TASCA
Monte Carlo Simulations

* "*hot*" fusion: $^{22}Ne + ^{244}Pu \rightarrow ^{261}Rf + 5n$
* "*warm*" fusion: $^{48}Ca + ^{238}U \rightarrow ^{283}112 + 3n$
* "*cold*" fusion: $^{50}Ti + ^{208}Pb \rightarrow ^{257}Rf + 1n$

- to optimize target thickness and gas pressure

- to obtain transmission and relative rate

for

1) DQ_hQ_v (high transmission)

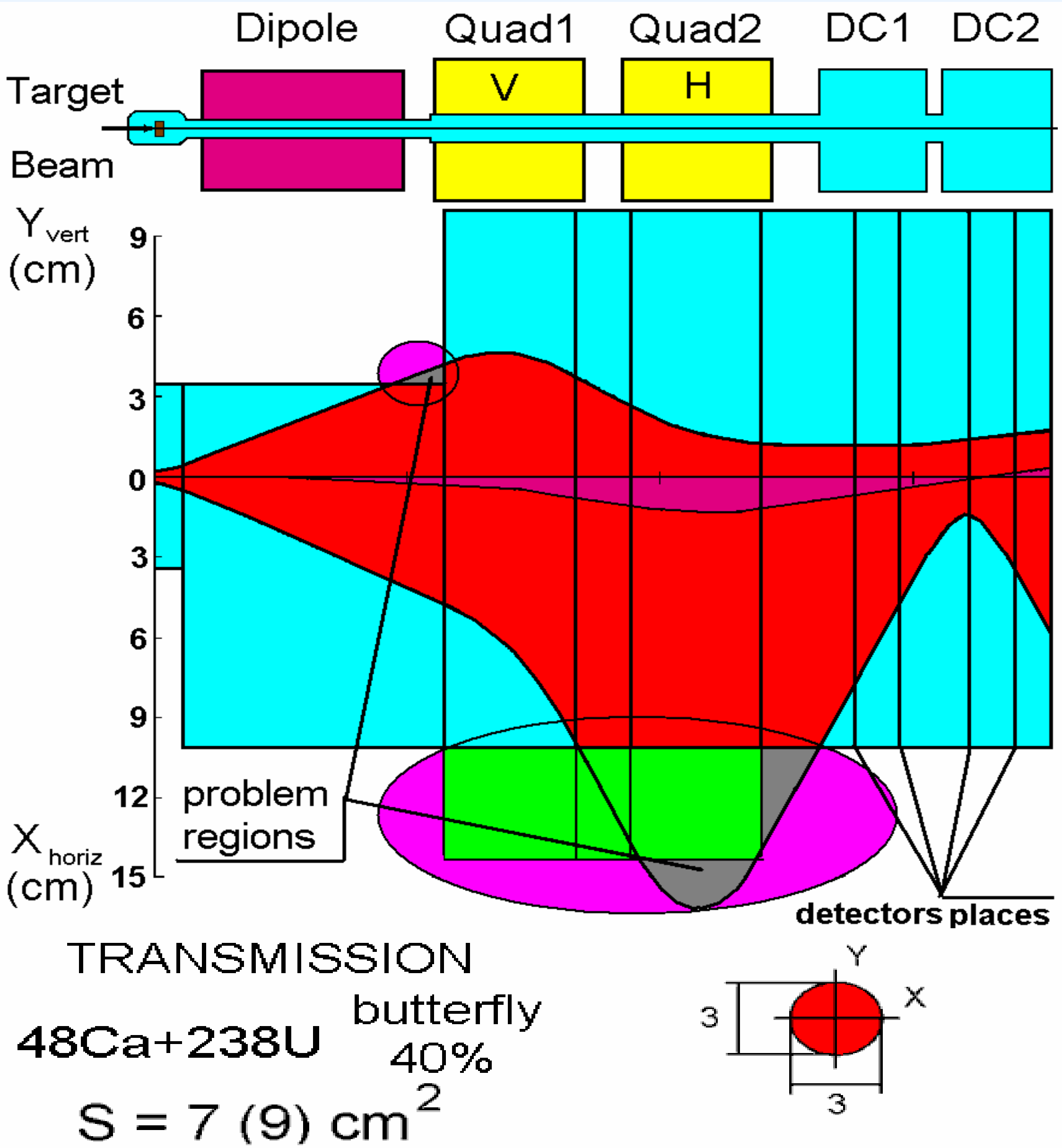
2) DQ_vQ_h (small image size)

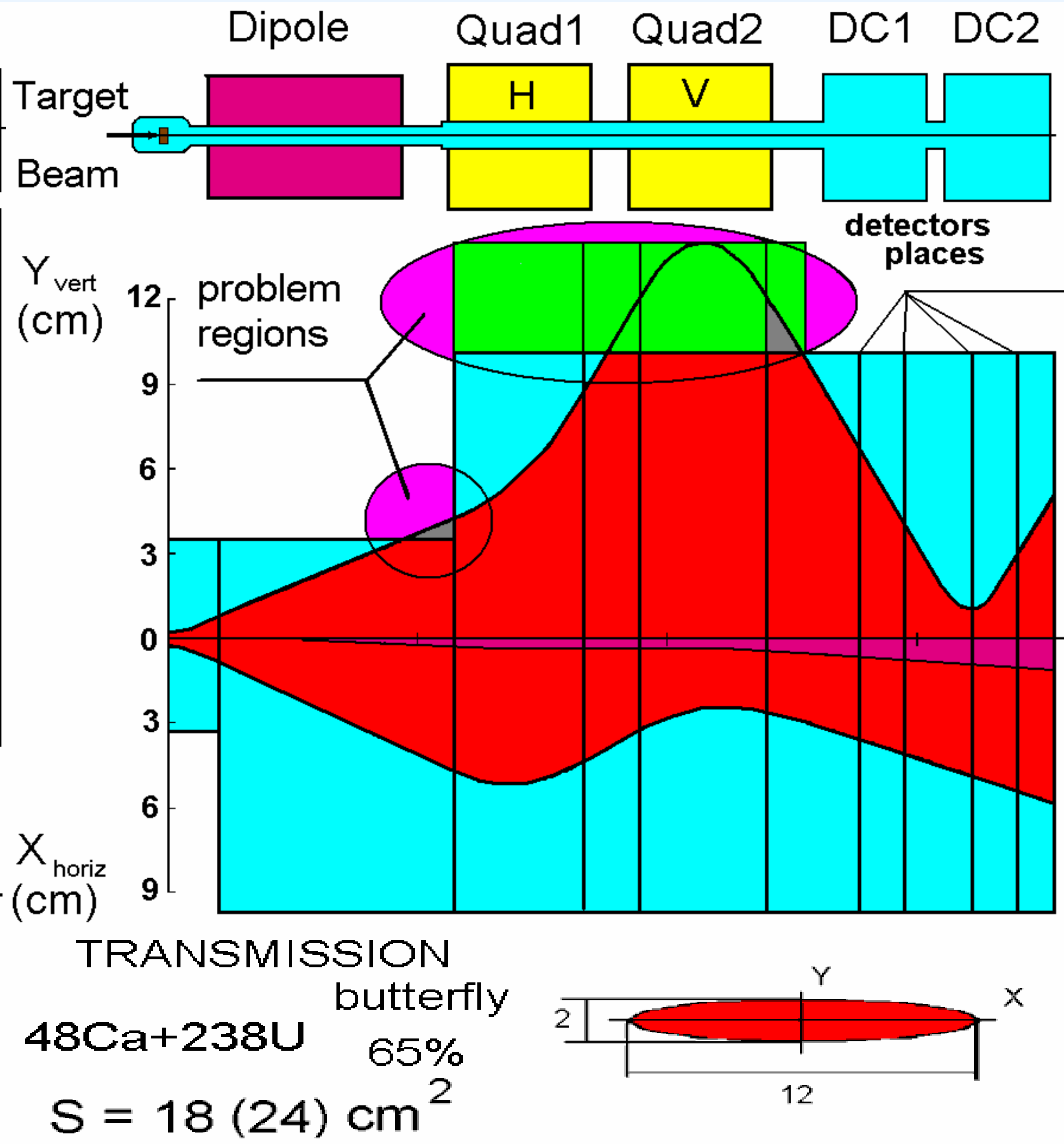
configurations

Monte Carlo program by K.E. Gregrorich, LBNL
Magnetic Fields modeling in Efremov Institute

TASCA DQQ – configuration (TRANSPORT calculations)

small image mode DQ_vQ_h / large transmission mode DQ_hQ_v

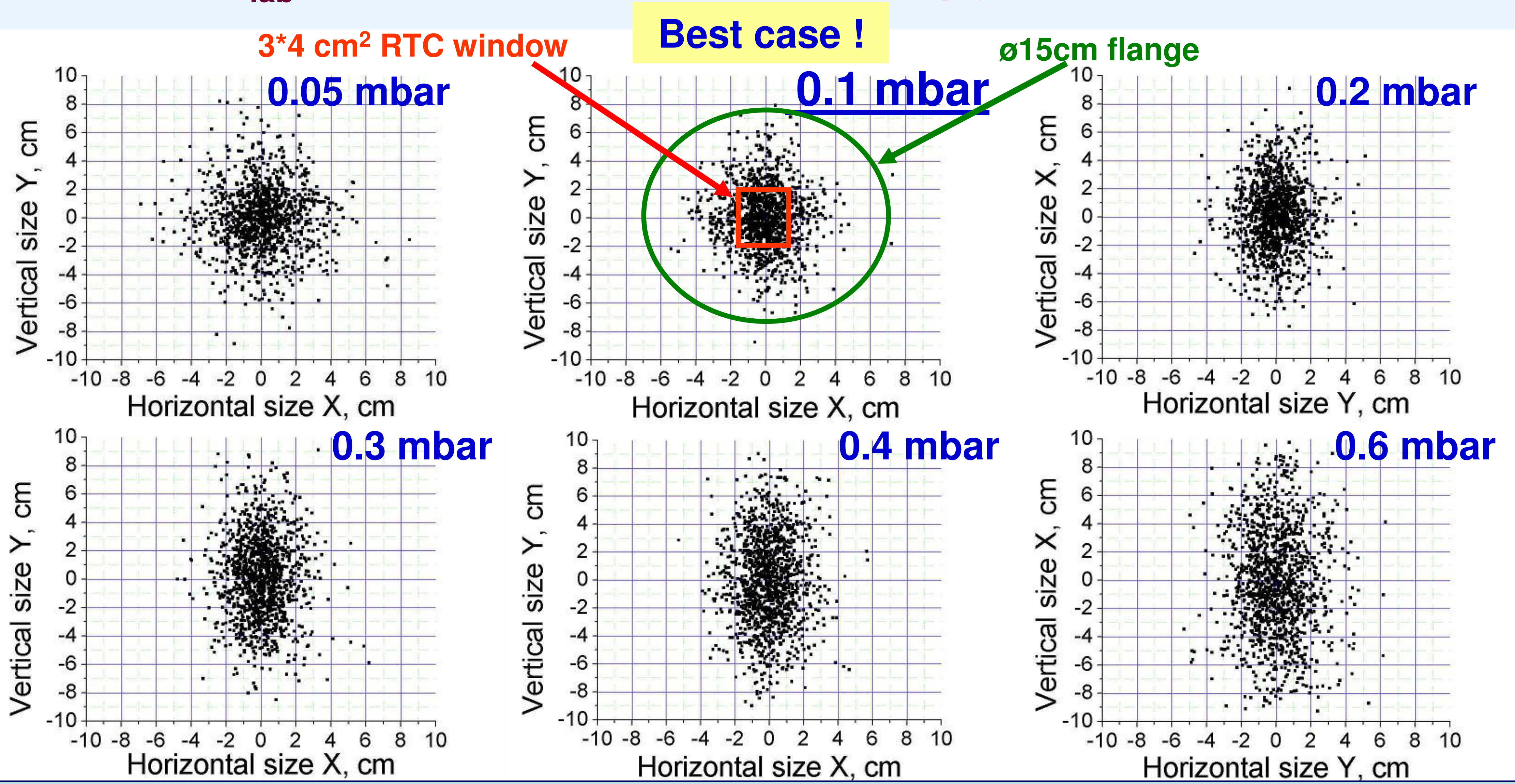




Focal Plane Images

pressure dependence - small image size: DQ_vQ_h

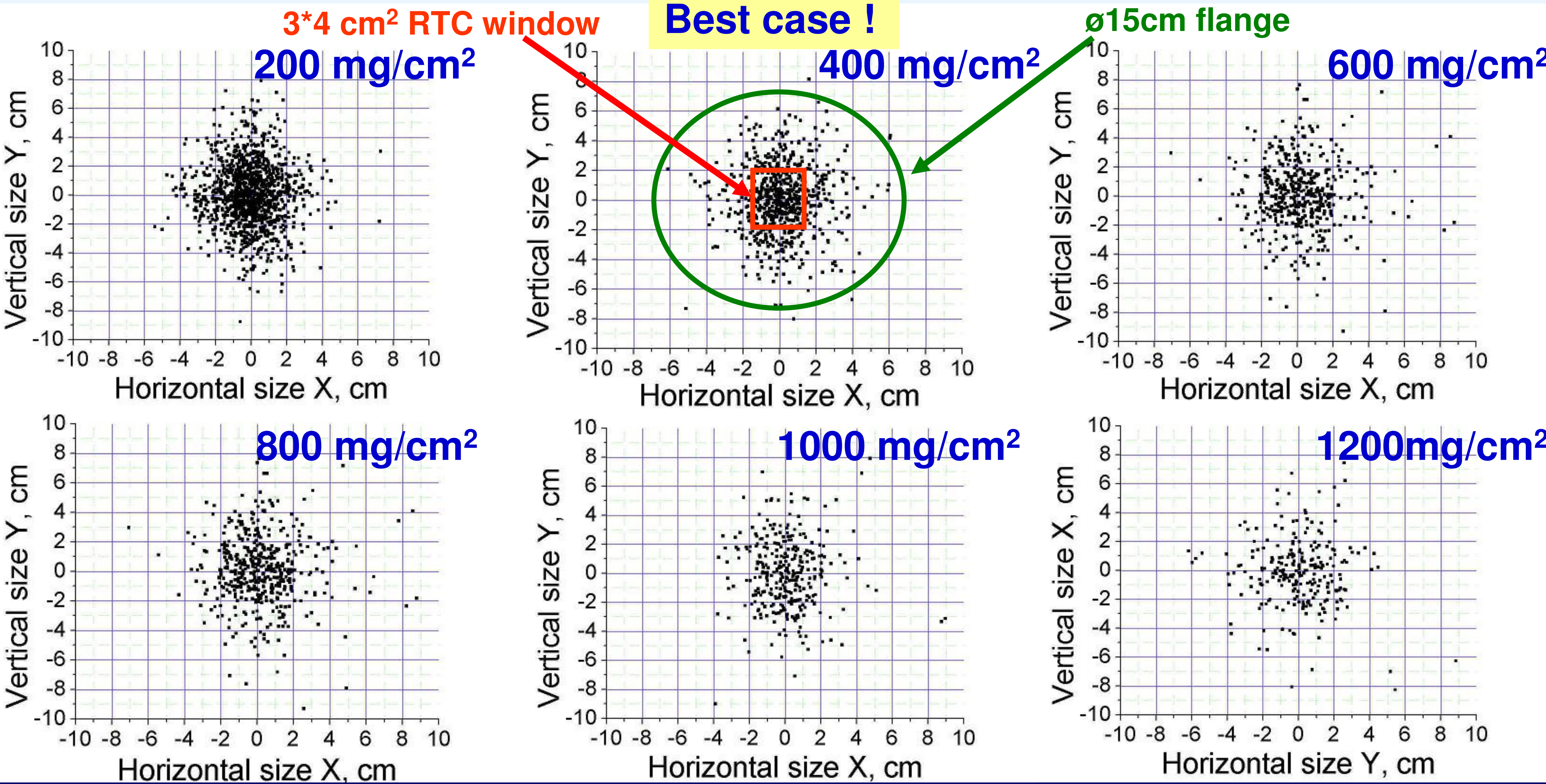
$^{22}Ne(E_{lab} = 115$ MeV CoT$) + ^{244}Pu$ (200 µg/cm²) → $^{261}Rf + 5n$



Focal Plane Images

target thickness depend. - small image size: DQ_vQ_h

$^{22}Ne(E_{lab}$ = 115 MeV CoT) + ^{244}Pu (@ 0.1 mbar He) → ^{261}Rf + 5n

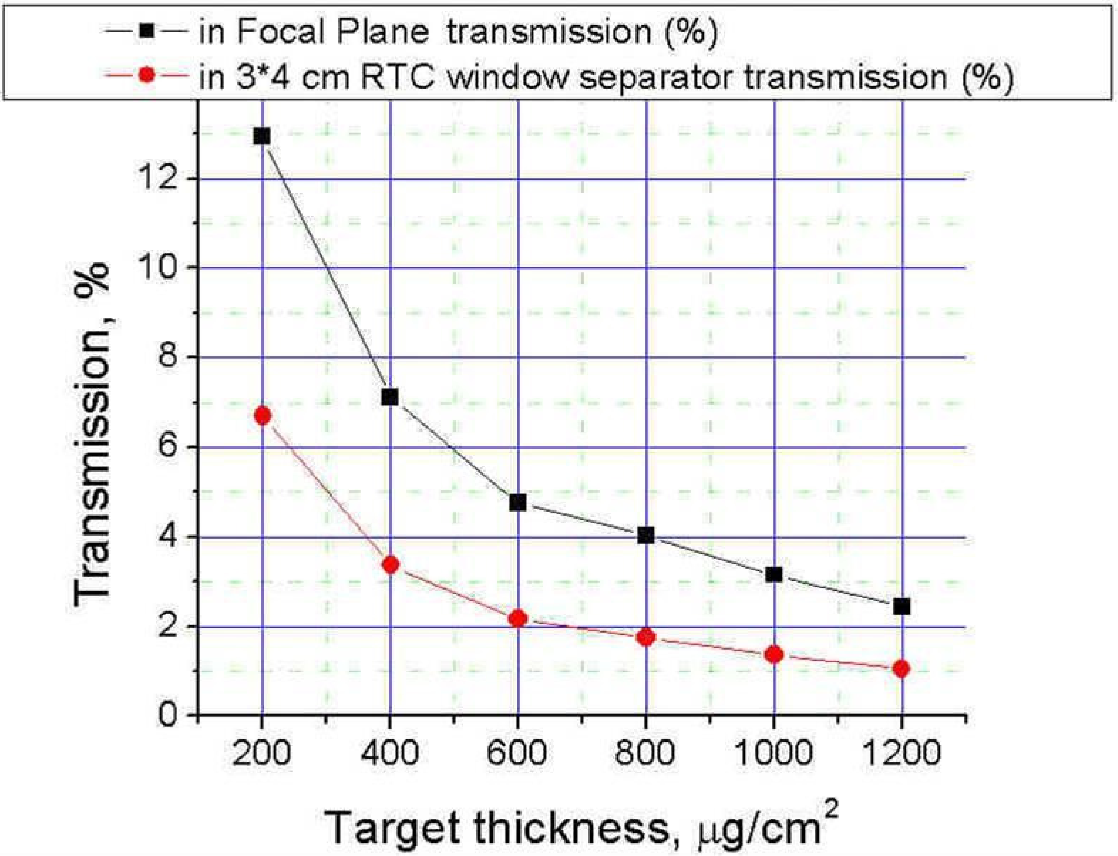


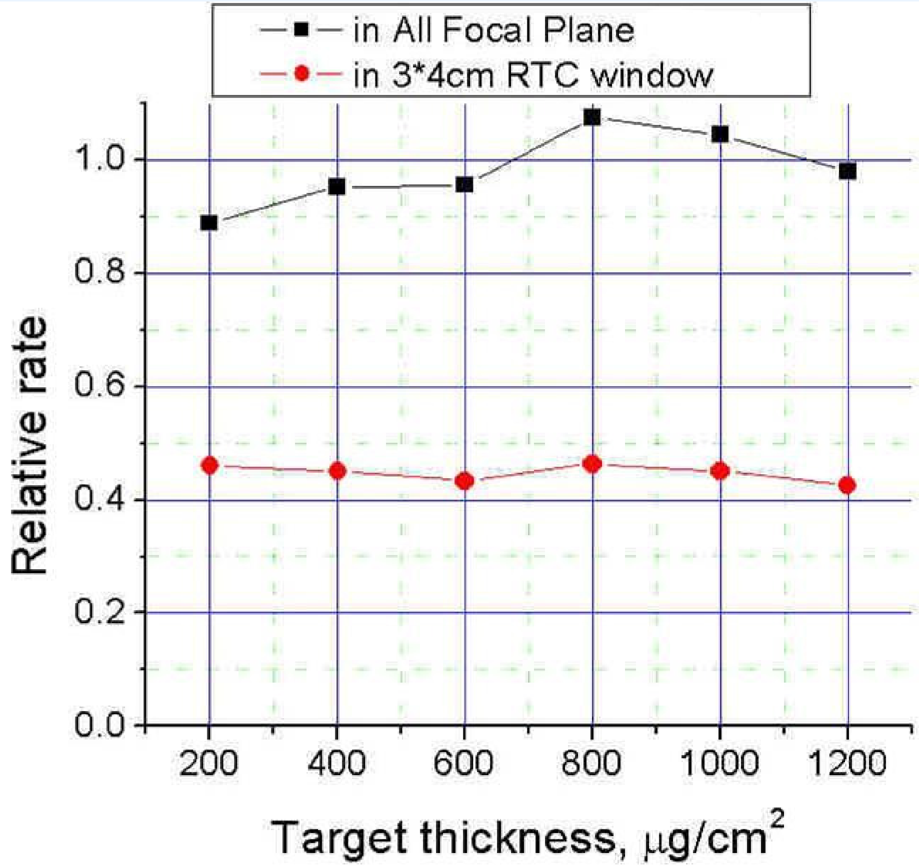
Transmission and Rate – DQ_vQ_h mode = small image size
target thickness dependence @ p(He) = 0.1 mbar

$^{22}Ne(E_{lab} = 115$ MeV CoT$) + {}^{244}Pu \rightarrow {}^{261}Rf + 5n$

Transmission of ^{261}Rf →
a) focal plane flange ø15cm²
b) 3x4 cm² RTC window

Relative rate of ^{261}Rf →
a) focal plane flange ø15cm²
b) 3x4 cm² RTC window

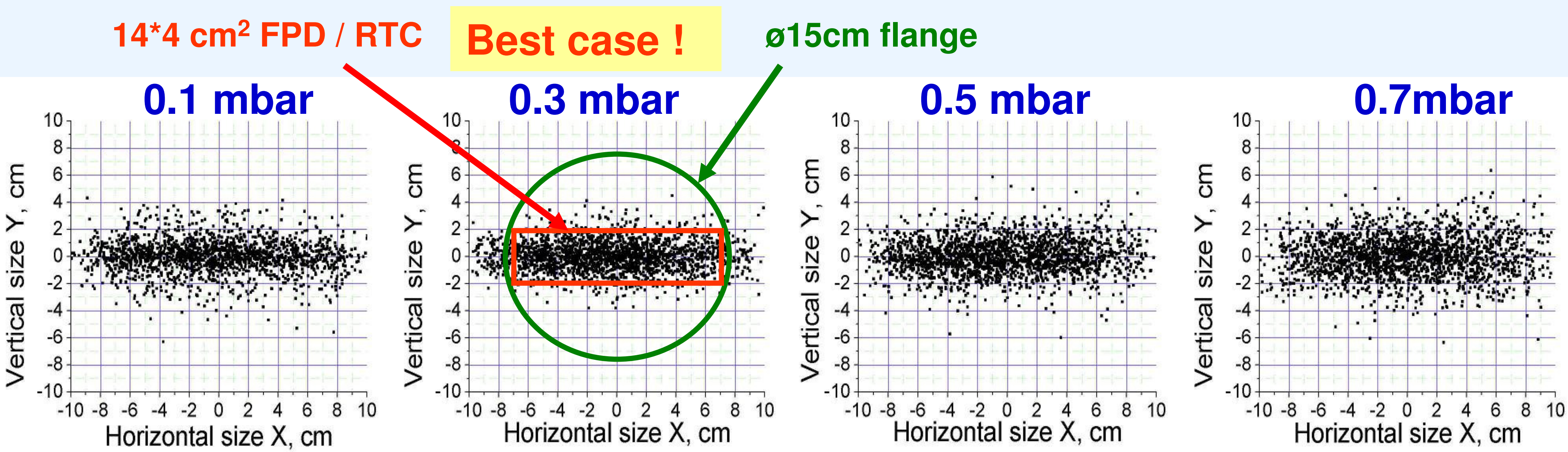


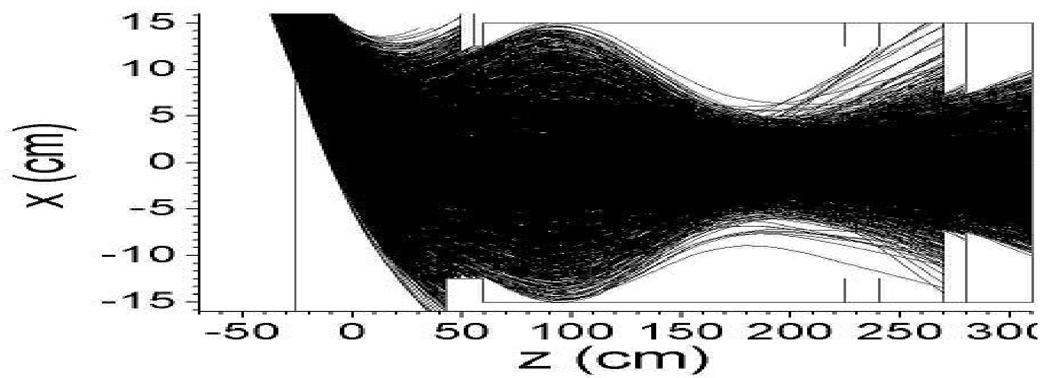


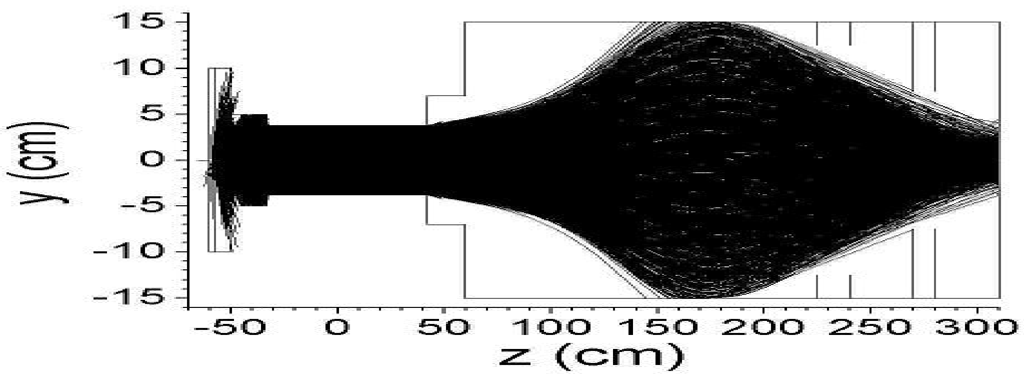
Focal Plane Images and Trajectories

pressure dependence – high transmission: DQ_hQ_v

$^{22}Ne(E_{lab}$ = 115 MeV CoT) + ^{244}Pu (200 µg/cm^2) → ^{261}Rf + 5n







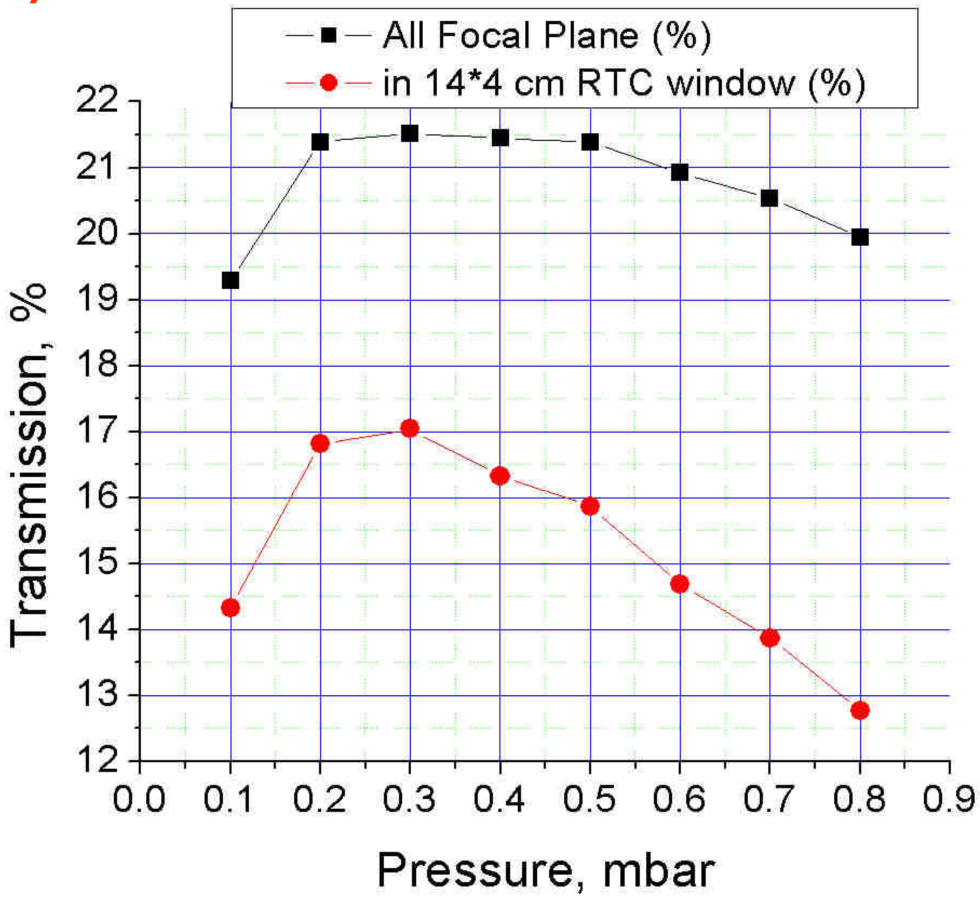
Monte Carlo Calculation: Transmission and Rate pressure dependence – high transmission: DQ_hQ_v

$^{22}Ne(E_{lab}$ = 115 MeV CoT) + ^{244}Pu (200µg/cm²) → ^{261}Rf + 5n

Transmission of ^{261}Rf →

a) focal plane flange ø 15 cm²

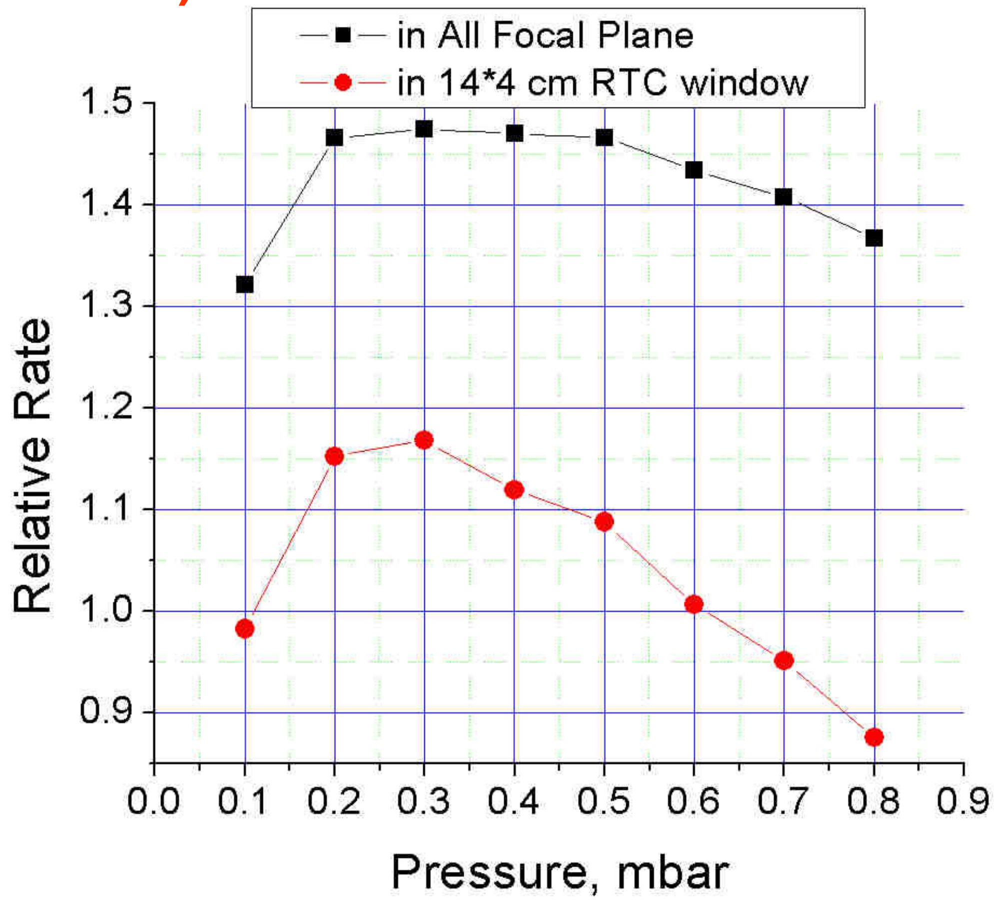
b) 14x4 cm² FPD / RTC window



Relative rate of ^{261}Rf →

a) focal plane flange ø 15 cm²

b) 14x4 cm² FPD / RTC window



Monte Carlo Calculation: Transmission and Rate

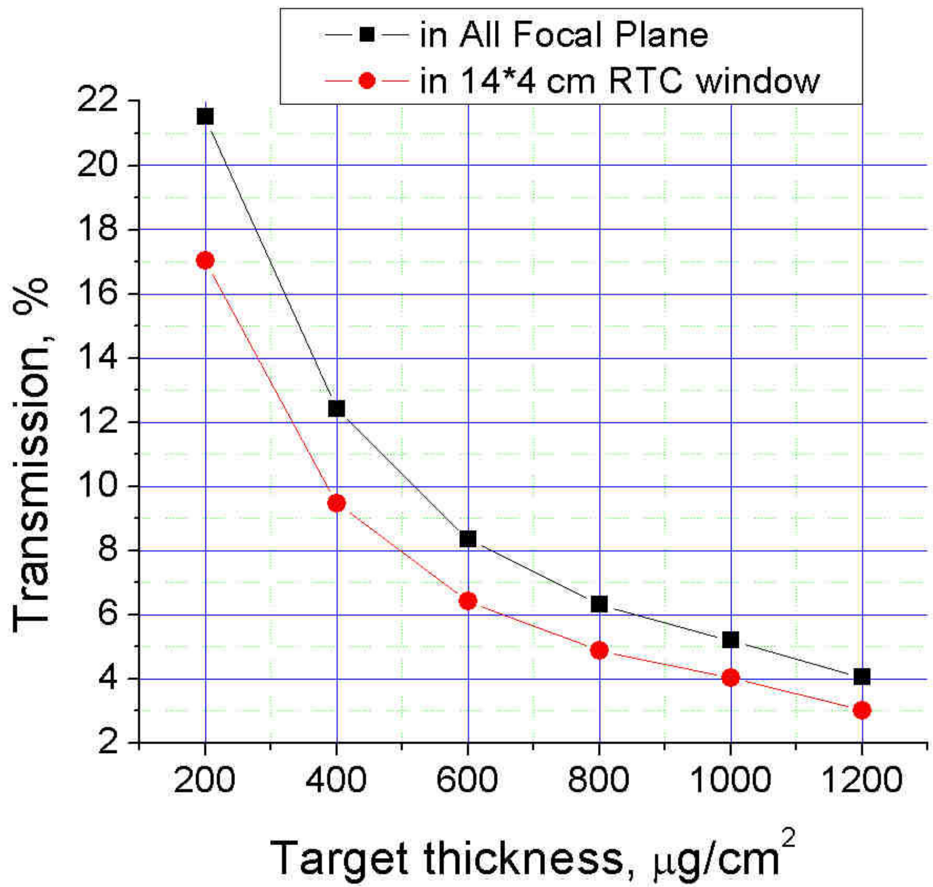
target thickness depend. – high transmission: DQ_hQ_v

$^{22}Ne(E_{lab}$ = 115 MeV CoT) + ^{244}Pu (@ 0.3 mbar He) → ^{261}Rf + 5n

Transmission of ^{261}Rf →

a) focal plane flange ø15 cm^2

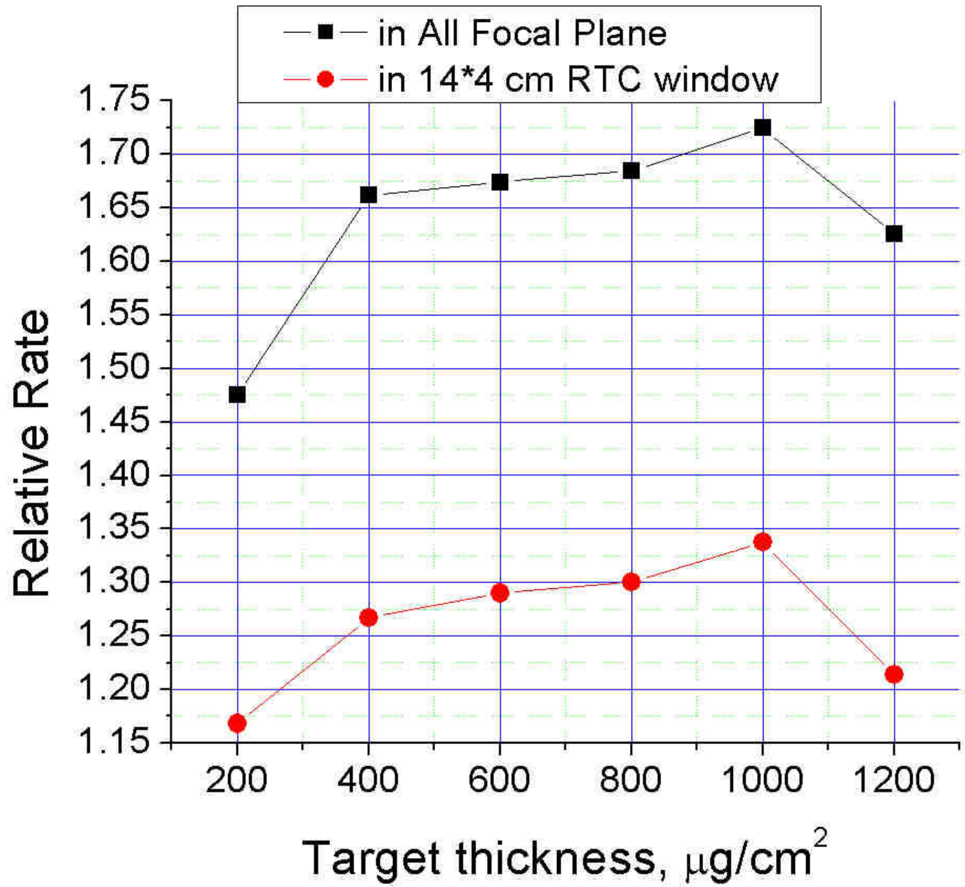
b) 14x4 cm^2 FPD / RTC window



Relative rate of ^{261}Rf →

a) focal plane flange ø15 cm^2

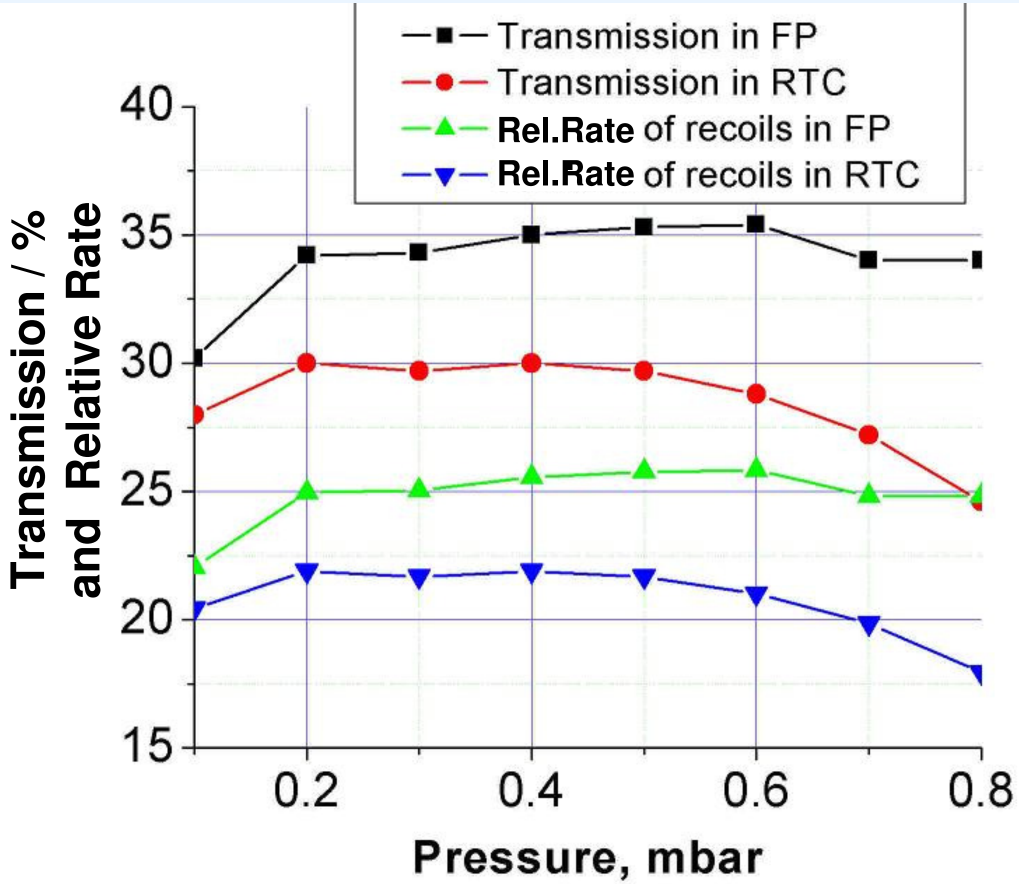
b) 14x4 cm^2 FPD / RTC window



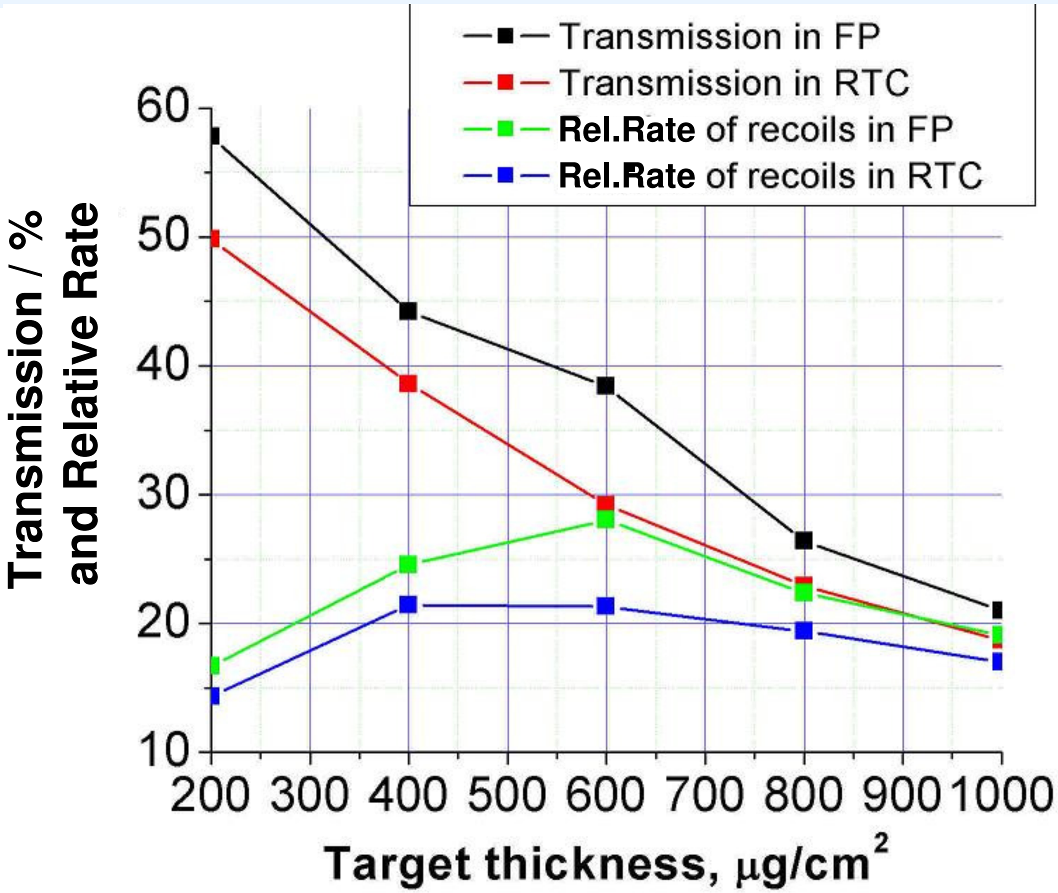
Monte Carlo Calculation: Transmission and Rate
small image size mode: DQ_vQ_h – 3x4 cm² RTC

^{48}Ca (E_{lab} = 235 MeV CoT) + ^{238}U → $^{283}112$ + 3n

pressure dependence
@ 600 mg/cm² target thickness



target thickness dependence
@ p(He) = 0.4 mbar

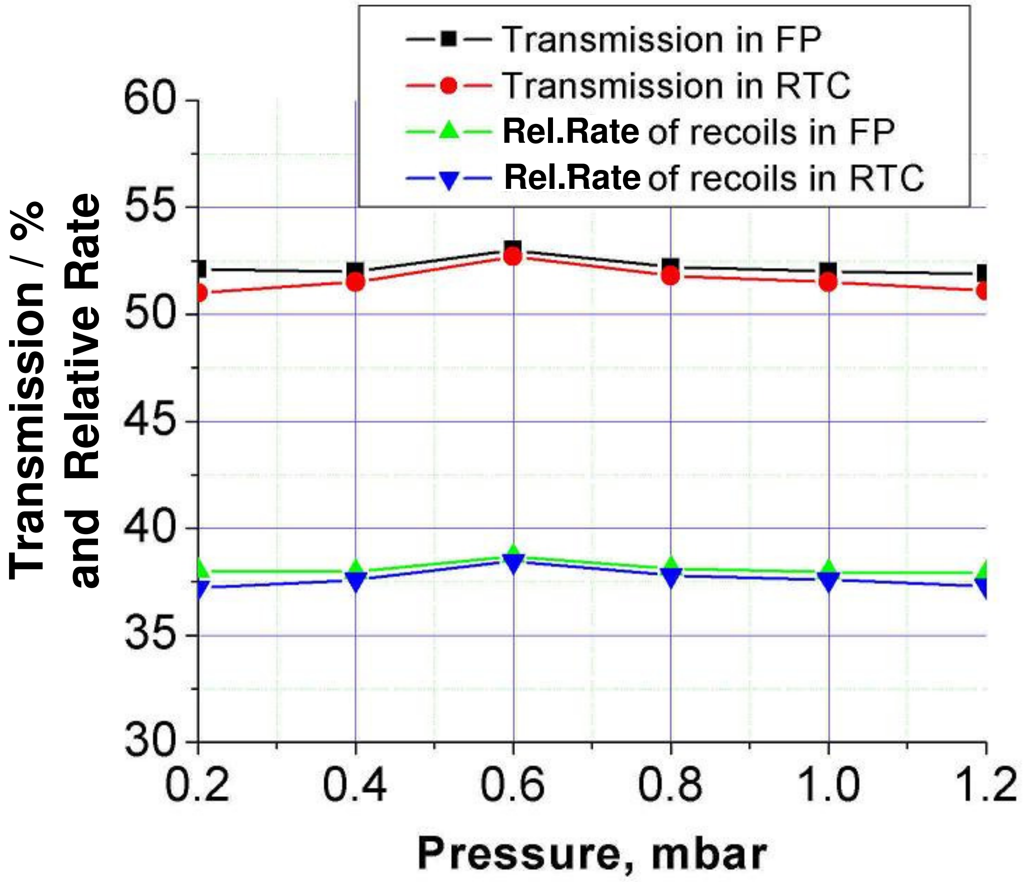


A.Semchenkov
GSI, 15.05.2006

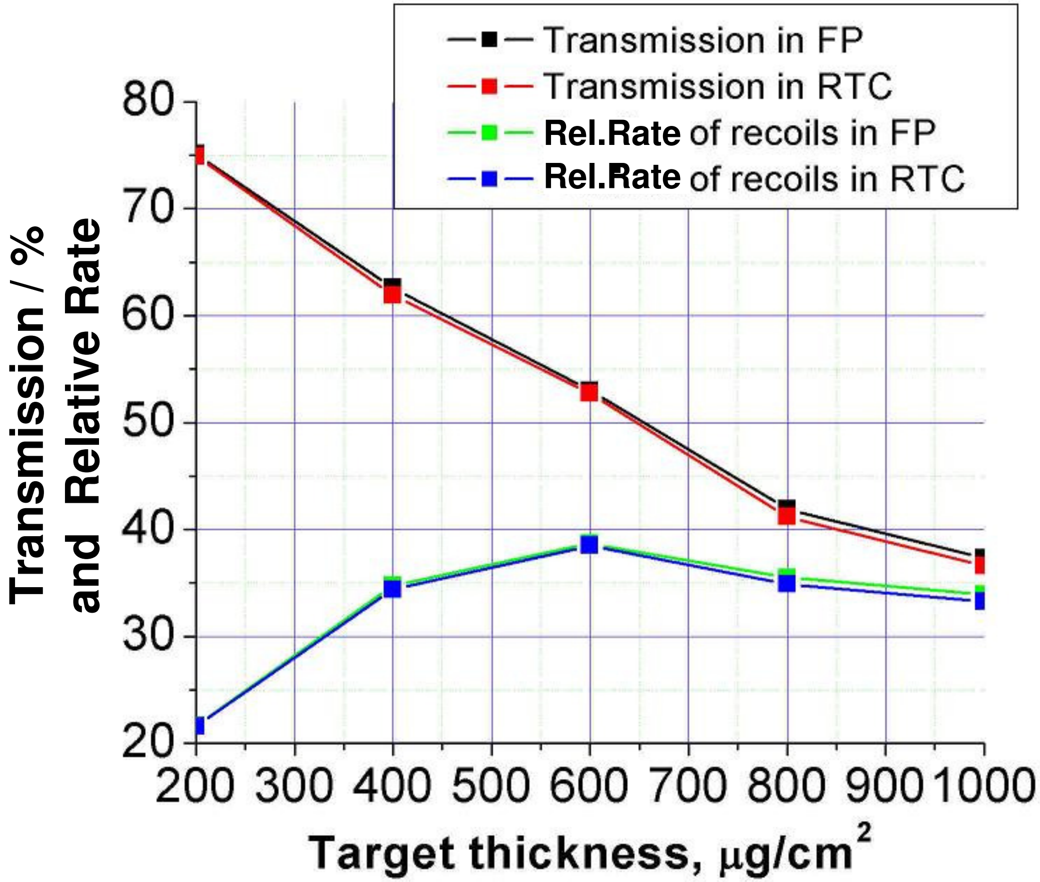
Monte Carlo Calculation: Transmission and Rate
high transmission mode: DQ_hQ_v - 14x4 cm² FPD / RTC

^{48}Ca (E_{lab} = 235 MeV CoT) + ^{238}U → $^{283}112$ + 3n

pressure dependence
@ 600 mg/cm² target thickness



target thickness dependence
@ p(He) = 0.6 mbar

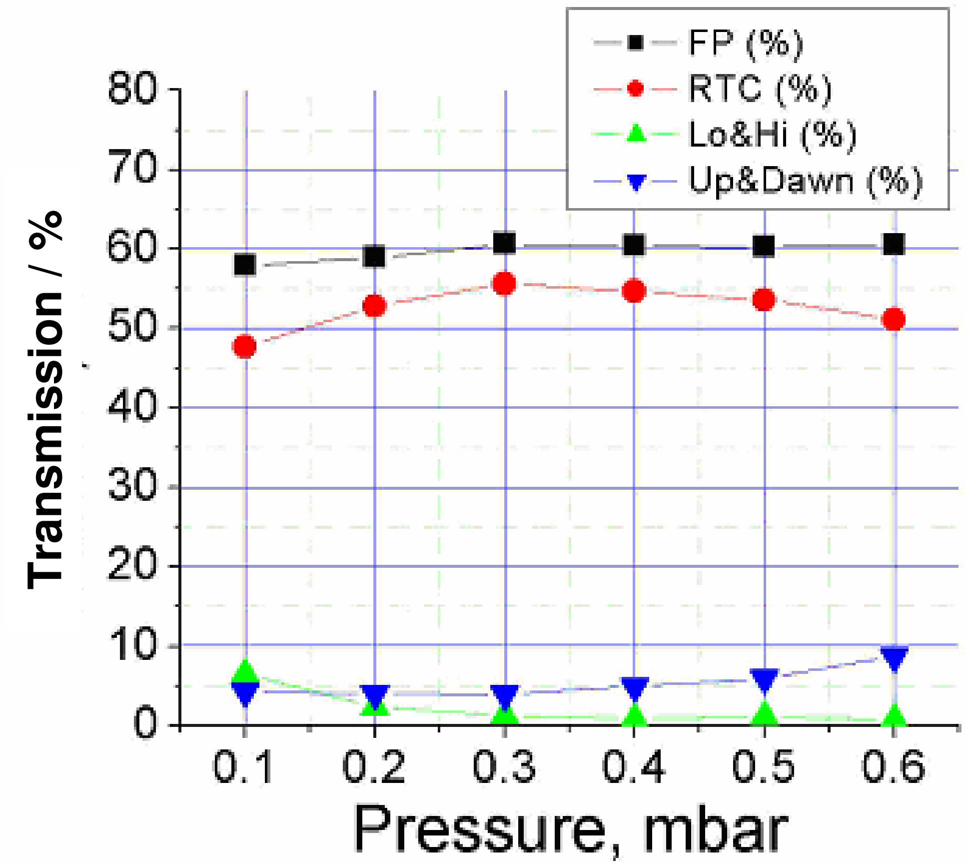


Monte Carlo Calculation: Transmission and Rate

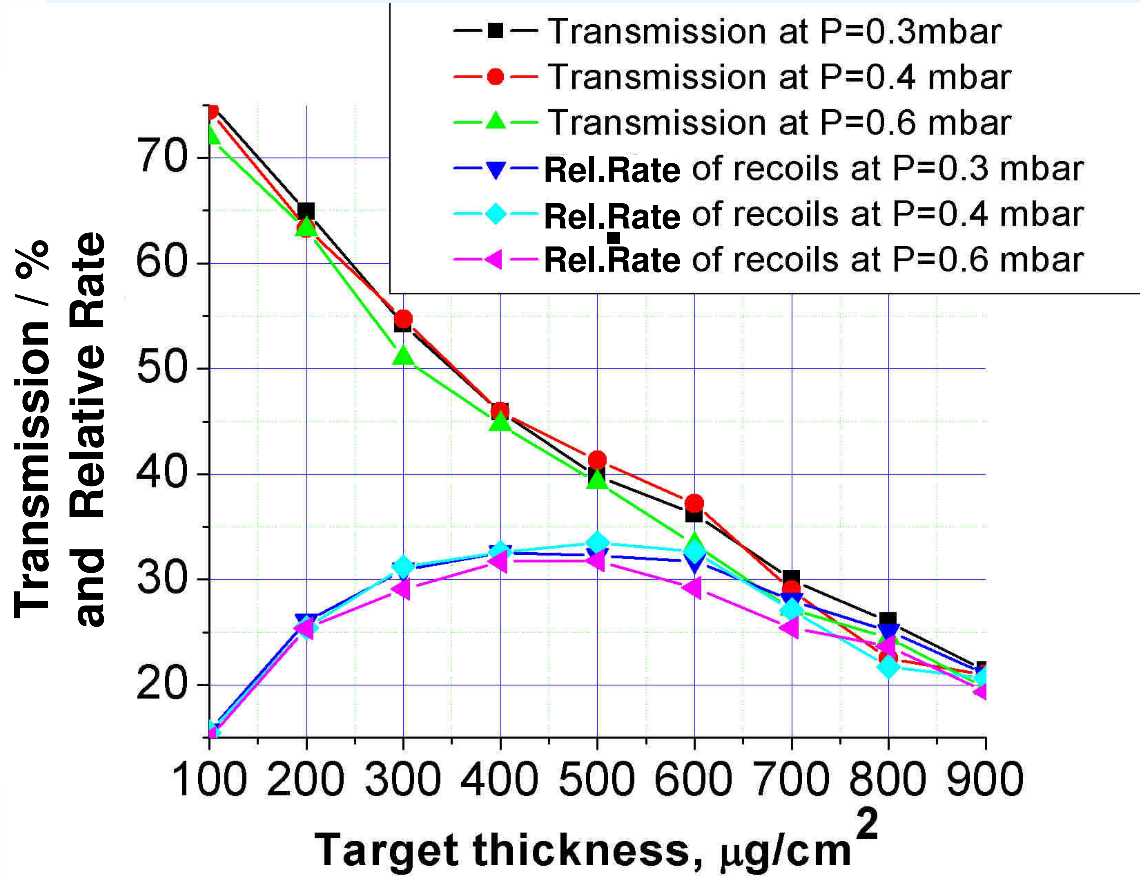
small image size mode: DQ_vQ_h – ø 3 cm RTC

$^{50}Ti(E_{lab} = 235\ MeV\ CoT) + {}^{208}Pb \rightarrow {}^{257}Rf + 1n$

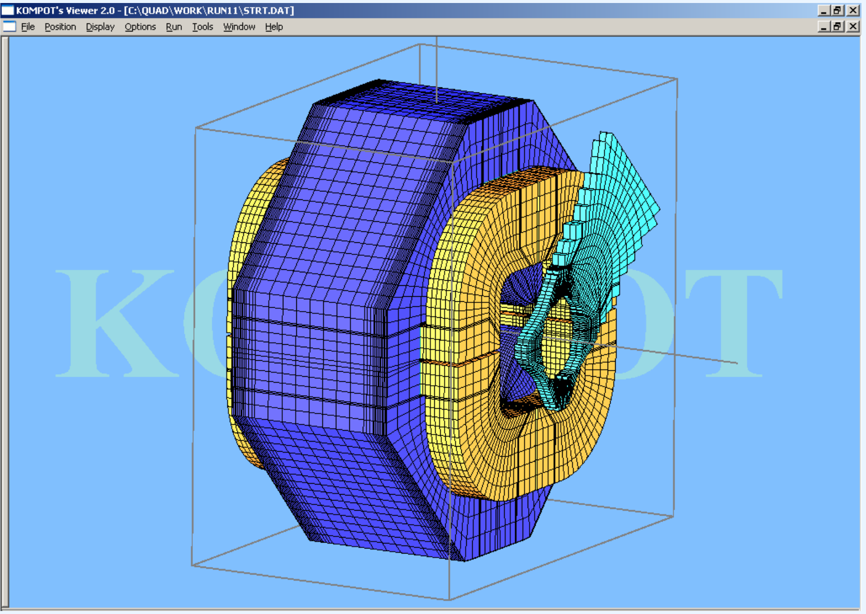
pressure dependence
@ 300 mg/cm² target thickness



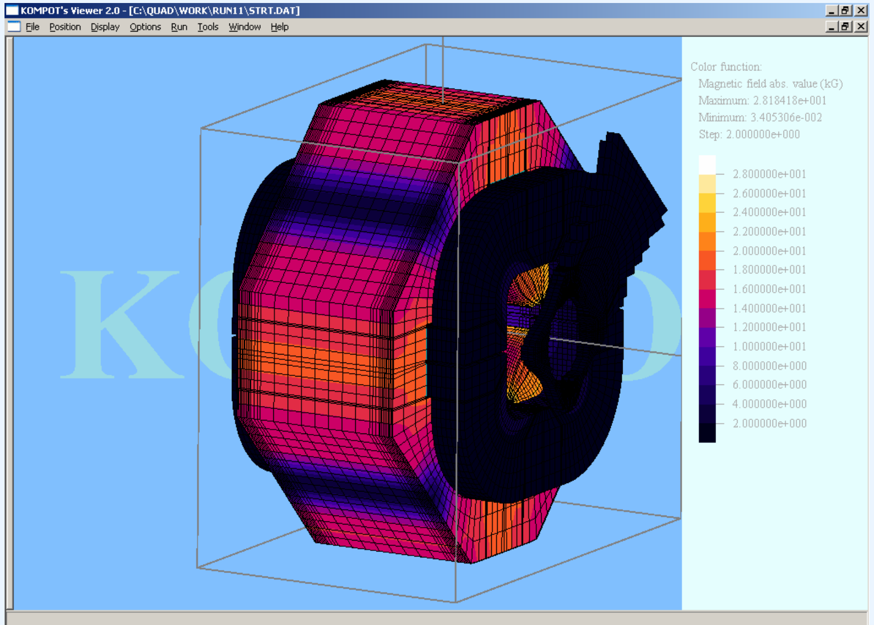
target thickness dependence
@ p(He) = 0.3, 0.4 and 0.6 mbar



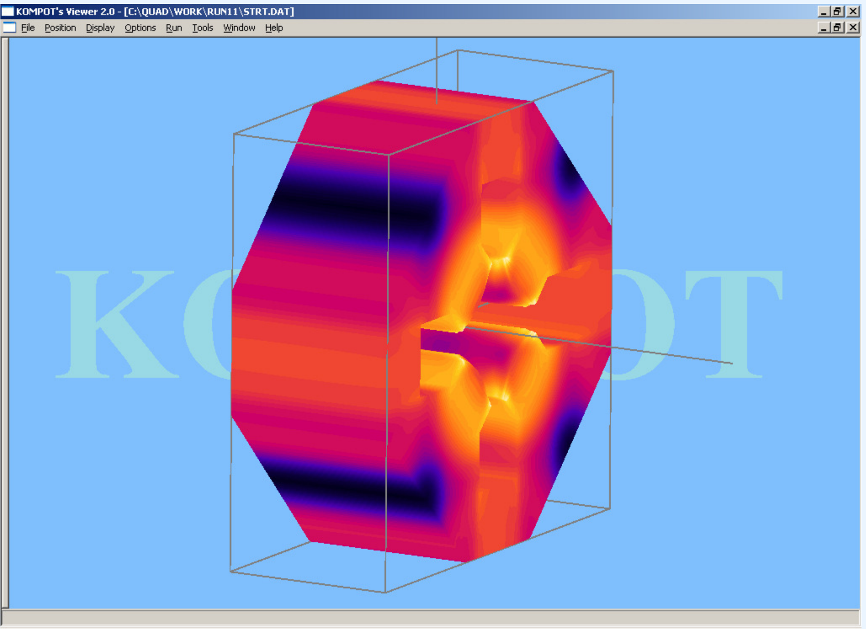
TASCA magnets KOMPOT simulations



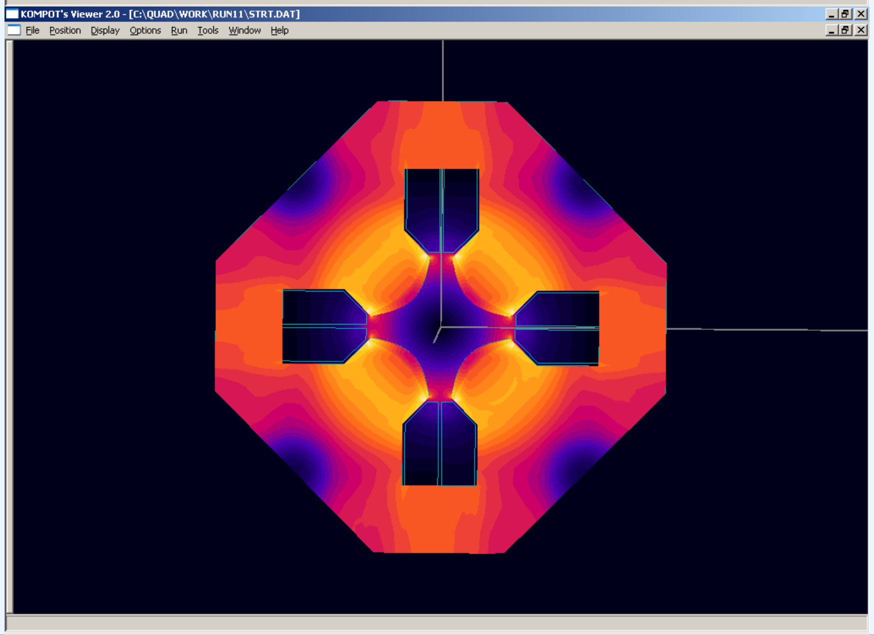
Finite element model of Quad, Vacuum chamber (not shown) and Valve (***0.5 million nodal points***)



Magnetic field distribution on the surface of Quad and Valve



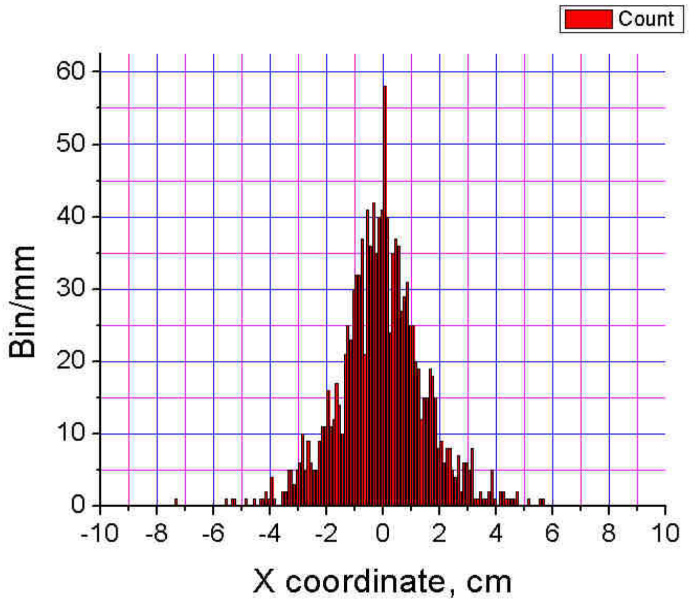
Magnetic field distribution on the surface of Quad Iron Yoke (without mesh)



Magnetic field distribution on the surface of Quad Iron Yoke and in air in the center region of the magnet

^{261}Rf x-y-distribution in TASCA focal plane, DQ_vQ_h mode

^{22}Ne (E_{lab} = 115 MeV CoT) + ^{244}Pu (200 µg/cm^2) → ^{261}Rf + 5n



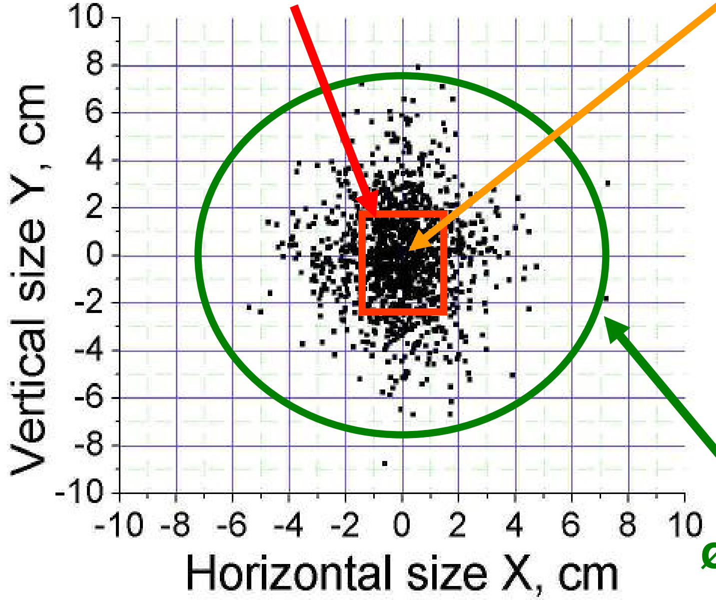
p(He) = 0.1 mbar

Transmission → Focal Plane: 12.6%

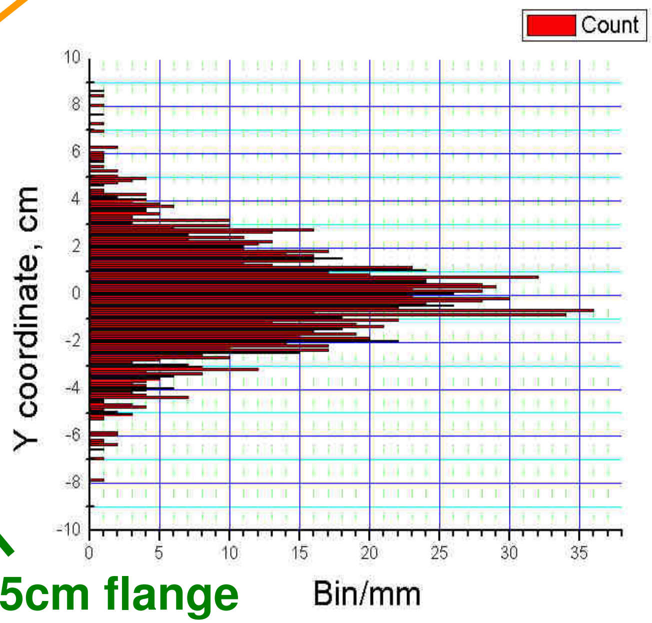
X coordinate	Fraction covered
±5 cm	100%
±4 cm	99%
±3 cm	97%
±2 cm	80%
±1 cm	71%

50% inside 3*4 cm RTC window

3*4 cm^2 RTC window



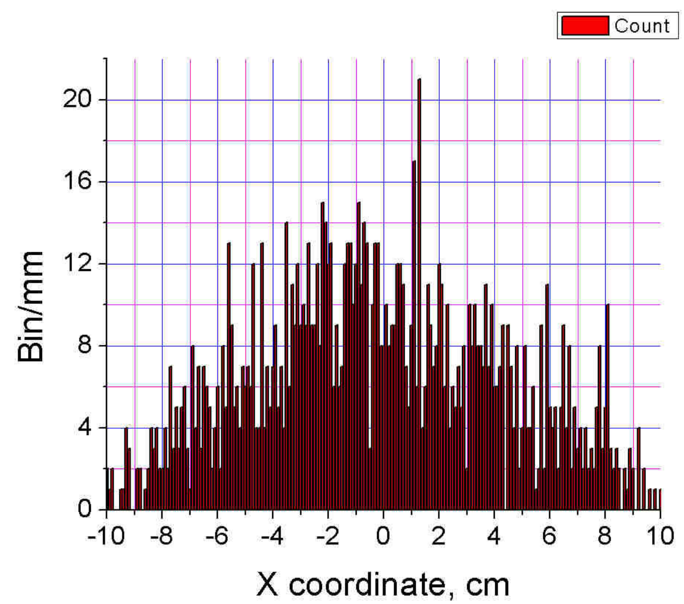
ø15cm flange



Y coordinate	Fraction covered
±6 cm	100%
±5 cm	99%
±4 cm	97%
±3 cm	93%
±2 cm	76%
±1.5 cm	65%

^{261}Rf x-y-distribution in TASCA focal plane, DQ_hQ_v mode

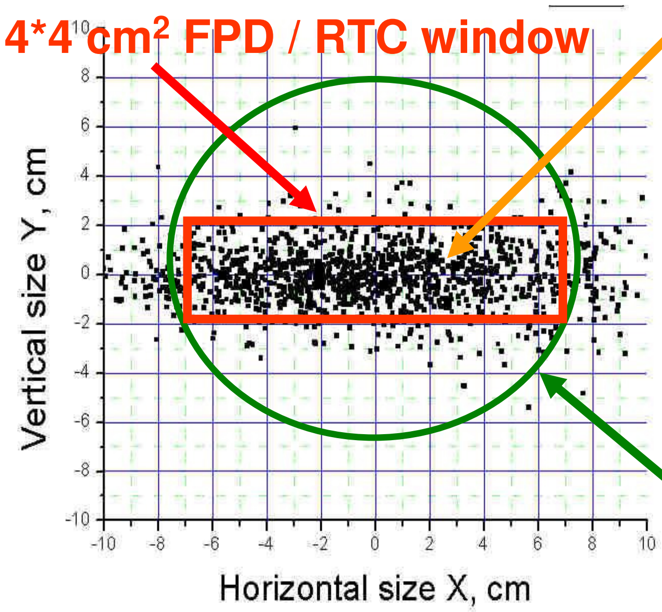
^{22}Ne (E_{lab} = 115 MeV CoT) + ^{244}Pu (400 µg/cm^2) → ^{261}Rf + 5n



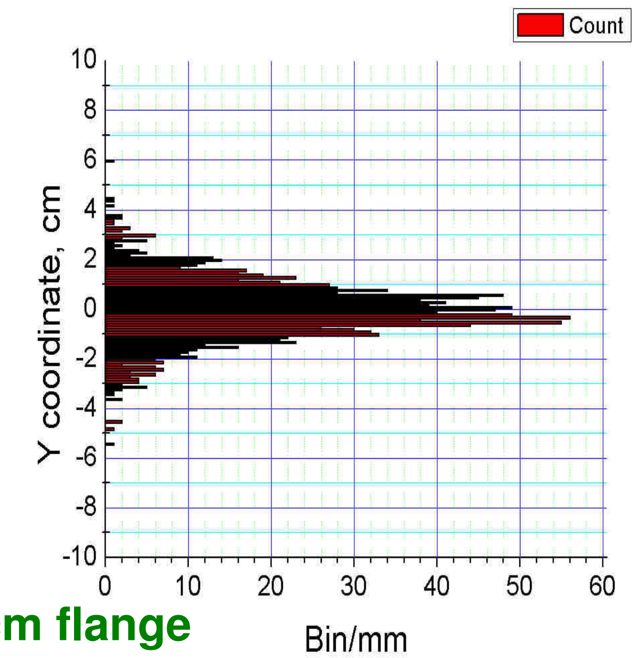
@p(He) = 0.3 mbar

Transmission →
Focal Plane flange: 12%

81% inside
14*4 cm RTC window



ø15cm flange



X coordinate	Fraction covered
±8 cm	99%
±7 cm	90%
±6 cm	80%
±5 cm	70%
±4 cm	60%
±3 cm	53%
±2 cm	33%
±1 cm	17%

Y coordinate	Fraction covered
±4 cm	99%
±3 cm	97%
±2 cm	90%
±1 cm	64%