Large Conference Room, Bldg. 911B
Thursday, January 28, 2010

Time	Length (min.)	Topic	Speakers
8:30 am	30	Executive Session	
9:00 am	10	Welcome	[redacted]
9:10 am	50 + 10	Past performance, accelerator and beams infrastructure, SPE, large beams, dosimetry, etc. Operations lessons learned	[redacted]
10:10am	10	*Break*	
10:20 am	20 + 5	Biology Support Infrastructure, lessons learned	[redacted]
10:45 am	20 + 5	Medical Support Infrastructure, lessons learned	[redacted]
11:10 am	15 + 5	Reporting Performance	[redacted]
11:30 am	20 +10	Budgets / Costs	[redacted]
12:00 pm	55	*Lunch - Small Conference Room, 911B*	
12:55 pm	20 +10	1.5 GeV & Mixed Fields	[redacted]
1:20 pm	10	Betsy Sutherland	[redacted]
1:30 pm	10 + 5	SACRR	[redacted]
1:45 pm	10 + 5	Summer School	[redacted]
2:00 pm	10 + 5	EBIS Status	[redacted]
2:15 pm	10	NSRL Schedule	[redacted]
2:25 pm	10	Animal Facilities and Staffing	[redacted]
2:35 pm	10	Miscellaneous (user feedback, etc.)	BNL
2:45 pm	25	Discussion	All
3:00 pm	30	Executive Session	
3:30 pm	30	NASA Feedback on Performance (BNL leads only – Speakers and BNL management)	NASA
4:00 pm		Adjourn	