TASCA Working Group Report:
Recoil Transfer Chamber

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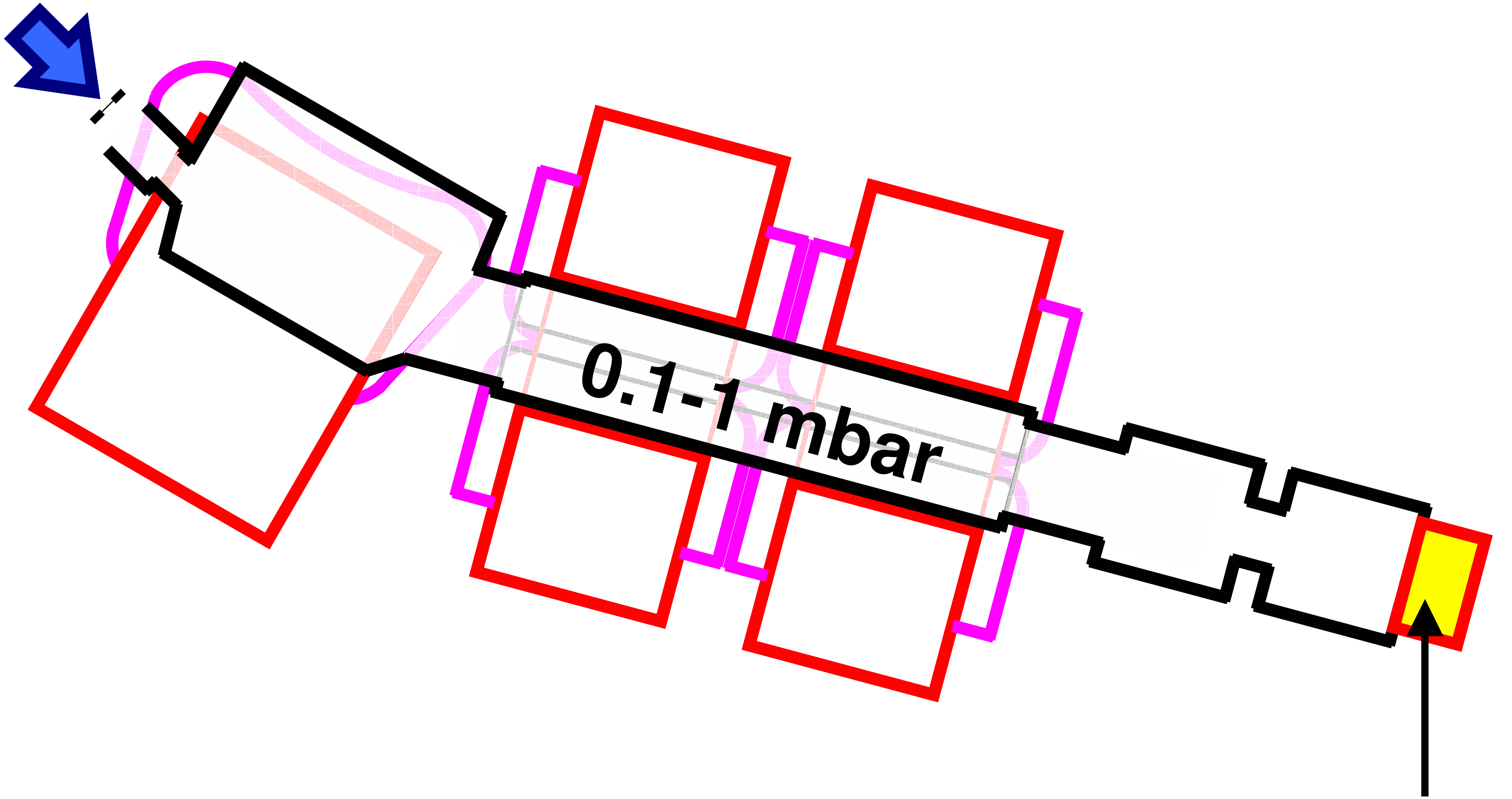
TASCA Commissioning Kick-Off Meeting
Monday, May 15, 2006, GSI, Darmstadt (D)

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

The best route to the "Chemistry TAN Isotopes"

Highest cross sections for a given element: Cold fusion with Pb/Bi targets.

⇒ Too short-lived (neutron-poor)

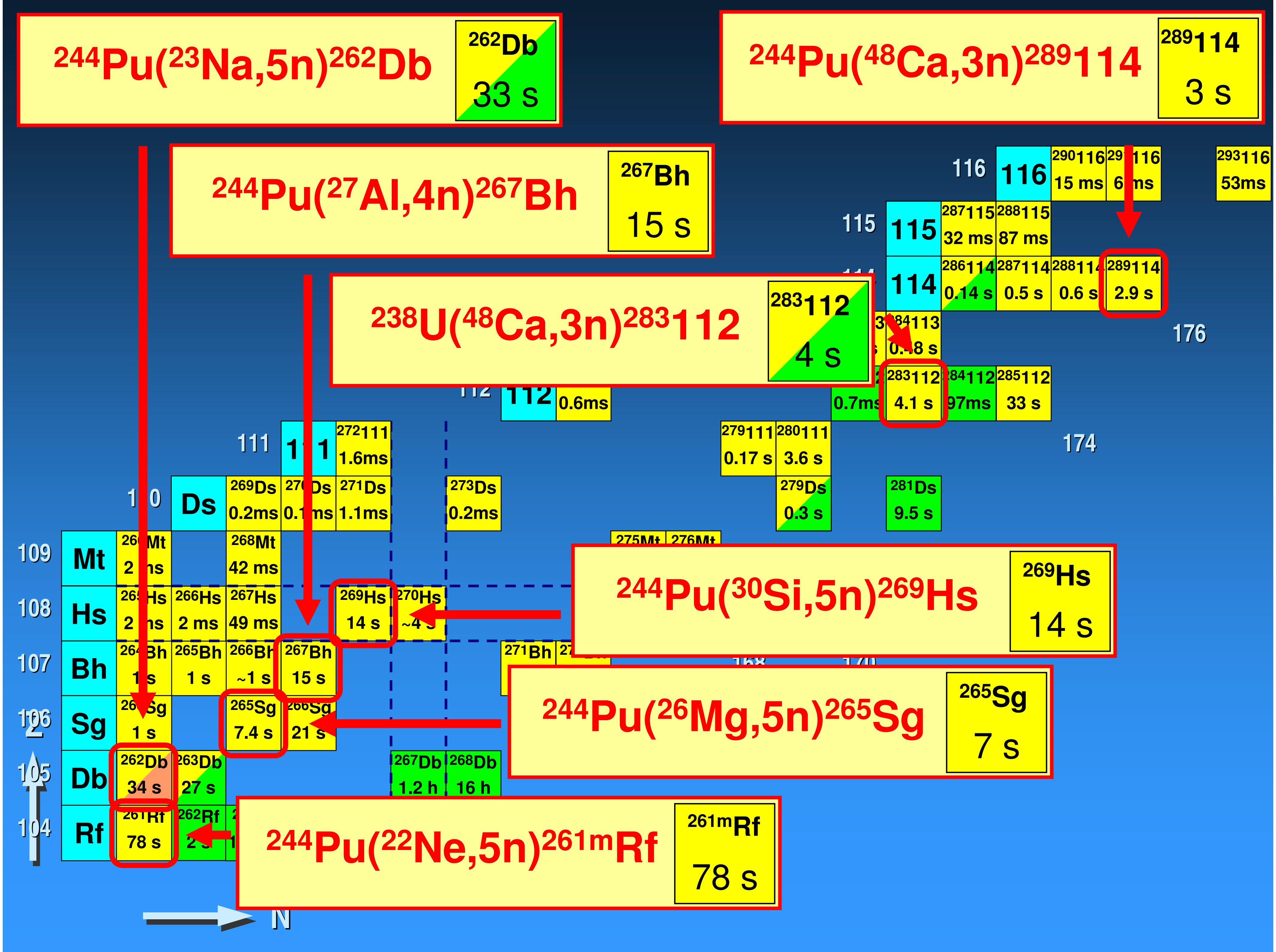
Longer-lived ones are accessible in asymmetric reactions. "Best" target traditionally: ^{248}Cm

⇒ Too slow recoils

Lightest target yielding these isotopes is ^{244}Pu.

⇒ σ is probably again lower, but their recoil energies are higher than with ^{248}Cm:

^{248}Cm(^{18}O,5n)^{261m}Rf vs. ^{244}Pu(^{22}Ne,5n)^{261m}Rf: 1.5x



244Pu(23Na,5n)262Db
262Db
33 s
244Pu(48Ca,3n)289114
289114
3 s
244Pu(27Al,4n)267Bh
267Bh
15 s
238U(48Ca,3n)283112
283112
4 s
244Pu(30Si,5n)269Hs
269Hs
14 s
244Pu(26Mg,5n)265Sg
265Sg
7 s
244Pu(22Ne,5n)261mRf
261mRf
78 s
116
290116 15 ms
293116 53ms
115
287115 32 ms
288115 87 ms
114
286114 0.14 s
287114 0.5 s
289114 2.9 s
176
283112 4.1 s
285112 33 s
0.7ms
0.6ms
174
111
272111 1.6ms
279111 0.17 s
280111 3.6 s
Ds
269Ds 0.2ms
271Ds 1.1ms
273Ds 0.2ms
279Ds 0.3 s
281Ds 9.5 s
109
Mt
268Mt 42 ms
108
Hs
266Hs 2 ms
267Hs 49 ms
269Hs 14 s
107
Bh
265Bh 1 s
267Bh 15 s
271Bh
Sg
265Sg 7.4 s
105
Db
262Db 34 s
263Db 27 s
267Db 1.2 h
268Db 16 h
104
Rf
78 s
262Rf
N

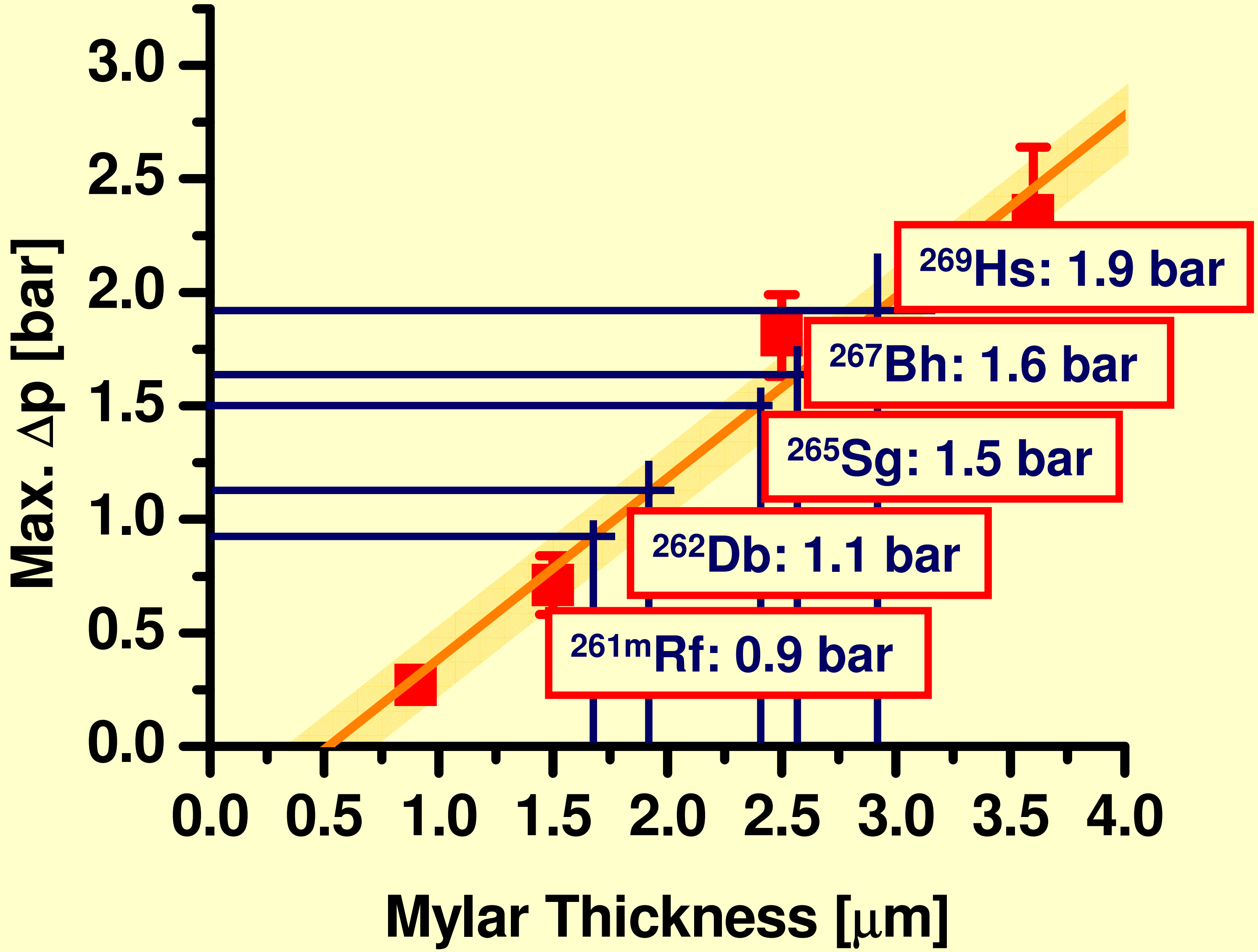
Recoil energies – Ranges in Mylar (SRIM)

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

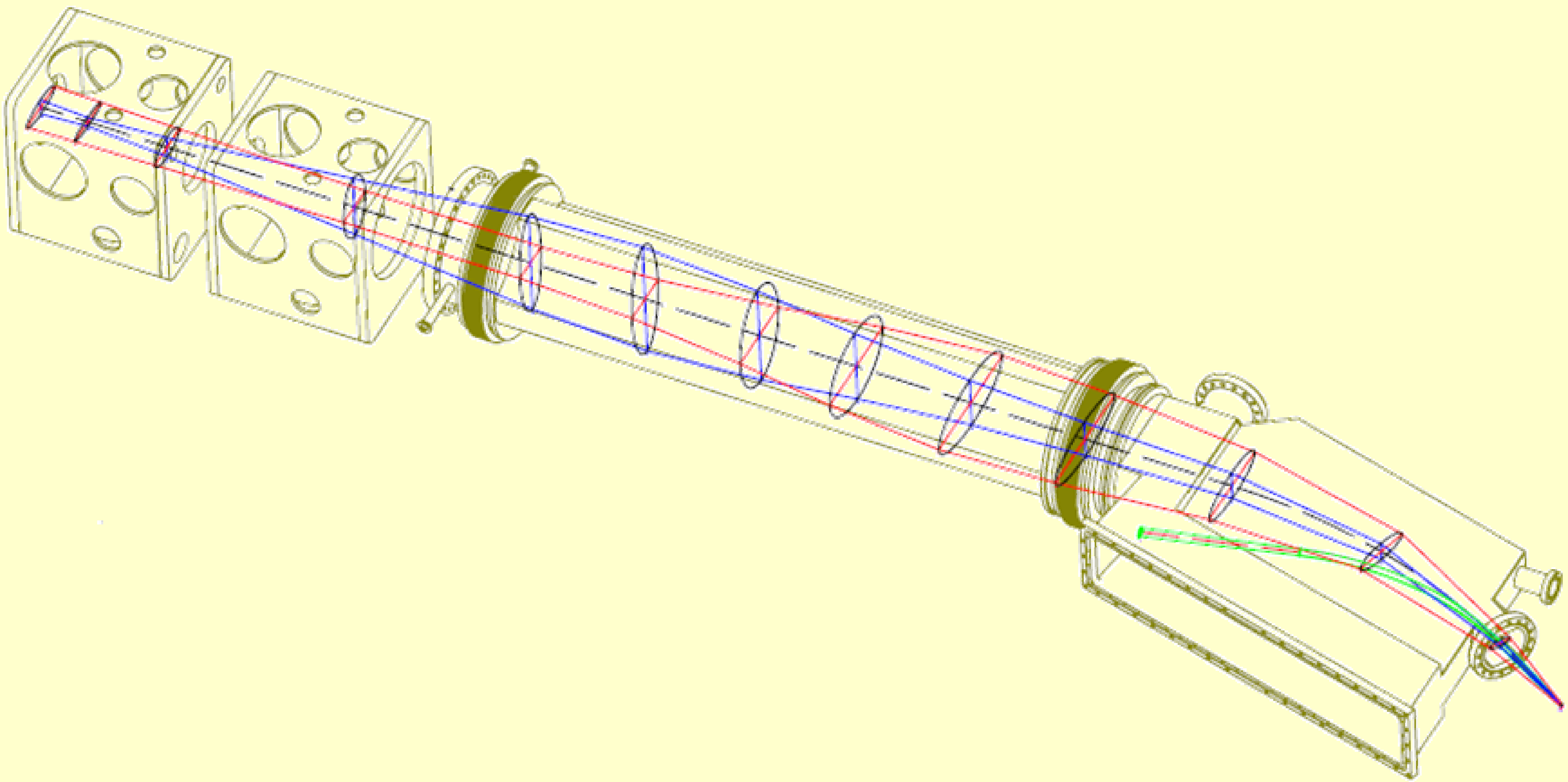


Presented at 3rd workshop on recoil separator at GSI, August 27, 2004

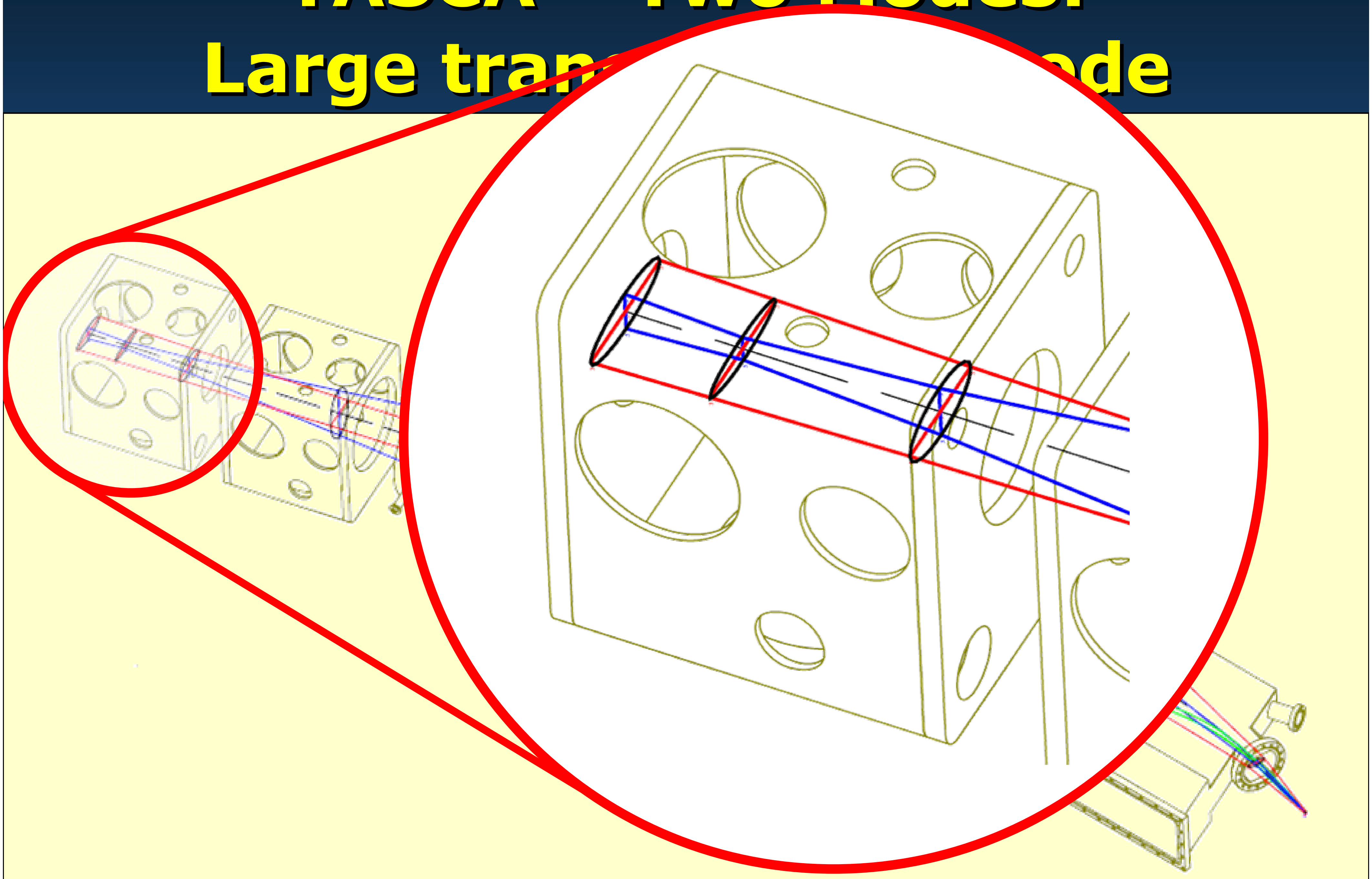
Large transmission mode (DQ_hQ_v)

For reactions leading to long-lived isotopes

TASCA – Two Modes:
Large transmission mode



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

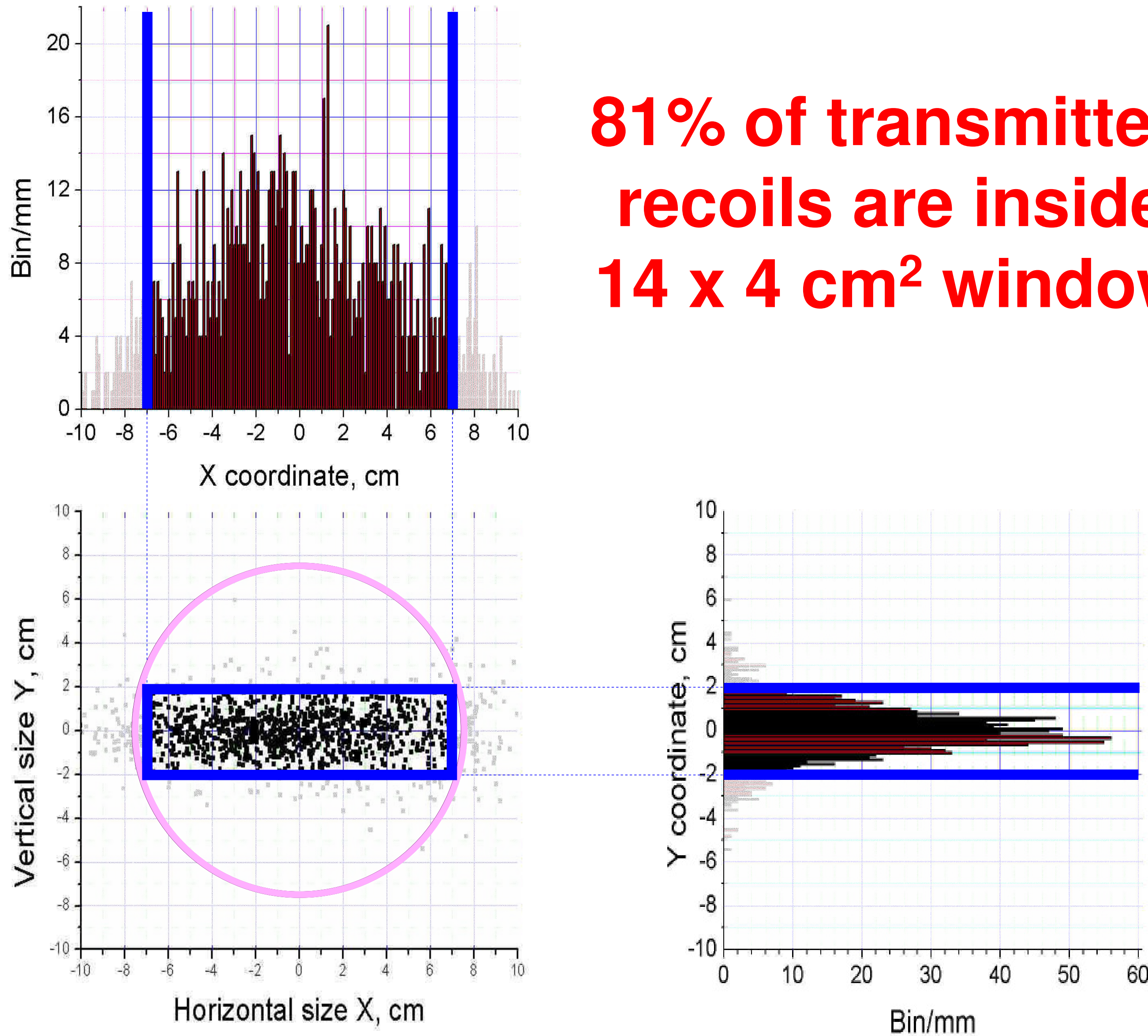
$^{244}PuO_2$

TASCA gas:

0.3 mbar He

Transmission to focal plane flange:

12 %

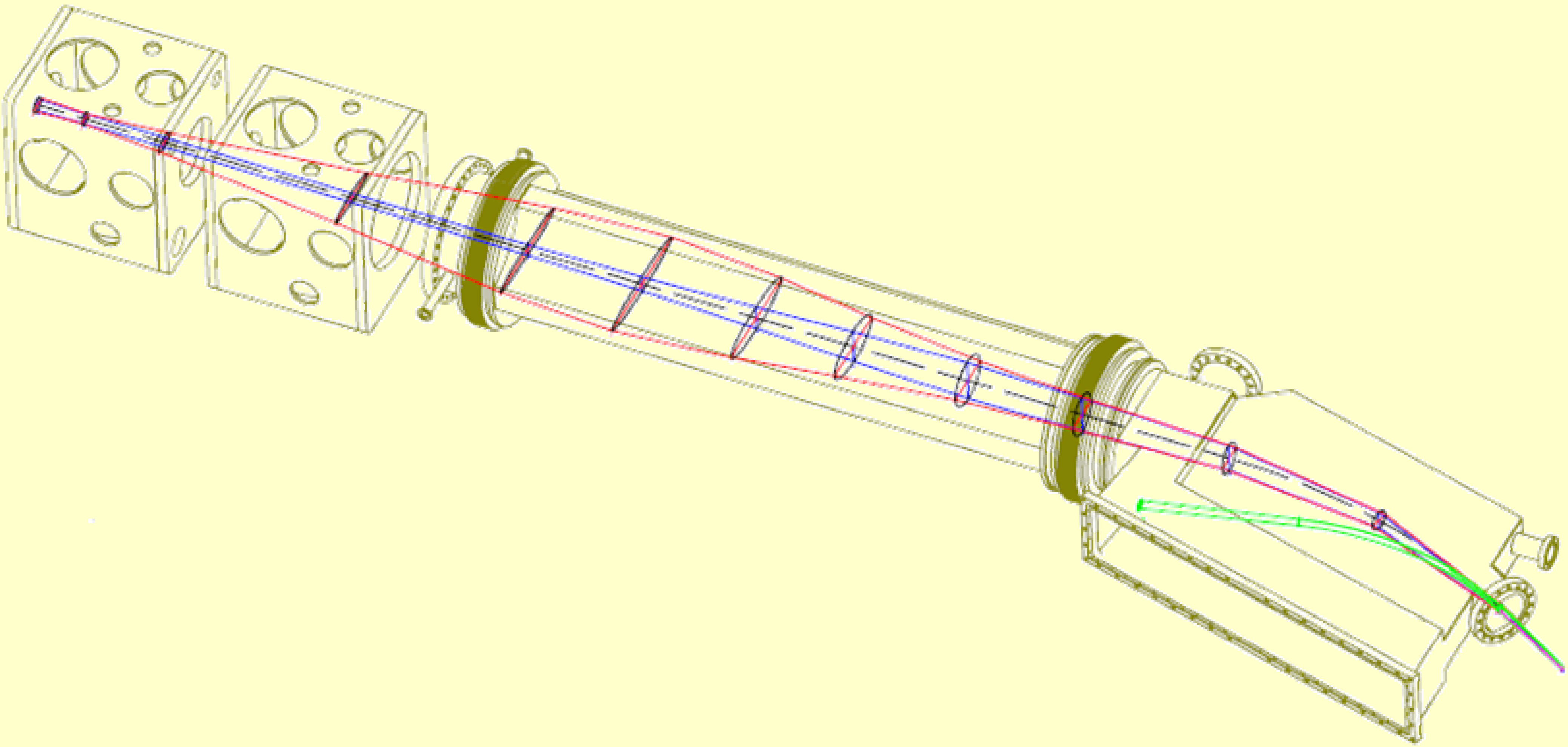


81% of transmitted recoils are inside 14 x 4 cm² window

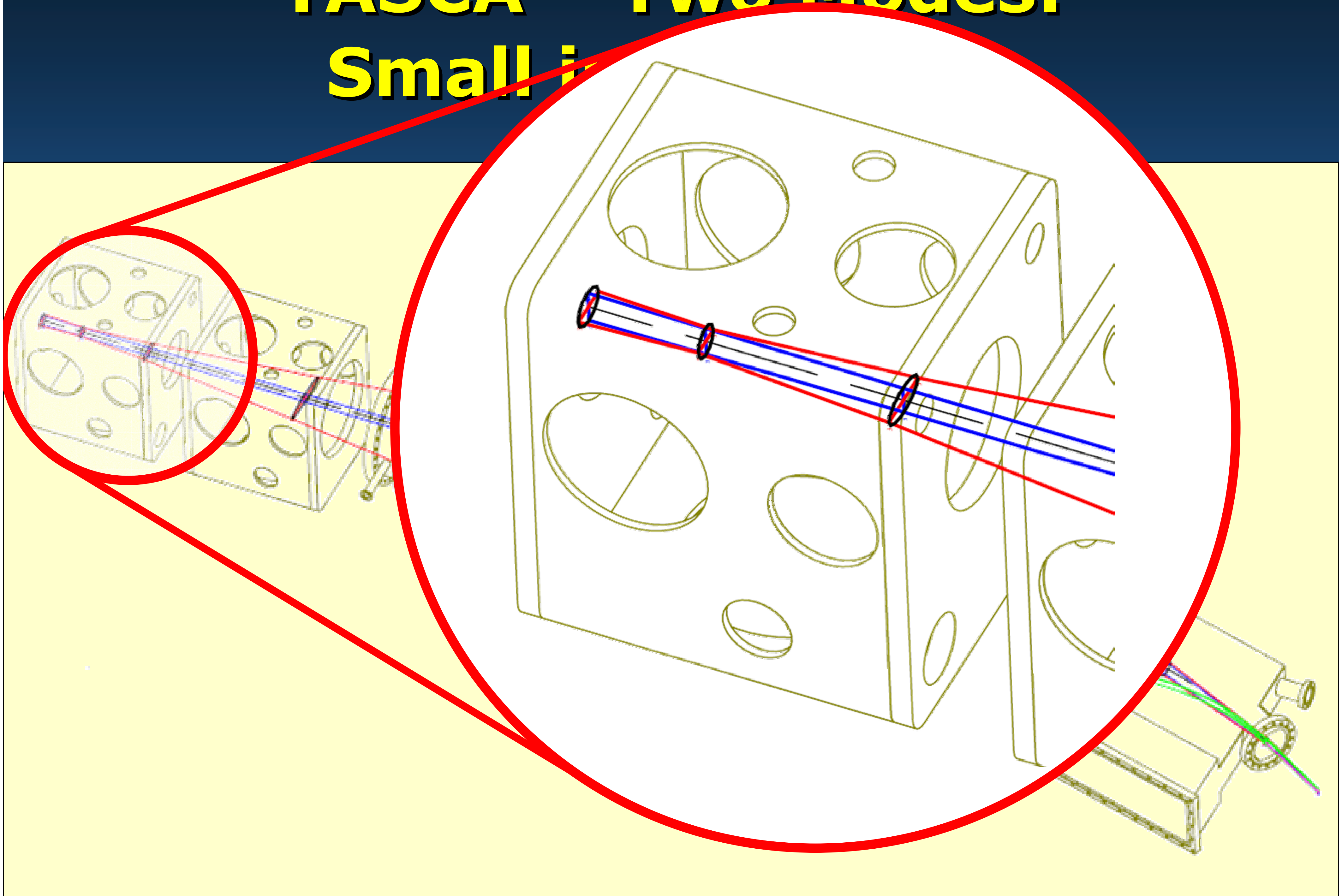
Small image mode (DQ_vQ_h)

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

TASCA – Two Modes:
Small image mode



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)

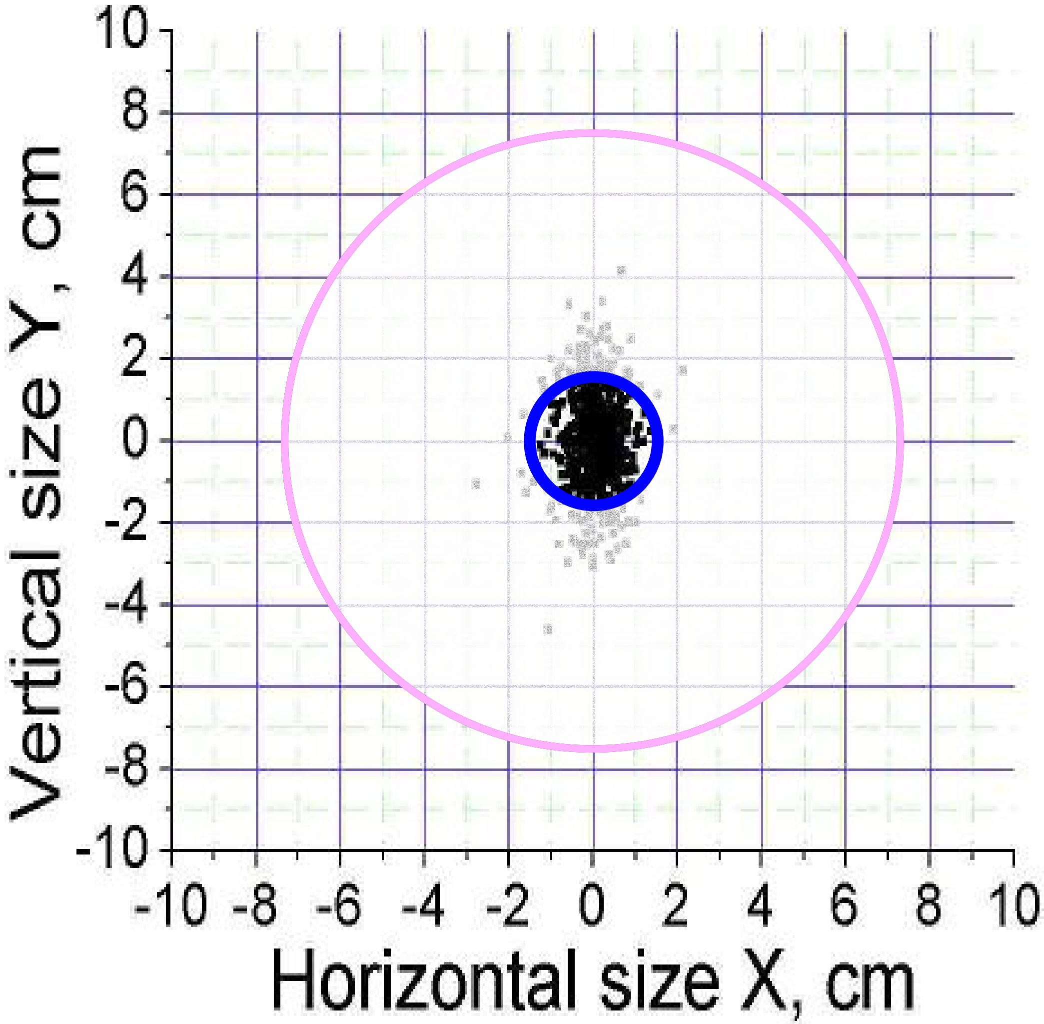
TASCA gas:

0.3 mbar He

Transmission to focal plane flange:

60 %

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

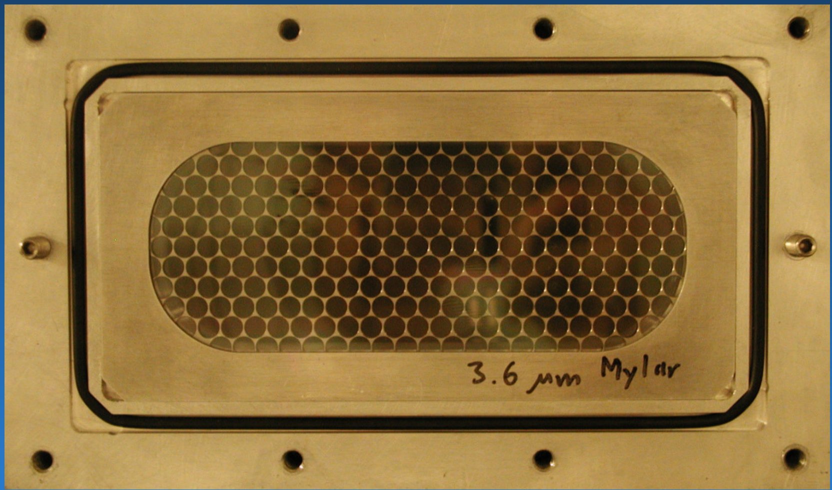


Current status

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

Next-generation RTC windows

Currently at BGS



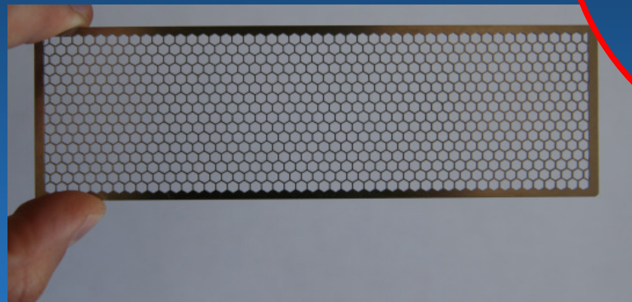
Support structure

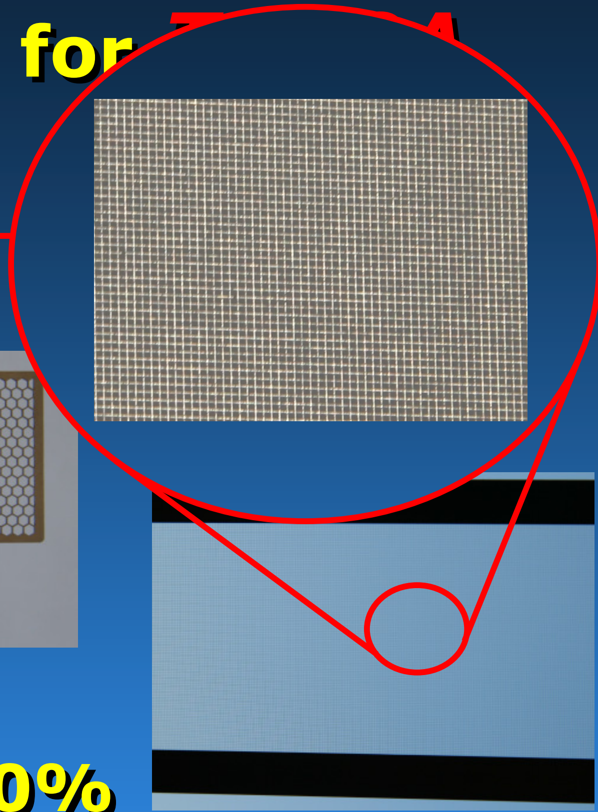
1 Layer:

- Ø 6.25 mm, T=80%

Under Way for

2 Layers:





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

Window

Currently at BGS

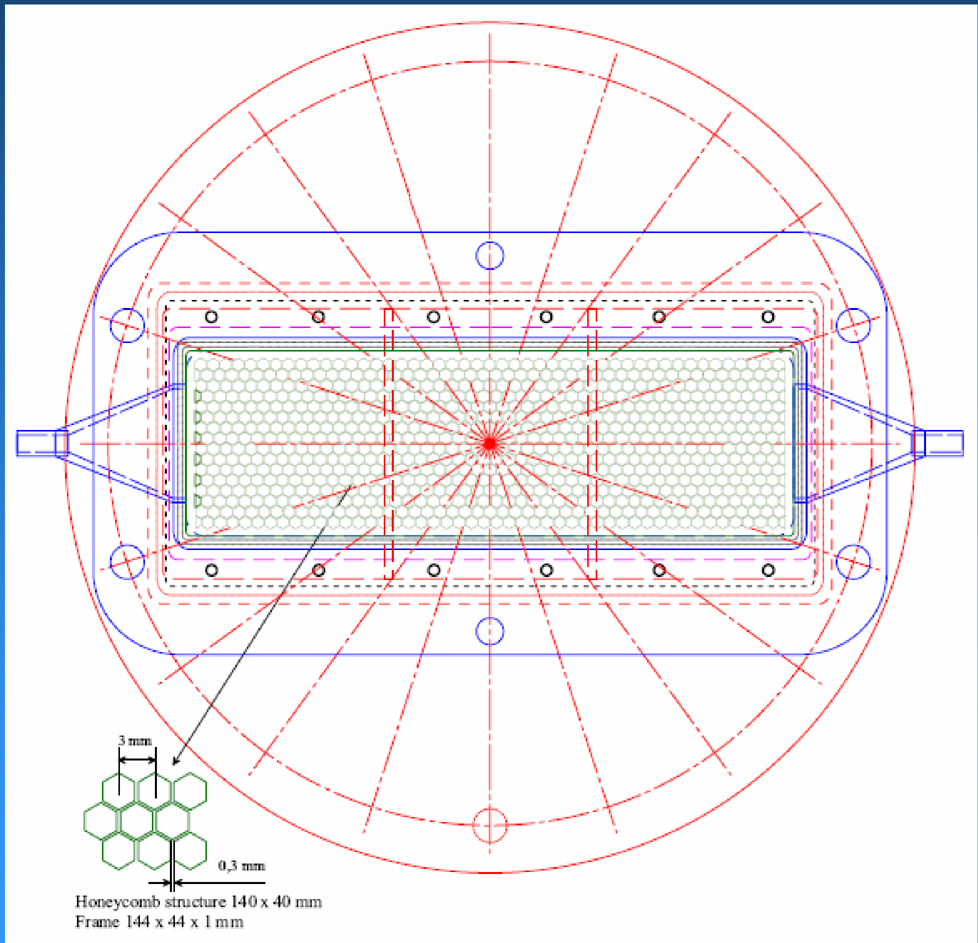
- 6.0 μm Mylar (Al)
- 3.6 μm Mylar

Under Way for

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

Planned: Two 'Commissioning' RTCs

Large Transmission mode (DQ_hQ_v)



Small image mode (DQ_vQ_h)

universität mainz

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