EXL Recoil Detector
Experience With the CHICSi Detector

L. Westerberg
The Svedberg Laboratory, Uppsala University , Sweden

CHICSi detector system

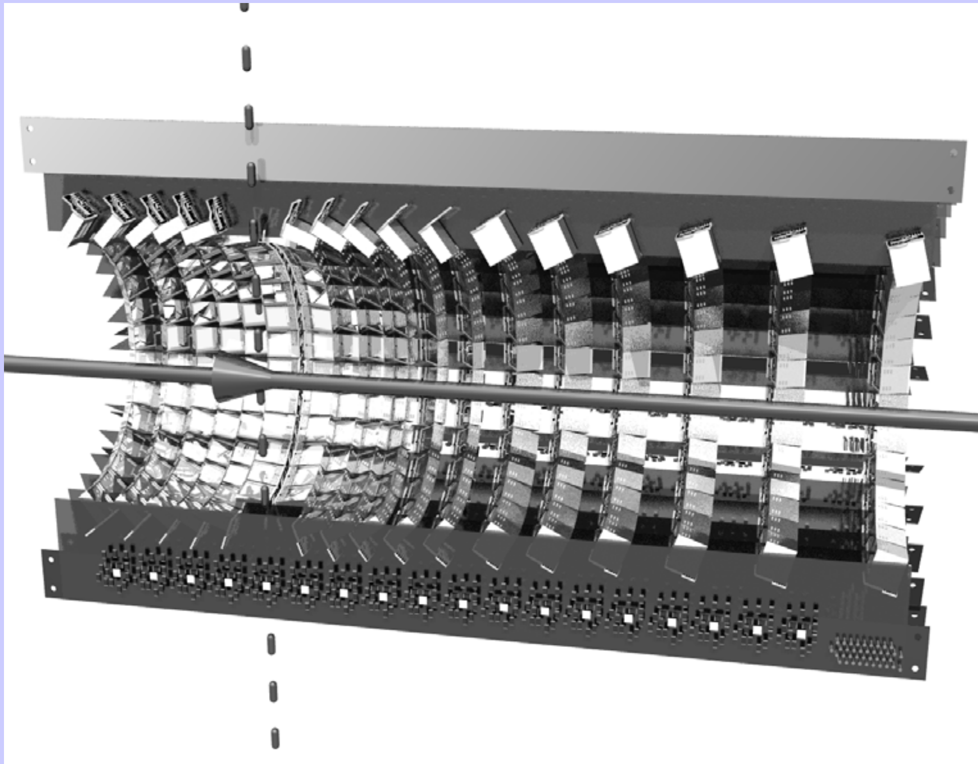
UHV compatibility studies

CHICSi auxiliary detectors

Possible CHICSi detector array for EXL

CHIC Collaboration

Lund, Uppsala
Copenhagen, Dubna
St. Petersburg, Cracow



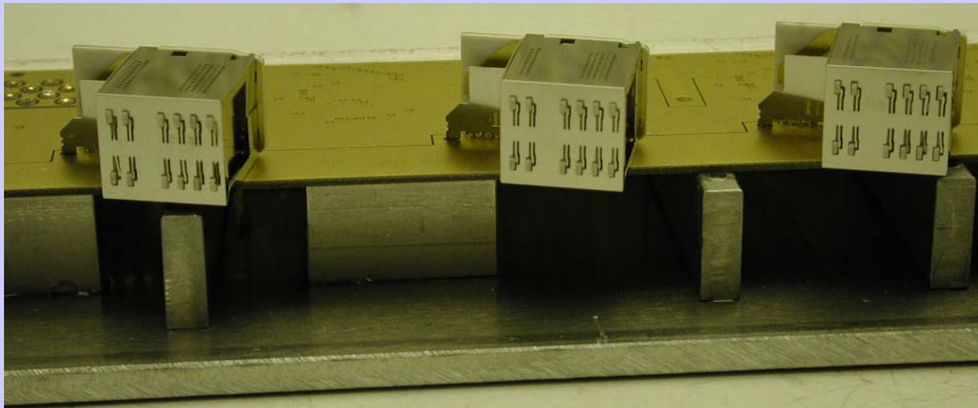
CHICSi: **C**ELSIUS **H**eavy **I**on **C**ollaboration **Si**licon Detector System

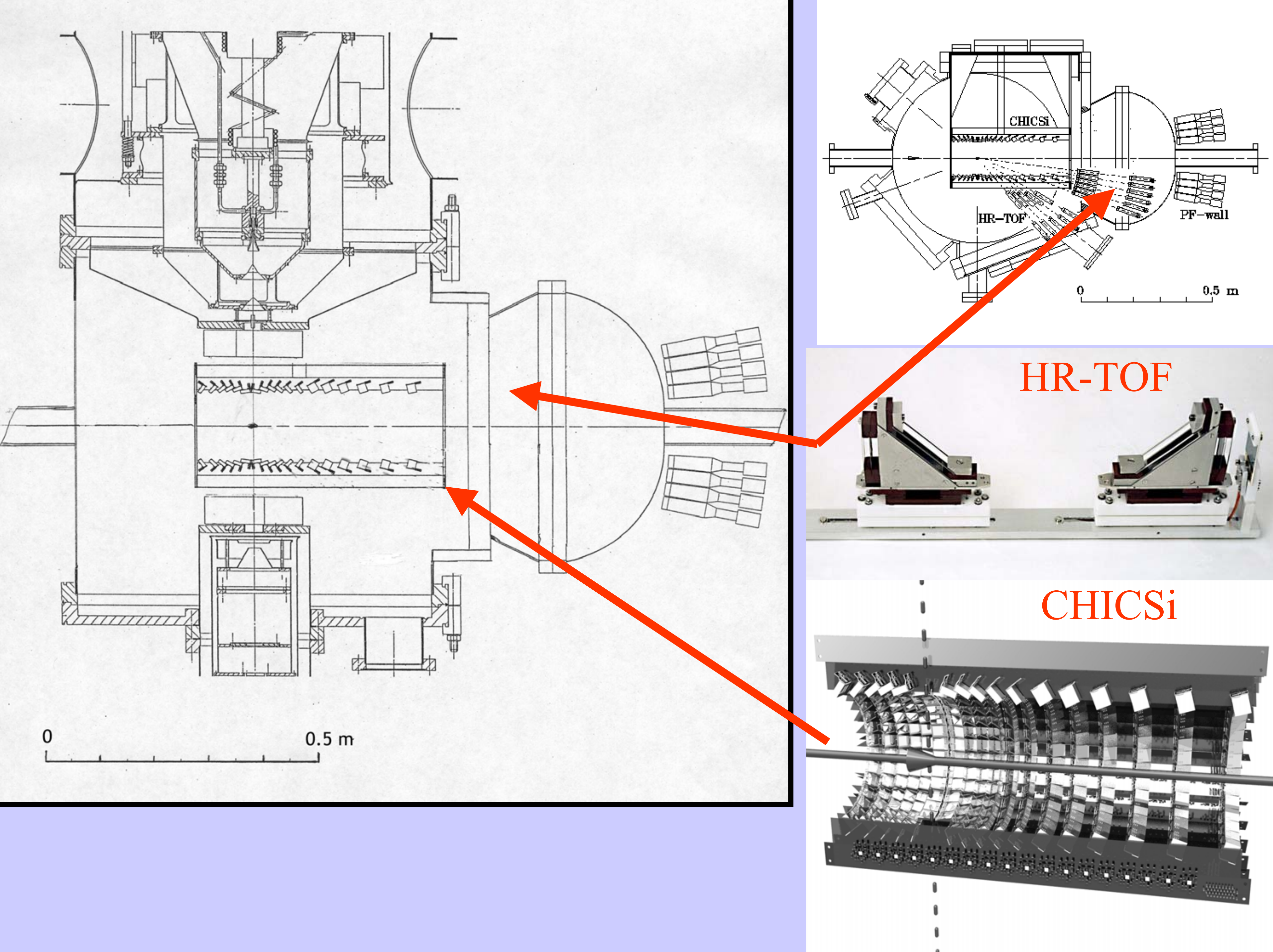
- A Compact Ultra-high Vacuum Compatible Detector System for Studies of Proton and Light Heavy-ion (N-Ar) Reactions on Cluster-jet Targets of Ar - Xe

- 504 1.0 Cm^2 Telescopes Si (10 μM) + Si (300 μM) + Si (300 μM Veto) or

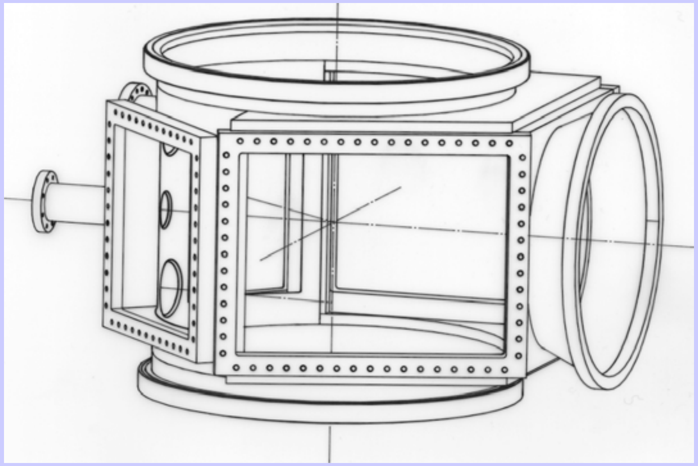
  6 Mm GSO Crystal + PhD

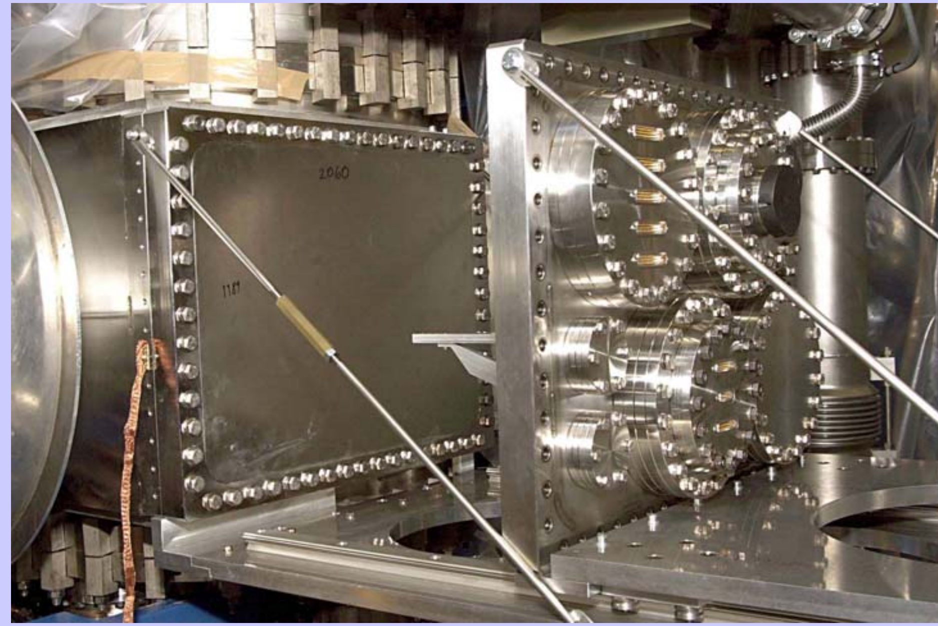
  -Identify Intermediate Mass Fragments **3 $\leq$ Z $\leq$ 10;** Threshold 700A keV




0
0.5 m
CHICSi
HR–TOF
PF–wall
0
0.5 m
HR-TOF
CHICSi

Scattering chamber

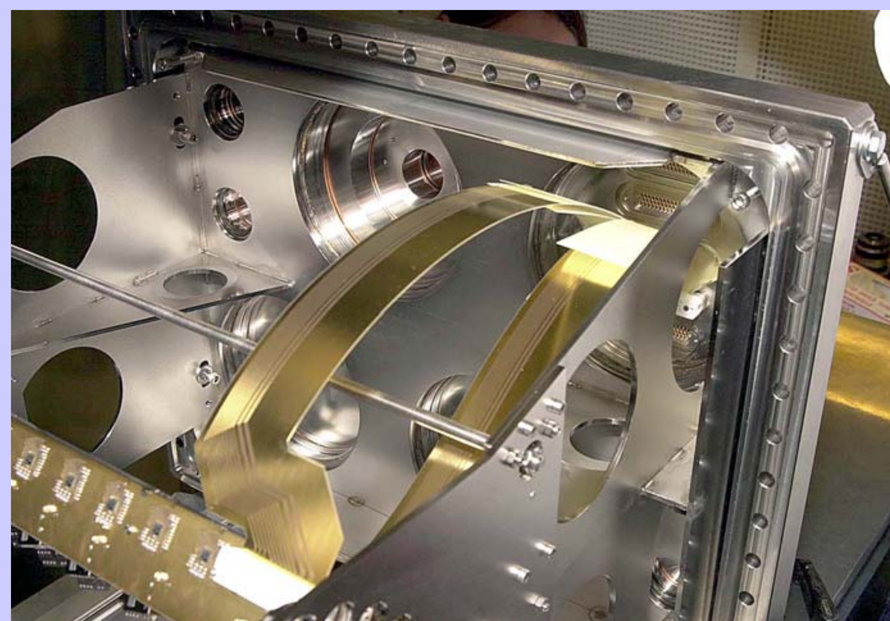




Readout cables

Kapton-insulated cables

Printed-circuit board cable



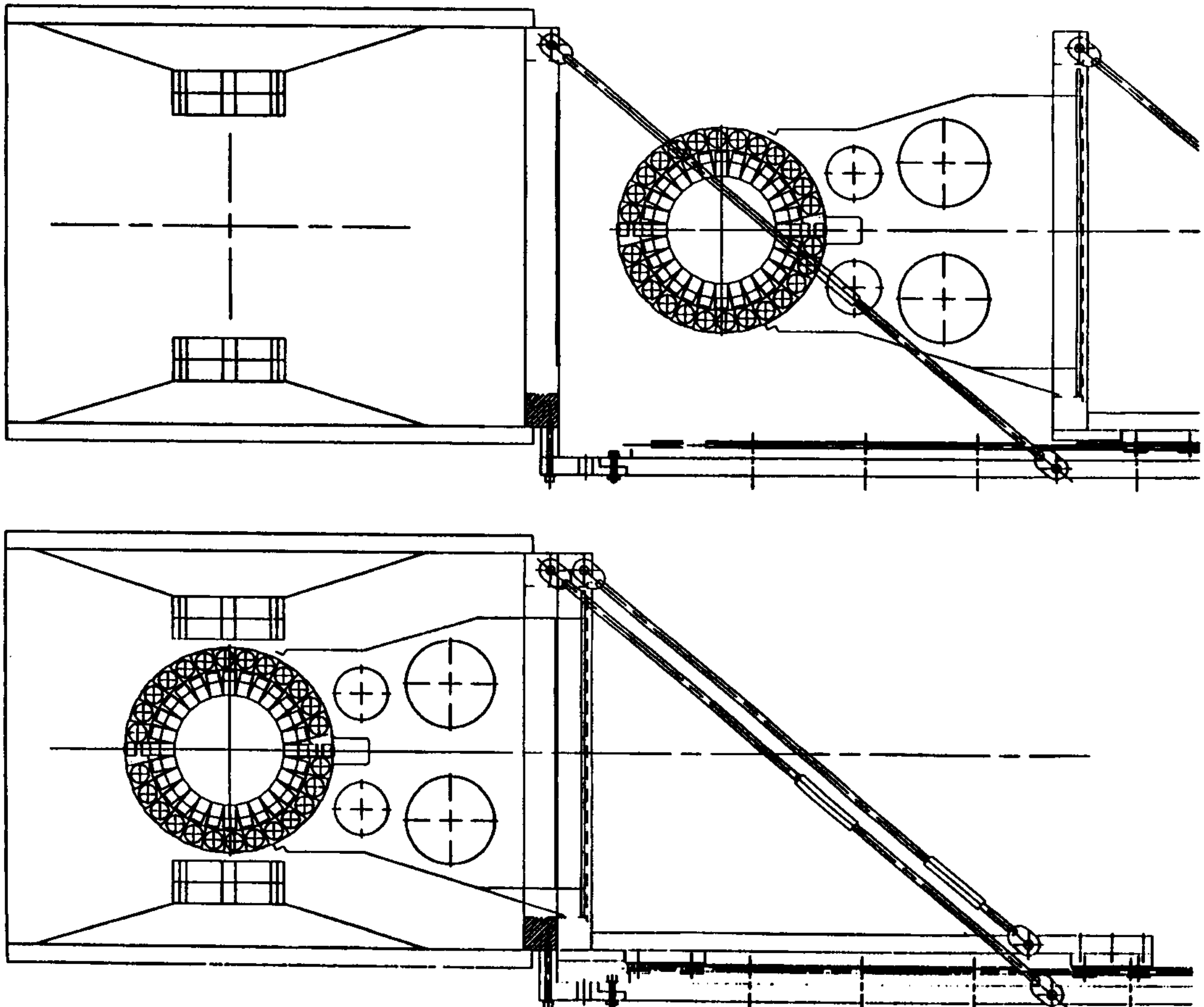


Fig. 5. A vertical plane cut of CHICSi and the scattering chamber. Upper: CHICSi located outside the chamber. Lower: CHICSi located in the chamber The total (internal) height of the chamber is 456 mm.

UHV compatible Materials needed

- New type of rectangular flanges for large ports
- Printed circuit boards for
  - detector mounts
  - VLSI readout
- Coaxial cables
- Flat cables
- Contacts for cables and printed circuit boards
- Conducting and insulating two-component glues

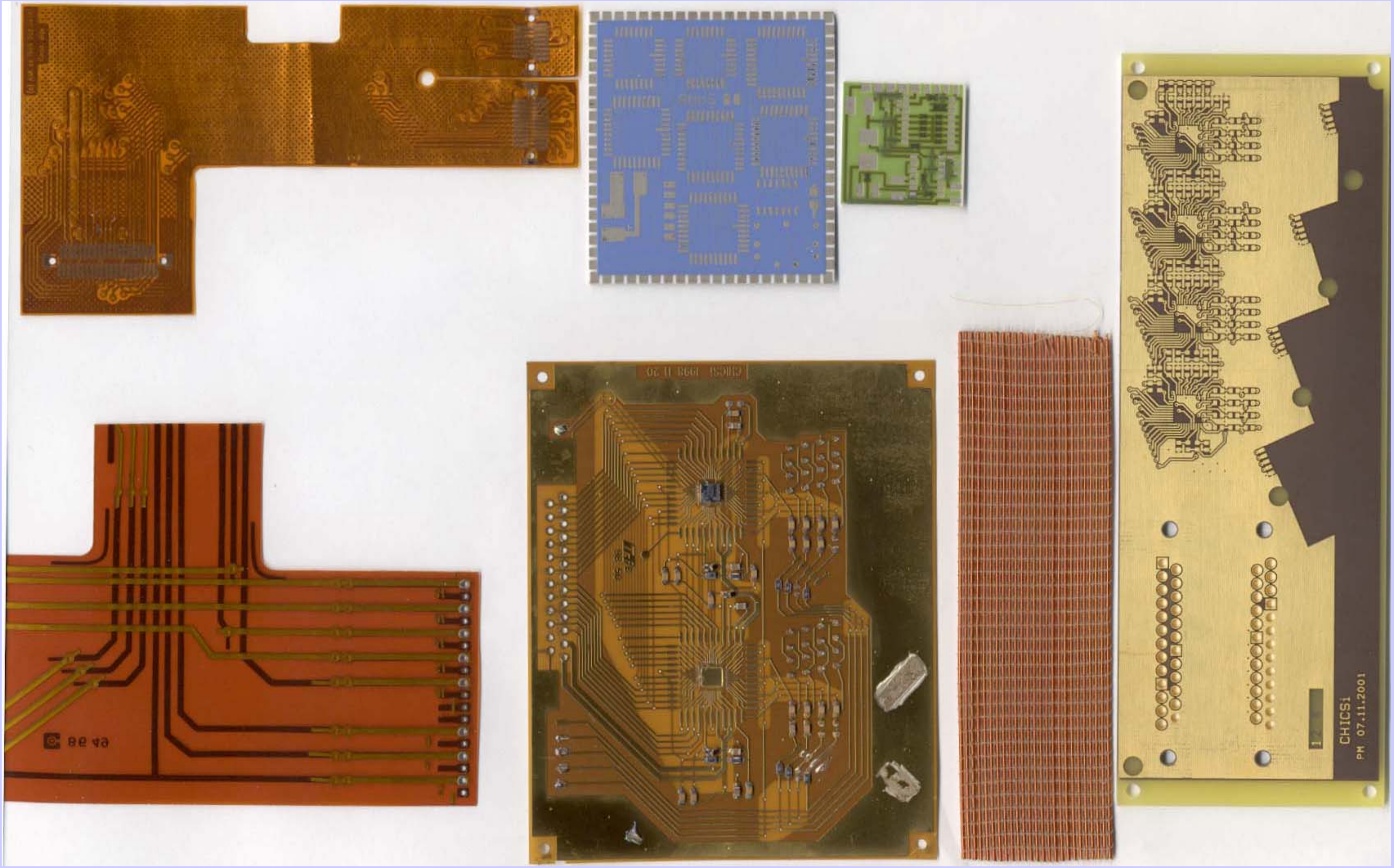
Insulators

Macor	Can break when machining Threads are fragile
Vespel	Varying outgassing Discharge can cause carbonizing
PEEK	High outgassing, H_2O
Photoveel	SiO2, Al_2O_3 ... Lower outgassing
M-soft Shapal	AlN Low outgassing, Expensive

Kapton

Ceramics

FR-4



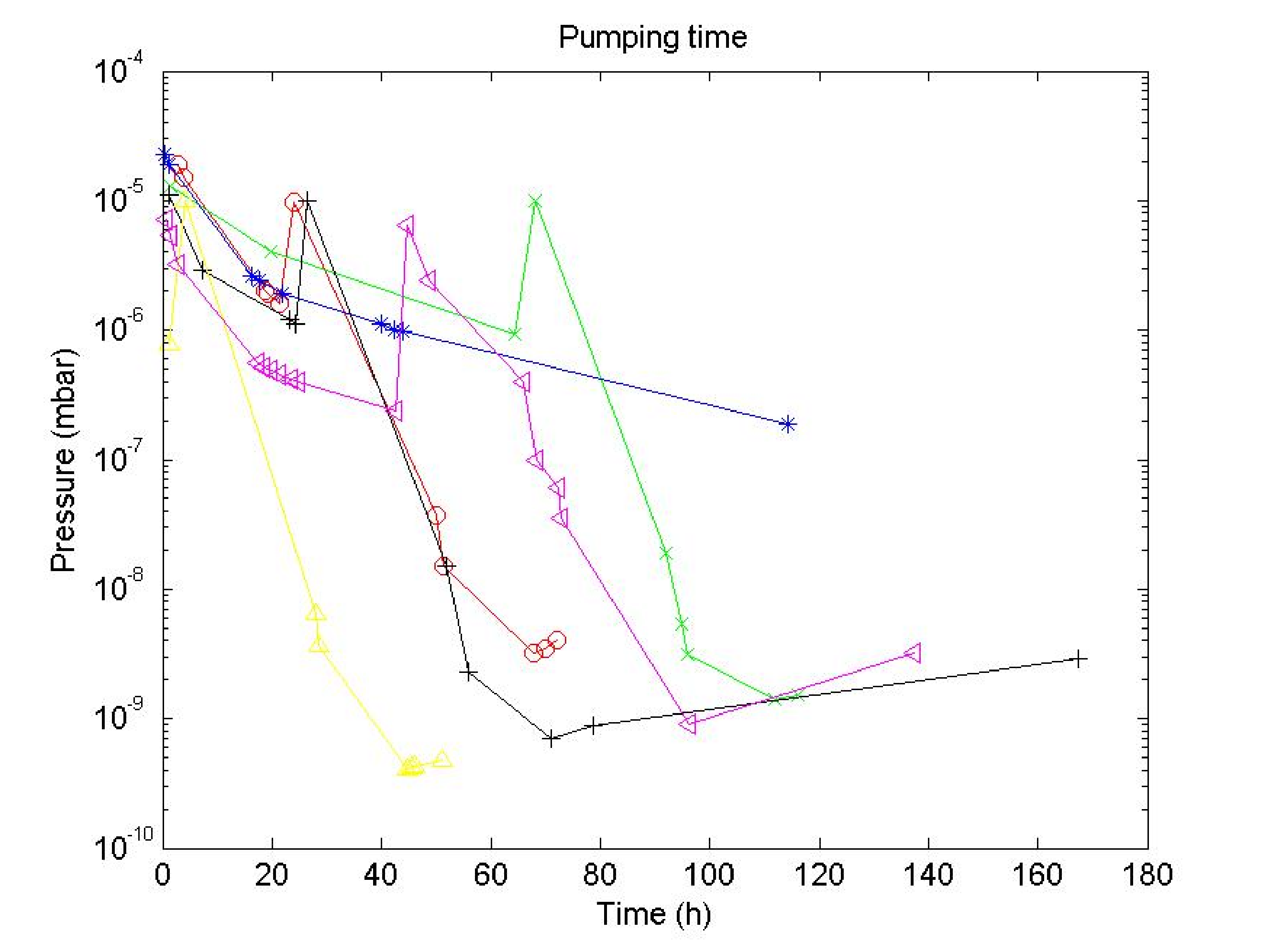
Outgassing measurements

Material	Area	Bake-out in air		Bake-out in vacuum		H_2	H_2O	CO	Total outgassing
	cm^2	Temp °C	Time h	Temp °C	Time h	W/m^2	W/m^2	W/m^2	rate W/m^2
PRINTED CIRCUIT BOARD MATERIALS									
Pyralux (2 layers)	19			150	20	$2\cdot10^{-5}$	$4\cdot10^{-7}$	$3\cdot10^{-6}$	$3\cdot10^{-5}$
AP (2 layers)	98			150	20	$2\cdot10^{-7}$	$4\cdot10^{-8}$	$3\cdot10^{-7}$	$1\cdot10^{-6}$
Epoxy-Acrylic (2 layers)	30			150	20	$1\cdot10^{-7}$	$3\cdot10^{-7}$	$3\cdot10^{-7}$	$3\cdot10^{-6}$
Epoxy-Glass fibre, 1 layer	36			150	20	$4\cdot10^{-7}$	$4\cdot10^{-8}$	$4\cdot10^{-8}$	$2\cdot10^{-6}$
Alumina (14 layer electrical print)	32			150	20				$3\cdot10^{-7}$
Glass reinforced Kapton™	74			150	24				$2\cdot10^{-8}$
FR4	475			150	30				$1.5\cdot10^{-8}$
FR4	331	150	24						$6\cdot10^{-7}$
FR4	331	150	24	150	23	$2\cdot10^{-10}$			$6\cdot10^{-8}$
FR4	331	150	24	150	77				$4\cdot10^{-9}$
FR4 – 6 layers	120			150	30	$<1\cdot10^{-7}$			$5\cdot10^{-7}$
INSULATORS									
PEEK				150	20	$1.4\cdot10^{-6}$	$8\cdot10^{-7}$	$5\cdot10^{-7}$	$3\cdot10^{-6}$
Photoveel	44			150	20	$1.6\cdot10^{-7}$	$1.0\cdot10^{-8}$	$3\cdot10^{-8}$	$2\cdot10^{-7}$
M-soft shapal	44			150	20	$1.4\cdot10^{-8}$	$1.0\cdot10^{-9}$	$4\cdot10^{-9}$	$1\cdot10^{-7}$
Macor™	75			200	26				$4\cdot10^{-8}$
Macor™, 30 min air expos	75								$2\cdot10^{-6}$

Outgassing measurements Epoxies (EPO-TEK)

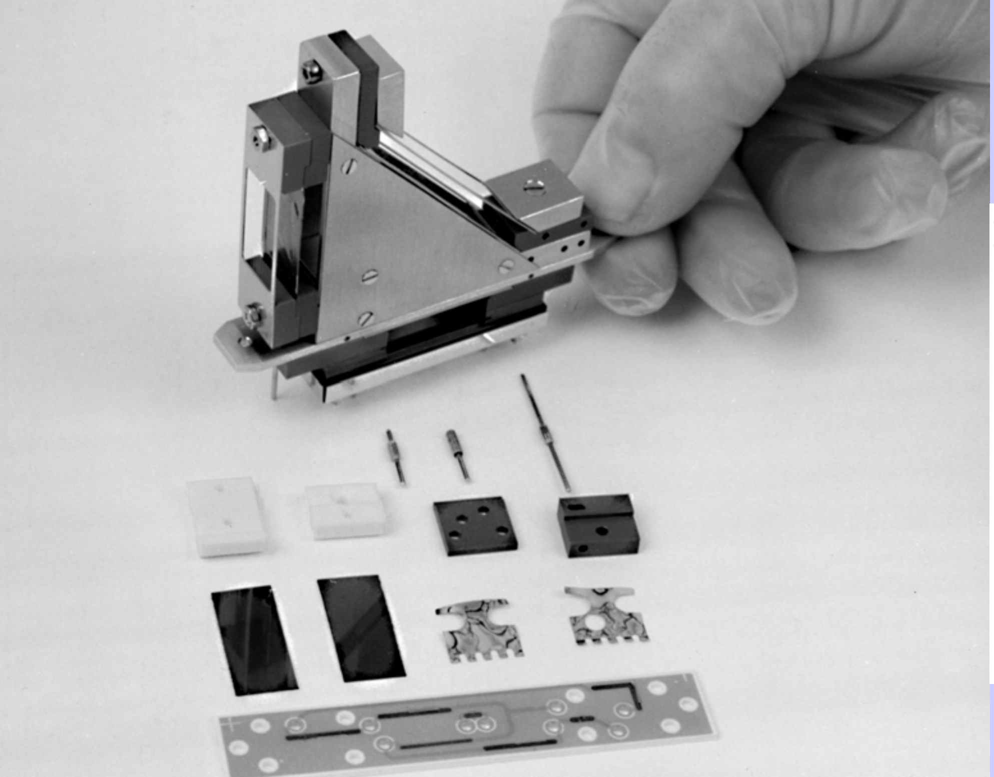
Type	Weight	Bake-out in air		Bake-out in vacuum		H_2	H_2O	CO	CO_2	CH_4	Total outgassing rate (W/g)
	(g)	Temp (ºC)	Time (h)	Temp (ºC)	Time (h)	(W/g)	(W/g)	(W/g)	(W/g)	(W/g)	
377	1.15	90	1.5								$1.4 \cdot 10^{-7}$
377	1.15	90	1.5	150	24	$1.3 \cdot 10^{-10}$	$1.8 \cdot 10^{-11}$	$2.0 \cdot 10^{-11}$	$4 \cdot 10^{-12}$	$6 \cdot 10^{-12}$	$4 \cdot 10^{-10}$
H20E	2.16	90	1.5			$4 \cdot 10^{-8}$	$1.6 \cdot 10^{-8}$	$6 \cdot 10^{-9}$	$8 \cdot 10^{-10}$		$6 \cdot 10^{-8}$
H20E	2.16	90	1.5	150	24	$4 \cdot 10^{-11}$	$1.2 \cdot 10^{-10}$	$3 \cdot 10^{-11}$	$2 \cdot 10^{-11}$	$1.4 \cdot 10^{-11}$	$7 \cdot 10^{-10}$
H27D	3.90	90	1.5								$1.1 \cdot 10^{-7}$
H27D	3.90	90	1.5	150	24						$3 \cdot 10^{-8}$

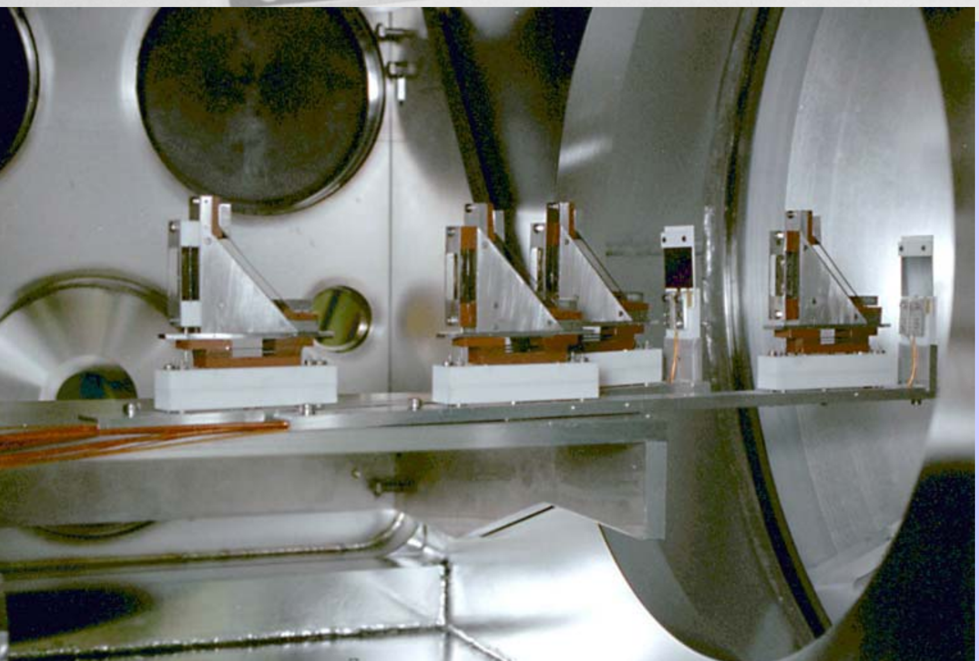
Outgassing from cables

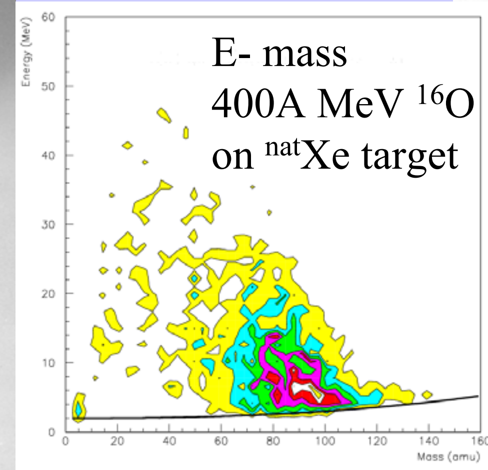


Red o AMGAB cable
Green x KAP2
Blue * KAP2 airbaked inst. after 48h delay
Black + KAP3
Yellow ^ Empty
Magenta< KAP2 airbaked inst. in chamber directly

HR-TOF time detector







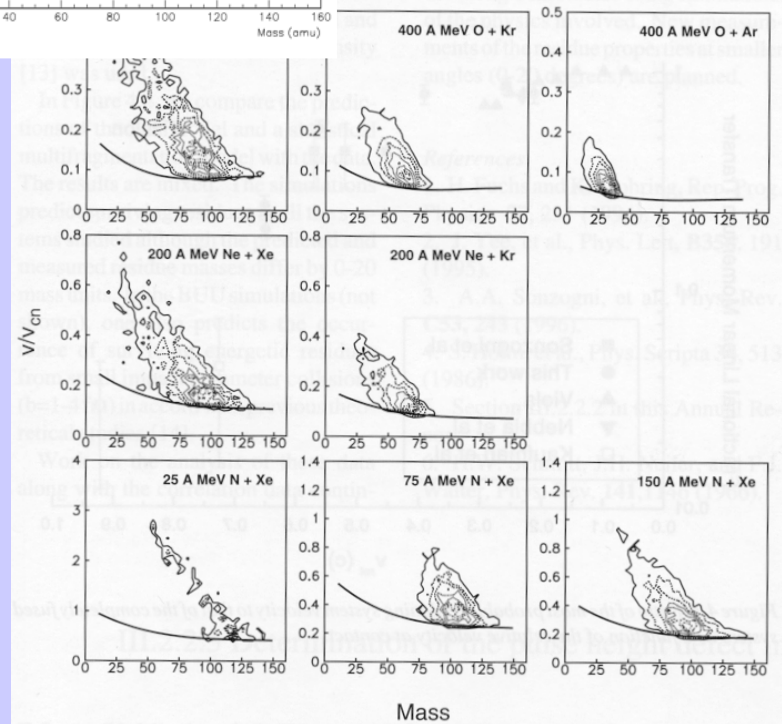


Figure 4.1. Dependence of the measured residue mass on the fragment velocity, expressed as a fraction of the compound nuclear velocity for the systems studied in this work

PF-WALL

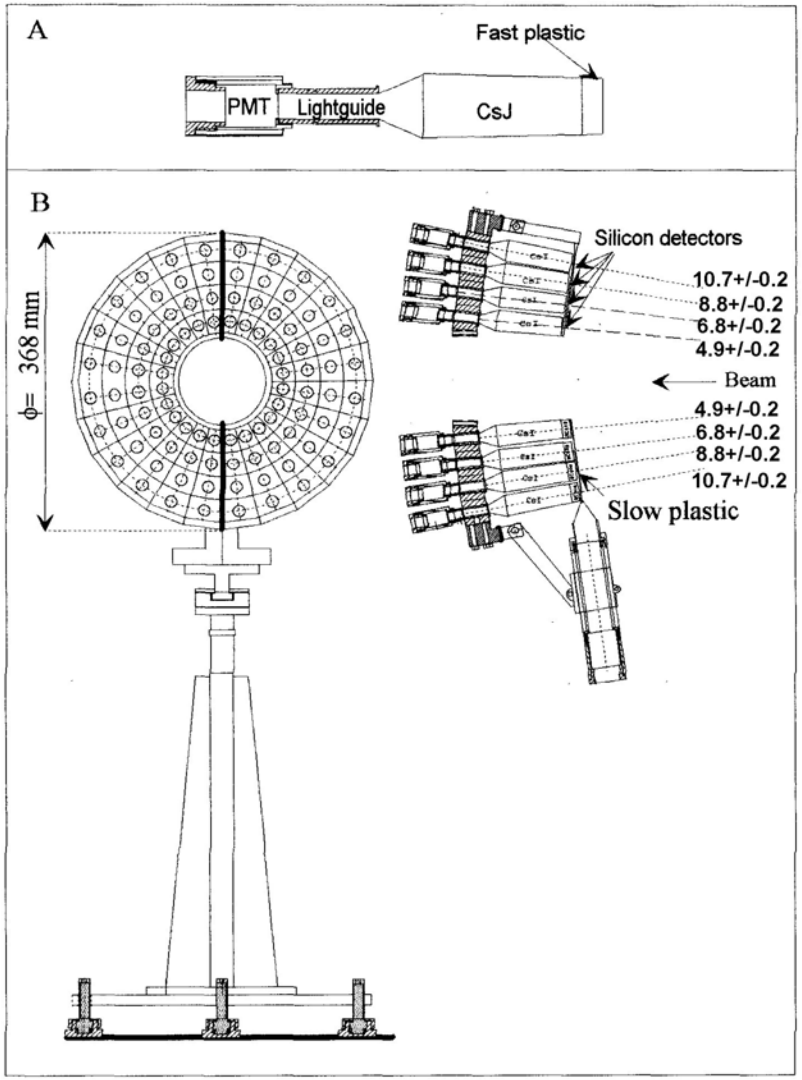
Projectile **F**ragmentation

WALL

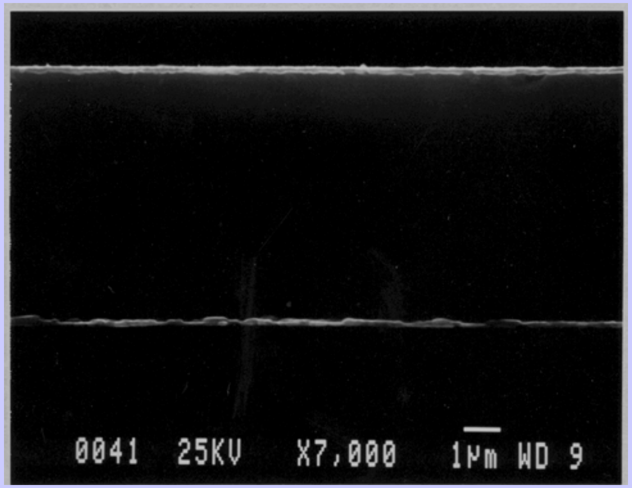
3.9 ° – 11-7 °

Z identification: **Z ≤ 18,**

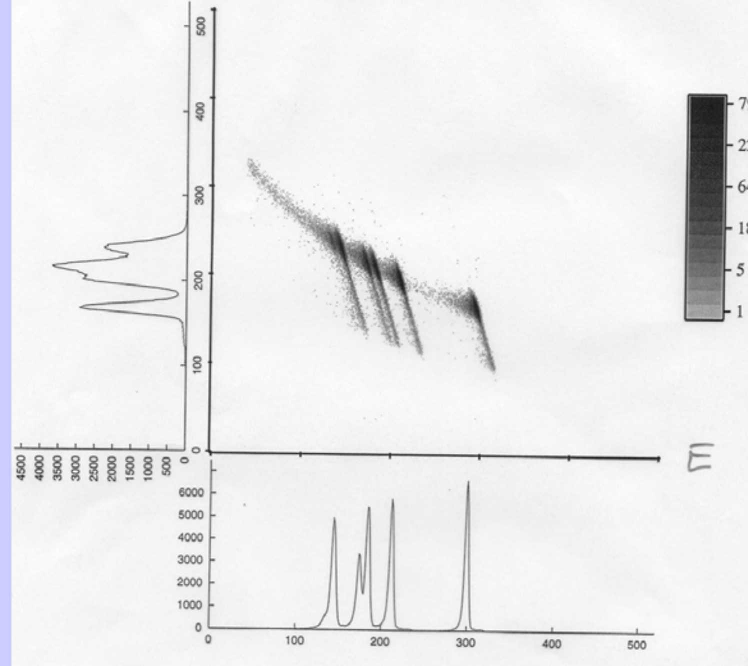
Mass identification: **H - He**



Integrated ΔE-E detector



ΔE



J.F. van der Veen / Ion beam crystallography

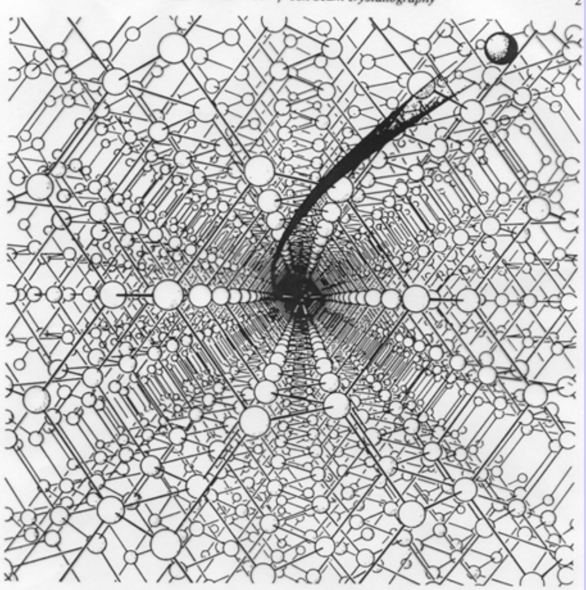
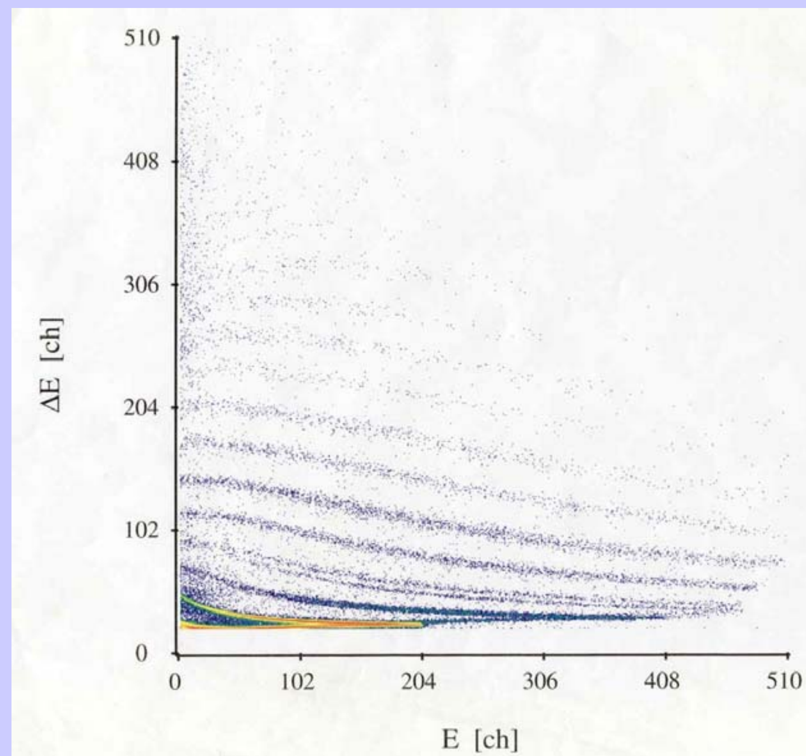


Fig. 9. Channeling of a particle in a crystal. From "Channeling in Crystals", by W. Brandt, Copyright © (March, 1968) by Scientific American, Inc., all rights reserved.

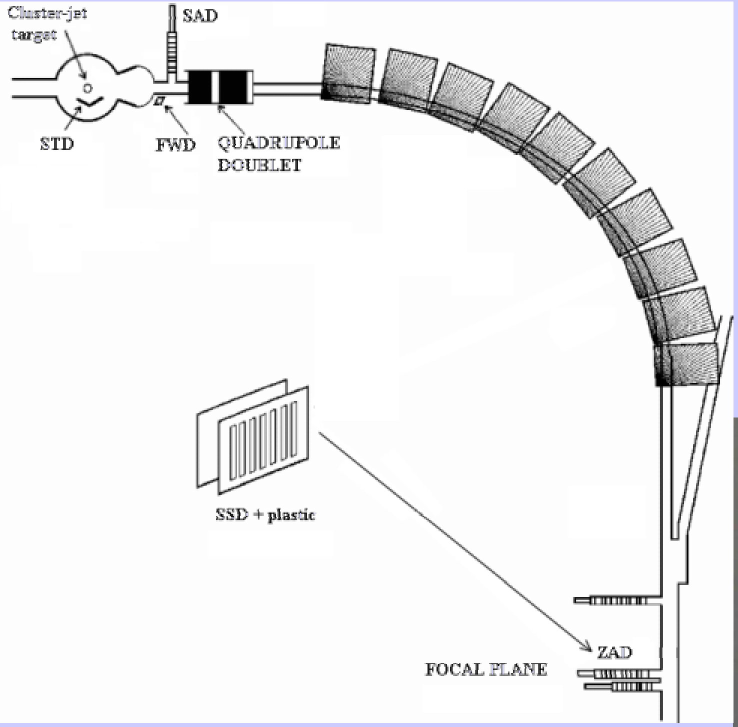


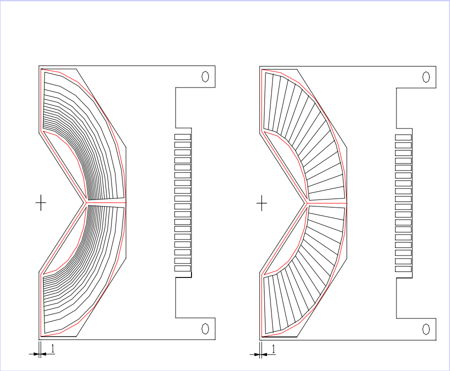
Small Angle Detector (SAD)

Study of Silicon SEU-hazardous recoils at CELSIUS

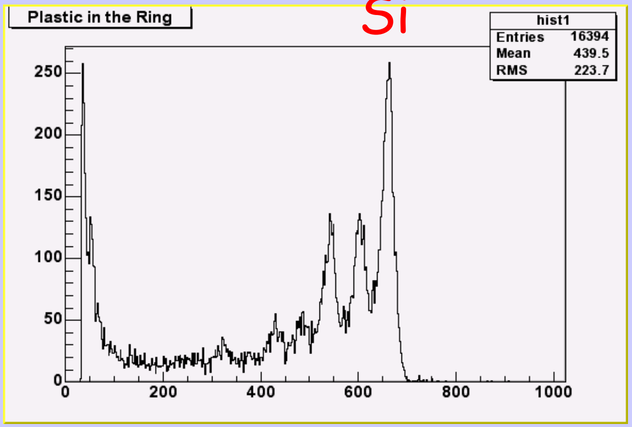
At 2300 cm distance from the H jet: 0.6^0-1.12^0

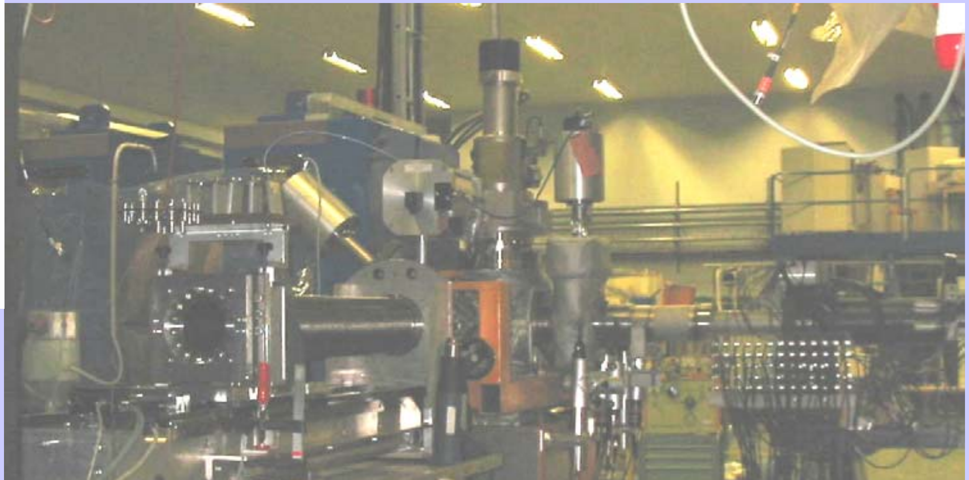
SAD core element : custom-made 300 um Silicon Strip Detetector





0,57°





CHICSi experiments

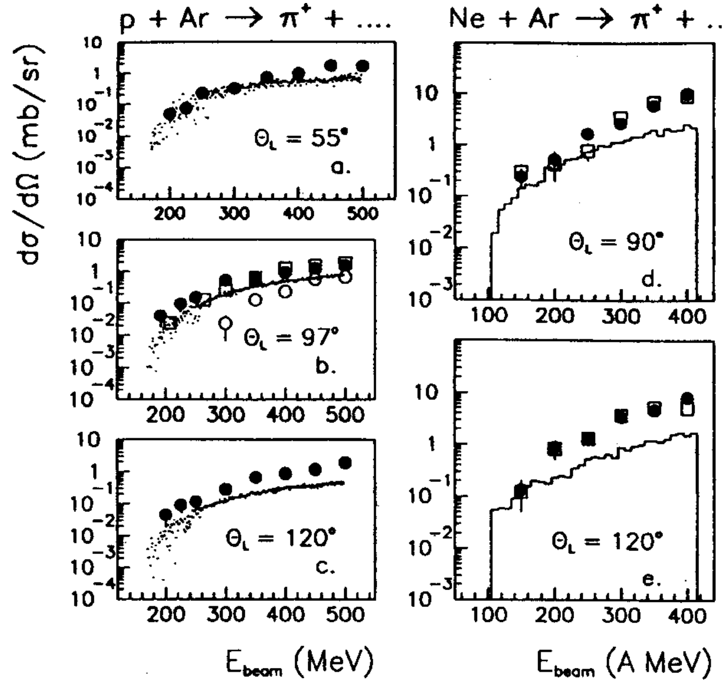
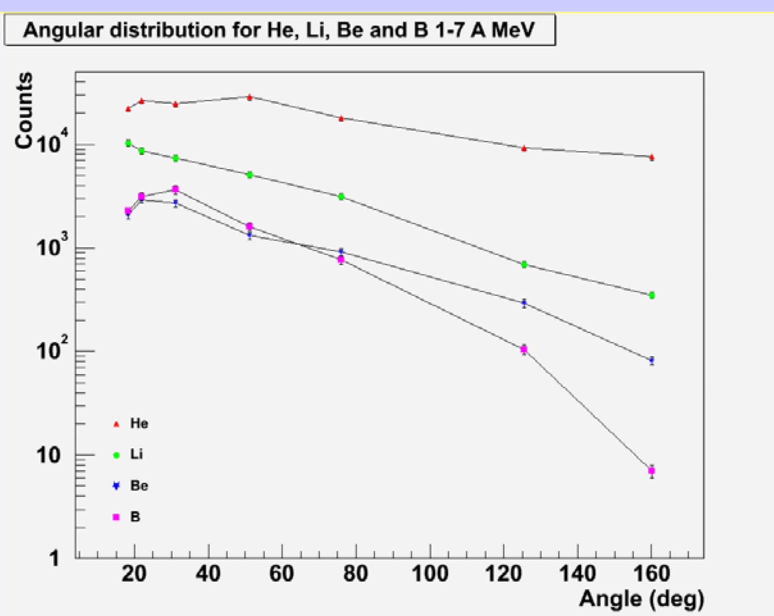


FIG. 2. Differential π^+ cross sections in p + Ar collisions at three angles (55°, 97°, 120°), and in Ne + Ar collisions at two angles (90°, 120°). The points represent BUU calculations



Pion production

Slow ramping experiments

Isotope ratios

Isobar ratios

Ne+Ar 2003-2004

p + Ar, Kr, Xe Autumn 2004

Ne + Ar, Kr, Xe Spring 2005

Xe + Xe at ESR 2006?

Charge distribution of low energy fragments from the ^{20}Ne + ^{40}Ar reaction at 200A MeV. CHICSi data (Oct. 2003)

CHICSi and EXL

Arrange 8 – 12 GMB's in the angular region 20˚ - 90˚

each with (8 – 12) telescopes,

mounted as a semi-cylinder of radius ~30 cm.

In this way installation can be performed in the same way as CHICSi at CELSIUS with all equipment on one flange.

Instead of using only two 300 μm Si detectors, as suggested for EXL transfer reactions, we suggest to introduce (at least in one part of the array) 15 μm + 300 μm Si + 6000 μm GSO/PD detectors stopping protons from 1 to 60 MeV.

This is a reasonable choice for interferometry and could possibly be used for other EXL (elastic?) reactions.


The Svedberg-laboratoriet
Entré