NATIONAL ISOTOPE DEVELOPMENT CENTER

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SBIR/STTR
SMALL BUSINESS INNOVATION RESEARCH
SMALL BUSINESS TECHNOLOGY TRANSFER

DOE Small Business Innovation Research/Small Business Technology Transfer

Manouchehr Farkhondeh

When the Isotope Production Program moved to the Office of Nuclear Physics, one substantial change took place. Funds were now available through the US Dept. of Energy Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs. The difference between the two programs is fundamental. The SBIR program was developed to provide R&D funds for small businesses that were developing technology products. The STTR program was a mechanism to facilitate interaction between small business and non-profit organizations such as universities and national laboratories to jointly develop technology.

A primary goal of the Department of Energy's Isotope Development and Production for Research and Applications Program (Isotope Program) within the Office of Nuclear Physics (NP) is to support research and development of methods and technologies in support of the production of isotopes used for research and applications that fall within the Isotope Program portfolio. The Isotope Program produces isotopes that are in short supply in the U.S. and of which there exists no or insufficient domestic commercial production capability; some exceptions include special nuclear materials and molybdenum-99, for which the National Nuclear Security Administration has responsibility.

NP participates in the SBIR/STTR programs through the annual SBIR/STTR funding opportunity announcements. Small businesses are encouraged to contact and to collaborate with NP-funded national user facilities, laboratories and universities to better understand the needs and the mission of the NP program and its community, and to best optimize resources aimed at current high priority technical challenges. These needs and challenges are reflected in the NP topics and subtopics published in the annual DOE SBIR/STTR Funding Opportunity Announcement in August. The maximum funding limits for Phase I and Phase II are $150,000 and $1,000,000 respectively.

Beginning in 2010, with the transfer of the Isotope Program to NP, the isotope science and technology topic was added to the NP SBIR/STTR annual solicitation. Currently, the NP isotope topic and subtopics are as follow:

Topic: Nuclear Physics Isotope Science and Technology

Subtopics:

a. Novel or improved production techniques for radioisotopes or stable isotopes
b. Improved radiochemical separation methods for preparing high-purity radioisotopes.

For subtopic a), research should focus on the development of advanced, cost-effective and efficient technologies for producing isotopes that are in short supply and that are needed by the research and applied communities. This includes advanced accelerator and beam transport technologies such as the application of high-gradient accelerating structures, high-energy/high-current cyclotrons, or other topologies that could lead to compact sources; and novel beam-delivery/restoring and target approaches needed to optimize isotope production. The successful research grants should lead to breakthroughs that will facilitate an increased supply of isotopes that complement the existing portfolio of isotopes produced and distributed by the Isotope Program. Research is also of interest to push the state of the art in high current, high power density accelerator targets for radioisotope production.

For subtopic b), the focus is on separation of isotopes from contaminants and bulk material. The purification of the isotope to customer specifications is a critical process in the production cycle of an isotope. Traditional strategies and techniques rely on old technologies and still require an extensive workforce to operate specialized equipment, such as manipulators for remote handling in hot cell environments. Improved radiochemical separation methods can be achieved and costs of isotope production can be reduced by a) improvements in separations chemistry methods, and b) implementing automated systems and robotics. Applications are sought for innovative developments and advances in separation technologies to reduce processing time, to improve separation efficiencies, to automate separation systems, to minimize waste streams, and to develop advanced materials for high-purity radiochemical separations.

SBIR/STTR Continued

For more details on the NP SBIR program and contact information including the isotope topic please visit: http://science.energy.gov/np/benefits-of-np/sbir-sttr/.

For general information on the DOE SBIR/STTR programs and funding opportunity announcements (FOA) visit the DOE SBIR/STTR webpage at http://science.energy.gov/sbir/

The release of FY2013 DOE SBIR/STTR Topics and FOA with isotopes are tentatively scheduled for:

- FY 2013 Topics description: July 16, 2012
- FY 2013 FOA August 13, 2012.

For further information please contact:

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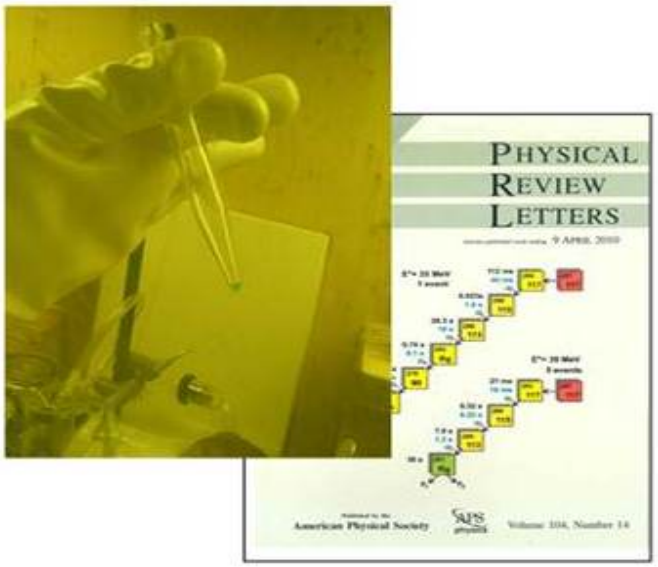
Isotope Program Research and Development

Dennis Phillips

In 2009 the National Isotope Production Program in the Department of Energy was moved from the Office of Nuclear Energy to the Office of Nuclear Physics in the Office of Science. The program was renamed to Isotope Development and Production for Research and Applications (IDPRA). The FY09 Omnibus Spending Bill provided an appropriation for the program which included line item funding to conduct research and development on new and improved capabilities to produce radioactive and enriched stable isotopes for research and applications. The Nuclear Sciences Advisory Committee was charged with forming a subcommittee on isotopes (NSACI) to make recommendations to the Office of Nuclear Physics on priorities for the R&D program. This subcommittee responded by publishing two reports in 2009 that included specific recommendations that have guided the investments into isotope R&D over the intervening years.



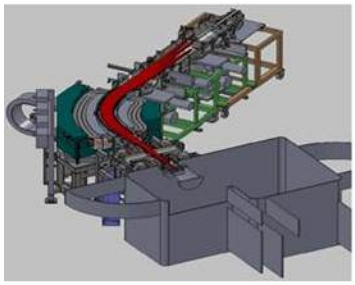
Isotopes produced by the IDPRA have been used for a variety of purposes. Recently, the program provided target material for researchers who successfully created element 117. This work has been building toward creating isotopes in an island of stability that has been predicted by nuclear theorists for decades.

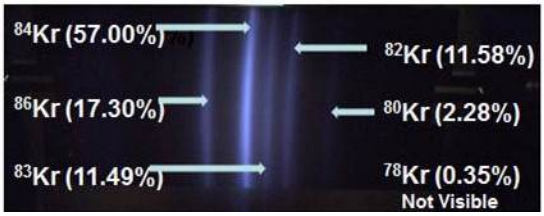
The national labs provide a variety of facilities to support isotope production. They include the High Flux Isotope Reactor (HFIR) at ORNL (upper left), the Brookhaven Linac Isotope Producer (BLIP) at BNL (right) and hot cells distributed throughout the national laboratory complex (center pictures).

Isotope Program R&D (continued)

The NSACI recommendations are:

- Invest in new approaches for the production of alpha-emitting radioisotopes having significant potential for new effective treatment modalities for certain cancer types. Actinium-225 was identified as the highest priority isotope.
- Create a plan and invest in production activities to meet the research needs for trans-uranic heavy elements.
- Coordinate production capabilities and supporting research to facilitate networking among existing DOE, commercial, and academic entities possessing accelerators, reactors, and processing capabilities to provide valuable radioisotopic materials.
- Conduct R&D to prepare for the re-establishment of a domestic source of mass-separated stable and radioactive research isotopes.
- Use R&D investments to facilitate education and training of personnel to create the next generation of expertise to develop new methods in the production, purification and distribution.





Since the calutrons at Oak Ridge National Laboratory were shutdown, there has been no electromagnetic separation capability operating in the US. The IDPRA has funded a development program to utilize state of the art technology to reinstate a capacity to produce enriched stable isotopes by this method. This program will provide enriched stable isotopes for a variety of applications in research and development.

Over $22,000,000 has been invested in 32 peer-reviewed research and development projects at six national laboratories, eight universities and three commercial entities selected from proposals submitted to open funding opportunity announcements. Several of the grants have involved collaborative efforts and have engaged students at both the undergraduate and graduate levels, as well as postdoctoral research associates, thereby providing unique training opportunities. Furthermore, additional grants have been provided to small businesses to support research aimed at commercial development of isotope products and technologies through the Office of Science's Small Business Innovative Research (SBIR) program. The SBIR program became accessible to commercial isotope development proposals as a direct result of the movement of the program into the Office of Science. The spectrum of supported projects closely coincides with the NSACI recommendations. Specific work supported has included:

- Research into the production of therapeutic alpha emitters (Ac-225, At-211, Th-229).
- Research into the production of isotopes for positron emission tomography (As-72, Cu-62, Cu-64, Y-86, Zr-89).
- Production of heavy elements for research and applications (Bk-249, Cf-252, Am-241).
- Development of technologies to produce therapeutic beta-emitters (Cu-67, Re-186, Rh-105, Pr-143).
- Development of new radioisotope extraction/separations technologies.
- Activities in workforce development (undergraduate, graduate, and post-doctoral training).
- Development of new technologies for stable isotope enrichment.
- Development of technologies for isotope harvesting at rare ion beam facility.
- Development of advanced targetry for accelerator and reactor isotope production.

Noted Research Scientist Michael J. Welch Remembered

Robert Atcher

Michael J. Welch

Michael J. Welch died on May 6, 2012. Mike was a member of the faculty at Washington University in St. Louis since 1967 with professorships in numerous departments. His impact on the field of nuclear medicine is huge in terms of the science he worked on and the progeny of his program who have populated programs around the world.

Mike is mentioned in the newsletter because his impact on the utilization of various radioisotopes in nuclear medicine was as significant as the radiopharmaceuticals that were developed in his program. Mike was never satisfied with the status quo if he believed there was a radioisotope that would provide better outcome for the patient than the one which was currently in use by the community.

Some of the early work that Mike's lab pioneered was the use of Auger emitters for therapy. Specifically, based on the fact that carbon-bromine bonds were stronger than carbon-iodine bonds, his team worked on incorporating Bromine-77 into therapeutic applications of small molecules for cancer therapy. Later, he extended this work to developing Bromine-76 as an alternative to Iodine-124 as a PET emitter with superior synthetic and imaging characteristics.

He and his collaborators worked on a variety of radiometals for imaging and therapy. His team laid the groundwork for the use of Indium-111 for labeling monoclonal antibodies and other longer lifetime targeting agents in imaging. They explored the use of gallium radioisotopes for imaging and were among the first to recognize the value of generator produced Gallium-68 in PET imaging.

Finally, he was one of the early adopters of radiocopper for nuclear medicine applications. His early work focused on Copper-67 as a therapeutic isotope. However, he recognized that a "contaminant" of the production, Copper-64, gave him the option of PET imaging in his biodistribution studies. He always asked that the radioisotope be shipped as soon as possible so he could take advantage of the two-fer with the two radiocoppers.

He was always very active in pursuing opportunities for the DOE isotope program to supply isotopes to the nuclear medicine community. His work with Bromine-77 and Copper-67 depended on a supply from national labs. He also recognized that there was a capability at PET cyclotrons to produce radioisotopes and secured funding to supply investigators with Copper-64 and Bromine-76 and was in the process of transitioning his program to the DOE isotope program.

Mike's legacy is represented by the breadth and depth of the work that came out of his laboratory. Those who collaborated with him, trained in his lab, and learned from his work will be challenged to continue to expand the portfolio of radiopharmaceuticals in nuclear medicine.

Upcoming Meetings of Interest

- **244th American Chemical Society National Meeting & Exposition (ACS),** August 19-23, 2012, in Philadelphia, Pennsylvania
- **14th International Workshop on Targetry and Target Chemistry (WTTC14)**, August 26-29, 2012, in Playa del Carmen, Mexico
- **8th International Conference on Nuclear and Radiochemistry (NRC 8)**, September 19-23, 2012, in Como, Italy

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