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International Nuclear Target Development Society

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Editors Note

Dear Colleagues,

The 17th World Conference has been and gone. The new INTDS President Bill Lozowski makes the traditional closing remarks in this Newsletter, but he is certainly too modest to acknowledge his own role as conference host. I am sure that the participants would wish me to extend thanks and appreciation for an effective and efficient conference conducted in the usual convivial INTDS atmosphere. There's always something new; in particular this year several excellent presentations on internal targets and, as always, the sheer inventiveness of the more humble of our species shines through. An especially pleasing moment was the presentation of an award to Frank Karasek in recognition of his contributions over the years.

I would also like to thank our secretary Mira Van de Lucht who has helped me compile the Newsletter since 1991, but who has now moved on to greener pastures (how is that possible?).

Chris Ingelbrecht
Editor

In Memory of Wayne Perry

It is with regret that we announce the death of Wayne Perry. Peter Dmytrenko sent word that Wayne died on Saturday, October 29, 1994 in Deep River, Ontario, Canada.

Those of us who attended the SUNY meeting in 1973 remember Wayne as a friendly, perceptive, and very active participant in the formation of the Society. With gratitude, we also remember that he and Joe Gallant persuaded Chalk River Nuclear Laboratories to publish the first Newsletter. In addition, Wayne and Joe co-chaired the 1974 conference: the first to produce published proceedings.

Thereafter, Wayne's area of work at the Chalk River facility changed from targets to isotope separation. We missed his continued participation then, and miss him now.

The INTDS members express their condolences to his family and friends.

W. Lozowski

In Appreciation of Hans J. Maier, President of the INTDS, 1990 - 1994

On behalf of the INTDS members, I offer warm thanks to Hans J. Maier for par excellent leadership of our society during his term as president.

During the past four years, I have had the distinct privilege of working with him as closely as anyone in the INTDS. But we all know him as a highly credible, hard-working advocate for our profession and the INTDS from its beginnings. An ongoing example is the session on target and sample preparation he organizes and chairs at the Denton Accelerator Conferences. This is a lot of work for him, but he continues to do it.

As your president, he visited the director of CRN in Strasbourg because he was concerned about obtaining an adequate amount of support for the '96 conference. He helped Conference Chair Andreé Meens turn an uncertain situation around and returned with news that CRN really wanted the conference and would actively pursue sources of funding for it.

In an open letter to Donald Erb of the US DOE division of Nuclear Energy, he made a strong, concise, eloquent argument for restoring funding to the isotope separation program and the target preparation facilities at ORNL. It is possible it did some good!

In addition, he has done such a good job of focusing the efforts of the Board to fine tune the internal policies and external relations of the Society that I am confident the INTDS will withstand my term as president.

With gratitude,

Bill Lozowski

Bill Lozowski

Summary of the 17th World Conference of the INTDS
Bloomington, IN, USA, October 17-21, 1994

The fifty-one conference participants traveled from fourteen countries to attend the 17th World Conference of the INTDS. Interested scientists and specialists from at least six additional countries would have attended if not for the expense of travel. In more than name, the Society remains *international.*

The formal presentations were arranged by subject into sessions covering the topics of: internal targets, target characterization and investigation, equipment of target preparation and use, target and stripper-foil preparation, activity reports of laboratories, and various other preparation techniques. Consecutive sessions allowed everyone an opportunity to listen to all presentations.

A more interactive exchange of technical information took place on the final morning of the conference. Open discussion of planned topics was begun with a brief introduction by a discussion leader. Five topics were scheduled, but in the 90 minutes available, it was possible to entertain only the first three: target and sample storage methods, packing methods for transportation of delicate targets, and rolling methods for difficult materials. The session was lively and apparently, enjoyed.

Hosting the conference was thoroughly rewarding and worthwhile! For that, we at the Indiana University Cyclotron Facility gratefully acknowledge the help received from the INTDS Program Committee and many hard-working individuals. The conference participants are foremost on our list, especially the authors of the forty excellent contributions presented during the sessions. For travel and/or conference fee support of seven attendees, the Organizing Committee sincerely thanks

The National Science Foundation via IUCF,
The International Science Foundation,
The Office of Research and the University Graduate School, Indiana University ,
The Office of the Vice President and Chancellor, Indiana University - Bloomington, and
The Office of International Programs, Indiana University.

Presently, the proceedings are being prepared for publication in NIM-A.

For the Local Organizing Committee,

Bill Lozowski
Bill Lozowski
Conference Chair, 1994

The Award Presentation to Frank Karasek by the INTDS, October 19,1994

To keep the event especially significant, the INTDS honors few of its members with a career achievement award. Your board of directors decided last year that Frank Karasek should definitely receive this award. The record of his service to the physics research community is remarkable, and fortunately, continues.

Frank's career at Argonne National Lab began in 1950, after he earned a college chemistry degree in night classes. He joined what later became Argonne's Metallurgy Department and grappled with finding ways to form experimental alloys into useful shapes. There is no doubt that he became very good at it because he was enlisted to work on a string of landmark research projects. He was involved in the development of prototype clad-fuel elements for the EBWR: an acronym for the experimental boiling water reactor that was the prototype for US commercial power reactors. In the mid-1950s, he fabricated the metal cladding of the fuel rods for the first nuclear submarine. Later, niobium into magnet coils for the first superconducting linacs. And not so long ago, he made a large number of foils to exacting specifications for an experiment on one of the first space shuttle flights. Throughout his years at Argonne, he was an acknowledged expert called upon to work with refractory alloys and a host of other nearly intractable materials.

It was in the late 1950s that he began to make thin foils of separated isotopes for the physicists at Argonne. Frank gained a reputation for producing high quality super-thin foils of exotic alloys and isotopes, at first probably because the physicists at Argonne gave them to their friends. The methods for roll-thinning he developed gained him an invitation to present a paper at the Second Symposium on Research Materials, sponsored by the AERA in Harwell, England in 1965: seven years before the first INTDS meeting. He also presented a paper at the Third Symposium, sponsored by ORNL in 1971, and of course he has made significant contributions at INTDS conferences. These remain a valuable introduction to his techniques and a reminder to other rolling-mill wizards of the lower thickness limits achievable with impeccable technique, and perhaps a bit of magic.

In 1967, officials at Argonne decided that Frank's time and the government equipment should not be used to supply foils for research beyond Argonne's research mission. So his evening hours and the basement in his home grew into Microfoils: his one-man business where making a profit has been much less important than meeting research needs. He has steadfastly been a patient teacher well known to give away hard-won knowledge. I have pages and pages of dog-eared notes from a day I spent with him in 1971. Frank has helped me with rolling problems for 23 years. He is a master at adjusting preparation procedures to accommodate unforeseen physical properties as they appear. When one must work with only a few milligrams of less-than-pure material so precious that further purification is out of the question, Frank's counsel has consistently been the best available.

Frank retired from Argonne in 1990 with the title of Engineering Specialist and more than 40 years of service. Today his foils are literally used in research institutions around the world. And so, Mr./Master Karasek, we honor you this evening.

(Presented at the conference dinner by INTDS President Bill Lozowski.)

W. Lozowski

Target Storage and Transport Methods

Summary of discussion held during the 17th INTDS World Conference
October 21 1994

Most targets labs have a vacuum or inert atmosphere storage facility for reactive or thin targets that would otherwise deteriorate in air. The simplest are glass or even plastic dessicators, which are occasionally pumped out. Storage of such dessicators in a freezer prolongs target life eg ^{40}Ca targets of 1 mg/cm^2 have been kept under Ar for up to a year in this way. Reaction rates are reduced by a factor of 2 for each 10° C decrement in temperature.

More sophisticated facilities are of stainless steel construction and continuously pumped, with a number of value connections for isolating and removing the individual containers. Such a system can be maintained at 10^{-7} mbar by a cryo-pump (University of Munich) which is surprisingly easy to maintain (regeneration once a year is required).

Transport containers need to be as light and cheap as possible, and preferably transparent to satisfy customs inspectors. A simple cylindrical plexi-glass jar with an O-ring seal (Fig 1, Micromatter) is used for vacuum transport of targets. The plexi-glass releases adsorbed moisture and this type of container should not be used for long term storage.

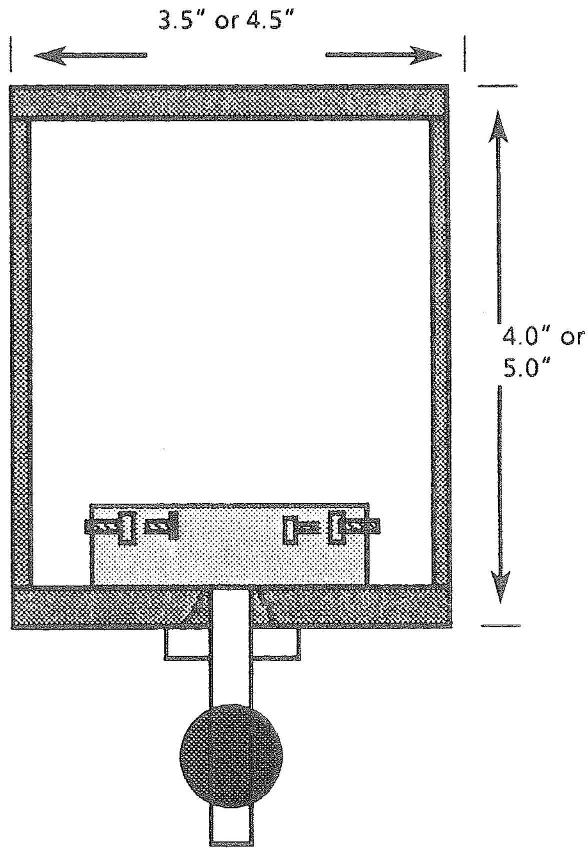


Fig 1 Plexi-glass transport container (Micromatter)

Thin foils can be easily broken by air pressure but are relatively shock resistant, so they are reasonably transportable under vacuum. This container also features a needle value, soft-seated in KEL-F to allow a slow venting.

A high vacuum transport container (Fig 2) designed by LNL* includes a spirally wound getter strip mounted on a Conflat flange, which serves as the container lid. The container is closed under Ar, and evacuated to 10^{-3} mbar, while a current of 30 A is passed through the getter strip, which getters the oxygen and is then regenerated. Samples can be protected from heat by metal foil and may reach 120° C. A vacuum better than 2×10^{-5} mbar can be maintained for more than 3 weeks.

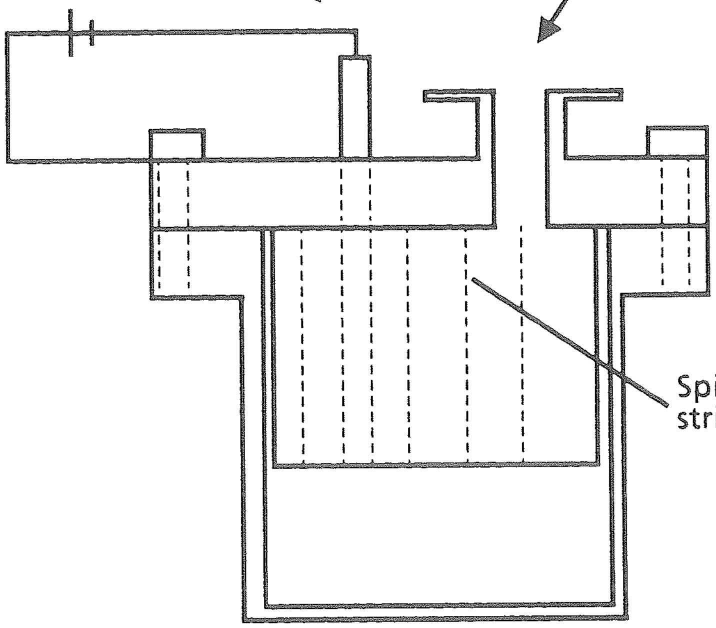


Fig 2 LNL high vacuum exsiccator

Stainless steel containers with a leak rate of $< 10^{-6}$ mbar $\cdot$l$\cdot$sec^{-1} (University of Munich) have been used for transport of rare earth metal foils. The containers were initially degassed by pumping for several days and heating. A transport container need by the Technical University of Munich for ^{40}Ca targets utilized a Ba gettering rod with a hand operated device for scratching the Ba surface periodically to expose a fresh gettering surface.

C. Ingelbrecht

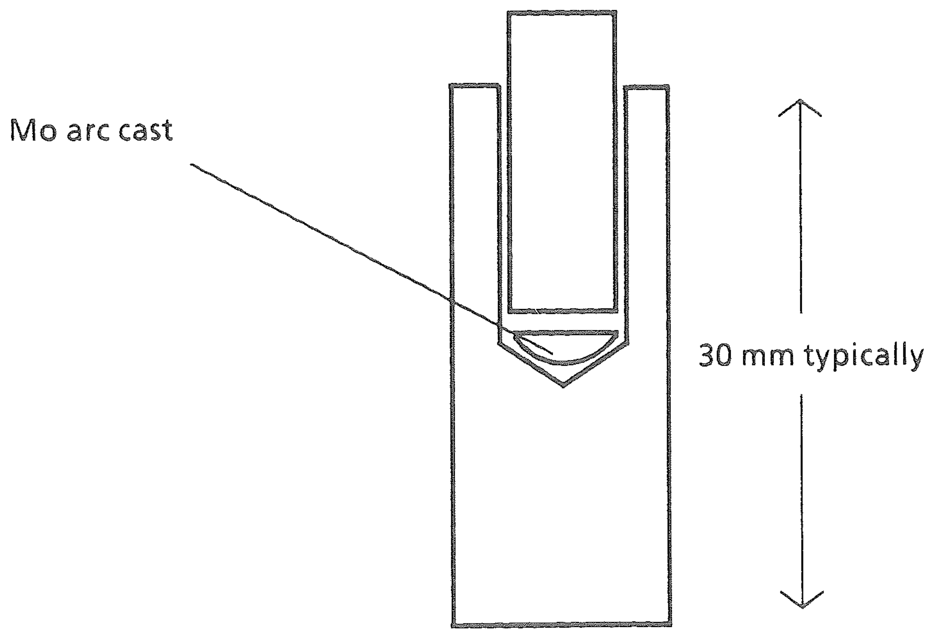
6.12.94

*R. Pengo and L. Ziomi, Nucl,. Instr. and Meth. A245 (1986) 205

Hot roll reduction of arc melted Mo buttons

F. Karasek
Microfoils, 7234 S. Central, La Grange, IL 60525

This method is for rolling gramme quantities of molybdenum metal to foil starting from arc melted buttons. A piece of square stainless steel bar with width about 50 % larger than the button diameter is cut to a length three to four times that of the width. A hole of diameter just larger than that of the button is drilled into the end of the bar to half the length of the bar. The inside surface is coated with Y_2O_3 parting agent, and the arc cast is placed in the hole upside-down so that the rounded surface fits the end of the drill-hole. A close fitting rod is then pushed into the hole and crimped or TIG-welded into place. The pack is then heated to 1000°C in air and rolled with a fast rolling speed and 10 % reduction per pass. The first passes should be length-wise to ensure the fixation of the plug. Rolling in the orthogonal direction can then be carried out. The pack should be reheated as necessary and rolled to typically 0.5 mm thickness. A final annealing at 900°C can then be performed and the pack cut open or placed in HCl to dissolve the stainless steel envelope. Cold rolling between highly polished stainless steel sheets to the final thickness can then be carried out.



See also: 1. Proc. of Seminar on the Preparation and Standardisation of Isotopic Targets and Foils. AERE-R 5097 (1965) III.

2. Nucl. Instr. and Meth. 102 (1972) 457.

3. Nucl. Sci. and Eng. 17 (1963) 365.

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July 20, 1994

ARGONNE NATIONAL LABORATORY
PHYSICS DIVISION
ANNUAL REPORT OF RESEARCH ACTIVITIES

April 1993 through March 1994

John P. Greene and George E. Thomas

HEAVY-ION TARGET PRODUCTION

In the past year, numerous targets were fabricated either as self-supporting foils or on various substrates, many of these targets for the first time. Targets produced included Ag, Au, 11B, 138Ba, Be, 12C, CaF2, 106Cd, 170Er, 193Ir, La, Melamine, 92Mo, 150Nd, 192Os, 208Pb, 144,147,154Sm, 116,122,124Sn, Ti, 184W, and 182WO3. Stretched targets of Al, Au, C, and Ni along with metallized mylar were produced for an atomic physics run at ATLAS. Targets of 154Sm and 122Sn were made onto stretched gold backing foils for Notre Dame for use in lifetime measurements.

An increased output of foils fabricated using our small rolling mill included targets of Ag, Al, Au, C, 106Cd, Co, 50Cr, Cu, 54Fe, 154,155,156,160Gd, Ho, 176Lu, Mg, 92,94Mo, 58,64Ni, 208Pb, 110Pd, Sc, Ti, Zn and 92,94Zr. Large quantities of APEX targets were prepared by rolling, primarily the 1 mg/cm2 Ta foils used for the experiment, but also Ag and Au. A series of rare-earth targets, Ho, Lu, Tb and Tm were needed for testing of the heavy-ion counters in APEX. Rolling has become the method of choice for most targets used in FMA experiments where the required areal densities range from 0.5 to 0.7 mg/cm2 and up to 1 mg/cm2.

HEAVY-ION TARGET PRODUCTION (cont.)

With the early implementation of GAMMASPHERE now operational, an increase in target requests for these experiments has been noticed. Targets of "stacked" 160Gd and 122Sn foils have made produced for Argonne runs at Berkeley. Sandwiched targets of Au-138Ba-Au and Au-150Nd-Au, both very reactive elements, were successfully prepared and transported under vacuum or argon to Berkeley for GAMMASPHERE experiments. Targets supplied for other institutions included 65Cu, 156Gd and 58Ni.

In all, approximately 856 targets were prepared for these various experiments during the past year.

STRIPPER FOIL PRODUCTION

As part of ATLAS support, the thin carbon stripper foils used in the Tandem as well as additional foils of thickness up to 1 mg/cm2 for secondary stripping are being routinely produced by the target lab. A total of 961 stripper foils of various types were prepared during the past year. As ATLAS is now on a 7-day schedule, this accelerator support will continue to increase.

Sincerely,

John P. Greene
Physics Division

Samples and Targets Prepared at IRMM during 1994

J. Pauwels, C. Ingelbrecht, P. Robouch, R. Eykens, A. Moens, F. Peetermans, A. Dean, H. Mast, S. Palmeri, J. Van Gestel, S. Clifford*, D. Egan*

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The Sample Preparation Group's nuclear activities include support for the nuclear data programme of IRMM, samples and targets for external customers and collaborators and the preparation and distribution of reactor dosimetry reference materials. During 1994, a total of 156 samples covering 34 requests were supplied for the IRMM programme, 523 samples were delivered to customers in 10 countries (see Table 1), and 149 reference material units were supplied.

Foils of ^{238}U metal and sprayed deposits of $^{NAT}UO_2$ were prepared for studies of Doppler broadening of low energy resonances. The required oxide thickness, which was too much for a single deposited layer and too little for a pressed powder sample, was achieved by mounting nine substrates, each coated on both sides, together in the target holder.

Samples of ^{237}Np, also for resonance studies, were prepared as Al-Np alloy foil and as a compacted NpO_2/sulphur powder mixture. The sulphur was used as a matrix to increase the target thickness and therefore improve the attainable thickness homogeneity. Sulphur was chosen because of its favourable nuclear properties and to simplify the separation and recovery of the NpO_2 from the target after use.

Samples for the studies of γ-ray spectra for neutron capture in chlorine and nitrogen were required. The materials chosen, C_2Cl_6, $C_3H_6N_6$ and NaCl, were all solids containing high fractions of the relevant target elements, and were pressed into pellets and encapsulated in PTFE, selected for its low neutron cross-section at low energy.

Many samples for neutron flux measurements were supplied. These were aluminium alloys with low concentrations of the target element or pure metals (17 elements). The product form was mainly foil (discs or strips up to 4 m long) or wire. Certification analyses of titanium for scandium (<0.1 mg·kg^{-1}) as a candidate reference materials for neutron dosimetry are continuing. Uranium glasses have been prepared and irradiated (in collaboration with the Institute for Nuclear Sciences, Gent) for use as fission track detectors for geological dating purposes.

*EC Fellows from the University of Limerick, Ireland

Studies on U-Pu based alloys for use as "spikes" for assay of spent fuel (solutions by mass spectrometry are continuing with the further development of a γ-spectromentry method for homogeneity measurements on solid samples.
A recently installed Nd-YAG welding laser was equipped with a PC-controlled positioning system and was used for closing flux monitor capsules, and containers for actinide metal samples and UF_6.
A vacuum evaporation facility was constructed for reduction/distillation of oxides and an investigation of different reducing agents, crucible and collector materials was started in order to allow routine production of stable isotopes in metal form from oxides for future target requests.

Table 1. Thin deposits, films and bulk samples supplied during 1994

Preparation	Number of Samples	Preparation Methods[1]
Thin deposits		
^{7}Li	1	VD
^{237}Np	3	VD
^{239}Pu	3	VD
^{240}Pu	5	VD, EL
^{242}Pu	4	VD
^{235}U	4	VD
^{238}U	9	VD, SU
Films		
Polyimide	15	CE-FL
Bulk samples		
Elements:		
Ag, Al, Au, ^{136}Ba, Co, Cu, Fe, In, ^{6}Li, Mg, Mn, Mo, Nb, Ni, ^{208}Pb, ^{238}Pu, Rh, S, Sc, Ti, ^{235}U, ^{238}U, V, W, Zr	458	LM, M, R, MA, CAN
Al alloys:		
Au, Ag, Co, Cu, Dy, In, Mn, ^{237}Np, ^{235}U, ^{238}U	157	LM-R-MA
Alloys, compounds:		
Ni-Cr	5	M-R-SP
Pb-Ag	1	M-R-MA
C_2Cl_6	1	CAN
$C_3H_6N_6$	1	CAN
NaCl	1	CAN
$^{237}NpO_2$/S mixture	1	CAN
Stainless steel	10	MA

(1) CAN canning; CE centrifuging; EL electrodeposition; FL flotation; LM levitation melting; MA machining; R rolling; SP sputtering; SU suspension spraying; VD vacuum deposition

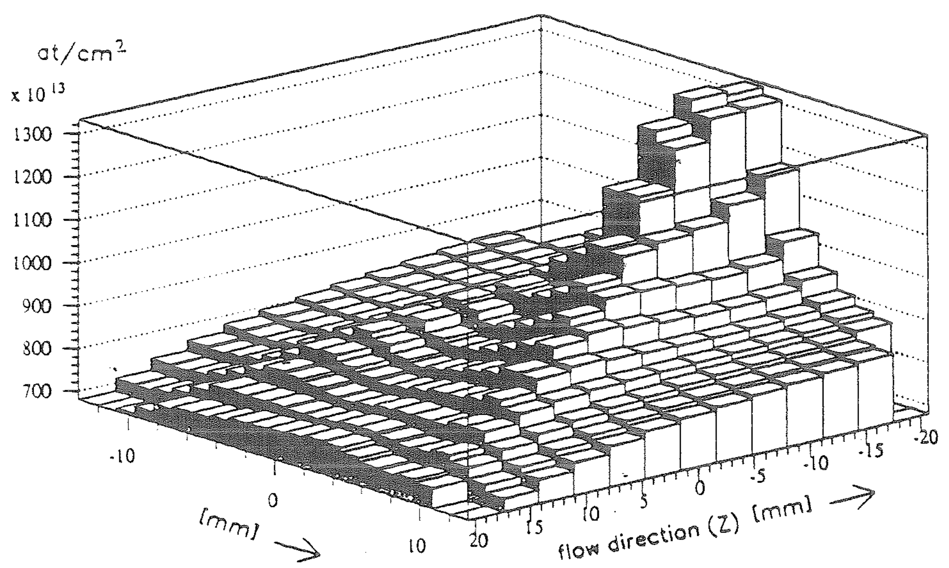
This work was carried out under the EU Research and Development Programme

Benefits from the 17th INTDS World Conference

Dimitri A. Dimitroyannis
NIKHEF/FOM, Postbus 41882, NL-1009 DB Amsterdam

After the succesful commission of the Amsterdam Pulse Stretcher Ring, AmPS, a storage ring attached to the existing 600 MeV electron linac, we started thinking about gaseous internal target development. When the AmPS operated as a storage ring, currents of up to 180 mA circulated, with beam lifetime up to 30 min. Such an intense current electron beam intercepting an internal target of 10^{16} cm^{-2} (corresponding approximately to 0.1 µg cm^{-2} for light nuclei) yields a luminosity of $L \sim$ 10 $nb^{-1}s^{-1}$. Typical crosssections for coincidence experiments, simultaneous detection of the scattered electron and a produced particle, are in the ~ µb level. With such a luminosity and high duty factors one can embark towards an study of the in-medium properties of nucleon resonances and mesons in nuclei.

Our graduate student Rob van der Meer on his doctoral thesis work studied a supersonic gas jet produced by pressing the gas through a rectangular slit nozzle with a large aspect ratio. Such nozzles have been known to produce a dynamical focusing of the expanding gas jet. We presented results of his work during our recent conference in Bloomington. Professor Sperisen's group has developed a similar gaseous internal target for use in the IUCF and I was privileged to exchange information about their setup. With my return to Amsterdam we modified our ionization measurement diagnostics (ionization of the gas by scanning with a 10 keV, 100 µA electron beam transversely to the expansion direction). A typical absolute density profile is shown below.



An integral density profile of the expanding gasjet as measured by the ionization method. Peak density of $1.3 \times 10^{15} cm^{-2}$ was measured over a background of two orders of magnitude lower. The slit nozzle is located at x=0.0 mm, z=55.0 mm.

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INTDS Newsletter **Dec.'94**

Request for advice

We are currently using thin polyethylene (CH_2) foils (100 to 600 $\mu g/cm^2$) as proton targets to measure radiative capture cross sections [A(p,γ)B reactions where A is a low intensity radioactive beam, e.g. ^{13}N, ^{19}Ne, ...). The deuterium content in the natural hydrogen (1.5 10^{-4}) is a problem, because the (d,n) reaction leads to the same final nucleus B with a cross section that can be three to four orders of magnitude larger than the (p,γ).

It is possible to get polyethylene foils or CH_2 powder, depleted in deuterium by one or two orders of magnitude ?

P. Demaret
P. Leleux
Cath. Univ. Louvain
Louvain-la-Neuve, Belgium

Please send advice to P. Demaret (Fax nbr 32.10.452183) or P. Leleux (e-mail : Leleux@fynu.ucl.ac.be).