Report of the "Recoil Transfer Chamber" working group

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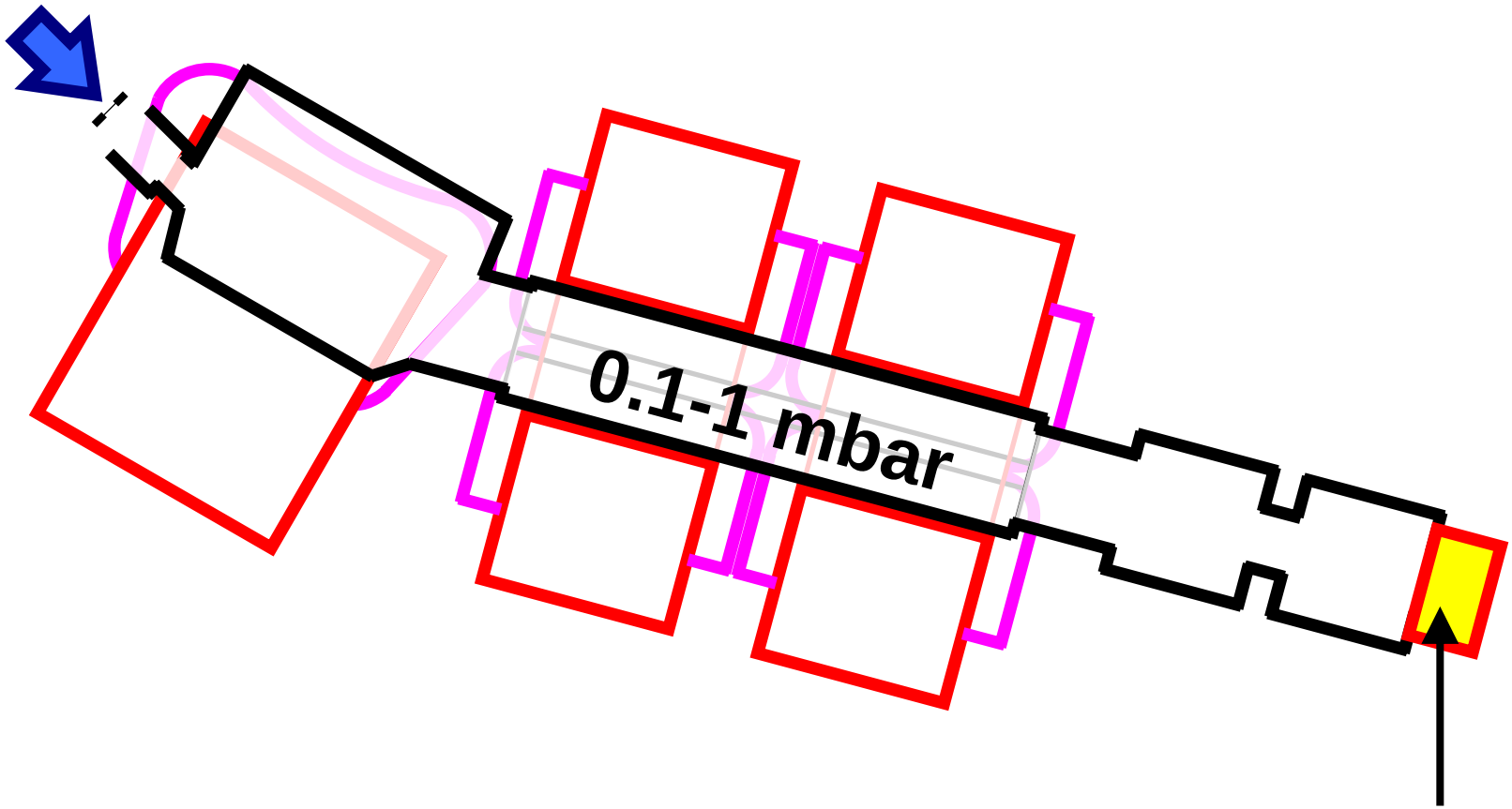
Presented on the 5th workshop on Recoil Separator for Superheavy Element Chemistry *TASCA 06*, September 29, 2006, Garching, Germany

The Recoil Transfer Chamber



TASCA @ GSI

TransActinide Separator and Chemistry Apparatus

Challenges for RTC builders

- Slow recoils ⇨ thin RTC windows
- Sophisticated support structures
- Two modes ⇨ two RTCs

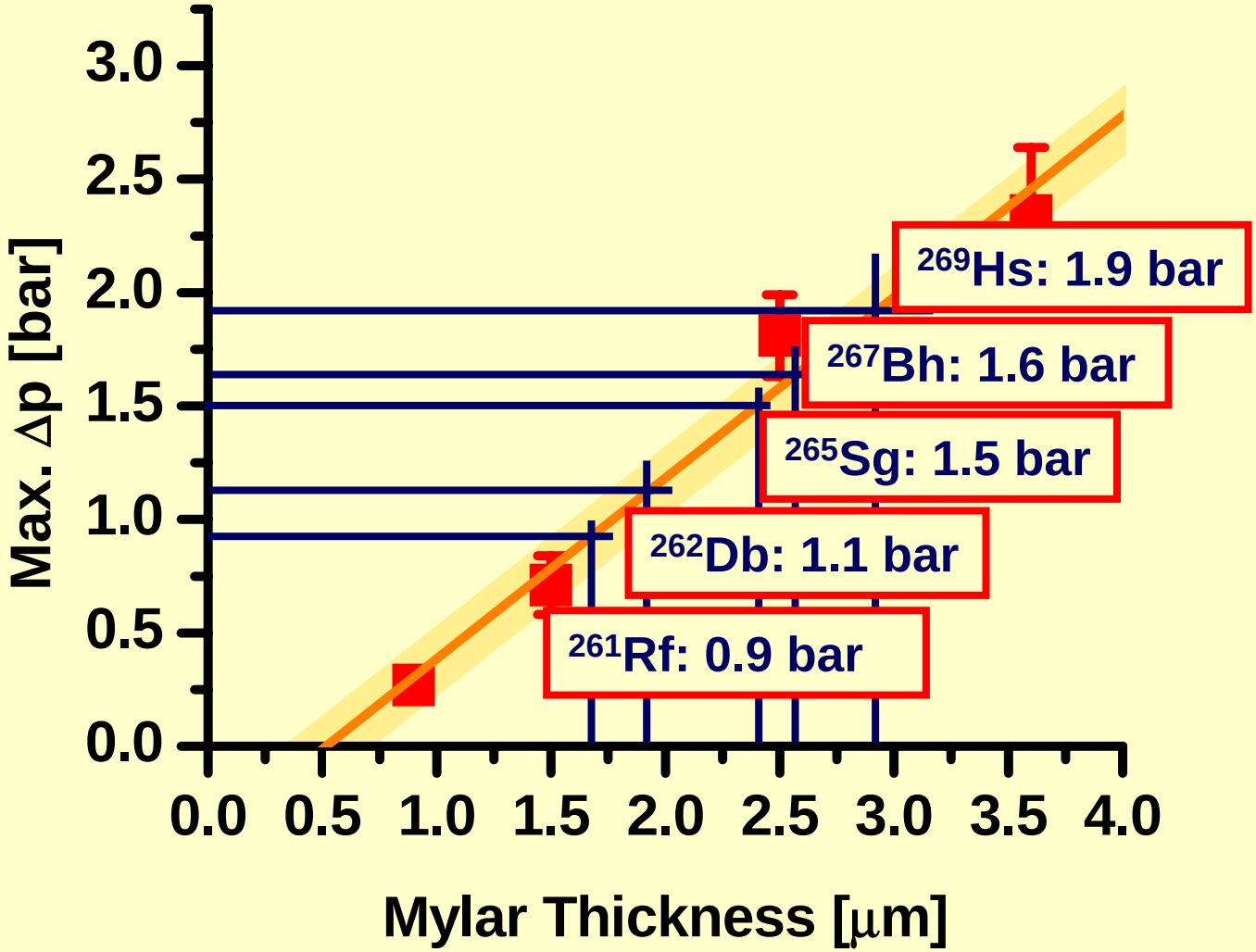
Recoil energies – Ranges in Mylar (SRIM)

Reaction	Nuclide	E_{Recoil}	R_{Mylar}
$^{208}Pb(^{50}Ti,1n)^{257}Rf$	^{257}Rf ~4 s	45.5 MeV	✓
$^{238}U(^{48}Ca,3n)^{283}112$	$^{283}112$ 4 s	39.3 MeV	✓
$^{244}Pu(^{30}Si,5n)^{269}Hs$	^{269}Hs 14 s	18.1 MeV	2.9 μm
$^{244}Pu(^{27}Al,4n)^{267}Bh$	^{267}Bh 15 s	14.4 MeV	2.6 μm
$^{244}Pu(^{26}Mg,5n)^{265}Sg$	^{265}Sg 7 s	13.5 MeV	2.4 μm
$^{244}Pu(^{23}Na,5n)^{262}Db$	^{262}Db 33 s	10.8 MeV	1.9 μm
$^{244}Pu(^{22}Ne,5n)^{261}Rf$	^{261}Rf 78 s	9.5 MeV	1.7 μm

Assuming beam energies corresponding to σ_{max} (HIVAP) (Db-Hs) or experimental data (Rf; 112)

Maximum allowable pressure on Mylar

Results from current RTC window structure at LBNL

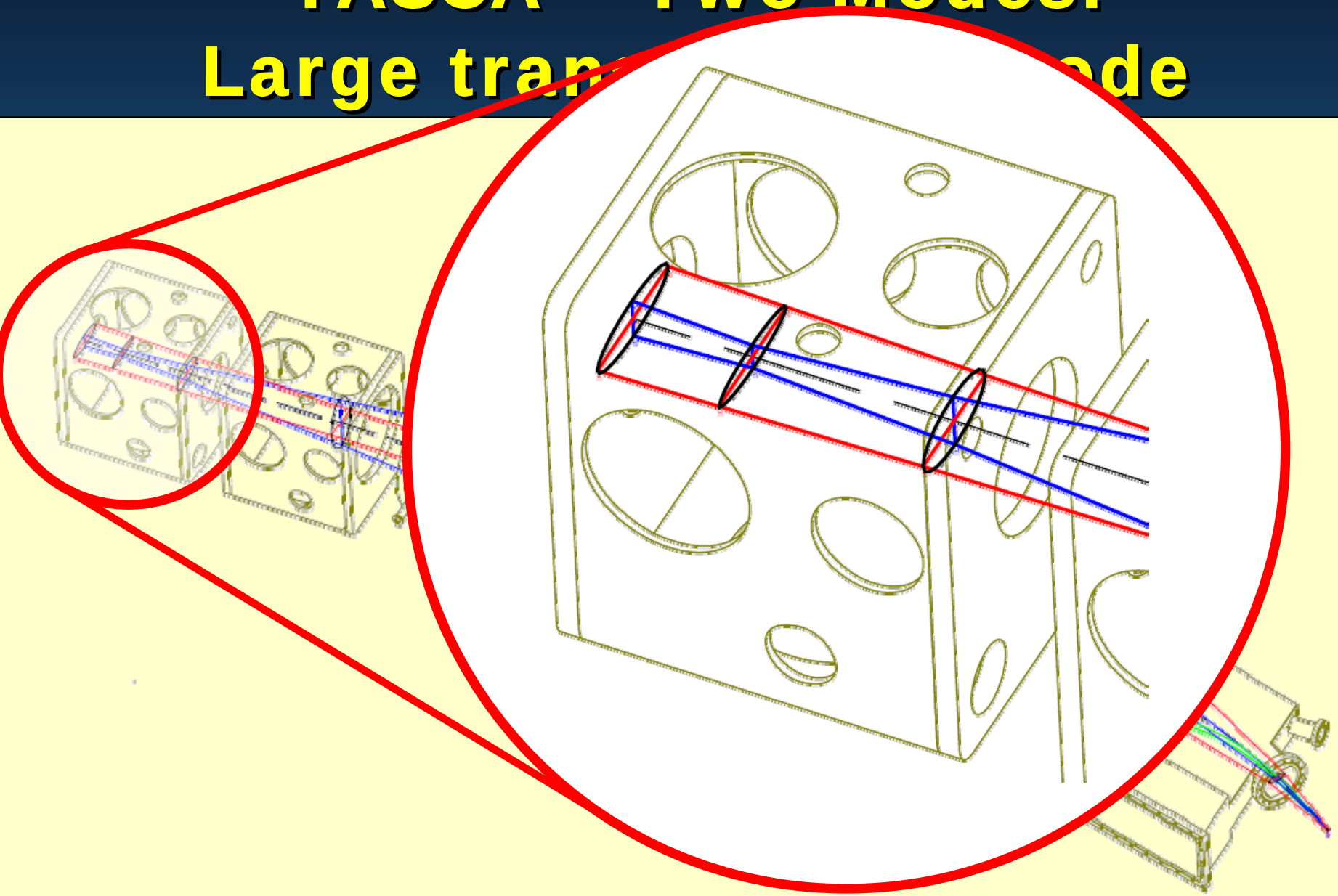


Presented at 3rd workshop on recoil separator at GSI, August 27, 2004

Large transmission mode (DQ_hQ_v)

For reactions leading to long-lived isotopes

TASCA – Two Modes:
Large tran… …ode



MCS: Focal Plane Image DQ_hQ_v Mode

$^{244}Pu(^{22}Ne, 5n)^{261}Rf$

Beam:

E_{Lab} = 115 MeV

Target:

400 μg/cm²

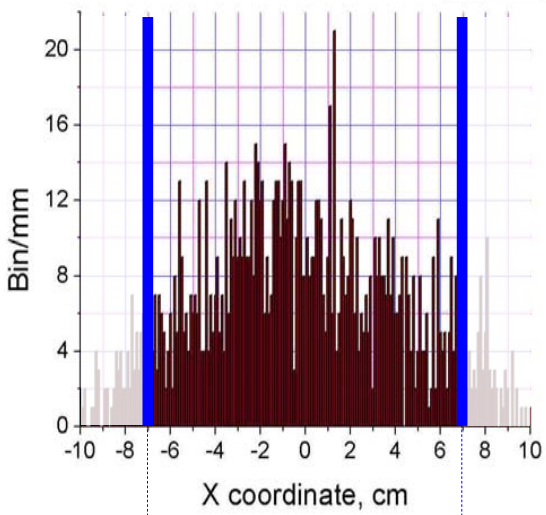
$^{244}PuO_2$

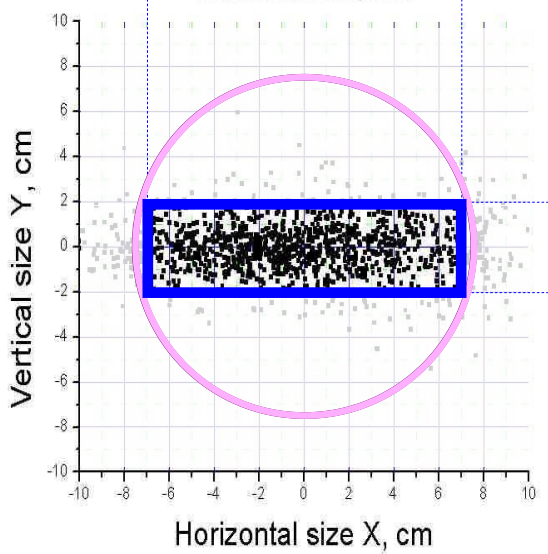
TASCA gas:

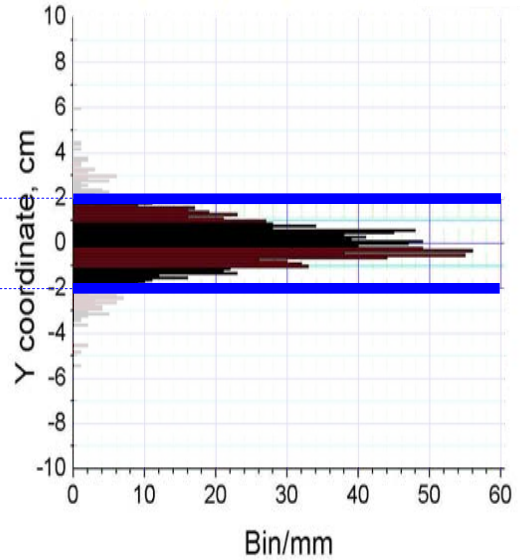
0.3 mbar He

Transmission to focal plane flange:

12 %





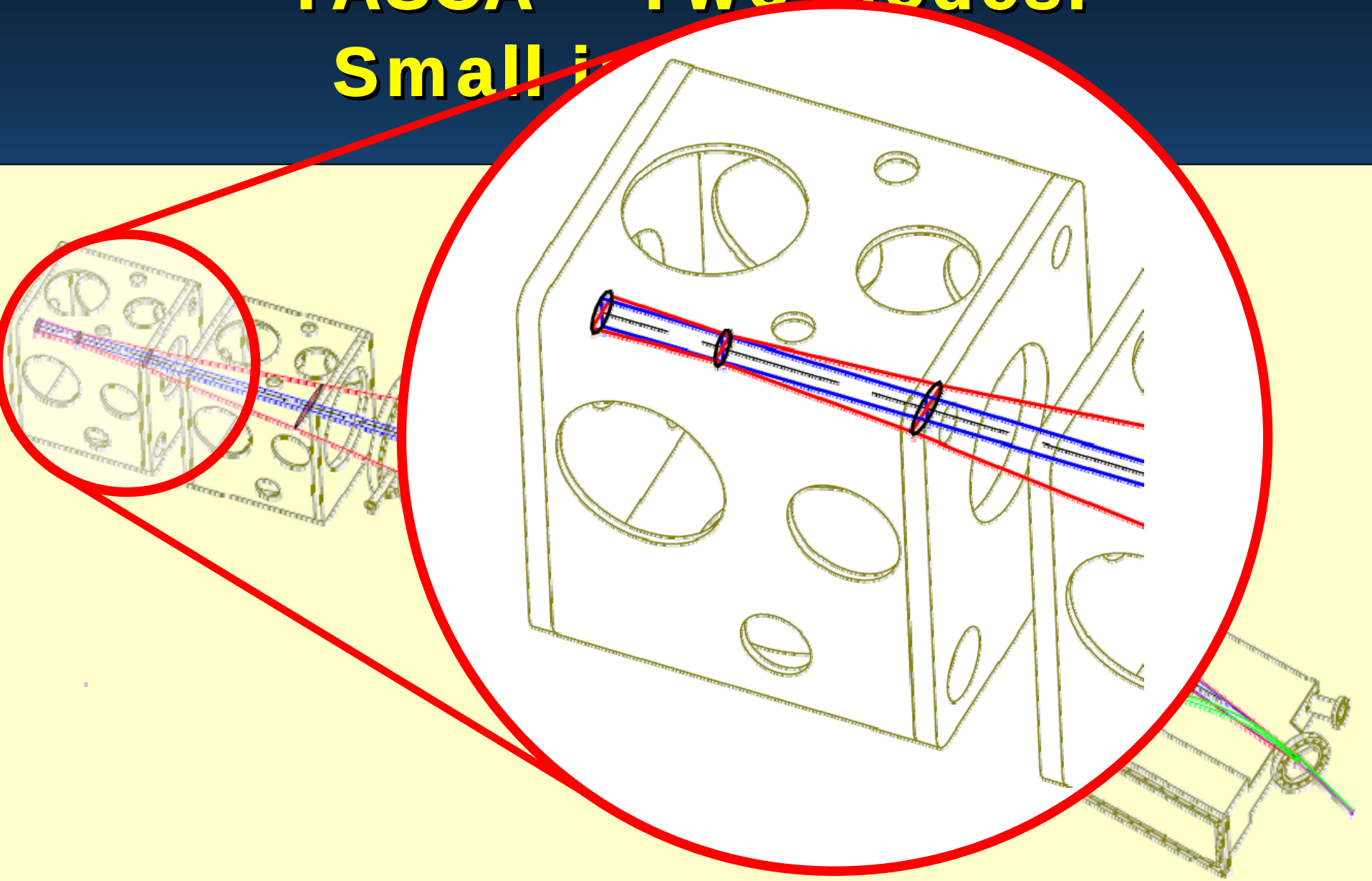


81% of transmitted recoils are inside 14 x 4 cm² window

Small image mode (DQ_vQ_h)

For reactions leading to short-lived isotopes (~4s-^{257}Rf, 4s-^{258}Db)

TASCA – Two Modes: Small i



MCS: Focal Plane Image DQ_vQ_h Mode

$^{208}Pb(^{50}Ti, 1n)^{257}Rf$

Beam:

E_{Lab} = 235 MeV

Target:

300 μg/cm²

^{208}Pb (metal)

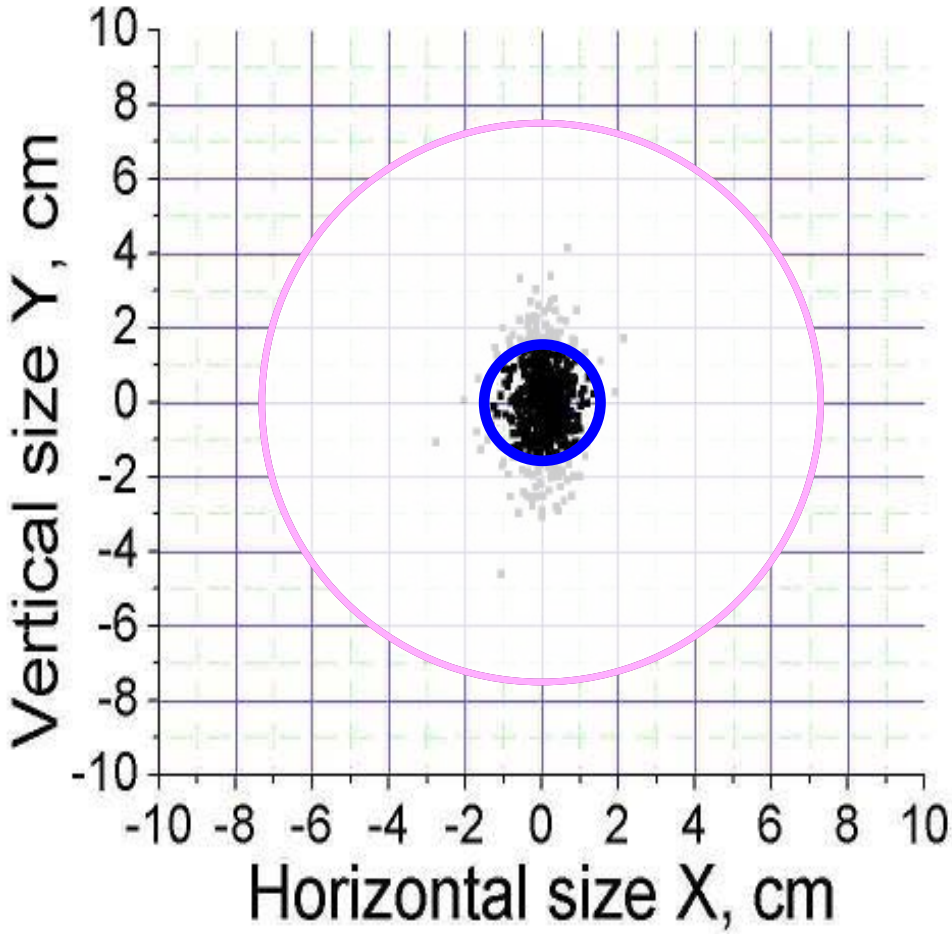
TASCA gas:

0.3 mbar He

Transmission to focal plane flange:

60 %

~80% of transmitted recoils are inside Ø 3 cm window



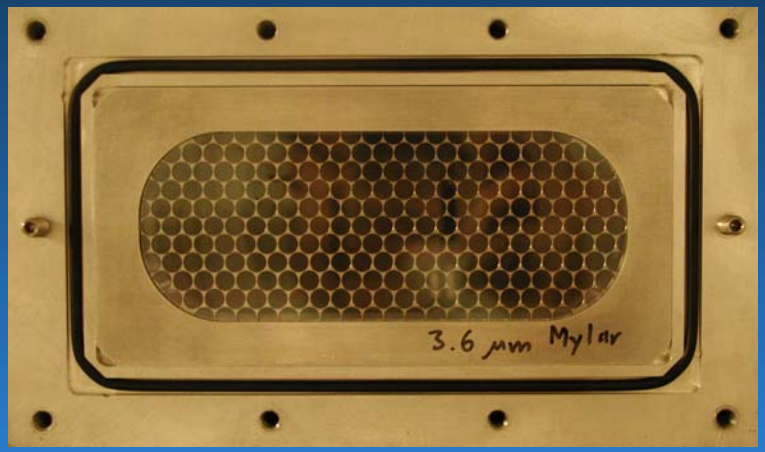
Current status

- ✓ Double layer support structure
- ✓ Different window materials available
- • Two test RTCs

Next-generation RTC windows

Currently at BGS **Under Way for**

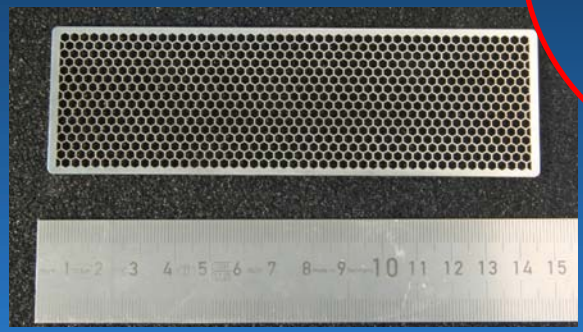
Support structure



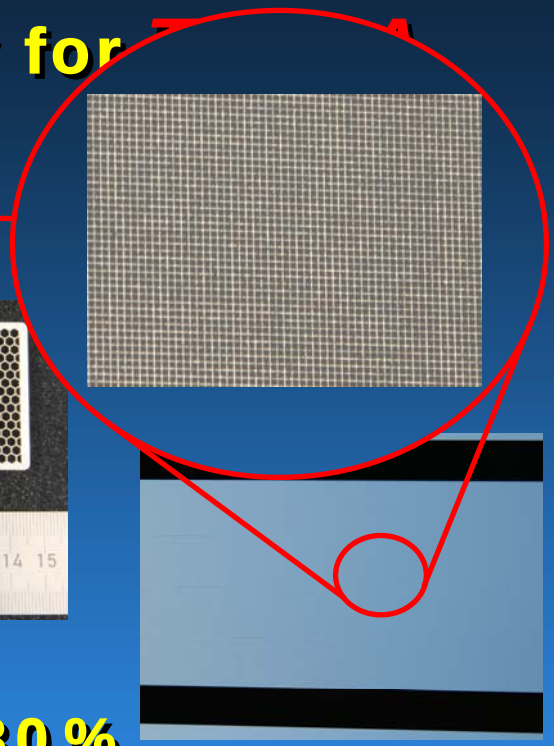
1 Layer:

- **Ø 6.25 mm, T=80%**

2 Layers:



- **Wide mesh:**
  Ø 2.5 mm, T=80%
- **Fine mesh: 20 µm thick Ni**
  □ 0.3 mm, T=90%

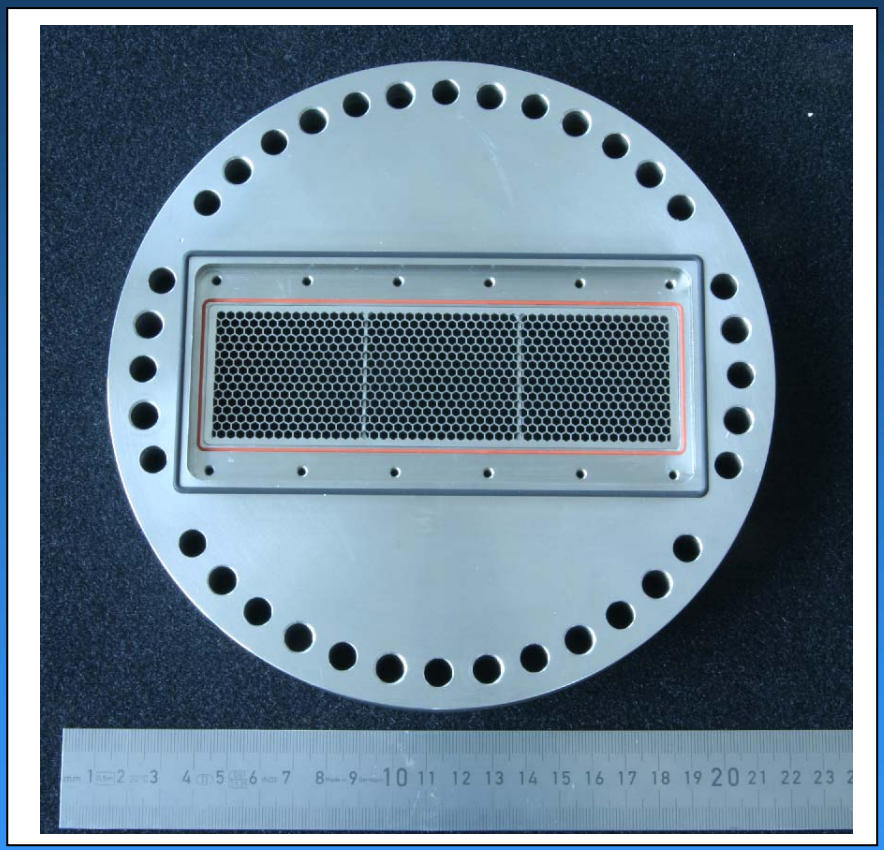


Window

- **6.0 µm Mylar (Al)**
- **3.6 µm Mylar**
- **1.5 µm Mylar (Al)**
- **0.9 µm Mylar**
- **0.45 µm 'plastic' with 'DuPont Coat'**

Two 'Commissioning' RTCs

Large Transmission mode (DQ_hQ_v)



RTC under construction at U Mainz

Test Oct/Nov 2006:

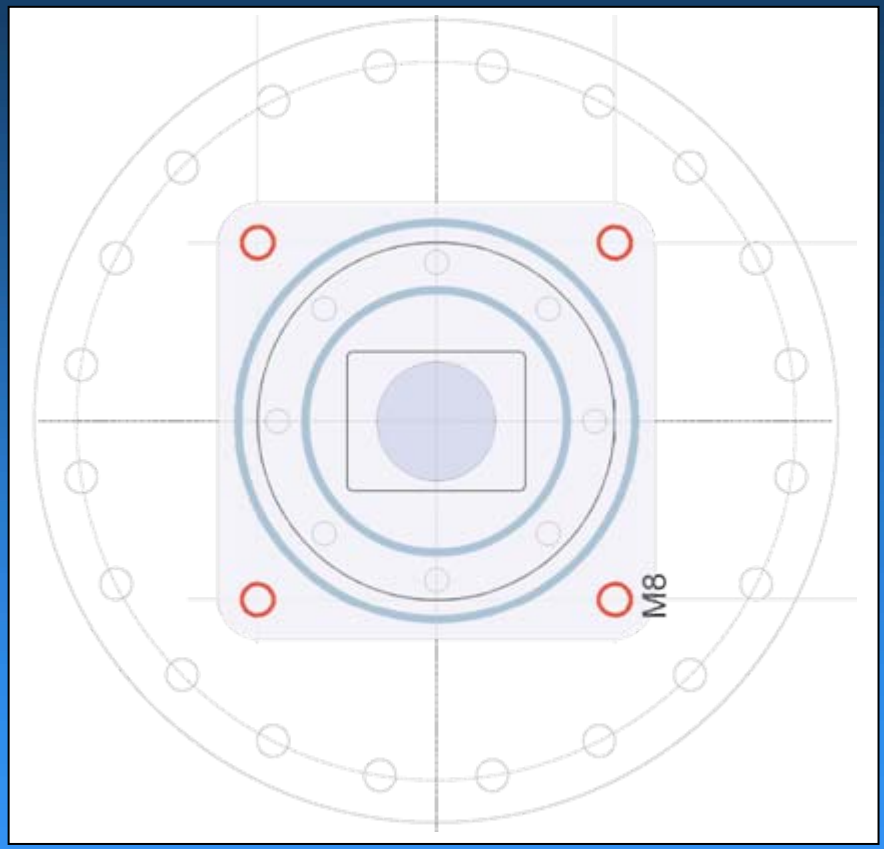
$^{nat}Gd(^{40}Ar,xn)^{196}Pb$ ($T_{1/2}$ = 30 min) and

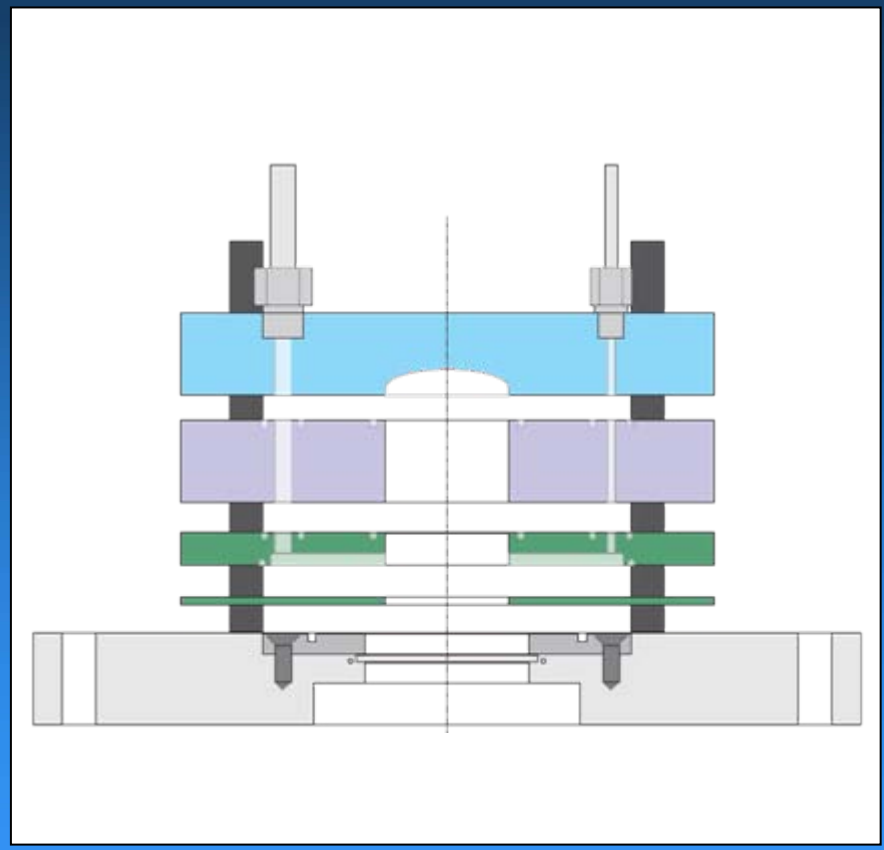
$^{208}Pb(^{40}Ar,3n)^{245}Fm$ ($T_{1/2}$ = 4 s; σ = 22 nb)

Two 'Commissioning' RTCs

Small Image mode (DQ_vQ_h)

UNIVERSITY OF OSLO





RTC under construction at U Oslo

Tests: $^{144}Sm(^{40}Ar,4n)^{180}Hg$ ($T_{1/2}$ = 2.6 s) and

$^{208}Pb(^{40}Ar,3n)^{245}Fm$ ($T_{1/2}$ = 4 s; σ = 22 nb)