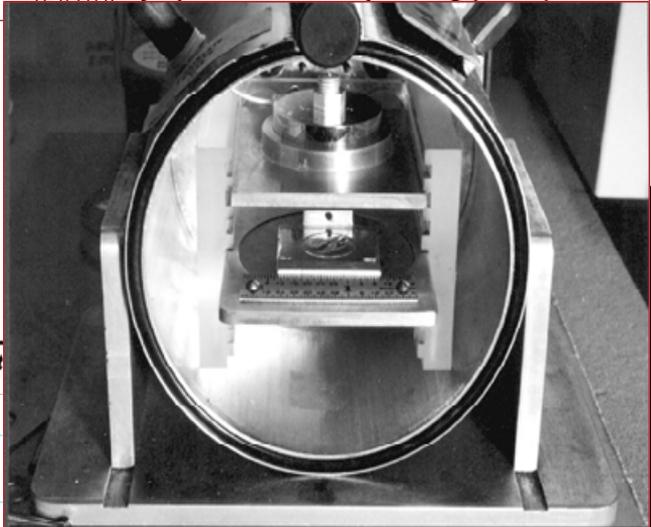
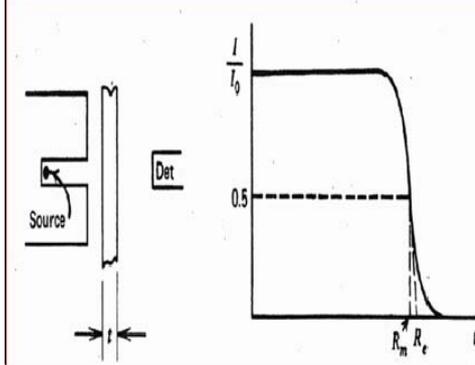
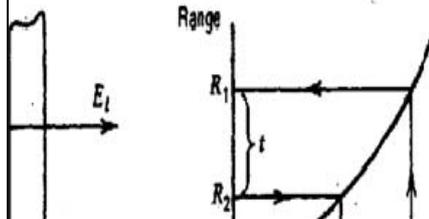


INTDS NEWSLETTER

energy	step size	thickness	energy loss	stop power
5.812	0.02	0	0.000	0.417168
5.804	0.02	0.02	0.008	0.417621
5.795	0.02	0.04	0.008	0.418075
5.787	0.02	0.06	0.008	0.418530
5.779	0.02	0.08	0.008	0.418985
5.770	0.02	0.1	0.008	0.419440
5.762	0.02	0.12	0.008	0.419896
5.753	0.02	0.14	0.008	0.420352
5.745	0.02	0.16	0.008	0.420809
5.737	0.02	0.18	0.008	0.421267
5.728	0.02	0.2	0.008	0.421725
5.720	0.02	0.22	0.008	0.422183
5.711	0.02	0.24	0.008	0.422642
5.703	0.02	0.26	0.008	

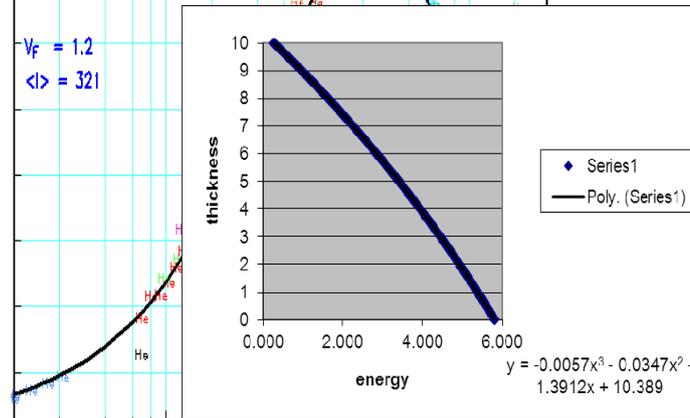


Ion = Helium (2)
Target = Nickel (28)

STOP-2011 (Solid Line)

Plotted are Ion Names

$V_f = 1.2$
 $\langle I \rangle = 321$



Peak Search Sensitivity: 3.00

Width	Centroid	Energy	Peak
Rel. Uncertainty		(keV)	Significance
0.0767	5115.13	4.18	
0.0155	5601.98	86.35	
0.0463	5991.05	13.54	

Peak noted
1.000 sigma

Energy of backing = 0 keV
Energy of target = 5601.98 keV
Energy of detector = 210.02 keV

Mass = 0.492 mg/cm²

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Correction: In the September 2010 issue of the Newsletter, in the photograph on page 24 the caption should read, “Roger Eykens, Awardee Isao Sugai, and David Gilliam at the INTDS Banquet.” *Our apologies to Roger for the error.*

Cover Photo

Selected figures from “Energy Loss Calculations for Target Thickness Determinations using SRIM and Excel” (Pawlak, Greene).

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LETTER FROM THE EDITOR

To the INTDS Membership,

In this issue, we present the Minutes of the 2010 INTDS Board Meeting and Membership meeting held during the last Conference at TRIUMF along with only one Technical Contribution. Also, through the focus of many members, especially our President and Treasurer we have thoroughly updated the current Membership Listing (found at the end of this issue). Finally we have tried to get new & current advertisements as well.

I have one suggestion as we look forward to future issues – that is for the INTDS Newsletter to be published and distributed in an electronic format **ONLY**. This would help in getting out issues in a timely manner, save on postage, and operate in a more green friendly environment by saving on paper, envelopes, etc. For those who wish – we could still accommodate the regular paper issue. I plan to bring this to the attention of the members at the Conference Board and Membership Meetings in Mainz. Let me know how you feel about this. I look forward to your continued support and feedback.

As Editor of the INTDS Newsletter, I wish to invite you to submit contributions of general or technical interest to the membership for upcoming issues.

Examples include:

- Description of recent target activities, i.e. your annual (or semi-annual) laboratory progress report.
- Information on any newly developed techniques.
- Requests for advice on making specific targets or obtaining special materials (enriched isotopes).
- Literature information regarding techniques and sample preparation.
- Employment opportunities.
- Nominations, promotions, retirement announcements, ... etc.

The Newsletter will accept advertisements placed by members, at the discretion of the editor. These ads should be one page in length or less, and must be relevant to target preparation. For instance, isotope services, equipment for sale, thin foil materials and/or targets in stock, etc.

Please send your contribution to my attention at your earliest convenience, preferably by email. Thank you.

John P. Greene
Editor

News of the INTDS

MINUTES OF THE 2010 INTDS BOARD MEETING

Present: K. Eberhardt, D. Gilliam, J. Greene, B. Kindler, B. Lommel, D. Steski, C. Stodel, A. Stolarz, I. Sugai, S. Zeisler
Recording Secretary: B. Kindler

AGENDA

Welcome address

- 1 **Inauguration of the new Officers (AS)**
- 2 **Changes/additions to the Agenda (AS)**
- 3 **Minutes of the 2009 virtual INTDS Board Meeting (John)**
- 4 **Reports on the INTDS Financial and Membership Status (David)**
- 5 **Status of the 2010 Conference, (Stefan)**
 proxy presentations for absentees,
 Disclosing reviewers?
- 6 **Proceedings (AS)**
 2010 Elsevier – NIM A
 Future: Procedia?
- 7 **Financial support of attendees**
 Approval of speakers and attendees for 25th conference (AS + David)
 Rules for the financial support (as)
- 8 **Election**
 report of the Nominating Committee for 2010 election (Klaus)
 Problem of candidates from the floor. Should we change our by-law?
- 9 **Status of the INTDS Newsletter (John)**
- 10 **Status of web site and INTDS Database (AS)**
- 11 **Host and site of the INTDS Conference 2012 (Mainz? Darmstadt? Warsaw? other?)**
- 12 **Karasek Memorial Fund (David)**
- 13 **Miscellaneous**
 (Awards,)
- 14 **Closing**

Anna welcomes the Board.

1. **Inauguration of the new Officer**
 Inauguration of BK as recording secretary
2. **Changes/additions to the Agenda**
 No changes
3. **Minutes of the 2009 virtual INTDS Board Meeting**
 - Minutes are accepted but should be published in the next newsletter in a summarized version.

- Better to meet virtually at one time to respond directly as computer conference with or without video. Agenda on the screen and talking either on telephone or at the PC. Meeting virtually twice between the conferences will be tried.
- Each participant has to check in the home institution how to connect and which system can be easily used.
- Or if this will not possible, perhaps open a document for each agenda point where everyone can add his or her point.

4. Reports on the INTDS Financial and Membership Status

- Treasurer's and membership report (both attached to email), reports are accepted.
- David reports that the INTDS is decapitalising itself during the last years partly because the interest rates have dropped dramatically.
- Number of Asian members has decreased since they joined at the conference in Japan. Also the number of North American members is declining.
- Make the INTDS more public.
- The lost members should be encouraged to join again or refresh their membership e.g. contact the isotope people.
- Making new contacts, like the laser target people (Gabriel Schaumann).
- Giving access to the list of publication for the public but full access of the proceedings only to members as incentive to join as a member.
- Emeritus members: Bill will be made an emeritus member. If we get enough copies of the proceedings we will give them to all the emeriti for free.

5. Status of the 2010 Conference

- Stefan reports on the conference budget (status report attached to email, all in Canadian Dollars). Travel support for 3 people should be paid from INTDS budget and in order to leave the conference budget balanced.
- Nobody from India and from Russia will come.
- A lot of people who applied for support were contacted and never did reply.
- Papers of Q. Fan and of S. Goyal will be read during the conference in order to be included in the proceedings. No money needed for invited speaker since they all come from TRIUMF.
- Reviewing will be handled as in the years before but reviewers who were late last time should not be asked. The people from the board will review additionally Paul Morral, Charles Bacri, Jurek Szerypö, Bill Lozowsik, Peter Maier-Komor (already confirmed), Helmut Folger, Powell Barber will be asked.

6. Proceedings

- Publication will now go as a supplement to NIM A and will be twice as expensive as last time.
- Time schedule has to be met seriously to give Elsevier more confidence in INTDS as a partner.
- The authors will have to send their paper latest two weeks after the end of the conference.
- The reviewers will be informed that the correction should be within 4 weeks of receiving the paper.
- All email contacts should go in copy either to Stefan, Anna or Dannie, as responsible editors. That will be assigned in the beginning.
- Stefan is in charge of the Elsevier correspondence.
- If Elsevier sends the information for last corrections in case the author does not answer within 2 weeks the paper goes to print like that.

The reviewers should pay attention to keywords, PACS no more needed for NIM-papers. New keywords can be added if really necessary. Anna will update the list afterwards.

- Elsevier has the tendency to close down the publishing of conference proceedings at all in future. The solution to publish it as a supplement is much more expensive than it used to be. A self-publishing will not be reviewed and as such is not accepted as a citable paper.
- Most of the board want to try to stay with NIM A as long as possible, since it was problematic since many years.
- Other possibilities: AIP (like the CAARI), which is not easily accessible for Europeans; other possibility Review of Scientific Instruments which is also under the umbrella of AIP. Both possibilities should be explored if the conference is not in America and under which conditions.
- Christelle Stodel will ask colleagues for information about Review of Scientific Instruments.
- Procedia, Elsevier, is at least at the moment not an alternative but each of us should have an eye on it and try to contact colleagues of our home institution who published successfully with Procedia.
- Financial situation has to be kept in mind but the conference fee should not be too high. No time limit in accessibility could be accepted; only electronic publication would be okay.

7. Financial support of attendees

- Three attendees will be supported; the papers have been approved.
- People coming new to the conference should be preferred in supporting but, if financially possible, people should be supported without time limitation in case the content of the paper within the scope of our conference.
- In future, the support will only be given if the abstract is accepted and under the condition **that the paper is sent at least 4 weeks in advance of the conference and the content is accepted.**

8. Election Report

- Accepting candidates from the floor is problematic since than people are voting for a different pool of candidates.
- We will go through the bylaws.
- For the moment no changes will be made.
- Next time the name of the board member who will stay on the board will be mentioned on the ballot to prevent invalid votes.

9. Status of the INTS Newsletter (Status report attached to email)

- The Newsletter has been revived and members should fill them at least once a year.
- John will continue in the job.

10. Status of web site and INTDS Database

- Website is located at the University of Warsaw, Anna is webmaster.
- Recommendations and any comments are most welcome.
- Database will be further completed by Anna.
- Area accessible for members only would make it possible to put more information on the web.

11. Host and Site of the INTDS Conference 2012

- In Warsaw the conference will not be possible because of overlap with another conference there.
- Mainz would be a possibility. It could perhaps be organized in a conference centre in Mainz downtown. It could be organized by University of Mainz and GSI in cooperation. Bettina and Klaus will talk with their institution. Decisions will be made until November.
- Contacts to the Isotope Society, which will host their conference in 2012 probably in Heidelberg and the European Target Fabrication workshop (<http://www.clf.rl.ac.uk/18838.aspx>) who will probably organize their workshop 2012 in Darmstadt.
- It is suggested to organize them either together or with an overlap or one after the other ...
- Candidates for 2014: IUAC Delhi as a proposal Kabiraj and RIKEN,
- Cape Town (2016 or 2018), India, Warsaw, Daresbury (announced at the membership meeting).

12. Karasek Memorial Fund

- Money for training available.
- Practical workshop at Anna's lab in Warsaw. 10 rooms would be available at the institute. The accommodation could be paid by the fund, the travel expenses had to be paid by the participants. Published via website, email and posters. Anna will check for a possible date when the rooms will be available.

13. Miscellaneous

- Awards for this year: Bill Lozowski and Isao Sugai for their outstanding work as target makers.
- Award for the best paper presented at the next conference?
- Change of the INTDS-logo? No decision made, to be discussed later.
- CERN workshop on actinides – high power uranium targets → In Mainz session on High power targets and contact the people of the CERN-workshop

14. Closing

MINUTES OF THE 2010 INTDS MEMBERSHIP MEETING

16 September 2010, 9:30, TRIUMF

Agenda

1. **Membership and financial report status 31 August 2010 (David Gilliam)**
2. **Board elections (Klaus Eberhardt)**
3. **Minutes of the virtual board meeting in 2009 by John Greene and pre-conference Board meeting at 14 September 2010 (Birgit Kindler)**
4. **INTDS venue 2012**
5. **Awards**
6. **Miscellaneous**

Election results and introduction of the all members of the INTDS Board

1. The Membership and Financial Reports were given by David Gilliam, please find the files attached.
2. Klaus Eberhardt chaired the board elections
3. *Birgit Kindler presented shortly the minutes of the virtual board meeting held in 2009 and reported by John Greene as well as the minutes of the pre-conference Board meeting at 12 September 2010 reported by her; both files are attached.*
4. Klaus Eberhardt proposed Mainz as a possible location for the INTDS2012. The conference probably could be co-hosted by the University of Mainz and GSI, in case both institutions agree. Klaus Eberhardt and Bettina Lommel will discuss the possibility in their home institution and will give a feedback until end of 2010. Candidates for the INTDS2014 or beyond are RIKEN, Japan; Delhi, India; Daresbury, UK; Cape Town, South Africa; Warsaw, Poland.
5. INTDS awards of Recognition were given to Isao Sugai and Bill Lozowski (who could not attend).
6. **Publishing with NIM:** Stefan Zeisler sees a future publishing in NIM critically but the overall opinion is unambiguously to stay with NIM if possible!

Election results - The newly elected officers are:

Bettina Lommel (2010 - 2014), GSI, Darmstadt, Germany
Atsushi Yoshida (2010 - 2014), RIKEN, Saitama, Japan
Stefan Zeisler (2010 - 2014), TRIUMF, Vancouver, Canada

Reviewers Meeting: A reviewer list was constructed and distributed to the reviewers → Report Stefan Zeisler.

Reporting secretary Birgit Kindler

I.N.T.D.S. MEMBERSHIP REPORT

31 October 2011

31 Aug. 2010

31 Oct. 2011

Regular Members	66	86
Emeritus	<u>10</u>	<u>13</u>
Total	76	99

(50 regular members have paid their dues through 2012 or 2014)

Regular Membership by Continent:

East and West Europe	40	47
North American	19	25
Asian	5	10
African	1	1
Australian	0	2
South American	0	0
Middle East	1	1

Respectively submitted,

David M. Gilliam
INTDS Corresponding Secretary/Treasurer

I.N.T.D.S. TREASURER'S REPORT
(CORRECTED)

I.N.T.D.S. TREASURER'S REPORT



26th International Conference of the International Nuclear Target Development Society

Targets for Accelerator-Based Research

Second Circular

We are pleased to give you more detailed information about the INTDS 2012 to be held in Mainz, Germany, from 19th to 24th of August 2012. The conference is co-organized by Johannes Gutenberg-Universität Mainz (JGU) together with GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, and will be supported by the Helmholtz-Institut Mainz (HIM) and the Helmholtz-Institut Jena (HIJ).

Scientific Program

Overview talks and contributions will cover current research and challenges both from the target maker's perspective as well as from the experimenter's point of view.

Participants are invited to send in contributions covering one of the following topics or related subjects:

- Preparation Techniques for Thin Films and Foils
- Stripper Foils
- Radioactive Targets
- High-Power Targets
- Liquid and Gas Targets
- Isotopic Enrichment and Isotopically Enriched Materials
- Target Characterization
- Targets and Coatings for Medical Radioisotope Production

All contributions accepted by the scientific committee will be presented in a talk in English (15 min. and 5 min) during the conference. All papers actually presented at the conference and submitted in due time will be published as conference proceedings in a peer reviewed journal.

Abstracts should not exceed one page, A4 size paper, including title, author(s), affiliation(s), reference(s). The abstracts should be submitted before **June 16, 2012**. They may be edited and reformatted by the Local Organizing Committee. Please submit your contribution to intds2012@qsi.de

Please send your abstract as MS Word or Open Office document as well as a pdf-file to ensure correct character encoding.

If you need a financial support to enable your participation in the INTDS 2012 please fill in the form for [Application for Financial Support](#). The Board of the INTDS decides on the application taking into account the scientific content of the contribution as it is described in the abstract as well as the relevance of the subject in the frame of the INTDS 2012. Persons that get support are obliged to present their contribution in a talk during the conference.

Please note that the support is given only under the condition that the complete paper is sent to the organizers at least 4 weeks in advance of the conference.

Conference Venue and Accommodation

INTDS 2012 will take place in the **Erbacher Hof** (www.ebh-mainz.de) which is located right in the historic city centre of Mainz. Very conveniently, the Erbacher Hof combines accommodation and conference site. Breakfast (included in room price) and lunch (included in conference fee) will be served directly in the Erbacher Hof, where also the welcome party (included in the conference fee) will take place.

Address: Erbacher Hof, Grebenstrasse 24-26, D-55116 Mainz.

Participants of the conference are invited to book their accommodation at their earliest convenience via email: hotel-intds2012@qsi.de

The rooms at Erbacher Hof are held back for arrival between August 18 and departure on August 25, 2012. These rooms will go on a first-come-first-serve basis. Deadline for reservation is May 15, 2012. After May 15 the reserved room contingent will be deblocked and can be allocated by participants of the European Target Fabrication Workshop. This Workshop is dedicated to target fabrication for laser applications and will be held parallel to the INTDS also at Erbacher Hof.

Prices per room and night / w/ breakfast:

Single room	55,00 €
Double room	80,00 €
Triple room	93,00 €
Additional charge for one night use	5,00 €

Please note: The bill will have to be paid directly at Erbacher Hof! Only cash and EC-cards are accepted, no credit cards and traveler's checks !

Travel Information

The nearest airports reaching Mainz are Frankfurt International Airport (FRA) in about 30 km driving distance, or Frankfurt Hahn (HHN) in about 90 km driving distance. From both airports there is public transportation to Mainz. Public transportation in Germany in general is quite convenient and for your stay in Mainz a car is not necessary.

Please note, that there are some places in the parking garage of the Erbacher Hof but they are not free of charge. Free public parking in the old town of Mainz is not possible.

Detailed [travel information](#) is provided on the INTDS2012 website!

Registration

Registration for INTDS 2012 will be open at February 01, 2012!

(<http://www-win.gsi.de/intds2012/registration.html>)

Registration costs for Participants

Fee: 350.00 €

Please make sure that the money will reach us before the deadline!

The fee can only be transferred to the conference bank account; payment with credit card is not possible. The bank connection will be sent to you after the successful registration via email. Please be aware of the fee for international money transfer and add the amount to your bank transfer!

Late Registration (after May 15, 2012)

Fee: 450.00 €

The registration fee includes:

- Conference attendance
- Welcome reception
- All breaks/lunches
- Excursions
- Conference banquet
- A copy of proceedings
- A 2 year membership in the INTDS

Registration costs for Companions

Fee: 150.00 €

Registration Fee for Companions includes:

- Welcome reception
- All breaks / lunches
- Excursions
- Conference banquet

All cancellations must be provided in writing to intds2012@gsi.de. No refunds will be provided for cancellations after May 15th 2012.

Preliminary Program

	So, 19.8.	Mo., 20.8.	Tu., 21.8.	We., 22.8.	Th., 23.8.	Fr., 24.8.
Morning	Board Meeting	Welcome Talks	Talks	Talks	Talks	Talks Closing of INTDS2012
12:00		Lunch	Lunch	Lunch	Lunch	Lunch
Afternoon		Talks	Survey lecture GSI Tour GSI	City Tour Mainz Winetasting Banquett	Survey lecture Reactor Mainz Reactor Tour Mainz University	Distribution of Papers
	Registration				Membership meeting INTDS	
	Reception					

Scientific Advisory Committee:

- Christoph E. Düllmann, Johannes Gutenberg-Universität, Mainz. GSI, Darmstadt, & HI Mainz, Germany
- Klaus Eberhardt, Johannes Gutenberg-Universität, Mainz, Germany
- David Gilliam, NIST, Washington, USA
- Birgit Kindler, GSI, Darmstadt, Germany
- Bettina Lommel, GSI, Darmstadt, Germany
- Dannie Steski, BNL, Upton NY, USA
- Thomas Stöhlker, HI Jena, Germany
- Anna Stolarz, HIL-UW, Warsaw, Poland
- Atsushi Yoshida, Riken, Japan

Local Organizing Committee:

- Klaus Eberhardt, Johannes Gutenberg-Universität, Mainz, Germany
- Birgit Kindler, GSI, Darmstadt, Germany
- Tatjana Litvinova, GSI, Darmstadt, Germany
- Bettina Lommel, GSI, Darmstadt, Germany
- Siglind Raiss, GSI, Darmstadt, Germany
- Petra Sach-Muth, Johannes Gutenberg-Universität, Mainz, Germany
- Brigitta Schausten, GSI, Darmstadt, Germany

Contact Information

Please find all information on the conference website: www.gsi.de/intds2012.

The conference poster is available as a download:

www.gsi.de/intds2012/info_news.html

Email: intds2012@gsi.de

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Technical Contributions

Energy Loss Calculations for Target Thickness Determinations using SRIM and Excel

A. S. Pawlak and J. P. Greene
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Abstract

The thickness of a thin target foil can be determined by measuring the energy loss of alpha particles that travel through it. In the Target Laboratory of the Physics Division at Argonne National Laboratory (ANL), this is accomplished by measuring the energy loss of the 5812 keV alpha particles emitted by a ^{249}Cf source using a silicon detector set-up [1]. The energy loss is translated into the target foil thickness using the stopping power for ^4He in the target material obtained from the stopping/range tables provided by SRIM. This calculation has until recently been carried out using a program developed for this purpose, "ENELOSS." This program uses the stopping/range tables from the original work published by Ziegler [2]. Additionally, due to its design, ENELOSS is unable to easily accommodate targets made from compounds. In order to perform these measurements using the most recent SRIM data, and to better calculate the thickness of compound targets, we have developed a "Thickness Calculation" spreadsheet using Microsoft Excel. This spreadsheet approach is not limited to elemental targets and employs stopping/range tables from the most recent edition of SRIM available on the web. The calculations obtained allow for more accurate target thicknesses and automates the process conveniently for repetitive measurements.

This work was supported by the U.S. Department of Energy, Nuclear Physics Division, under Contract No. W-31-109-Eng-38.

1. Introduction and Motivation

The target laboratory in the Physics Division at ANL is responsible for the production of accelerator targets for use at the ATLAS accelerator as well as other facilities around the world [3]. Accurate thickness of thin target foil layers is an essential measurement needed. For thin delicate films (a few $\mu\text{g}/\text{cm}^2$), gravimetric determination of their thickness cannot be undertaken. This thickness, however can be ascertained by measuring the energy loss of alpha particles that traverse the foil, taking advantage of the stopping power of the target material;

$$S(E) = - dE/dx$$

In our case, this is accomplished by measuring the energy loss of the 5812 keV alpha particles emitted by a ^{249}Cf source using a silicon detector set-up in vacuum. The measured energy loss is translated into a target foil thickness using the stopping power for ^4He in the target material. The stopping power was obtained, in past experience, from empirical data compiled in stopping/range tables provided by Ziegler and incorporated into computer code for ease of use. Until recently, these calculations have been carried out using a program developed for this purpose called “ENELOSS” [4]. There are many such codes used for this purpose throughout the world.

In today’s WINDOWS (Microsoft Corp.) oriented personal and laboratory computing environment, having the resources to compile and run these sometimes repetitious measurements/calculations became cumbersome. Especially with new computing availability and hardware upgrades, taking advantage of applications such as EXCEL can streamline the process. SRIM runs under WINDOWS and is consistently upgraded with the most recent computations and data. Another drawback when using ENELOSS, due to its design, is that it cannot easily accommodate multiple layers (target backings) or targets made from compounds. In order to perform these measurements using the most recent version of SRIM, and to better calculate the thickness of compound targets and targets with backings, we have developed a “Thickness Calculation” spreadsheet employing Microsoft Excel. The calculations obtained allow for more accurate target thicknesses and automates the process conveniently for repetitive measurements.

2. SRIM and EXCEL

A computation method for determining energy loss of ions through matter for many years has been the SRIM program available to run under WINDOWS and is quite versatile in the ability to handle targets of many layers, compounds and even gases. This monte-carlo simulation code calculates ion ranges based on the binary collision approximation (BCA) [5] and uses a repulsive potential developed by Ziegler, Biersack and Littmark. This ZBL potential is constructed by fitting a universal screening function from theoretical values obtained for a large assembly of ion pairs. The calculation follows the movement of the ion through the target sample by a succession of collisions between the recoil ion and atoms in the target. In each collision, the classical scattering integral is computed by numerical integration. SRIM for WINDOWS was developed with an easy to use graphical interface, allowing for any ion with an energy up to 1 GeV and a variety of target layers both solid and liquid. There also exists a library of commonly found compounds and shielding elements, plastics, ionizing gases and even biological materials. Table 1 shows an example of the

stopping power and ranges for ^{58}Ni over the relevant energy range needed for measuring such targets.

Microsoft EXCEL is a powerful and versatile spreadsheet application program with the capability of handling large data sets and for graphical data analysis consisting of functions, interpolating and curve fitting routines [6]. Using the stopping and range table generated by SRIM for an alpha particle traversing a particular target material, an iterative alpha particle energy vs. range table is generated. It is calculated by a third order polynomial which approximates the relevant interval of the stopping power curve provided by SRIM. Using the energy loss determined by measurement of the shifted peak spectrum for a particular target, the table is searched until the corresponding alpha particle range, and therefore target thickness, is obtained. A sample listing for ^{58}Ni is shown in Table 2.

3. Experimental Setup and Results

For the alpha particle energy loss measurements, a small evacuated chamber containing a surface barrier silicon detector is employed (see Figure 1). A series of “shelves” provide for collimation of the alpha particles before and after passing through the thin target foil. To supply the alpha particles, a thin, mass separated ^{249}Cf deposit on aluminum was obtained. This source provides a 5.812 MeV alpha particle (main peak 84.4%) with a rate of $2 \times 10^5 \alpha$ dpm for the measurements. A pre-amp and spectroscopy amplifier provides a signal to an ADC card (Canberra, Industries) mounted within a laboratory personal computer. GENIE software (Canberra Industries) installed on the computer can display and manipulate the detected alpha particle as an energy vs. intensity spectrum. The procedure is to first calibrate and obtain a spectrum of the ^{249}Cf without a target in place; then with a target installed, measuring the energy of the now shifted 5.812 MeV peak. The observed energy difference constitutes the energy loss of the alpha particles within the target material. A peak search algorithm is employed to ascertain the shifted peak centroid and a text report is generated.

This text report is entered into the EXCEL spreadsheet, and the shifted peak energy in keV is simply entered into the desired cell. The program searches the alpha particle energy vs. range table as previously described to find the target thickness directly in units of surface density ($\mu\text{g}/\text{cm}^2$). Included in this calculation can be an energy loss due to any target backing material as part of the target (set to zero for self-supporting films). The energy loss from this backing foil can be previously measured or may be calculated from a given known foil thickness. Determination of the energy loss in keV for a target or target backing is another valuable function available in the EXCEL spreadsheet calculated using SRIM.

Overall the process is quite simple and automated; within the GENIE software, a target energy loss is measured using α particles, the shifted energy peak centroid is determined, reported and then pasted into the EXCEL spreadsheet for this target material. The shifted peak energy value is entered into the appropriate cell where the target thickness is then calculated. If desired, this calculation page from EXCEL can be printed out and saved in the target preparation logbook (see Table 3).

4. Conclusion

A spreadsheet program has been developed using EXCEL based upon the most recent version of SRIM available on the web for analyzing alpha particle energy loss data for

accelerator target thickness measurements. This allows for more accurate determinations and quicker turnaround for repetitive measurements. Spreadsheets have been compiled for many target elements and compounds and, in some instances, for isotopic targets as well. Spreadsheets for additional target materials can be created simply as need arises.

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Table 1: SRIM Stopping Range Data for ⁵⁸Ni in He.

<p>===== Calculation using SRIM-2006 SRIM version ---> SRIM-2008.04 Calc. date ---> October 20, 2011 =====</p>						
<p>Disk File Name = SRIM Outputs\Helium in Nickel</p>						
<p>Ion = Helium [2] , Mass = 4.003 amu</p>						
<p>Target Density = 8.8955E+00 g/cm3 = 9.2360E+22 atoms/cm3 ===== Target Composition =====</p>						
Atom	Atom	Atomic	Mass			
Name	Numb	Percent	Percent			
----	----	-----	-----			
Ni	28	100.00	100.00			
<p>=====</p>						
<p>Bragg Correction = 0.00%</p>						
<p>Stopping Units = MeV / (mg/cm2)</p>						
<p>See bottom of Table for other Stopping units</p>						
Ion	dE/dx	dE/dx	Projected	Longitudinal	Lateral	
Energy	Elec.	Nuclear	Range	Stragglng	Stragglng	
<p>-----</p>						
4.00 MeV	5.223E-01	4.805E-04	6.84 um	3173 A	4326 A	
4.50 MeV	4.898E-01	4.349E-04	7.95 um	3644 A	4739 A	
5.00 MeV	4.613E-01	3.976E-04	9.12 um	4113 A	5176 A	
5.50 MeV	4.361E-01	3.666E-04	10.37 um	4585 A	5636 A	
6.00 MeV	4.136E-01	3.404E-04	11.69 um	5061 A	6121 A	
<p>-----</p>						
<p>Multiply Stopping by for Stopping Units</p>						
<p>-----</p>						
8.8952E+01	eV / Angstrom					
8.8952E+02	keV / micron					
8.8952E+02	MeV / mm					
1.0000E+00	keV / (ug/cm2)					
1.0000E+00	MeV / (mg/cm2)					
1.0000E+03	keV / (mg/cm2)					
9.6310E+01	eV / (1E15 atoms/cm2)					
1.0350E+01	L.S.S. reduced units					
<p>=====</p>						
<p>(C) 1984,1989,1992,1998,2008 by J.P. Biersack and J.F. Ziegler</p>						

Table 2: Energy Loss versus Thickness Calculation Table for ⁵⁸Ni in He.

Energy	Step Size	Thickness	Energy Loss	Stop Power
5.812	0.02	0	0.000	0.417168
5.804	0.02	0.02	0.008	0.417621
5.795	0.02	0.04	0.008	0.418075
5.787	0.02	0.06	0.008	0.418530
5.779	0.02	0.08	0.008	0.418985
5.770	0.02	0.1	0.008	0.419440
5.762	0.02	0.12	0.008	0.419896
5.753	0.02	0.14	0.008	0.420352
5.745	0.02	0.16	0.008	0.420809
5.737	0.02	0.18	0.008	0.421267
5.728	0.02	0.2	0.008	0.421725
5.720	0.02	0.22	0.008	0.422183
5.711	0.02	0.24	0.008	0.422642
5.703	0.02	0.26	0.008	0.423101
5.694	0.02	0.28	0.008	0.423561
5.686	0.02	0.3	0.008	0.424022
5.677	0.02	0.32	0.008	0.424483
5.669	0.02	0.34	0.008	0.424944
5.660	0.02	0.36	0.008	0.425406
5.652	0.02	0.38	0.009	0.425868
5.643	0.02	0.4	0.009	0.426331
5.635	0.02	0.42	0.009	0.426795
5.626	0.02	0.44	0.009	0.427259
5.618	0.02	0.46	0.009	0.427723
5.609	0.02	0.48	0.009	0.428188
5.601	0.02	0.5	0.009	0.428653
5.592	0.02	0.52	0.009	0.429119
5.584	0.02	0.54	0.009	0.429586
5.575	0.02	0.56	0.009	0.430053
5.566	0.02	0.58	0.009	0.430520
5.558	0.02	0.6	0.009	0.430988

Table 3: Excel Program Output for ⁵⁸Ni in He.

Peak Locate Analysis Report		8/16/2010 11:47:01 AM		Page 1

P E A K L O C A T E R E P O R T				****

Detector Name: DET01				
Sample Title: Sample title.				
Peak Locate Performed on: 8/16/2010 11:47:01 AM		Peak Locate From		
Channel: 1	Peak Locate To Channel: 1024			
Peak Search Sensitivity: 3.00				
Peak No.	Centroid Channel	Centroid Uncertainty	Energy (keV)	Peak Significance
1	541.01	0.0767	5115.13	4.18
2	729.63	0.0155	5601.98	86.35
3	880.37	0.0463	5991.05	13.54
? = Adjacent peak noted				
Errors quoted at 1.000 sigma				
energy loss through backing =		0	keV	
shifted peak energy of target =		5601.98	keV	
energy loss =		210.02 keV		
target thickness =		0.492 mg/cm^2		

Figure 1: Image of Vacuum Chamber.

