

FIRST STUDENT TARGET WORKSHOP AT ARGONNE NATIONAL LABORATORY



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CENTER FOR ACCELERATOR TARGET SCIENCE

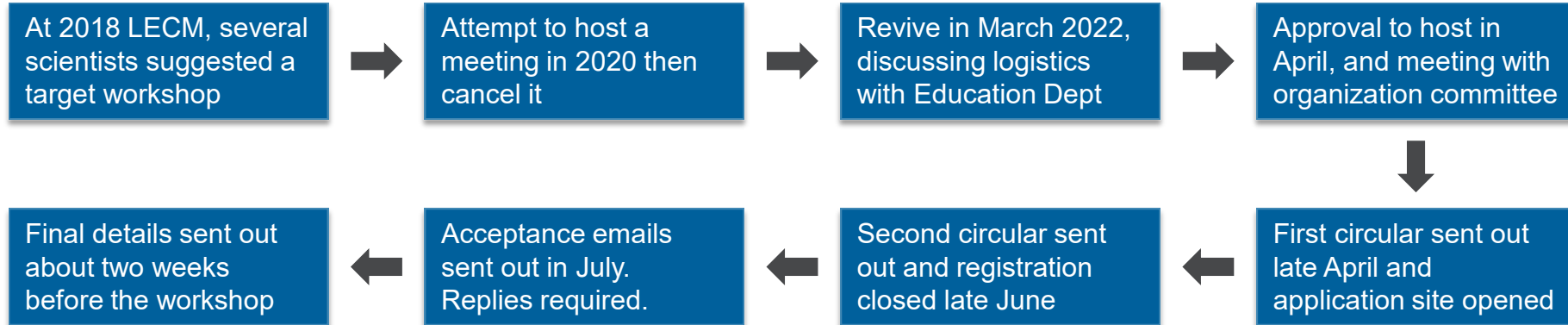
The Center for Accelerator Target Science (CATS) is a national center for the development and fabrication of targets.

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.

ROADMAP FOR WORKSHOP

- Hosted at Argonne National Laboratory in partnership with CENTAUR.
- Instructors from national lab, academia, and industry
- Due to funding sources, we were restricted to United States citizens.
- Limited to 16 students due to COVID
- Covered housing, food, and all materials. Students (or their institutions) were responsible for travel.



STUDENT STATISTICS

- 16 students selected (with 5 alternates)
- Final attendance was 12 Students
 - Two were later determined ineligible
 - One had flight cancellations prevent attendance
 - One cancelled late with financial concerns
- Career stages:
 - 9 graduate students
 - 1 postdocs
 - 2 young professionals
- From 6 universities and 3 national laboratories.

BASIC FLOW OF THE WORKSHOP

- Modules:
 - Resistive-Heating Vapor Deposition
 - Electron Beam Vapor Deposition
 - Hydrogen and Hydrogen-Containing Targets
 - Foils, Pack Rolling, and Powder Techniques

2022 STUDENT TARGET WORKSHOP			
	Thursday Aug 11	Friday Aug 12	Saturday Aug 13
8:30	Check-in at Bldg 203		
8:45		Check-in Bldg 203	Check-in Bldg 203
9:00	Welcome - ANL (Tovesson)	Module Rotation #2	Module Rotation #4
9:15	Welcome - CENTAUR (Marley)		
9:30	Course Outline (Gott)		
9:45	Safety Highlight (Glombicki & Feinberg)		
10:00			
10:15			
10:30			
10:45	Target Making Essentials (Greene)		
11:00			
11:15			
11:30	ATLAS tour (Various)	Lunch Break	Close Out / Lunch
11:45			
12:00			
12:15			
12:30	Lunch Break	Module Rotation #3	
12:45			
13:00			
13:15			
13:30			
13:45			
14:00			
14:15	Module Rotation #1		
14:30			
14:45			
15:00			
15:15			
15:30			
15:45			
16:00			
16:15	Donut with Scientists		
16:30			

MODULE ONE

Resistive-Heating Vapor Deposition

Pre-load evaporator with Teepol slides and prepare initial gold foils for floating

- Discussion on importance of substrates and parting agents
- Prepare Teepol-coated glass slides
- Introduction to:
 - PVD
 - Resistive-heating
 - Choice of boats
 - Deposition monitors
 - Evaporation geometries and efficiency
- Evaporate Au onto slides
- Floating Au off of slides



MODULE TWO

Electron Beam Vapor Deposition

- Discussion on carbon foil preparation
- Float carbon onto frames and dried
- Introduction to:
 - e beam evaporation and sputtering
 - Heating and cooling of target substrates during deposition
 - Thickness calculations from QCM
- Evaporate nickel onto carbon backings

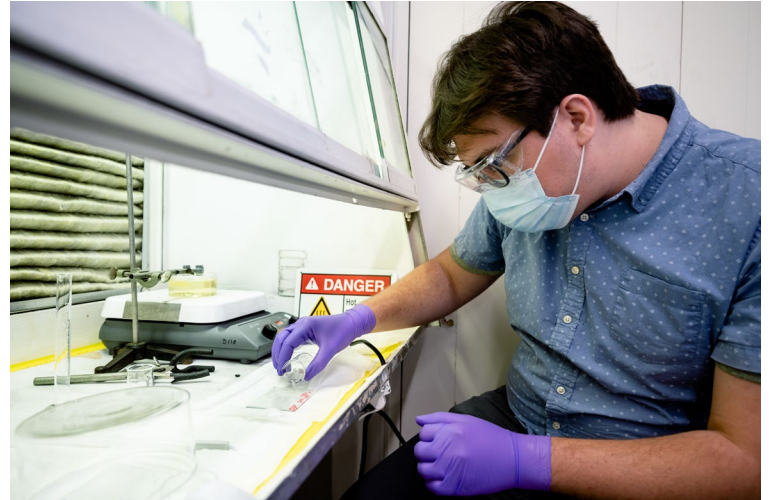
Pre-load evaporator with carbon backings on frames



MODULE THREE

Hydrogen and Hydrogen-Containing Targets

- Discussion on hydrogen-containing targets, preparation of CD_2 targets, gas targets at RAISOR
- Pour-casting CD_2 foils:
 - Clean large area glass slides
 - Weigh out CD_2 , add xylene, and heat
 - Pour CD_2 films and allow to dry
- Float CD_2 targets off of slides
- Discussion on thickness measurements by gravimetric determinations and α -particle energy loss measurements and SRIM
- Thickness measurements using ruler & balance then by α loss



Have prepared CD_2 foil at each stage. Set and bake student foils for later floating.

MODULE FOUR

Foils, Pack Rolling, and Powder Techniques

- Discussion on mechanical rolling, using packs, rotating foil
- Prepared Al foil by rolling
- Cut prepared foil and glue to frame
- Thickness measurements using weighing and α loss
- Discussion on pellet pressing and application to reductions, in situ reduction, and sputtering
- Discussion on powder milling, HIVIPP, and spin coating



No additional efforts

ATLAS TOUR AND DONUTS WITH SCIENTISTS

- Tour of facility with an emphasis on what targets are used at which experimental stations
- Relaxed discussion with several scientists and accelerator operators



STUDENT FEEDBACK

- Post-event survey given to all participants
- All students “strongly agree” the workshop was a welcoming/comfortable event, helped them learn research methods related to targetry, and would recommend this event in the future.
- Favorite moments were mostly surrounding the hands on experiments particularly doing the floating
- Students would additionally like to work hands on with the evaporator and work on electrodeposition (plus many others)
- More time spent on lectures and more downtime for discussion with instructors

“Overall, very helpful and increased my interest in potentially continuing with targetry for my career”

LOGISTICS / FINANCIAL CONSIDERATIONS

- Preparing program, lectures, etc... but also preparing target frames, storage box, stations for target prep/floating, (coffee)
- Education department resources (available for use)
- Argonne staff paid under ATLAS as outreach
- Travel, housing, and honorarium provided to three external speakers (~\$2k)
- Housing for students; includes breakfast (~\$5k)
- Lunches (students and instructors) and dinners (students only) (~\$2k)
- Materials (~\$2k)
- **Total cost ~\$11k**

IMPROVEMENTS FOR NEXT TIME

- Slow it down! (additional day to enable more offline discussion and to add electrodeposition)
- Add a “deeper dive” lecture in the mornings to better explain critical topics
- Add requirement for letter of recommendation during application process
- Improve hands-on stations layout to prevent cramped spaces
- Broader range of instructors (show R&D projects to demonstrate wider range of target preparations)

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THANKS!
QUESTIONS?

