^{211}Astatine production update for the University of Washington

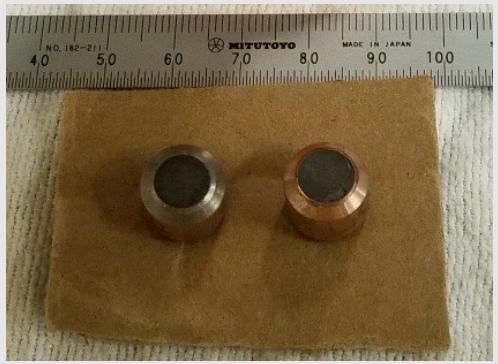
Robert Emery

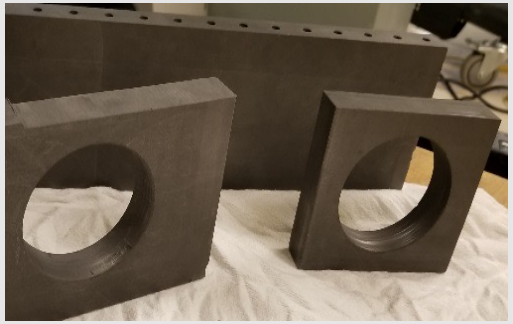
Accelerator

- Scanditronix MC 50
- Commissioned - 1984
- Protons, Deuterons, Alphas
- Variable Energy
- 1990 – 1 uA, 29 MeV Alphas
- 2022 – 50 uA, 29 MeV Alphas

Mods to increase Alpha Beam

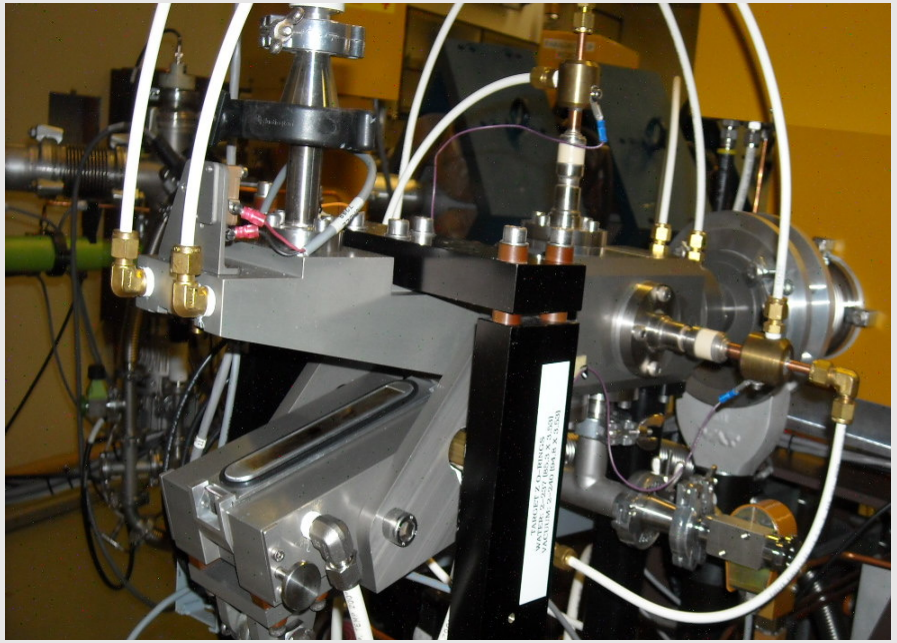
- Modified Dee Tip
- Modified Source window
- New HfC Cathodes
- New Tungsten-Copper cathode housing
- Molybdenum to Tantalum Windows
- New Arc Supply
- Modified Source Impedance (to deliver higher arc current)
- Reduced Dummy Dee Gap Spacing (better extraction)
- Add water cooling to beam scrapers (Alpha beam is wider than P+)
- Larger Quadrupoles
- Modified Septum Temperature Monitoring





Previous ^{211}At Target Station

- Large target and material
- Manual installation and retrieval
- Limited flexibility



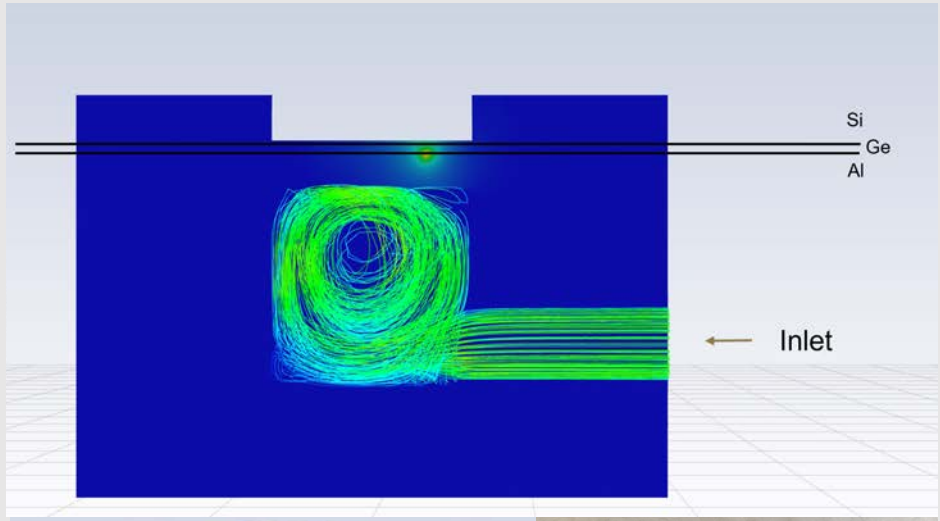
New Target Station Design Criteria

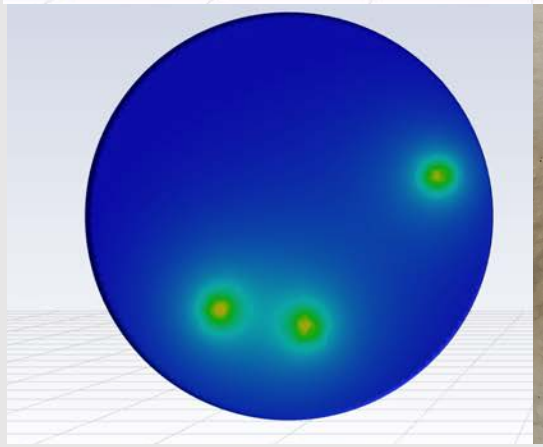
- ^{211}At targets to 100uA of 29MeV Alpha beam
- Auto load/eject targets, minimize exposure to personnel
- Compatible with commercial transport systems
- Adaptable for other isotope production targets
- Cost effective to produce and maintain
- **Ability to share within DOE IP production network**

Thermal Modeling

- Water cooling design
- Ansys SpaceClaim, MCNP, & Ansys Fluent
- Modeling parameters:
  - 100uA electrical beam current
  - Lateral energy distribution determined by beam scanner
  - Depth energy distribution modeled by MCNP
  - Water flow: 6.2 L/min (measured)
  - Target backing thickness

Poor cooling design led to target failures





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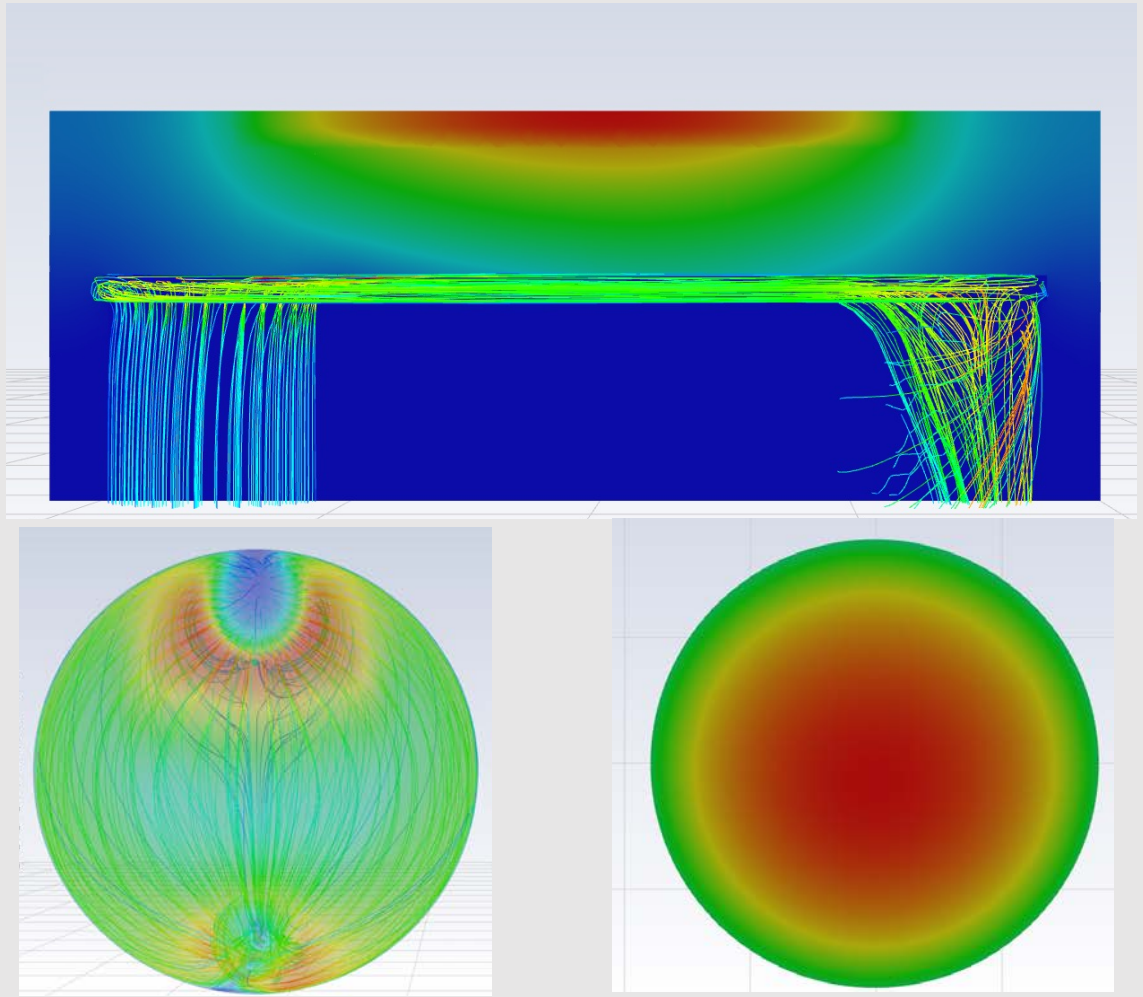
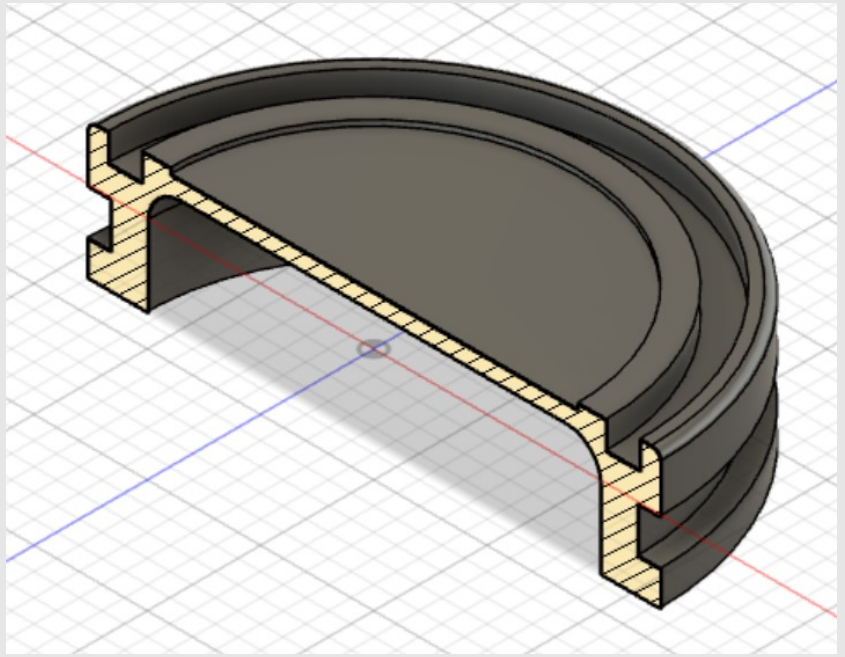
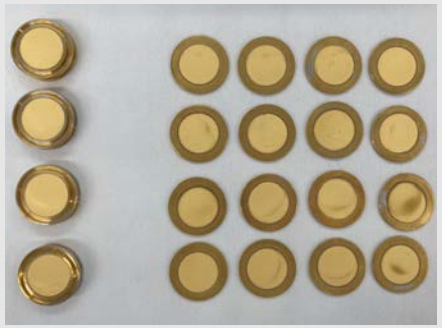
Improved flow path improves cooling



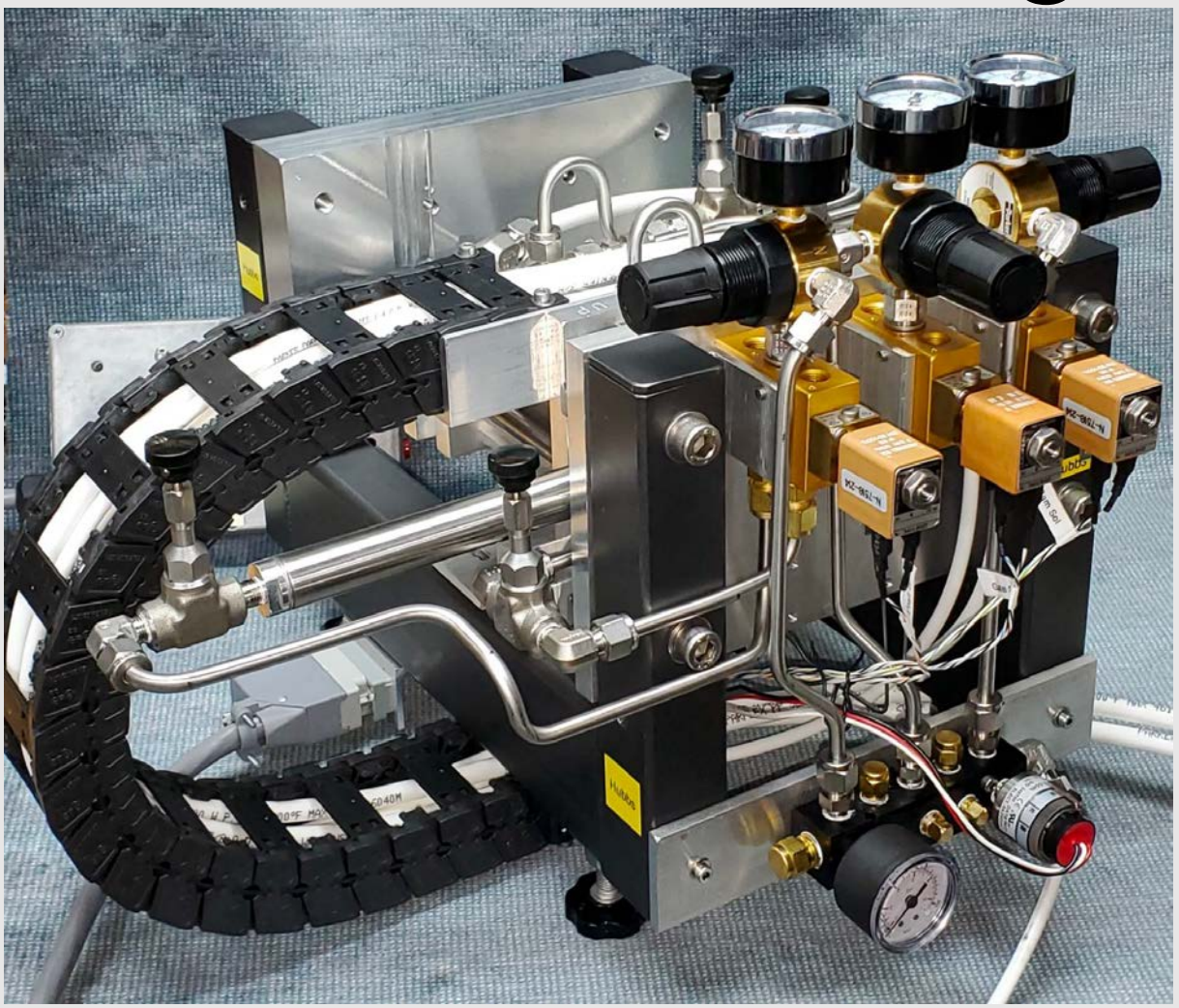
New Bismuth Target Design

- Al Backing thickness optimized for bismuth cooling
- Bi thickness optimized to capture 29MeV – 21MeV of production curve for ^{211}At
- Current: 5N Al backing with melted Bi
- Future: 6061 Al backing with plated Au and Bi
- Future: Electroplated Bi
- Special tooling to deliver even/precise Bi layer
- Profilometer to confirm thickness and flatness



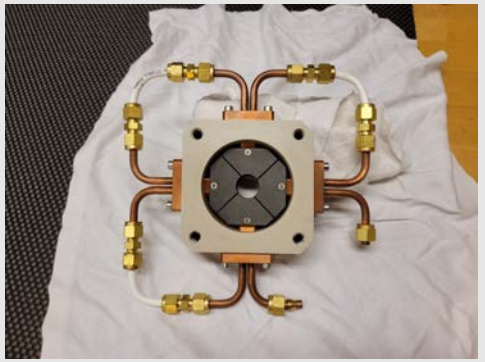


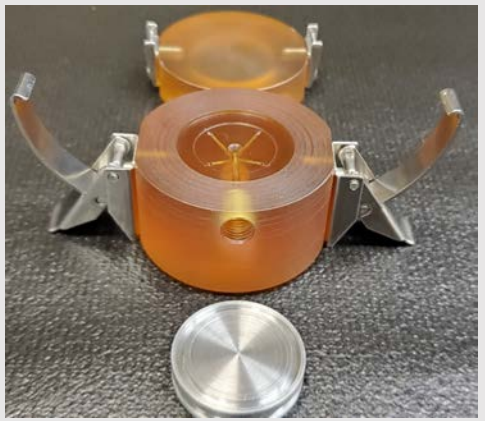
Target Station



System Status

- 11 ^{211}At production runs to date
- Ramping up beam power
- Evaluating
  - Make Rate
  - Personnel Exposure
  - Chemistry Yield
  - Beam profile (D-Pace UniBEaM scanner)
- Producing for Target Evaluation and Radiochemistry use only
  - Will begin animal study and clinical trial production once system is optimized
- New dissolution chamber for coin target





Target Station Version 2.0

- New beamline spring 2023
- Thermocouple integration for monitoring and model validation
- New 4 sector quadrant collimators
- Radiation Monitoring, Air sampling at the station
- Modified target backing to reduce personnel exposure
- Target transfer system