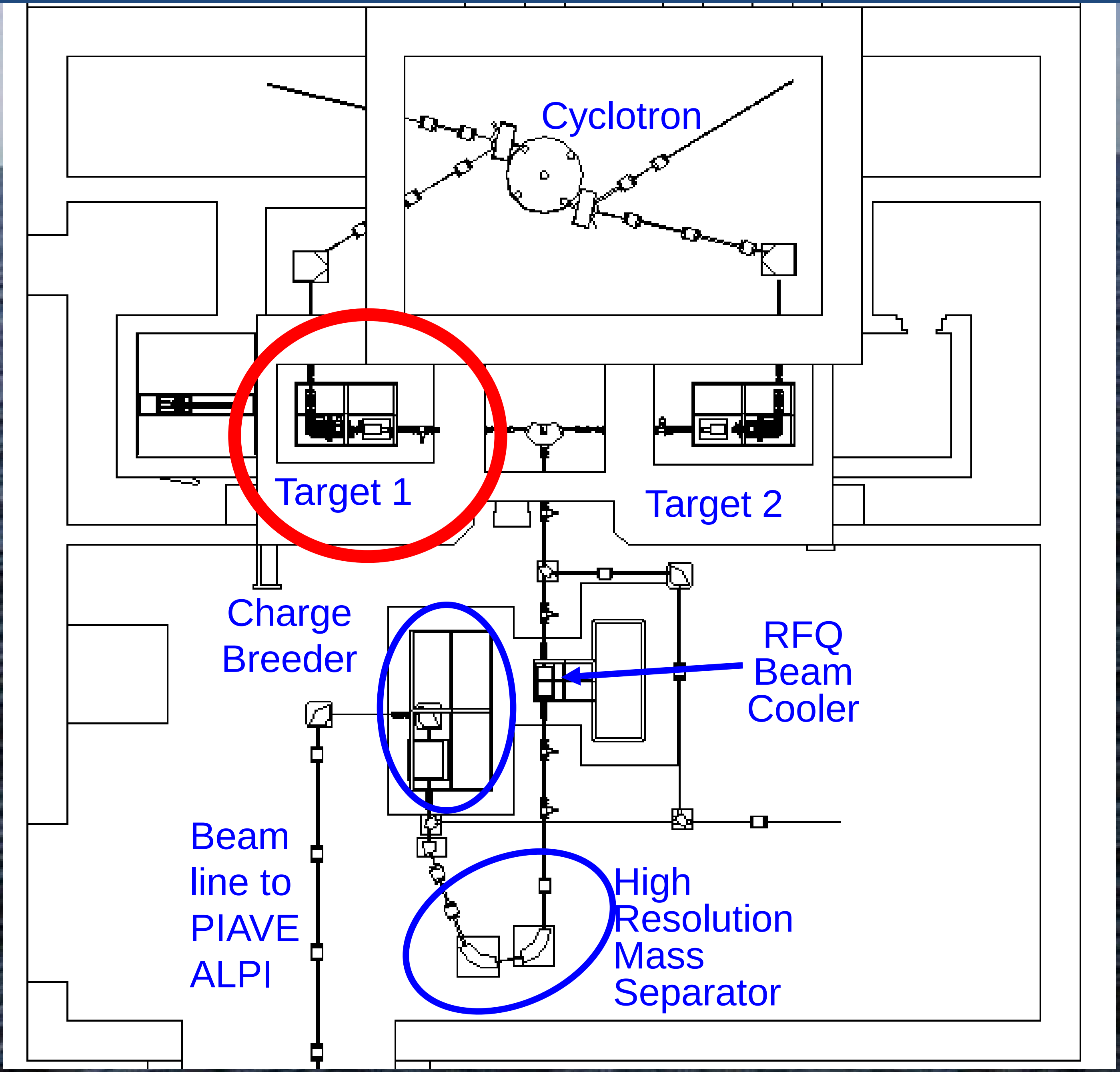
TRANSPORT, SELECTION AND PURIFICATION OF SPES SECONDARY BEAM

A. Andrighetto, M. Comunian, A. Dainelli, A. Galatà, F. Moisio, A. M. Porcellato, L. Costa, M. De Lazzari, M. Maggiore, J. Montano, L. Calabretta et Al.

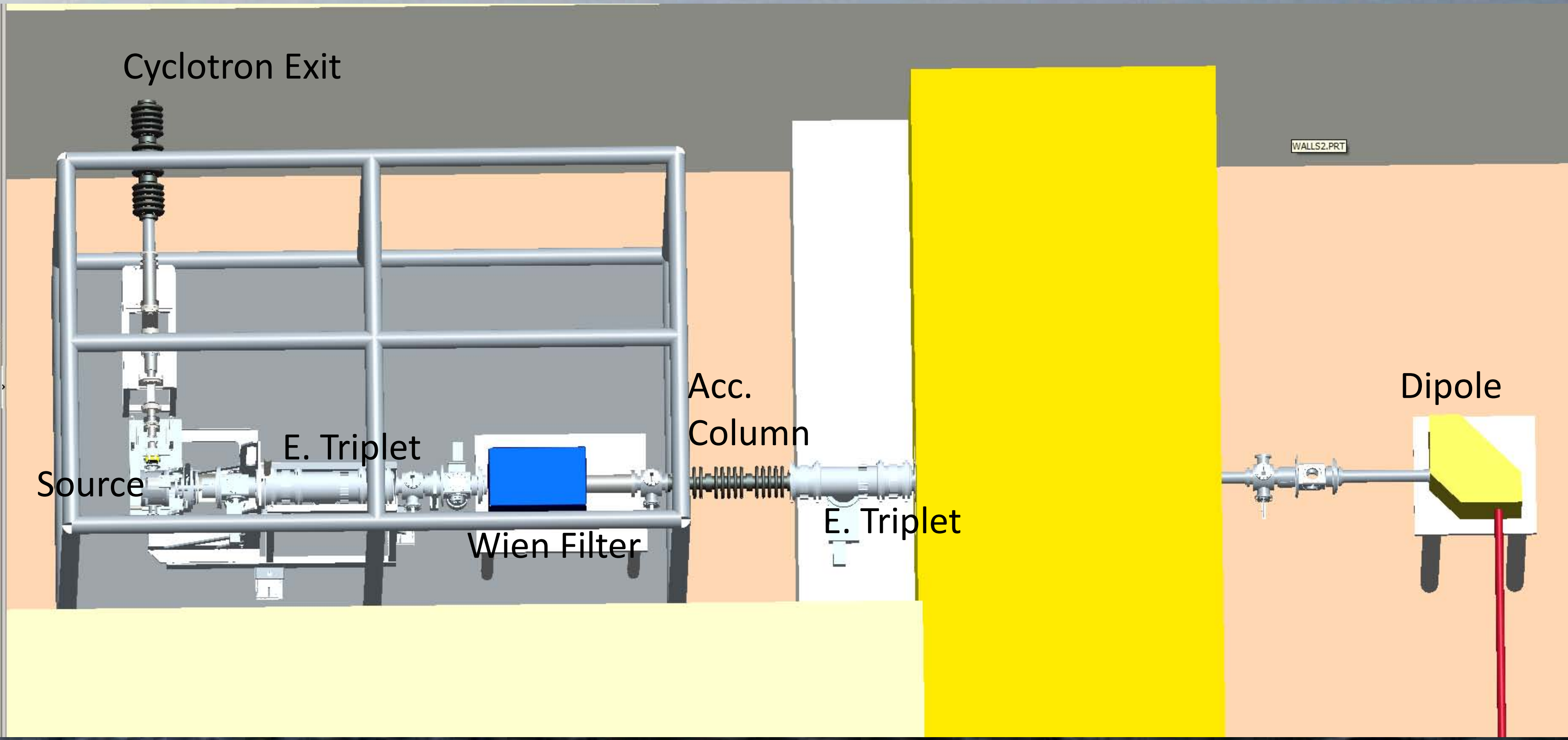
SPES, secondary beam transport layout

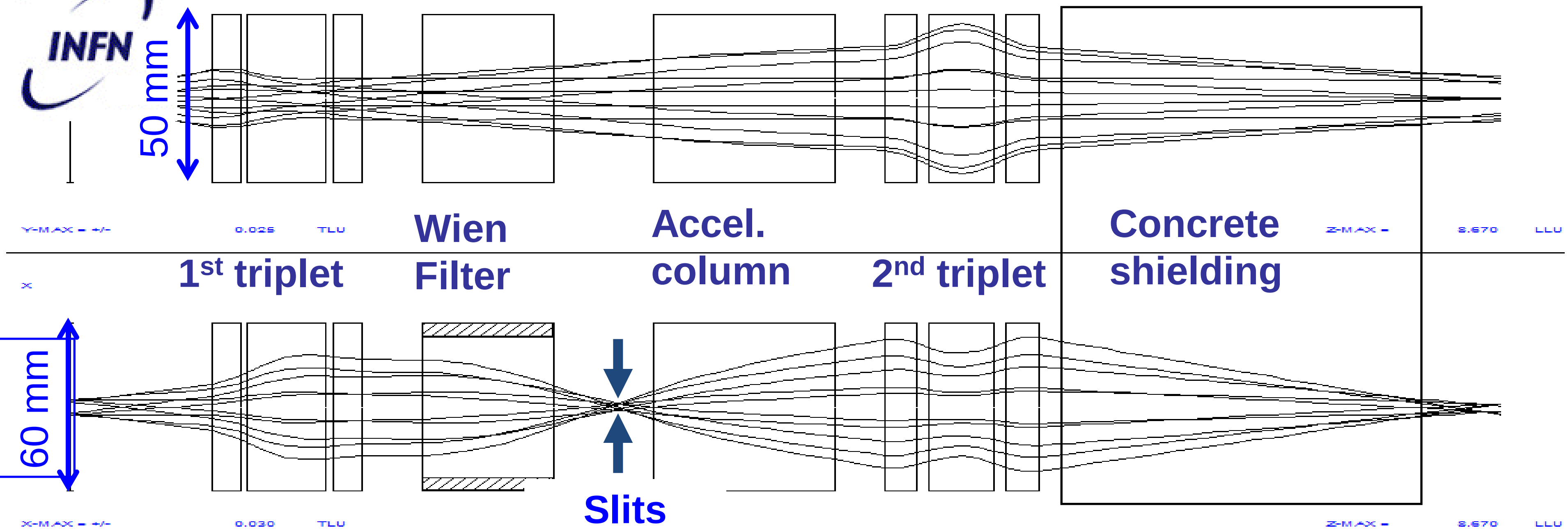


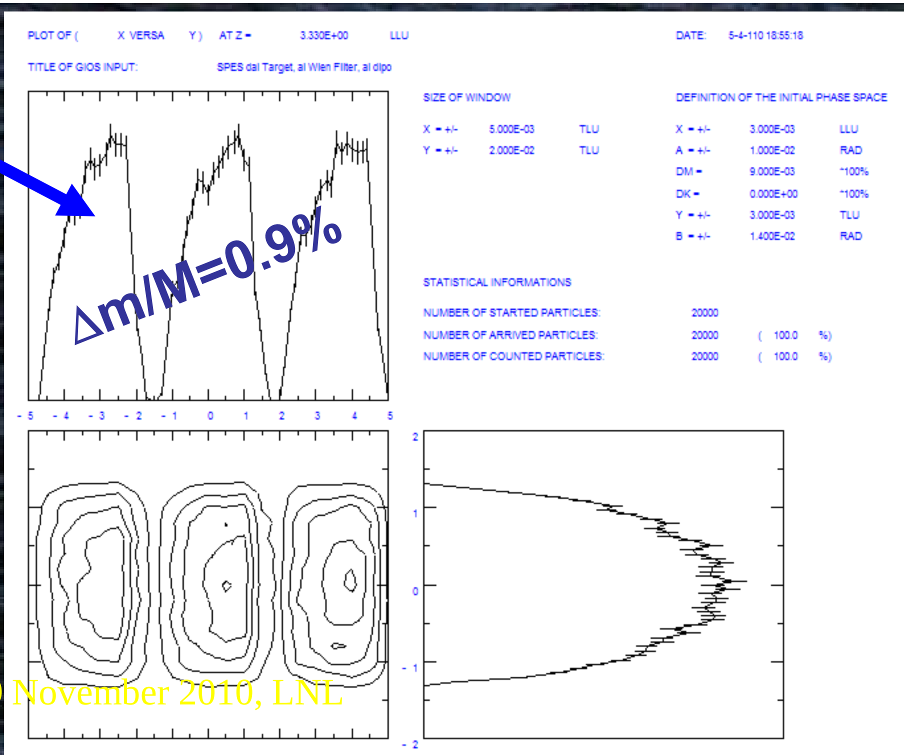
Design Parameters from Front-End

- Plasma Source hole of 6 mm
- Total Emittance(100%)=30 πmmmrad @ 60 keV
- RMS Norm. Emitt. =0.013 mmmrad
- Ion: Tin 132, 1+ (18+ after charge breeder)
- BetaX=BetaY=0.66 mm/mrad. AlfaX= AlfaY=-1
- Bρ=0.405 Tm @ 60 keV
- Bρ=0.84 Tm @ 260 keV

Front-End &Transport Line

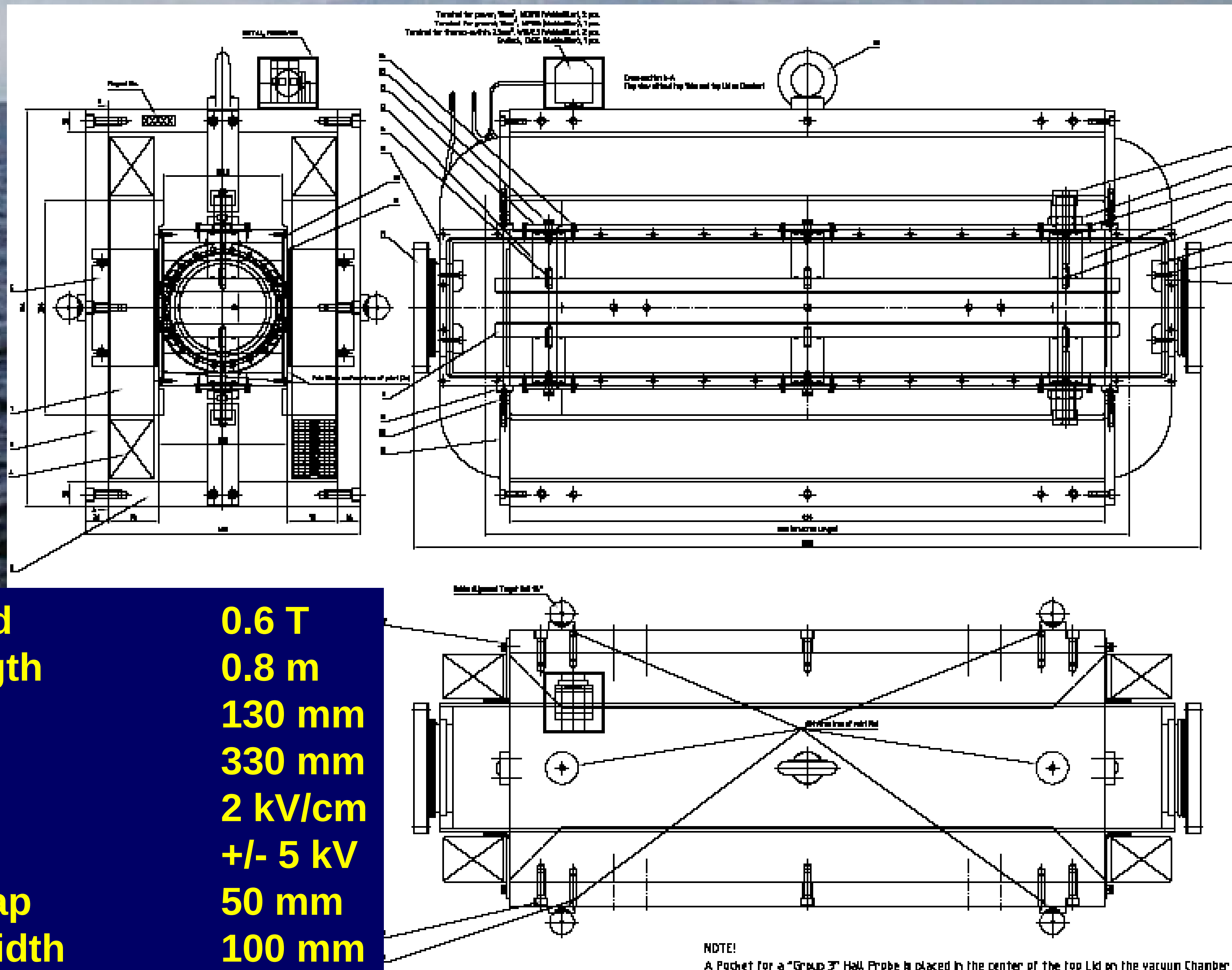




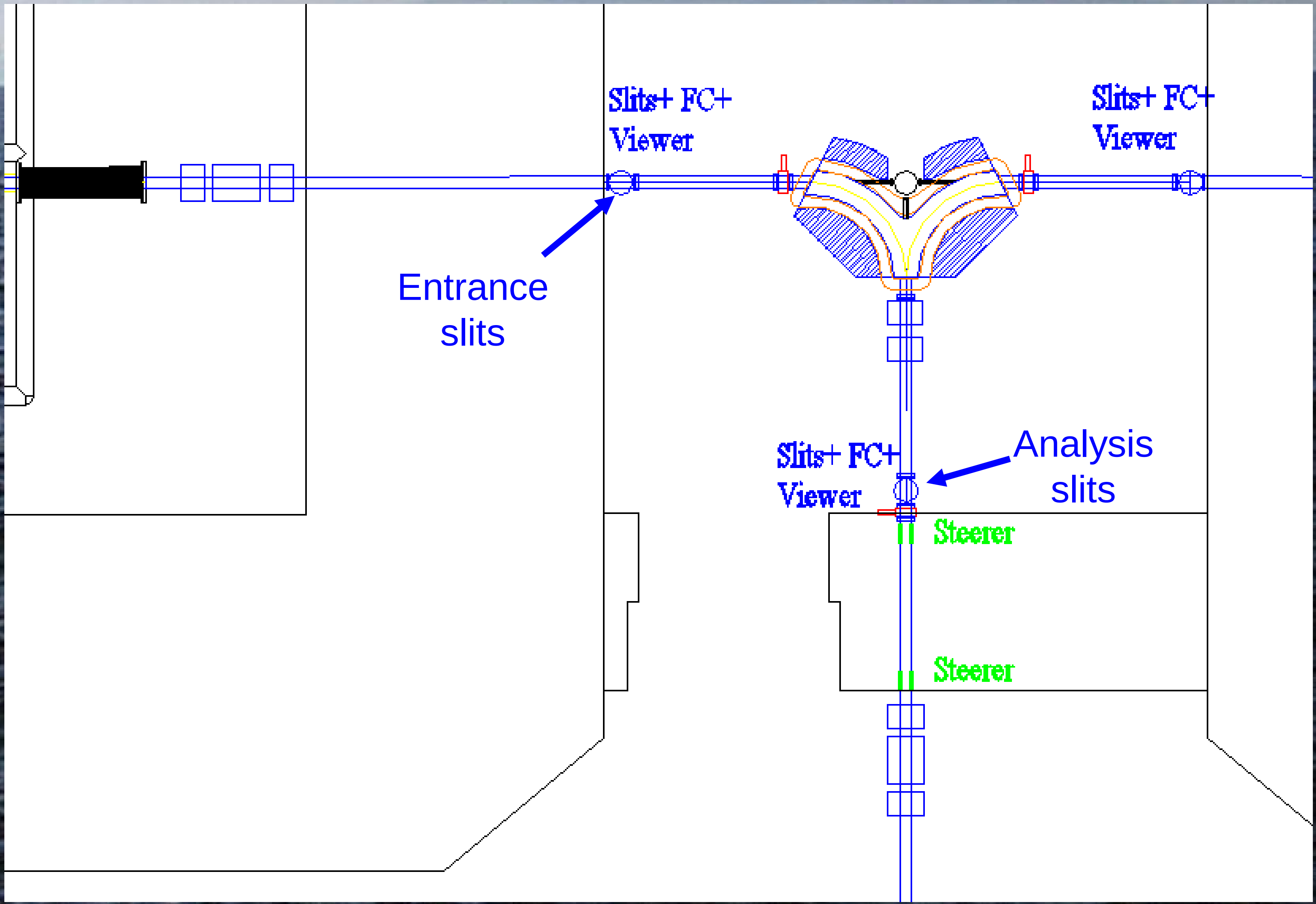


Simulation include 3 order effects

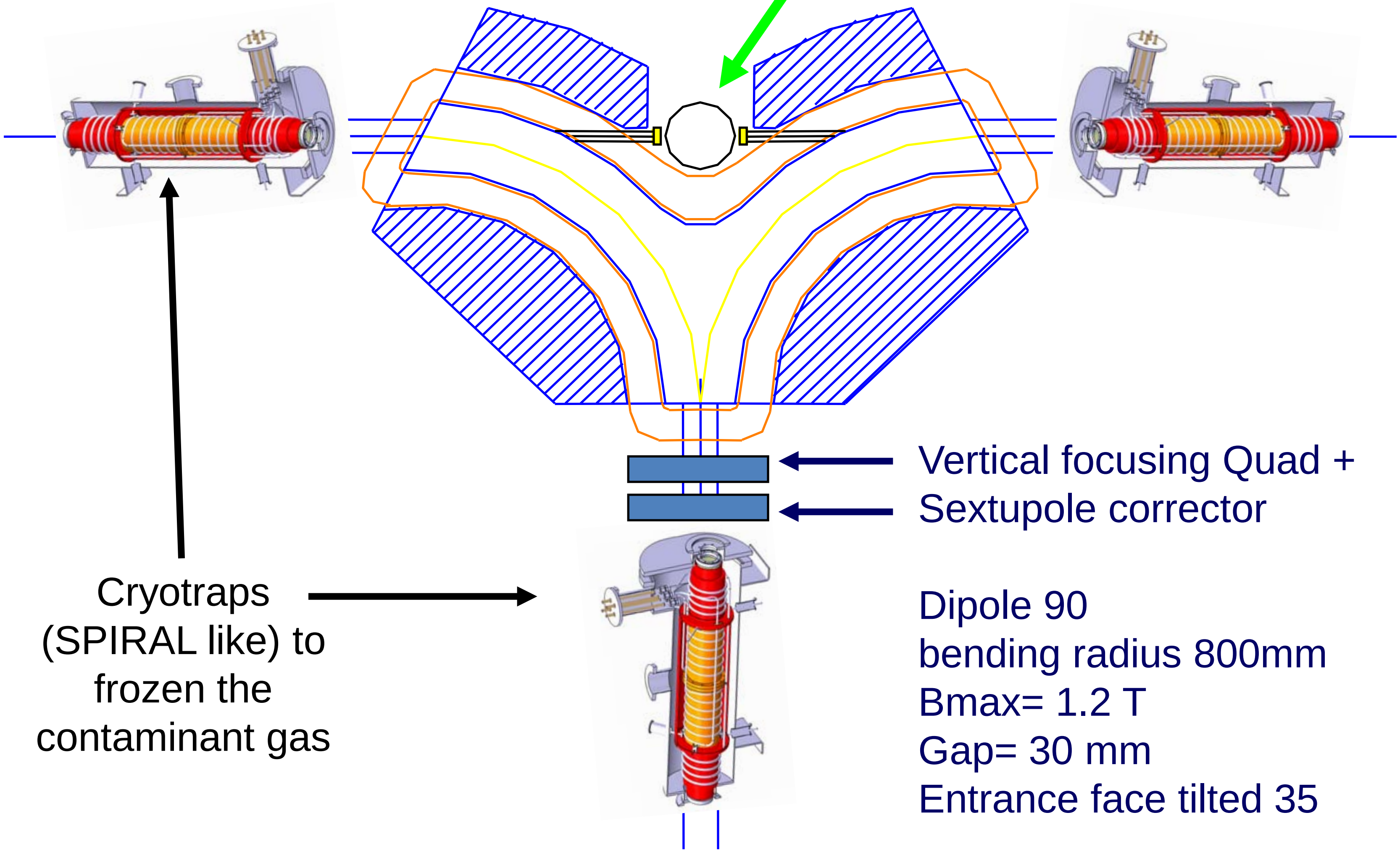
Wien filter parameters



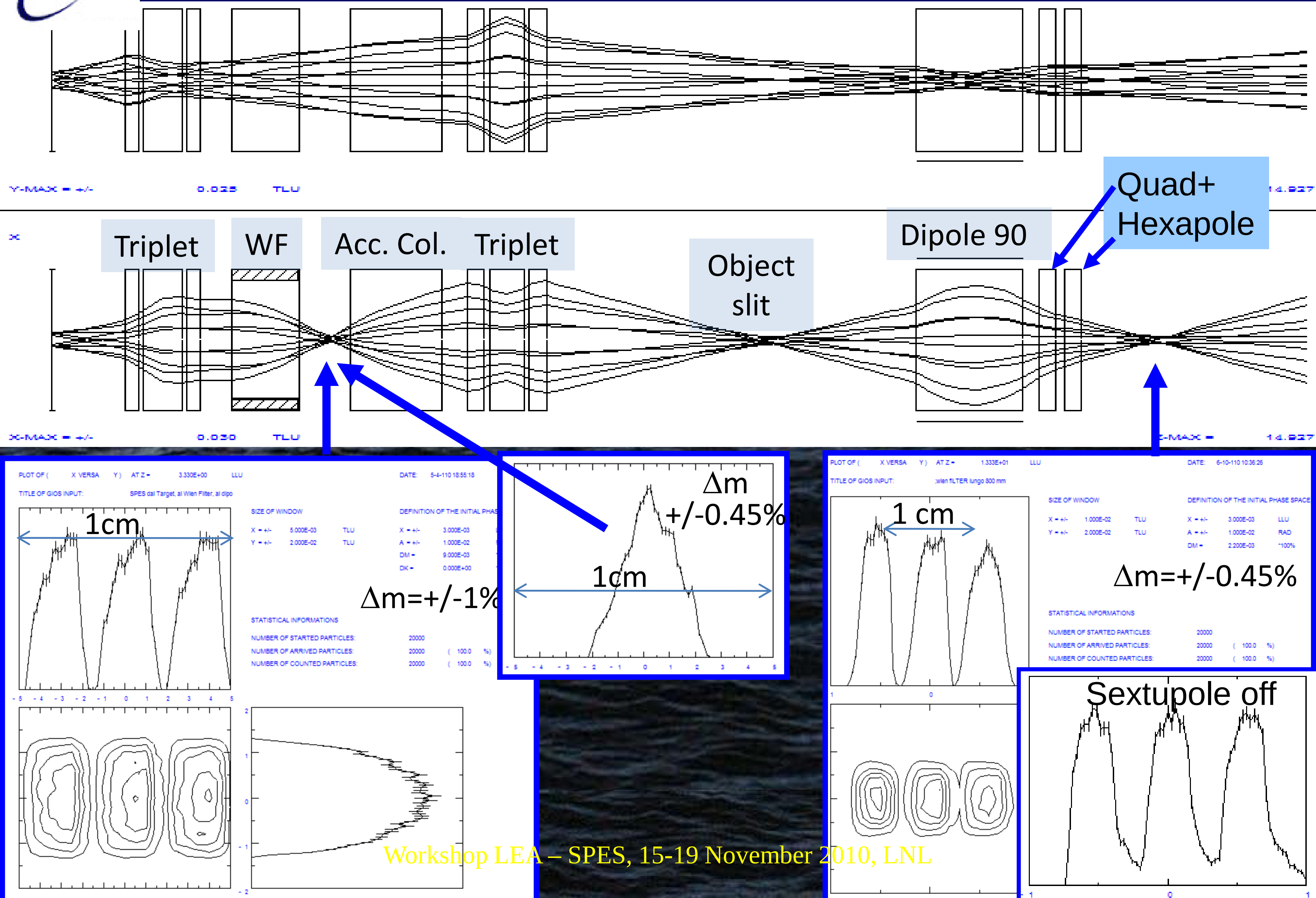
Magnetic field	**0.6 T**
Effective length	**0.8 m**
Pole Gap	**130 mm**
Pole width	**330 mm**
Electric field	**2 kV/cm**
Max. Voltage	**+/- 5 kV**
Electrodes gap	**50 mm**
Electrodes width	**100 mm**


Slits+ FC+
Viewer
Slits+ FC+
Viewer
Entrance
slits
Slits+ FC+
Viewer
Analysis
slits
Steerer
Steerer

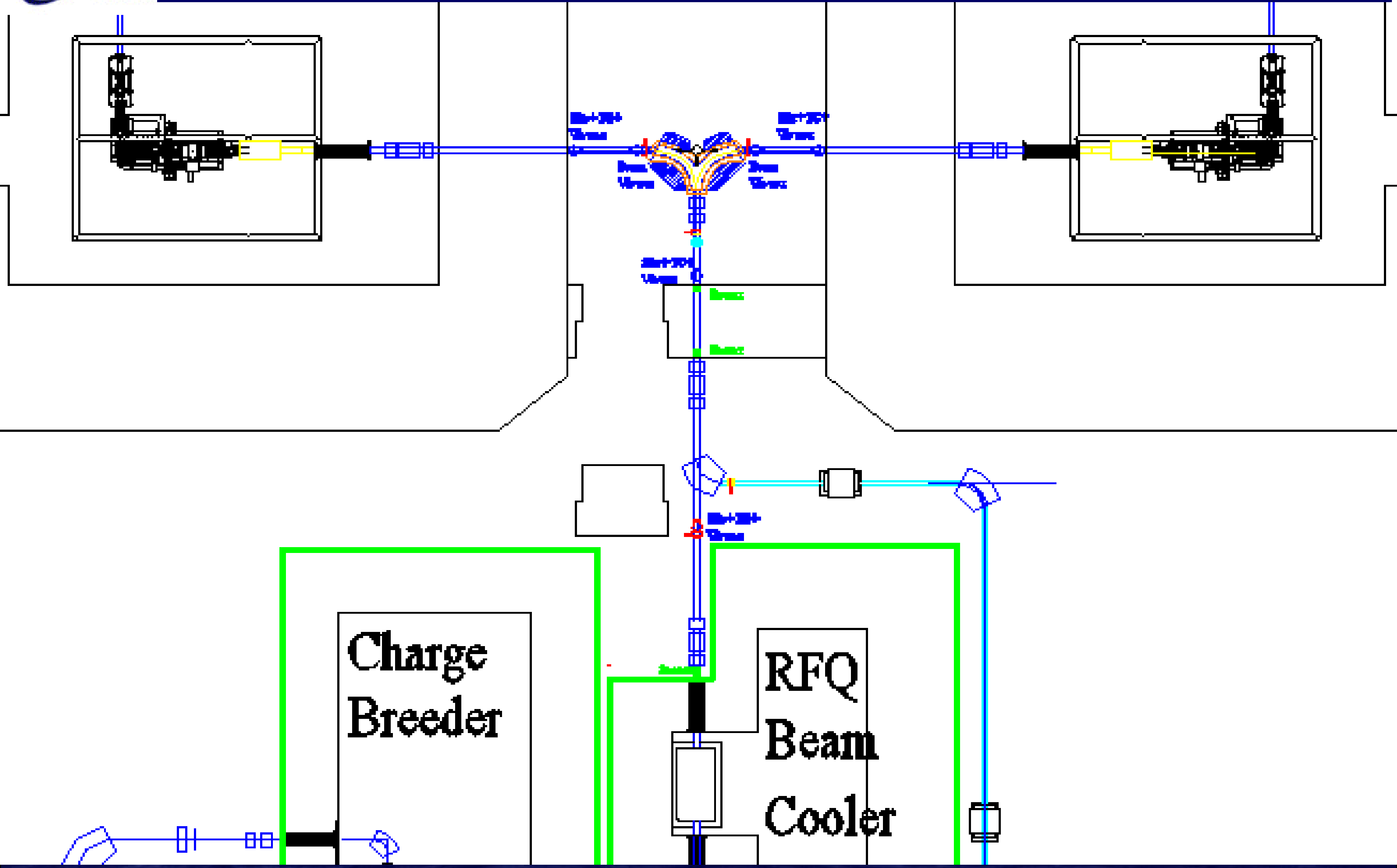
In this area a mirror will be installed, to drive the laser light to the Light Ion Source



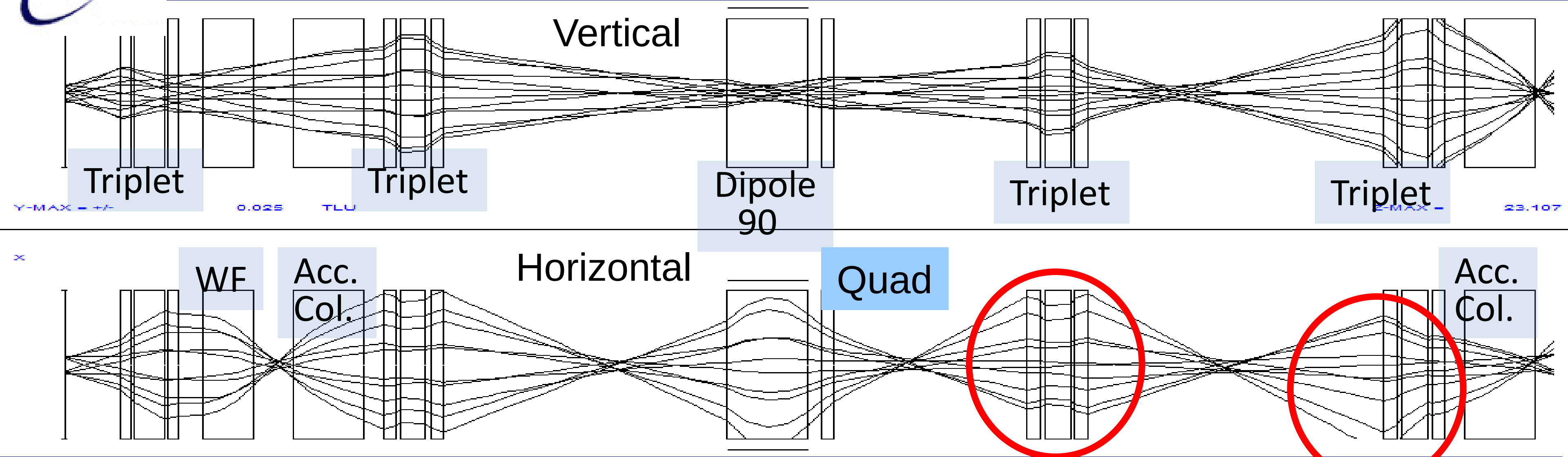
GIOS Results, 3° Order



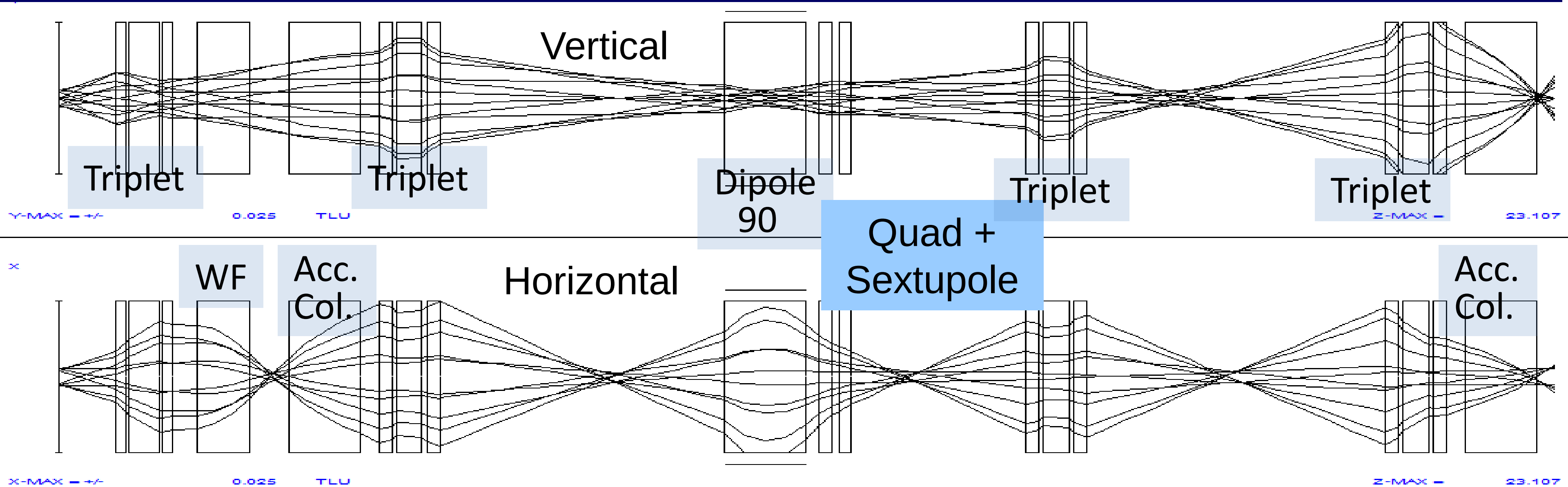
Update Transport Line to RFQ Cooler



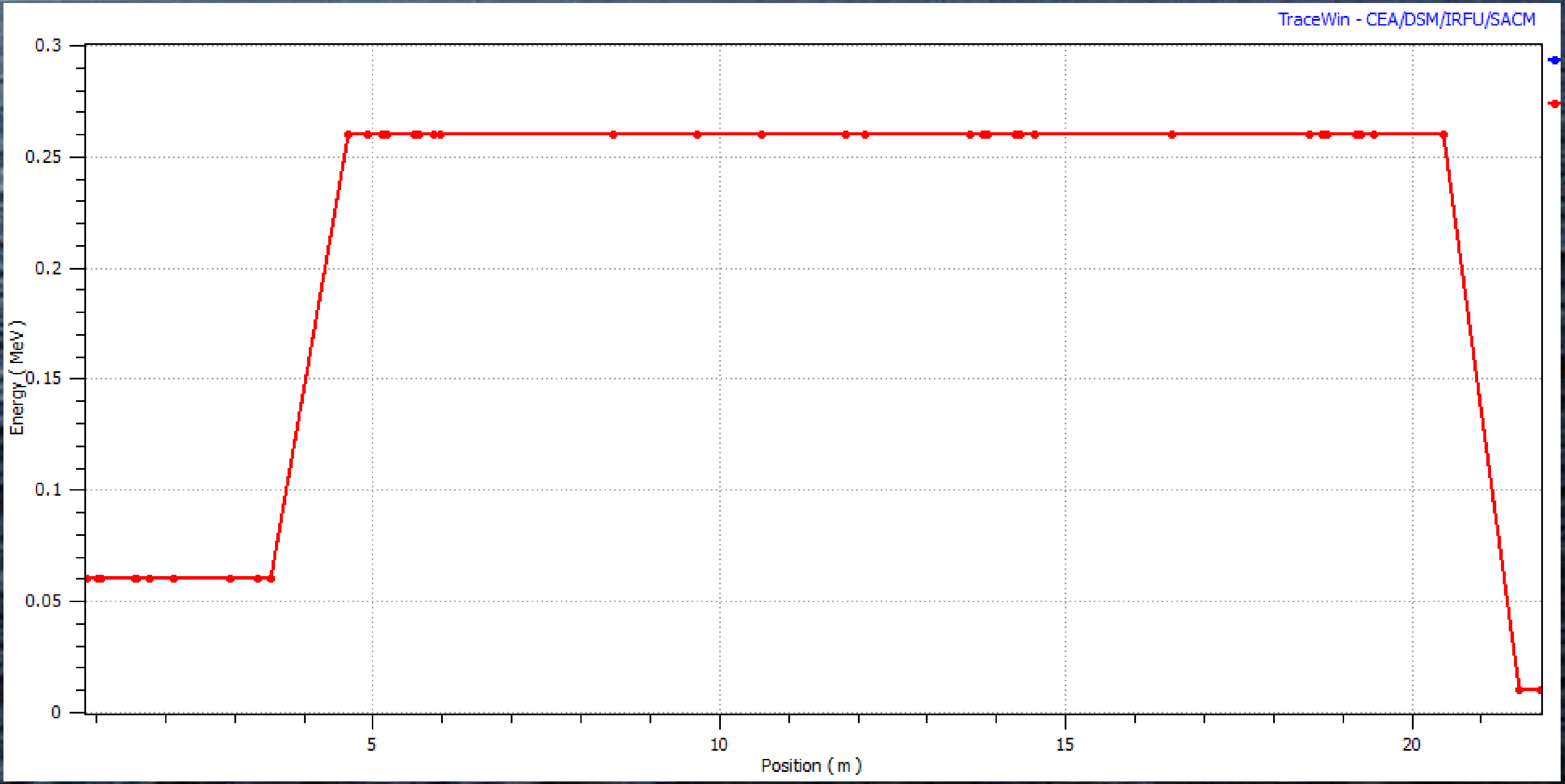
Beam Envelope, sextupole OFF



Beam Envelope, sextupole ON



Energy Profile from Front-End to RFQ Cooler



Why we need a Beam Cooler?

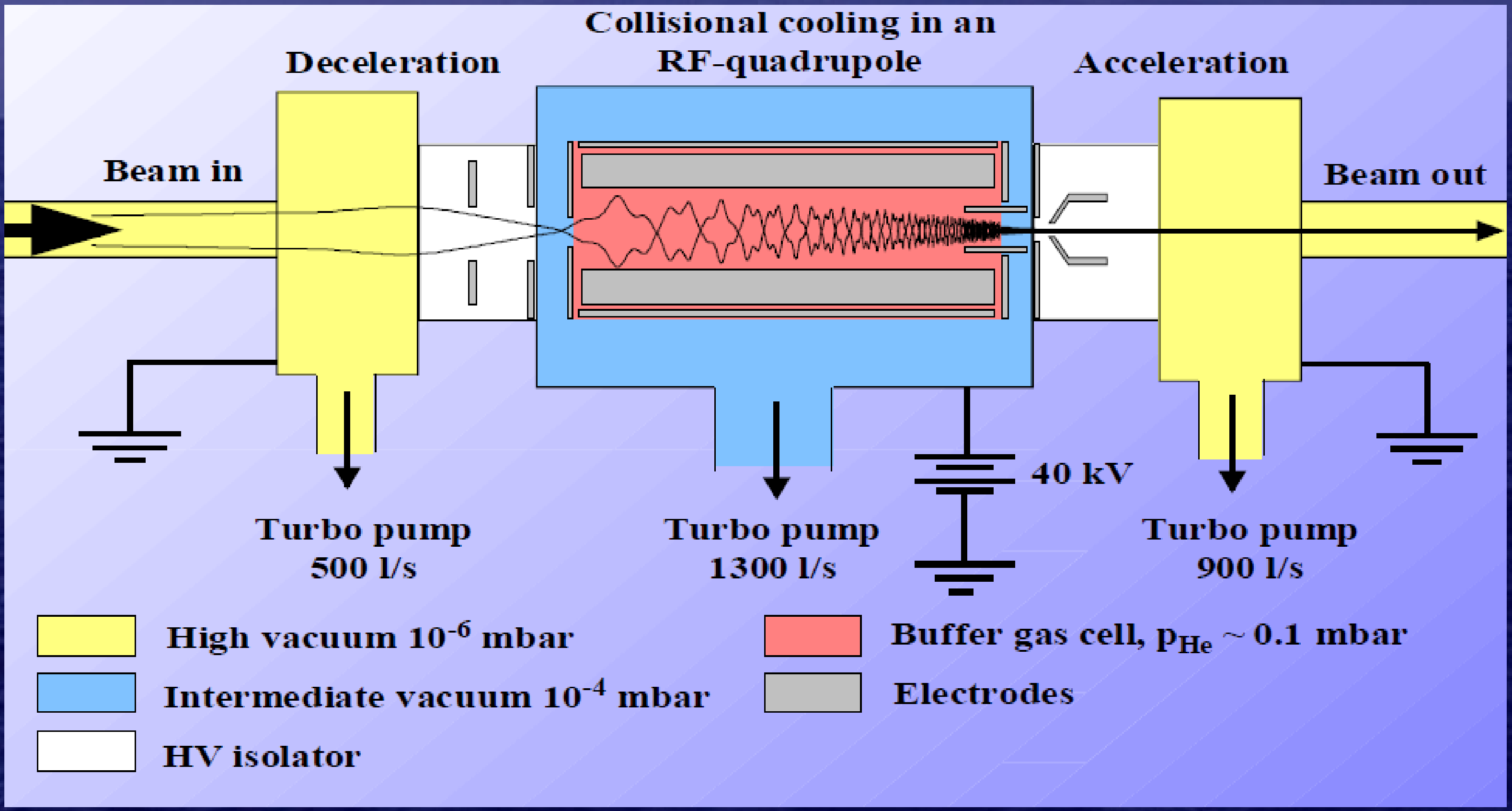
Beam parameters delivered by the source

- Intensity ~2 μA (at source), after the Wien filter ~**400 nA**
- **9 < A < 170**
- Emittance < **30 π mm.mr @ 60 keV, for LIS source 3 π mm.mrad**
- ΔE=2 ÷ 3 eV intrinsic + voltage platform ripple

Cooler Acceptance → COOLING → Beam delivered

- INTENSITY: as high as possible
- Emittance < 2 π mm.mr @ 260 keV
- ΔE<1eV

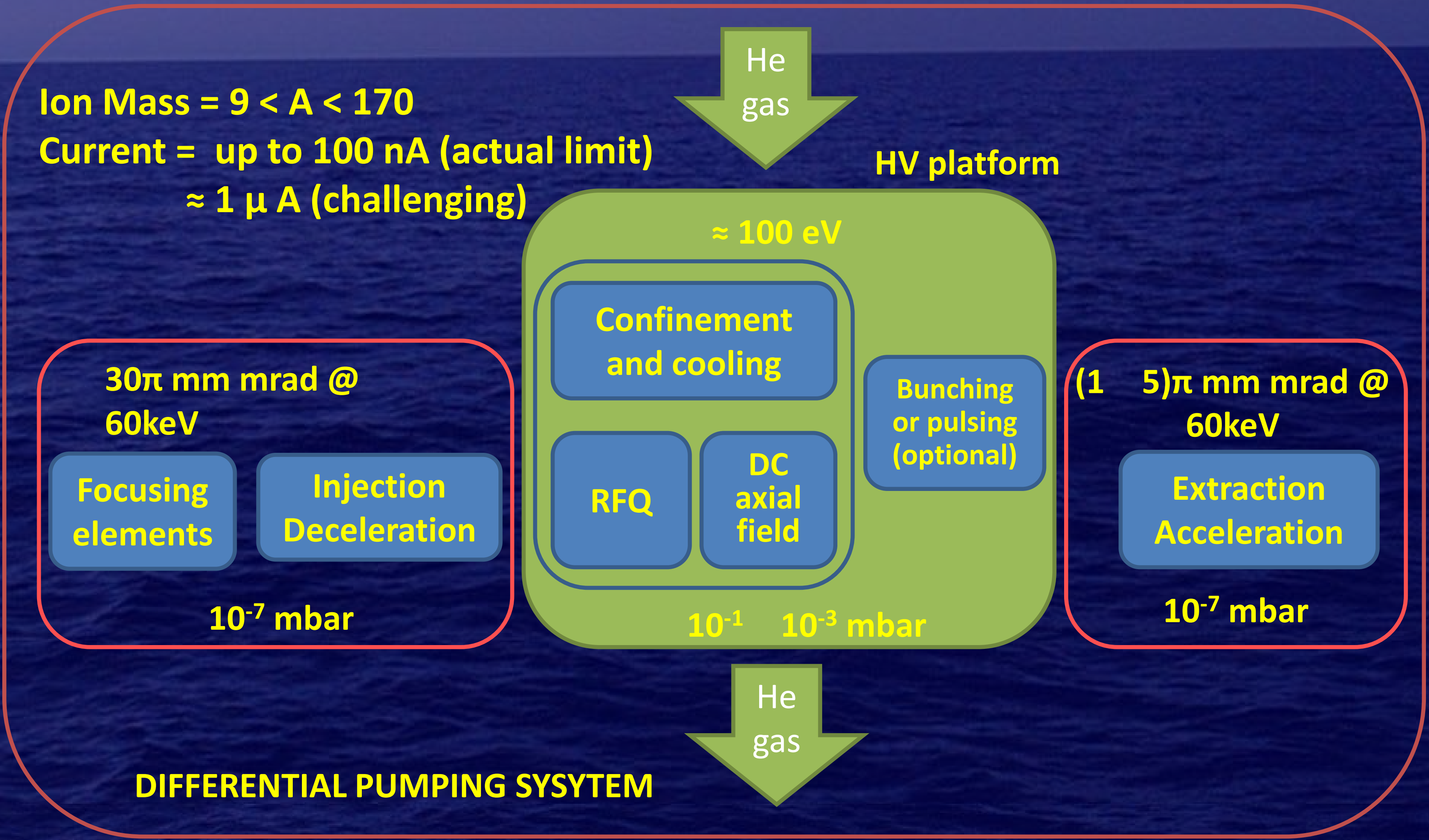
Buffer-gas filled RFQ trap

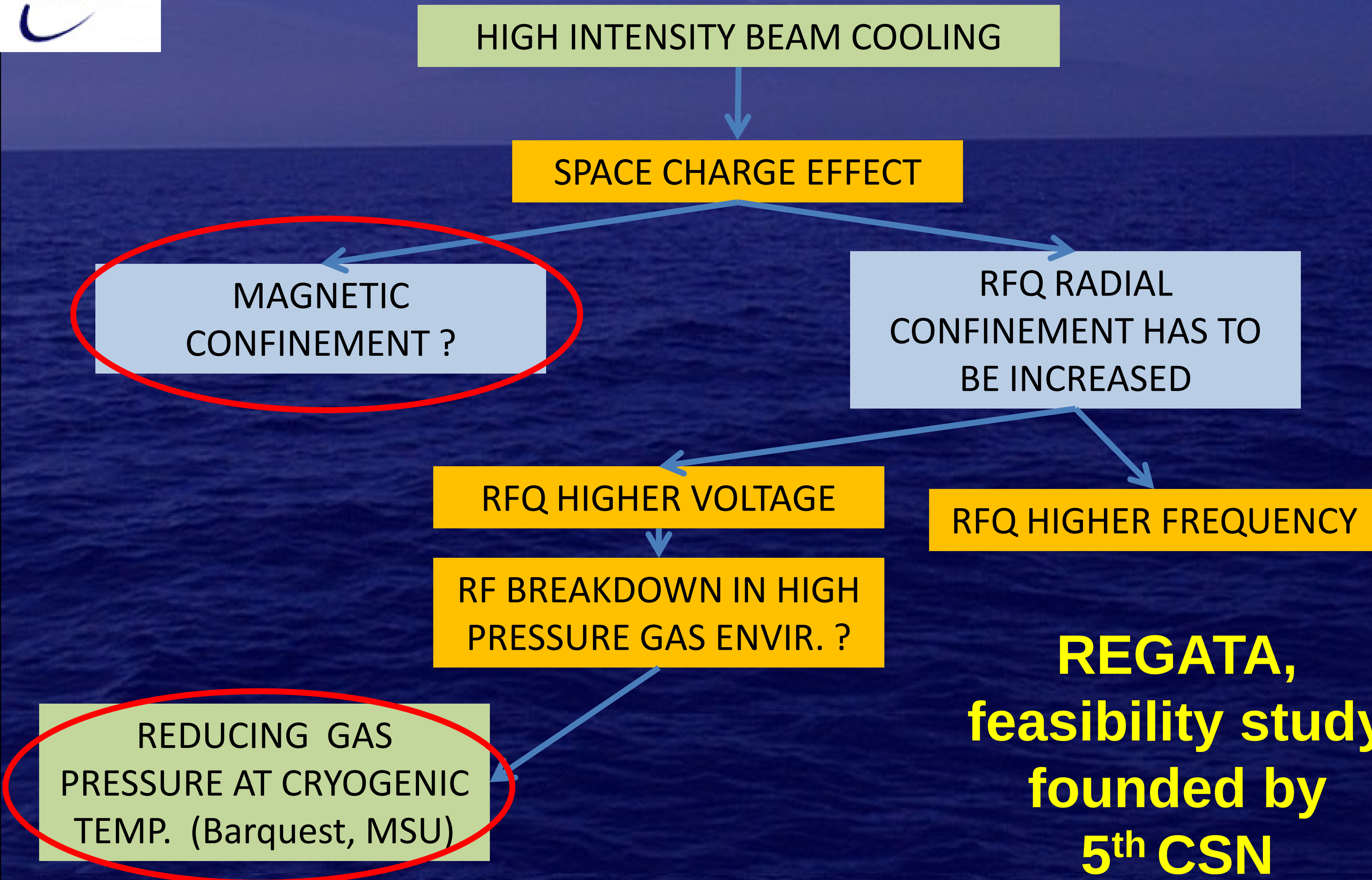


To reduce transversal emittance and energy spread

→ to improve resolving power of Mass separator

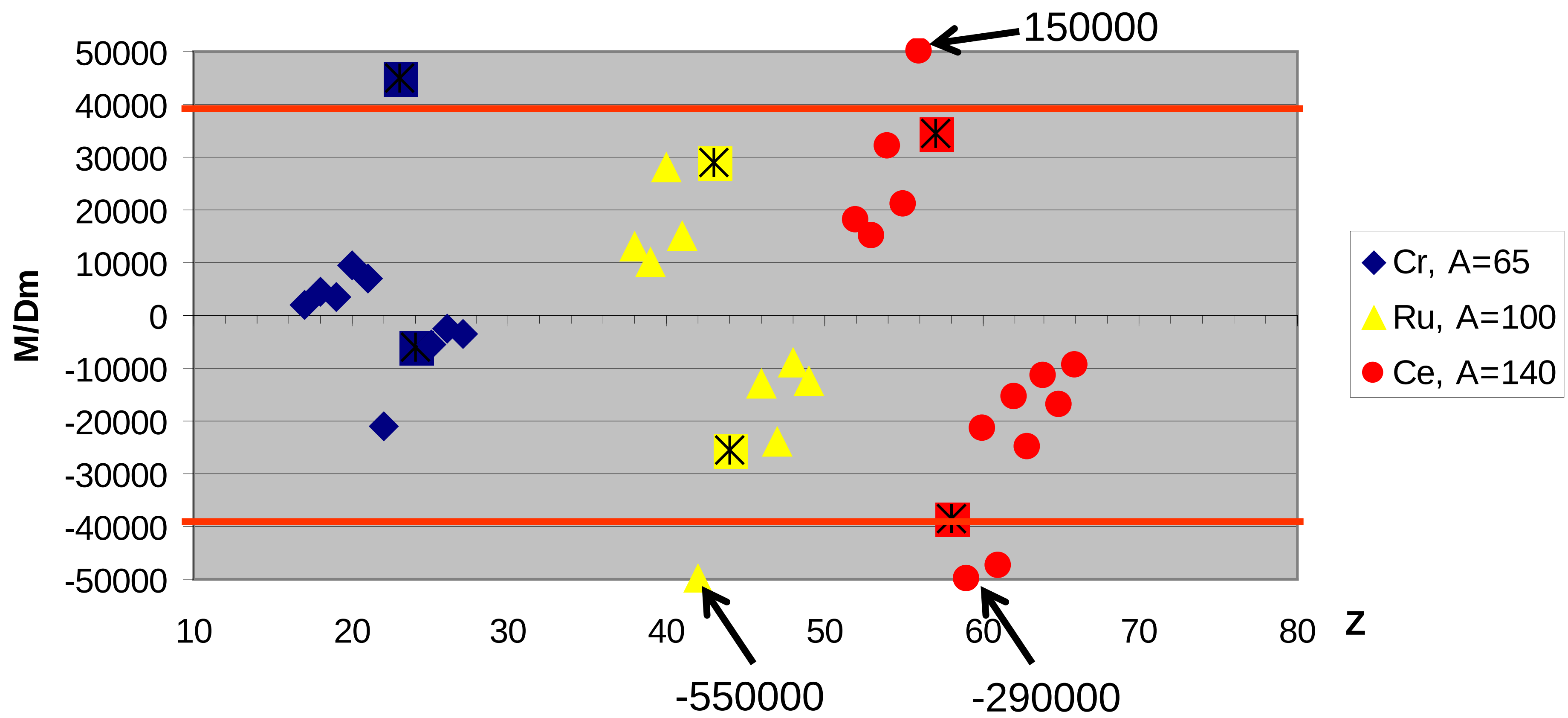
REGATA, feasibility study founded by 5th CSN





REGATA, feasibility study founded by 5th CSN

What mass resolving power we need?

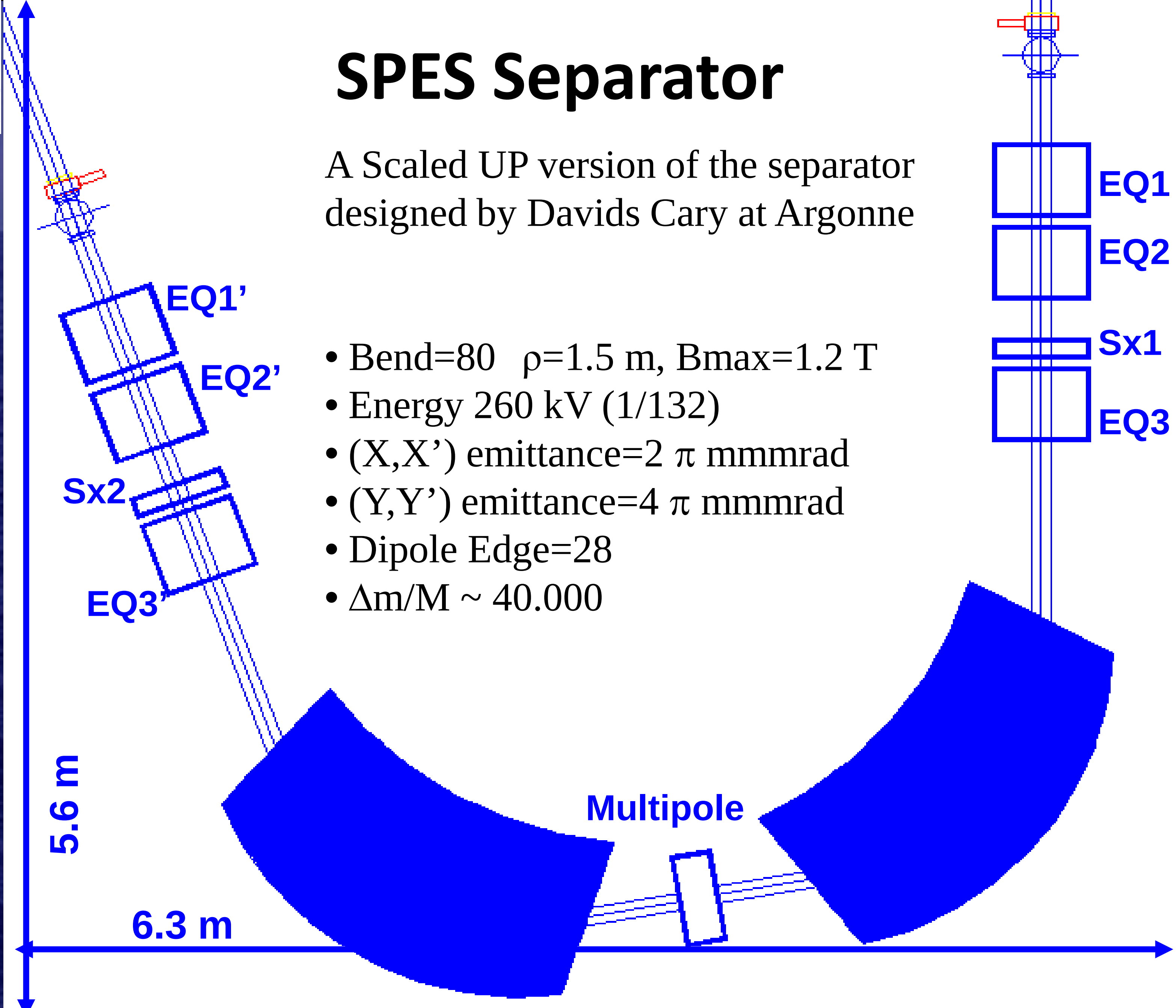


Despite a mass resolving power of 30.000 seems enough, it is more conservative to achieve higher values to reduce the tails of contaminant with higher yields

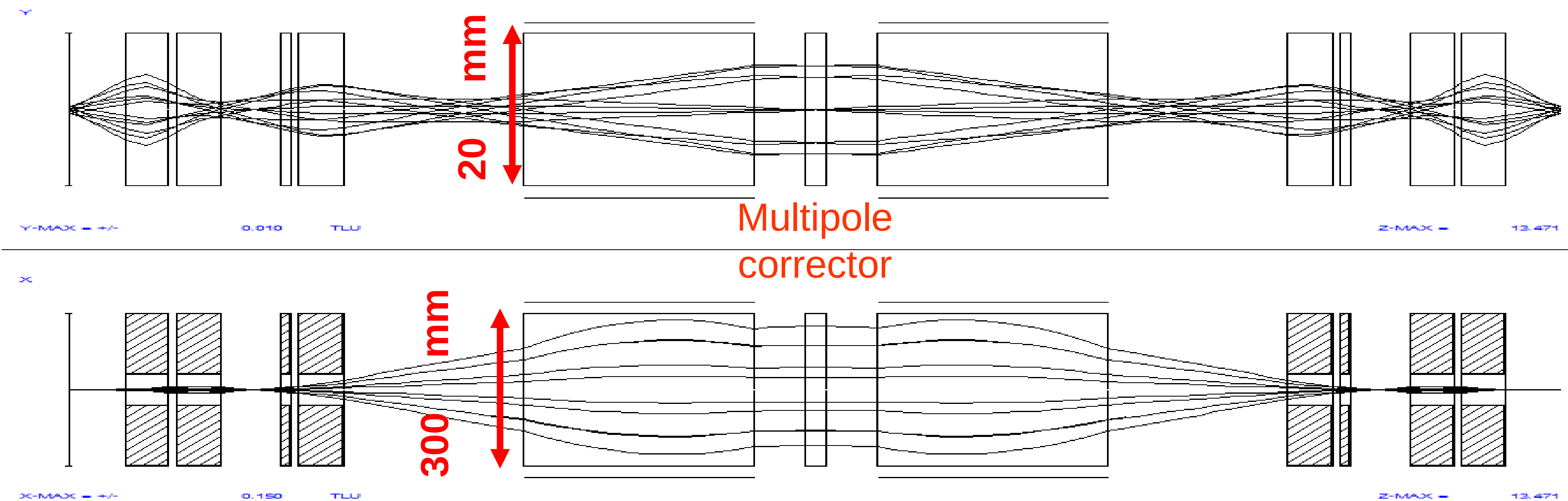
SPES Separator

A Scaled UP version of the separator designed by Davids Cary at Argonne

- Bend=80 ρ=1.5 m, Bmax=1.2 T
- Energy 260 kV (1/132)
- (X,X') emittance=2 π mmmrad
- (Y,Y') emittance=4 π mmmrad
- Dipole Edge=28
- Δm/M ~ 40.000

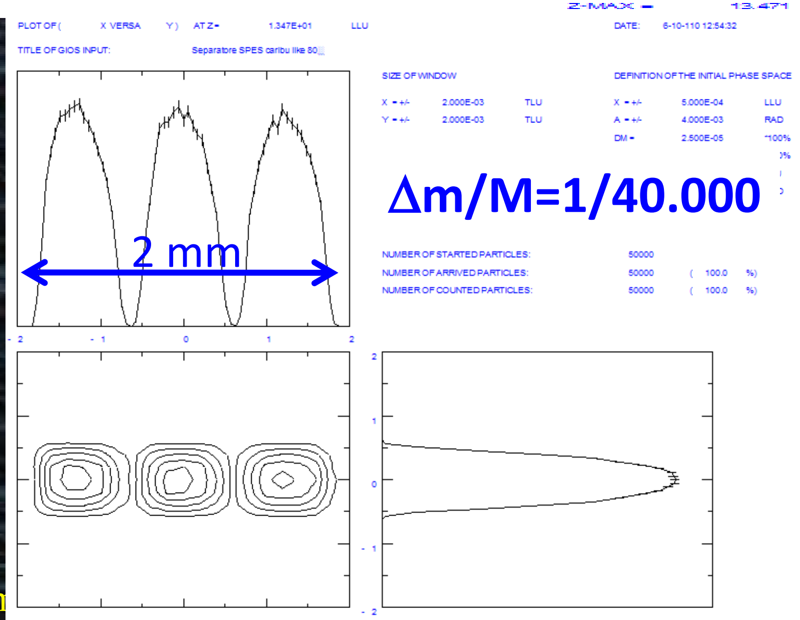


Beam envelope by GIOS code @ 3rd order

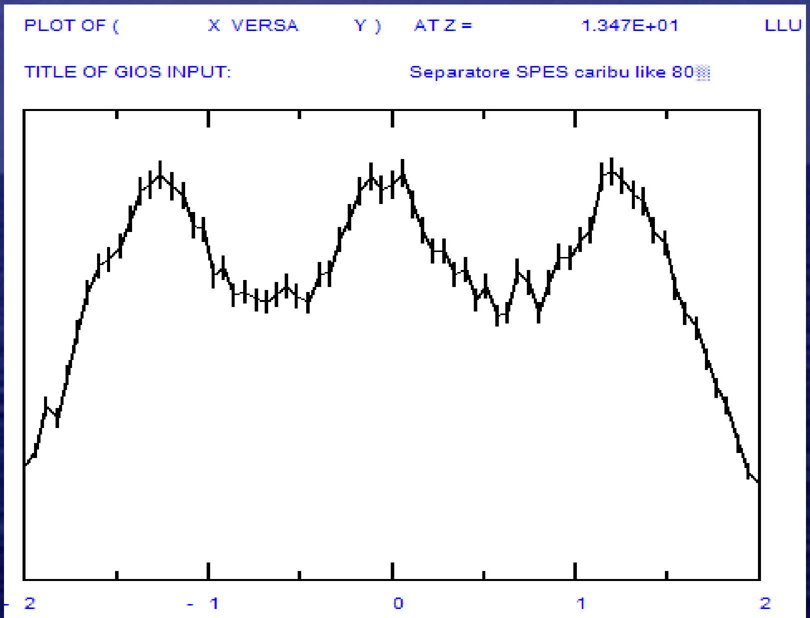


Beam emittance
(x,x') = 2π mm.mrad
(y,y') = 4π mm.mrad

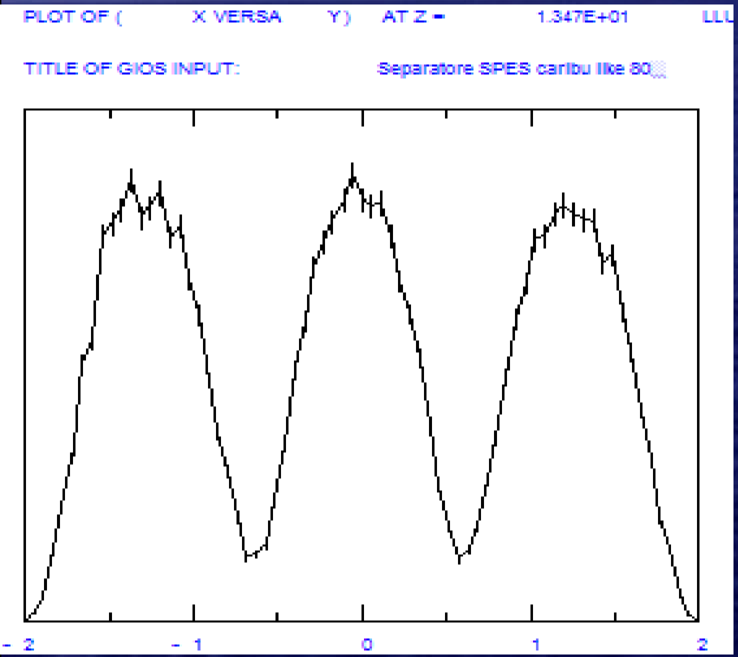
Without energy spread



energy spread 2.6 eV/260 kV

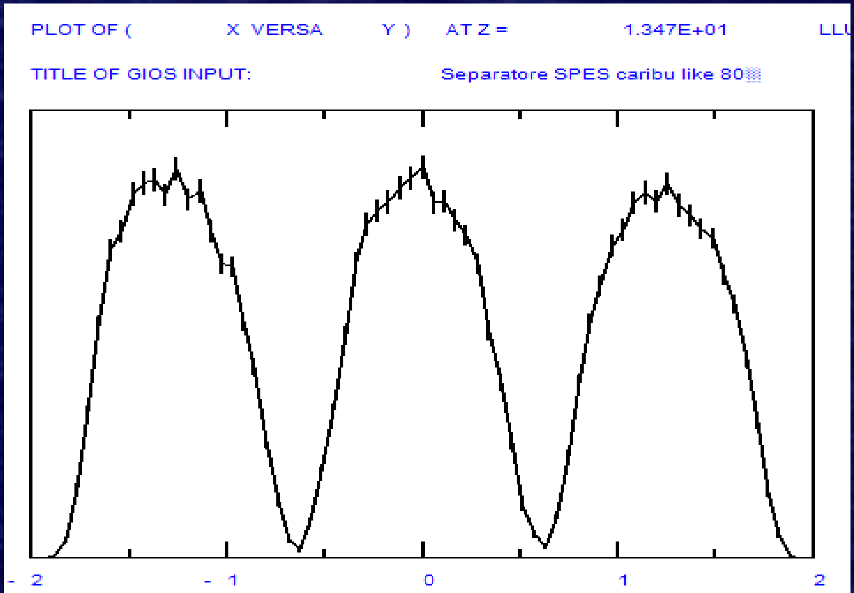


energy spread 1 eV/260 kV



$\Delta m/M=$ 1/40.000

energy spread 0.5 eV/260 kV



What happened if the beam cooler is off?

The beam emittance will be about 10 π mm.mrad in both the planes, larger than the values 2 π mm.mrad we assumed.

We can not change the magnets parameters, so we have to match the larger beam emittance in the separator acceptance!

Simplest way is to increase the size of the beam at the object and then at the image position. We change the beam size from 1 mm → 5 mm

Resolving power decrease from 40000 → 8000

Next Steps

Finalize the design of Spectrometer

Errors Study

Platforms Design

Beam Cooler Study and Design

Spectrometer Engineering Design

and That's All Folk …

Thank you for your attention!