Isothermal VAcuum Chromatography (IVAC) @TASCA

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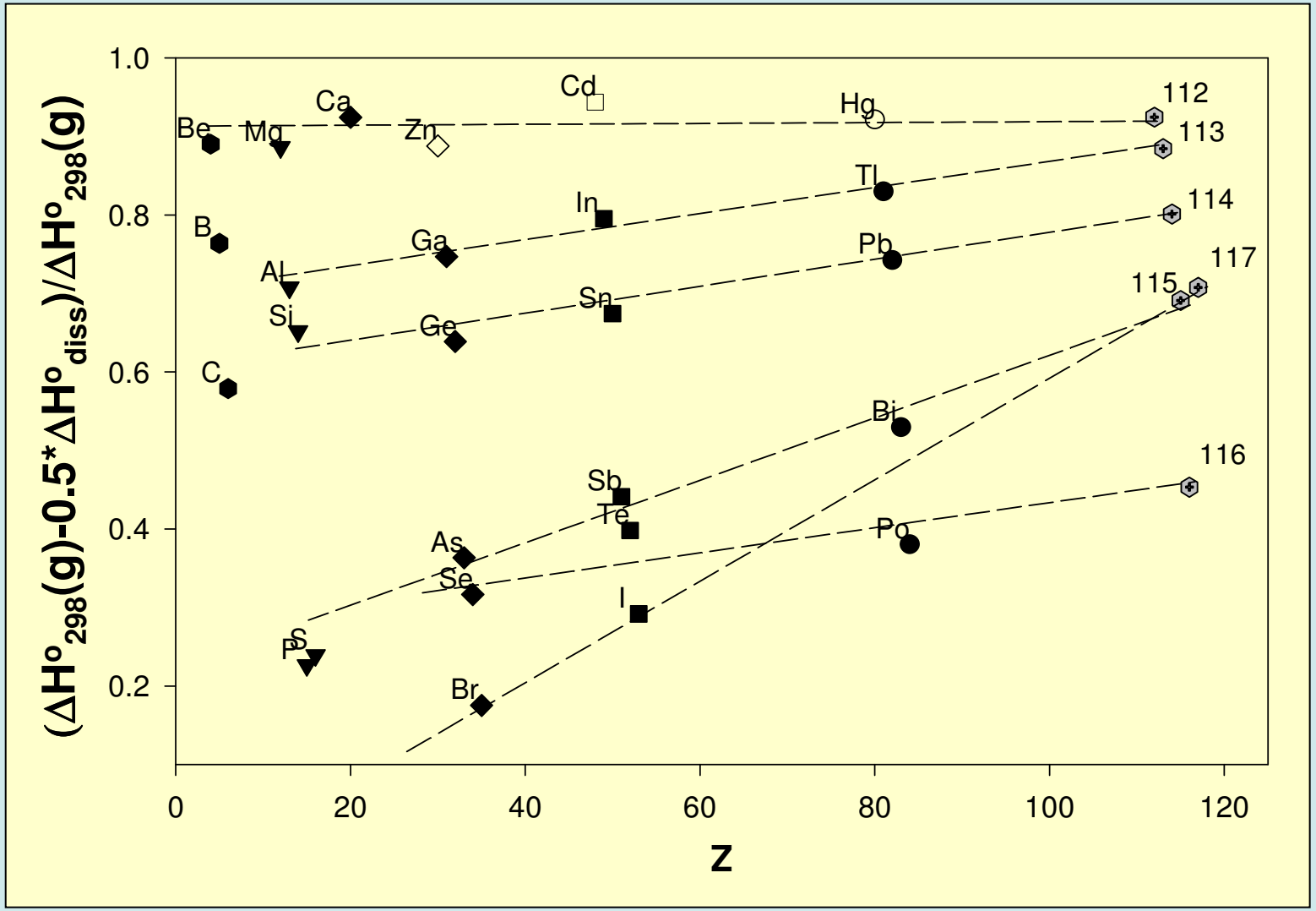
for the PSI/University Bern Heavy Elements group

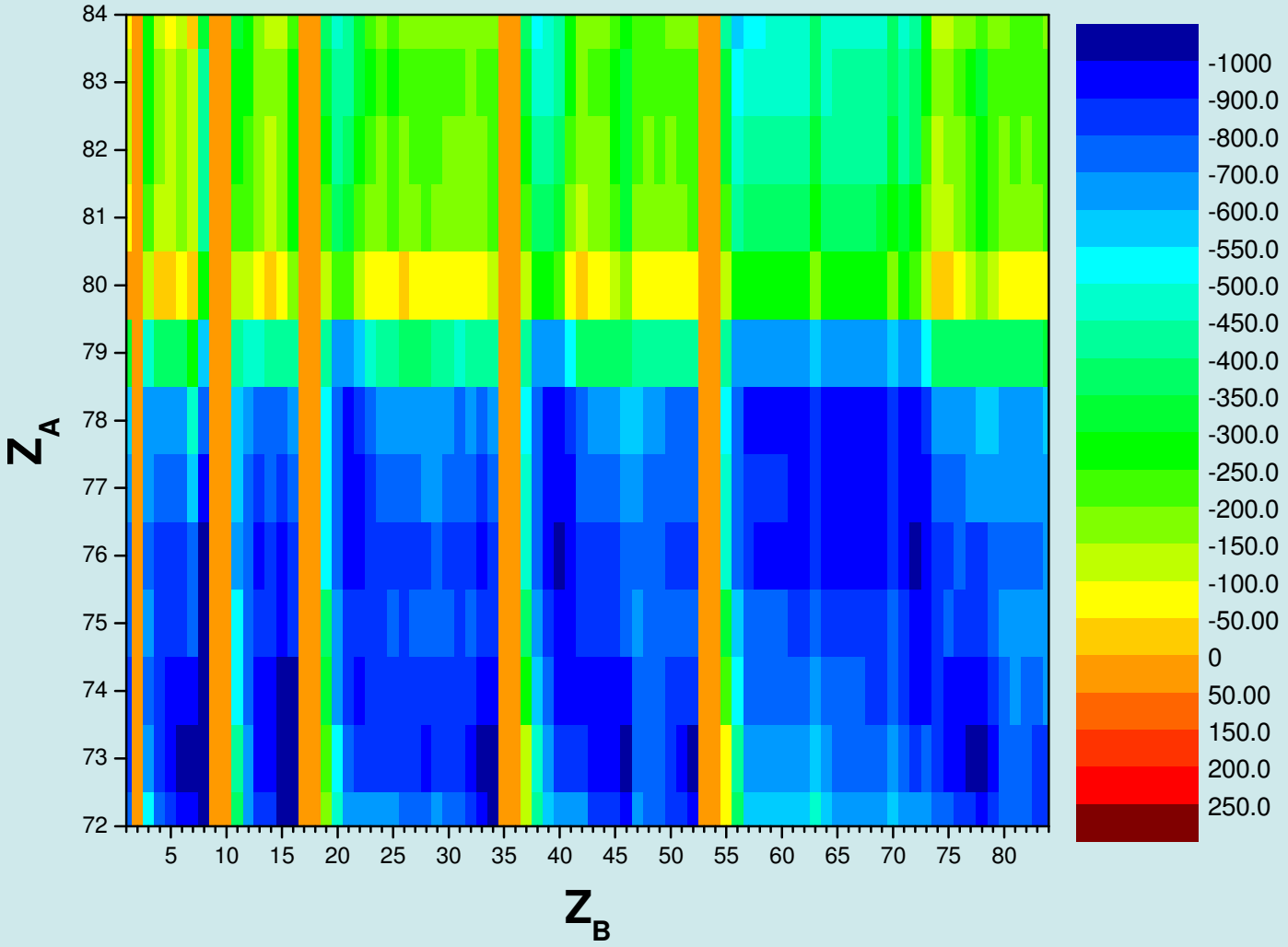
Why Vacuum?



dimer formation (non metals) ←→ lattice formation (metals)

Why Vacuum?

Eichler-Miedema ΔH_{ads}(A in surface of B), kJ/mol



R.Eichler, TASCA Workshop Davos Sept. 28, 2007

Advantages of Vacuum

* Fast chromatographic process
* Clean surfaces
* Stable surfaces also for more reactive metals
* Stable elemental state for TA
* No co-adsorption phenomena
* (Good spectroscopic resolution)

Problem

Heavy Ion induced Nuclear Fusion Reaction

Recoiling Products with momentum of the beam: ->~30-50 MeV

Thermalization ???

Catcher Materials (Diffusion/Release)

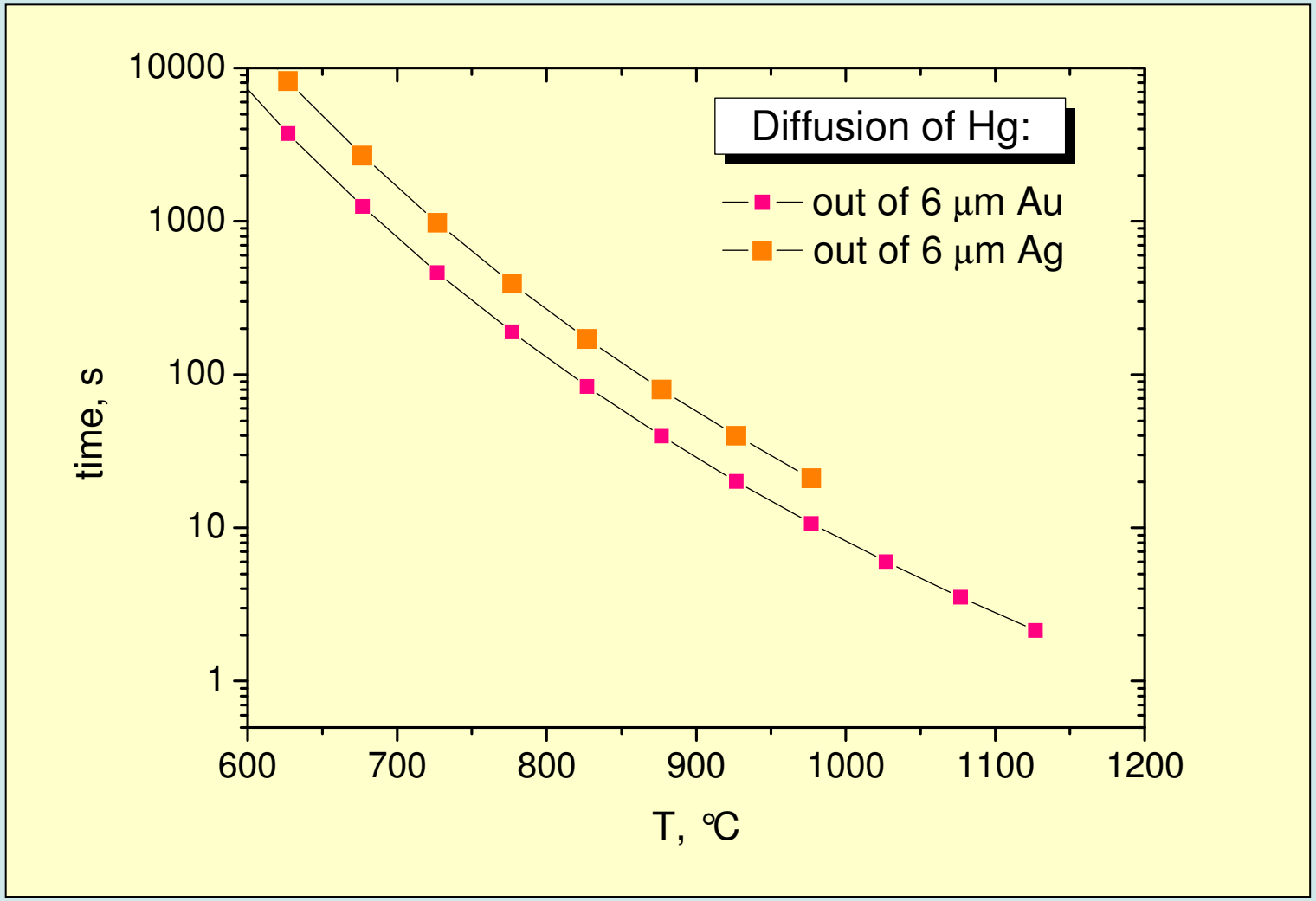
or

Gas jet (Impaction → Desorption)

Vacuum Chromatography

Impaction and Release

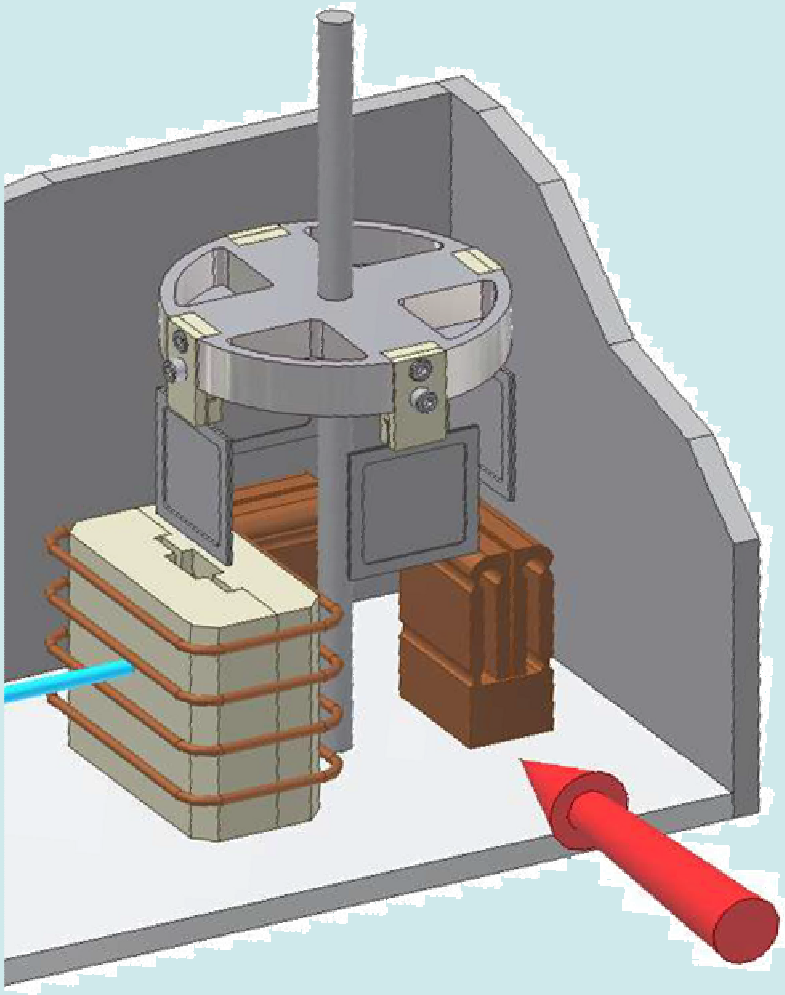
Release Kinetics



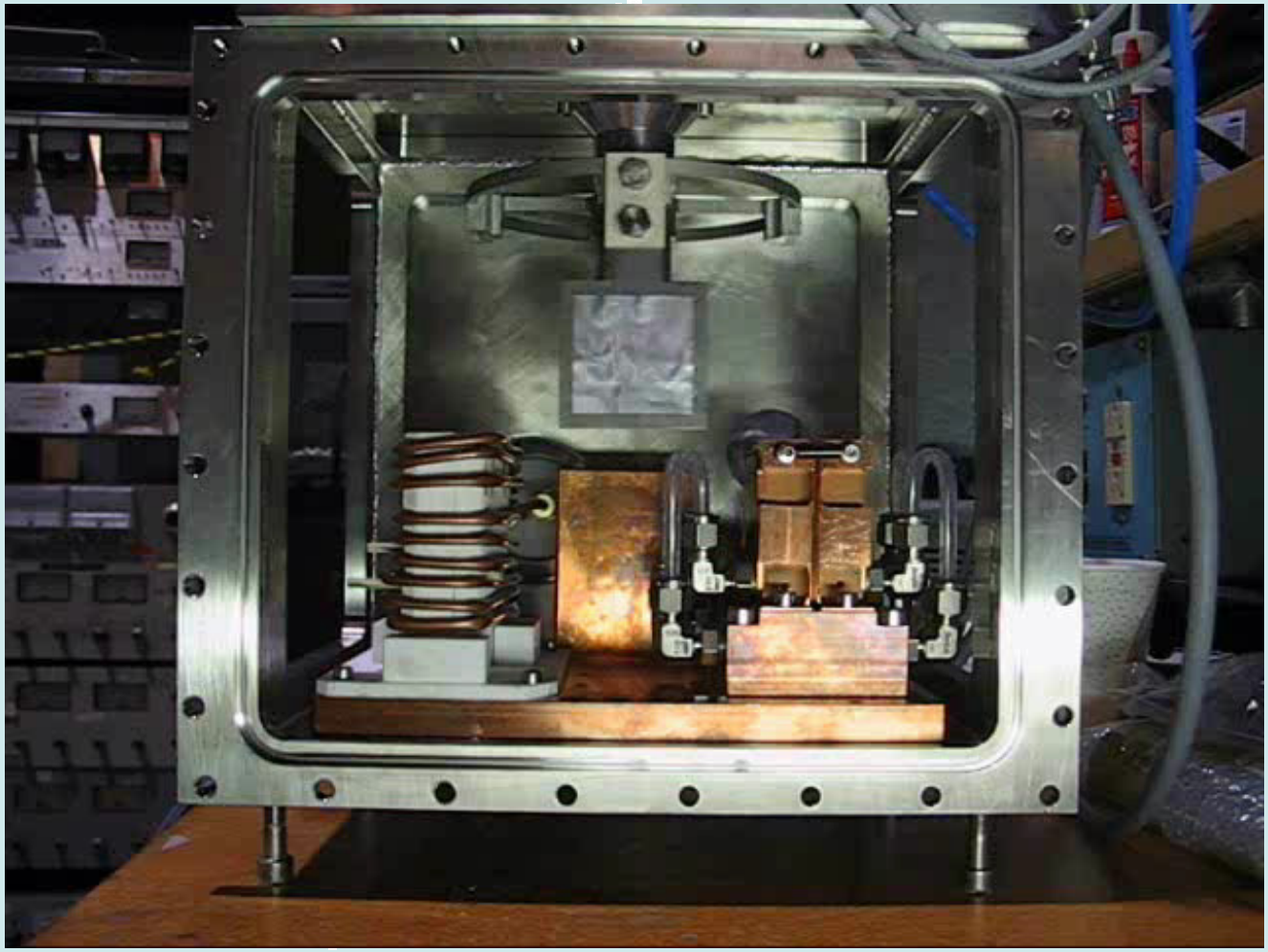
J. Askill, Tracer Diffusion, Plen. Press, IFI 1970

R.Eichler, TASCA Workshop Davos Sept. 28, 2007

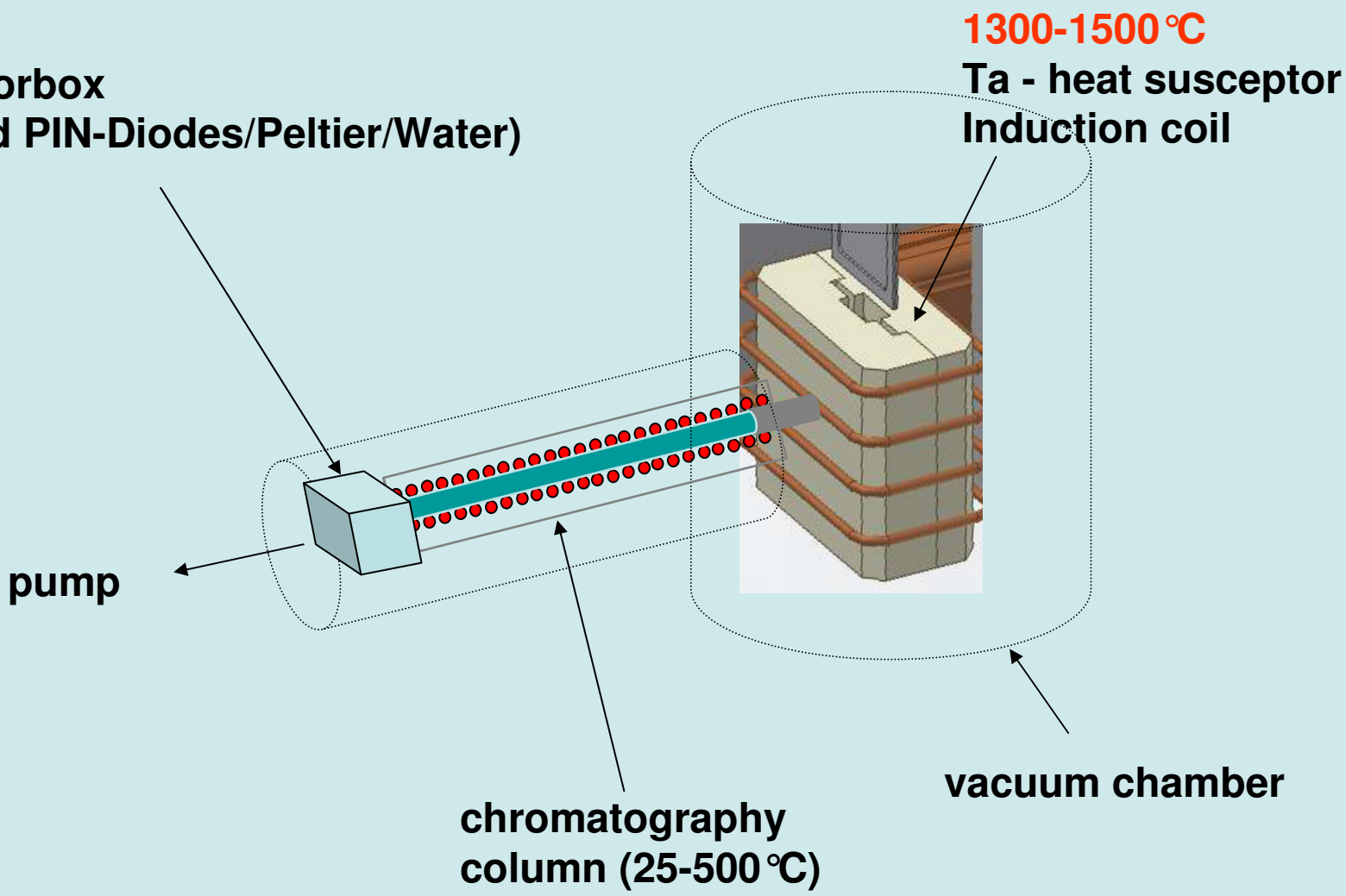
CRATE @ BGS



CRATE @ BGS

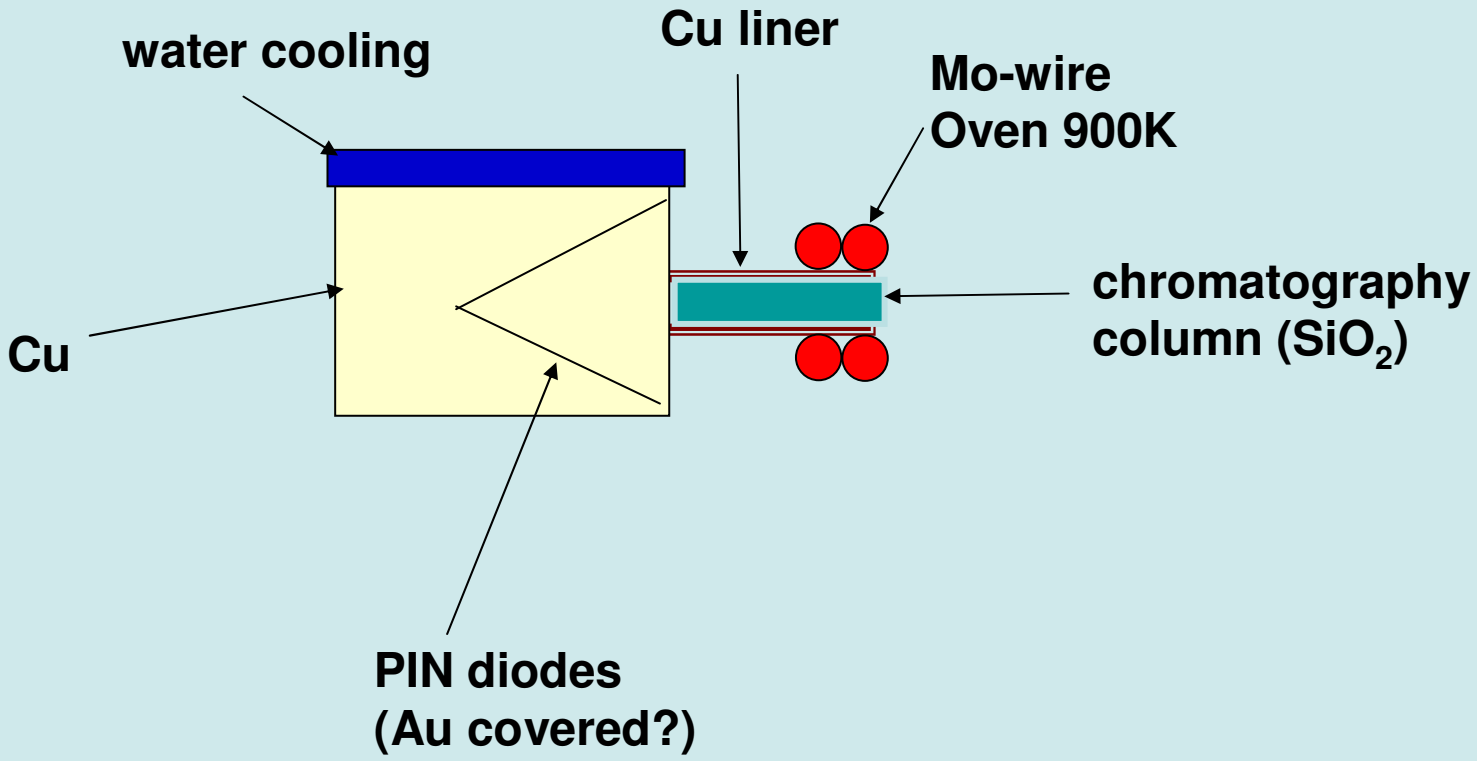


IVAC Schematic



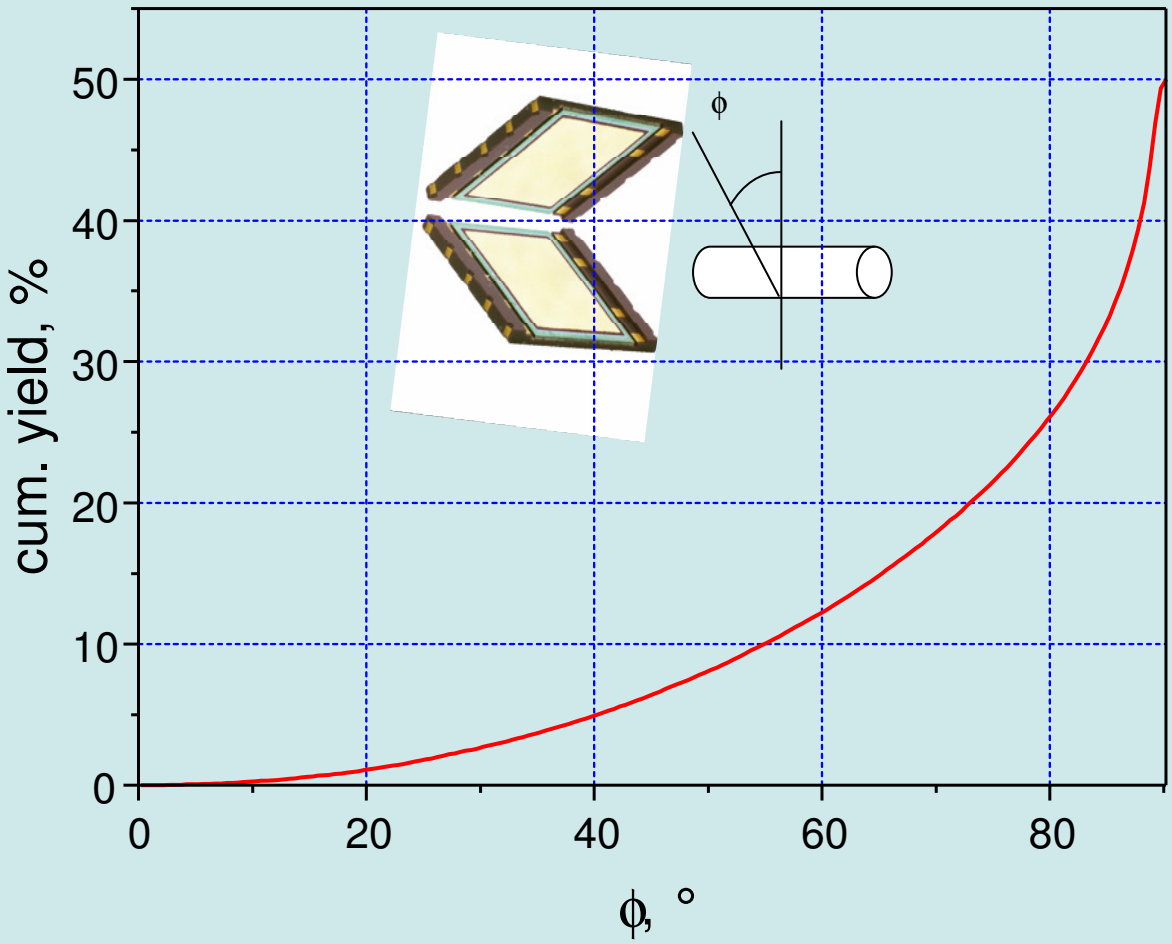
IVAC Schematic

Detector box scheme

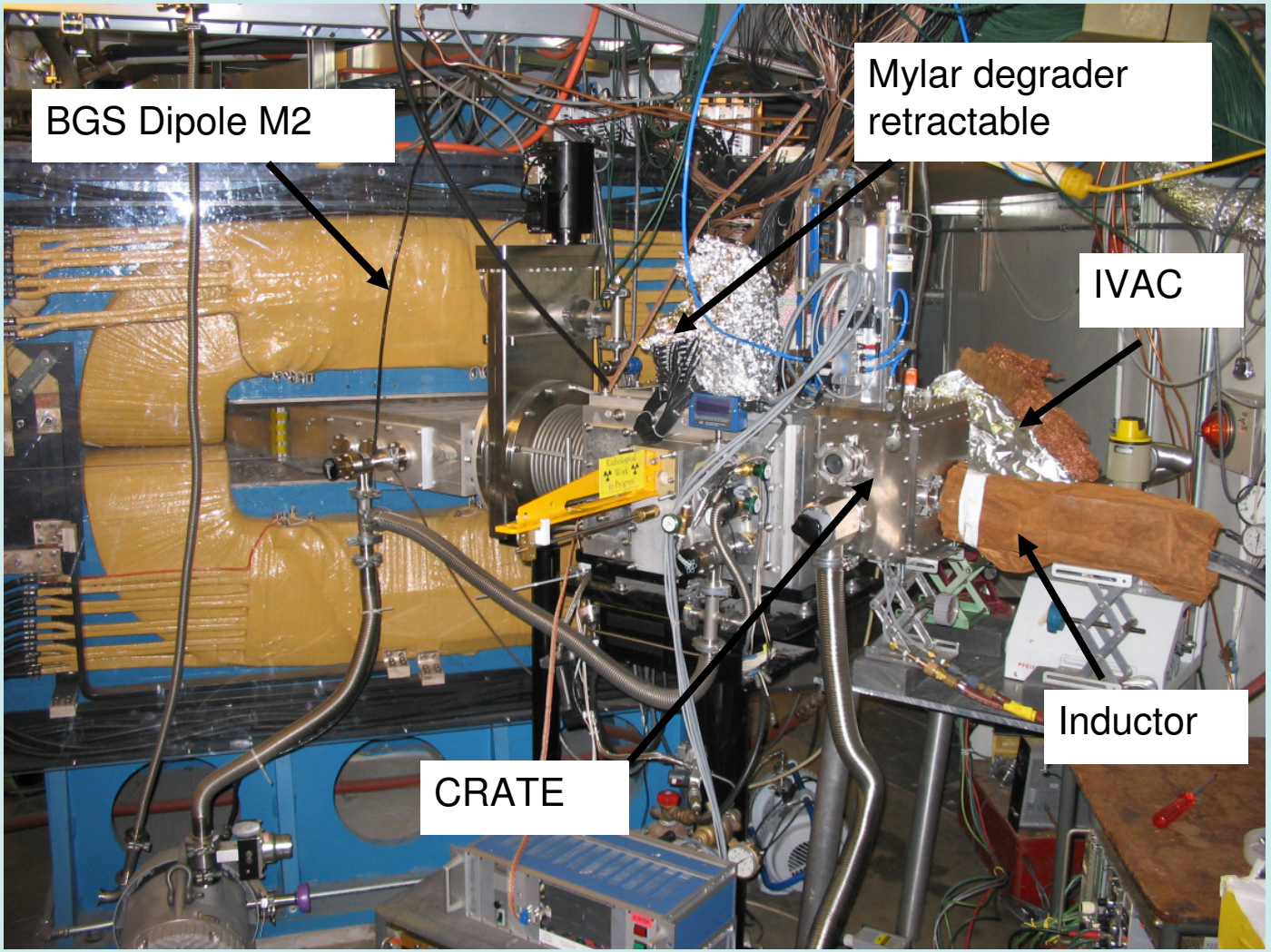


IVAC Set-Up

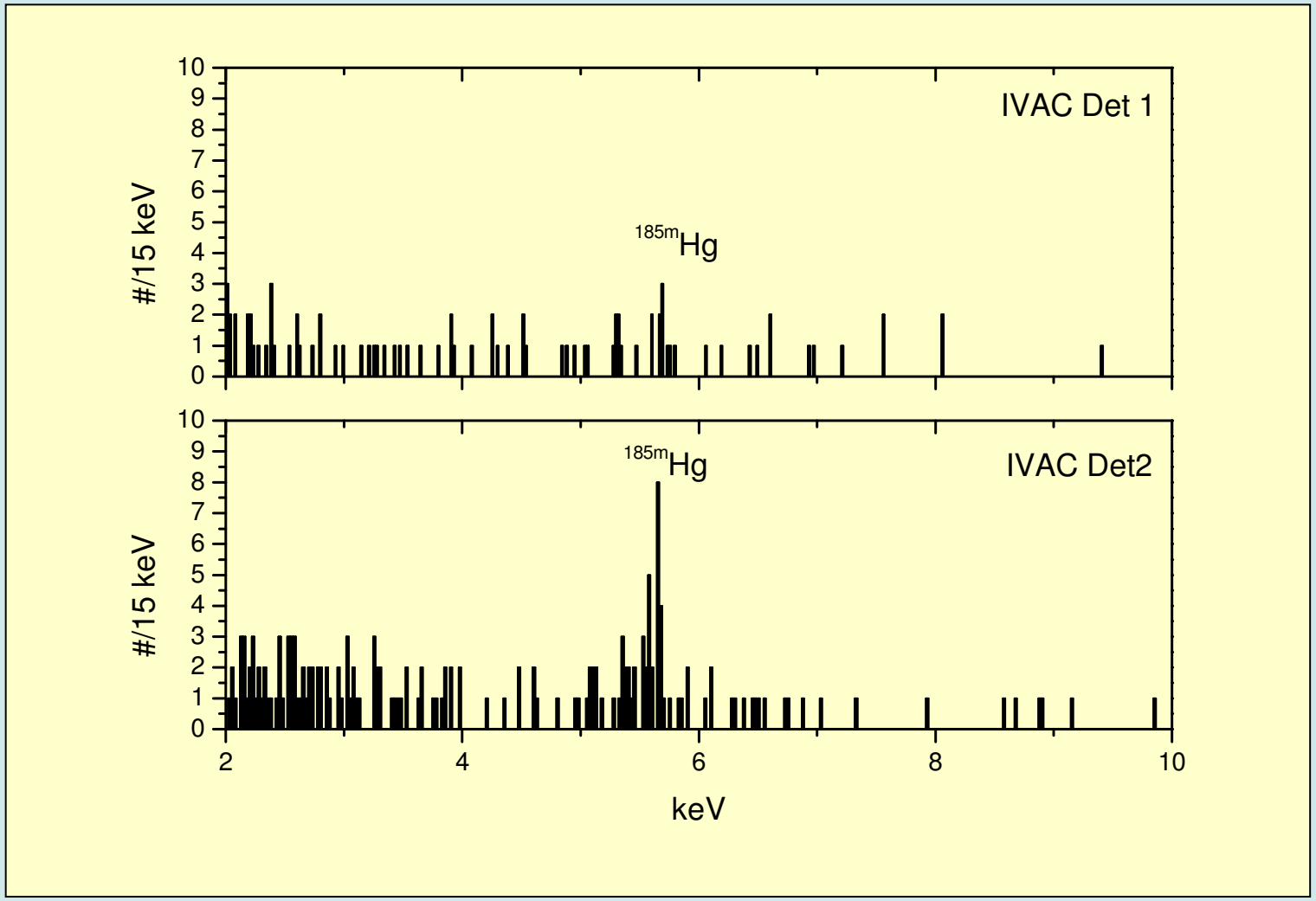
Angular distribution of products leaving the column



CRATE @ BGS

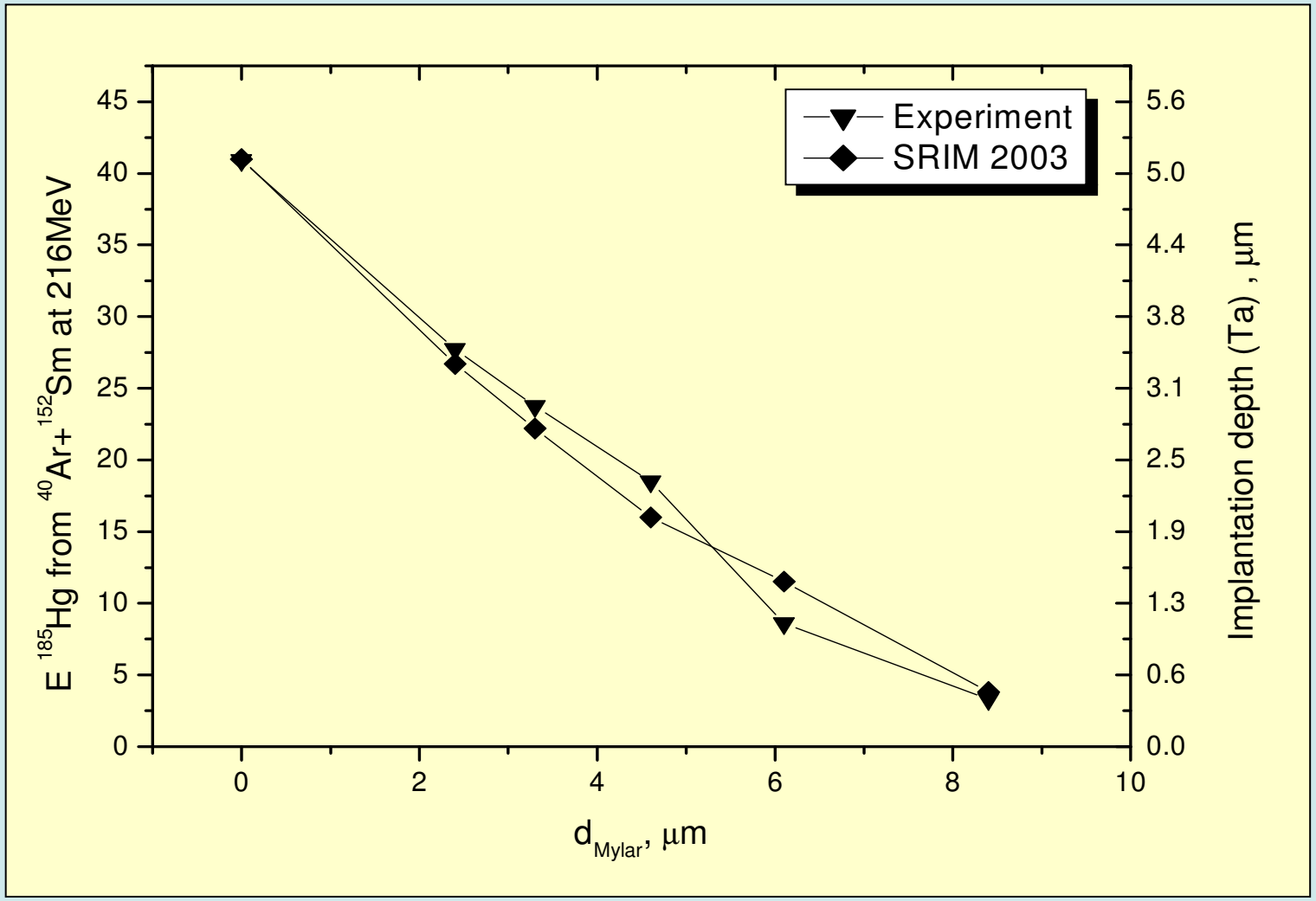

BGS Dipole M2
Mylar degrader retractable
IVAC
Inductor
CRATE

CRATE @ BGS

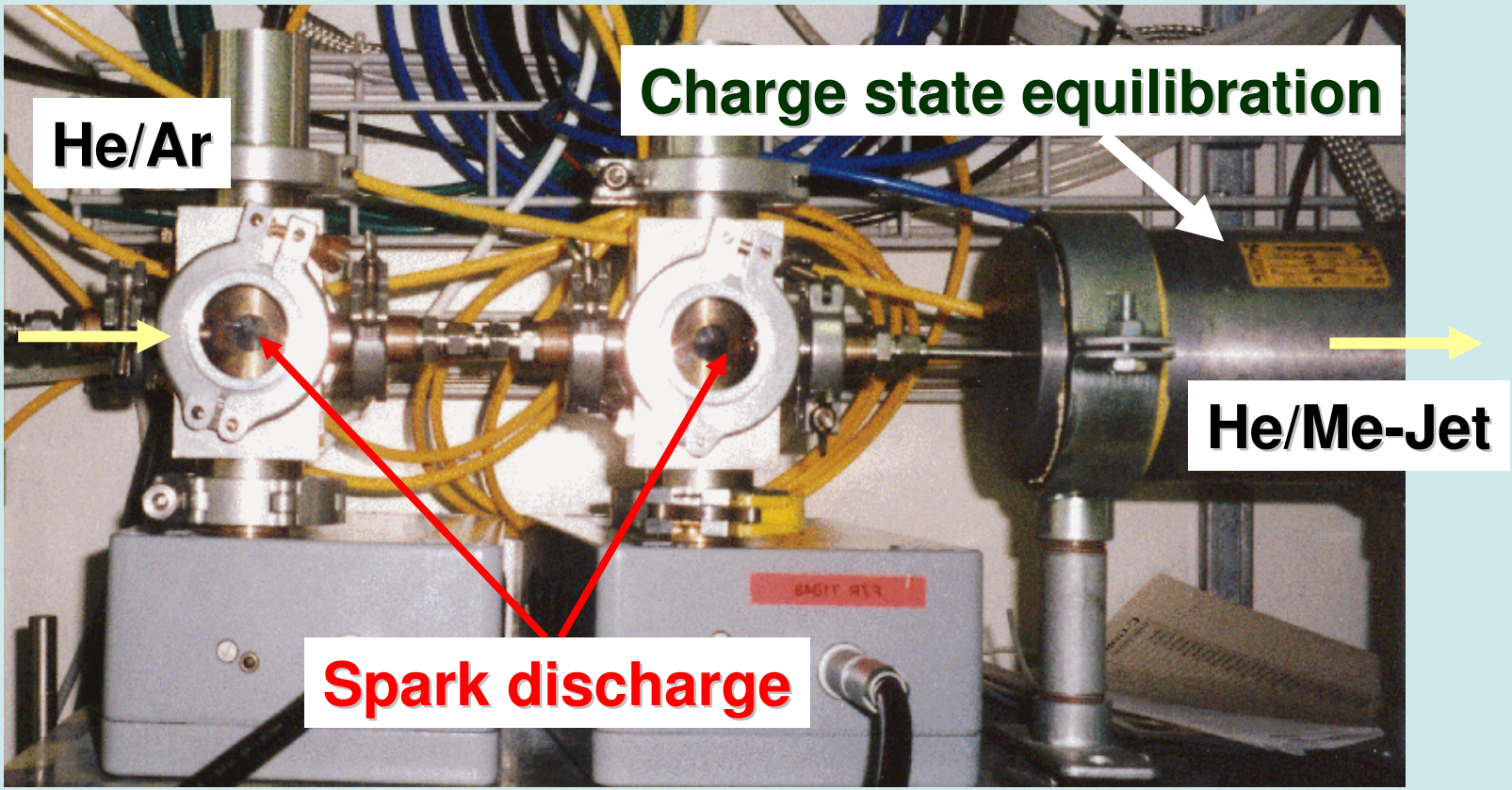


Impaction and Release

Mylar degraders / Implantation depth

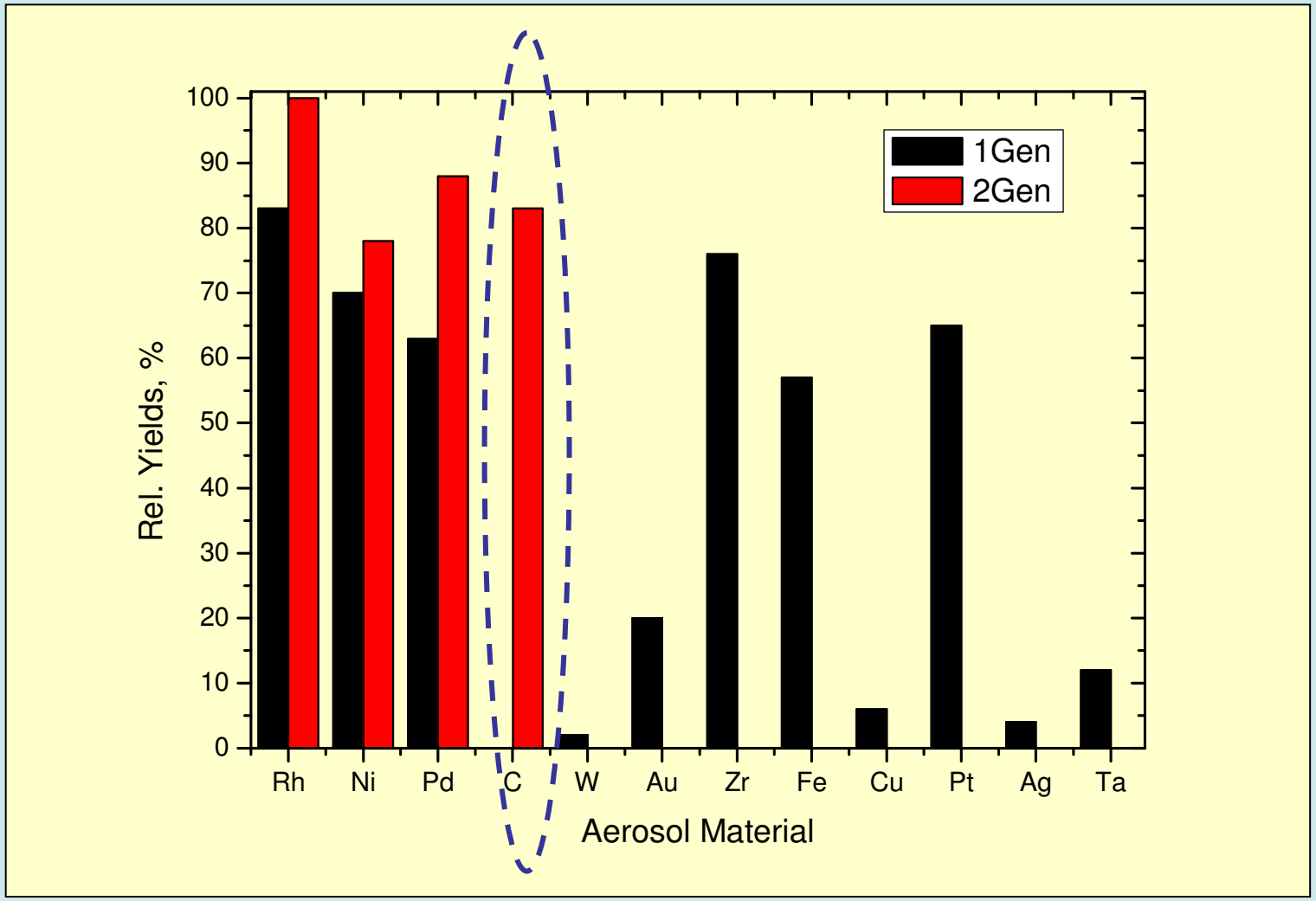


Metal-Aerosol Particles



Metal-Aerosol Particles

$^{nat}Sm(^{40}Ar,6n)^{178-185}Hg(\alpha)$ ⟶ **PSI TAPE Detection system**

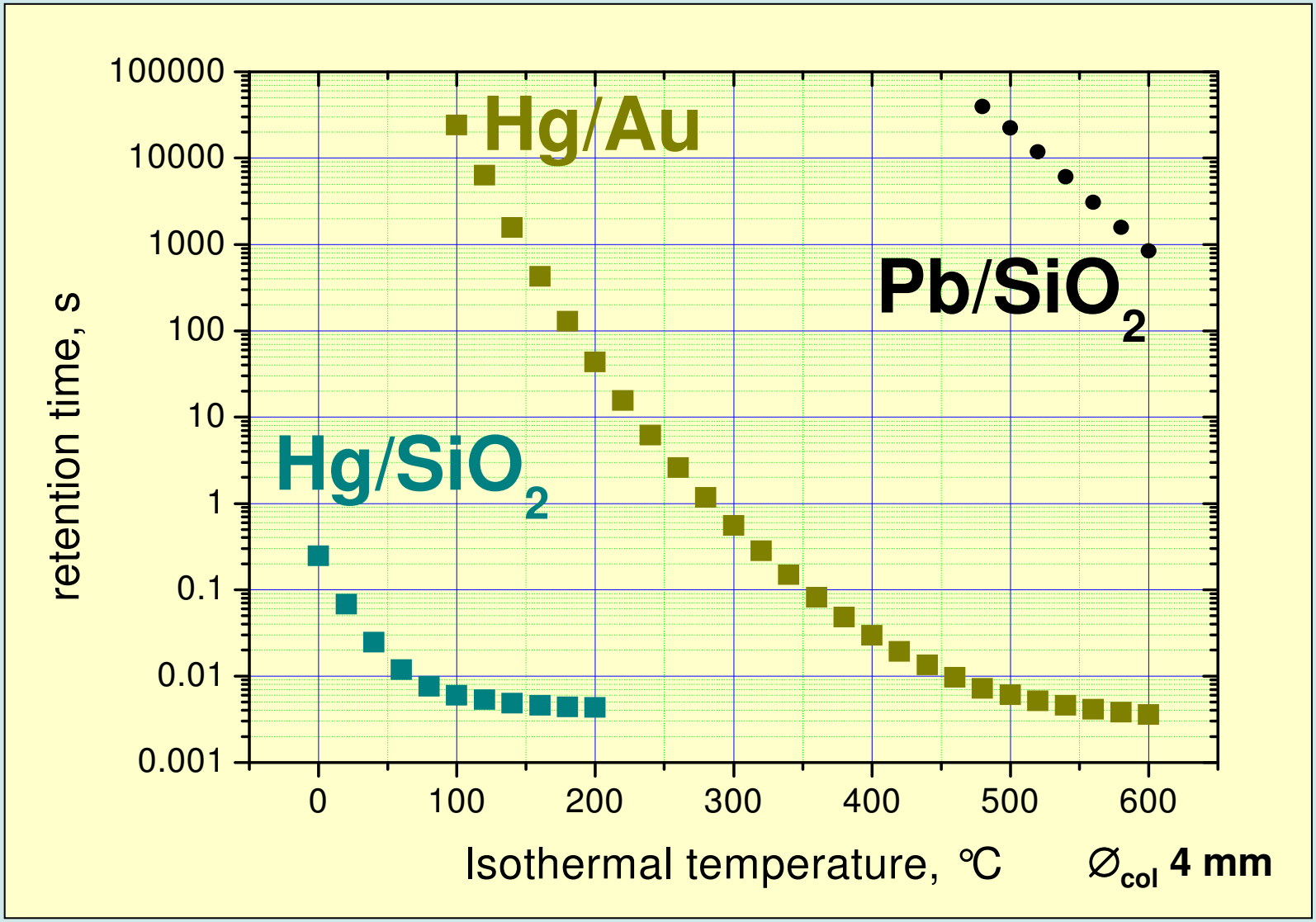


1l He+100 ml/minAr

12 h experiments

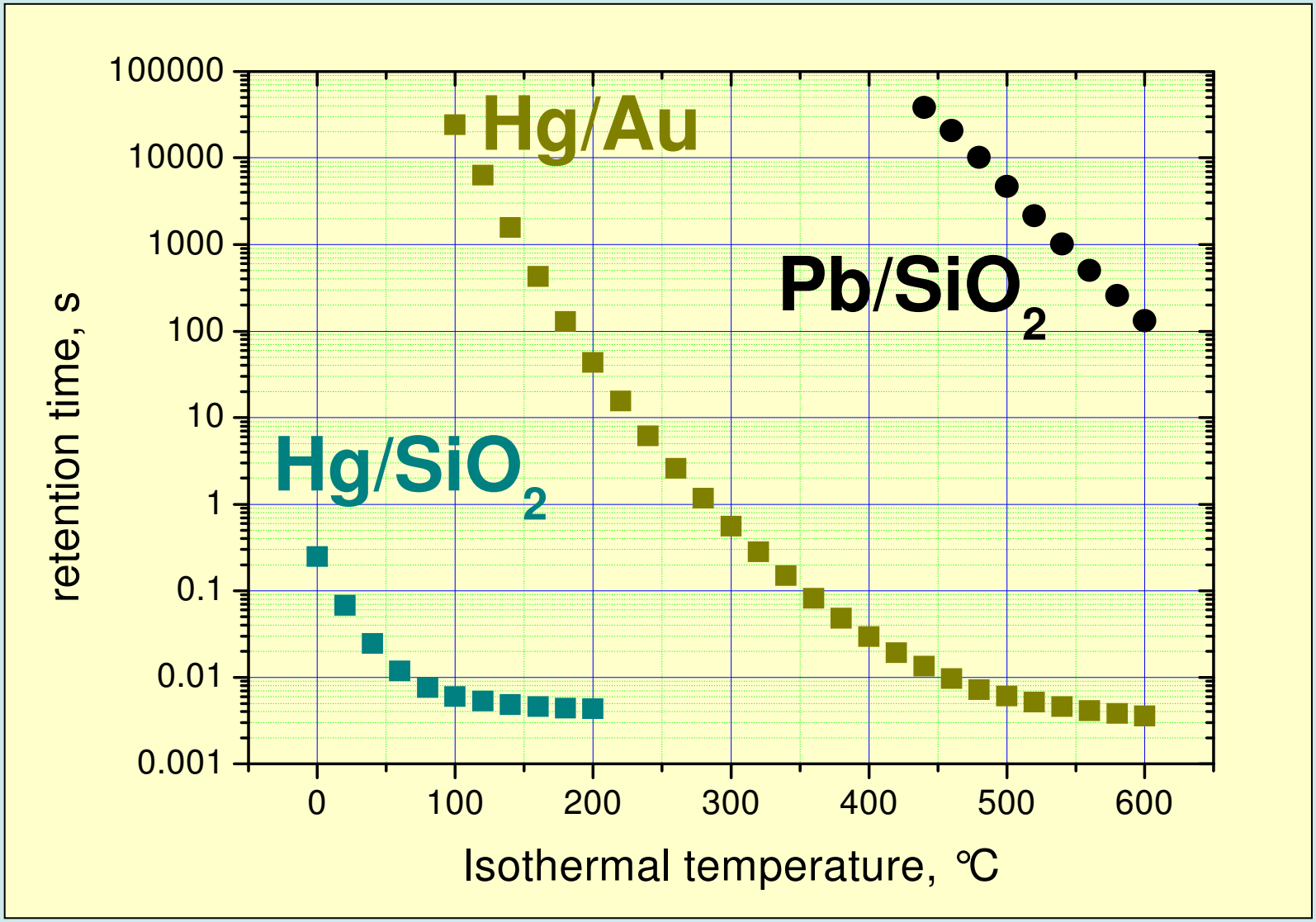
IVAC Set-Up

column length: 30 cm

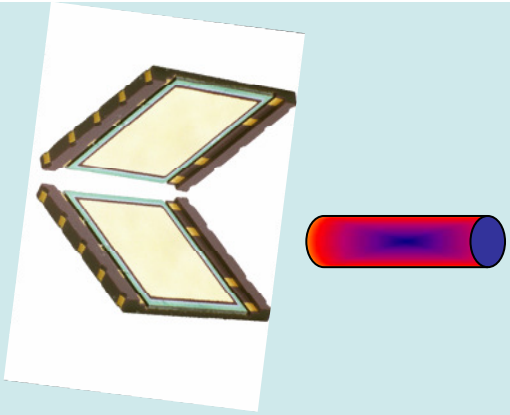


IVAC Set-Up

column length: 30 cm column length (Pb) 10 cm



Experiments with Detectors



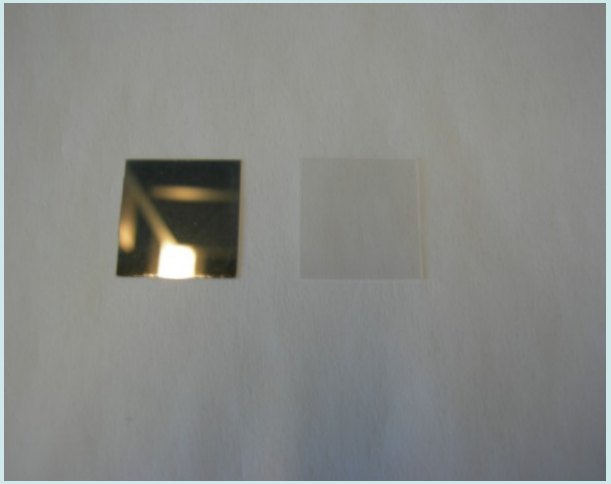
Problem: semiconductors detectors are sensitive to light irradiation (visible light, IR)

Solution: coverage of detector surface by protection layer (carbon, metals with low Z)

Coverage materials used: C, Al, Mg, Mn, Co, Fe, Zn, Ag

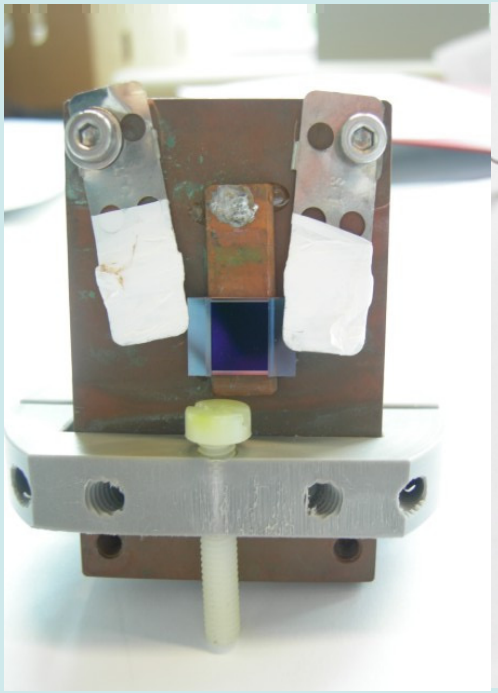
Best material

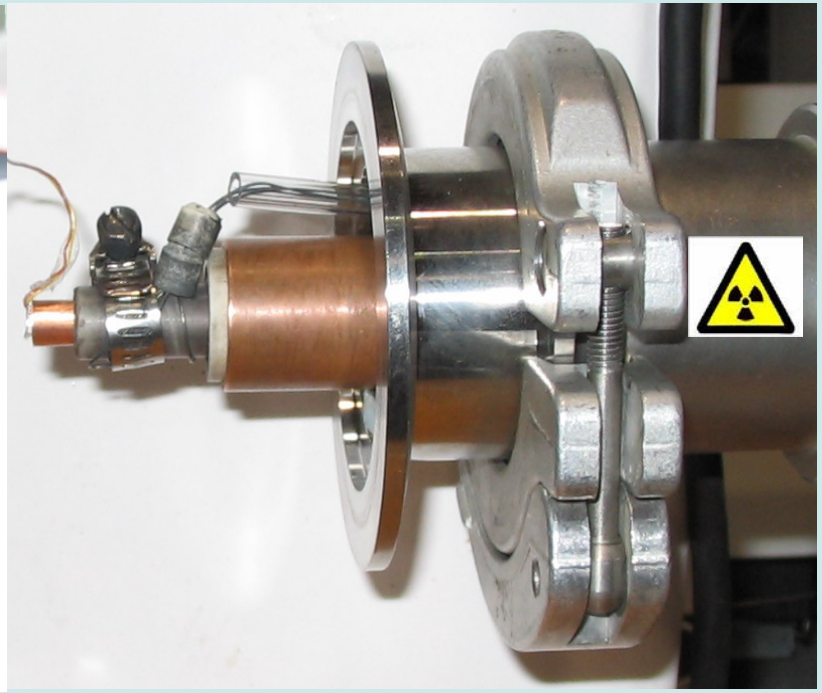
Experiments with Glasses



Covered and non-covered glass
60 μg/cm² Mg/MgO Coverage

Experiments with PIN/PIPS Detectors





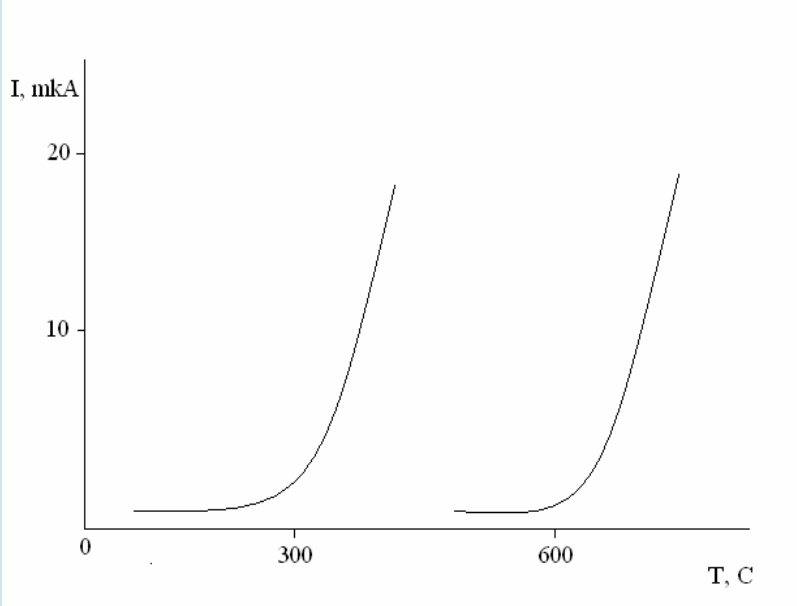
α-source: ^{227}Ac (located at sealed end of column, inside of the oven)

$^{227}Ac \longrightarrow {}^{219}Rn\ (E_\alpha=6{,}8MeV) \longrightarrow {}^{215}Po\ (E_\alpha=7{,}6MeV) \longrightarrow {}^{211}Pb(\beta) \longrightarrow {}^{211}Bi\ (E_\alpha=6{,}6MeV)$

Column length: 15 cm
Outlet of oven shielded by aluminum foil
Diode located at ~5mm from the open end of column

Experiments with PIN/PIPS Detectors

Online Tests with α-source



Maximal operation temperature for:

1) **Non-covered – 375 ^{0}C**
2) **Covered – 675 ^{0}C (!)**

α-resolution needed is about <100 keV

R&D Proposal IVAC@TASCA

1. Test experiment: 2x 6 Shifts ^{40}Ar, ^{nat}Sm, ^{nat}Gd targets from GSI, Metal Aerosol tests with Pb and Hg
   GSI – ROMA Detection system (Fall 2008)
   (PSI-RTC, Small Image Mode)
2. Test experiment: 2x 6 shifts ^{40}Ar, ^{nat}Sm, ^{nat}Gd targets from GSI, Gas-jet Impaction and Release Experiments with CRATE&IVAC (2009)
   (PSI-RTC, Small Image Mode)
3. Test experiment: 2x6 Shifts ^{40}Ar, ^{nat}Sm, ^{nat}Gd targets from GSI, CRATE with Catcher & IVAC (Silicon, Sn(?) TUM) (2009)

4. Follow-on Proposal: Hg, Tl, Pb, Bi, Po, At studies on various stationary phases (Cu, Ag, Au, SiO_2)(2010).
5. Experiments with TA not before 2011-2012