INTDS

Newsletter

International Nuclear Targets Development Society

Target Preparation Laboratory of Nuclear Physics Department
Horia Hulubei National Institute for Physics and Nuclear Engineering
Măgurele, Romania

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Contents

Editorial

Dear Members of the INTDS community!

We are happy to present the latest edition of “Target Laboratories of the World”, featuring the IFIN-HH in Măgurele, Romania. We thank Nicoleta for making this contribution possible!
In this Newsletter you will find a new category designed to introduce new target makers. In this issue you will get to know the new (and old) team of Argonne National Lab. We intend to periodically fill this section, relying on your submissions or suggestions, to facilitate introductions and connections within our community.
The Executive Board of the INTDS met several times online this year, working on the new by-laws of our society. This was necessary since we had to register the INTDS new in Tennessee and to apply for the re-institution of the non-profit status. John Greene already worked hard on this for a long time in Illinois and now Matt Gott will hopefully finish this task in Tennessee before next year’s conference. You will receive the current and proposed version of the by-laws for your approval once they are concerted by the Board of Directors and approved by a lawyer.
This issue also includes reports of target trainings from 2022 and 2023 as well as announcements of upcoming events.
Apart from that, Christmas is approaching with mighty steps and the year slowly draws to an end. This will hopefully bring a quiet time to take a deep breath and gather strength for a new successful year, which holds great prospects for many of us. In 2024, the next INTDS World Conference will be hosted by Oak Ridge National Laboratory. This occasion presents a unique opportunity for many of us to convene, share insights, and address the pressing questions surrounding target production.

To keep the INTDS Newsletter engaging and informative, we rely on your contributions, ideas, advertisements, or any insights you wish to share with fellow INTDS members. Please send your submissions to INTDS-Newsletter@gsi.de. Let's all contribute to enriching our community by sharing tips, tricks, and valuable knowledge with fellow target makers!

Best wishes,
Bettina Lommel, Birgit Kindler and Noemi Cerboni

Target Laboratories of the World

Target Preparation Laboratory of IFIN-HH: Technical Services
Horia Hulubei National Institute for Physics and Nuclear Engineering (IFIN-HH), Măgurele, Romania
Nicoleta M. Florea, Andreea Radu, Daniel Tofan

The Target Preparation Laboratory (TPL) at IFIN-HH (Horia Hulubei National Institute for Physics and Nuclear Engineering, Măgurele, Romania) was established in 2013 to support the research endeavors undertaken within the Nuclear Physics Department. This department serves as a multidisciplinary research unit in the field of nuclear and atomic physics.

The primary objective of TPL is the preparation of targets for nuclear physics experiments conducted at both the 9 MV Tandem and the 3 MV Tandetron accelerators at IFIN-HH. Furthermore, TPL also provide targets for collaborative international research institutions, including but not limited to CERN, IPN Orsay, and LNL.

The TPL provides solid targets in the form of thin films with a thickness range spanning from several tens of μg/cm^2 to several hundreds of mg/cm^2. These targets are produced using either naturally occurring materials or enriched stable isotopes.

The laboratory is equipped with state-of-the-art equipment for target preparation, employing techniques such as physical vapor deposition (PVD) with both resistive heating and electron beam-based systems, as well as cold rolling and tablet pressing methods (Figure 1).

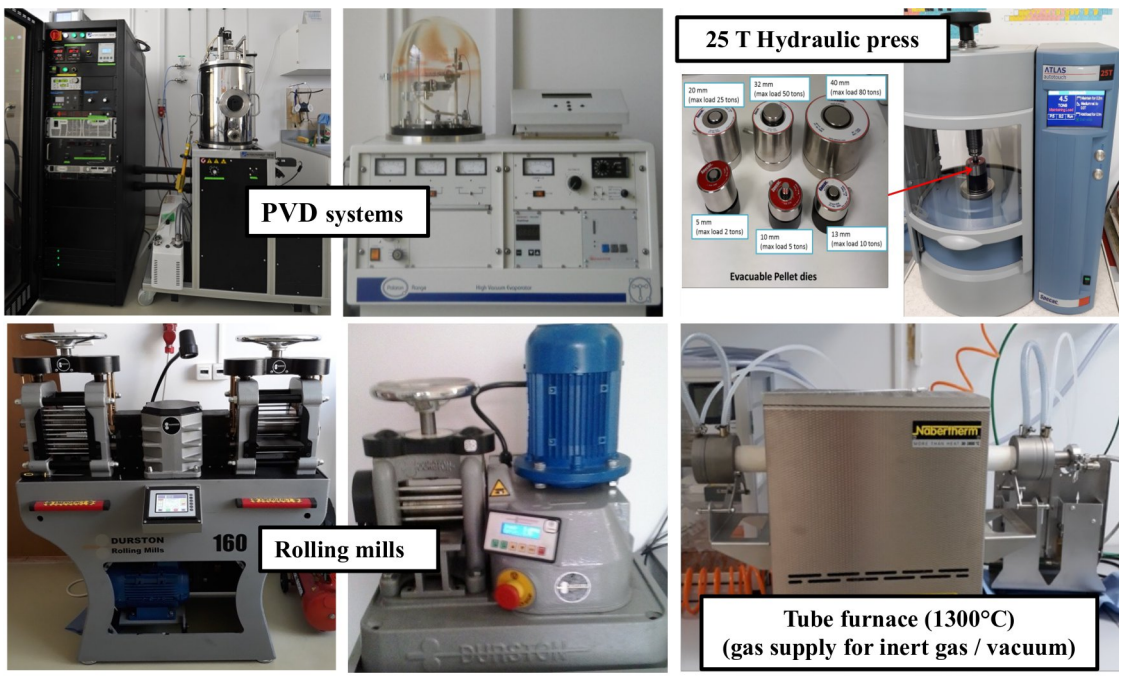


Figure 1: Equipment available for target preparation.

TPL also possesses advanced capabilities dedicated to target characterization:

1. Thickness determination:
   - Rutherford Backscattering Spectrometry
   - Alpha Transmission
2. Microstructure characterization:
   - X-ray Powder Diffraction
3. Morphological characterization:
   - Optical Microscopy
   - Atomic Force Microscopy
   - Scanning Electron Microscopy
   - Energy Dispersive X-ray Spectroscopy

Based on the available capabilities, TPL has successfully produced a large variety of both natural or isotopic targets, spanning across a wide spectrum of chemical elements and compounds (Figure 2).

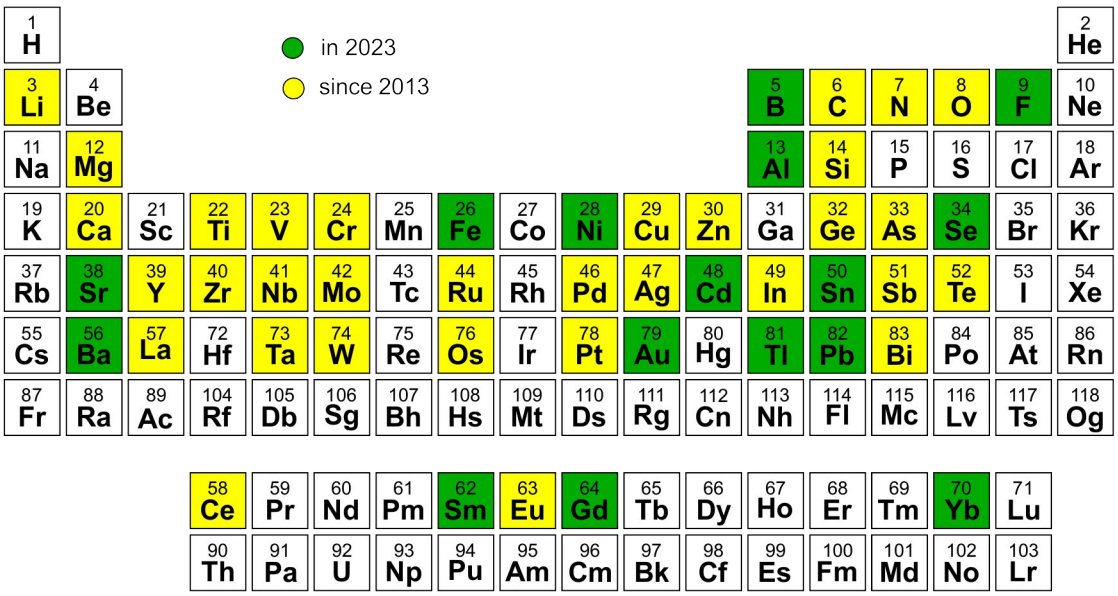


Figure 2: Elements featured in the nuclear targets produced at TPL since it was established in 2013.

In general, the required targets have been manufactured using high vacuum evaporation, cold rolling and tablet pressing techniques. Moreover, the TPL frequently employs a wide range of metallothermic reduction reactions involving various oxides and dedicated reducing agents. This approach has proven successful in generating numerous high-purity metallic targets, starting from commercial oxides such as $^{30}SiO_2$, $^{46}TiO_2$, $^{72,73}GeO_2$, $^{121}Sb_2O_5$, $^{140}CeO_2$, $^{144,147,149,152,154}Sm_2O_3$, $^{160}Gd_2O_3$, $^{nat}Eu_2O_3$, $^{nat}Tm_2O_3$, $^{176}Yb_2O_3$ and more. Thin films of ^{nat}Ba, ^{86}Sr, ^{40}Ca, ^{24}Mg in metal form, capable of withstanding exposure to air, have also been produced using this methodology. These films are often sandwiched between inert gold layers.

Additionally, thick, self-supported targets of ^{13}C, ^{14}N, ^{16}O, and ^{30}Si targets have been prepared through the tablet pressing method, employing a hydraulic press. Figure 3 shows a variety of targets produced at TPL.

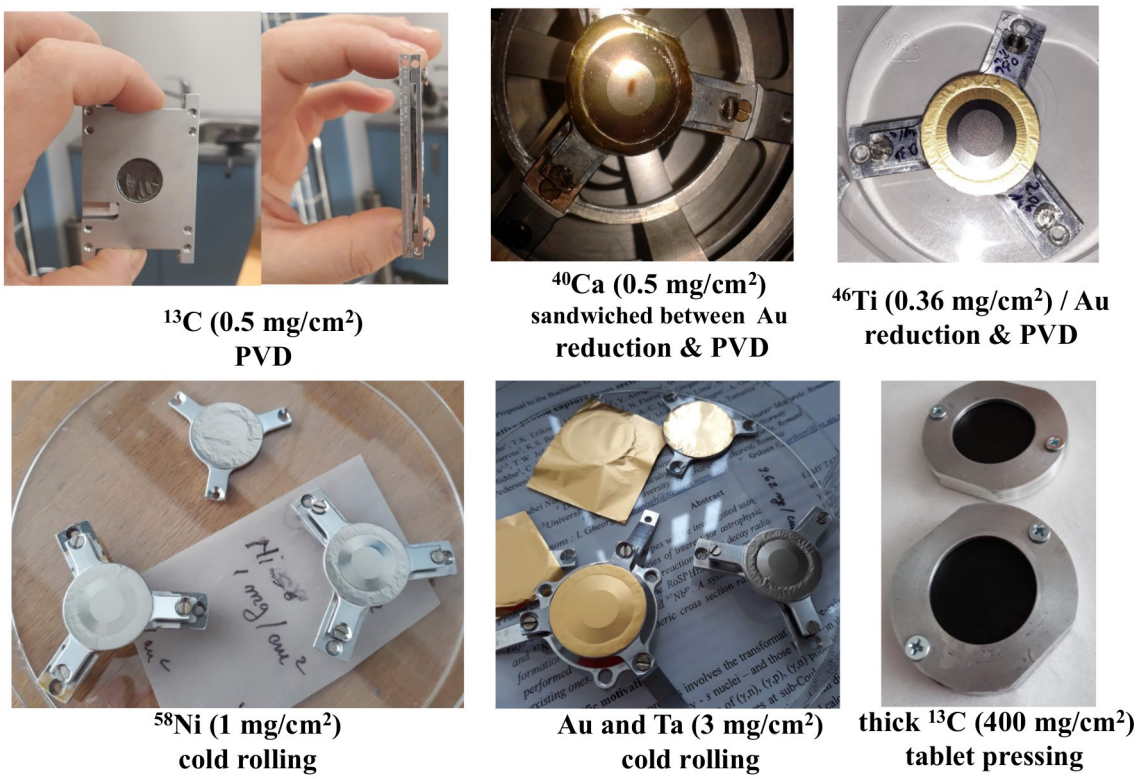


Figure 3: Examples of targets produced in our laboratory.

In summary, the Target Preparation Laboratory at IFIN-HH is equipped with advanced technical capabilities, complemented by a team of highly specialized professionals possessing the essential know-how. This collective expertise enables the precise and high–quality preparation of targets for nuclear experiments.

Acknowledgement:
This work was supported by the Romanian Ministry of Research, Innovation and Digitization under Contract PN 23 21 01 02.

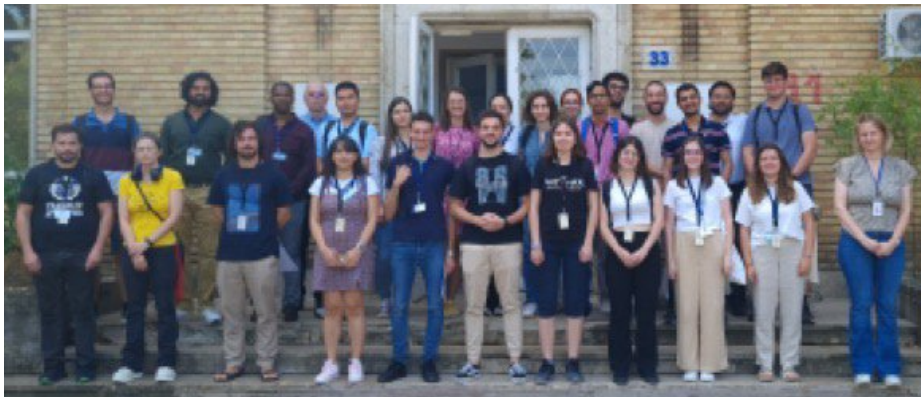
EURO-LABS Basic training school 2023

Horia Hulubei National Institute for Physics and Nuclear Engineering (IFIN-HH), Măgurele, Romania
Nicoleta M. Florea, Daniel Tofan

From the 13th to 23rd September 2023, IFIN-HH (Horia Hulubei National Institute for Physics and Nuclear Engineering in Măgurele, Romania) hosted the EURO-LABS Basic Training School 2023 (BTS23). In the frame of this event TLP (Target Preparation Laboratory) organized hands-on activities regarding techniques for target preparation and characterization. The main objective was to help the participants have a clear understanding about the methodologies employed in the preparation of targets for nuclear physics experiments.

The poster for the BTS23.

A number of 27 attendees with diverse backgrounds, including undergraduate, master's, doctoral, and postdoctoral students from institutions across Europe, Africa, Asia and the Americas were selected to participate. These participants with dedicated interest in nuclear physics had the opportunity to get a general overview on the target preparation and characterization techniques employed within the TPL of IFIN-HH.



BTS23 participants.

To improve the BTS23 experience and give each participant a chance to be actively involved in the preparation process of nuclear targets, the attendees were divided into three smaller working groups. The hands-on activities were spread over three days, where each group exercised preparing their own target over the three hours course per day.

The training practice started with a lecture aimed at covering the fundamental concepts necessary for target preparation. The lecture had also an interactive session, where participants could ask questions; this allowed them to understand the physical processes' advantages and limitations involved in the process of obtaining the targets for nuclear experiments. The participants were also taken on a general tour of the target laboratory of IFIN-HH, during which, PVD and rolling equipment were discussed in more detail.

Target preparation, featuring hands-on experience with cold-rolling and PVD techniques (images from the participants' final reports).

Next, an interactive demonstration on preparation of an aluminum-backed gold target was made and each group prepared its own target. First, the participants practiced the cold rolling method through thinning down a commercial Al foil.

Before starting to work with the rolling mill, the factors that may influence the quality of the obtained metallic foils (metal substrate purity, surface uniformity and cleanness of steel strips, reduction per pass, etc) were discussed.
After this, the participants were guided through the process of selecting and manipulating clean steel strips and incremental steps. They successfully achieved the goal of reducing the thickness of the Al foil from about 7 mg/cm^2 to 2-3 mg/cm^2.

Participants practicing cold-rolling.

Next, they were supervised in choosing an appropriate glue and in mounting the obtained Al foil onto a target frame.

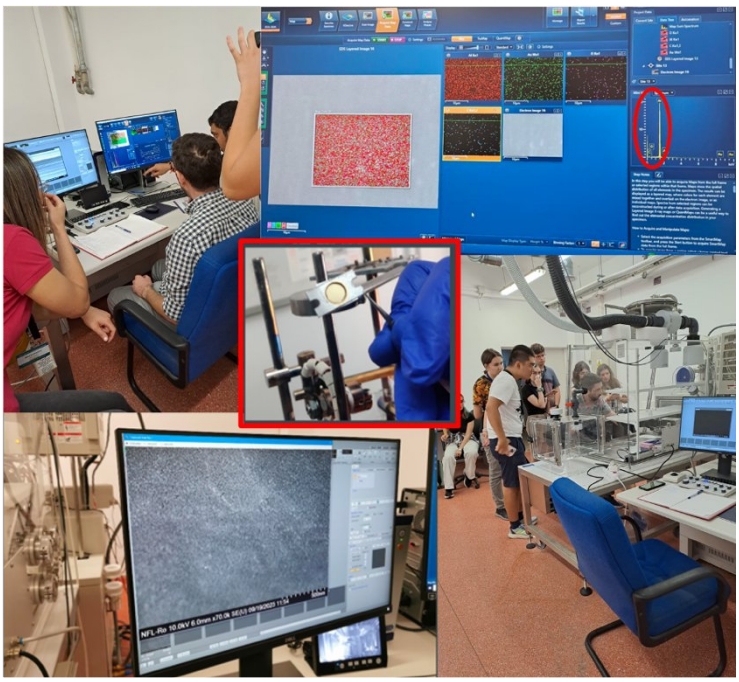
The next step was to deposit a very thin gold layer onto the already prepared Al foil using PVD via resistive heating. The students were guided through the processes of choosing a refractory metal basket compatible to the evaporant to avoid alloy formation and of selecting the mounting geometry to maximize substrate deposition while minimizing deposition of contaminants into the condensed film. Finally, students were directed on how to generate a slow evaporation rate that maximizes the uniformity of the deposited substrate.

The Al foils prepared by participants were covered with a thin gold layer by PVD via resistive heating.

While waiting for reaching the right vacuum for PVD, the students were also trained to mount thin carbon foils onto the target frame via the floating method.

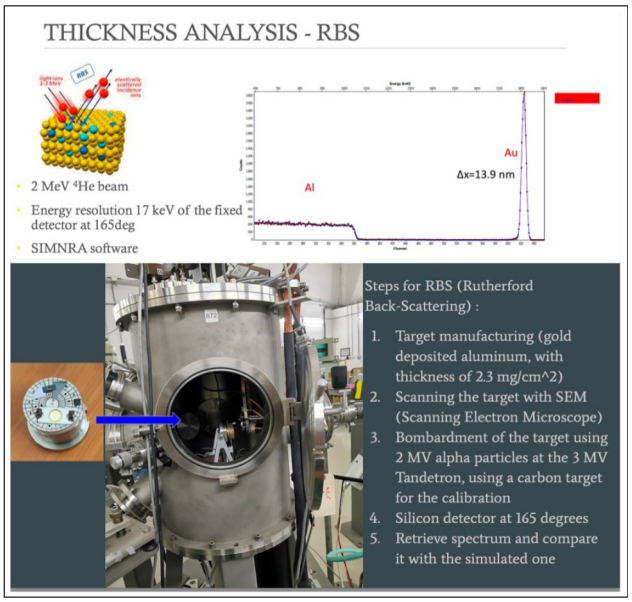
One of the participants practicing the floating method for mounting the carbon foil onto the target frame.

The participants had the opportunity to characterize their obtained targets using SEM-EDX for obtaining information about target surface's morphology via SEM, and to verify its elemental purity by EDX.



Targets prepared by each group were analyzed by SEM-EDX (images from the participants' final reports).

Finally, once the participants had confirmed the elemental composition of their own target, they were taken to the 3MV Tandetron accelerator where they assisted in measurements of the thickness of the gold layer via the Rutherford Backscattering Method (RBS).



Finally, each of the prepared targets were analyzed by RBS to measure the thickness of deposited Au layer (images from the participants' final reports).

At the end of the BTS23, each of the three groups gave oral presentations of their activities during the school with a special emphasis on their target preparation experiences.

Taking into account that the participants were trained on all the aspects of target preparation and characterization and looking to their final reports one can say that the EURO-LABS Basic Training School 2023 has reached its main objective in the field of target preparation.

THE 2022 FRANK KARASEK MEMORIAL SCHOLARSHIP FUND

Nicholas E. Esker*, Justin Diaz
San José State University, One Washington Sq., San Jose CA 95192

Matt Gott†, John Greene
Physics Division, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439

Introduction

As outlined in previous reports, [1, 2, 3] the Frank Karasek Memorial Scholarship Fund is a sponsored program to help support young researchers as they learn the science (and art) of target foil rolling. The fund acts as a travel award, supporting the recipient as they travel to an expert target maker and learn to roll their own foils. It is graciously administered by the International Nuclear Targetry Development Society (INTDS), and held in memory of Frank's historical contributions to our field in terms of both developing rolling methods [4, 5] and training the next generation of nuclear target makers.

The 2022 award went to support the travel and lodging for Nicholas E. Esker and Justin Diaz, both of SJSU, as they visited Argonne National Laboratory to learn cold rolling from Matt Gott and John Greene at the CATS facility [6]. Esker is a recently hired faculty who is starting a new targetry development and training group at SJSU, and Diaz is an SJSU undergraduate student researcher. Gott nominated Esker for this award and, after the INTDS Executive committee's approval in early 2022, acted as the generous site host for the SJSU personnel's visit from Jun 06 – Jun 10, 2022.

Brief Description of Research Interaction

The SJSU Targetry Lab is a recently established nuclear targetry lab located at San José State University. SJSU is a primarily undergraduate institution (PUI) and does not have any on-site accelerator facilities or experimental nuclear reaction capabilities. But we see this as an asset for our students: given how approachable and engaging targetry is, this area of study offers undergraduate students a path to meaningfully collaborate on many different accelerator-based nuclear reaction studies. Student training and efforts to broaden the nuclear science pipeline is a core component of our group's mission.

The primary goal of the trip was to introduce the SJSU personnel to the production of free-standing metal targets via cold-rolling. In particular, we rolled a set of ^{54}Fe targets to be used in a nuclear structure study at EMMA, the recoil mass spectrometer located at TRIUMF's ISAC-II facility [7]. The planned experiment will look at the nuclear structure of ^{100}In produced in the ^{54}Fe(^{50}Cr, $p3n$) reaction. For the targetry work, Esker brought an enriched iron oxide sample obtained commercially. The sample was reduces under H_2 in a tube furnace [8], melted

Figure 1: Photo of J. Diaz rolling the ^{54}Ti target using the CATS rolling mill.

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†Now at Oak Ridge National Lab

into a bead using the e-beam, and rolled using a jewelers mill. Several targets in the range of 800 $\mu g/cm^2$ were produced using this method. Figure 1 show a picture of J. Diaz manipulating the foil during a rolling session.

In addition to the rolling of the ^{54}Fe target, Esker and Diaz aided the CATS group in several other target productions, including producing evaporated Sm and Gd targets as well as solvent casting CD_2 films.

Undergraduate Perspective

The following is adapted from a reflection paper written by J. Diaz after his time at Argonne.

> As an SJSU student, nuclear science is not taught as widely as in other universities. Despite this, there have been ongoing efforts to expand teaching nuclear science at SJSU. The Esker lab is focused on nuclear science research and through the efforts of collaborators such as Argonne National Laboratory, has provided an avenue for undergraduates to seek research opportunities in this field... The trip to ANL aided us in developing more skills in target production. At first, it was a little tricky. But after a few runs of cold rolling, we were able to produce a thin film of ^{54}Fe to its desired thickness of 0.8 mg/cm^2... Nuclear science is an exciting field and the partnership with national laboratories like Argonne offers students an opportunity to interact with co-workers outside their home institution, and learn exciting new techniques.

Conclusion

In conclusion, the visit to Argonne by Esker and Diaz was very successful in that it introduced two young researchers to the technique of cold rolling, helped create an opportunity to interact with colleagues outside of ones home institution, and began a new exchange that fosters collaboration between CATS and SJSU. As stated in previous reports on the Karasek fund, this support for young researchers to engage in foil rolling for target preparation "should be continued and encouraged wherever and whenever possible."

Acknowledgments

The authors would like to thank Christelle Stodel (INTDS President), Ntombi Kheswa (INTDS Vice-President), Dannie Steski (INTDS Treasurer), and the entire INTDS Executive Committee for their support in this effort. NEE and JD would like to thank Matt Gott and John Greene for being such amazing hosts.

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Target Maker's Introduction

Center for Accelerator Target Science
Argonne National Laboratory, Lemont, Illinois, United States
Claus Müller-Gatermann, John Greene, Connor Mohs

Naturally, ATLAS (Argonne Tandem Linac Accelerator System, www.anl.gov/atlas) and its users set the priorities for the target laboratory in Argonne. But in 2016 the Center for Accelerator Target Science (CATS, www.anl.gov/phy/cats) was founded and the objectives were extended to serve the DOE-NP (Department of Energy Office of Nuclear Physics) low energy community with targets whenever possible. Moreover, Research and Development of targetry and the training of our future workforce on the methods are further goals, as well as keeping an inventory of existing targets to be available on a first-come first-serve basis.
Recently, there was a personnel change and CATS got reviewed externally for the DOE, if these goals are met. About one year ago Matt Gott left to Oak Ridge National Laboratory and is now leading the Stable Isotope Materials and Chemistry Group. Claus Müller-Gatermann (www.anl.gov/profile/claus-mueller-gatermann) did his PostDoc at this time in the low energy physics group and took the challenge to take over ad interim and since March as the new target maker. Claus has a broad background in accelerator and detector physics, ion beams, material analysis and specialized later in gamma-ray spectroscopy with a focus on Doppler-shift methods. He got his PhD 2019 in the group of Alfred Dewald at the University of Cologne (Germany) conducting lifetime measurements of excited nuclear states. These experiments are typically using plunger targets, which need to be stretchable and of high surface quality. The need for these targets is also one reason why Claus started with targetry about 10 years ago in Cologne and other labs where experiments were performed. Claus is supported by Connor Mohs (www.anl.gov/profile/connor-mohs), who joined as a technician in February 2022. Connor has a bachelor in Physics from Purdue University and worked with several detector setups for high energy physics. The team is completed by our national treasure John Greene (www.anl.gov/profile/john-p-greene) who has become an Argonne Associate. John has now finally the time to do R&D, when he is not passing along his experience which is much appreciated.



Figure 1: Team of CATS: Claus, John and Connor (from left). The faces changed, but we try to deliver the same quality targets as in the past.

The performance of CATS as a national center for targets has been recently reviewed and the external committee came to the conclusion that we are meeting the goals. We will share more of the outcome and a status update of CATS in the next newsletter. Until then, please reach out with any question or request and keep our lives interesting.

31st Conference of the International Nuclear Target Development Society

2024

Hyatt Place Downtown, Knoxville, Tennessee, United States / August 18-23, 2024 / First Announcement

Dear Colleagues,

Oak Ridge National Laboratory is excited to invite you to the 31st Conference of the International Nuclear Target Development Society (https://www.intds.org/) at the Hyatt Place in downtown Knoxville, Tennessee, USA from Aug. 18-23, 2024.

The INTDS Conference covers current research and challenges in target development and application. Participants are invited to submit their contribution to the following topics or related subjects:

- Preparation and characterization of high-purity and special materials for target fabrication
- Preparation of thin films and foils (e.g., evaporation, sputtering, electrodeposition, rolling)
- Preparation of radioactive targets
- Preparation of liquid and gas targets
- Beam charge strippers (i.e., foil, liquid, gas, plasma)
- Targets for high-intensity beams
- Targets for special applications (e.g., medical, industrial, controlled fusion)
- Target characterization
- Target recycling and disposal

The conference format includes general talks and oral contributions selected from the abstracts submitted to the scientific committee. The conference website will be made available early in 2024 and continuously updated with the newest information and announcements.

We look forward to seeing you in Knoxville!

Local Organizing Committee:
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Jenny Conner
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Distributor Level – USD 700

In addition to the company name dispersal provided at the Promoter Level, the company is invited to provide product information for distribution in conference folders. Companies participating at this sponsorship level will assume all costs related with material reproduction and shipping to the conference organizers at least one week prior to the start of the conference.

Exhibitor Level – USD 1000

The company is invited to send up to two (2) representatives to exhibit products during the conference. The company will also receive the benefits listed above for the Distributor and Promoter levels.

Company Logos/Artwork

All exhibitors and sponsors are required to supply an electronic version of their logo (300dpi) for inclusion in the conference program and on the conference website (along with applicable signage). Sponsors will be contacted for graphics to be used in promotional materials and on the conference website once their full payment is received. Deadline for artwork submission will be announced later.

Advertisement

Save the date

10th July to 13th July 2024

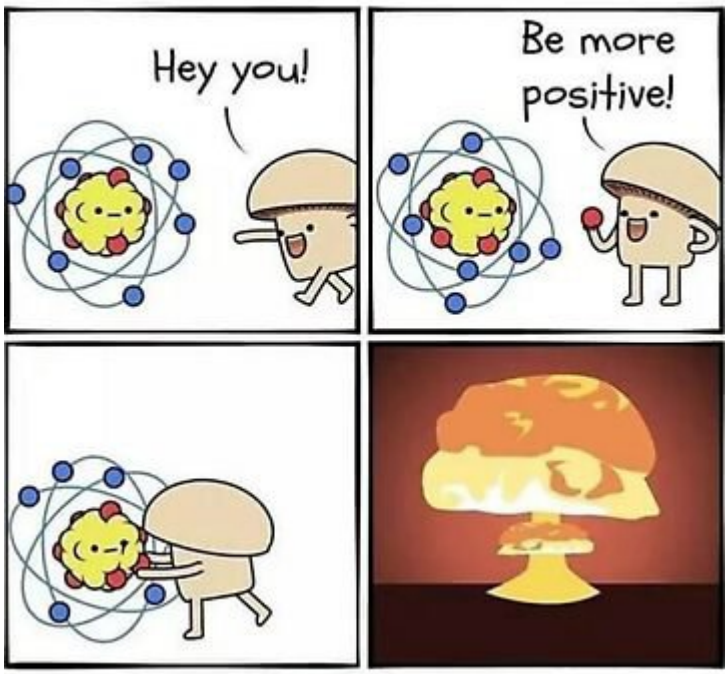
Student Target Workshop at Argonne National Laboratory

The successful Hands-on Targetry Workshop for Students of 2022 will be repeated next year. Further information will be published on the CATS homepage (https://www.anl.gov/phy/cats) and a first circular sent through mailing lists soon. The event will be followed by the Exotic Beam Summer School (EBSS) in the upcoming week. We are again grateful for the support from CENTAUR (Center for Excellence in Nuclear Training And University-based Research https://centaur.tamu.edu).

CENTER FOR EXCELLENCE CENTAUR IN NUCLEAR TRAINING AND UNIVERSITY-BASED RESEARCH

Argonne NATIONAL LABORATORY

Laughs for Target Makers



For further information on the INTDS, please refer to our website: www.intds.org.