NIDC | NATIONAL ISOTOPE DEVELOPMENT CENTER
MANAGED BY THE U.S. DEPARTMENT OF ENERGY ISOTOPE PROGRAM

Newsletter

Fall 2021

New Capability Announcement—Idaho National Laboratory Radioisotope ElectroMagnetic Isotope Separator

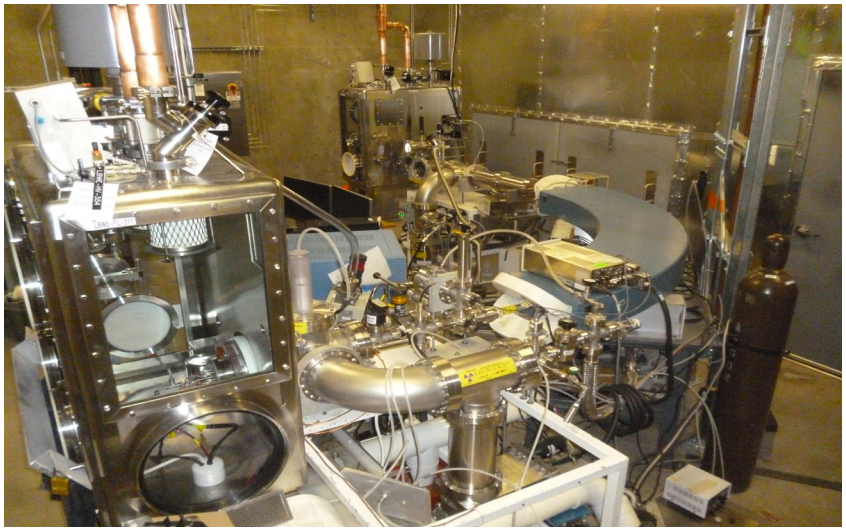
The Department of Energy Office of Isotope Research & Development and Production (DOE Isotope Program) has recently added a new capability into its isotope production network. The Radioisotope Electromagnetic Isotope Separator, or RAD EMIS, located in the Materials and Fuels Complex at Idaho National Laboratory (INL) is now under the stewardship of the DOE Isotope Program. This unique instrument is able to enrich small quantities of rare or short-lived radioisotopes for use in research as radiotracers, national security exercises, and precision analytical measurements as internal standards.

Developed in 2015, the RAD EMIS is the only electromagnetic separator in the United States that is designed to enrich actinide isotopes. The RAD EMIS uses thermal vaporization and electron impact ionization to produce ion beams. It was designed with remote operations in mind, shielding for protection, high feedstock utilization efficiency, and for the rapid recovery of product in case short-lived isotopes are produced.

The RAD EMIS team at INL is focused on producing enriched neptunium-236 as its first major project for the DOE Isotope Program. This long-lived isotope is used as a standard for mass spectrometry to determine neptunium-237 in environmental samples.

During the next several years, the team will focus on isolating uranium-237 from uranium-238, which can be produced by high energy Bremsstrahlung photonuclear reactions.

The DOE Isotope Program is evaluating enrichment of isotope products from high energy proton and deuteron irradiations, some of which may be enriched and purified using the RAD EMIS at INL.



Idaho National Laboratory's radioisotope electromagnetic isotope separator

INSIDE THIS ISSUE

- New Capability: Idaho National Laboratory RAD EMIS
- Isotope User Meetings - Ac-225, At-211, Pb-212, and Cu-67
- Marc Garland Retires
- Isotope Availability: Ra-224/ Pb-212 Generators
- DOE IP COVID-19 Response
- Suzanne Lapi Awarded SNMMI Fellowship
- Cerium-134 for PET Imaging
- SIPRC Update
- DOE IP Welcomes New Staff and Says Farewell to Retirees
- ISOtopics: Staff Recognition, Publications, Events, Awards

Isotope User Meetings—Actinium-225, Astatine-211, Lead-212, and Copper-67

The DOE Isotope Program hosted four virtual isotope user meetings in 2021. Participants tuned in to listen to presentations focused on alpha-emitters: actinium-225 (Ac-225), astatine-211 (At-211), and lead-212 (Pb-212). A session focused on the beta-emitter copper-67 (Cu-67) was also presented, marking the first User Group Meeting for this isotope. The webinar-style sessions featured brief presentations by leading researchers showcasing their latest progress in these emerging fields, followed by interactive panel discussions and a moderated question and answer session.

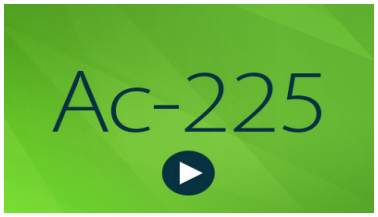
The Ac-225 session was moderated by Dr. Eva Birnbaum from Los Alamos National Laboratory. Presentations from Dr. Rebecca Abergel with the University of California at Berkeley, Dr. Ekaterina Dadachova with the University of Saskatchewan, Dr. James O'Leary, and Thomas Armor with Fusion Pharma, Dr. Neil Bander with Weill Cornell Medicine, and Dr. George Sgouros with Johns Hopkins University were included.

The At-211 session was moderated by Dr. Yawen Li from the University of Washington. Presentations from Dr. Rob Emery with the University of Washington; Dr. Michael Zalutsky with Duke University; Dr. Lauren McIntosh with Texas A&M University; Dr. Eric Prebys with the University of California, Davis; and Dr. Mehran Makvandi with the University of Pennsylvania were included.

The Pb-212 session was moderated by Dr. Roy Copping from Oak Ridge National Laboratory. Presentations from Dr. Mengshi Li with ViewPoint; Dr. Rebecca Abergel with the University of California, Berkeley; Dr. Ebrahim Delpassand with RadioMedix; and Mr. Matt O'Hara with Pacific Northwest National Laboratory were included.

The Cu-67 session was moderated by Dr. David Rotsch from Argonne National Laboratory. Presentations from Dr. Jack Shively with the City of Hope National Medical Center, Dr. Alan Packard with the Boston Children's Hospital, Dr. Brian Zeglis with Hunter College, Dr. Jennifer Bartels with the University of Alabama at Birmingham, and Mr. Shaemus Gleason with Clarity Pharmaceuticals were included.

To view recordings of each of the isotope user meetings and the associated presentations, visit the NIDC website at **https://www.isotopes.gov/2021-isotope-user-group-meetings**.



Actinium-225 User Meeting Recording Link



Astatine-211 User Meeting Recording Link



Lead-212 User Meeting Recording Link



Copper-67 User Meeting Recording Link

Isotope Availability Highlights

Now Available

- Actinium-225 (accelerator-produced)
- Aluminum-26
- Americium-241
- Astatine-211
- Barium-133
- Cadmium-109
- Copper-67
- Lutetium-177
- Rubidium-83
- Ruthenium-96
- Selenium-75
- Silicon-32
- Strontium-89
- Tellurium-119m
- Thorium-228
- Thorium-232
- Titanium-44
- Uranium-234

Coming Soon

- Beryllium-7
- Carbon-14
- Cerium-134
- Cerium-139
- Iridium-192
- Iron-55
- Iron-59
- Holmium-163
- Promethium-147
- Selenium-72
- Yttrium-86
- Zinc-65

Under Investigation

- Argon-39
- Gadolinium-153
- Heavy water (D_2O)
- Lithium-7
- Manganese-52
- Molybdenum-98
- Molybdenum-100
- Niobium-93m
- Platinum-195
- Scandium-47
- Silicon-28
- Silver-111
- Uranium-230
- Xenon-129
- Ytterbium-176

DOE Isotope Program Deputy Director Marc Garland Retires



Dr. Marc Garland

After more than ten years with the DOE Isotope Program, Dr. Marc Garland retired from the DOE in January. Marc served as the program manager for Isotope Program Operations and the deputy director of the DOE Isotope Program, where he oversaw programmatic issues and managed the National Isotope Development Center.

During his tenure, he facilitated the growth of the DOE Isotope Program, and NIDC and was instrumental in managing numerous large projects. Among those projects is the production of actinium-227, a radioisotope used to manufacture the cancer drug Xofigo®, which stands out as one he is honored to have played a role in developing.

"Participating in the development of actinium-227 production for Xofigo® was by far one of the most rewarding efforts in my career with the DOE Isotope Program."

Marc received a BS degree in biology from the University of Washington, an MS degree in electrical engineering from Washington State University, and MS and PhD degrees in nuclear engineering from the University of Maryland. Early in his career, he spent 18 years in nuclear facility operations and project management at the Hanford Site and was a faculty member in the nuclear engineering program at the University of South Carolina. Marc also spent time at Oak Ridge National Laboratory conducting research and development in radioisotope production, radiation detection and measurement, medical applications of radioisotopes, and radioisotope power sources before joining the Department of Energy Isotope Program in September 2010.

In his retirement, Marc plans to spend his time traveling, enjoying time with friends, and appreciating all that the Washington D.C. area has to offer. The DOE Isotope Program is thankful for Marcs service and will miss him dearly. We wish him all the best in his future endeavors.

Availability Notice: Radium-224/Lead-212/Bismuth-212 Generators

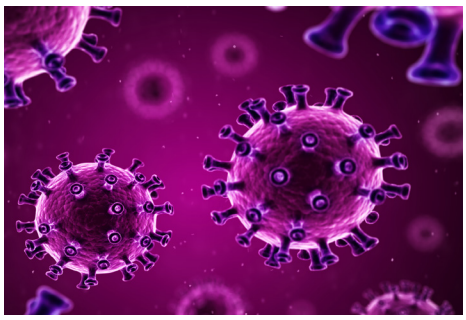
The DOE Isotope Program has radium-224/lead-212 gererators (Ra-224/Pb-212) available for purchase through the NIDC.

Lead-212 is an alpha-emitting radionuclide of interest within the nuclear medicine community for it's use as a radioimmunotherapy in a variety of cancers including melanoma, prostate, stomach, ovarian, and breast.

Our radium-224/lead-212/bismuth-212 generator ($t_{1/2}$ = Ra-224: 3.6 days, Pb-212: 10.6 hours, Bi-212: 61 minutes) is produced at Oak Ridge National Laboratory through the decay of thorium-228 (Th-228). Radium-224 is separated from the Th-228 and is loaded on a generator so that the Pb-212/Bi-212 can be milked periodically. Shipments of the generator product take place every two-three weeks.

For further inquiries about Ra-224/Pb-212/Bi-212 generators contact the NIDC at **contact@isotopes.gov** or visit **www.isotopes.gov/catalog/**

DOE Isotope Program COVID-19 Response



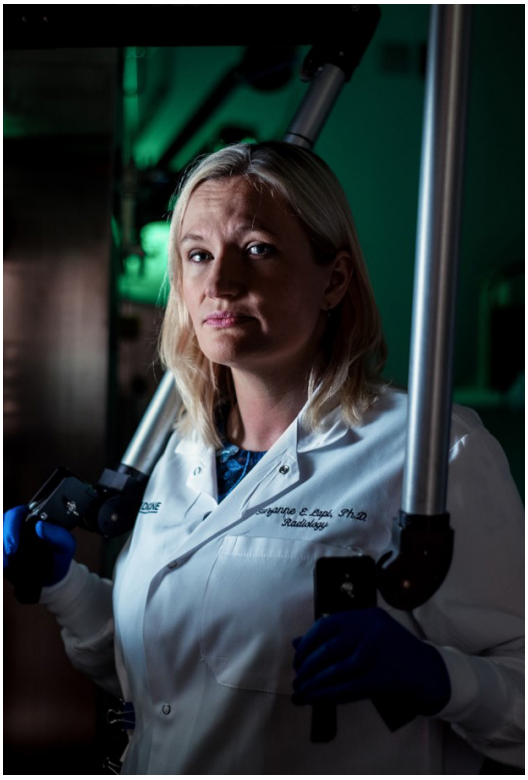
During the pandemic, the DOE Isotope Program has managed to navigate through the uncertain effects of the coronavirus as it affects nearly every corner of the world.

During this time, we have closely monitored isotope supply and demand, acting where necessary to mitigate shortages. This includes working with customers and other isotope producers, and adjusting our production plans to allow for additional inventory in the event a critical isotope is needed in the market. The production of isotopes was identified as mission essential within the DOE complex, and our sites have maintained operations to deliver products as needed.

We have been able to supply actinium-225 to multiple researchers and institutions on the waitlist for this isotope. They received shipments when other customers had to postpone or cancel orders due to limited or suspended operations at their receiving facilities.

As the effects of the virus continue to impact isotope production and transportation across the globe, the Isotope Program will remain diligent in monitoring isotope markets and facilitating when necessary. For questions regarding COVID-19 and the DOE Isotope Program's response, contact us at **contact@isotopes.gov**.

DOE Isotope Program Early Career Awardee Named SNMMI Fellow 2020



Dr. Suzanne Lapi, Fellow of the Society of Nuclear Medicine and Molecular Imaging

Dr. Suzanne Lapi, professor of radiology and chemistry and director of the Cyclotron Facility at the University of Alabama at Birmingham (UAB), was recently awarded the status of Fellow of the Society of Nuclear Medicine and Molecular Imaging (SNMMI). This prestigious and formal recognition is available to long-time SNMMI members and is awarded for exceptional achievement in the field of nuclear medicine and molecular imaging.

In her role at UAB, Dr. Lapi oversees production of positron emission tomography (PET) radionuclides and imaging radiopharmaceuticals for both preclinical research and clinical trials. Her research interests include the development and translation of new PET radionuclides and molecular imaging agents. Her research group holds more than 15 active Investigational New Drug applications with the FDA and routinely supplies research isotopes to domestic and international research groups. She has more than 100 publications and is actively funded by research grants from the DOE Isotope Program, National Institutes of Health, private foundations, and industry partners.

Currently, the UAB Cyclotron Facility and Dr. Lapi are preparing to join the DOE Isotope Program's University Production Network and will work to develop and offer vanadium-48 and manganese-52 through the NIDC. Dr. Lapi will also aim to partner with the DOE Isotope Program as an experimental resource center to facilitate studies related to isotope production. This will allow UAB staff and students to perform preliminary studies including target development, irradiations, yield measurements, and small-scale separation chemistry. In addition, UAB can host students, staff and scientists from other facilities to enable new experiments in isotope production, purification techniques, and quality control.

In 2009 while at Washington University in St. Louis, Dr. Lapi worked on the production of nonstandard PET isotopes, which was supported by several DOE grants including an Early Career Award in 2011. This was the first Early Career Award made by the DOE Isotope Program after it moved from the Office of Nuclear Energy to the Office of Science in 2009.

LANL Researchers Develop Cerium-134 for Use as a PET Imaging Agent with Alpha-Emitters



LANL scientist Veronika Mocko processing cerium-134 in the hot cells at LANL

Los Alamos National Laboratory (LANL) researchers funded by the DOE Isotope Program have developed an effective production route for cerium-134, which holds promise as a PET imaging analogue to actinium-225 and thorium-227. Establishing a routine production pathway for cerium-134 is an essential step in advancing the use of the alpha emitters for cancer therapy.

"This advancement offers new possibilities for medical staff and drug developers to better characterize new actinium and thorium therapeutics," said Stosh Kozimor, lead LANL researcher on the joint project with Lawrence Berkeley National Laboratory, the University of California at Berkeley, and the University of Wisconsin–Madison. For more information you can **read the full article**.

U.S. Stable Isotope Production and Research Center (SIPRC)

The DOE Isotope Program has selected Oak Ridge National Laboratory as the site of the new U.S. Stable Isotope Production and Research Center (SIPRC).

The new, 54,000 square-foot facility will enable the large-scale enrichment of stable isotopes using both electromagnetic isotope separator (EMIS), and gas centrifuge isotope separator (GCIS) technologies. Stable isotope enrichment is a top priority of the Isotope Program. Stable isotopes have direct medical applications, serve as targets to produce critical radioisotopes, and are used for numerous research and industrial applications. The facility is a crucial step in re-establishing domestic stable isotope production and mitigating U.S. dependence on foreign isotope supplies.



Rendering of the new SIPRC facility

At the present time, conceptual design reports for all SIPRC subprojects have been completed, and the project will advance through of a series of internal and external cost and project reviews in 2021. Approval to proceed to the design phase and begin long-lead procurements was awarded in October 2021.

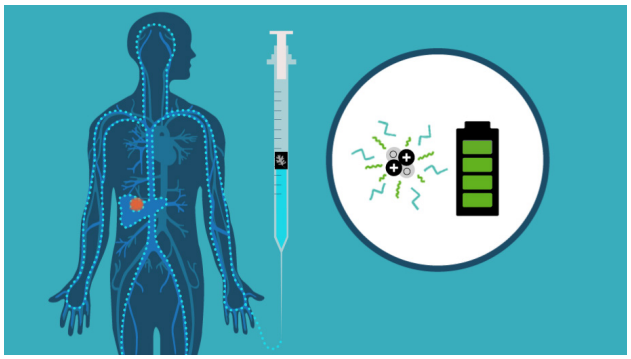
There are a suite of isotopes that wil be enriched using EMIS technology in the new facility including ytterbium-176. Highly enriched ytterbium-176 serves as target material to produce lutetium-177, a radioisotope used in treatments for cancers of the digestive tract, as well as numerous clinical trials for prostate cancer.

Isotopes slated to be enriched using GCIS technology constructed in SIPRC include molybdenum-98 and molybdenum-100, which can be used to produce the technicium-99m radioactive tracer that is used in tens of millions of medical diagnostic procedures annually.

The current cost range for the SIPRC project is $178M–$338M with expected completion late in the decade.

Actinium-225 (Thorium-229 Derived) Drug Master File Accepted by the FDA

The DOE Isotope Program is pleased to announce that the U.S. Food and Drug Administration (FDA) has accepted its Type II Drug Master File (DMF) submission for actinium-225 nitrate (thorium-229 derived). The alpha-emitting radionuclide and its decay product bismuth-213 have gained considerable interest within the medical community for targeted radiotherapy of cancer and other diseases.



Targeted alpha therapy can deliver radiation to specific cells, with minimal effect on surrounding, healthy cells. Credit: Michelle Lehman and Jaimee Janiga/Oak Ridge National Laboratory, U.S. Department. of Energy

The material is derived from thorium-229 stocks maintained at ORNL. Actinium-225 is one of the key radioisotopes that occur as the thorium decays. A by-product from past nuclear programs, the thorium material is processed regularly to separate the Ac-225 for distribution. Because of the high demand for Ac-225, the quantity of the isotope available by this route is fully committed this year; however, the DOE Isotope Program is pursuing multiple other production routes for the isotope including **accelerator-produced Ac-225**.

A DMF is a confidential, detailed document that is submitted to the FDA with information about facilities, processes, or articles used in the manufacturing, processing, packaging, and storing of human drug products. An active DMF enables clinical investigators or pharmaceutical companies to reference the filing in their regulatory submissions.

For more information on this DMF, follow the link below to read the full article at **ORNL.gov**. If you have questions regarding Th-229 derived Ac-225, email **contact@isotopes.gov**.

The DOE Isotope Program Welcomes New Staff and Says Farewell to Retirees



Dr. Joe Glaser

After five years with the DOE Isotope Program, Dr. Joseph Glaser retired in December 2020. Joe served as the federal Program Manager for Alternate Isotope Production. He provided oversight of strontium-90 operations at Pacific Northwest National Laboratory and research and development of dual-use isotopes during his time.

Joe graduated from the Polytechnic Institute of Brooklyn with his PhD in aerospace engineering. Before joining federal service, Joe worked at Lawrence Livermore National Laboratory in a variety of roles. In 2000, Joe joined the DOE with the National Nuclear Security Administration. During his 20-year tenure in federal service, he also served as a senior advisor to the associate administrator/deputy undersecretary for counterterrorism and counterproliferation before joining the DOE Isotope Program office.

In retirement, Joe and his wife are looking forward to traveling across the United States and internationally. They also plan to spend time in with their son in New York City and volunteering a few days each week at performing arts centers and museums in the Washington DC area. The DOE Isotope Program is thankful for Joe's service and wishes him all the best in his future endeavors.



Mr. Joel Grimm

After eight years with the DOE Isotope Program, Joel Grimm retired from the DOE in August 2020. Joel served as the federal program manager for Accountable Nuclear Materials and Stable Isotopes. He oversaw re-establishing americium-241 production at Los Alamos National Laboratory and was responsible for directing and overseeing several efforts to renew and expand isotope enrichment at ORNL.

Joel had 34 years of federal service, which began in waste management. He was promoted to oversee all waste management at LANL, including certifying the first defense transuranic waste shipments to the newly opened Waste Isolation Pilot Plant. He helped establish DOE's Offsite Source Recovery Project, recovering thousands of excess and unwanted DOE Loan-Lease Program sources and other commercially owned radioactive materials. He continued this work and expanded it to other related nuclear material management activities after relocating to NNSA's headquarters office in 2004.

Joel and his wife Janet are looking forward to numerous hobbies, volunteering, and domestic and foreign travel adventures. The DOE Isotope Program is sad to see Joel leave but wishes him an enjoyable and long retirement.

David Bivans has joined the DOE Isotope Program as the federal program manager for Alternative Isotope Production, replacing Joe Glaser. Dave had been on a detail assignment as a technical advisor from the Office of Environmental Management (EM) since June 2020.



David Bivens

Dave started his DOE career within the weapons program addressing research and component manufacturing development and the processing of nuclear materials with a focus on plutonium recovery and purification at the former Rocky Flats Plant. Subsequently, he transferred to nuclear materials production providing program direction and oversight for the restart of the Savannah River Site F-Canyon/FB-Line processing facilities following environmental reviews for the stabilization/disposition of plutonium solutions and irradiated targets. His most recent assignment with EM was as a supervisor in the security and emergency preparedness office. Dave has a BS degree in chemical engineering from the University of Maryland.

David Bivans can be reached at **david.bivans@science.doe.gov**

Dr. April Gillens has joined the DOE Isotope Program as the federal program manager for Stable Isotopes, replacing Joel Grimm. April has a broad background in nuclear forensics, stable isotope signatures, nuclear materials processing, nuclear security and policy, nuclear safeguards, weapons sustainment, and quantum information science.



Dr. April Gillens

April will oversee stable isotope inventory and activities associated with the distribution of stable isotopes. She is also responsible for stable isotope research and development at laboratories and universities, management of the production of enriched stable isotopes, and approval of stable isotope production plans, as well as many other initiatives for the Isotope Program.

April is a graduate of North Carolina Agricultural and Technical State University, where she received a BS degree in biological engineering. She then pursued a PhD at Clemson University, graduating as the first and only Department of Homeland Security Nuclear Forensics Graduate Fellow at Clemson University, and the first African American woman to earn a Ph.D. in environmental engineering and science from Clemson. After an internship at Lawrence Livermore National Laboratory, she worked at the U.S. Department of Defense, supporting the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters. April later accepted a position in the Science, Technology Assessment, and Analytics Team at the Government Accountability Office, where she supported engagement on quantum information technologies before joining the DOE Isotope Program.

Dr. Gillens can be reached at **april.gillens@science.doe.gov**

ISOtopics

RESEARCH EXCELLENCE

C. Shaun Loveless, a graduate student at the University of Alabama, Birmingham in the Radiology and Chemistry Department has successfully defended his PhD thesis titled "Production of Medical Isotopes using Titanium Accelerator Targets." A paper detailing his work has been accepted at the Journal of Nuclear Medicine titled **"Cyclotron Production and Separation of Scandium Radionuclides from Natural Titanium Metal and Titanium Dioxide Targets."**

Dr. Loveless also recently accepted a position at Curium Pharmaceuticals. Congratulations Shaun, we wish you the best of luck in your future endeavors!

*The DOE Isotope Program sponsors work performed in the Radiology and Chemistry Dept. at UAB.

STAFF ACCOMPLISHMENTS



Dr. Josh Peterson-Droogh

The DOE Isotope Program is pleased to congratulate Josh Peterson-Droogh, reactor physics analyst with Idaho National Laboratory (INL), on the completion of his MS in data science. Josh received his PhD in nuclear engineering from the University of Texas at Austin and an MS in nuclear engineering at Idaho State University. He specializes in modeling irradiation experiments in test and research reactors, including modeling radionuclides targets such as cobalt-60 (Co-60) and iridium-192 (Ir-192).

For his master's project, Josh was able to show that with advanced machine learning algorithms such as random forest regression, the prediction of Co-60 in INL's Advanced Test Reactor can be performed in a matter of minutes instead of weeks with reliable results. Congratulations Josh, we appreciate your hard work and value your contribution to the Isotope Program.

NEW STAFF

Brookhaven National Laboratory (BNL) recently welcomed three new staff members to the BNL isotope production team. Michael Skulski has joined as a postdoctoral research associate working on the Tri-Lab Effort, Christopher Vitkun has joined a production manager focused on the production of cGMP isotopes, and David O'Rourke has joined as a BLIP Operator and is assisting in the startup of the new cyclotron facility.

FEATURED PUBLICATION

Featured in *Inorganic Chemistry* is "A Solid State Support for Separating Astatine-211 from Bismuth." Funded by the DOE Isotope Program, researchers from Los Alamos National Laboratory and the University of Washington, Department of Radiation Oncology contributed to the publication, which discusses the rapid isolation of astatine-211 from bismuth targets using the commercially available prefilter resin.

Recovery of At-211 is important to advance an understanding of basic astatine chemistry. As an alpha emitter with a short half-life, At-211 is showing tremendous promise as a targeted alpha therapy treatment. **To read the full research article, click here.**

UPCOMING EVENTS

Society of Nuclear Medicine and Molecular Imaging 2022 Annual Meeting, Vancouver, British Columbia

The Society of Nuclear Medicine and Molecular Imaging 2022 Annual Meeting will take place in Vancouver, British Columbia June 11–14, 2022 at the Vancouver Convention Centere as an in-person event. Join the DOE Isotope Program and NIDC in our booth located in the exhibit hall. Stay tuned for more information on sessions chaired by the Isotope Program, one-on-one customer meetings, and more in the coming months.

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