

CATS – THE CENTER FOR ACCELERATOR TARGET SCIENCE



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Facilities Working Group

CENTER FOR ACCELERATOR TARGET SCIENCE

The Center for Accelerator Target Science (CATS) is a national center for the development and fabrication of targets.

The Physics Division at Argonne National Laboratory maintains a target development laboratory in direct support of ongoing low-energy nuclear physics research undertaken at the Argonne Tandem Linac Accelerator System (ATLAS) facility. The mission of the target laboratory is also to support research by the low-energy research group of the Physics Division. Under certain conditions, the target laboratory has also supplied targets to other scientists, including ATLAS users, for experiments carried out at other locations, both within the US and abroad, but only a fraction of these outside requests can be addressed. It was thus proposed to create a National Center for Accelerator Target Science (CATS) based on the existing target development laboratory at Argonne. The objectives of the center are as follows:

1. Serve the DOE-NP low-energy community by producing targets whenever possible by either manufacturing them or by directing requests to other facilities best able to perform the task;
2. Train individual investigators and students in target making in order to provide a workforce capable to address present and future needs;
3. Carry out R&D activities dedicated to novel production techniques and optimization of existing ones;
4. Develop an inventory of existing targets that will serve as a pool available to the community.

FACILITIES

Target Fabrication Facility

- Natural occurring and enriched stable isotopes in elemental or compound form
- State-of-the-art equipment used for thin-film fabrication
- Techniques: resistive heating, focused ion beam sputtering, glow-discharge plasma deposition, electron beam and electron bombardment evaporation, electrodeposition, mechanical rolling, pellet pressing, pour casting and hydrogen reductions



FACILITIES

Target Research and Development Laboratory

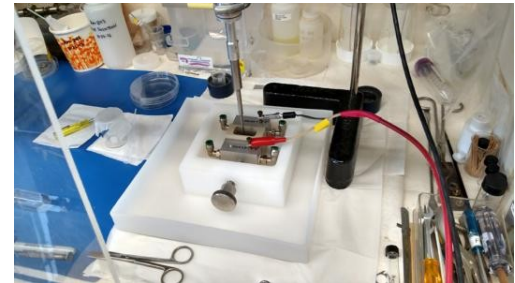
- dedicated to the development of novel accelerator targets and new target production methods
- Chemical fume hood and laminar flow box
- High Energy Vibrational Powder Plating – HIVIPP
- High-Temperature vacuum furnace – sintering and graphitization
- Spin Coating
- Scanning Electron Microscope
- Ball mill
- High power induction oven



FACILITIES

Radioactive Material Handling Laboratory

- split glovebox for handling actinides, a HEPA-filtered hood for working with metal powders, and several chemical fume hoods for working on various processing/production methods
- No evaporation/reduction, just wet chemical methods, molecular deposition, mechanical rolling and pressing
- Small tube furnace for tritiation of metal foils
- Aging radiological infrastructure is maxed out for targets and sources for ATLAS
- Design, age and legacy contamination required
Stop work and ALARA review
- Increasing demand on radioactive targets



FACILITIES

Radioanalytical Counting Laboratory

- Connected via an adjoining door to the Hot lab for immediate characterization
- 2 cm³ LEPS (FWHM: 0.5 keV at 122.06 keV)
- 25% Ge (FWHM: 1.8 keV at 1332.49 keV) within lead shield
- surface barrier detectors (FWHM: 15 keV) for Alphas in evacuated chambers
- PIPS for electron counting (FWHM: 10 keV)



FACILITIES

Target Library and Archives

- CATS has target collections recovered from several institutions and accumulated ATLAS targets
- The targets are made available to the community
- Notes on target fabrications go back to the 60's
- Electronic tables in pdf format available online
- A searchable database would be advantageous



TEACHING INDIVIDUALS

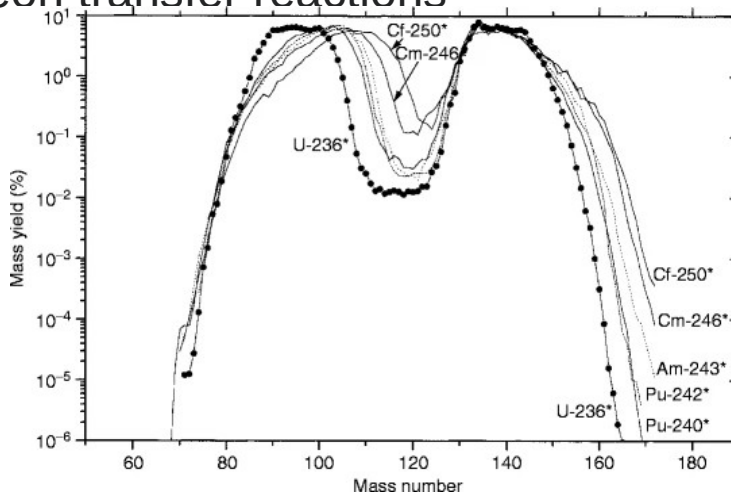
- Student Target Workshop has been held after the last LECM with great response, plan for repetition every other year alternating with Europe.
- Continuous demand of individuals
- Matt Gott prepared notes for remote teaching CD_2 target preparation



“The availability of the needed target making capabilities, and a trained workforce, is a must for successful experiments at FRIB, and at other accelerators.”
Report of the Scientific Advisory Committee, February 20-22, 2010

ATLAS RELATED

- N=126 and rare-earth factory, ^{198}Pt and ^{164}Dy (reduction)
- Chemical conversion or reduction for beams (TiCl_4 , Ca)
- nuCARIBU ^7Li production and fission targets of ^{235}U , ^{239}Pu , ^{229}Th , ^{242}Am , ^{249}Cf
- ^{14}C , ^3H targets for Helios and Gretina/Gammasphere
- ^{210}Pb targets for multi-nucleon transfer reactions
- ^{252}Cf nuclear data
- Ra for EDM project
- Detector windows, reset and stripper foils, scintillators



Denschlag, J.O. (2011). Nuclear Fission. Handbook of Nuclear Chemistry. Springer, Boston, MA.

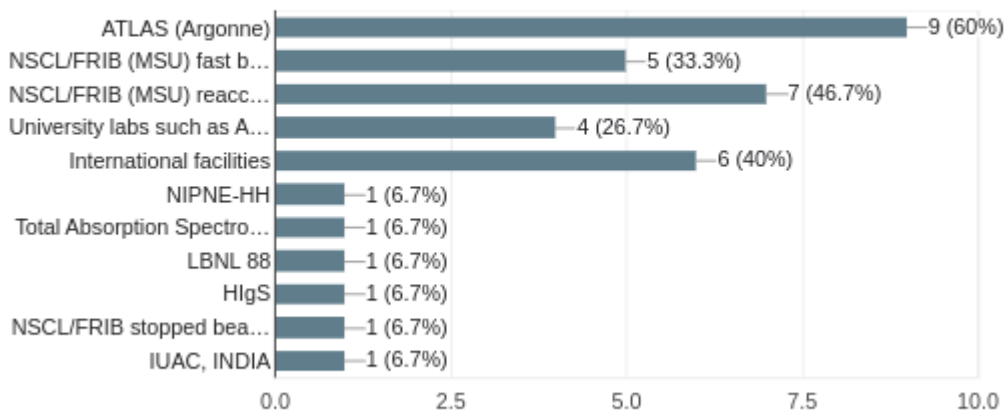
FRIB RELATED

- The Targets (AT-CATS) Working Group is a collaboration between the previous Gas Jet/Advanced Targets Working Group and the Target Lab Working Group.
- Precision target foil fabrication for FRIB science is a goal of this Working Group
- Needs are thick targets for fast beams, thin films for re-accelerated beams and detector windows
- Approaches to meet the demand are dedicated lab space as part of the FRIB complex, another location as the 'Lead Target Lab' and commercial opportunities

TARGET NEEDS SURVEY

My research is primarily conducted at (choose all that apply):

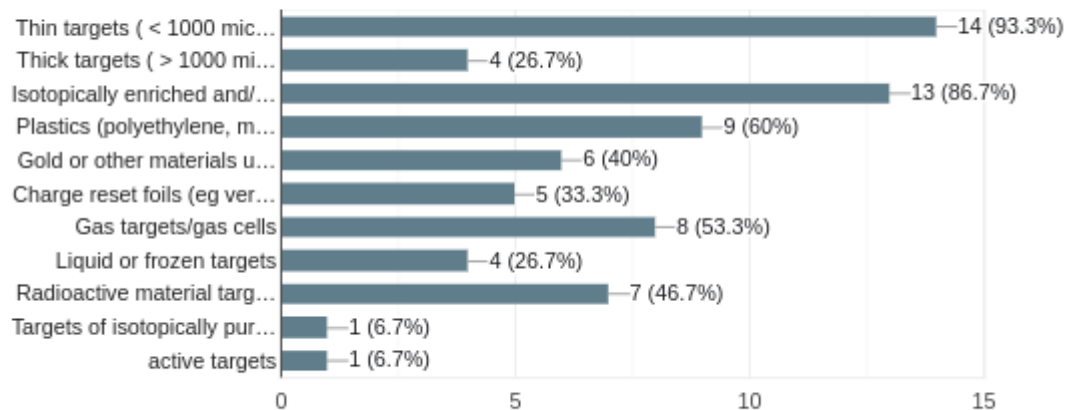
15 responses



TARGET NEEDS SURVEY

Generally, I need (choose all that apply):

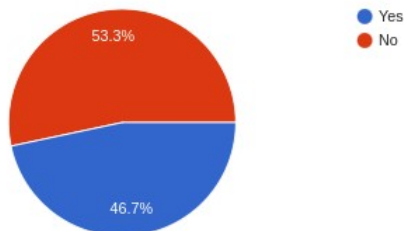
15 responses



TARGET NEEDS SURVEY

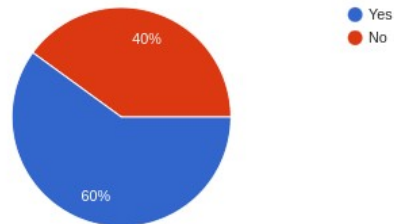
For any of your choices above, do you have specific target thickness/density tolerances?

15 responses



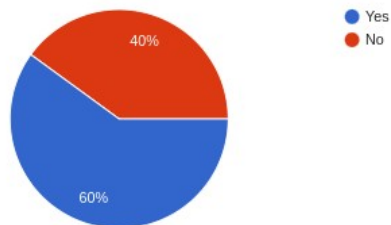
For any of your choices above, do you have specific isotopic purity tolerances?

15 responses



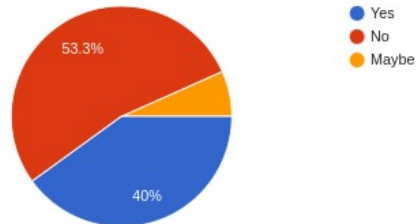
For any of your choices above, do you have specific target needs for which preparation in vacuum or an inert atmosphere is necessary?

15 responses



Are you aware of the CATS Target Library?

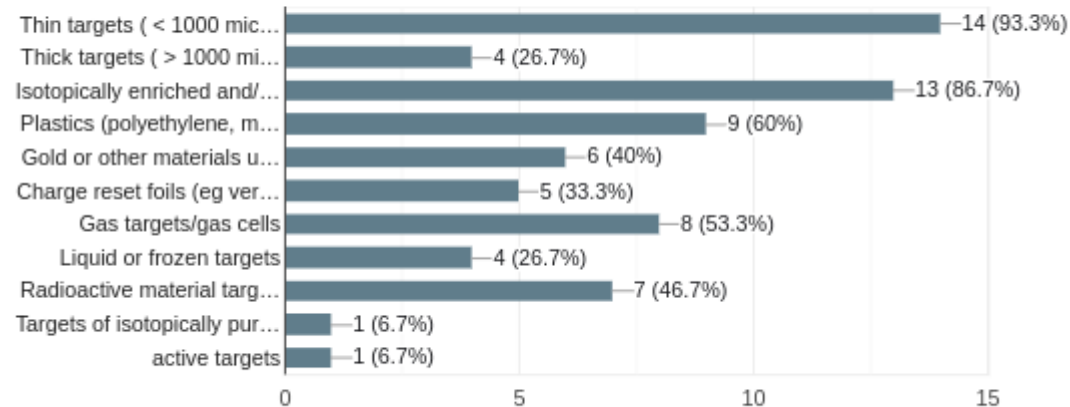
15 responses



TARGET NEEDS SURVEY

Generally, I need (choose all that apply):

15 responses



TARGET NEEDS SURVEY

Other comments

- Other capabilities like RBS for thickness determination and independent contaminant or enrichment determination is important. PIXE, PIGE and thickness scans are mentioned.
- More info in the target library (backings) useful, everything searchable.
- Liquid hydrogen target needs an upgrade/spare
- Reductions of oxides are sometimes needed

TARGET NEEDS SURVEY

Specific target requests

- ^{235}U
- Actinides
- ^{10}Be , ^{14}C
- ^{26}Al
- Silicon targets, compounds like CaCl_2 and ^{15}N as TaN
- ^{244}Pu
- ^3H

THANKS FOR YOUR ATTENTION

We need further (continuous) input what your needs are

Targets need development, reach out early

Do not hesitate to ask

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