Current status of infrastructure and capabilities for nuclear data measurements at BLIP

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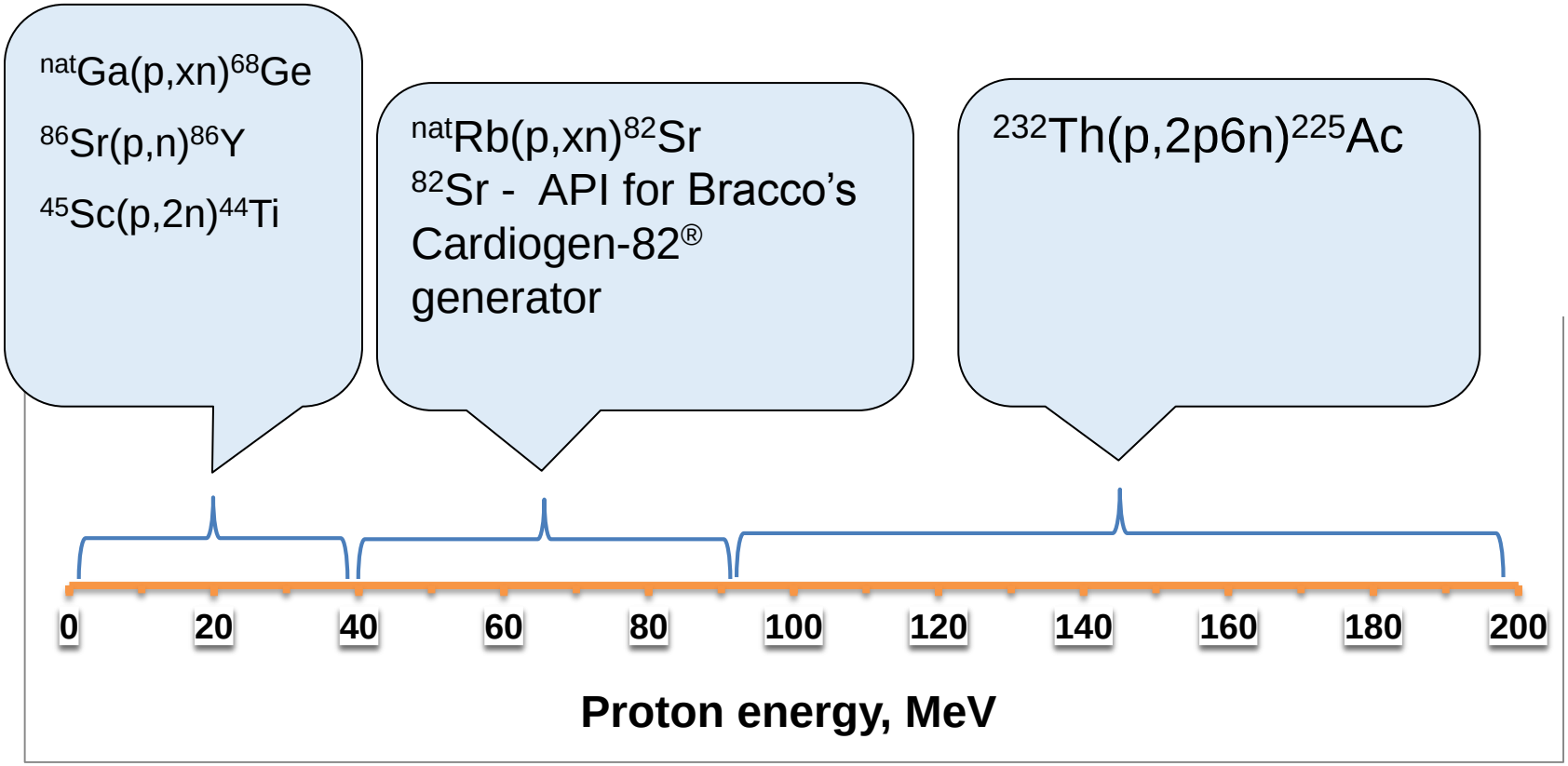
Nuclear data required for isotope production is the nuclear reaction cross section. It is needed to:

- determine optimum energy range for isotope production: maximum yield and the best radiopurity,
- calculate the isotope yield,
- predict radionuclidic and radioisotopic purity of the product.

✓ As the charged particle energy increases, availability of cross section data becomes more and more scarce

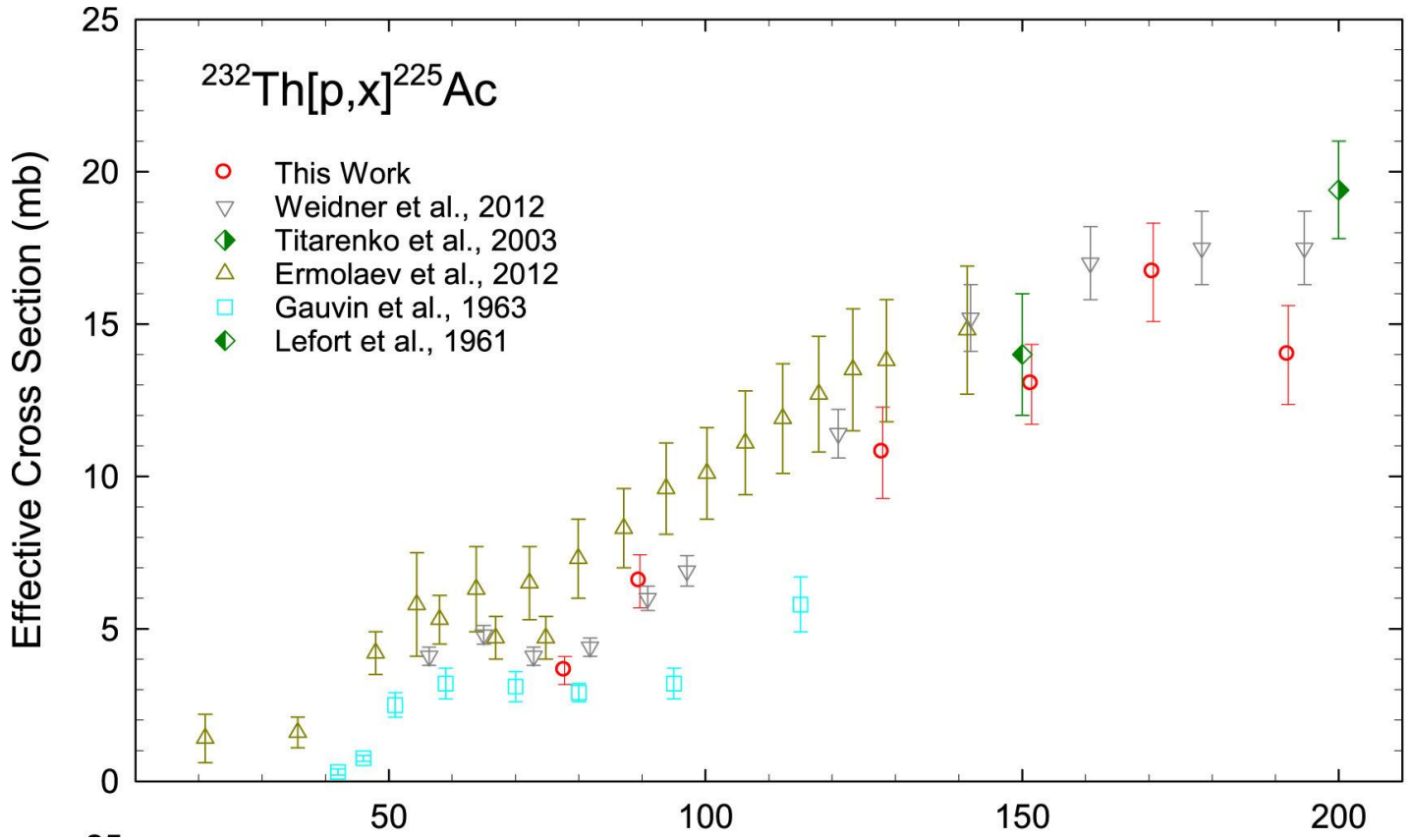
✓ With 70 MeV proton capability becoming available commercially, more accurate cross section data for intermediate to high proton energy is required

Successful production of these isotopes relied on accurate nuclear cross section data



In general, only few recent measurement of cross section data above 100 MeV was carried out

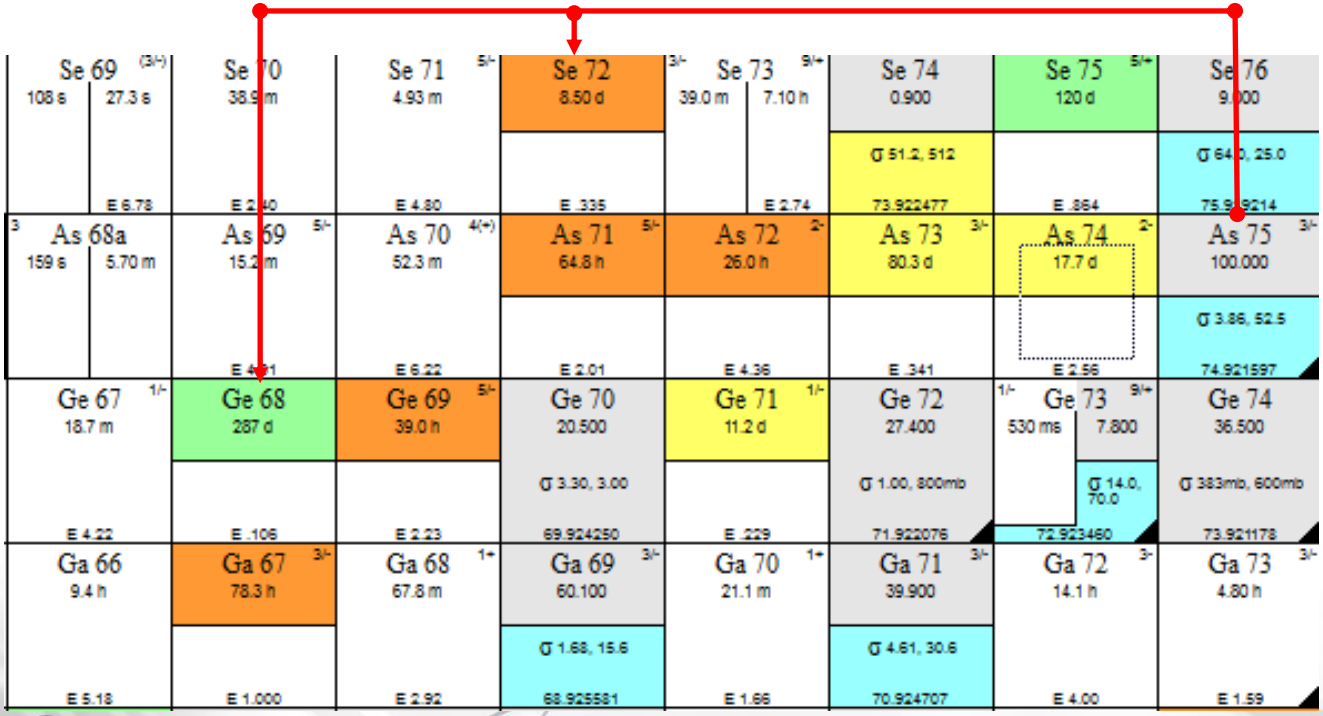
Cross sections for Ac-225 production*



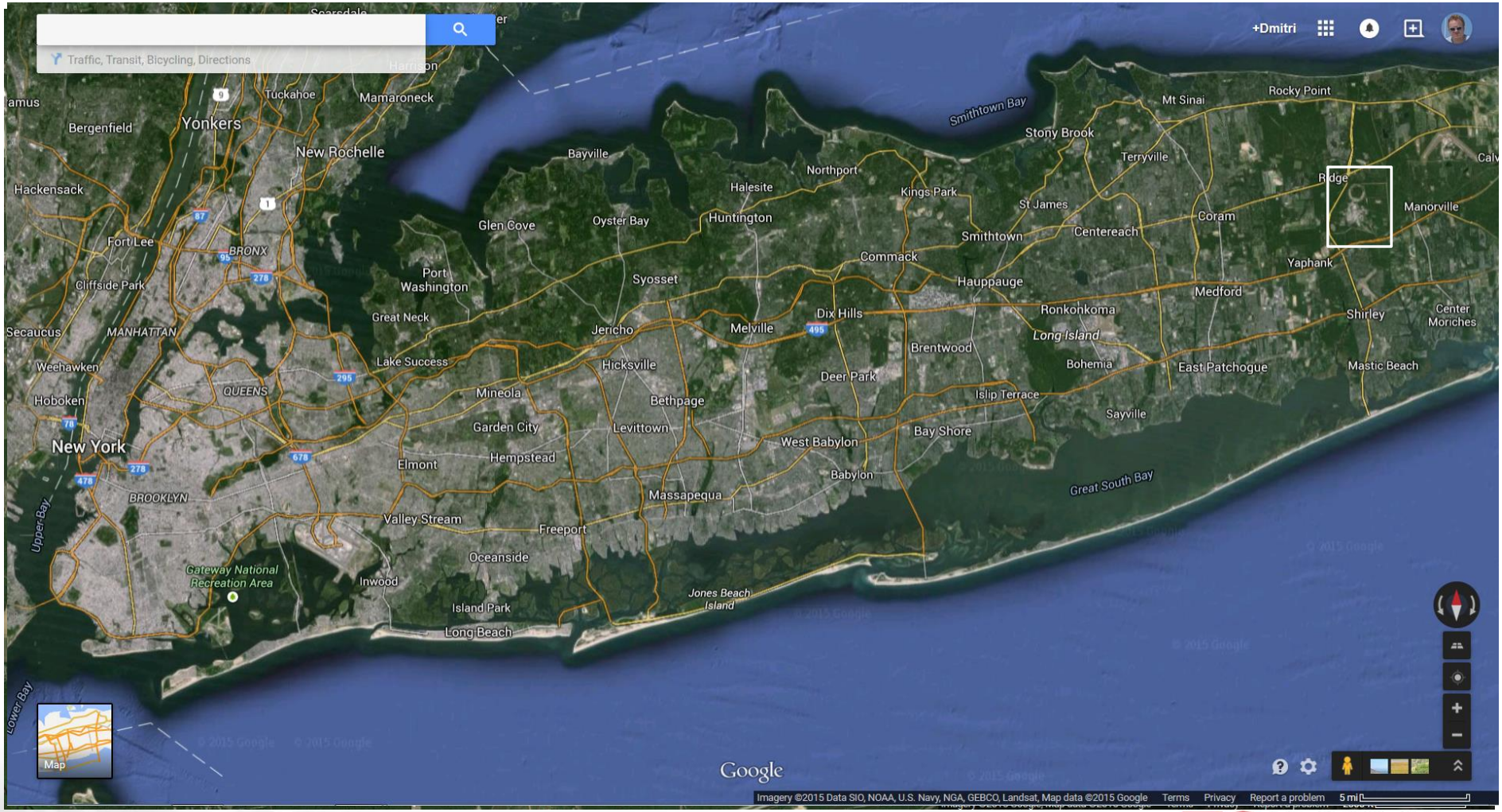
*J.R. Griswold et. al. Appl. Radiat. Isot. 118 (2016) 366. Work is part of Tri-Lab collaboration between BNL, LANL, and ORNL on a large scale production of Ac-225 from Th

New opportunity funded by Office of NP Isotope program

- Generate cross section data for ^{nat}As(p,x) reaction for proton energy range up to 200 MeV
- Joint project between
  - LBNL (<45 MeV)
  - LANL (45-95 MeV)
  - BNL (95 to 195 MeV)
- Aiming to produce parents of PET isotopes Ge-68/Ga-68 and Se-72/As-72



Brookhaven Lab and its accelerator complex



AGS – Alternating Gradient Synchrotron, RHIC-Relativistic Heavy Ion Collider

U.S. DEPARTMENT OF ENERGY

BROOKHAVEN NATIONAL LABORATORY

70 YEARS OF DISCOVERY

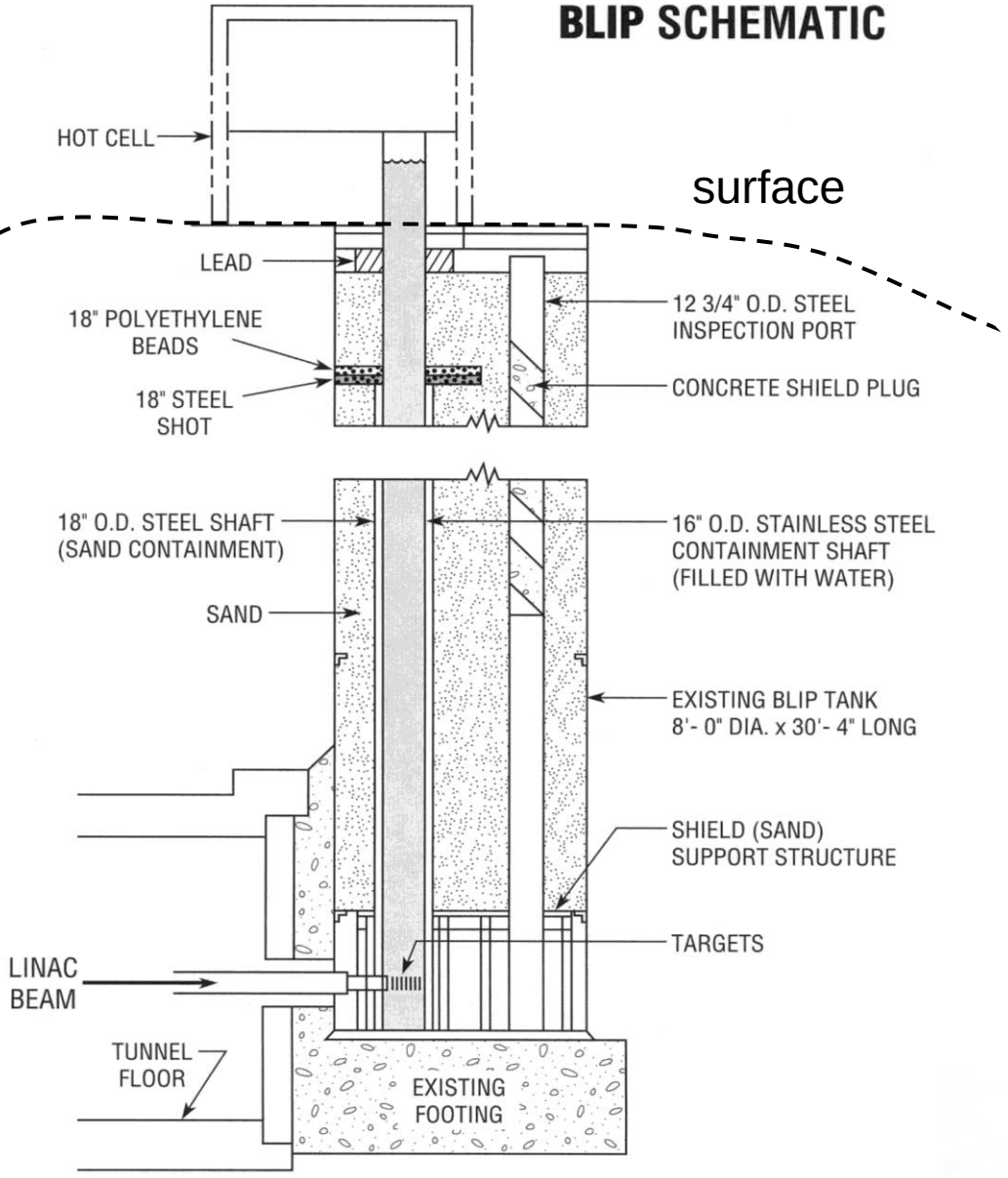
A CENTURY OF SERVICE

200 MeV Linac at BNL

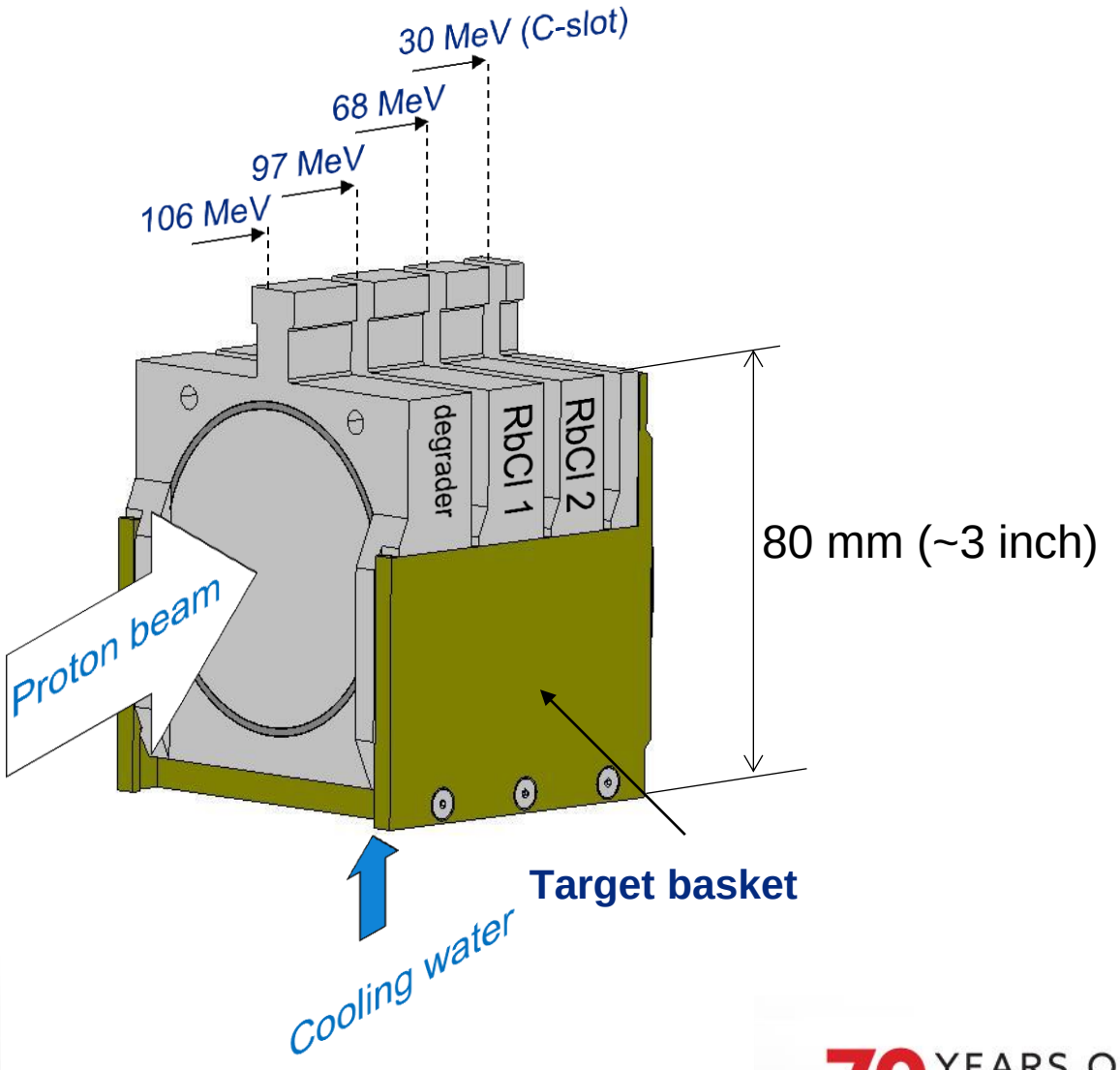
- 459 foot long with nine accelerator radiofrequency cavities
- Energy is incrementally tunable form 33 to 200 MeV
- Operates in a pulsed mode: 90% of the pulses are used for isotope production, the rest is used for RHIC experiments
- The pulses for BLIP occur at frequency 6.67 Hz. Each pulse is 450 μsec long and can be up to 55 mA in intensity
- Maximum average current of 165 μA is regularly achieved

Brookhaven Linac Isotope Producer (BLIP) target station

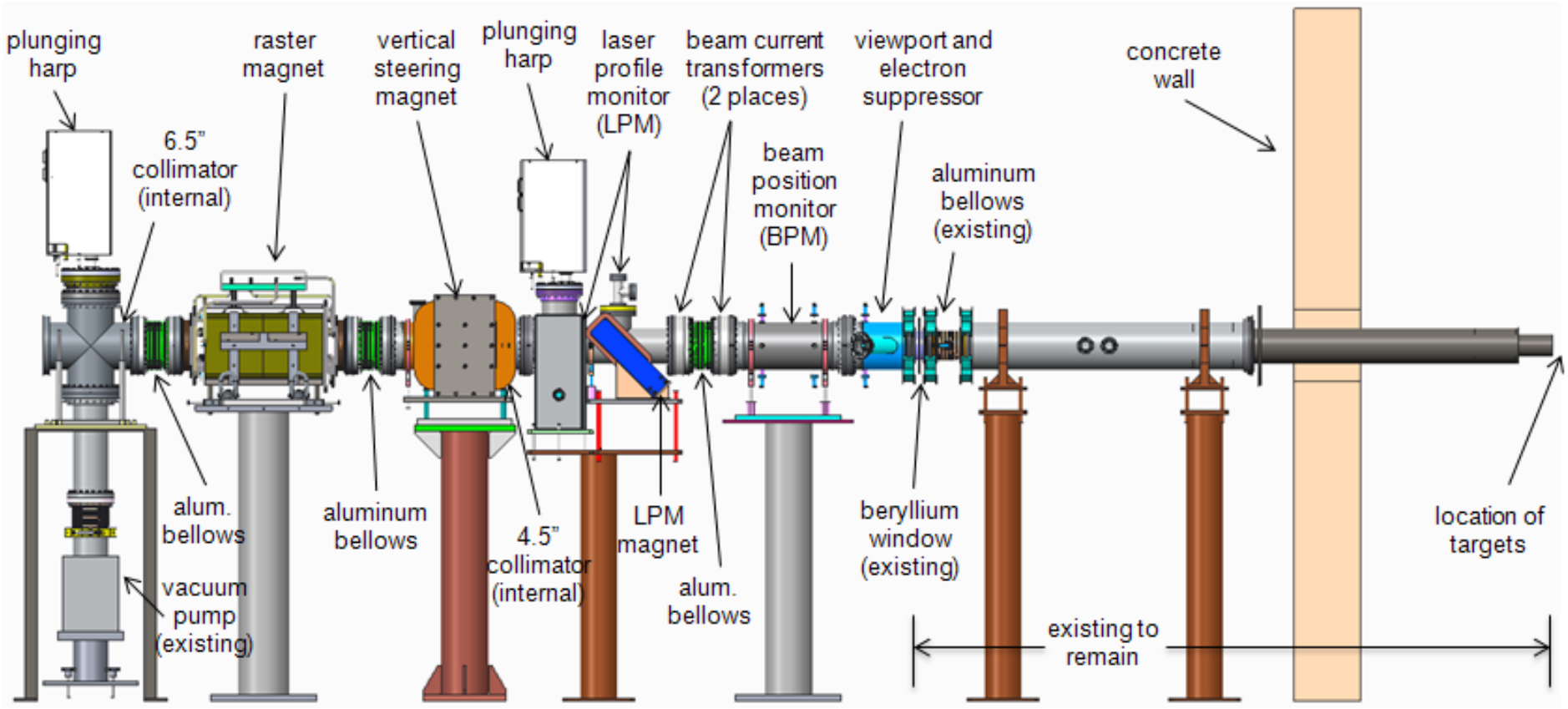
- Located 30 feet below the surface, close to the bottom of the water shaft
- Targets delivered to and retrieved from the beamline using chain drive system
- About 6 inches (152.4 mm) of space available along the beam pass for target positioning
- Designed specifically for isotope production: operation at high current



3D rendering of BLIP target stack

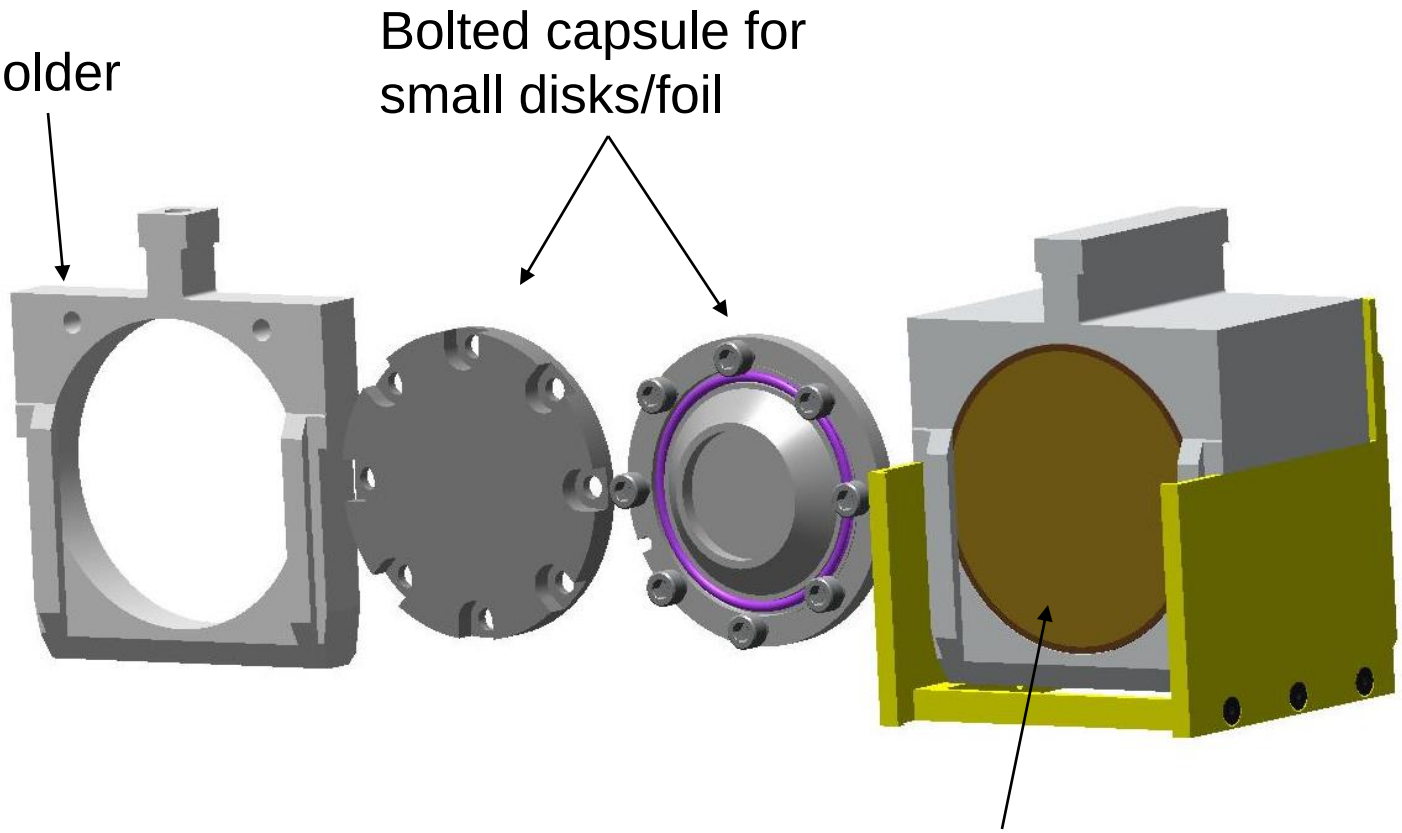


Schematic representation of the BLIP beam line hardware*



*Mausner et al. The new BLIP raster system and associated target modifications. *AIP Conference Proceedings*. 1845, 020014 (2017)

Operations with focused beam continues for excitation functions measurements and enriched targets irradiation

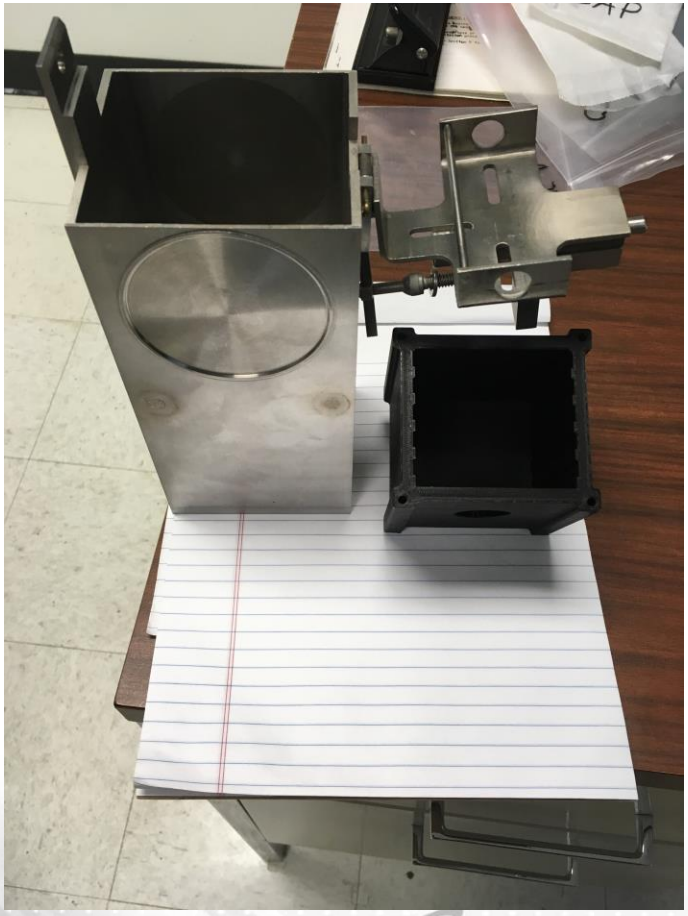


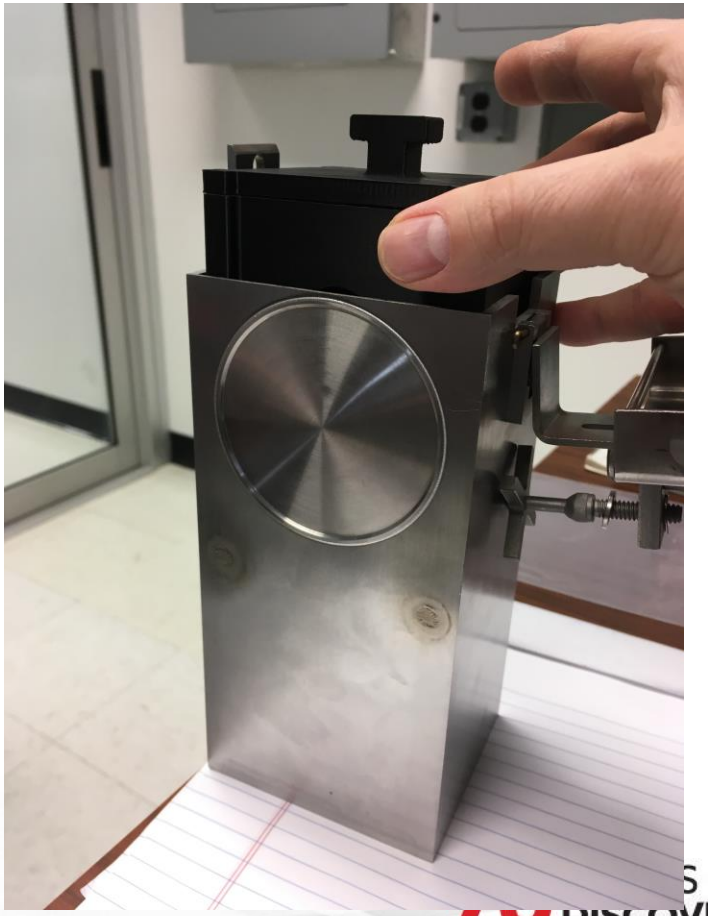
High level Brookhaven tasks under new project

- Test LINAC operation and validate beam line electronics at 200 MeV and very low current (0.1 μA)
- Develop hardware for foils irradiation compatible with current set up
- Establish counting capability close to target station (at BLIP)

Adaptation of LANL foil holder design for experiments at BLIP

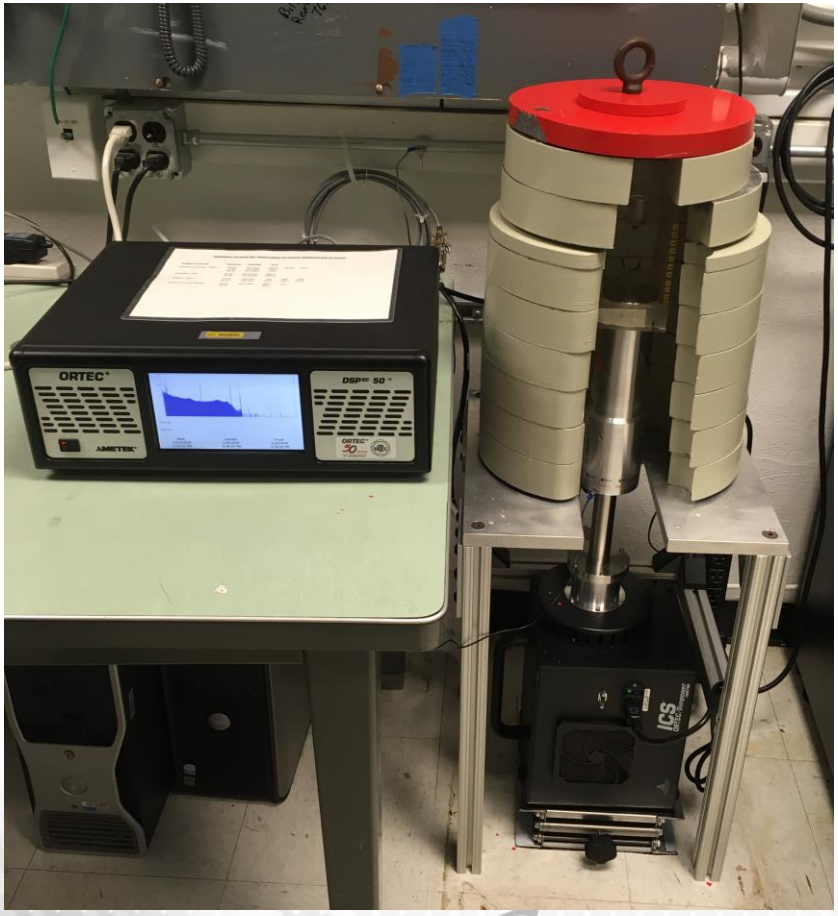
3D printed model of foil holder (black)





Counting capability at BLIP

ORTEC HPGe detector with electric cooler



Fit test of holder and target box

Funding

- The program at BNL is funded by the US DOE Nuclear Physics Isotope program within Office of Science