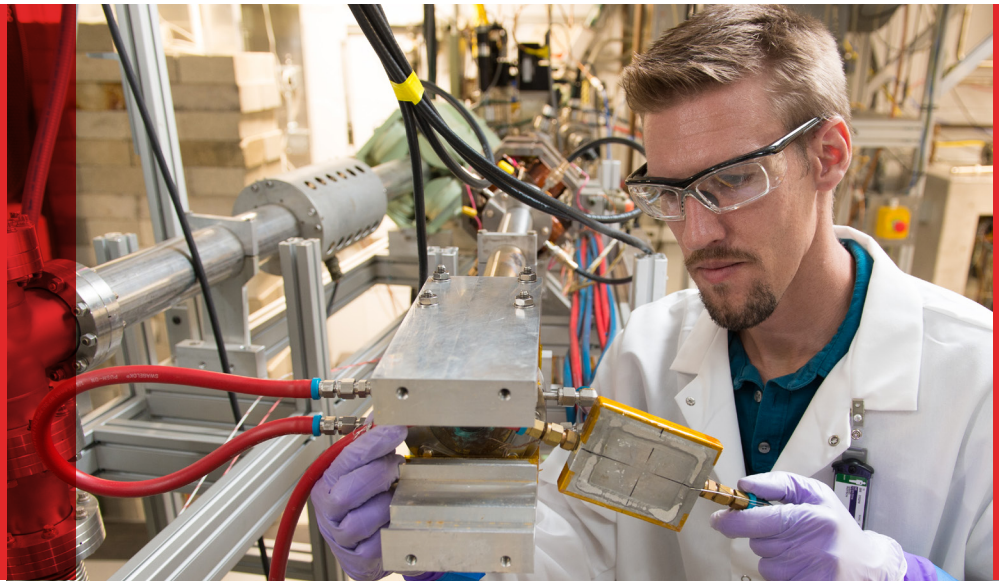
Argonne NATIONAL LABORATORY

RADIOISOTOPE RESEARCH AND PRODUCTION PROGRAM

Argonne National Laboratory



- Low-Energy Accelerator Facility (photonuclear production)
- Argonne Tandem Linear Accelerator System User Facility (light-ion production)
- Radiochemical and separation science expertise
- Van de Graaff generator (radiation damage and stability studies)

Argonne National Laboratory houses the Low-Energy Accelerator Facility (LEAF) and the Argonne Tandem Linear Accelerator System (ATLAS) User Facility. These facilities represent a unique blend of capabilities, expertise and/or product offerings that support a broad base of research and applications.

LOW-ENERGY ACCELERATOR FACILITY (LEAF)

The LEAF houses Argonne's electron linear accelerator and provides a unique method for cost-effective, high-yield production of radioisotopes used for medical, national security, basic science, and industrial applications. This method, based on photonuclear reactions, also results in high-specific activities needed for certain clinical applications that are not always achievable through research reactors or proton accelerators.

Originally built in 1969, Argonne's e-Linac was recently upgraded with National Nuclear Security Administration funding to enable R&D that supports domestic production of molybdenum-99. The LEAF Facility is now part of the DOE Isotope Program, producing isotopes in short supply for the Nation. The e-Linac now delivers energies up to 53 MeV and average power over 25 kW from 25 to 35 MeV. Multiple beam lines allow for multiple target stations. The combination of these beam energies and power enable the production of radioisotopes with Curie-level activities in just 2- to 5-day irradiations.

The Argonne team recently designed, constructed, and commissioned a general-purpose isotope production station with support from the DOE Isotope Program. Currently, this station aids in the production and delivery of high-specific activity Cu-67, a valuable cancer-fighting isotope. For a complete list of available isotopes through the DOE Isotope Programs National Isotope Development Center (NIDC) please visit *www.isotopes.gov.* The team plans to expand its medical isotope portfolio to include scandium-47 (Sc-47) and actinium-225 (Ac-225).

The LEAF also houses a 3 MeV Van de Graaff generator (VDG) useful for radiation damage and stability studies. The VDG can deliver a large dose of radiation without activating the material of interest.

U.S. DEPARTMENT OF ENERGY
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SUPERCONDUCTING ION LINAC

Supported by the Office of Nuclear Physics, ATLAS is a DOE National User Facility capable of producing a wide variety of light and heavy ions that are useful for R&D and limited production of emerging isotopes using low-energy, ion-induced reactions. Ions available through ATLAS include protons, helium-3, helium-4, lithium-6, lithium-7, beryllium-9, as well as heavier options.

Relevant R&D conducted at ATLAS may include the exploration of production reaction yields via high-cross-section compound-nuclear reactions. Beam intensities available are well within the range required to produce research quantities of medical isotopes such as astatine-211 (At-211), and research towards the development of a Rn-211/At-211 generator has begun. Similar reactions enable development of a wide variety of Auger-electron emitting therapeutic and theranostic isotopes.

LABORATORIES

Argonne has a full array of conventional and radiological laboratories and radio-analytical counting equipment, including α-, β-, and γ-spectrometers; high-purity germanium (HPGe) detectors; multi-sample liquid scintillation; and NaI well detectors. Expertise and equipment to aid in the separation of radioactive material are also available.

For trace analysis and quality control, Argonne's analytical laboratory includes inductively coupled plasma mass spectroscopy (ICP-MS), inductively coupled plasma–optical emission spectroscopy (ICP-OES), and other instrumentation. Argonne recently purchased an Atomlab 500 dose calibrator for product distribution, a LabLogic. Scan-RAM radio-TLC scanner for effective specific activity measurements, and an additional HPGe detector.

HOT CELLS

Hot cells are used for processing activities on the hundred Curie-level scale. The first cell is adjacent to the e-Linac experimental hall, and a second, currently being outfitted for Cu-67 production, is in an adjacent building. Other hot cells are available on site. Samples can be conveniently introduced and removed from these hot cells, and the interior equipment is fully customizable. Radiochemical laboratories are also available for processing of lower-activity samples, as well as for final chemical processing and quality assurance/quality control activities.

TEAM EXPERTISE

Through long-term and collaborative programs in physics, chemistry, and chemical and nuclear engineering, the Argonne team has developed extensive knowledge in technologies essential to research and production of radioisotopes. Their wide-ranging expertise includes:

- Accelerator design, engineering, and operations;
- Specialized target design and engineering;
- Chemistry and chemical engineering for isotope separation and purification;
- Nuclear engineering for shielding and design of targets with nuclear material;
- Engineering capabilities for the design and installation of hot cells and specialized equipment;
- Radiochemistry techniques; and
- Robotic handling to support the development of advanced remote isotope separation processing.

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