American Nuclear Society
Accelerator Applications Division

Upcoming Events

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# AAD News

## A newsletter of the ANS Accelerator Application Division

### Your AAD Leadership Team

**Officers:**

William C. Horak — Past Chair

Gregory E. Dale — Chair

Valeriia N. Starovoitova — Vice-Chair

Lin Shao — Secretary

Eric J. Pitcher —Treasurer

**Executive Committee (3 year term):**

Mohamed Yousry Gohar (2023)

Khalid Hattar (2023)

Charlie A. Cooper (2023)

Eva R. Birnbaum (2022)

Irina I. Popova (2022)

Rolland P. Johnson (2022)

Blair Bromley (2021)

Lawrence Heilbronn (2021)

Fredrik Tovesson (2021)

John D. Galambos (2020)

Michal Mocko (2020)

Lin Shao (2020)

## Message from the Chair

As I begin my term as Chair of the AAD I would like to extend my thanks and appreciation to my predecessor in this position, William Horak. Bill deftly guided the division through several significant challenges during his tenure. His leadership during these very challenging times is greatly appreciated. It is unfortunate that we were not able to send him off in person at the 2020 summer meeting, but extend our warmest and heartfelt thanks to him.

I would also like to congratulate and introduce the newly elected members of the AAD Executive Committee: Charlie A. Cooper, Mohamed Y. Gohar, and Khalid Hattar. These individuals join Blair Bromley, Lawrence Heilbronn, and Fredrik Tovesson as voting members of the AAD Executive Committee. The AAD officers consist of myself, Valeriia Starovoitova as Vice Chair, Lin Shao as Secretary, and Eric Pitcher as Treasurer.

We will strive to keep our division members informed during these times of change. Please continue to read this newsletter, keep an eye out for our e-mails and messages from ANS Collaborate, and check our website at http://aad.ans.org/ for the latest news. Please also feel free to reach out to any of us with your ideas and concerns.

As you can imagine, one of the biggest challenges facing the division right now are conferences and in-person meetings. Regretfully we had to cancel the AccApp'20 conference scheduled to be held at the IAEA in Vienna in early April. This was one of the very first conferences around the world to cancel as the pandemic began to gain steam. In hindsight, canceling was obviously the right decision. In late February and early March, when these decisions had to be made, it wasn't nearly that straightforward. My greatest appreciation goes out to Phil Cole and all the other members of the conference committee as they had to adapt to a rapidly changing and highly unknown situation. The AAD committee remains committed to organizing future AccApp conferences and we are currently planning for the next iteration. I hope to provide more details on this in our next newsletter.

Other items of business for the executive committee in this upcoming year includes continuing to support the ANS as a whole in the implementation of their change plan. This plan is available for viewing at https://www.ans.org/about/changeplan/. A lot of the change plan has to do with improving and modernizing the governance and operation of the ANS. You as members have likely observed these changes as a greatly improved ANS Website and an updated Nuclear News magazine. A reminder that the AAD can contribute to Nuclear News. I solicit your ideas on accelerator news and articles that would help highlight our division to the larger ANS community.

In closing, I would like to thank Valeriia for the tremendous work she does editing and publishing this newsletter. I would also like to thank Charles Kelsey and Peter Hosemann for continuing to serve as the webmasters for the division website. The strength of the AAD is due to its members and its volunteers. Please share your talents with us by volunteering as well. We will definitely need your help planning and executing the next AccApp. Another option is to serve on the AAD Executive Committee. Nominations for new executive committee members will likely begin around the end of August, so be thinking about that as well. Feel free to reach out to me or any other of the AAD Committee members via ANS Collaborate for more information on how you can help.

Wishing you all the best of health.

Sincerely,

Gregory E. Dale

# Spotlight Article: Argonne National Laboratory Researchers Leverage World-Class Low Energy Accelerator Facility (LEAF) in the Development of Domestic Production of Mo-99

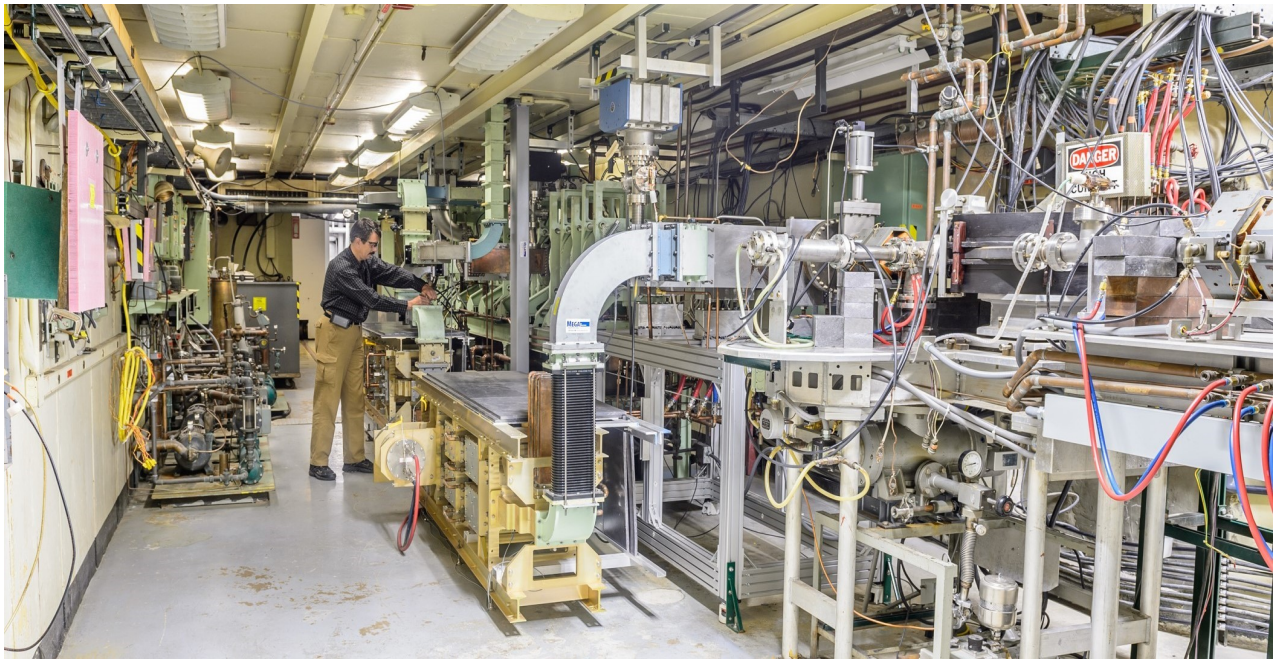
**By Sergey Chemerisov**

Every day, health care professionals in the United States use Tc-99m, daughter of Mo-99, in over 40,000 medical procedures to diagnose critical illnesses. Argonne researchers—in collaboration with researchers from other national laboratories — are supporting the National Nuclear Security Administration (NNSA) in its mission to establish a reliable domestically produced supply of Mo-99 without the use of highly enriched uranium. As part of that mission, NNSA has awarded cooperative agreements to Niowave, Inc., located in Lansing, Michigan; NorthStar Medical Radioisotopes, LLC, located in Beloit, Wisconsin; SHINE Medical Technologies, located in Janesville, Wisconsin; and Northwest Medical Isotopes, located in Corvallis, Oregon. Cooperative agreements require companies to achieve, at the end of the project, a production goal of 3,000 six-day curies of $^{99}$Mo per week.

*"Currently, an Argonne team of researchers is working with three emerging domestic producers of $^{99}$Mo: SHINE Medical Technologies, Niowave, Inc., and NorthStar Medical Radioisotopes."*

Currently, an Argonne team of researchers is working with three of those emerging domestic producers of $^{99}$Mo: SHINE Medical Technologies, Niowave, Inc., and NorthStar Medical Radioisotopes. These three producers are developing different technologies for $^{99}$Mo production—a common theme for those producers is the use of the accelerators for $^{99}$Mo production. Because of these commonalities, Argonne researches are able to leverage chemical separation expertise and availability of high-power electron linac to assist in development of new technologies for $^{99}$Mo production.

The SHINE Medical Technologies process uses fast neutrons produced in the nuclear reaction of hydrogen isotopes to bombard an aqueous solution of uranium, creating fission products that include $^{99}$Mo, which is the parent isotope of $^{99m}$Tc. The chemical part of the SHINE process was developed and demonstrated at Argonne, where low enriched uranium (LEU) uranyl sulfate solution was irradiated with fast neutrons produced in a depleted uranium target




*Maintenance work is performed on the 55 MeV electron linac at ANL*

*(cont. on next page)*

# Argonne National Laboratory Researchers Leverage World-Class Low Energy Accelerator Facility (LEAF) in the Development of Domestic Production of Mo-99 (cont.)

bombarded with an electron beam from Argonne's linear accelerator. The Argonne Molybdenum Research Experiment (AMORE) was used to produce, separate, and purify $^{99}$Mo. The first phase of experiments at Argonne was completed in 2015. Argonne's analysis of the $^{99}$Mo from the demonstrations has shown that it met the purity specifications of the industry standard, the British Pharmacopoeia. The second phase of the AMORE continues. In this phase, a larger amount of $^{99}$Mo is produced, allowing direct loading on a commercial $^{99}$Mo/$^{99m}$Tc generator. Several production irradiations of phase 2 AMORE experiments were completed in preparation for shipment of the material to commercial partners.

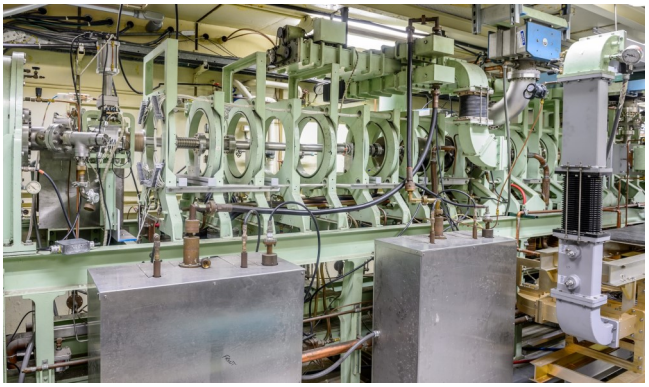
*"Several target designs were tested at the LEAF, and multiple demonstration batches were produced and shipped to a commercial partner. All of the produced molybdenum met purity requirements for $^{99}$Mo."*

NorthStar Medical Radioisotopes is developing accelerator-based production of $^{99}$Mo by using the photonuclear reaction $^{100}$Mo(γ,n)$^{99}$Mo in an enriched $^{100}$Mo target. A high-power electron accelerator is used to produce an intense flux of bremsstrahlung photons to efficiently drive the nuclear reaction. The threshold for the reaction is 9 MeV. The maximum cross-section is 150 mb at 14.5 MeV. Because of the high cost of enriched $^{100}$Mo targets, the material has to be recycled, and losses during the recycling process and size of the target have to be minimized to make the process commercially viable. Minimization of the enriched material inventory drives interest in using targets that are as small as possible and to use the highest possible beam power. Those requirements make the cooling of the target challenging.

To help overcome that challenge, Los Alamos National Laboratory researchers designed a helium cooling system that was built and tested at Argonne's world-class LEAF. An advantage of helium cooling, compared to traditional water-cooling, is that helium is already in a gaseous form at room temperature, so the target can be heated to very high temperature, thereby increasing thermal transfer from target material to cooling media. Also, helium, as a noble gas, does not react with molybdenum, while radiolysis products in the water lead to target corrosion. Several target designs were tested at the LEAF, and multiple demonstration batches were produced and shipped to a commercial partner. All of the produced molybdenum met purity requirements for $^{99}$Mo.

*The dedicated work of the Argonne team and support from DOE's NNSA, Office of Material Management and Minimization, enable accelerated domestic production of an important medical radioisotope, Mo-99. Work supported by the U.S. Department of Energy, National Nuclear Security Administration's (NNSA's) Office of Defense Nuclear Nonproliferation, under Contract DE-AC02-06CH11357. Argonne National Laboratory is operated for the U.S. Department of Energy by UChicago Argonne, LLC.*





*Injector and front end of the 55 MeV linac at Argonne*

# Dedication and collaboration accelerate mission-essential LANSCE isotope production

**by Eva Birnbaum**

To support production of critically needed medical isotopes, the Los Alamos Neutron Science Center (LANSCE) accelerator powered up weeks ahead of its typical annual run cycle schedule. It was late winter at the start of the COVID-19 pandemic, and while many operations at Los Alamos National Laboratory (LANL) were moving to telework, the LANSCE accelerator and the Isotope Production Facility (IPF) began ramping up as a mission-essential function at LANL in support of the Department of Energy's Office of Isotope R&D and Production. For LANSCE and the Isotope Program to meet this national need during the time of COVID-19, a broad collaboration of experts across LANL evaluated the possible safety issues associated with the planned work and—in light of COVID-19 hazards—potential off-normal conditions. Both routine operations and responsive maintenance operations had to be considered to ensure work could be conducted safely. Safety is always at the forefront of IPF planning given that the work involves high-current irradiations for large-scale production. Now, operations were assessed to evaluate the need for additional controls to mitigate the COVID-19 hazard.

Operational and maintenance successes by workers across the LANSCE mesa allowed multiple IPF isotope production runs to be flawlessly executed. The 100-MeV proton beam was delivered at an average current of 265 μA to the IPF target station at high reliability. The runs generated multiple targets that were processed to assure continued supply of essential isotopes. In addition, a target was irradiated to produce Ac-225, as part of the DOE Isotope Program's effort to increase availability of this promising isotope for cancer treatments.

*This work is supported by the U.S. Department of Energy Isotope Program, managed by the Office of Science for Isotope R&D and Production. Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC, for the National Nuclear Security Administration of the U.S. Department of Energy under contract 89233218CNA000001.*

*IPF operators Michael Connors (left) and Ross Capon (right) prepare to use the remote manipulators at the IPF hot cell to package the irradiated targets containing the newly formed radioisotopes.*

# Upcoming Events

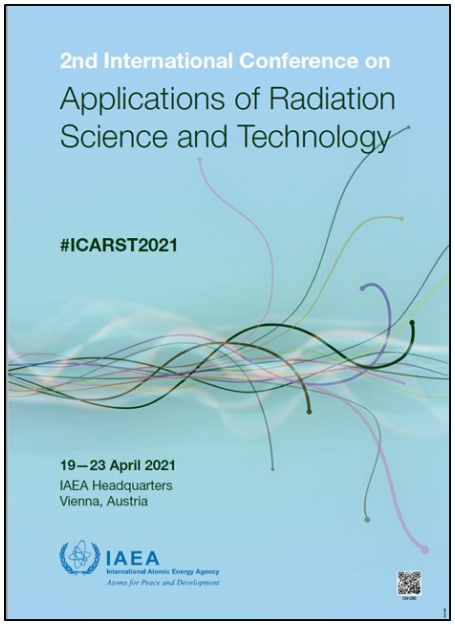
## Second International Conference on Applications of Radiation Science and Technology (ICARST-2021)

### April 19-23, 2021, Vienna

The IAEA is organizing the Second International Conference on Applications of Radiation Science and Technology (ICARST-2021) to take place in April 2021. The meeting will provide a unique opportunity to review the 'state of the science' in the field of radiation technologies as well as key developments in the applications of radiation science and technology. Space is available for commercial exhibitors as well as limited travel support for young professionals. Please submit your abstracts by September 15th.

More information is available at:

https://www.iaea.org/events/icarst-2021




# Have a Story to Tell?

Would you like to contribute a news item or article to a future edition of the ANS ADD Newsletter?

Member contributions to the newsletter are always welcome.

Please send your article to Valeriia Starovoitova (starvale@isu.edu).