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One of the ten national laboratories overseen by the Office of Science of the U.S. Department of Energy (DOE), Brookhaven National Laboratory conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and homeland security. Brookhaven Lab also builds and operates major scientific facilities available to university, industry and government researchers. Brookhaven is operated and managed for DOE's Office of Science by Brookhaven Science Associates, a limited-liability company founded by Stony Brook University, the largest academic user of Laboratory facilities, and Battelle, a nonprofit, applied science and technology organization.

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NASA Space Radiation Laboratory at Brookhaven Lab

Earth-based Research on Space-Radiation Risks

NASA

Traveling beyond the protection of the Earth's atmosphere and geomagnetic field, and shielded only by their spacecraft and spacesuits, astronauts are constantly being bombarded by cosmic rays from space. Cosmic radiation consists mostly of protons and ions of heavier atoms such as iron — all of which have enough energy potentially to cause biological damage to living cells.

Prompted by the concern for astronaut safety and a desire to protect space travelers from harm, NASA has been studying the possible biological risks of space radiation and how to mitigate them since the 1970s at Earth-based particle accelerators. In 1995, NASA moved experiments using heavy ions to the U.S. Department of Energy's Brookhaven National Laboratory on Long Island, N.Y., which then operated the only heavy-ion accelerator in the U.S. suitable for radiobiology studies. For the past eight years, the NASA Biomedical Research Program has supported fundamental studies in radiation biology at Brookhaven and other research centers.

In 1997, NASA and Brookhaven Lab recognized that another of its particle accelerators — the Booster — was better suited to simulate the less than 1 billion electron volt energy range of most space radiation. So a four-year, $34-million project to develop the Booster's potential as the best heavy-ion accelerator in the U.S. for this research and to triple NASA-sponsored researchers' ability to perform radiobiology experiments and to investigate new shielding materials was begun. In 2003, the NASA Space Radiation Laboratory (NSRL) at Brookhaven Lab was opened.

For its inaugural three-week run, NSRL hosted 75 experimenters from about 20 space centers, national laboratories including Brookhaven, and universities and medical schools in the U.S. and abroad. Participants included scientists from nations participating in the International Space Station (ISS). Since crewmembers are spending more time in space on the ISS, they are exposed to more cosmic radiation than space travelers on previous missions — which makes the completion of NSRL and the participation of an international collaboration in NSRL research particularly timely.

From the Booster to NSRL, beams of heavy ions such as iron, silicon, carbon and titanium are delivered through a new, 100-meter transport tunnel to a 400-square-foot shielded target hall. There, radiobiologists and medical scientists irradiate a variety of biological specimens, tissues and cells, as well as DNA. Specifically, they are investigating radiation-induced damage to chromosomes, as well as to organs such as the skin, eye and brain. Other researchers test dietary measures and drugs that may counteract the effects of radiation. In other experiments, various materials are subjected to irradiation to determine their suitability for spacesuits or spacecraft shielding.

For researchers' use during their three to four experimental runs per year, the 4,560-square-foot NSRL also contains five laboratories and specimen rooms, as well as a dosimetry room and a control room. While Brookhaven's Collider-Accelerator Department operates the Booster, is responsible for NSRL accelerator systems, and provides the radiation dosimetry necessary for the radiobiology experiments, the Laboratory's Biology and Medical Departments provide experiment support services to NSRL facility users. Staff from all three Brookhaven departments also perform research at NSRL.

Research conducted at NSRL contributes to an ongoing, extensive effort to study space radiation and to find ways to keep astronauts fit and healthy as they travel through the solar system and after they return. NASA is funding approximately 50 research grants in radiation biology and radiation shielding at U.S. universities and national laboratories.

This research may also be helpful to earthbound citizens who never venture into space. For instance, advances in radiation detection, shielding and other radiation-mitigation techniques may be applied to workers both on Earth and in space. And a better understanding of the effects of radiation on living cells may lead to improvements in the use of radiation to treat disease, as well as to the prevention of radiation-induced illnesses.