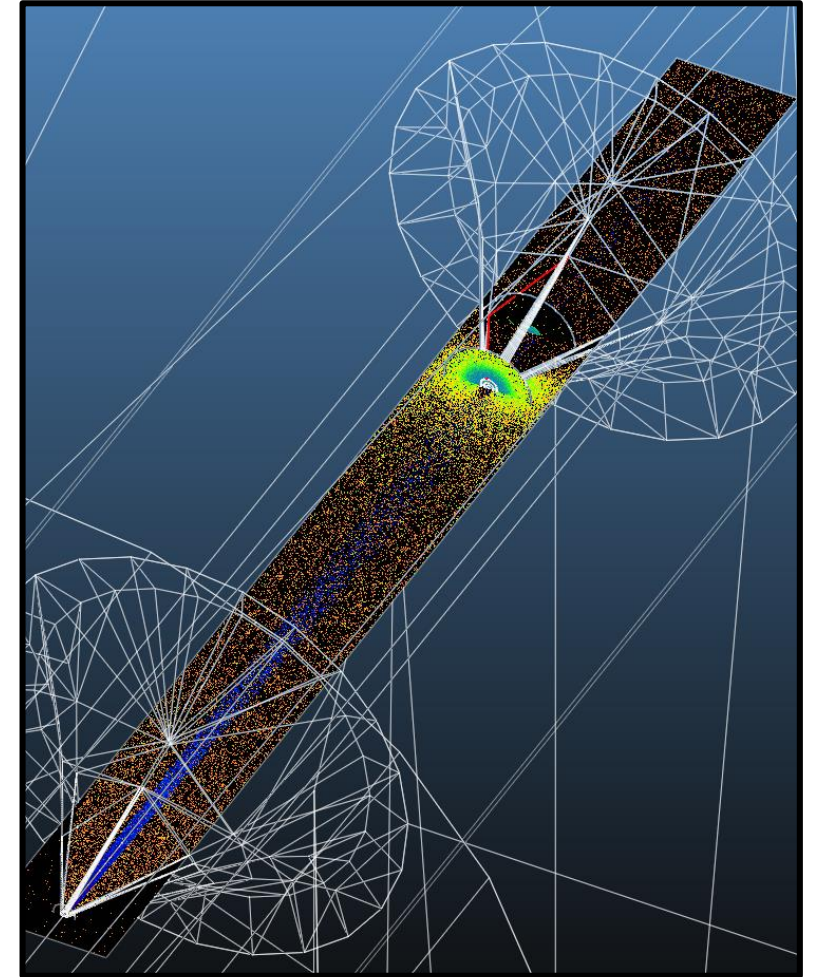
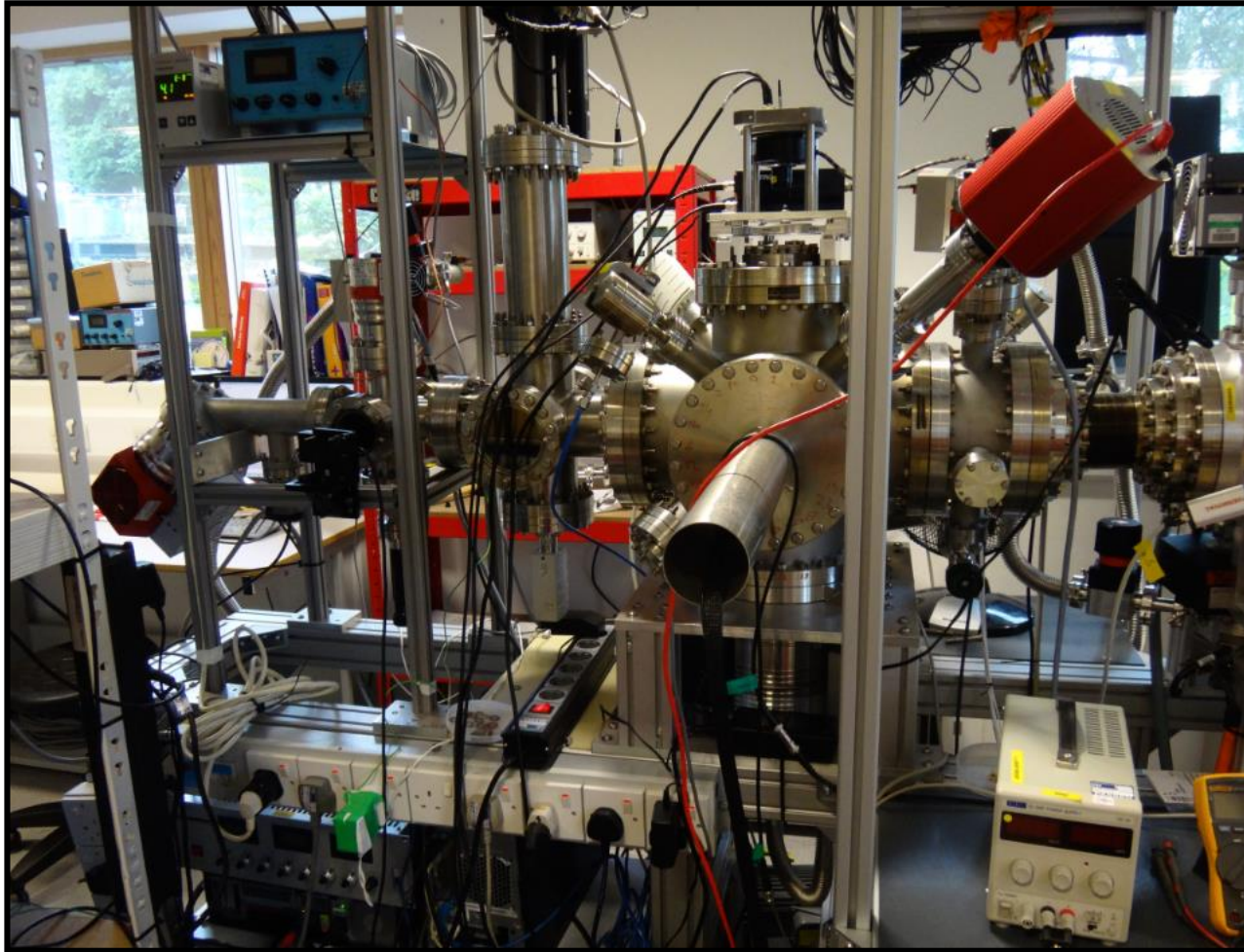
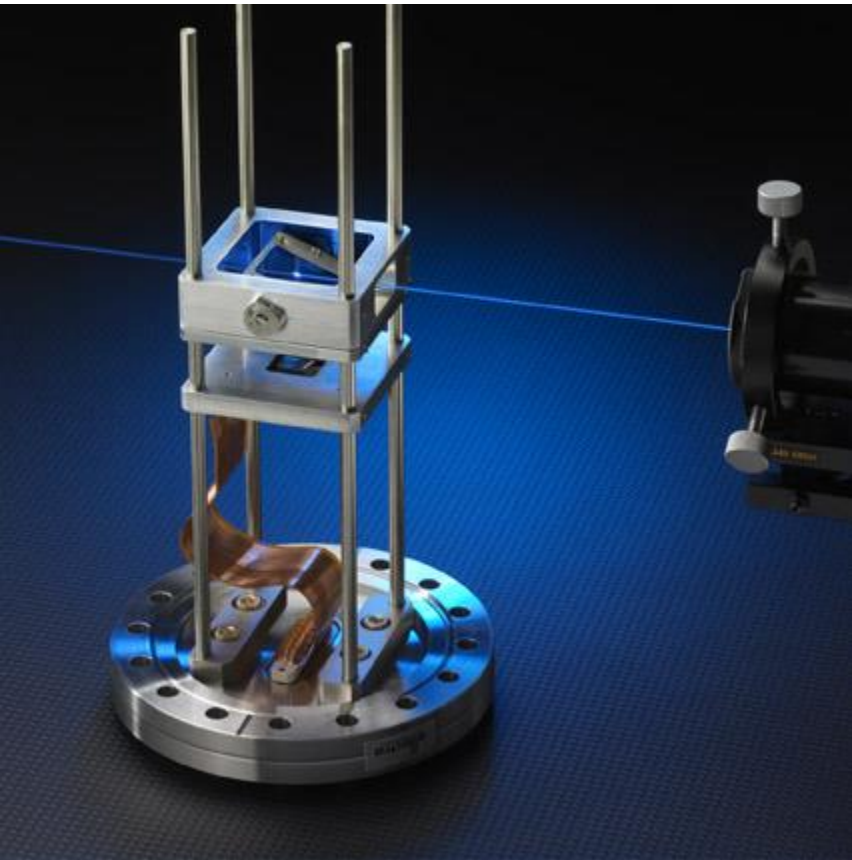


Design of a Beam Gas Curtain monitor



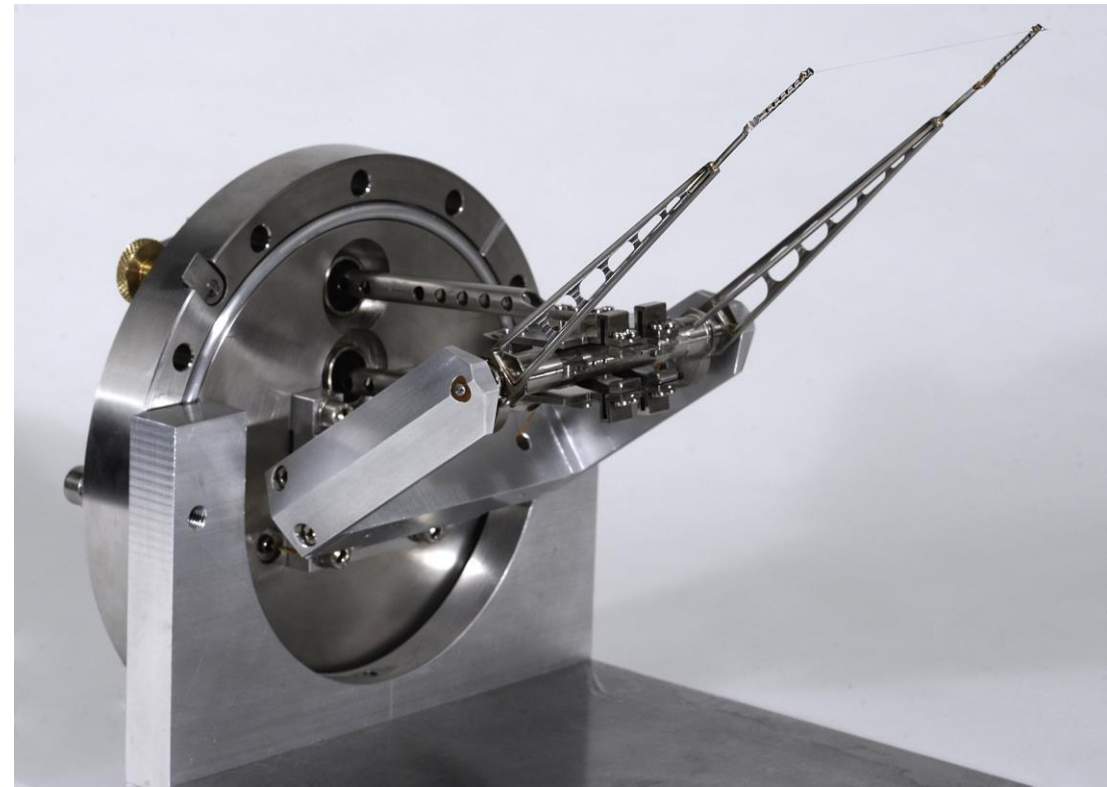
Existing beam position monitors



Scintillating screen (ESRF)



Electrode (CERN)



Wire scanner (CERN) ²

Idea: Beam induced fluorescence

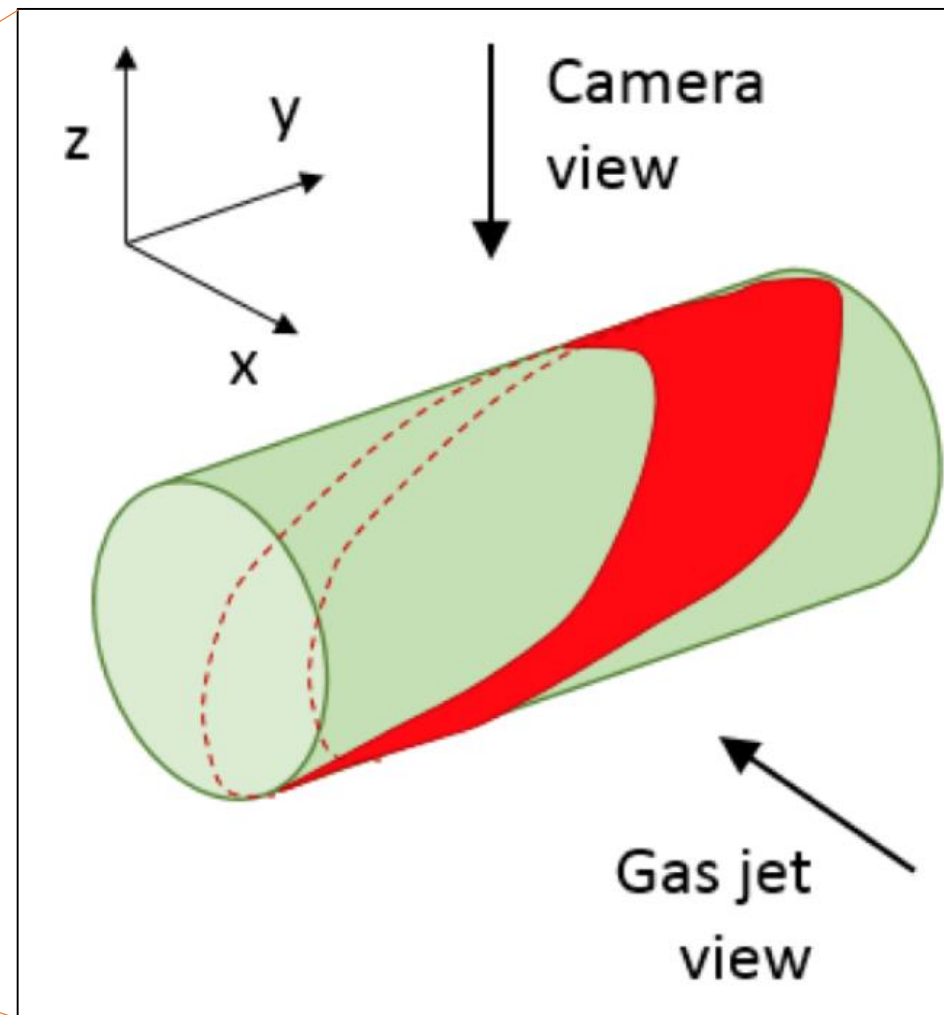
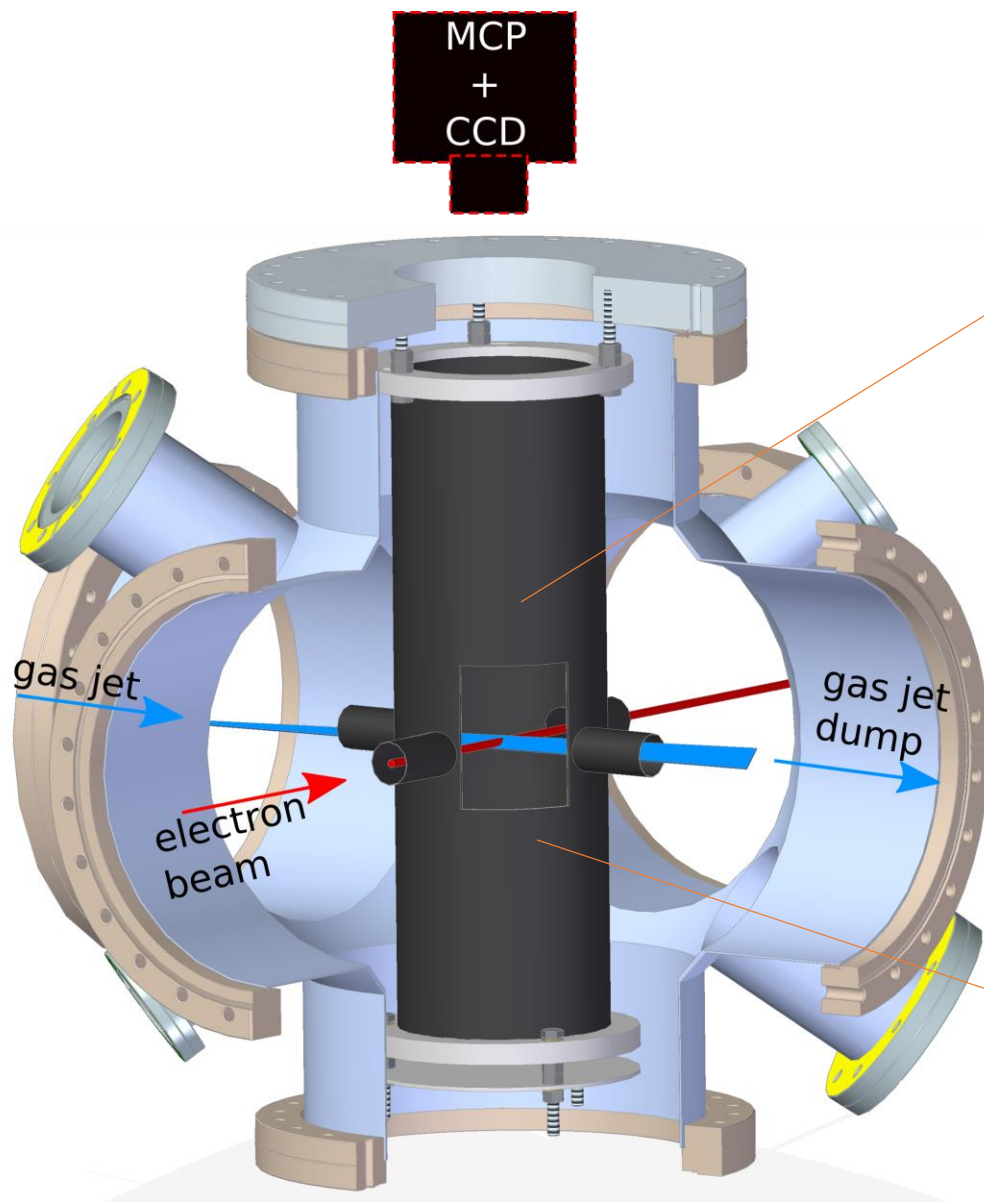
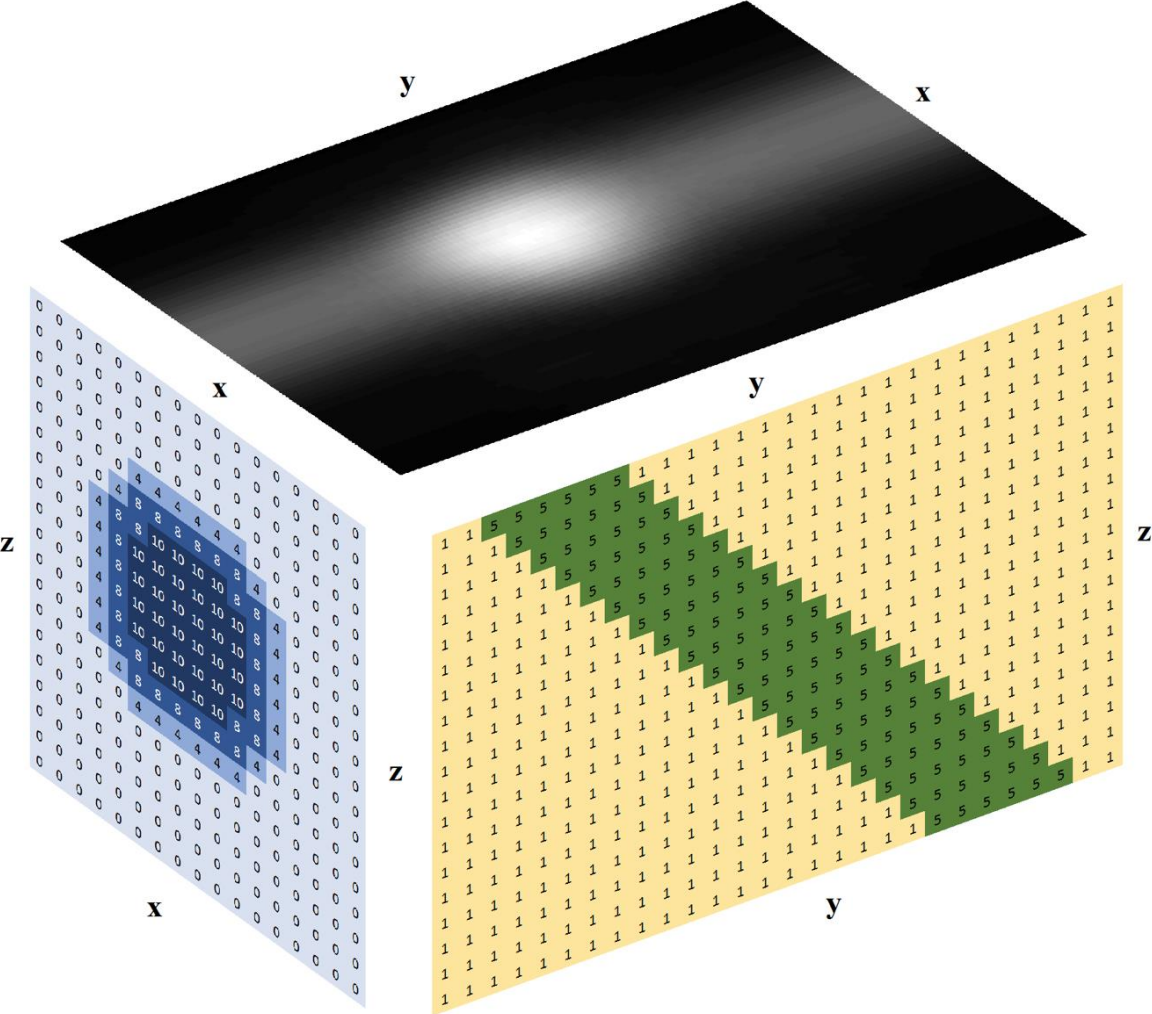
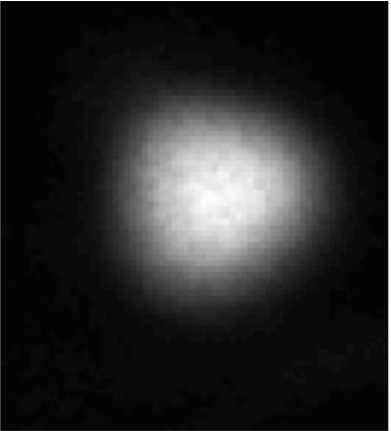
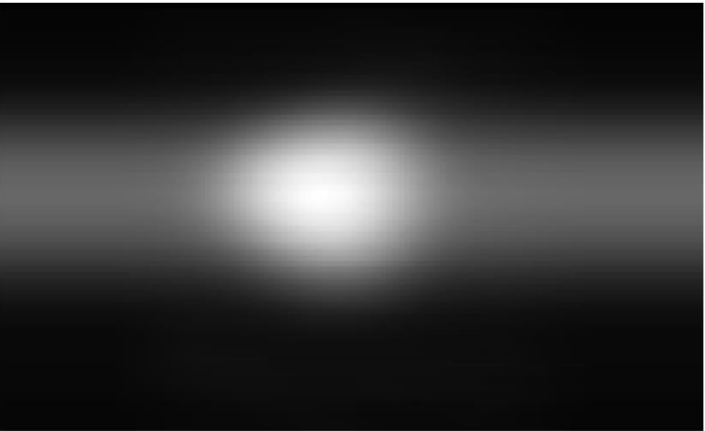
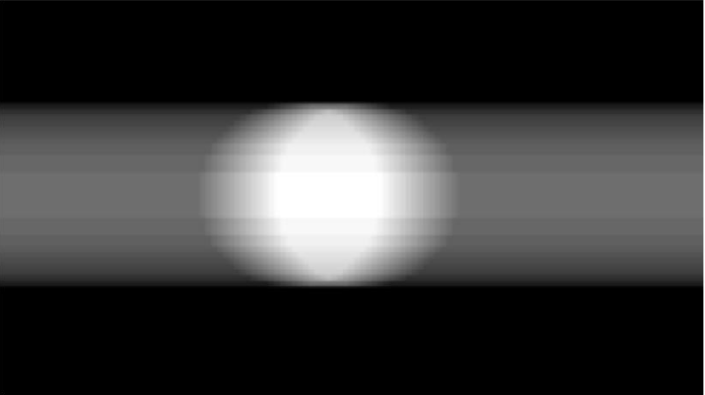


Image reconstruction

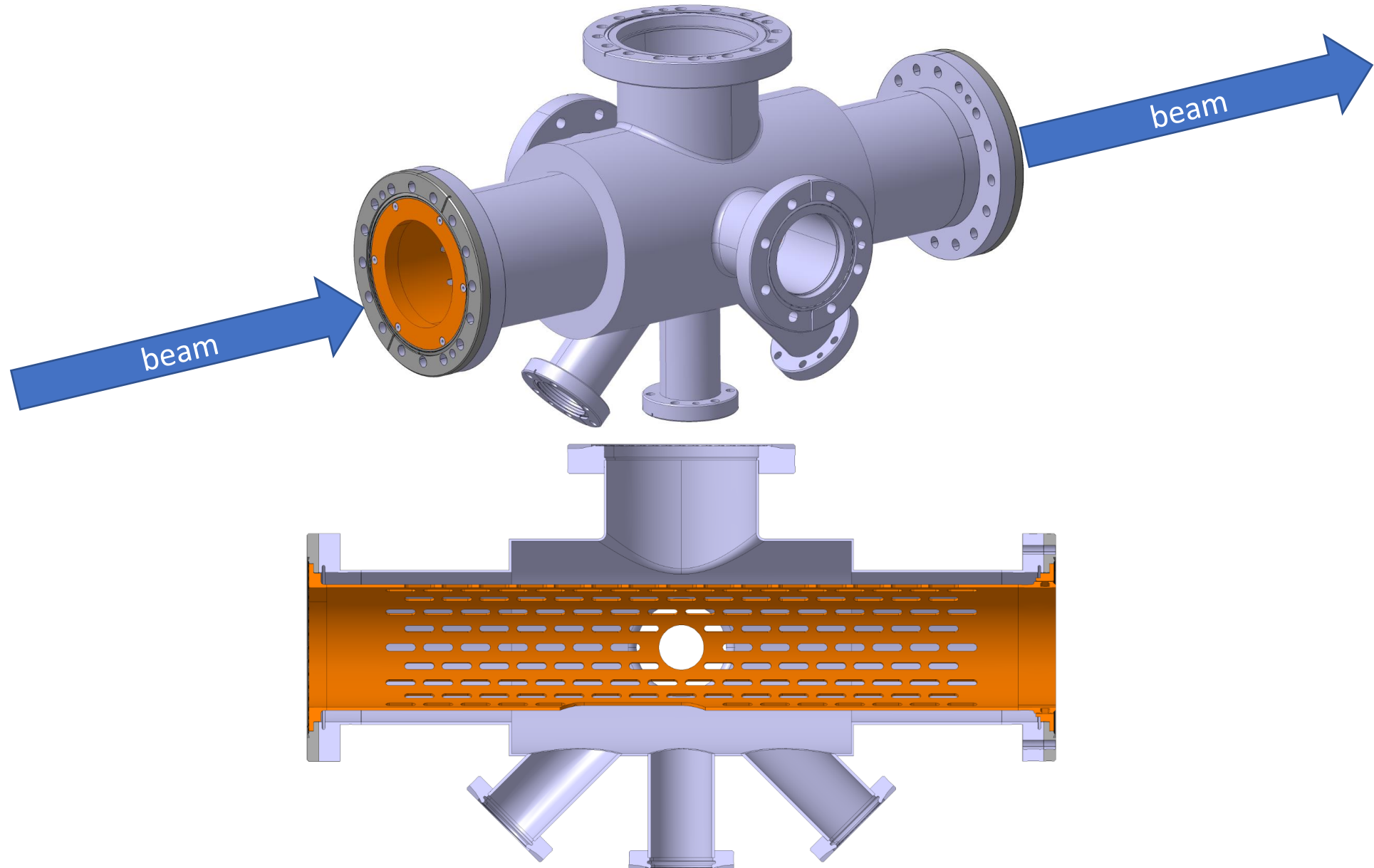


Perfect cylindrical beam

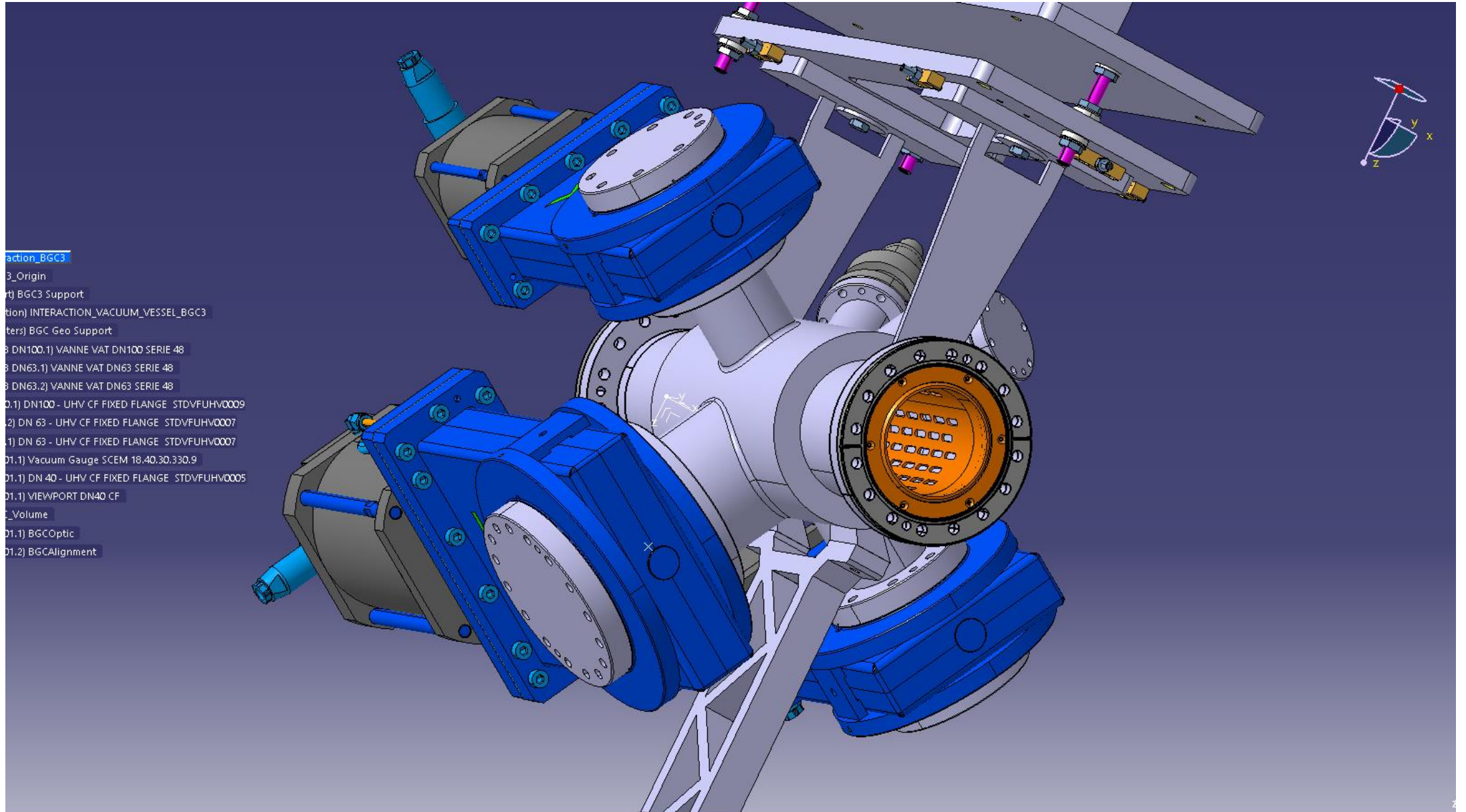


Gaussian beam

Stage 1: LHC interface only

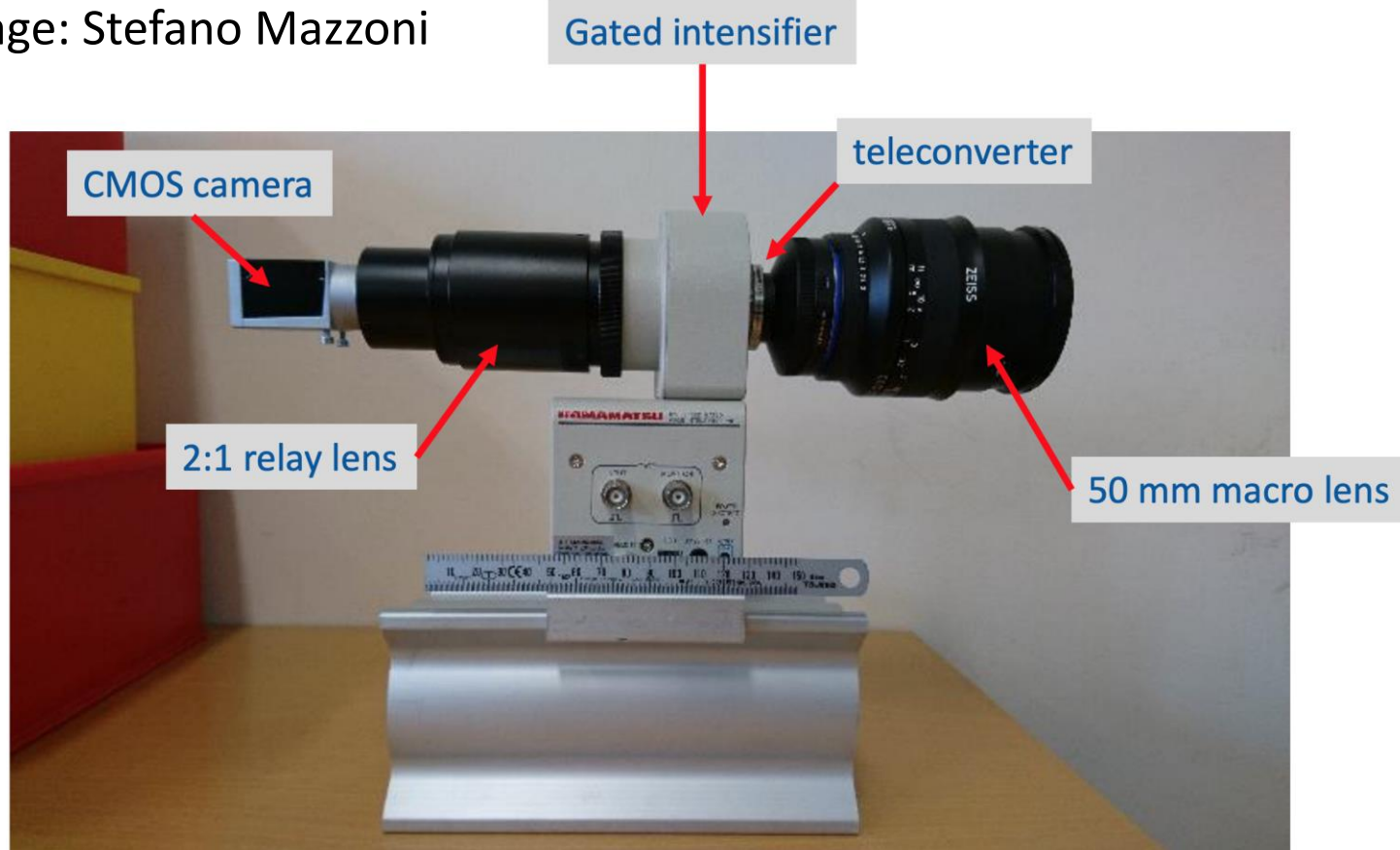


Instrument can be completely isolated from LHC

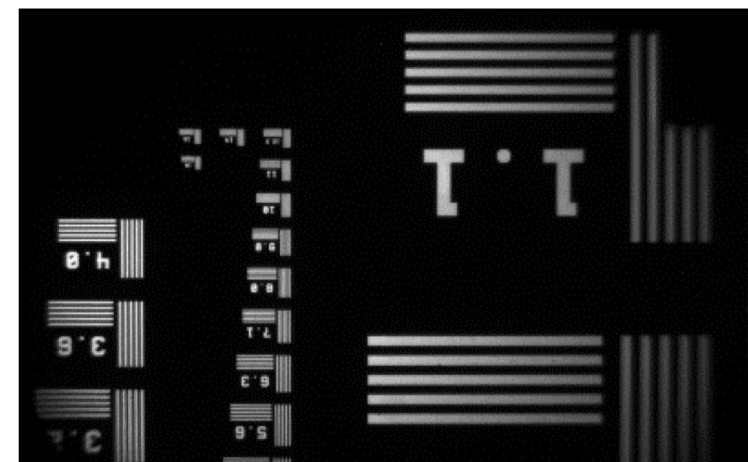
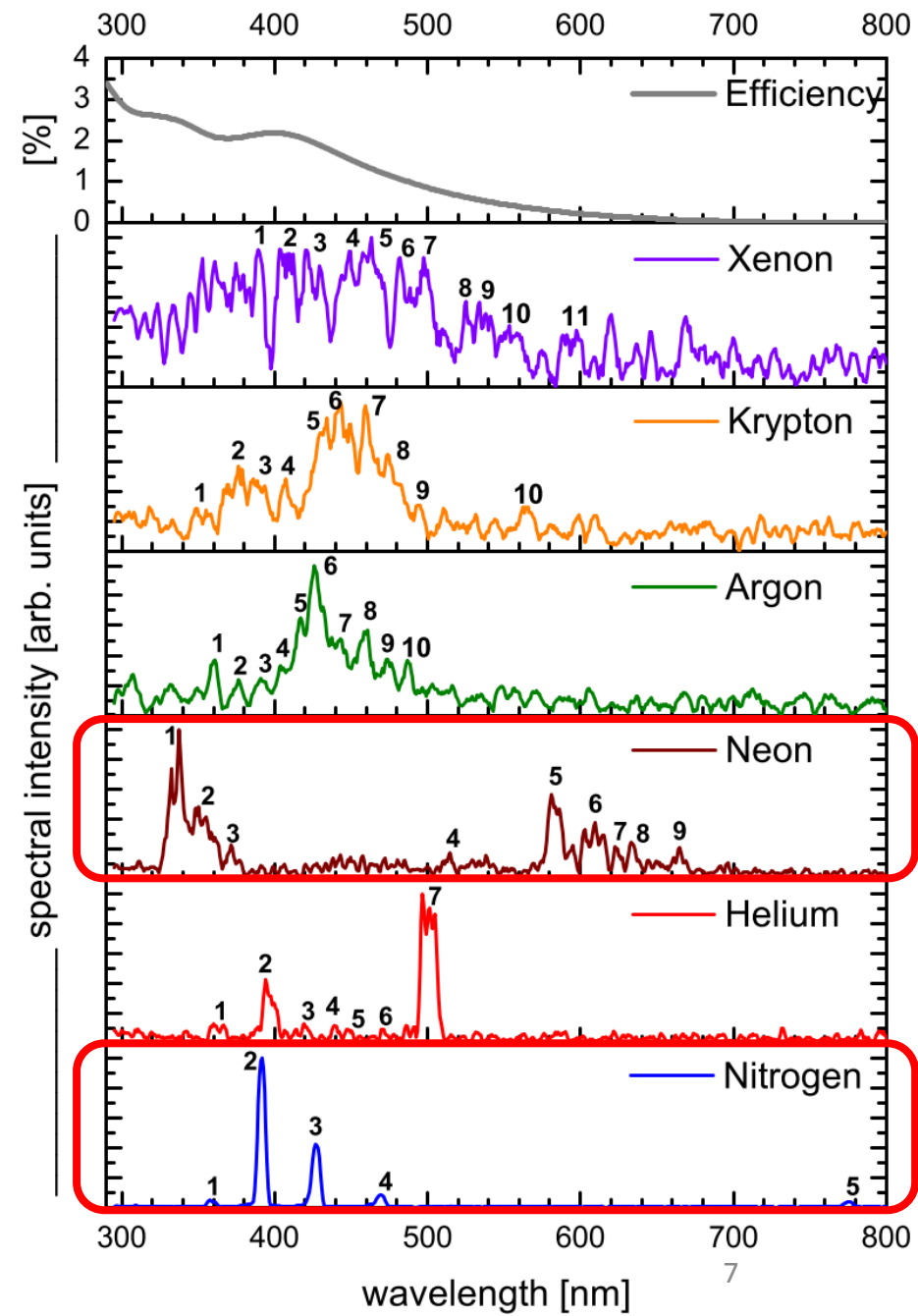


Model: Tom Dodington

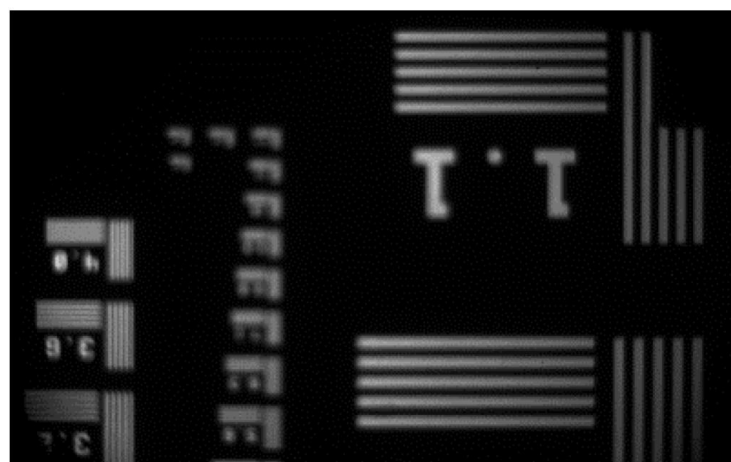
Image: Stefano Mazzone



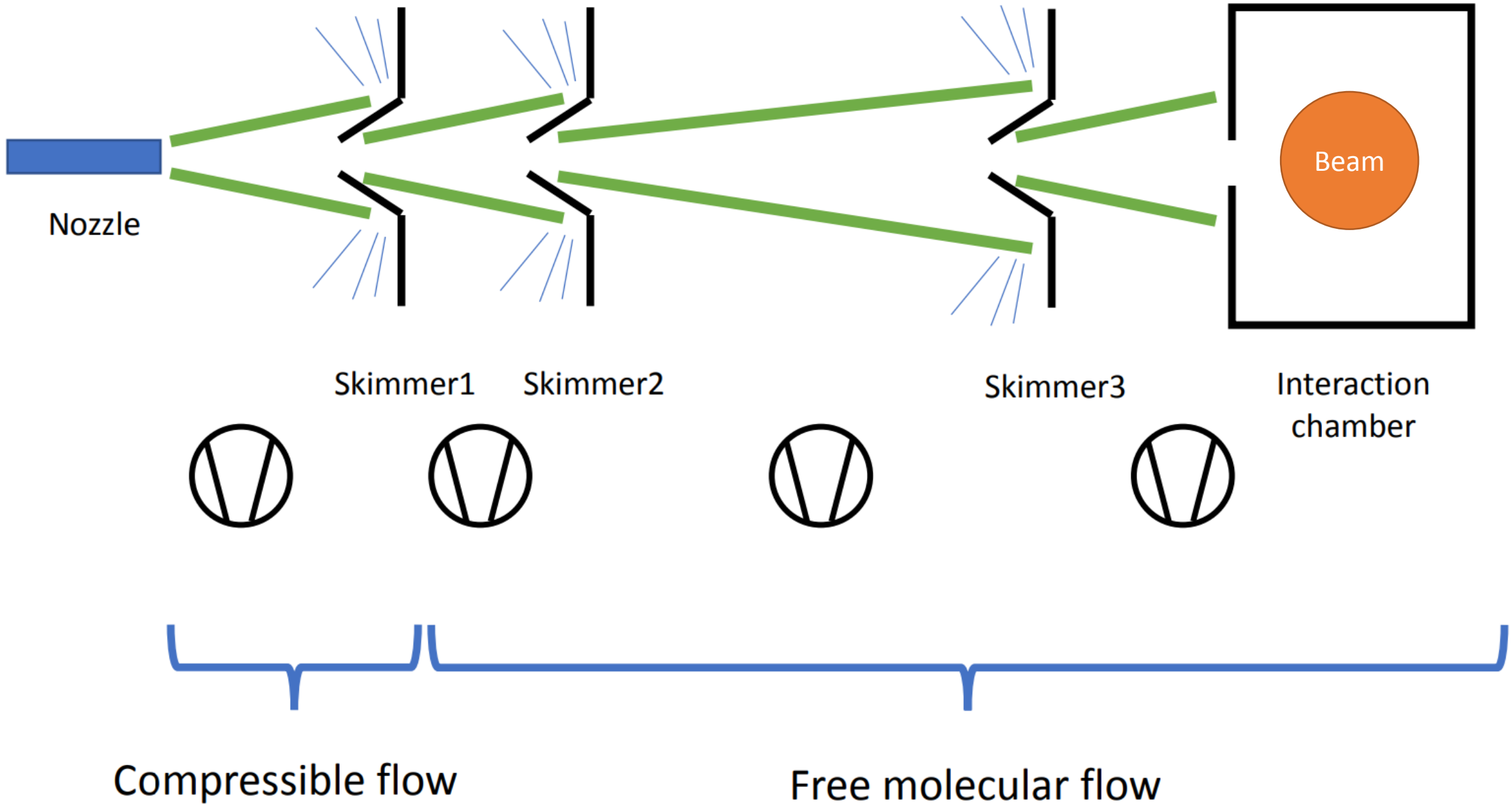
p @ 4,757 MeV/u

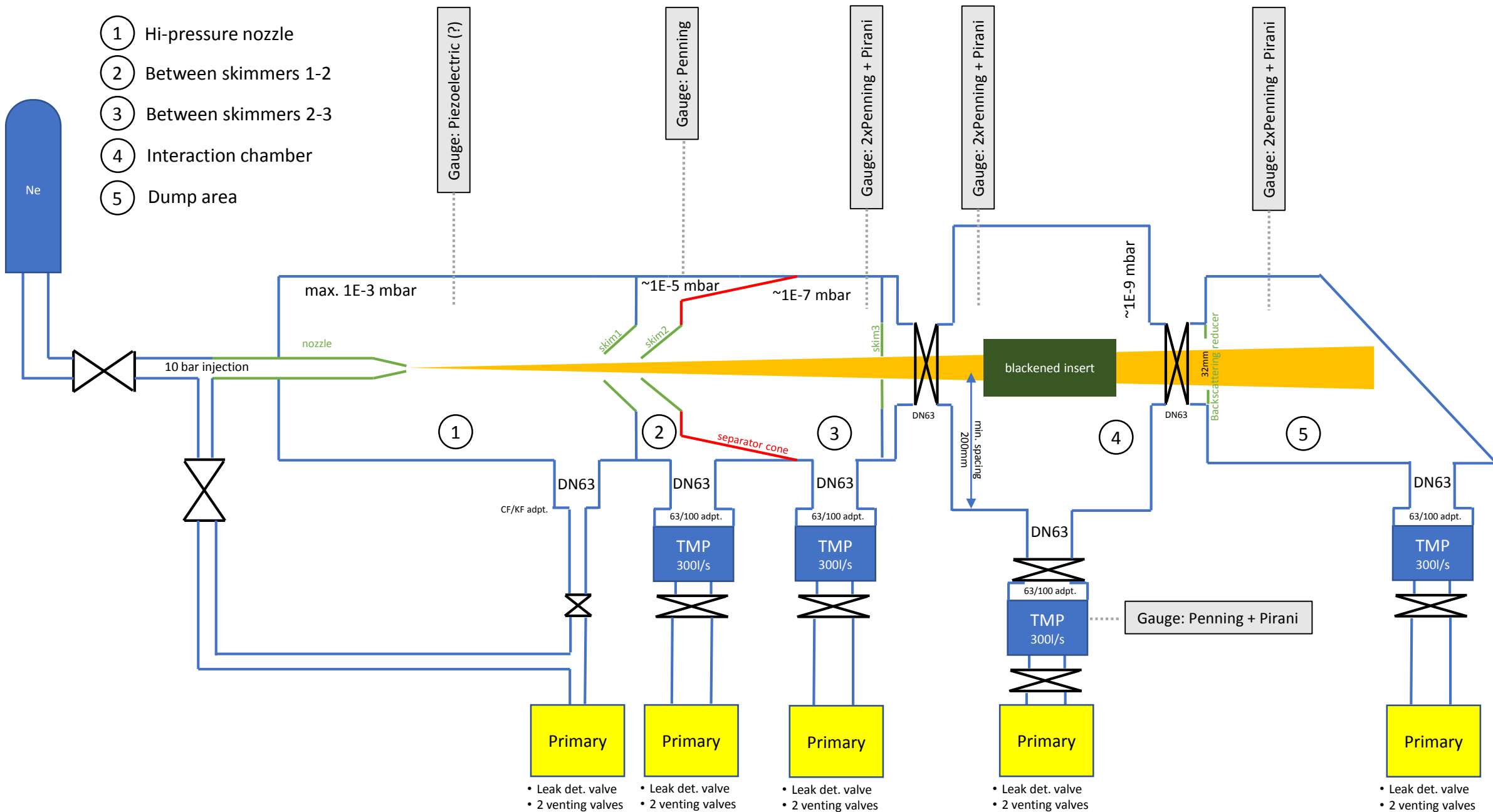


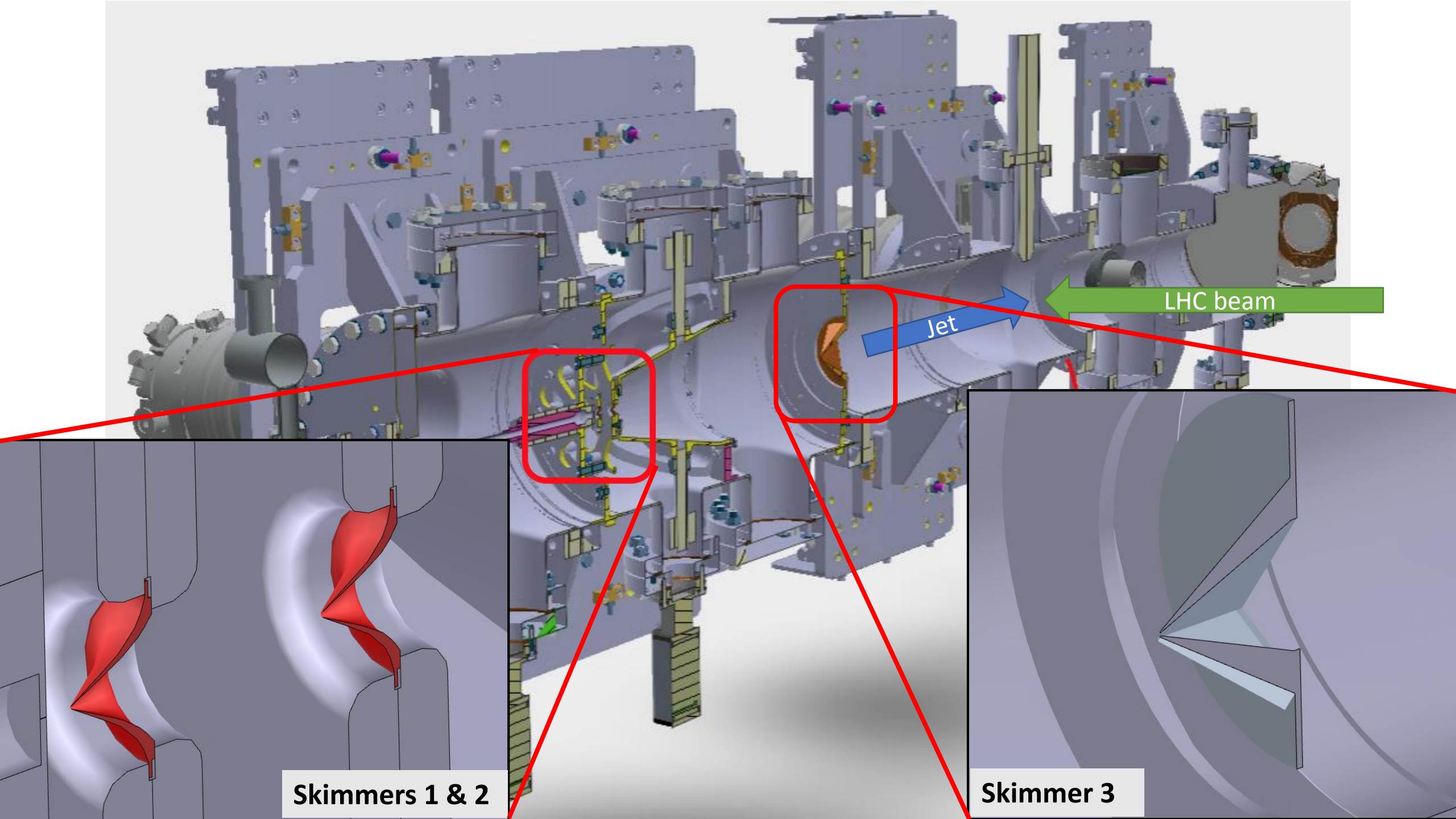
Reference plane



Target + 5 mm wrt reference







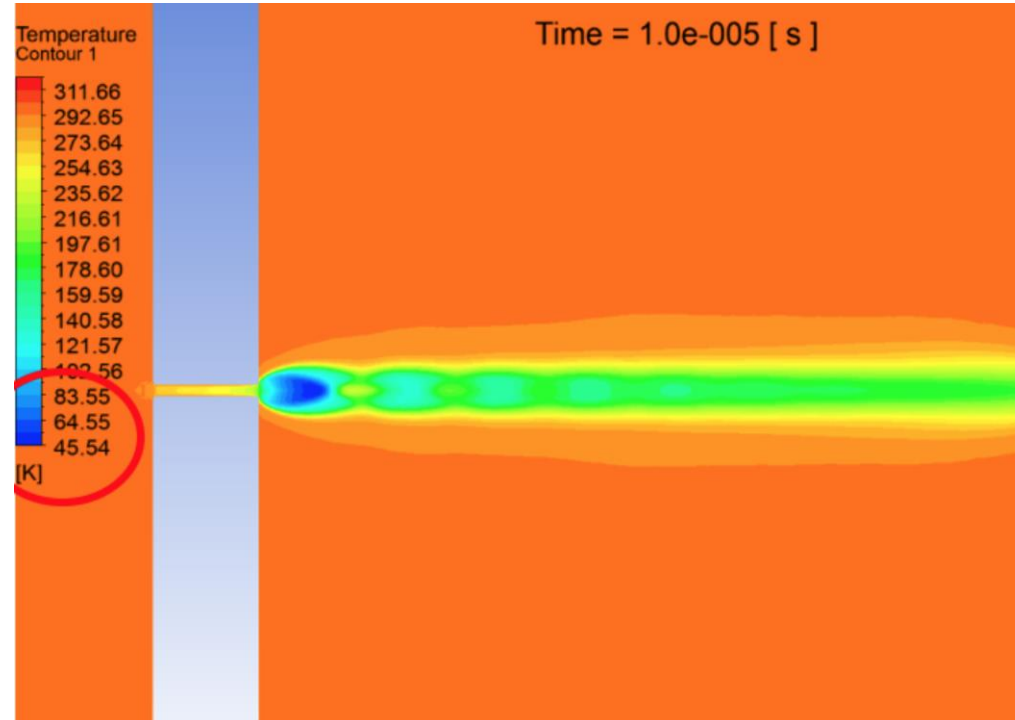
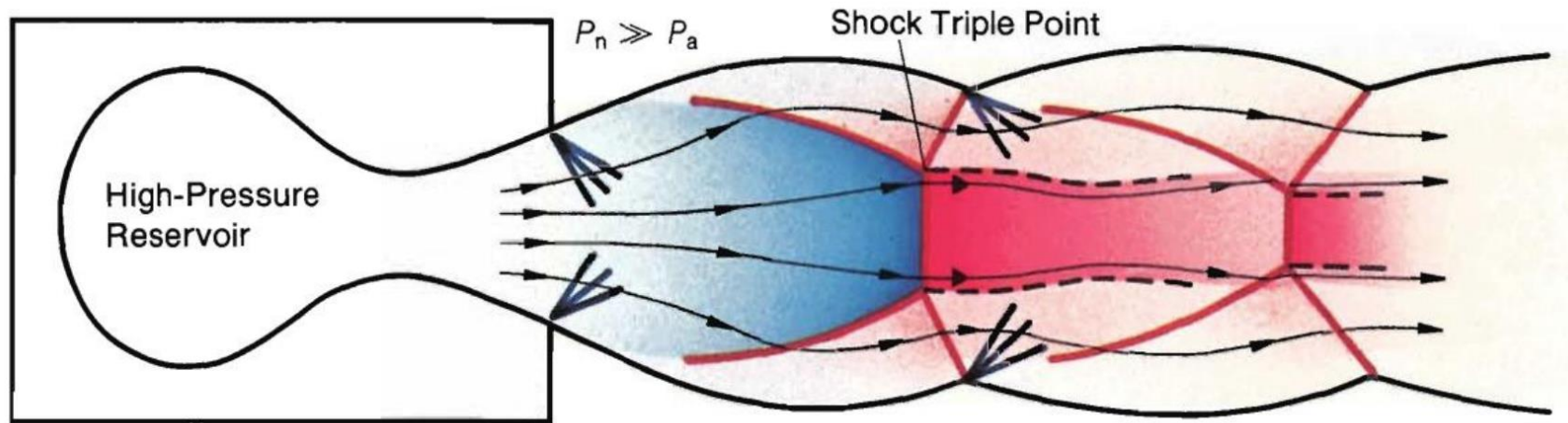
LHC beam

Jet

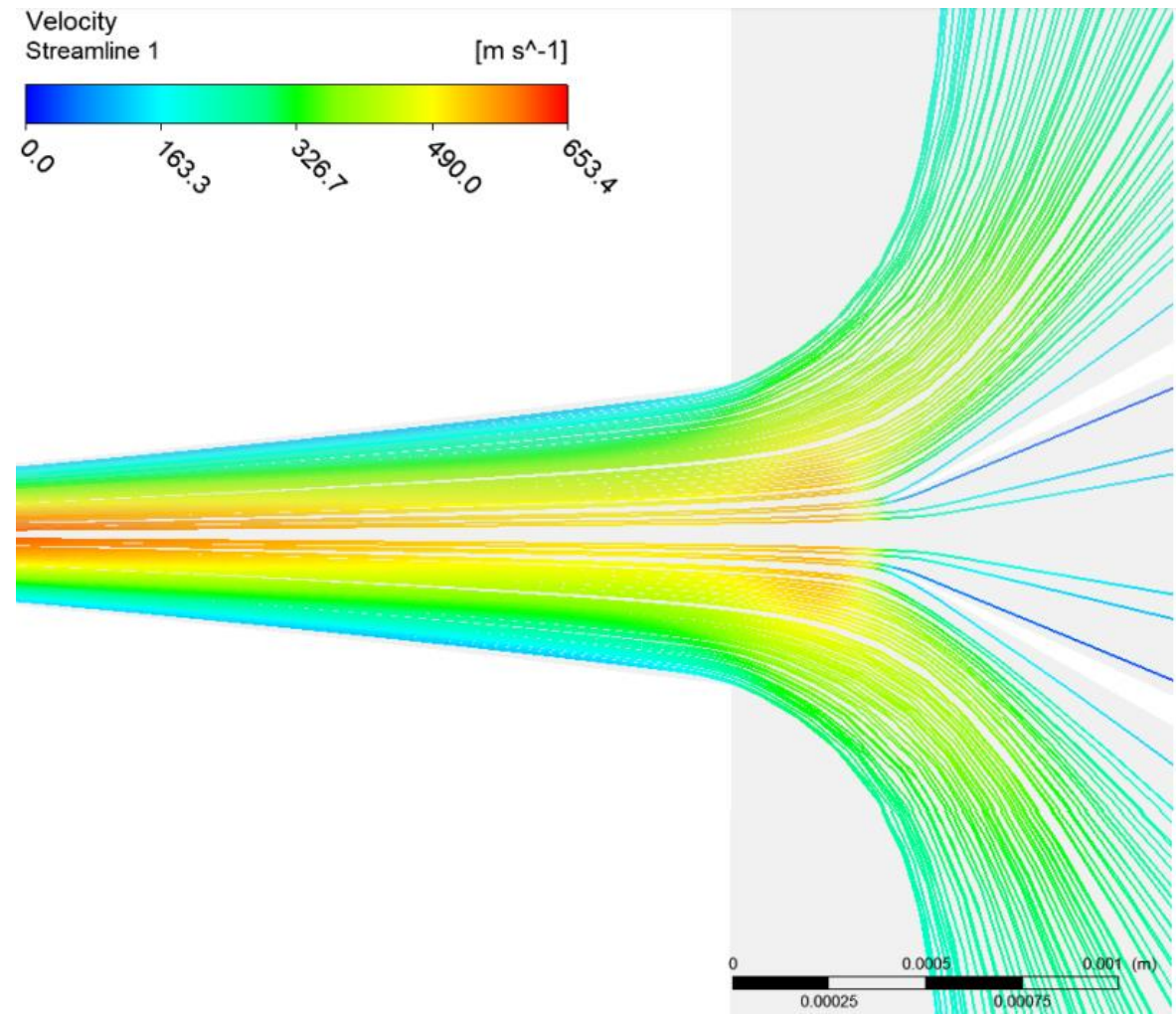
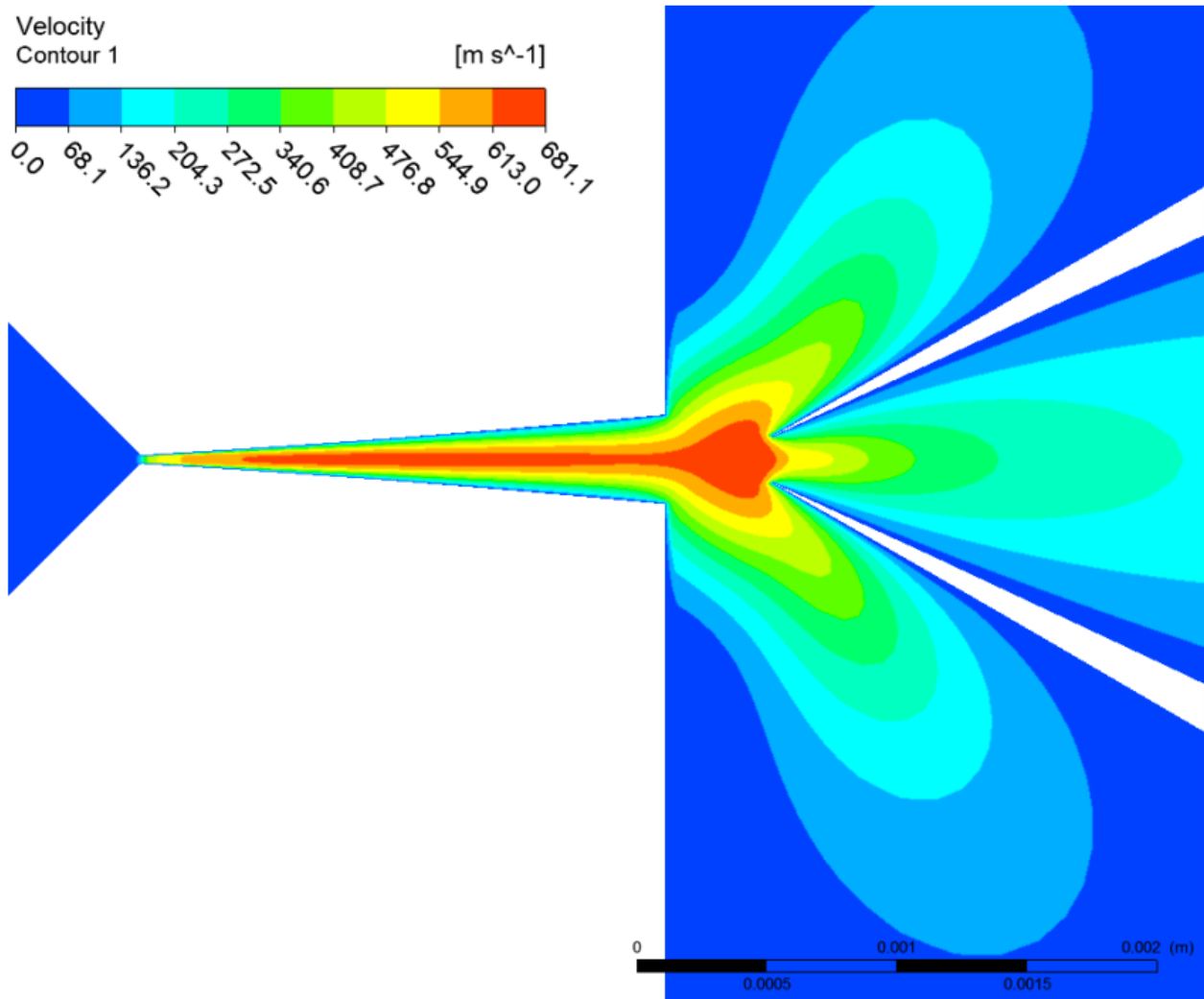
Skimmers 1 & 2

Skimmer 3

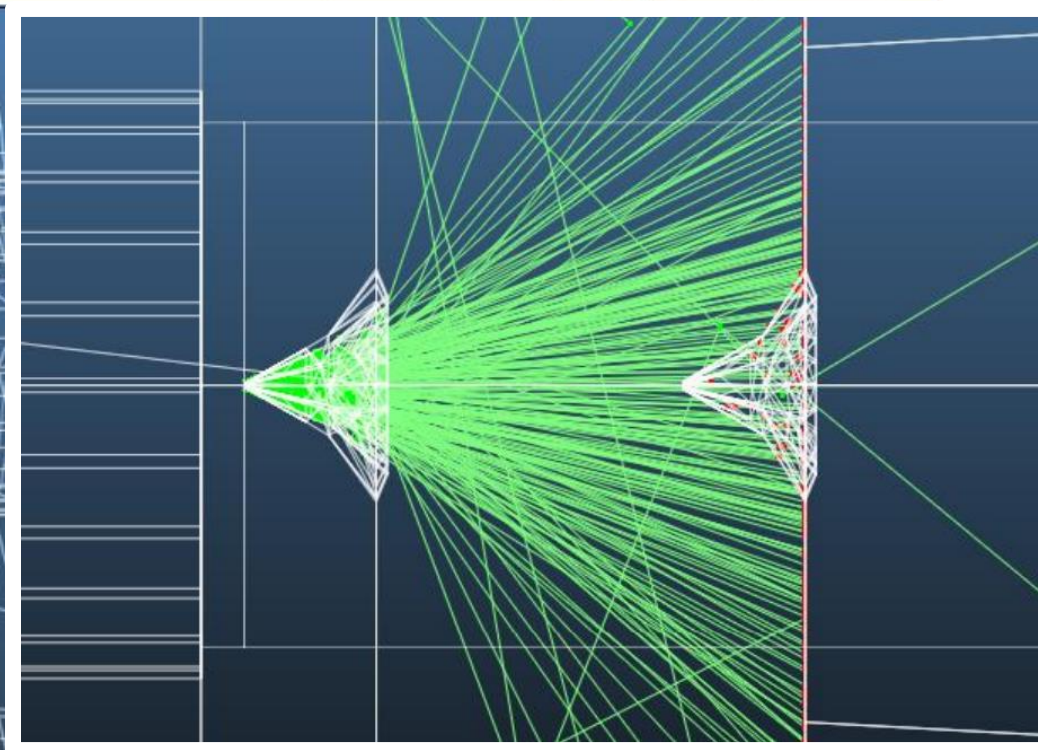
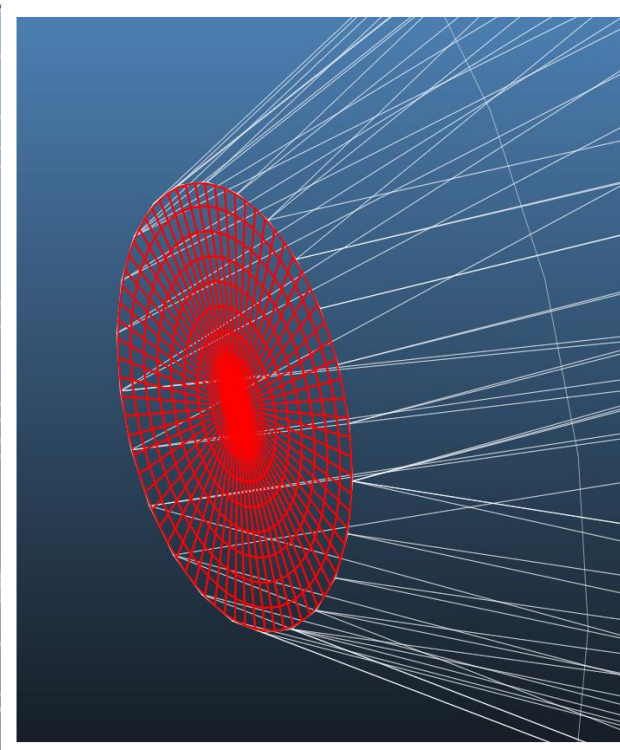
High-pressure injection from divergent-convergent nozzle



High-pressure simulations



Desorption:



Skimmer 1
Viscous/molecular
boundary

Texture Scaling

Texture Range

Min: 0 Autoscale Use colors

Max: 1 Include constant flow Logarithmic scale

Set to current Apply Swap 2.50MB

Current

Min: 2.671E+17

Max: 5.027E+22

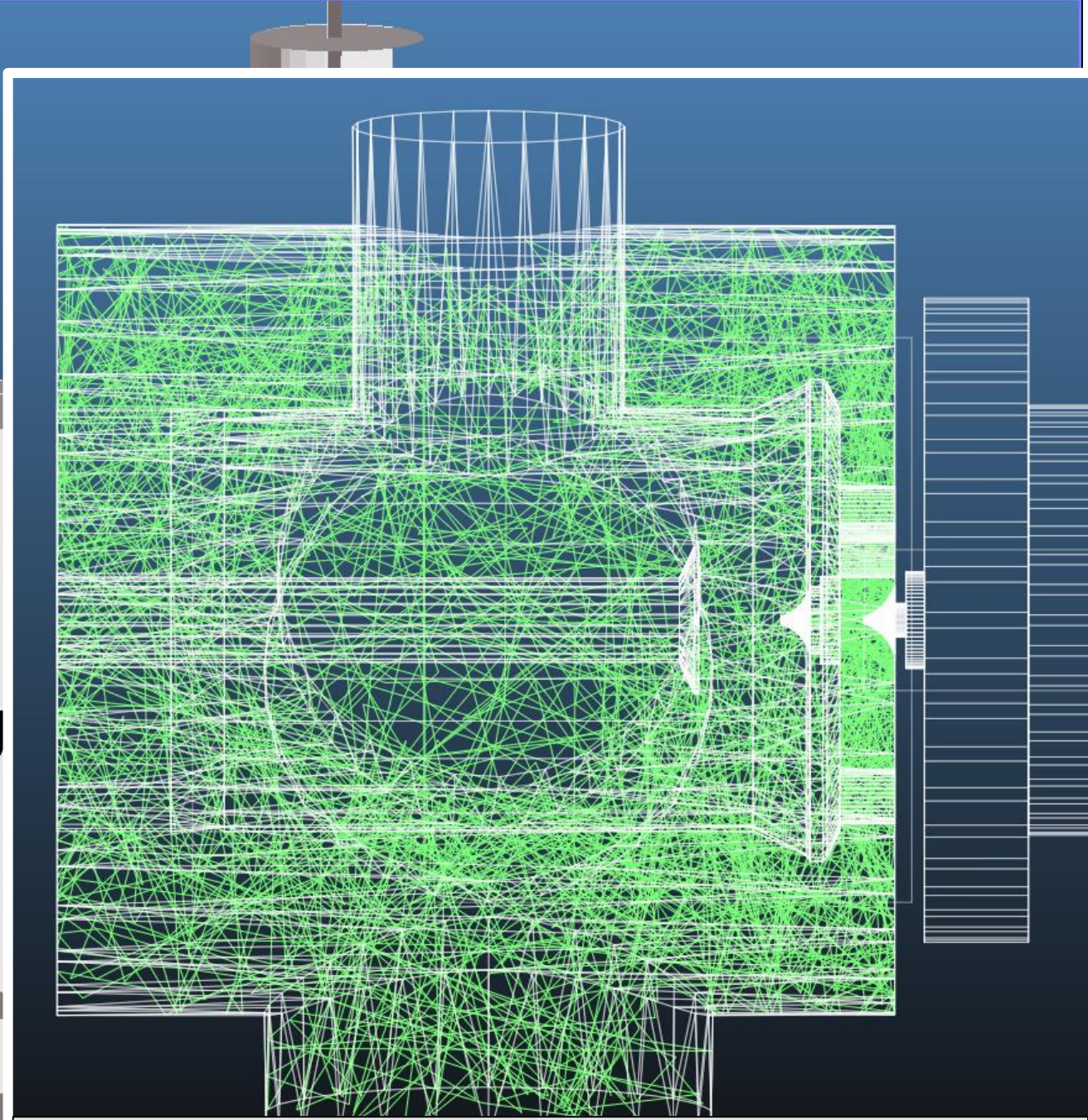
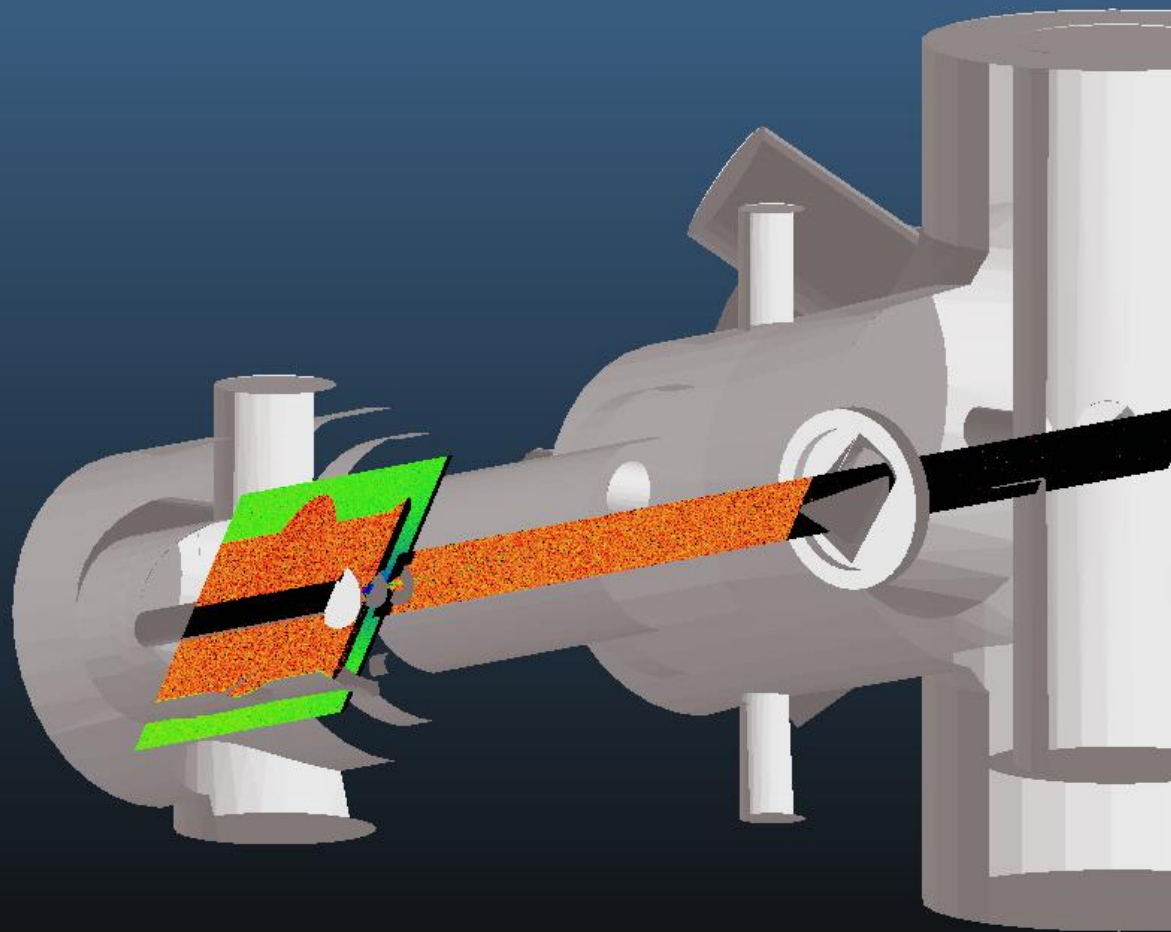
Gradient

2.11e22

100e18 100e19 100e20 100e21 100e22

Show: Particle density [1/m³]

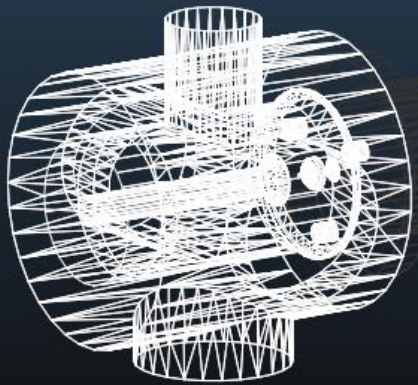
Simulating at once



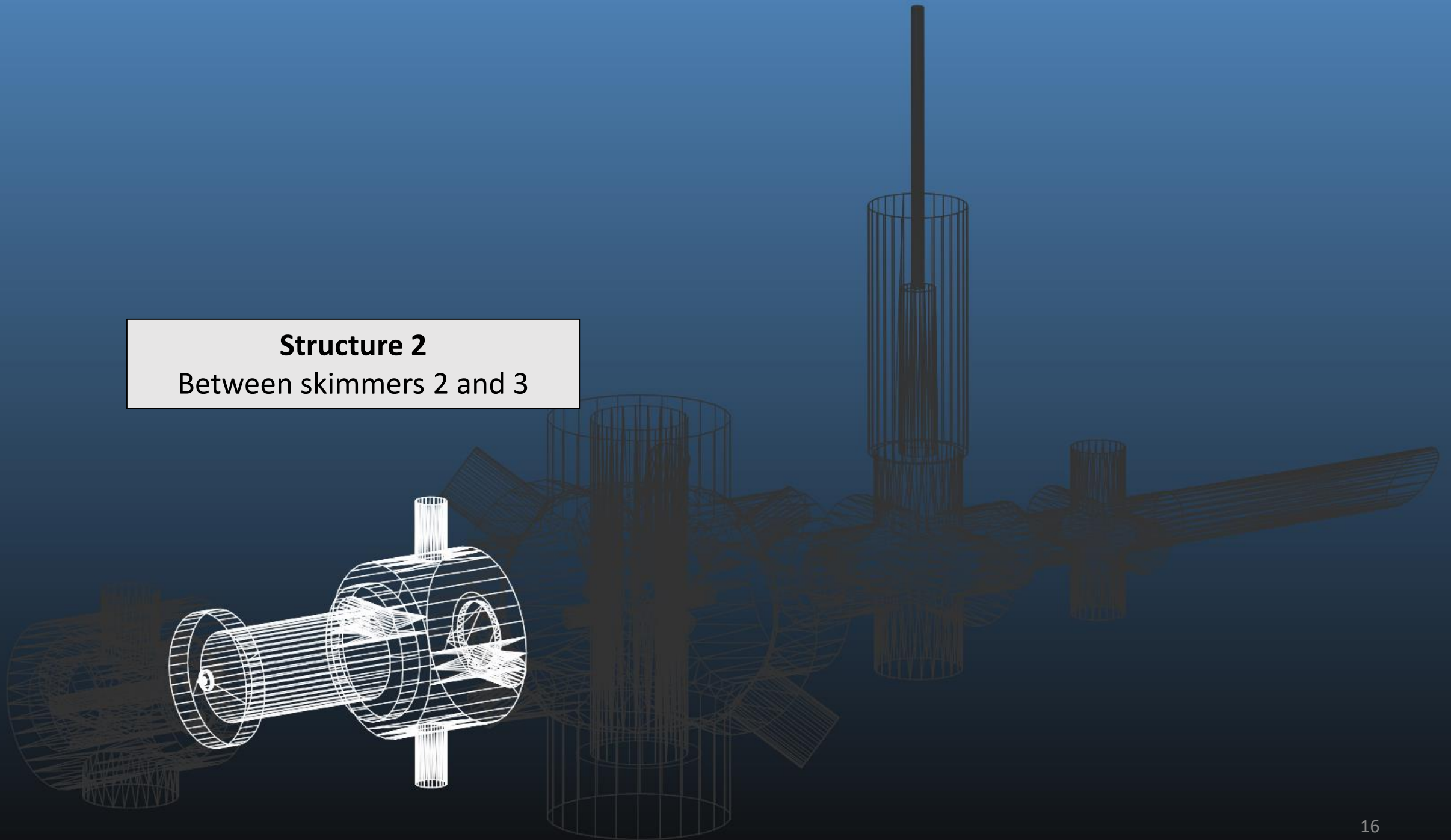
Large density differences: Monte Carlo weakness

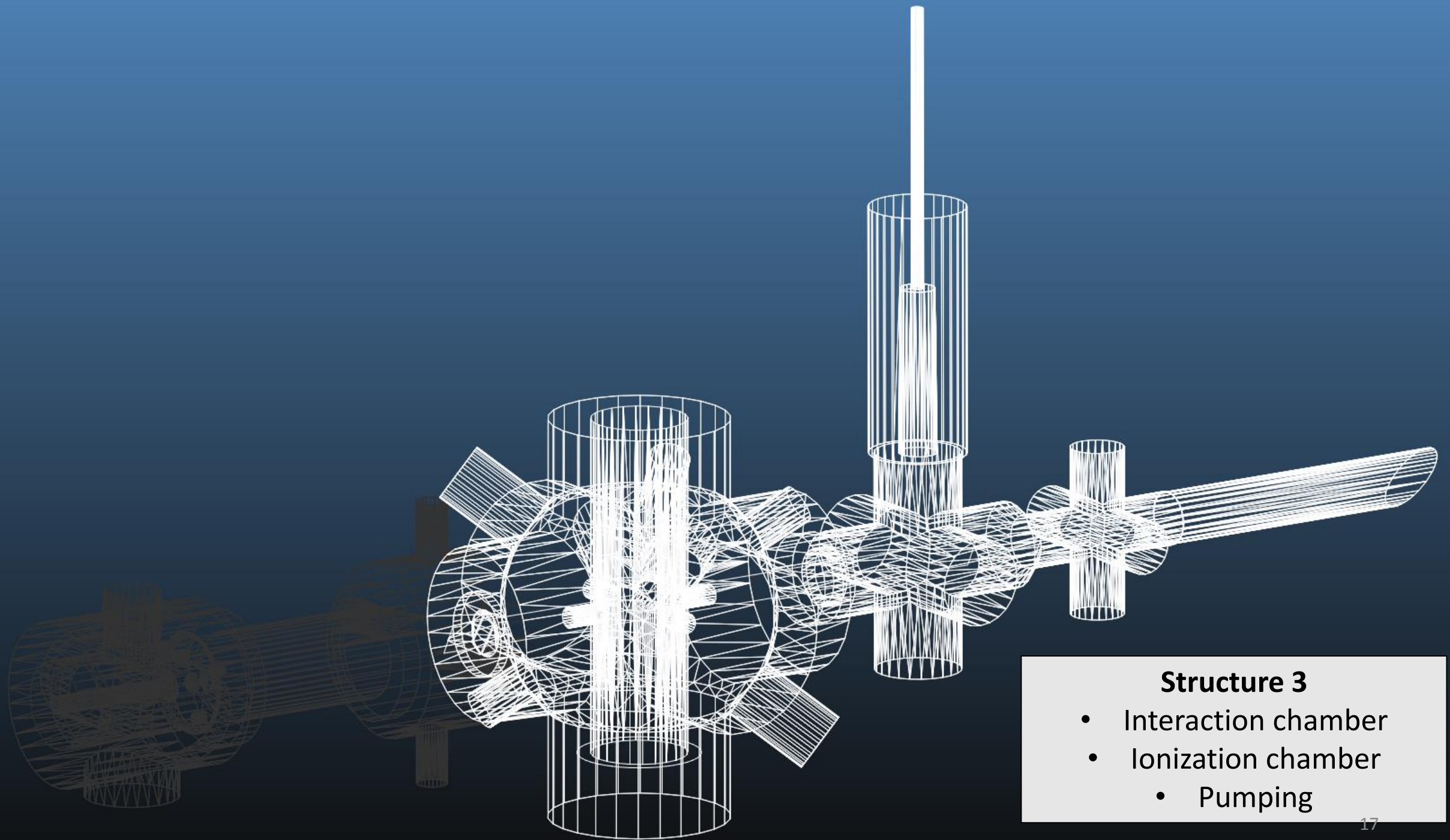
Structure 1

- High pressure nozzle
- Skimmer 1 & 2



Structure 2
Between skimmers 2 and 3

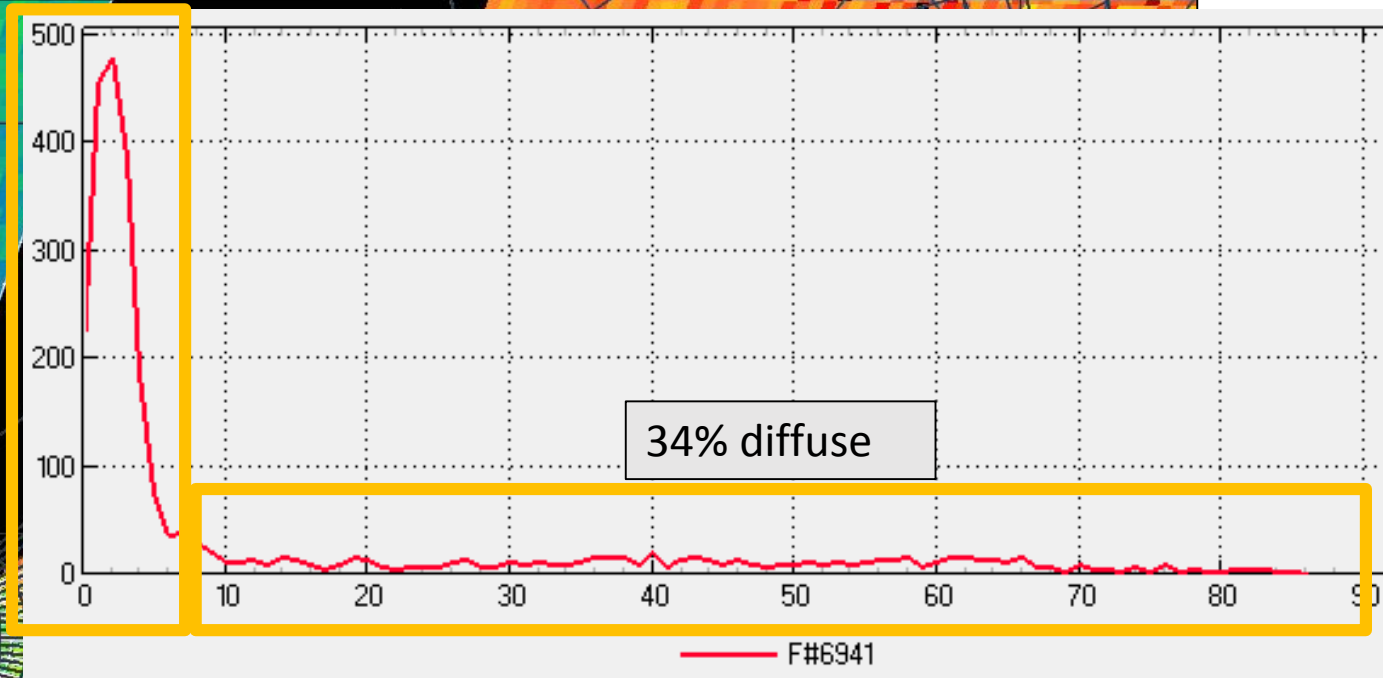




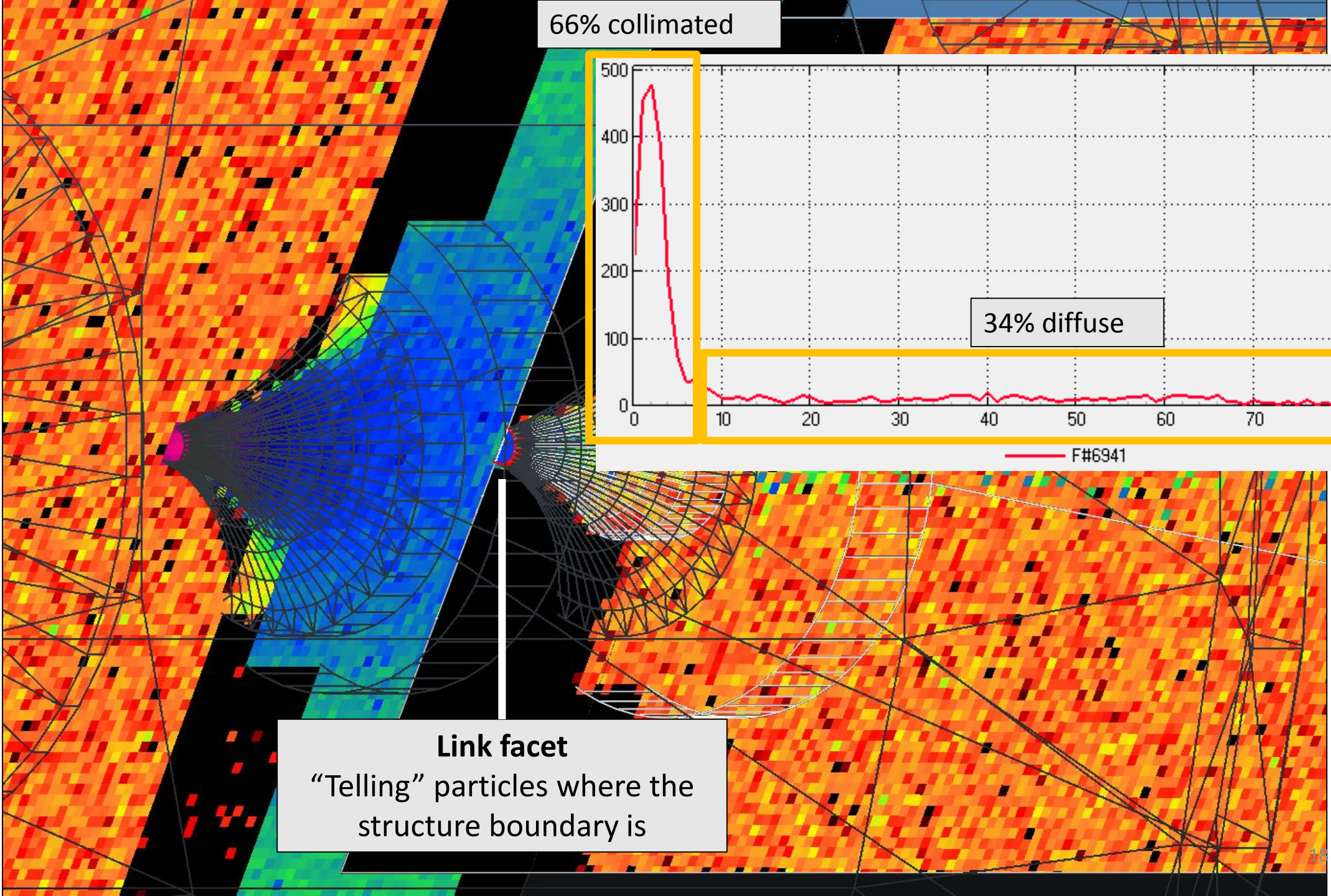
Structure 3

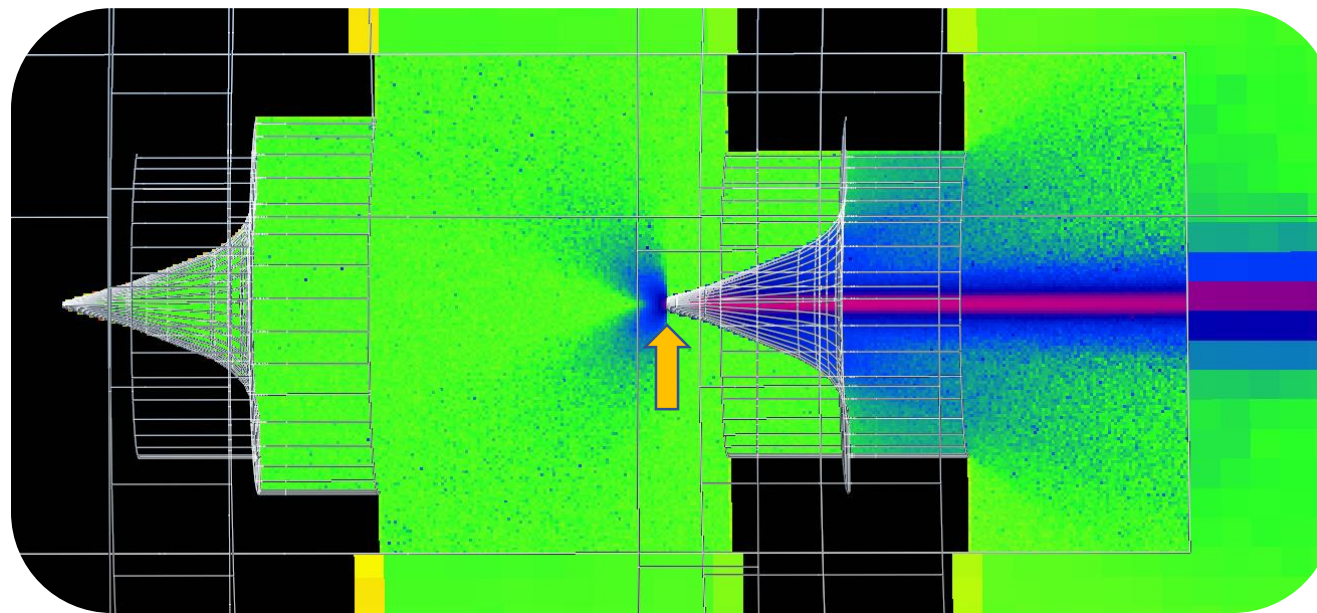
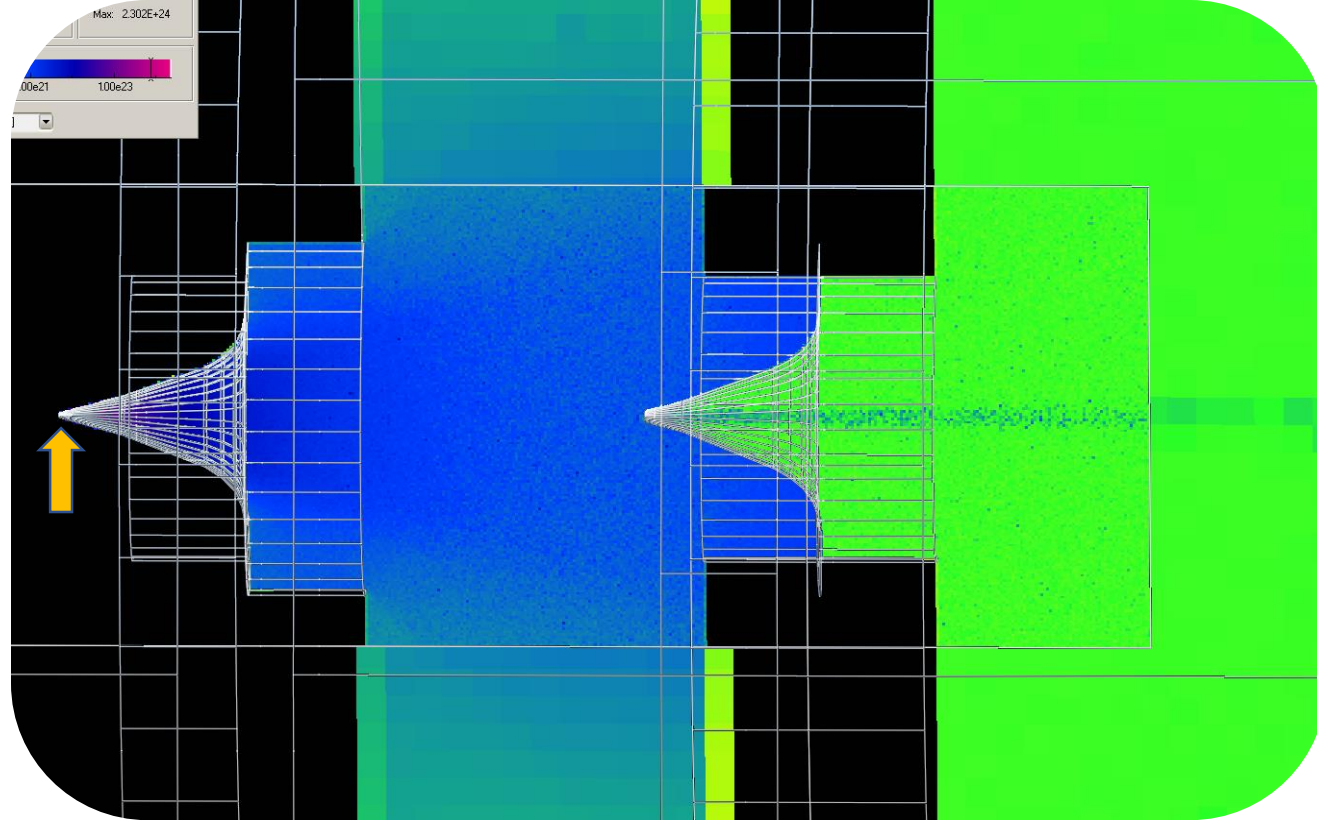
- Interaction chamber
- Ionization chamber
 - Pumping

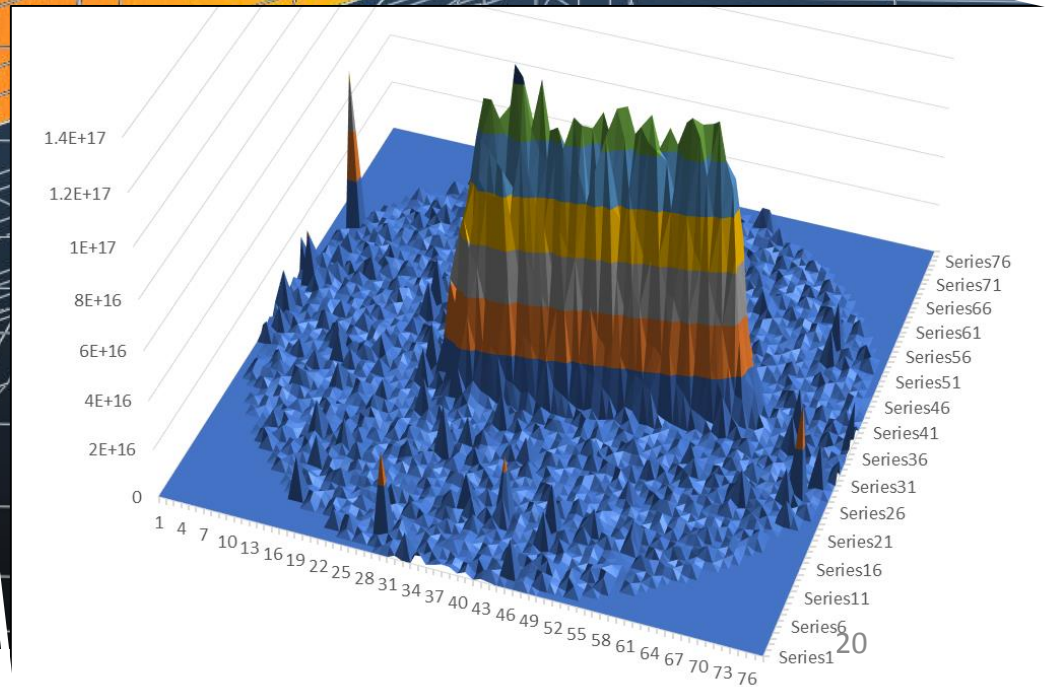
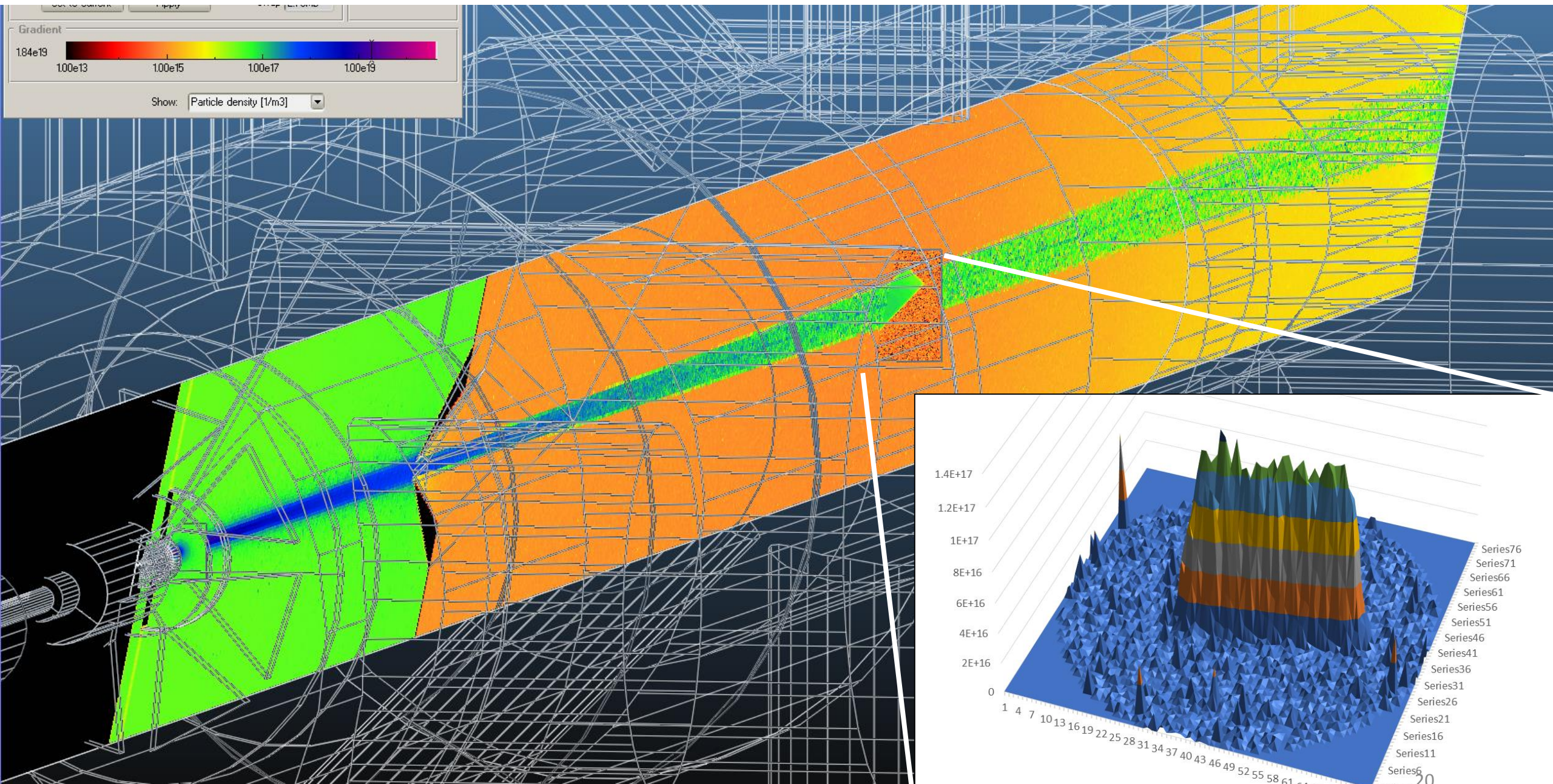
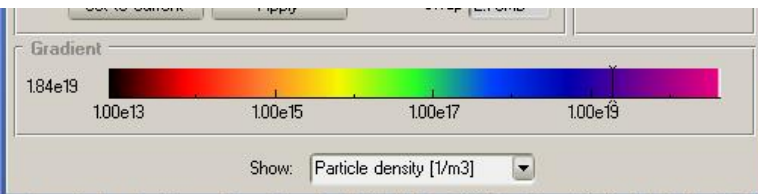
66% collimated



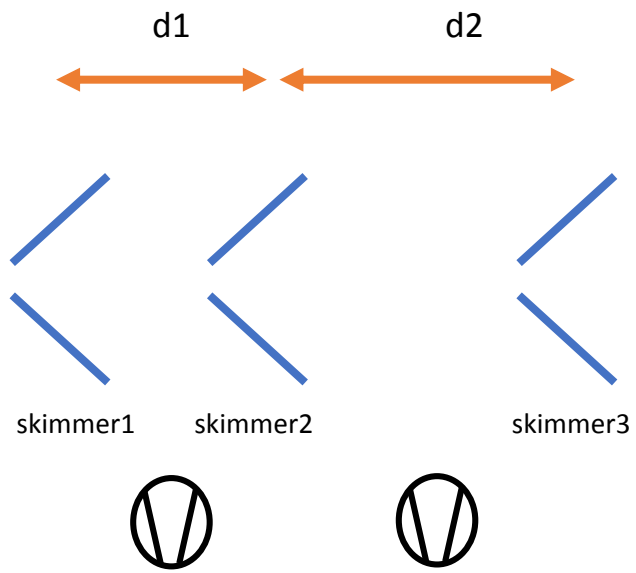
Link facet
“Telling” particles where the structure boundary is



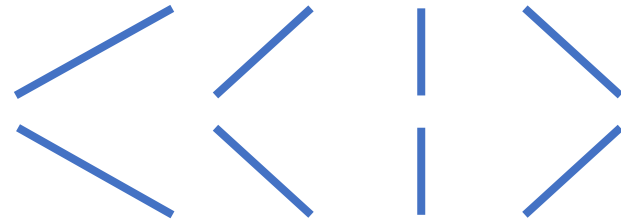




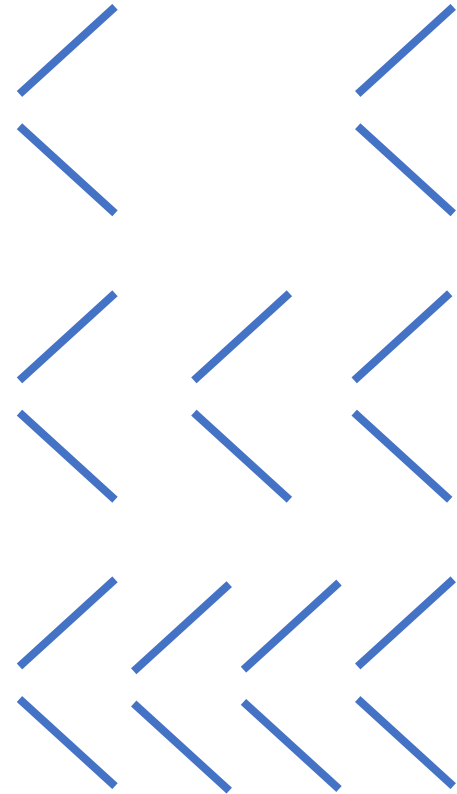
Free parameters, low pressure part



Distance between skimmers



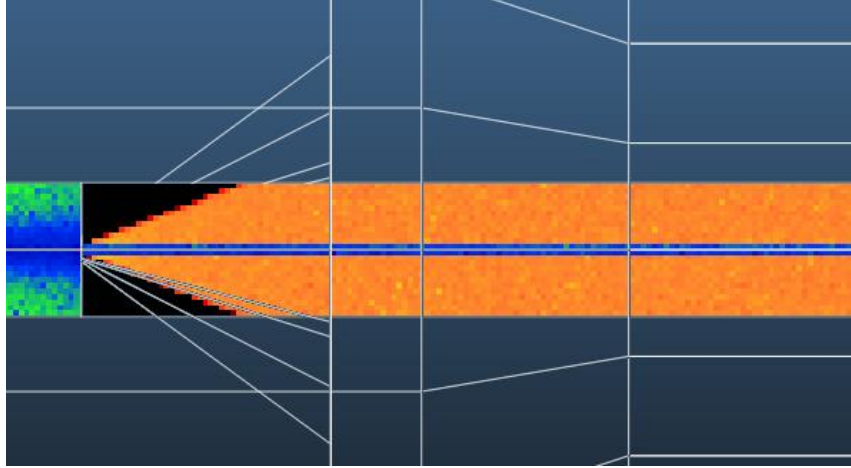
Skimmer shape



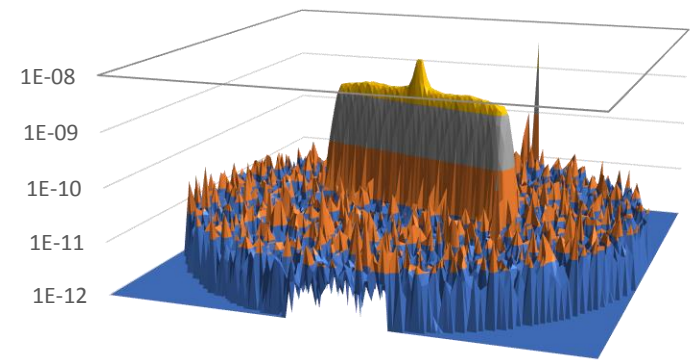
Number of skimmers

Skimmer variants

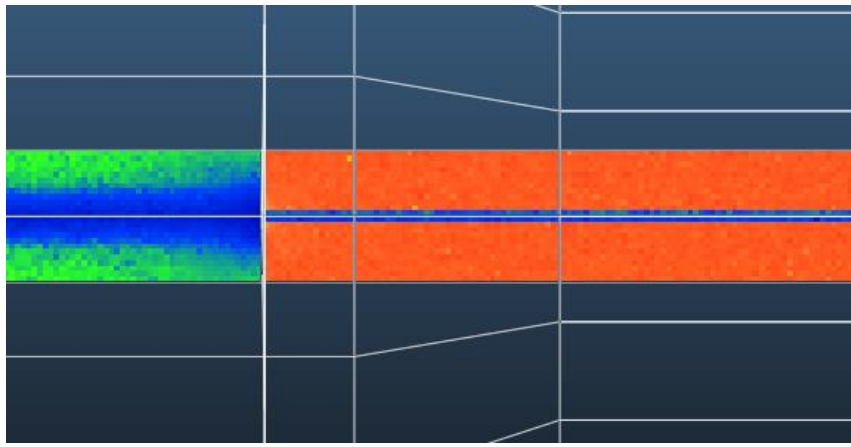
JET →



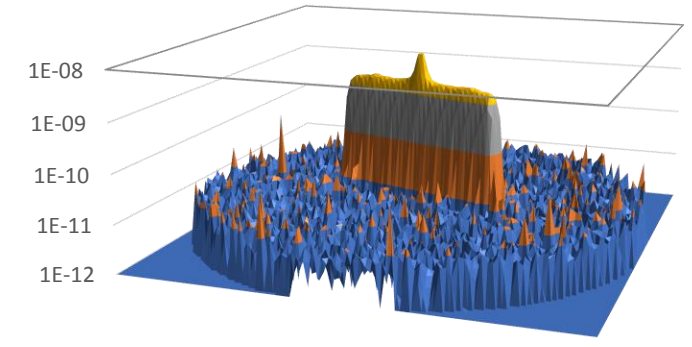
normal skimmer 3



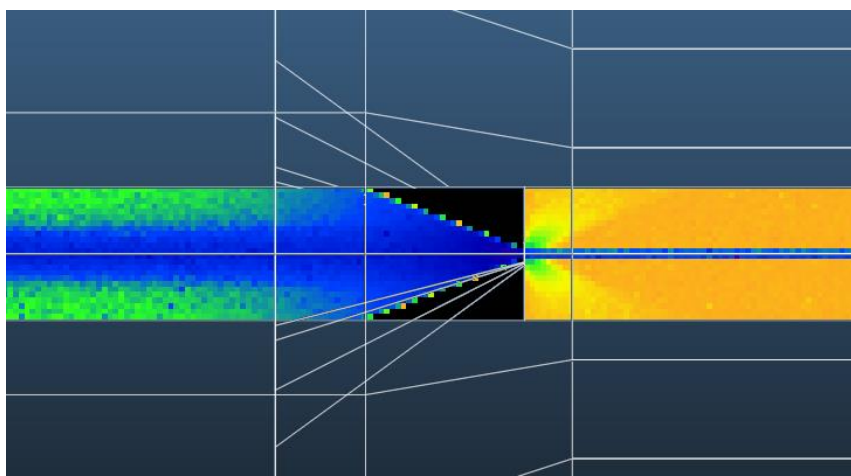
JET →



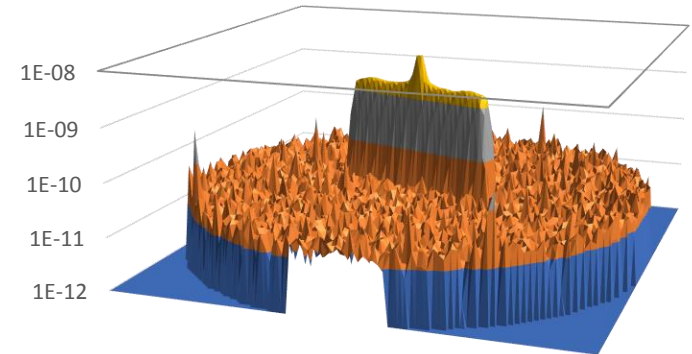
flat skimmer 3

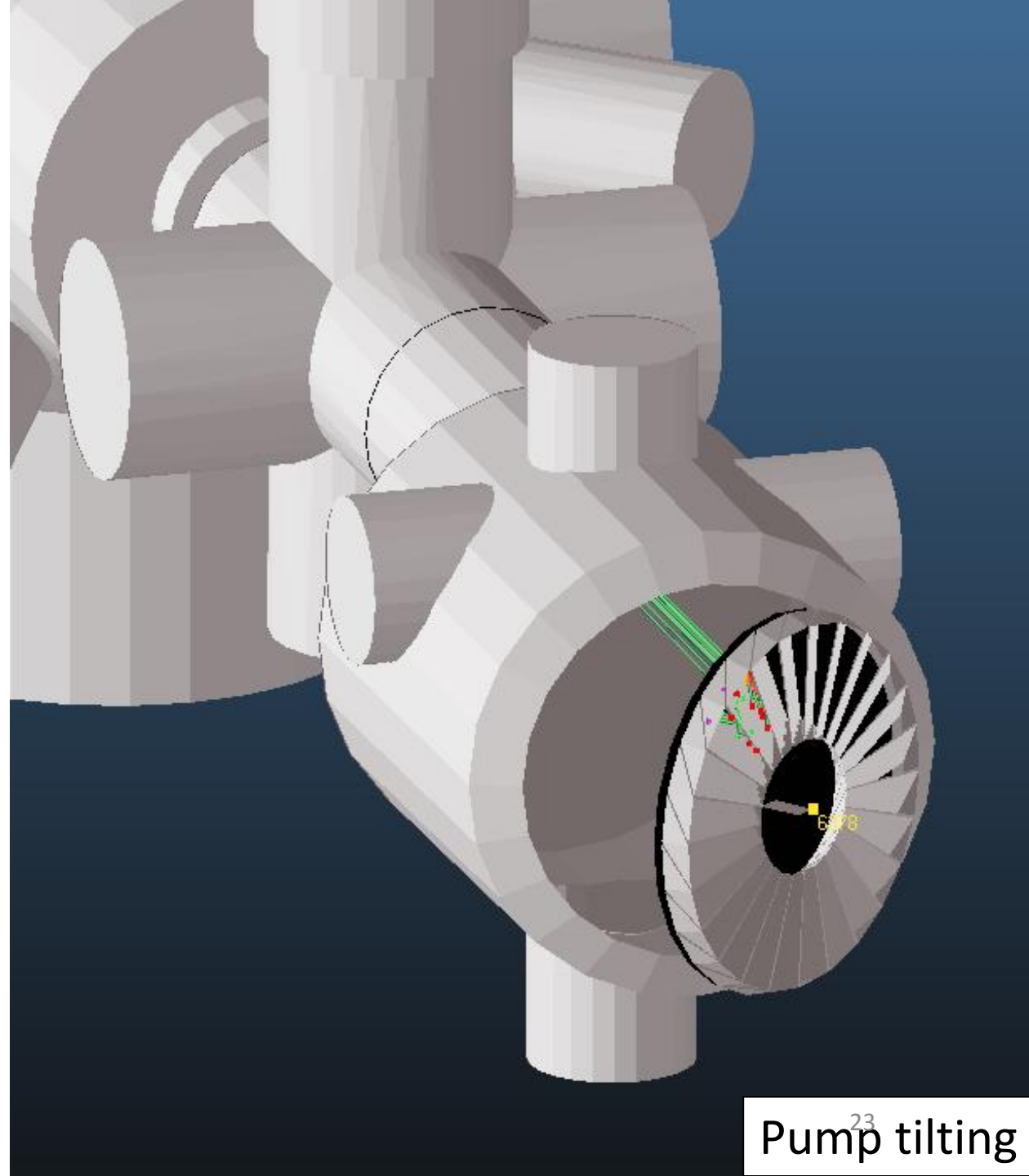
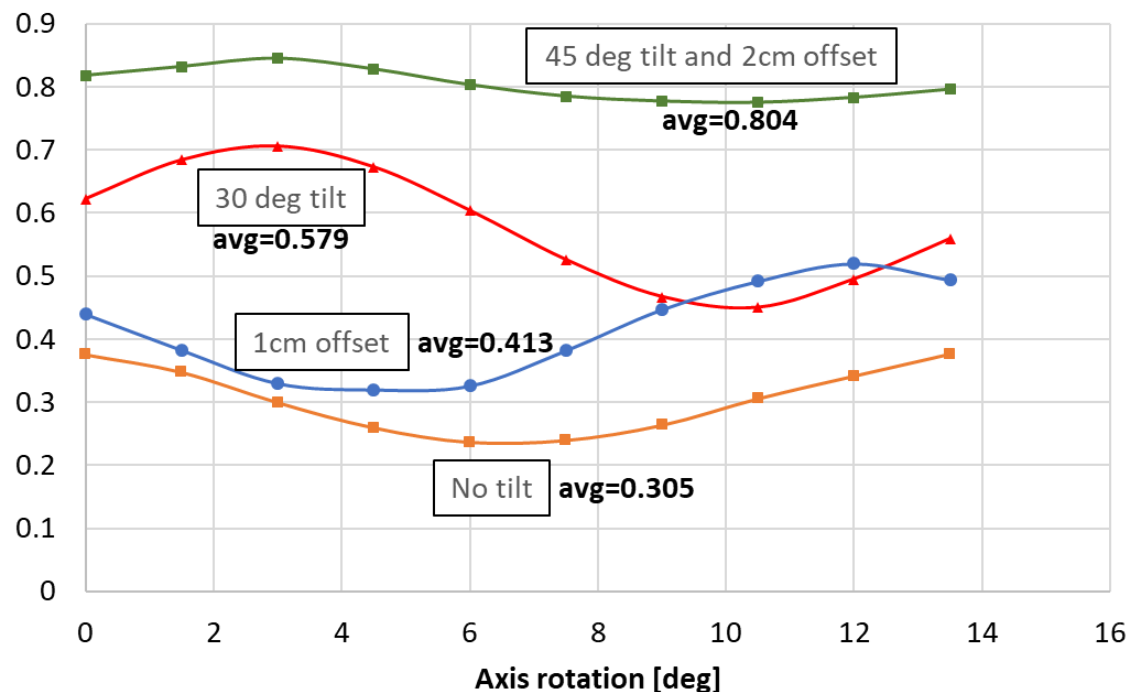
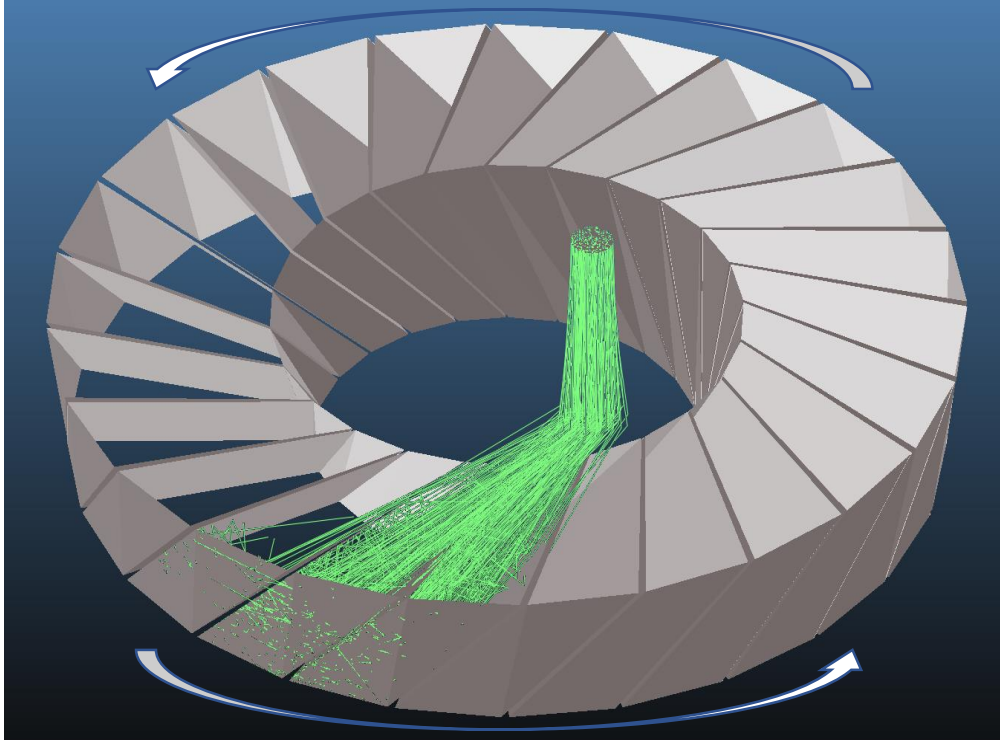


JET →

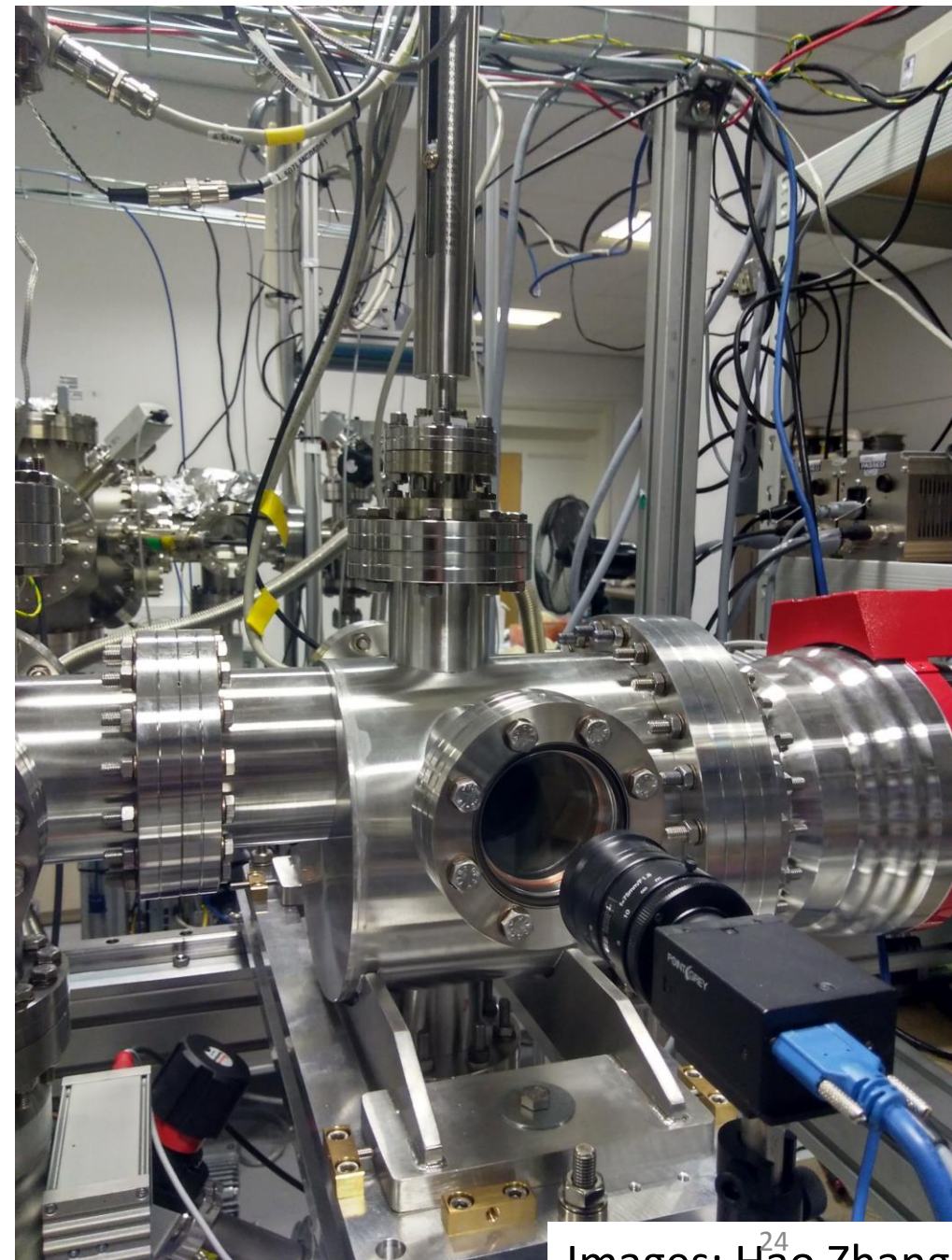
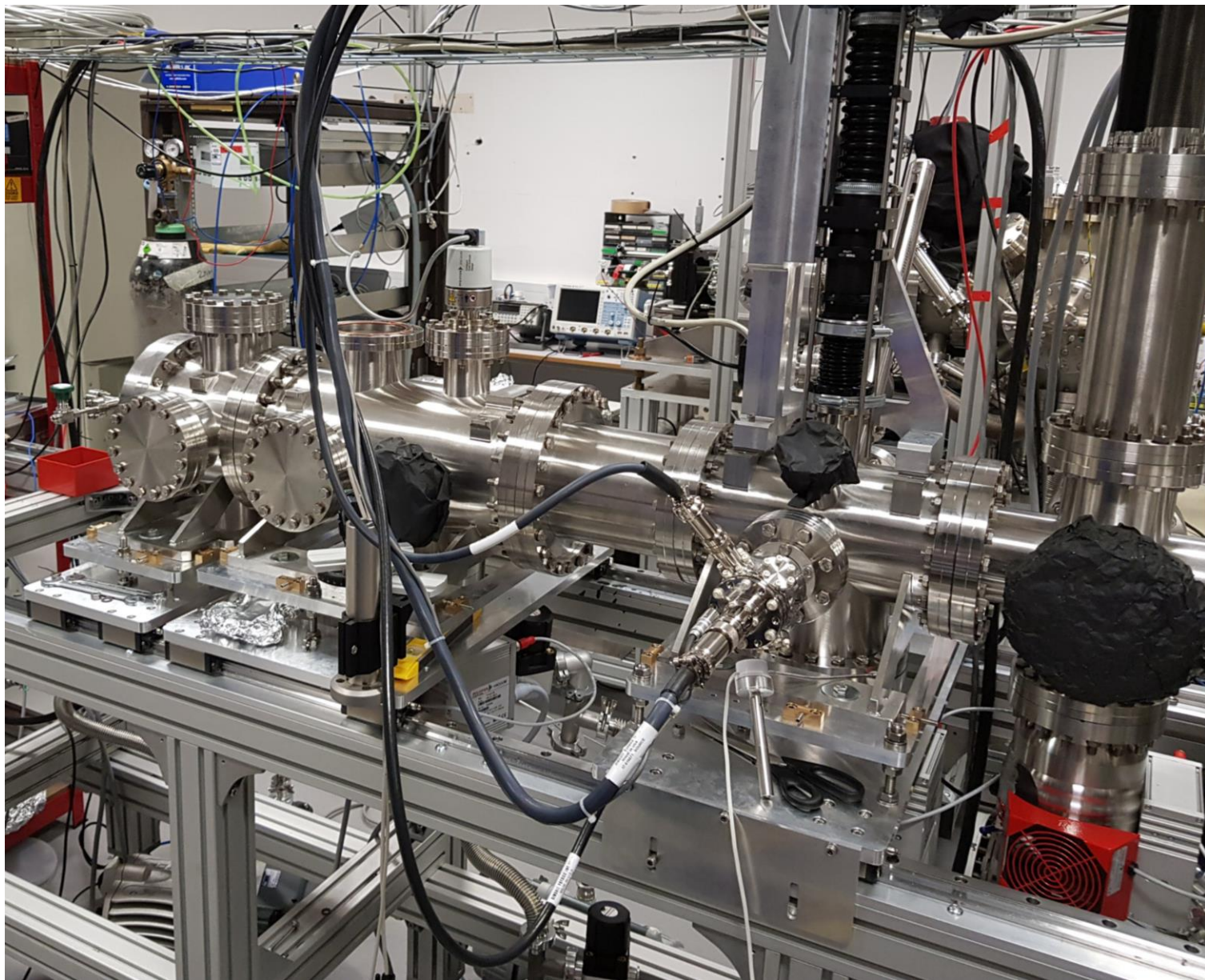


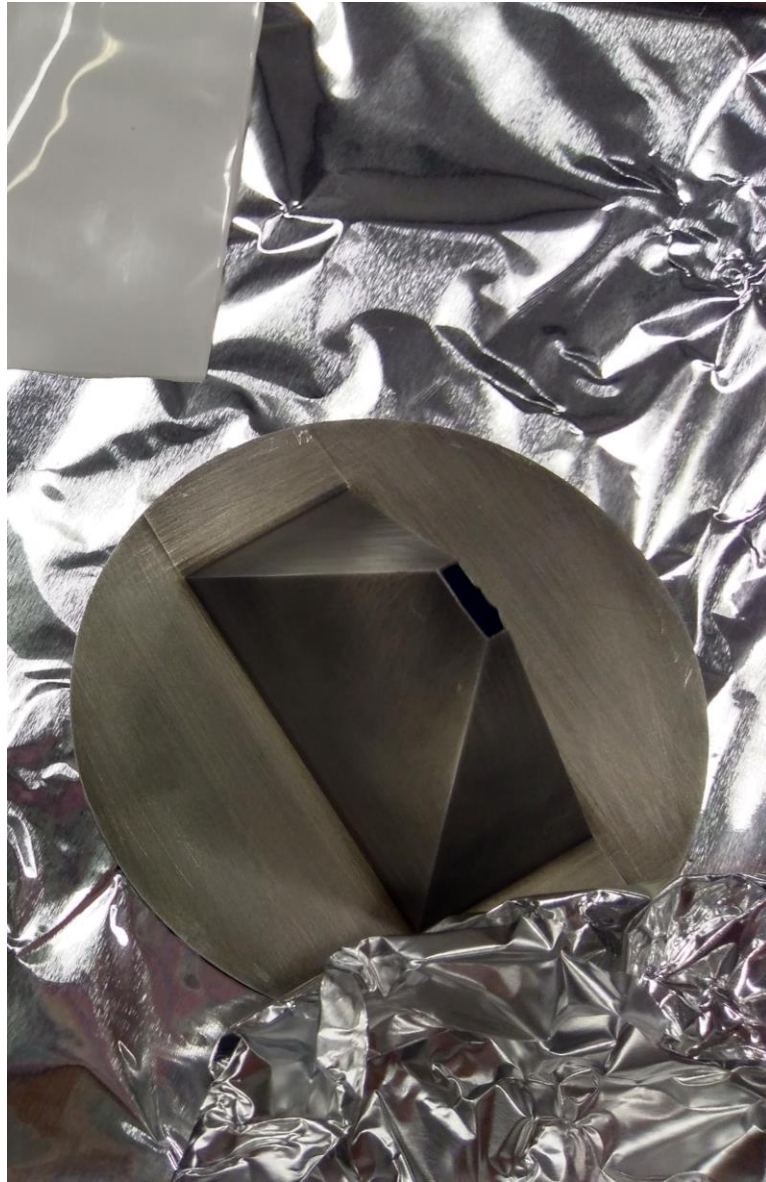
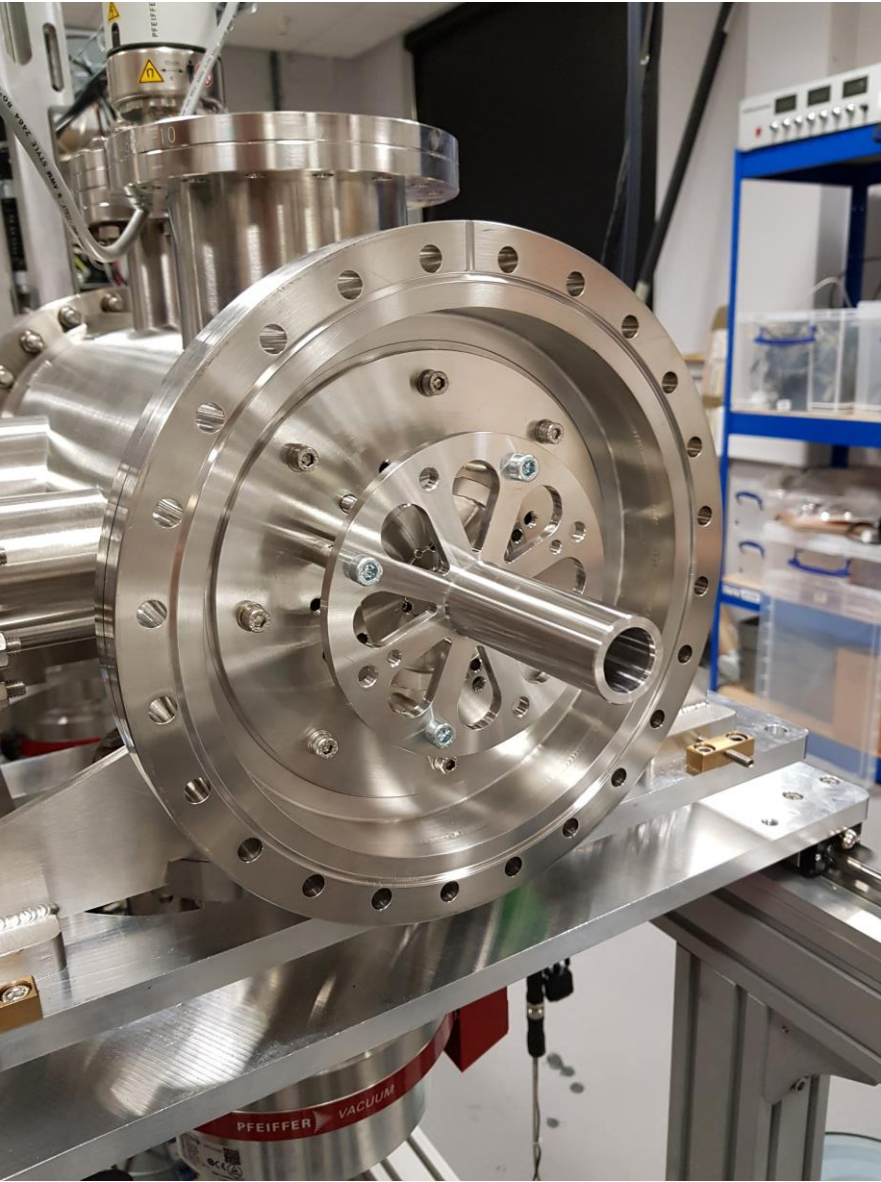
inverse skimmer 3





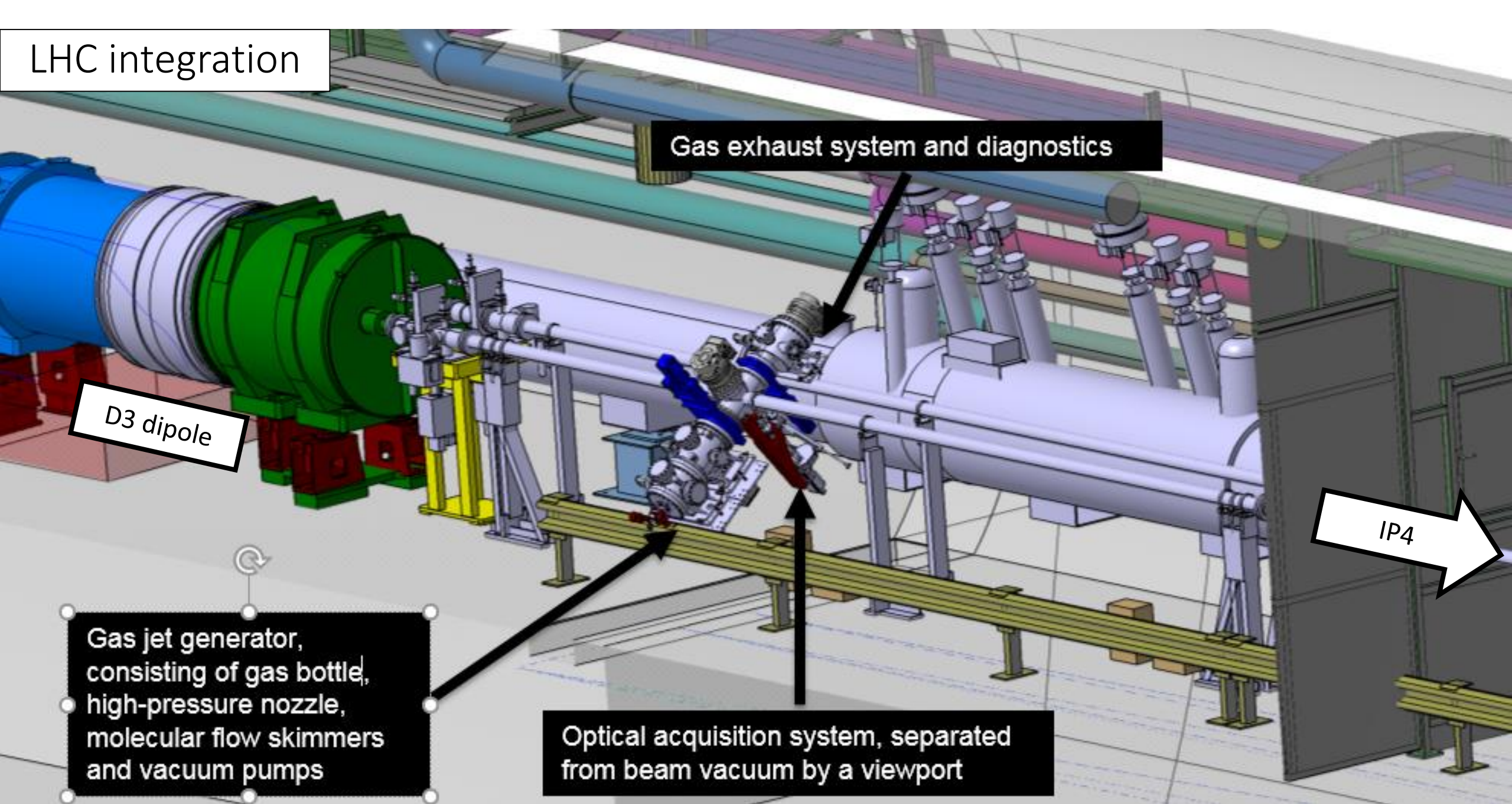
Prototype at Cockcroft Institute (UK)





Images: Johanna Glutting

LHC integration



D3 dipole

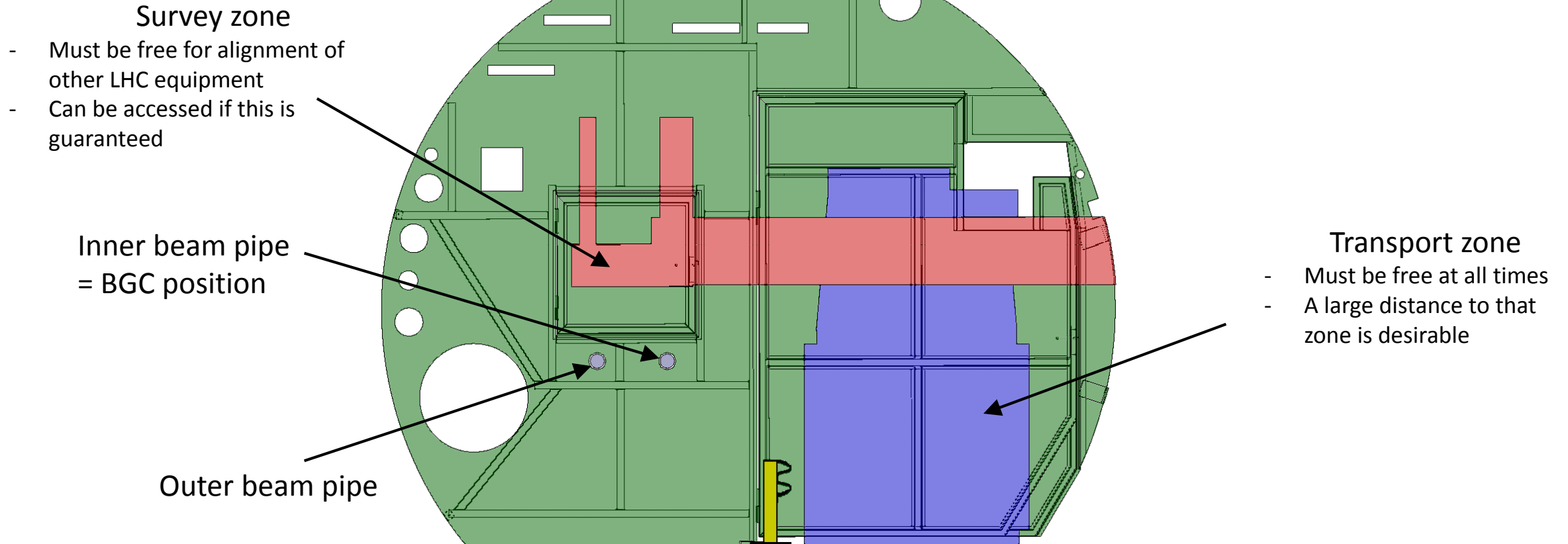
Gas exhaust system and diagnostics

IP4

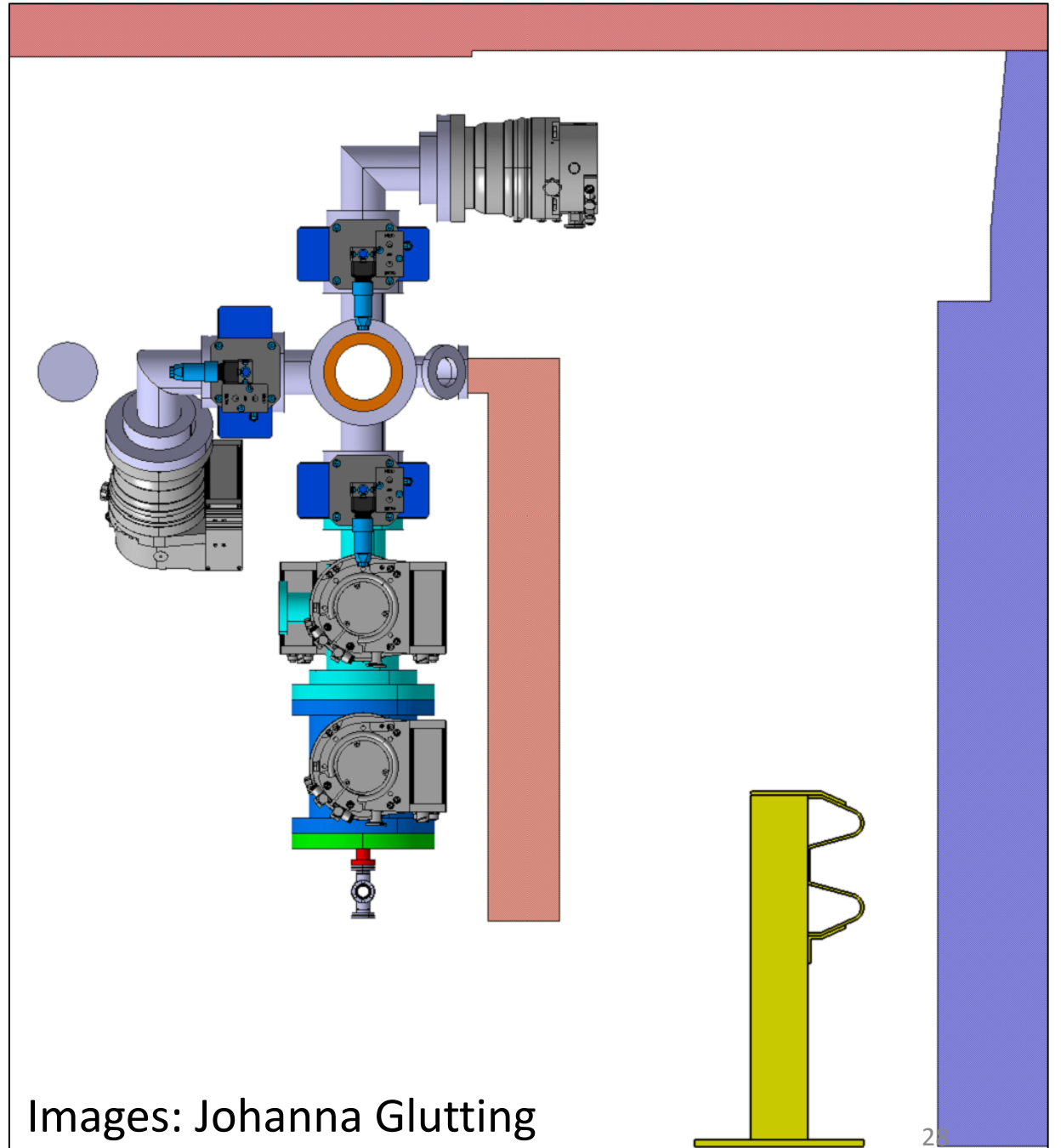
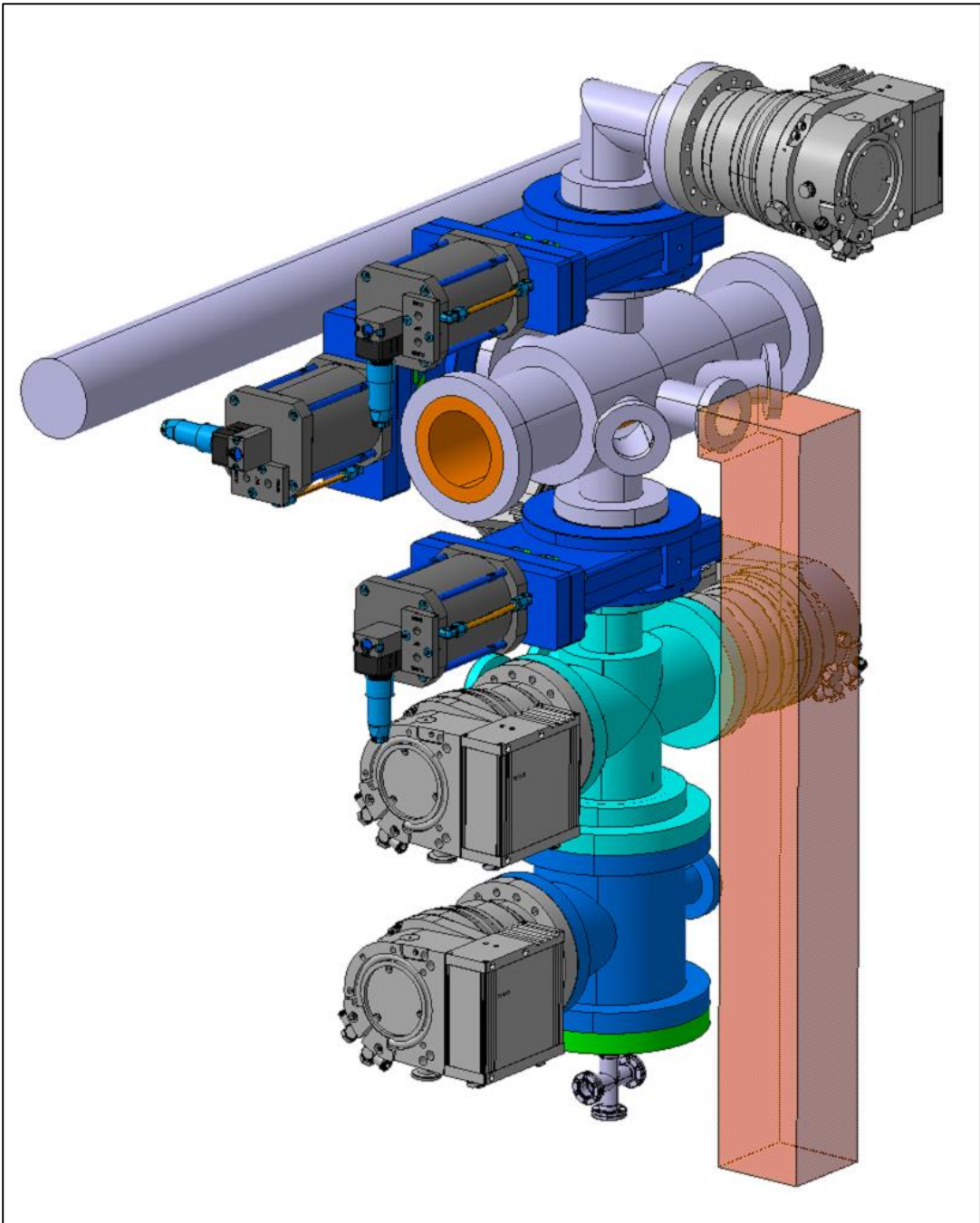
Gas jet generator,
consisting of gas bottle,
high-pressure nozzle,
molecular flow skimmers
and vacuum pumps

Optical acquisition system, separated
from beam vacuum by a viewport

BGC space restrictions

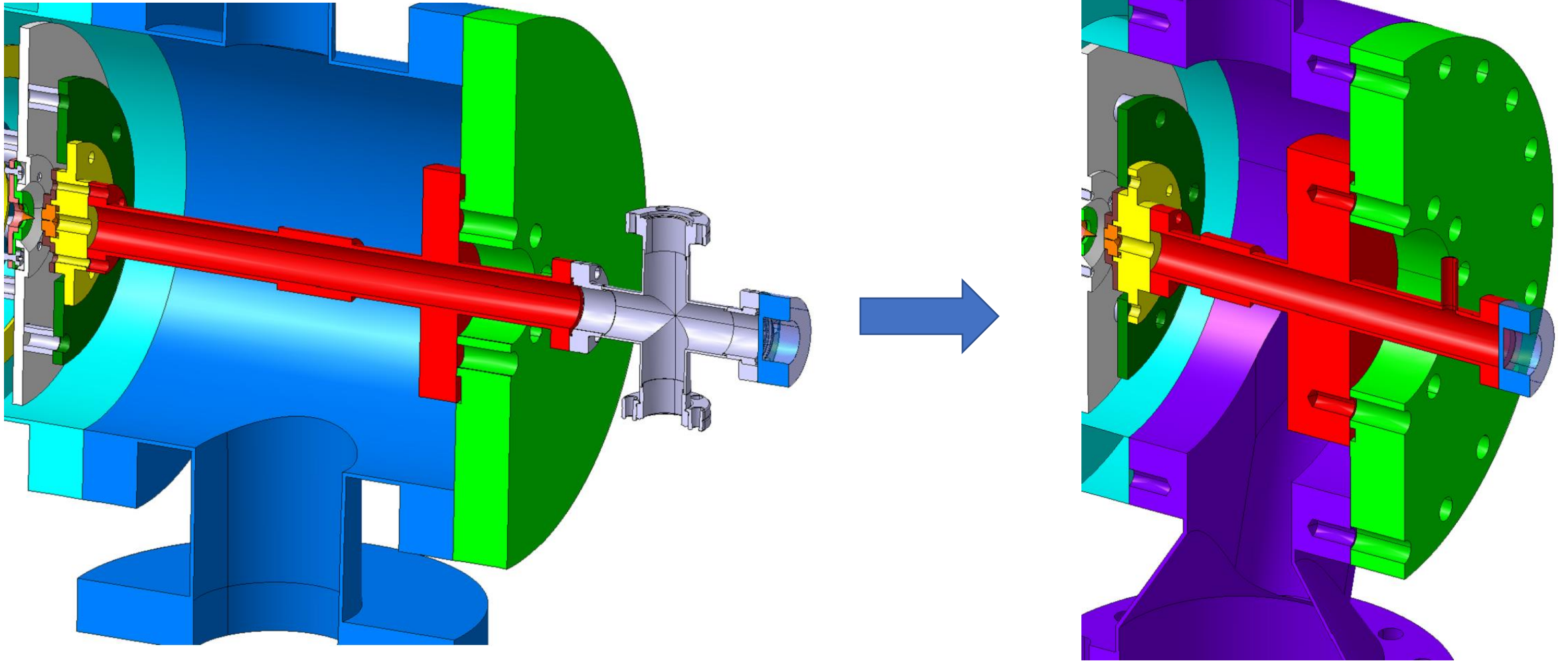


Images: Johanna Glutting

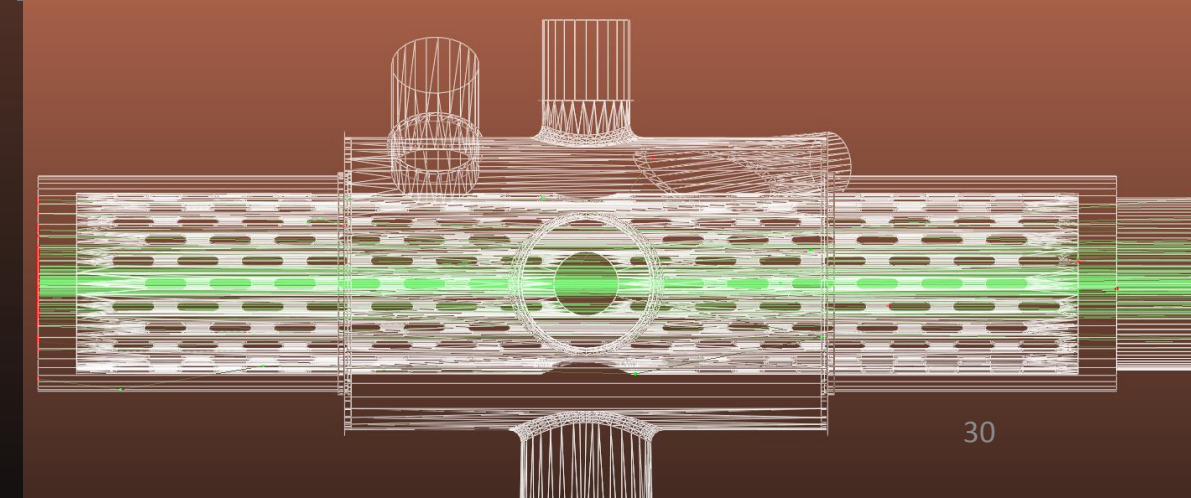
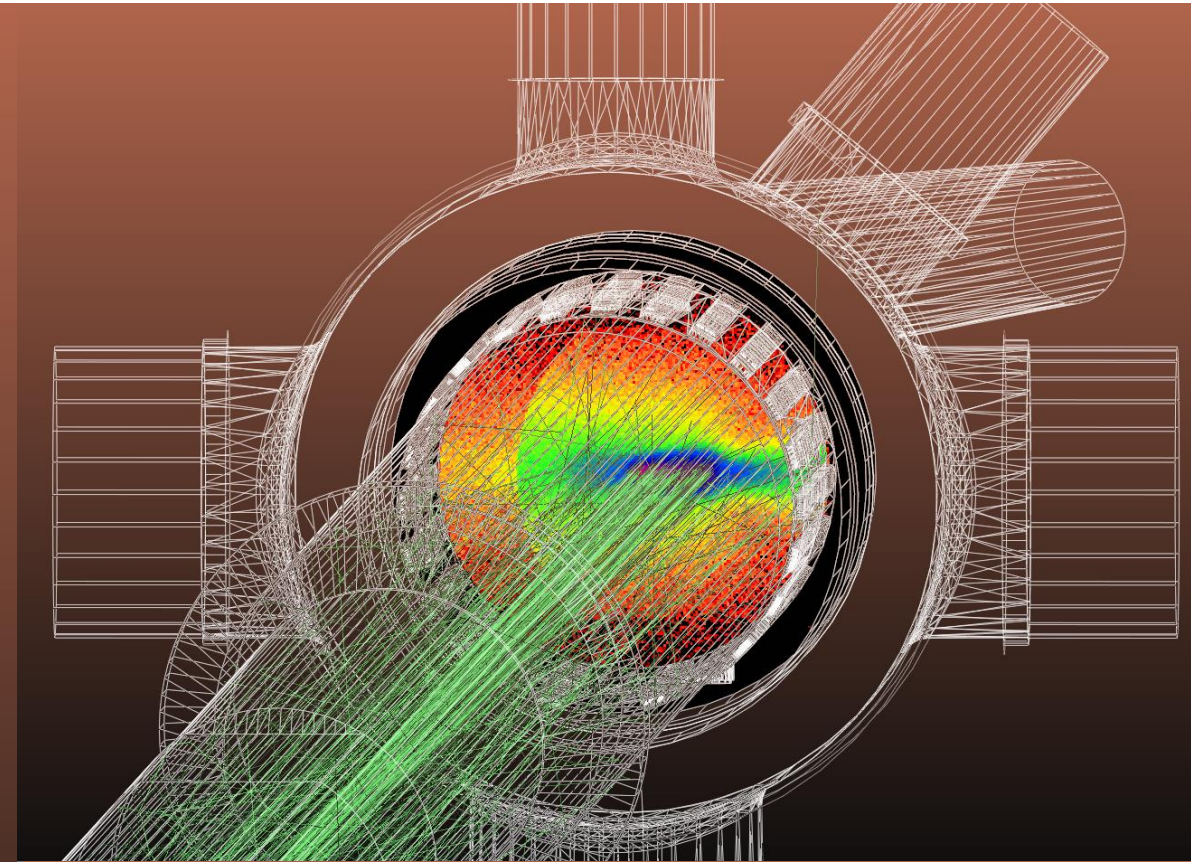
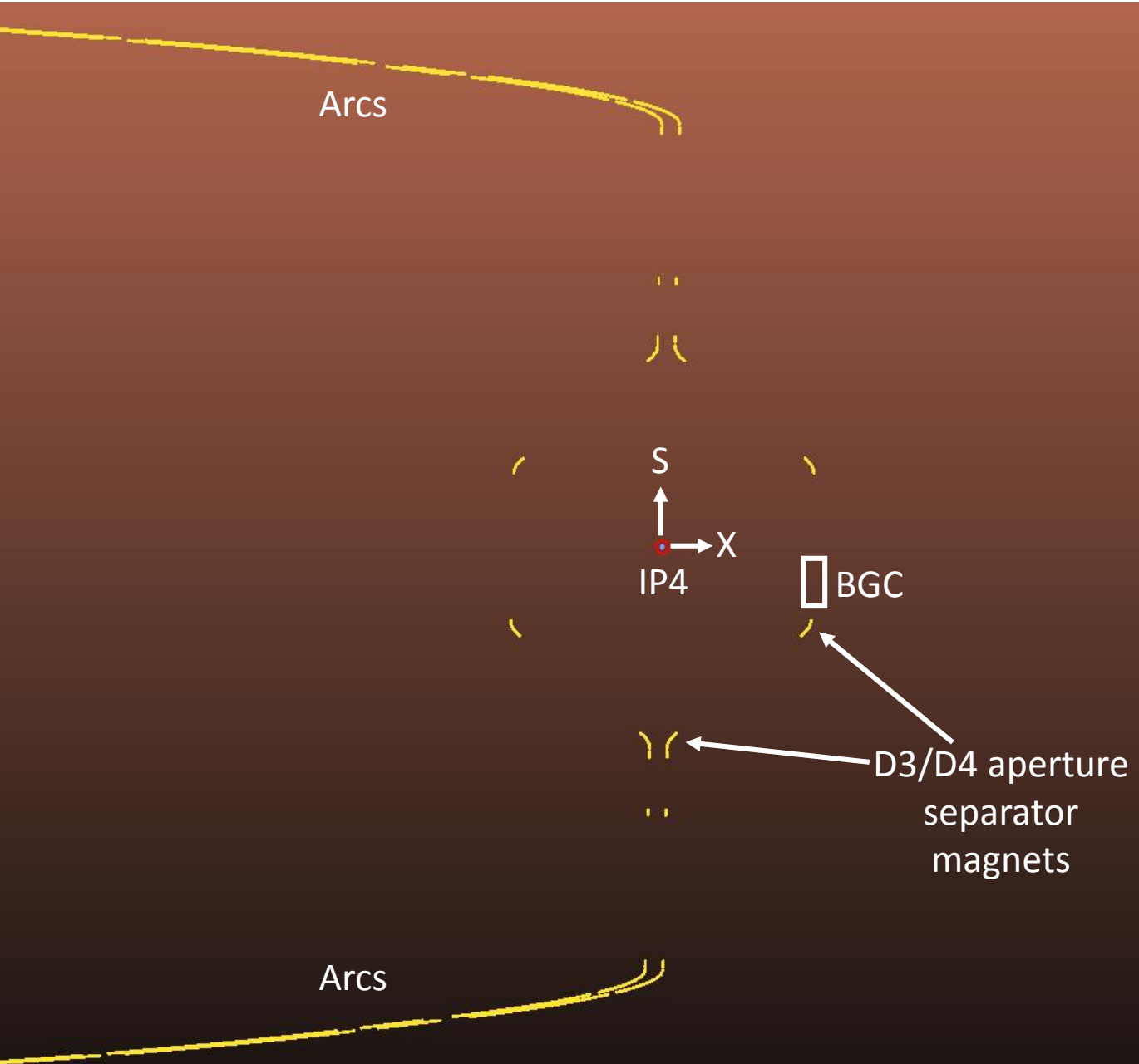


Images: Johanna Glutting

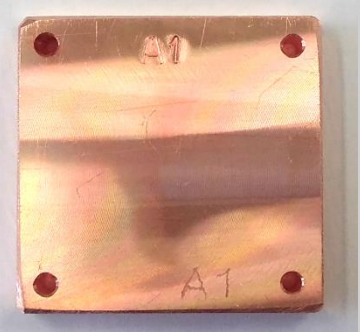









Compressed gas inlet



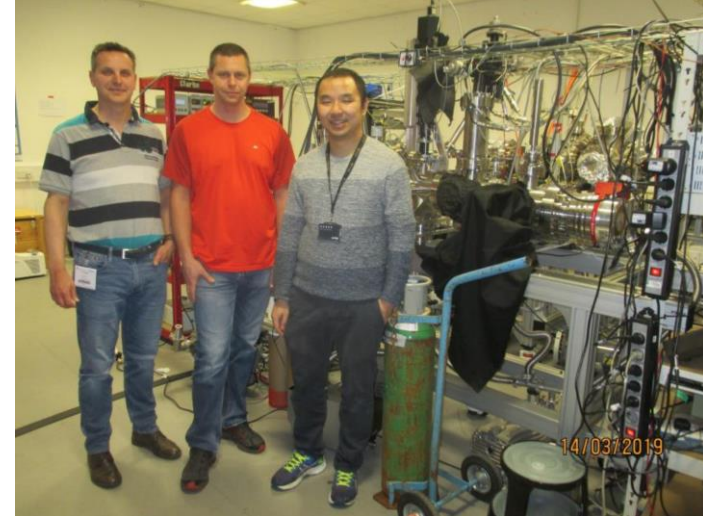
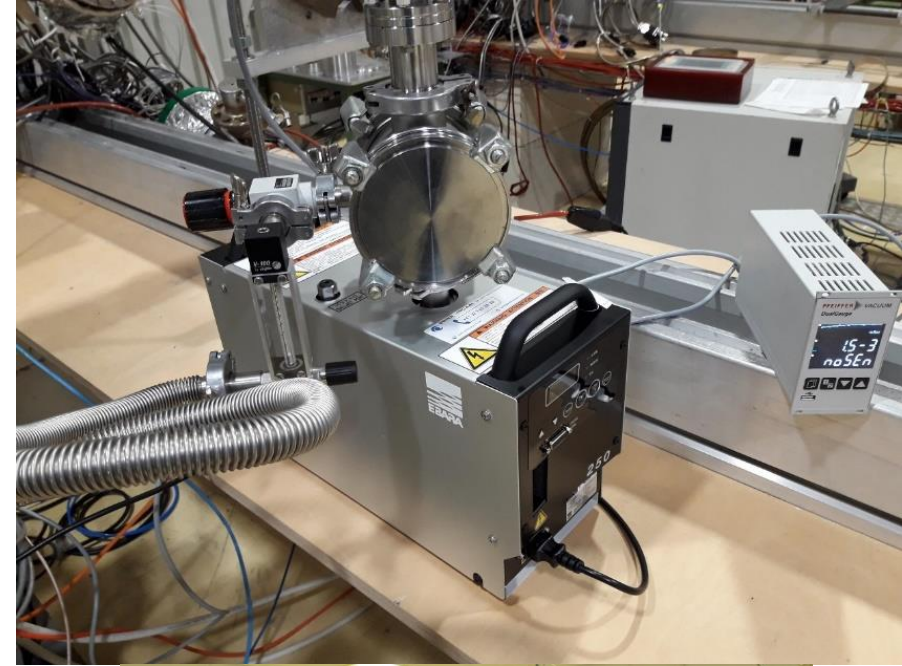
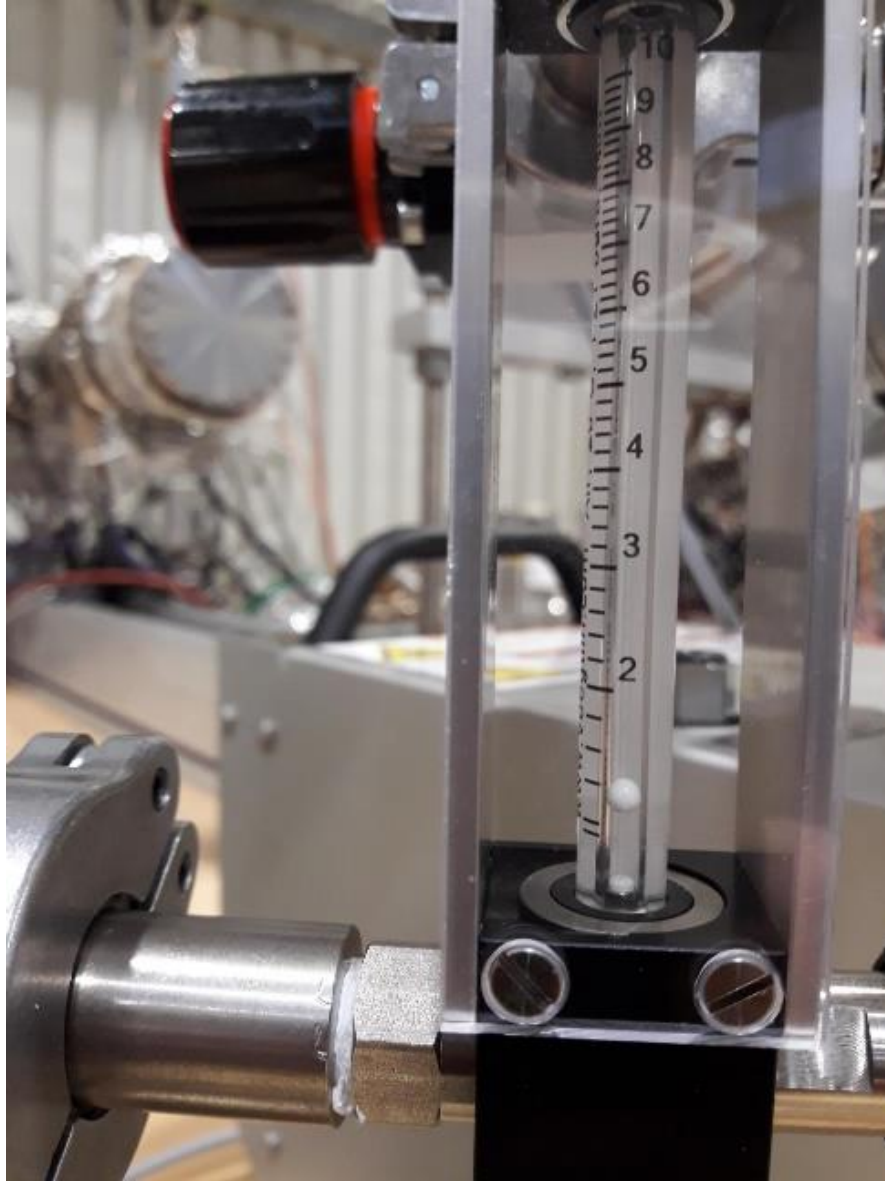
Synchrotron radiation



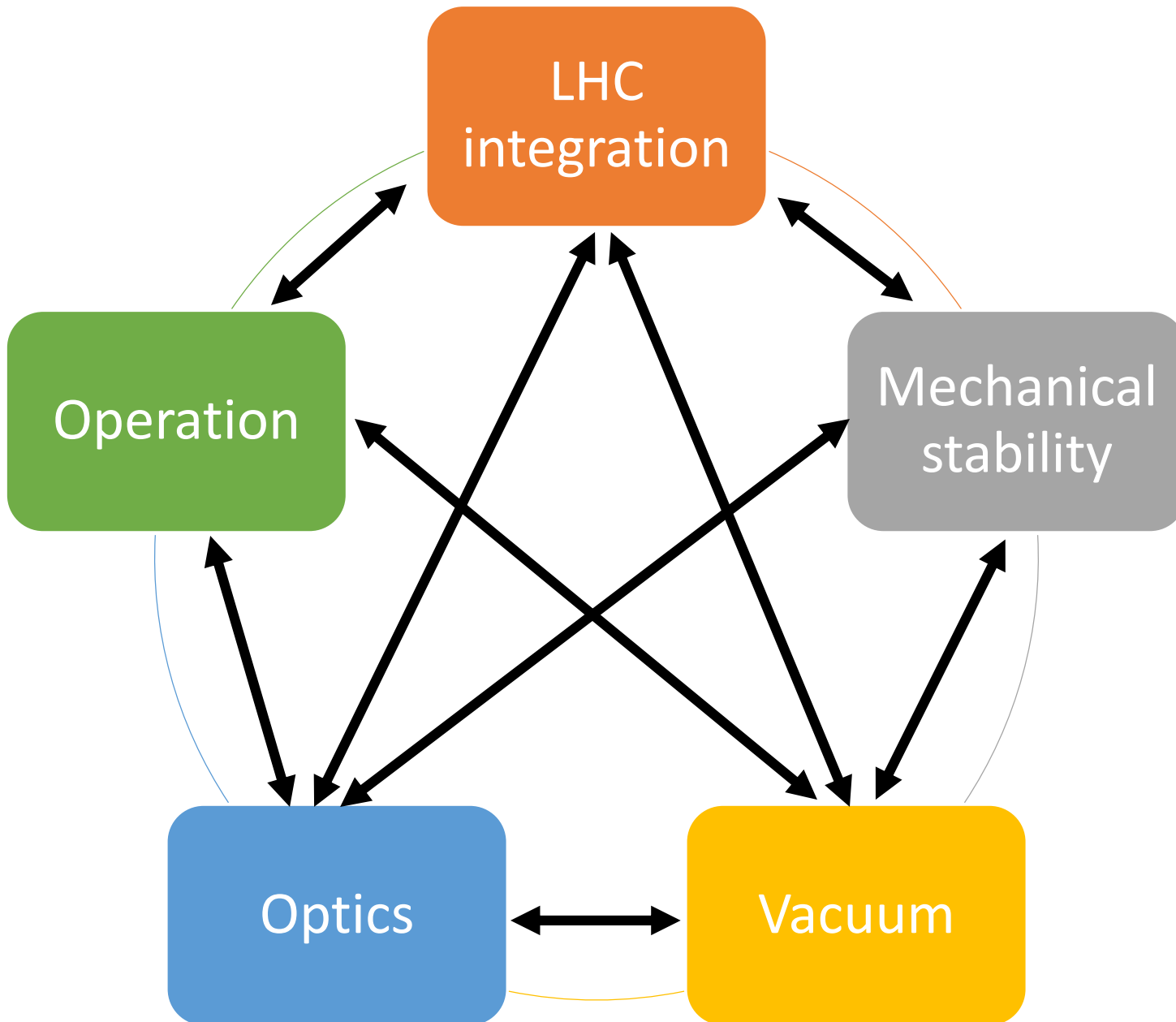
Reflectivity at neon wavelength 584nm

	Degreased no coating	NEG	Amorphous carbon	LESS (Dundee)	Multilayer sputtering (Polyteknik)
Copper	$\approx 85\%$ 	$\approx 45\%$ 	$\approx 13\%$ 	$\approx 2\%$ 	$\approx 0.2\%$ 
Steel	$\approx 56\%$ 	$\approx 45\%$ 	$\approx 14\%$ 	$\approx 2\%$ 	$\approx 0.2\%$ 

Finding a suitable dry pump



Images: Eric Page



Contributing from TE-VSC:

Integration & Operations

Giuseppe Bregliozi
Julien Finelle
Eric Page

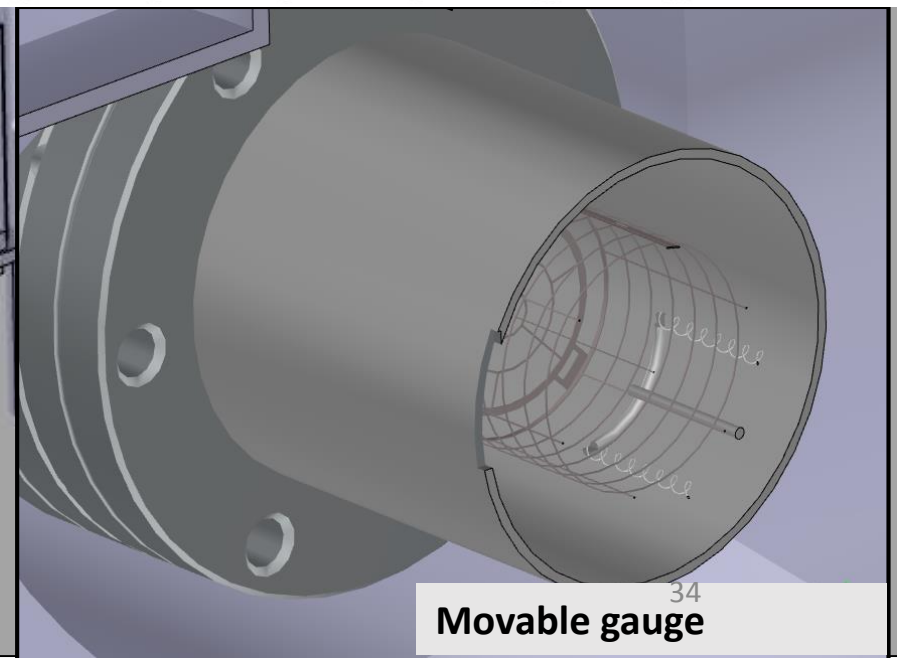
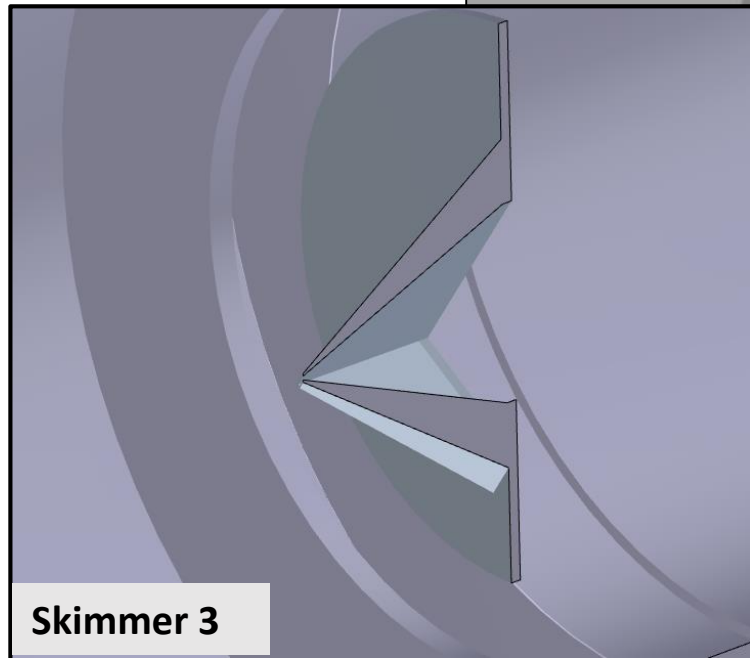
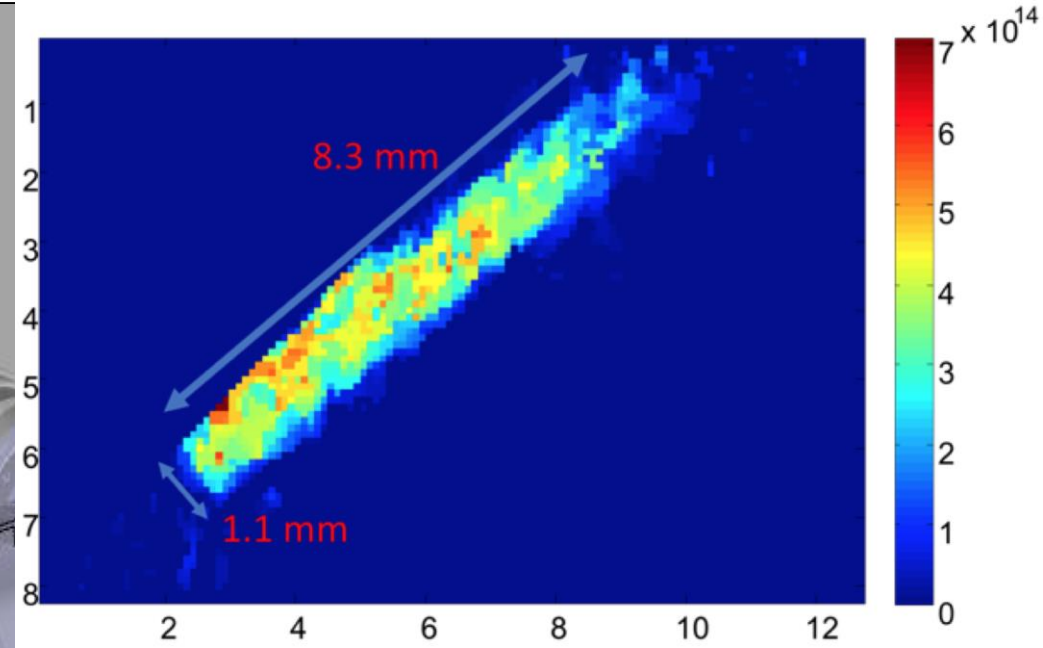
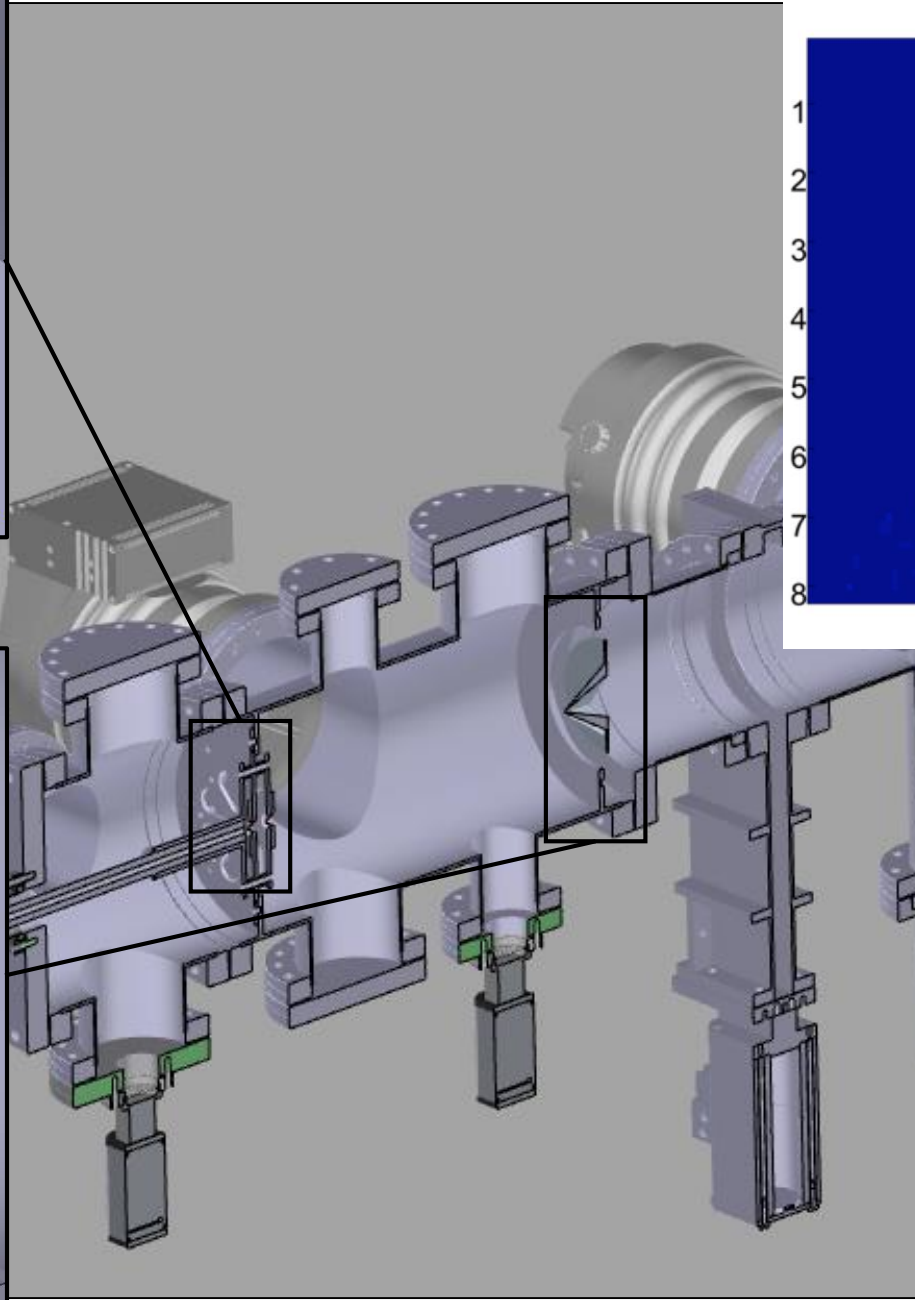
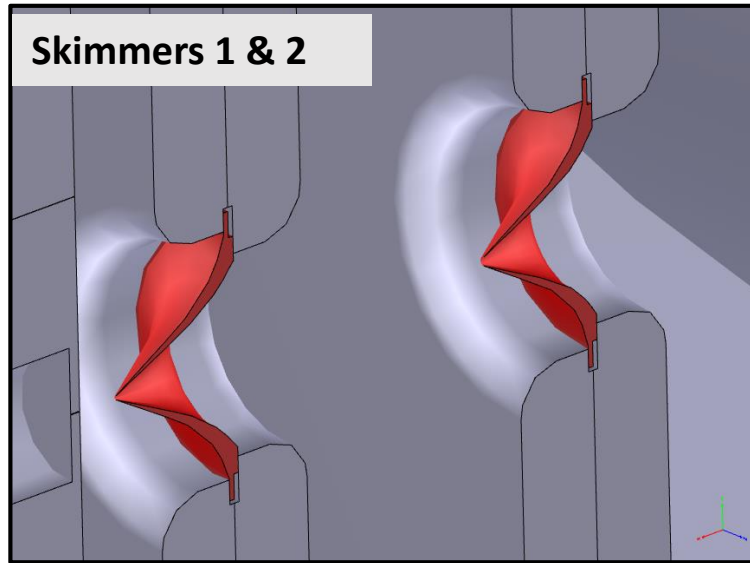
Cabling & Controls

Gregory Pigny
Pablo Prieto

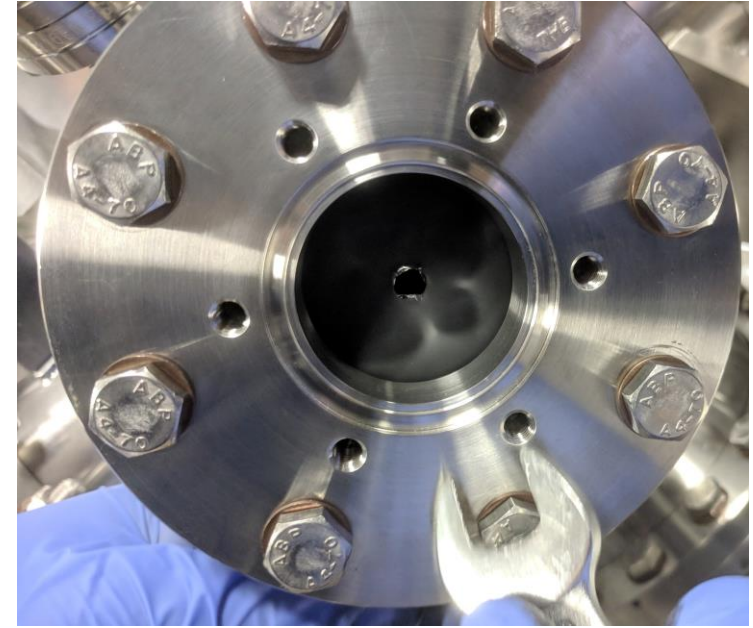
Simulations

Roberto Kersevan
Marton Ady

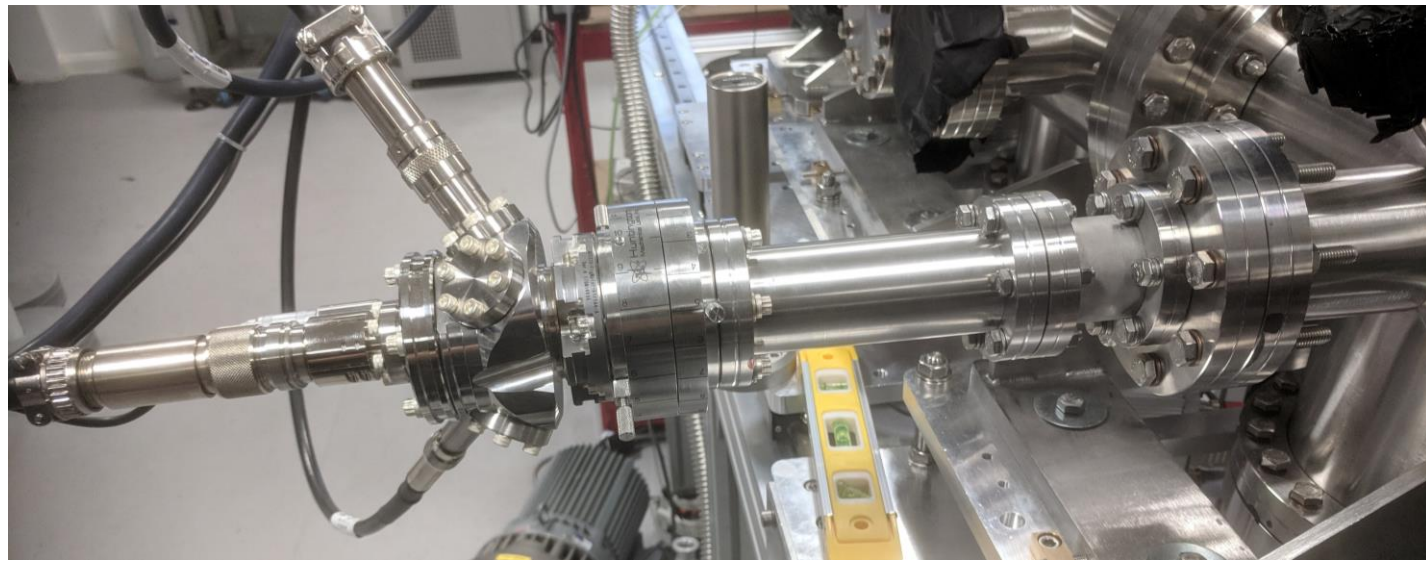
Part 3: Improved setup



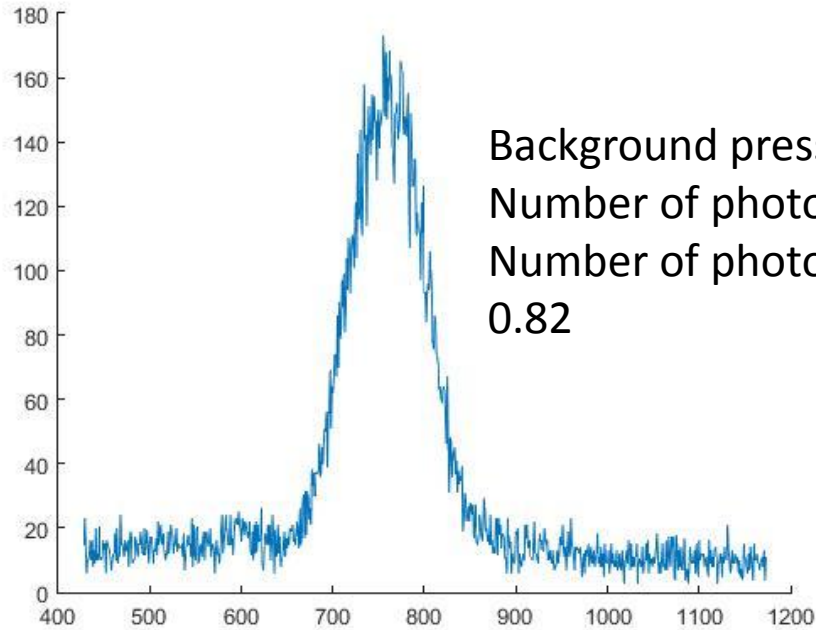
Creating a beam with an electron gun



- Energy: 100 eV to 10 keV
- Current: 200uA to 10mA
- Spot size: 1.5mm to 20 mm



Residual gas calibration



Background pressure 2.5e-7mbar

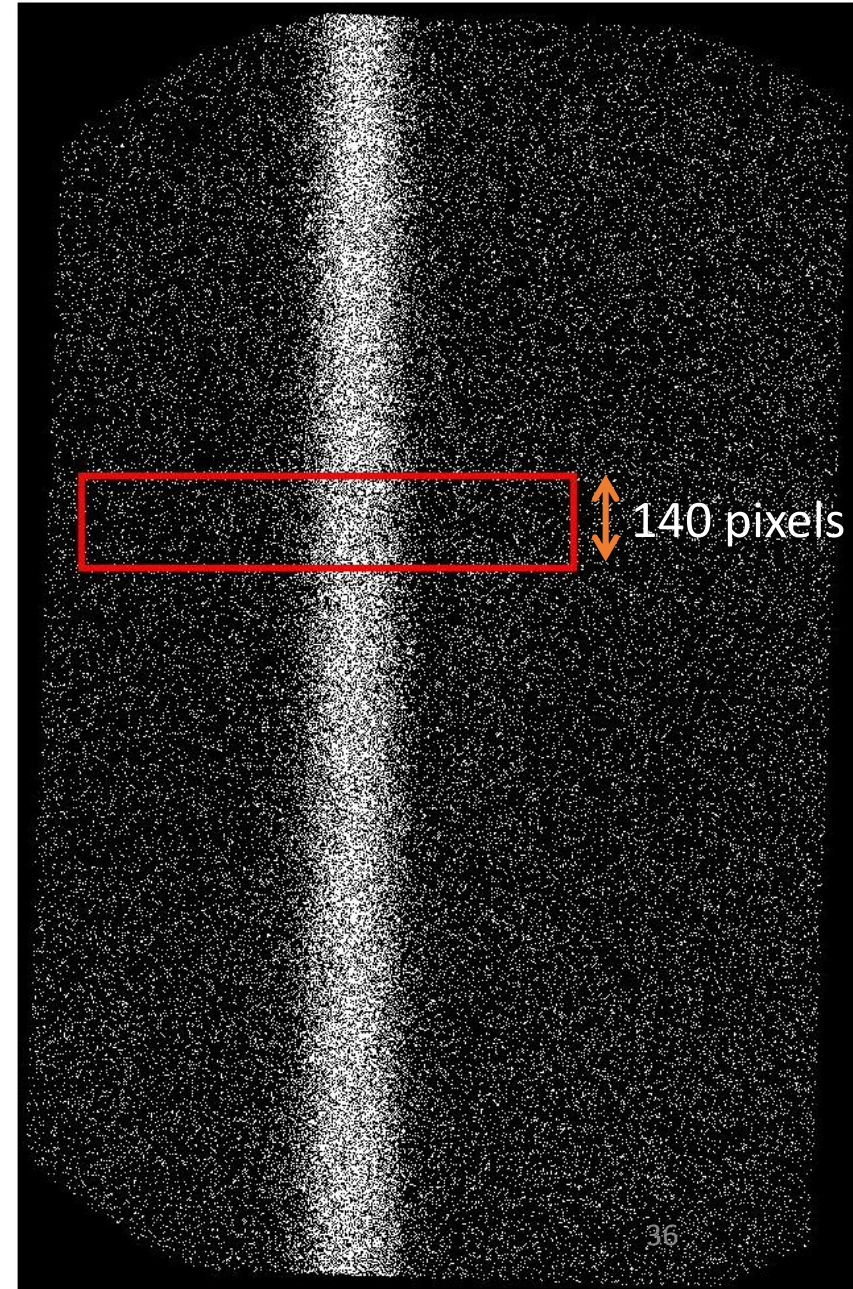
Number of photons = 4.60E4

Number of photons per pixel per second = 0.82

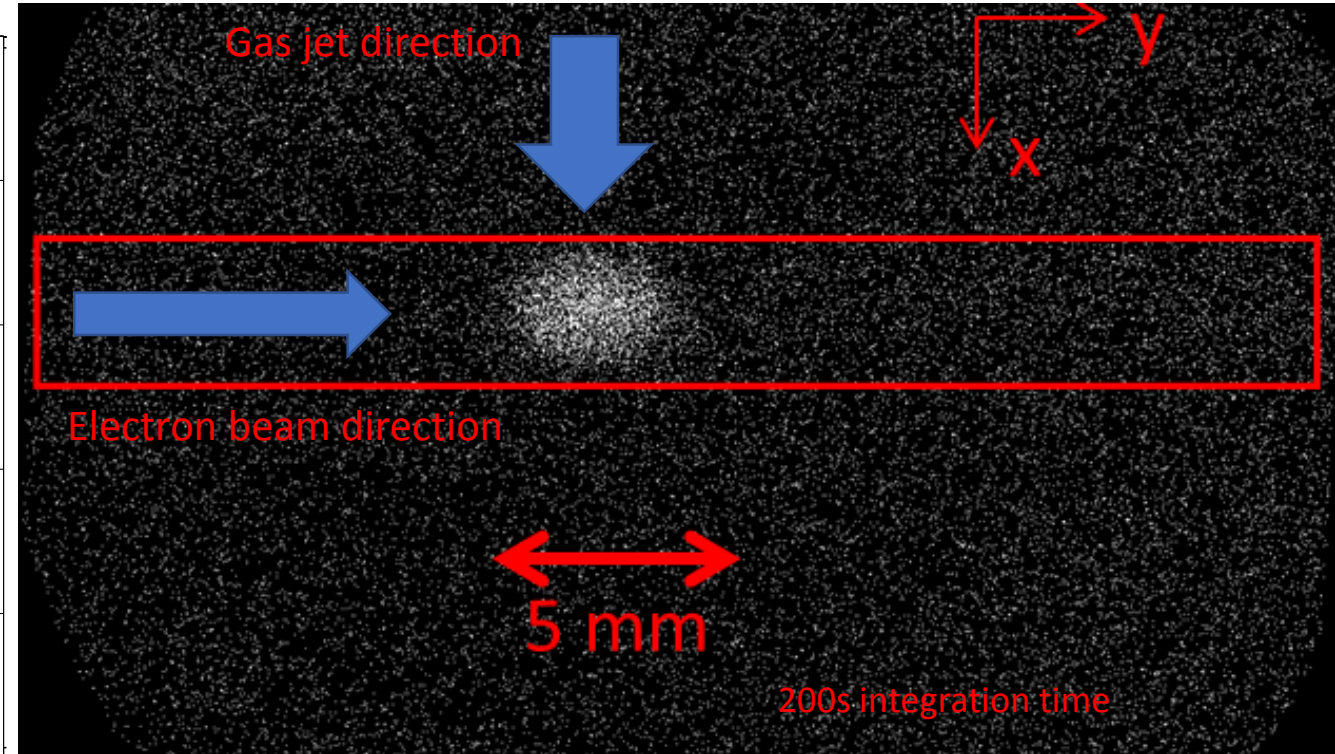
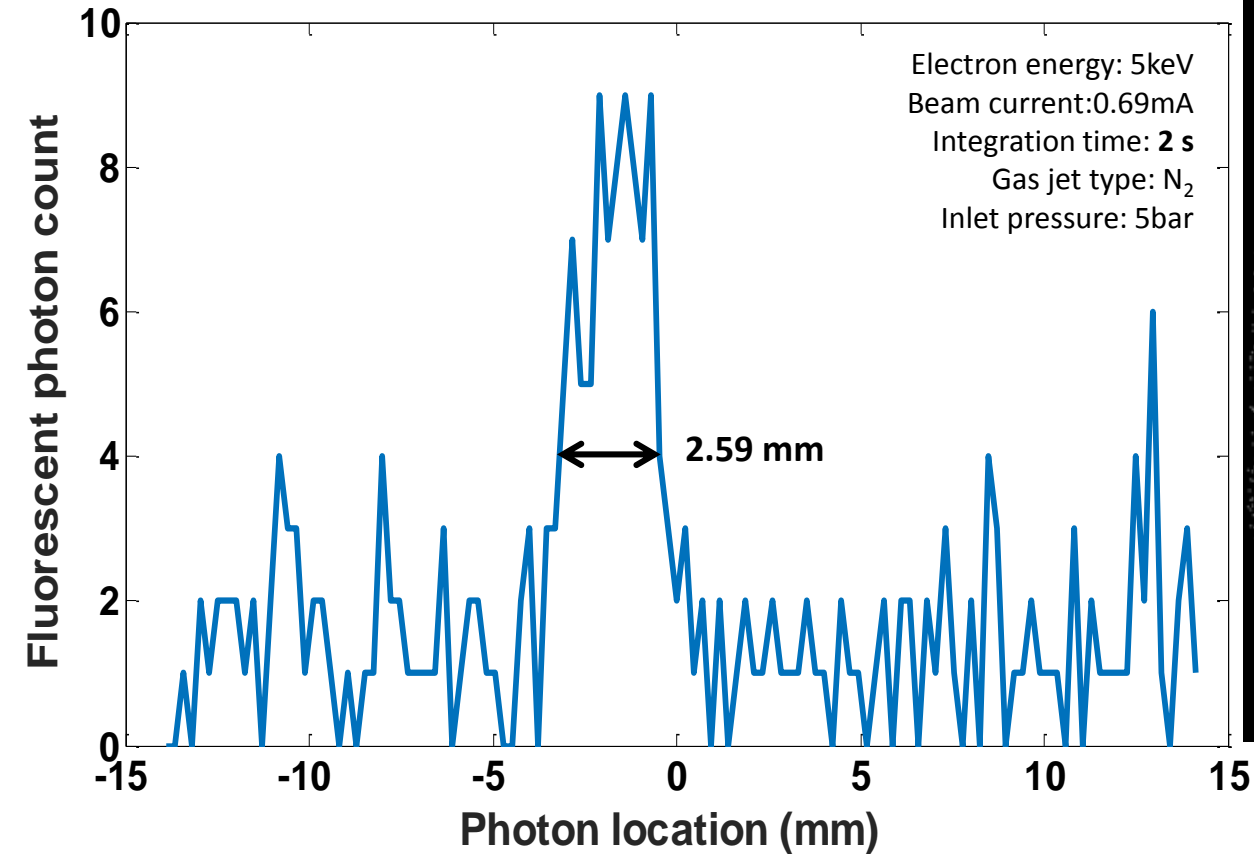
Fitting equation: $F(x) = \frac{N}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-b)^2}{2\sigma^2}\right) + Ax + B$

Photon
number

Beam size
Gaussian equation + linear background



Nitrogen gas jet test



More time to give a 2D detailed image

2s integration time to give a profile
Background pressure: 1.56E-08mbar

Project status

**Version 1
prototype**

Cockroft
institute

Done

**Version 2
prototype**

Cockroft
istitute

Ongoing

**Stage 1
(interaction
chamber)**

LHC

LS2

Version 3

surface testing

After LS2?

**LHC
Integration**

controls,
cabling,
interlocks

Yets 2021?

Version 3

LHC

2022?