status report of the

XFEL-**Reaction Microscope**

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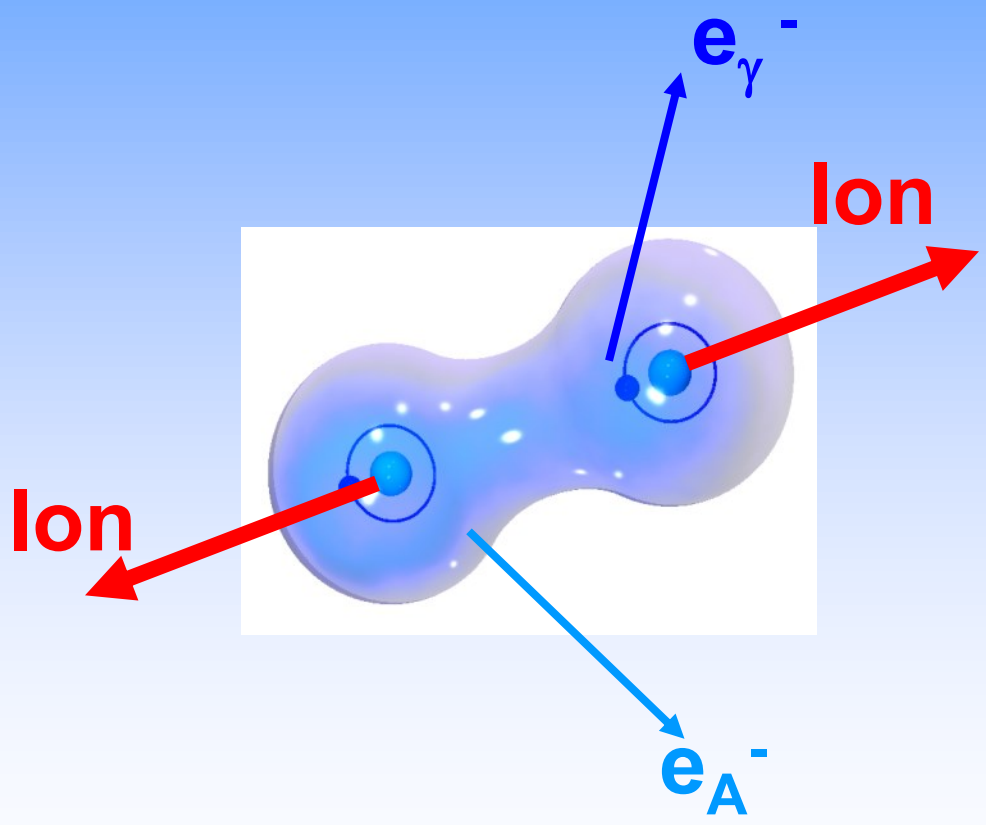
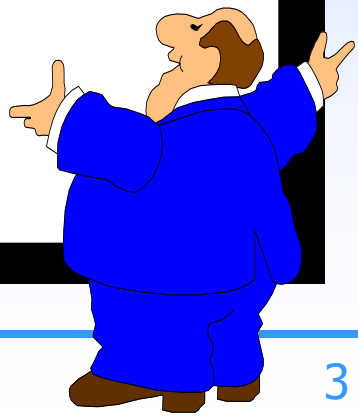
Introduction



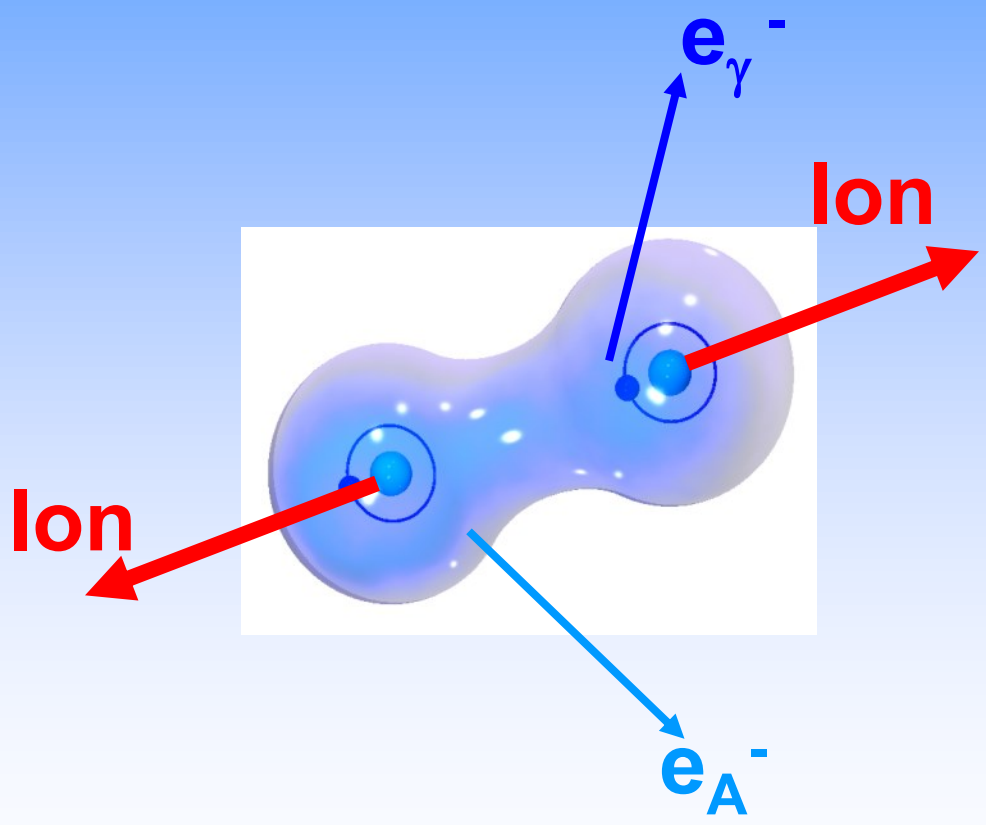
Ion detection

Ion detection → internuclear wave function

→ molecular geometry



Photoelectron



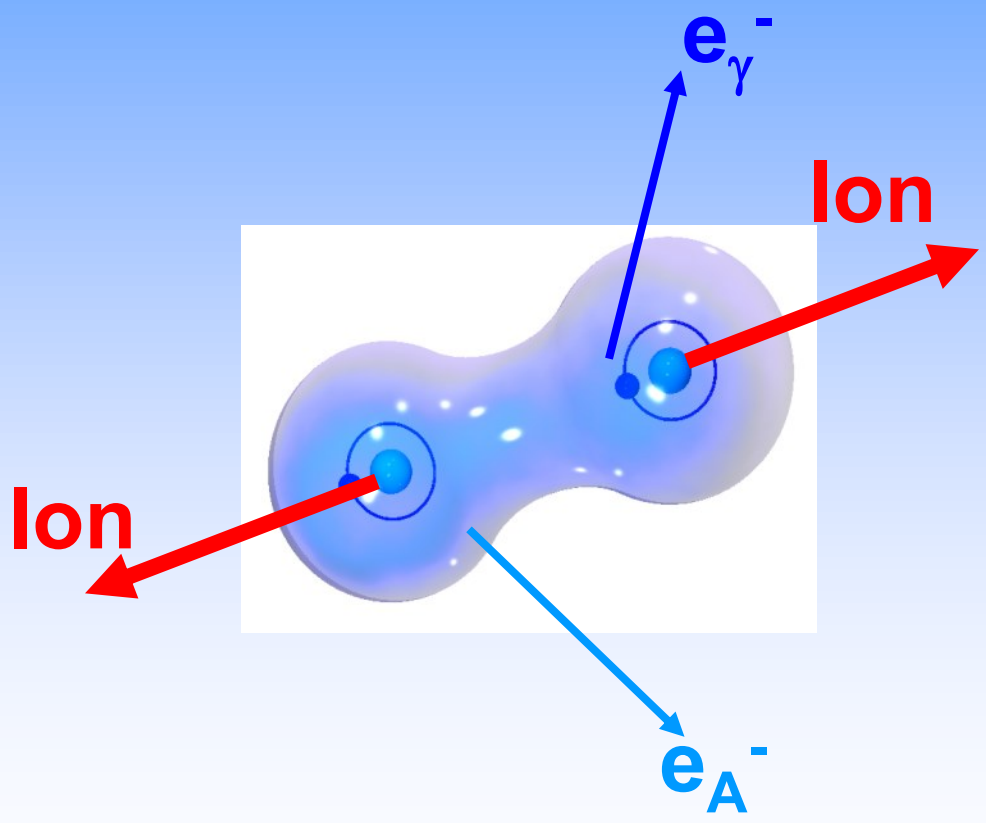
Photoelectron

Ion detection → internuclear wave function

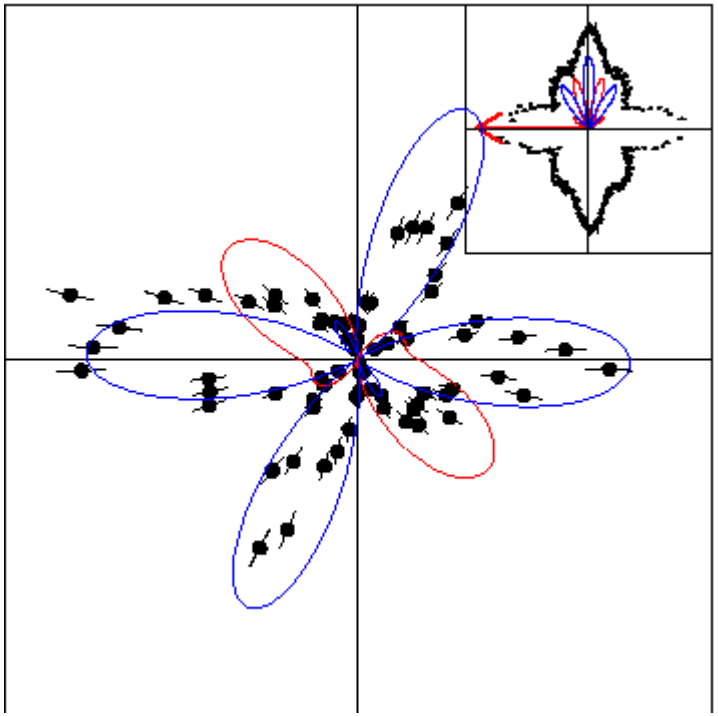
→ molecular geometry

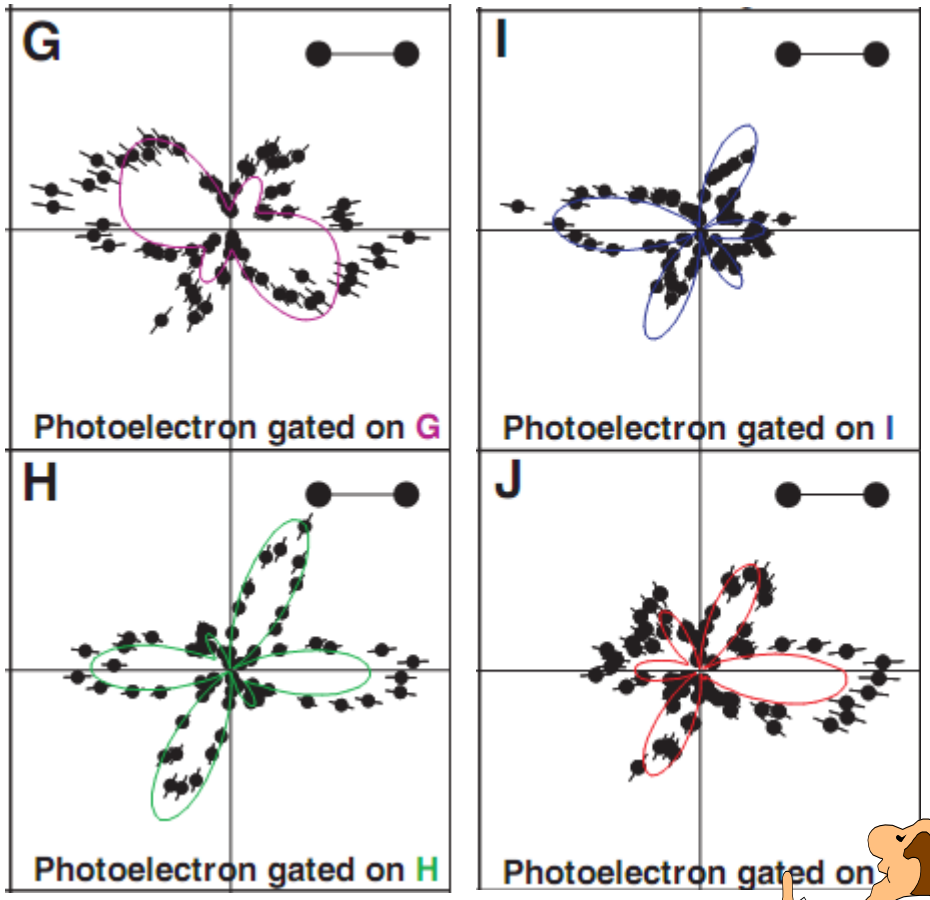
Photoelectron → molecules illuminated from within

Secondary electrons

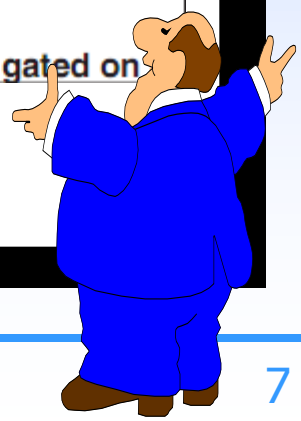


Electron-Electron-coincidences





„Corehole localization & electron entanglement in N_2"
Schöffler et al., Science **320**, 920 (2008)



Electron-Electron-coincidences

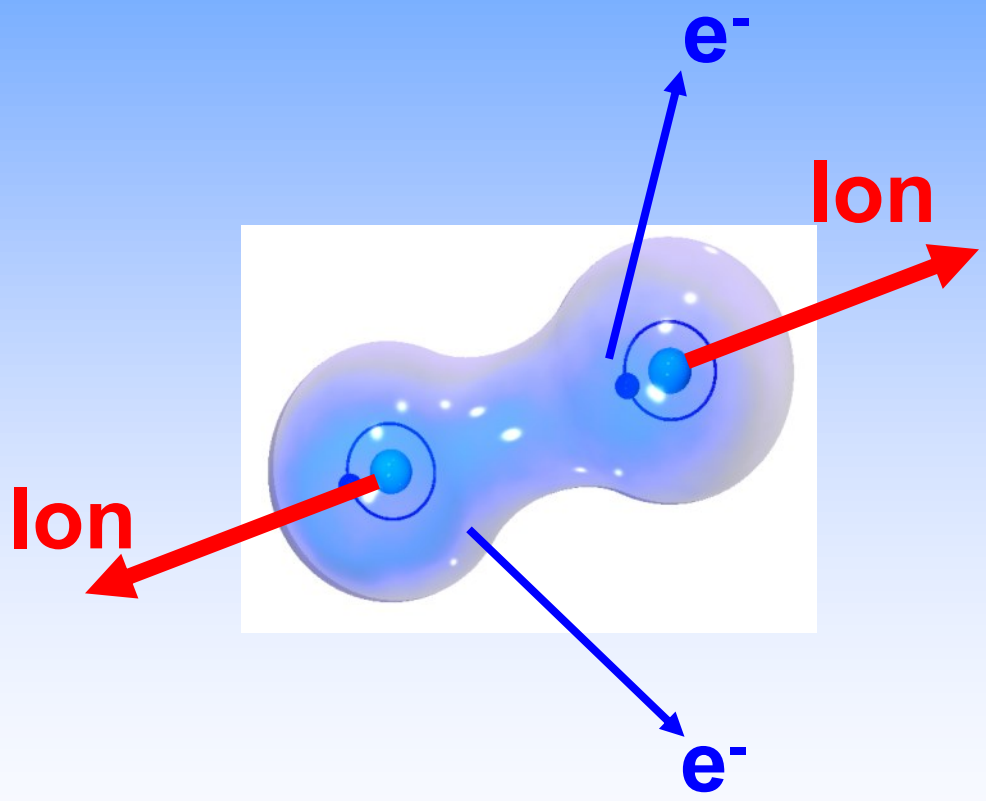
Ion detection → internuclear wave function

→ molecular geometry

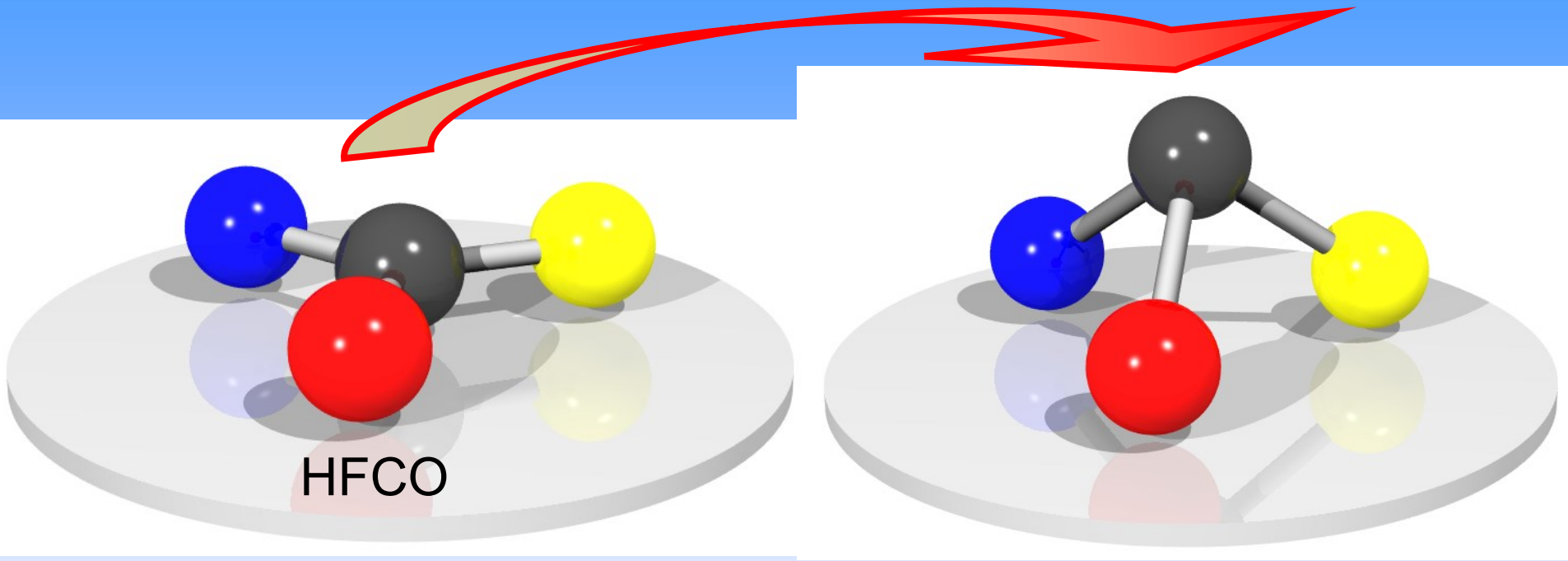
Photoelectron → molecules illuminated from within

2nd electron → entanglement

Pump-Probe



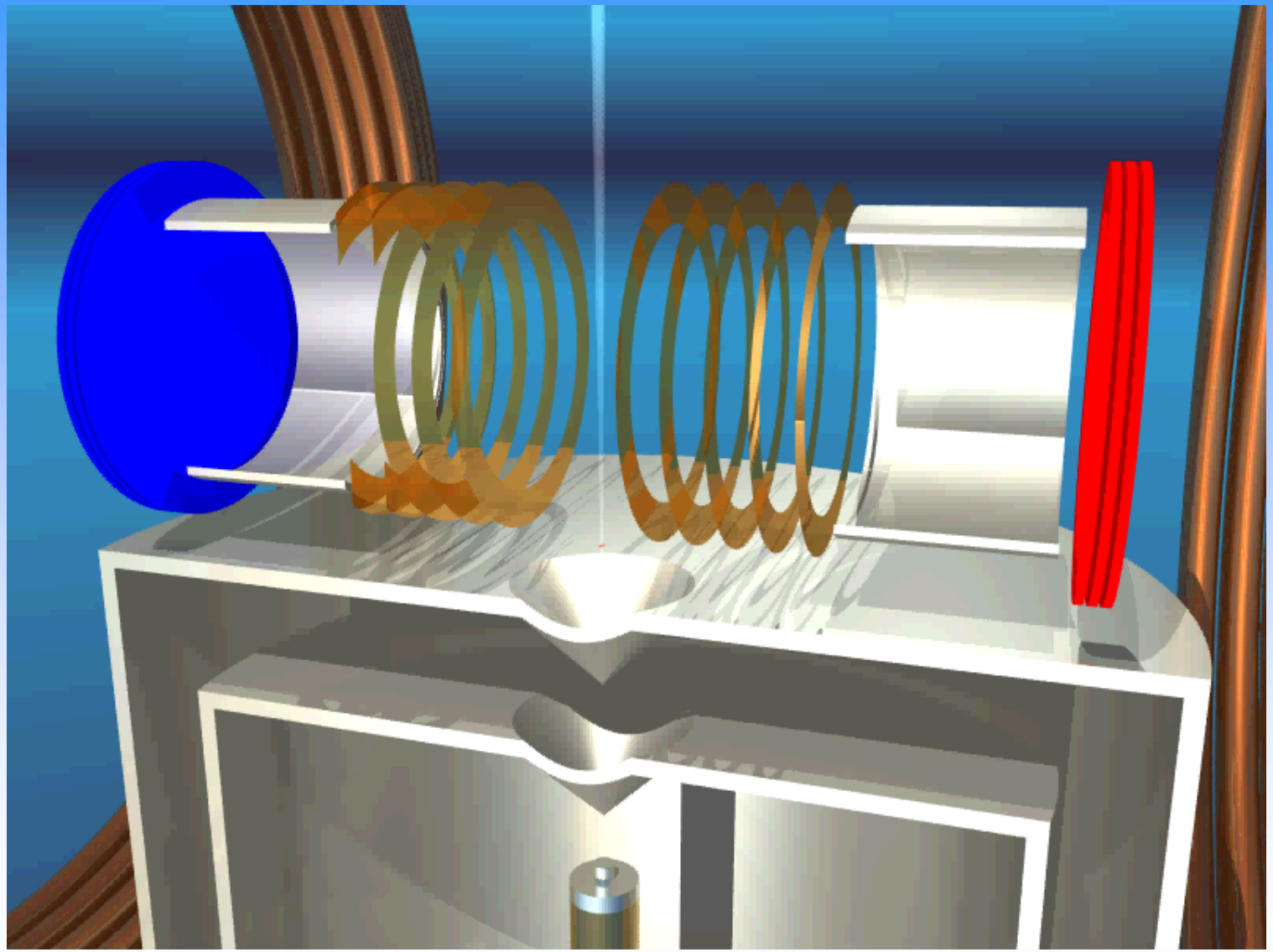
Molecular movie



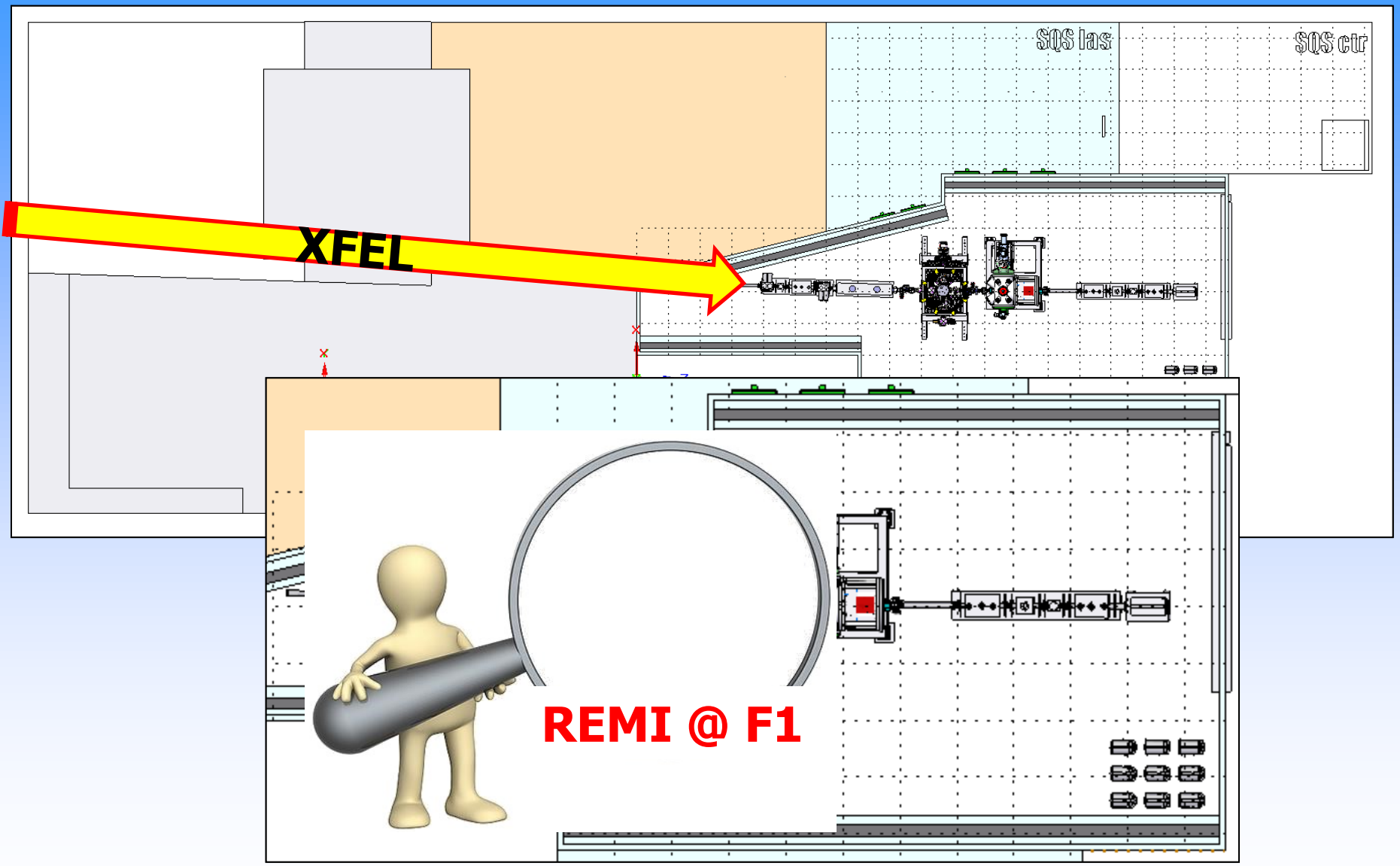
achiral → excitation (pump) → chiral

XFEL (probe)

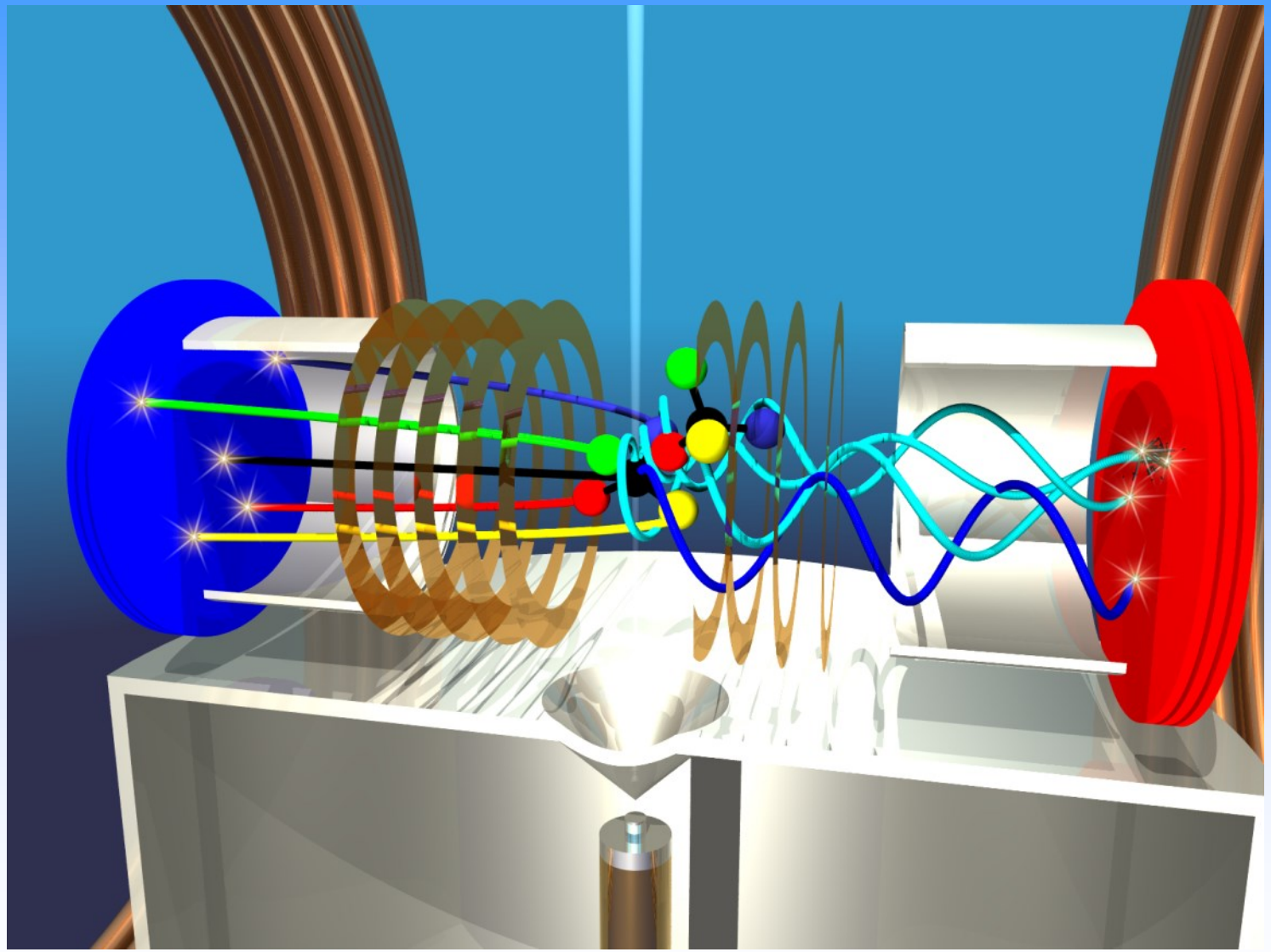
The COLTRIMS-Reaction Microscope



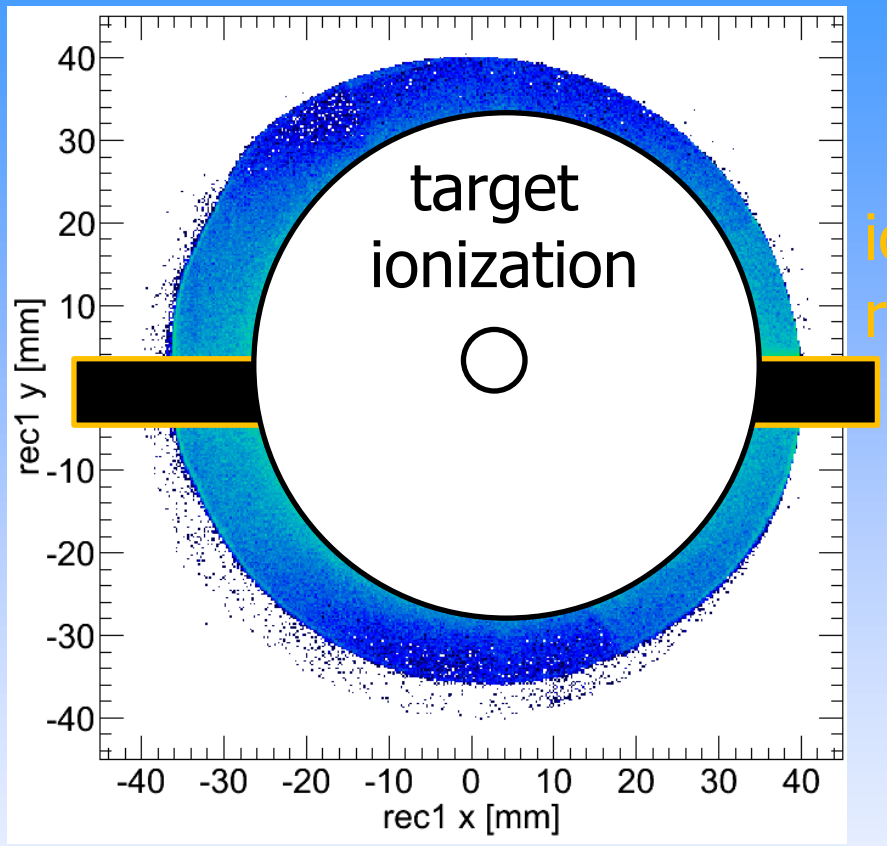
Where are we?



The main challenge

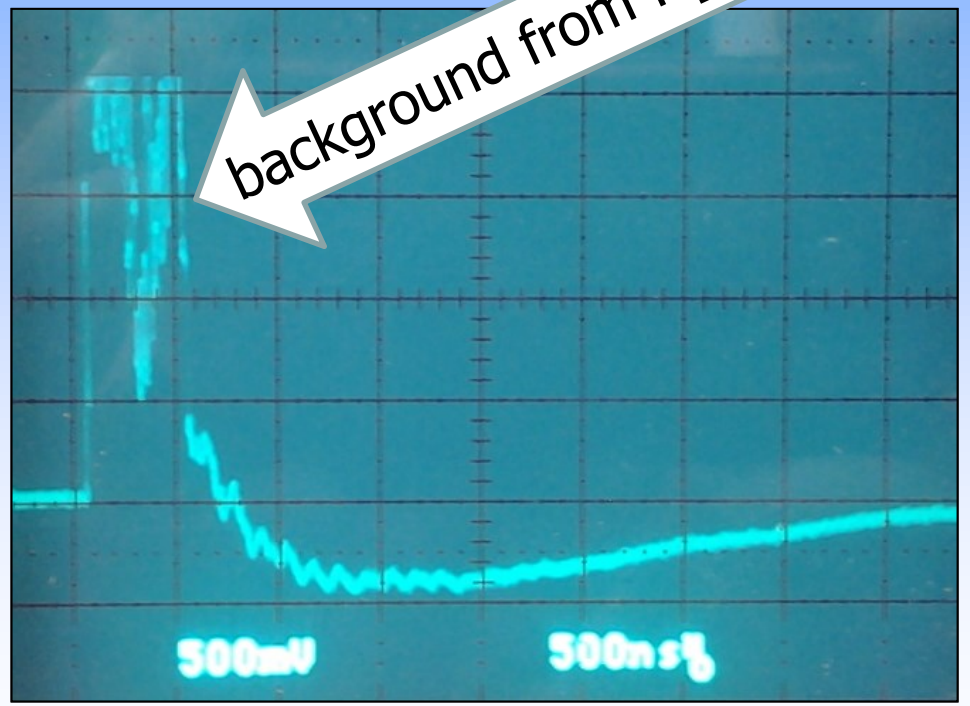


The main challenge



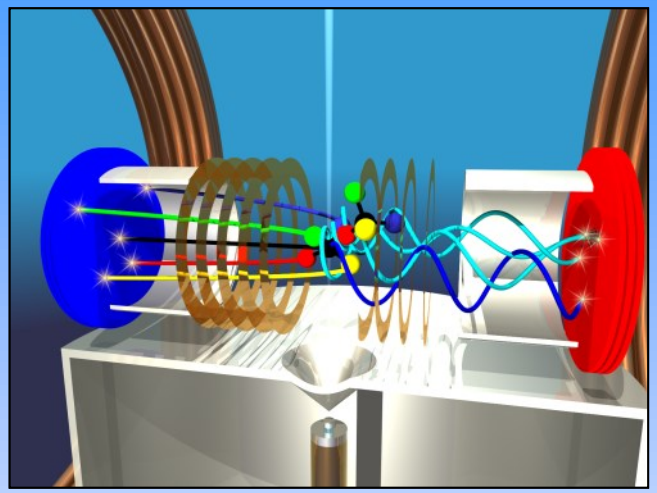
ionization of residual gas

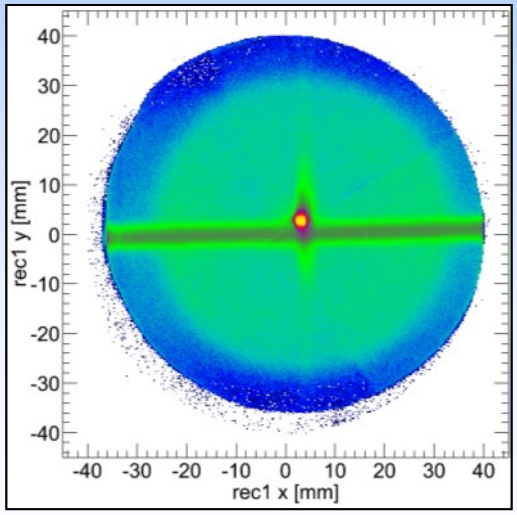
light propagation direction



saturated detector signal (FLASH)

The main challenge: countrates

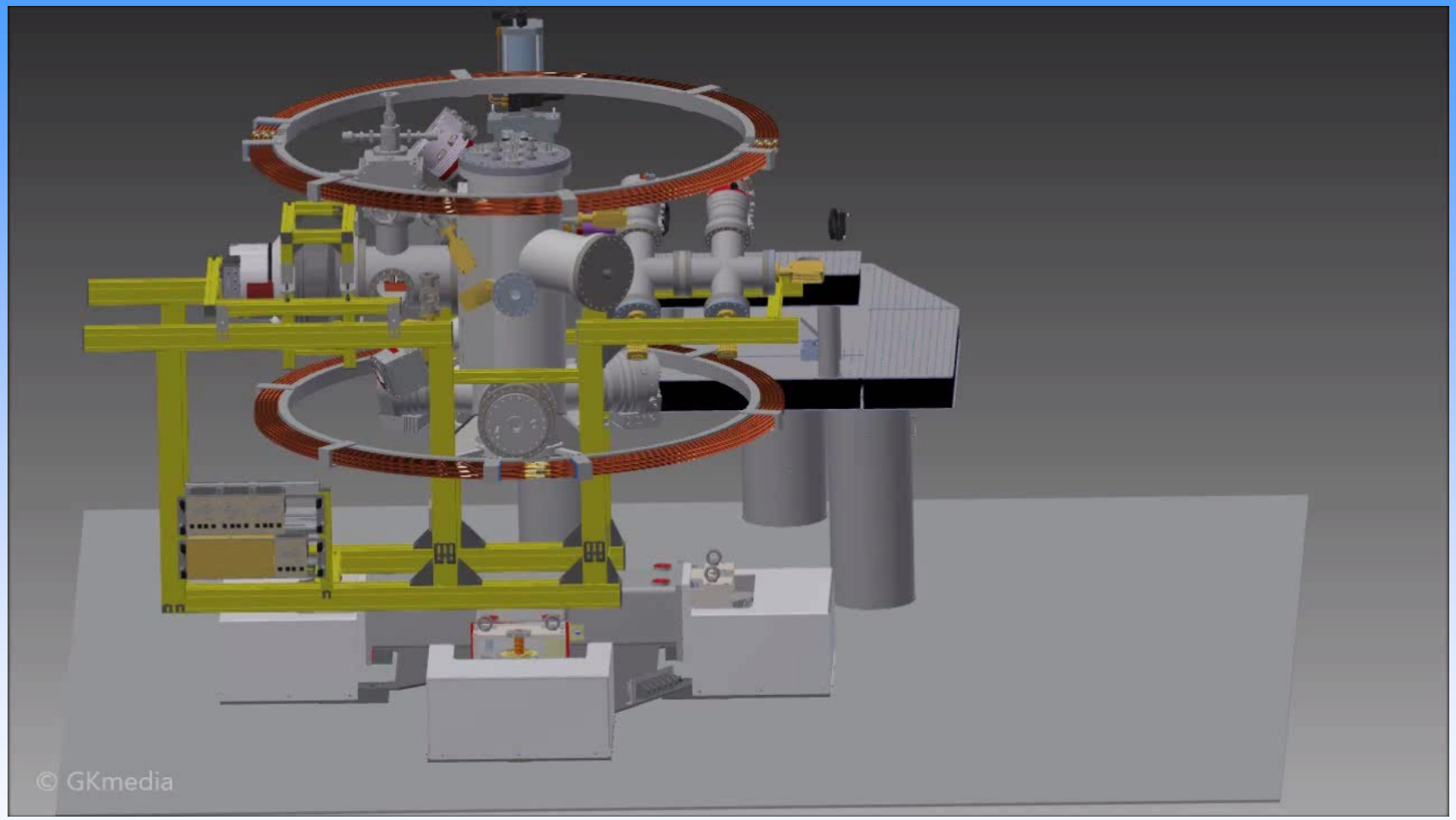




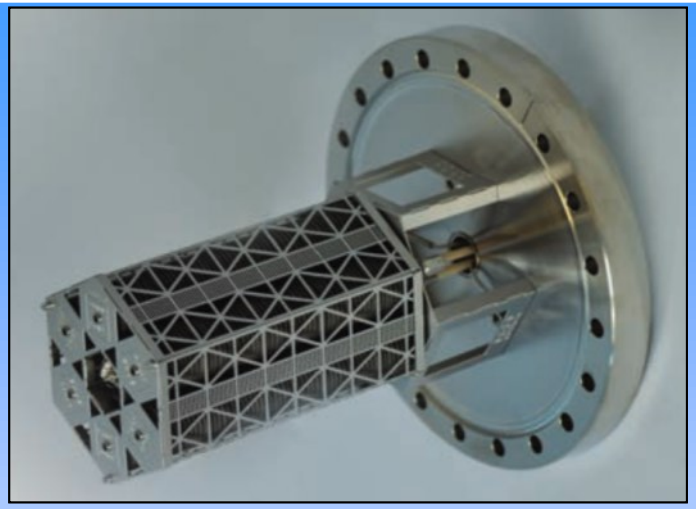
target density < low
(<1 ionization/pulse)

residual gas << low
(<<1 ionization/pulse)

Movie

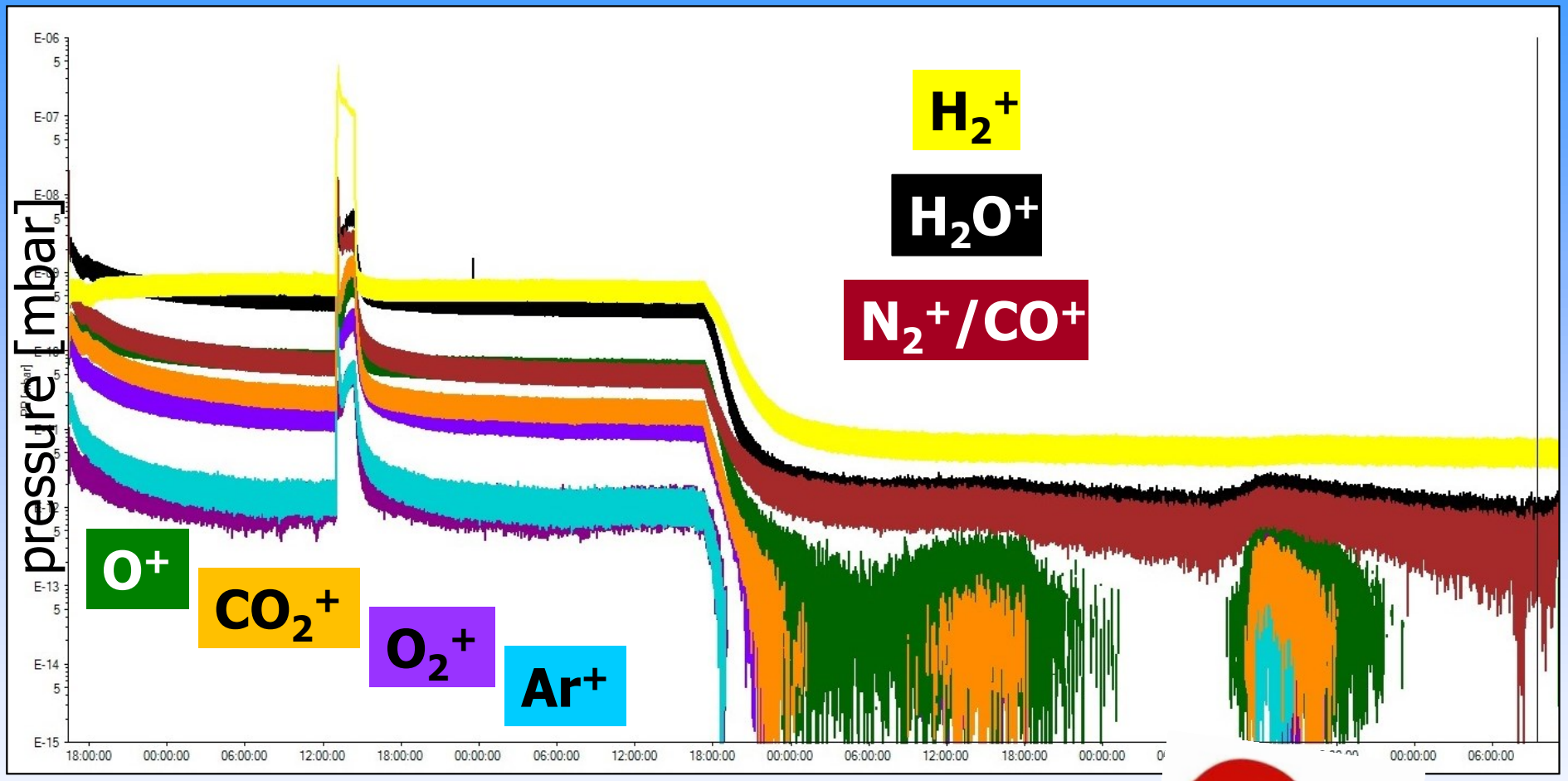


Vacuum (interaction chamber)



- turbo molecular pump (2 x 700 l/s), doubly backed with turbo pumps
- NEG pump (3500 l/s H_2, 2700 l/s H_2O)
- optional LN_2 cold trap + TSP (>2000 l/s H_2 & H_2O)

Vacuum (interaction chamber)

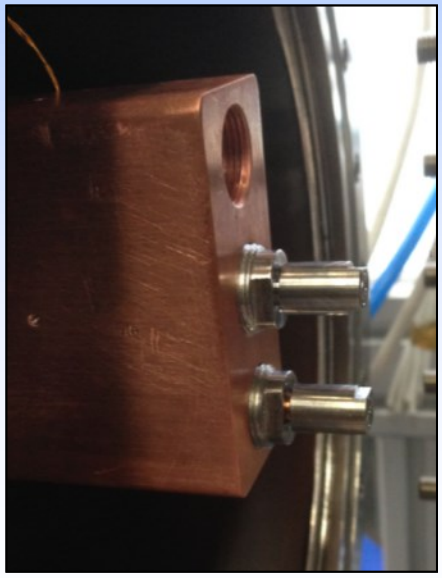


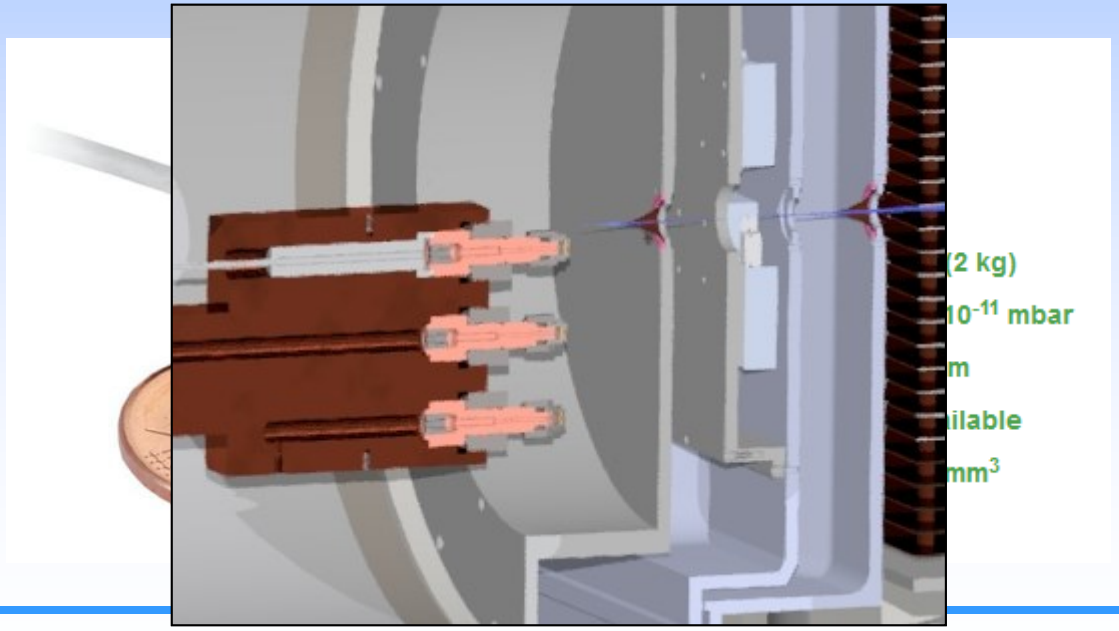
$p_{total}=6\cdot10^{-12}$ mbar (mass spectrometer)

$p_{total}=2\cdot10^{-11}$ mbar (extraction gauge)

Target

- Cryostatat (10 – 500 K) for precooling/heating
- 3 different nozzles (5 – 200 µm)
- nano-positioner for variable target geometry (<10 µm @ target)
- long dilute 4-stage jet (length ≈1.5 m)
- short dense 3-stage jet (small cross section; XFEL=Synchrotron)

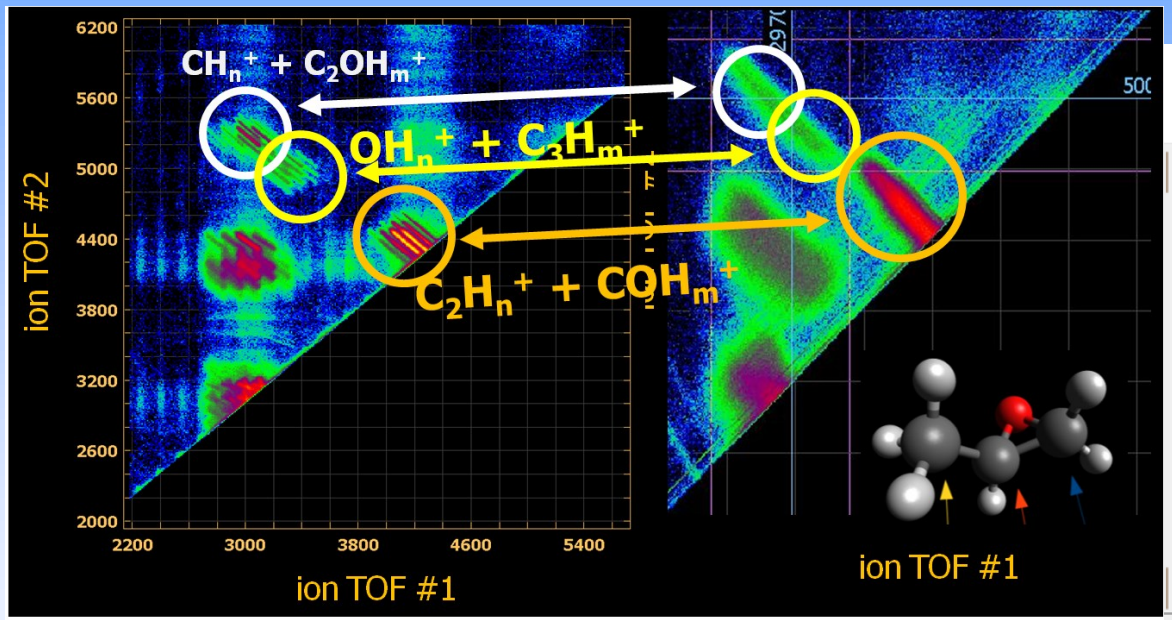


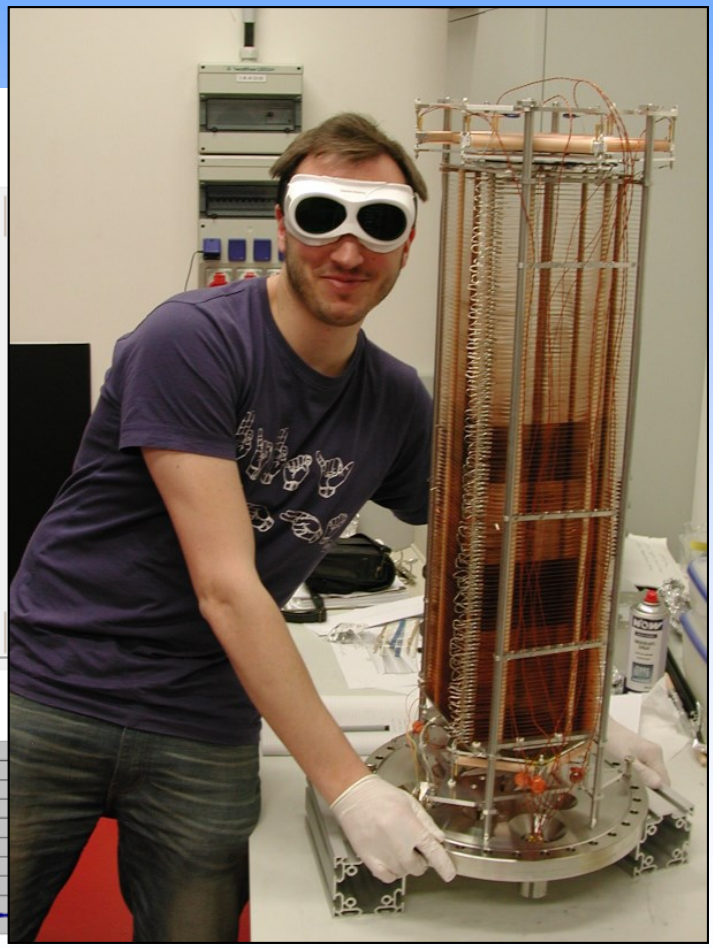


densities & rates

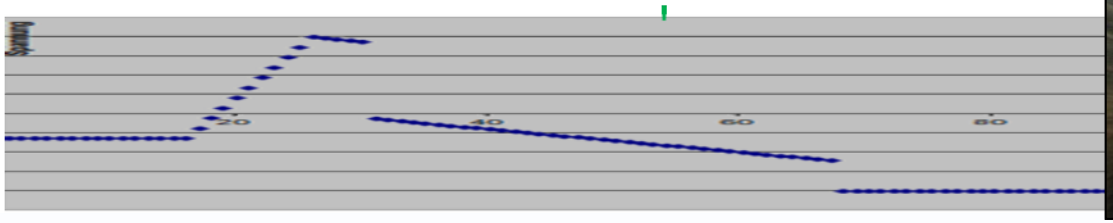
Spectrometer

- variable in length/geometry (5 – 75 cm) for optimal resolution

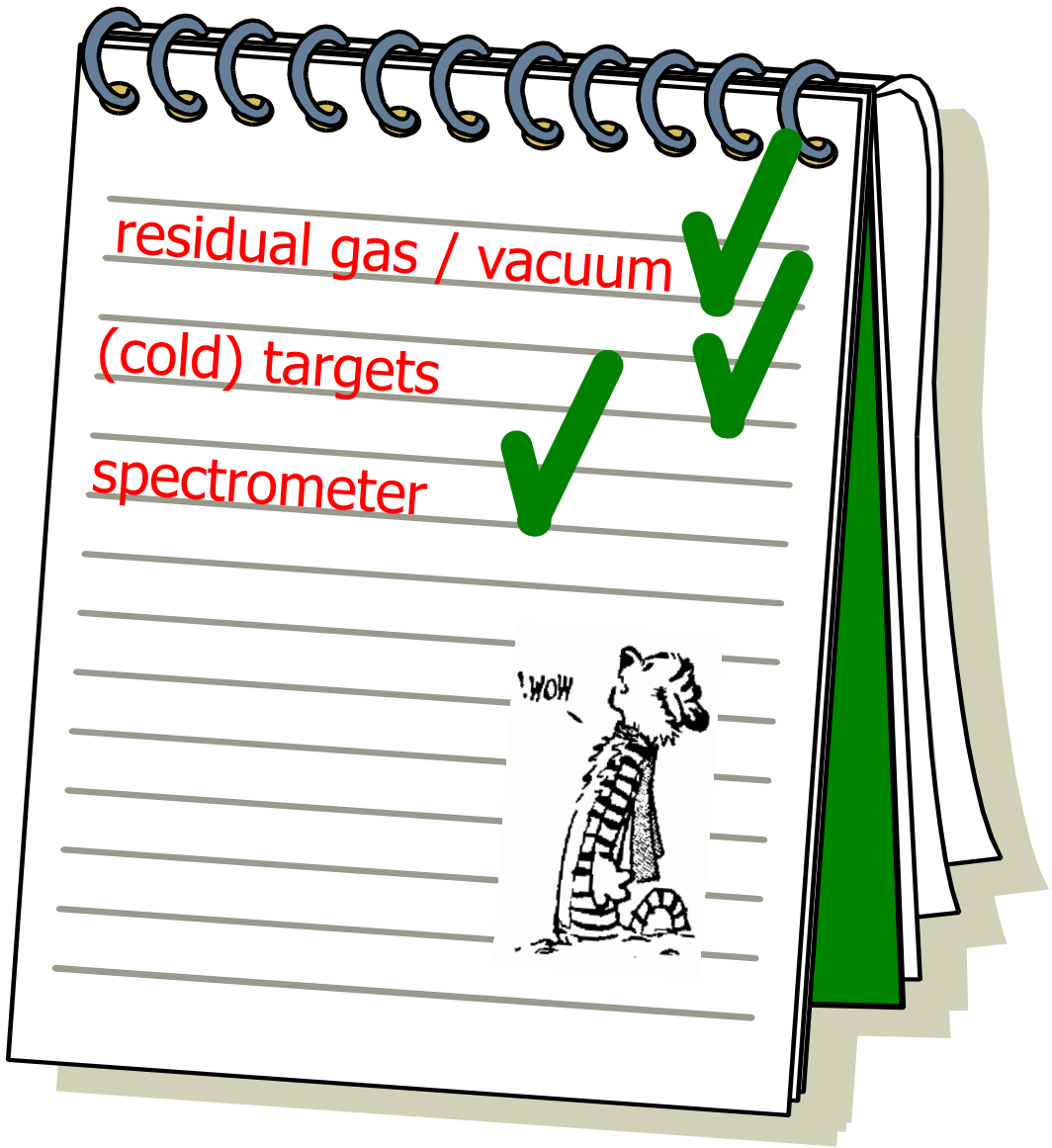




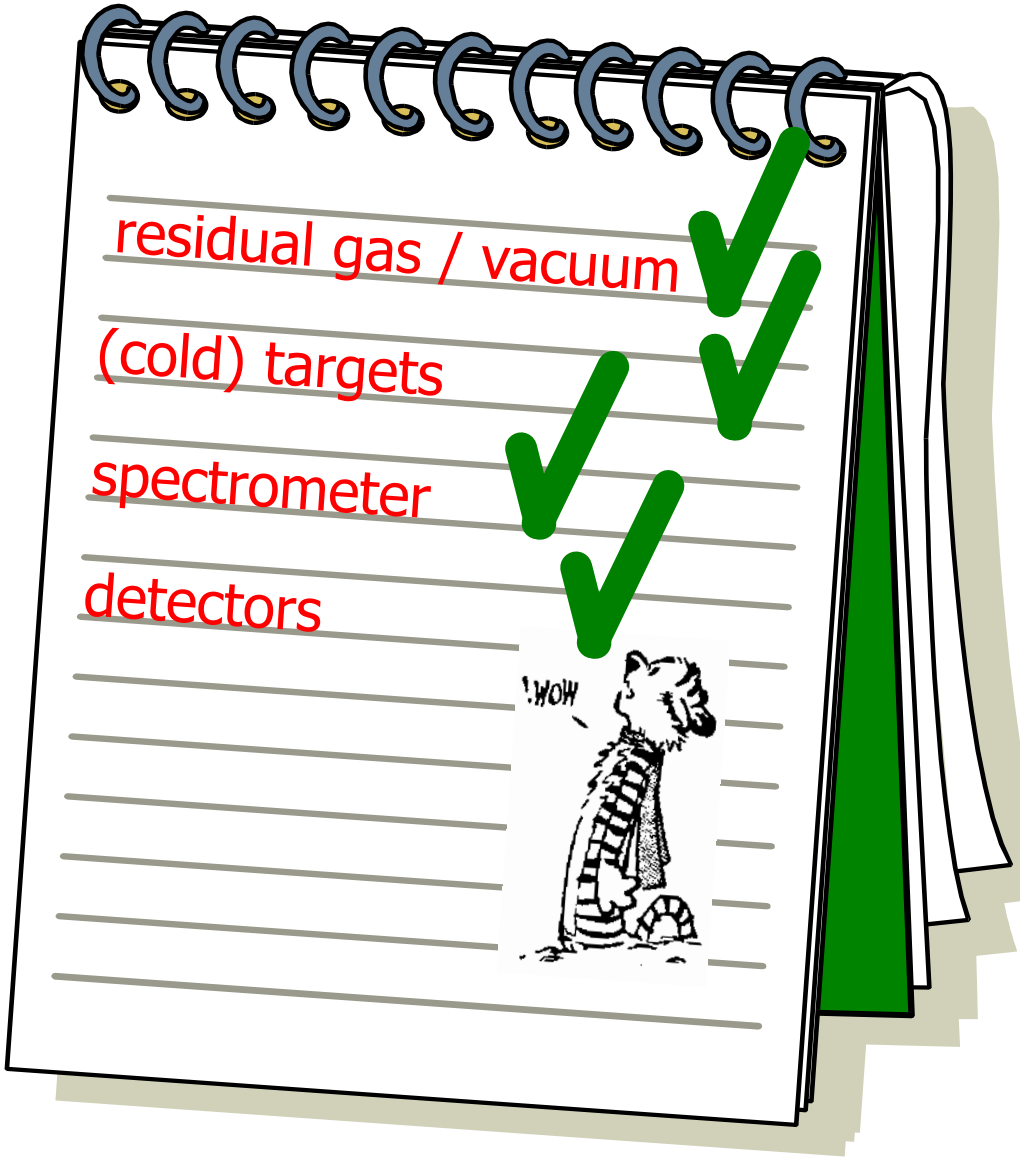
spectrometer 2015 **spectrometer 2013**



Spectrometer



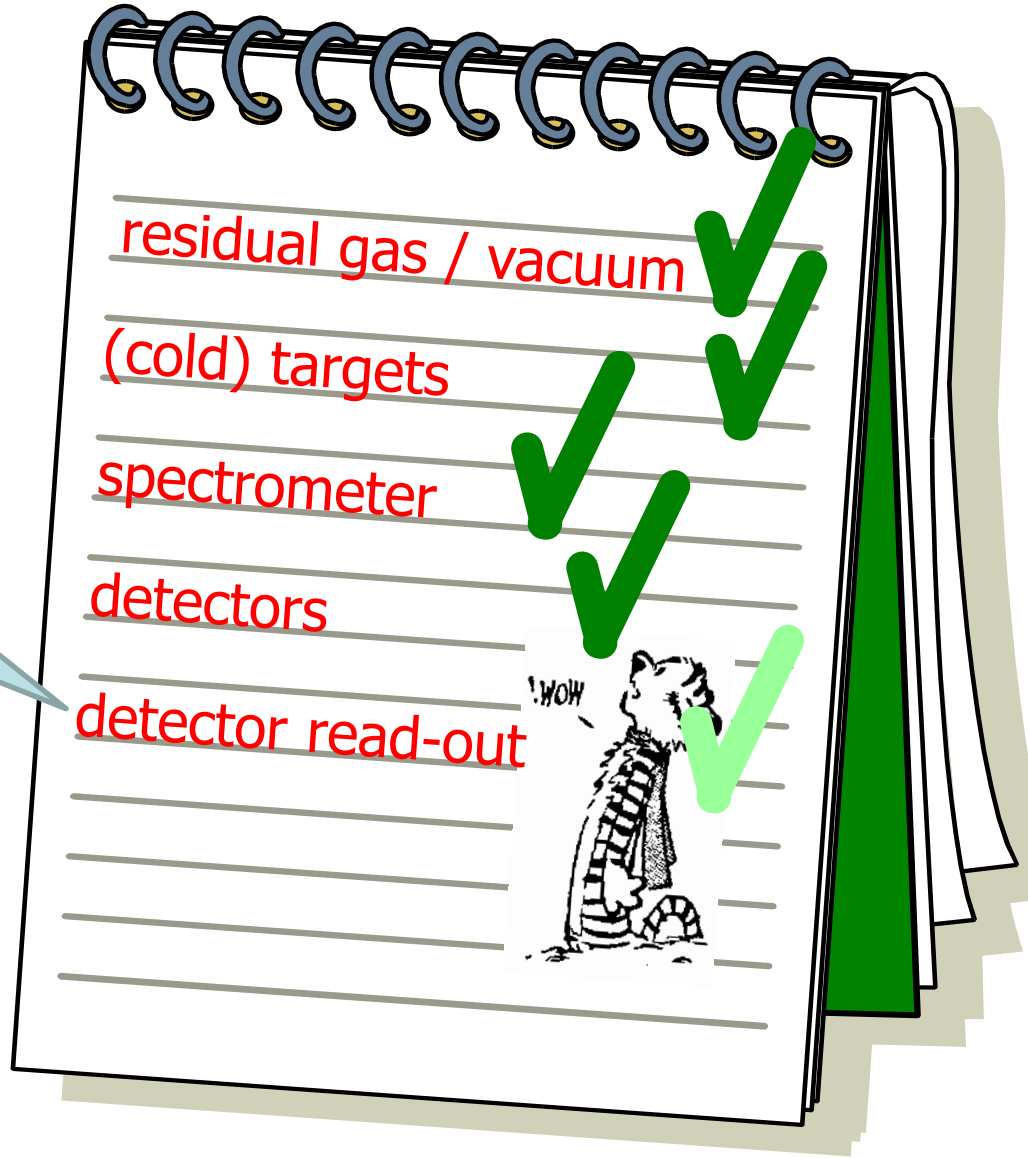
Detectors


residual gas / vacuum
(cold) targets
spectrometer
detectors
!WOW

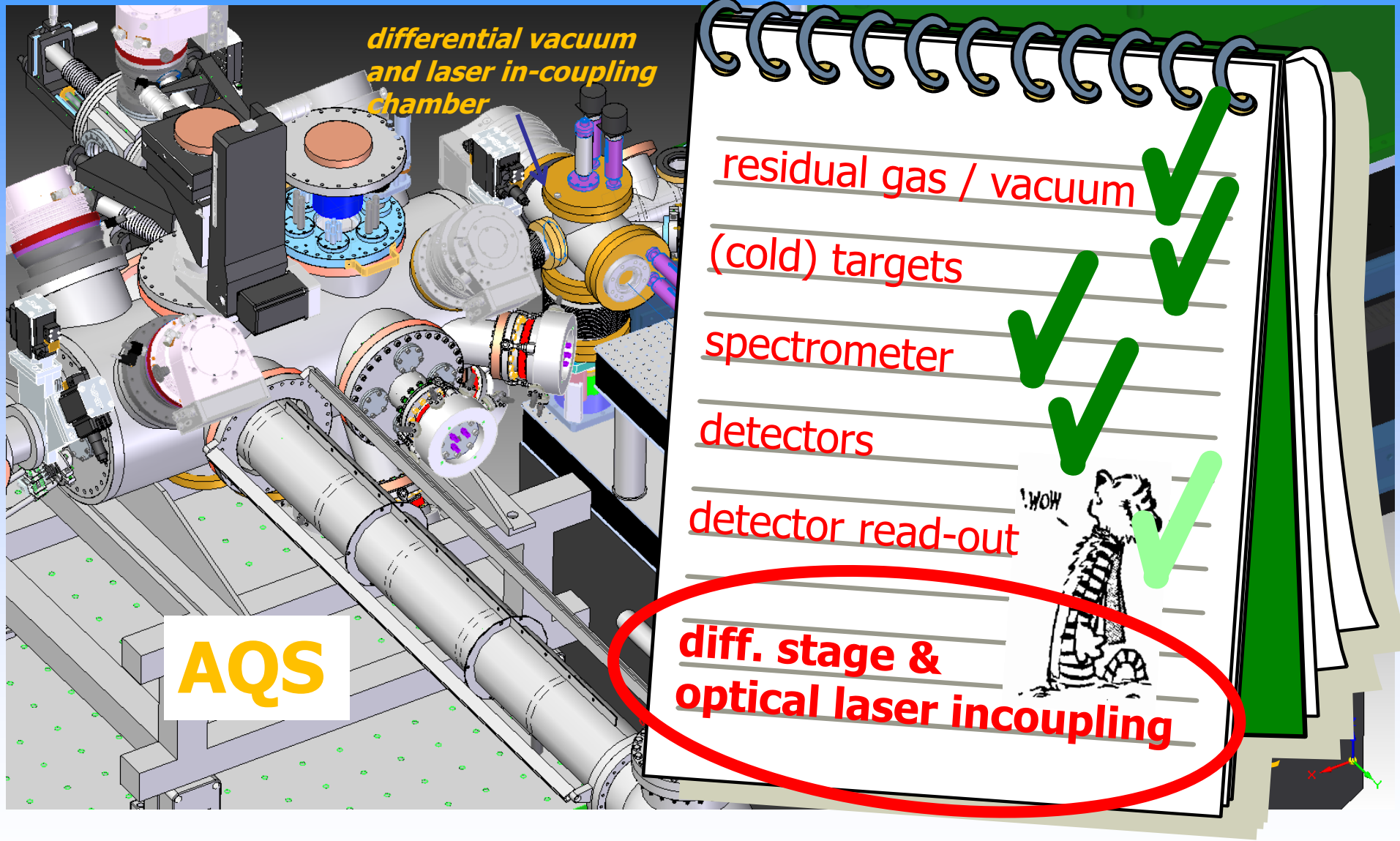
Detectors

to be implemented

at XFEL/SQS



differential pumping & optical laser



The XFEL-REMI

commissioned @ Soleil 10/2016

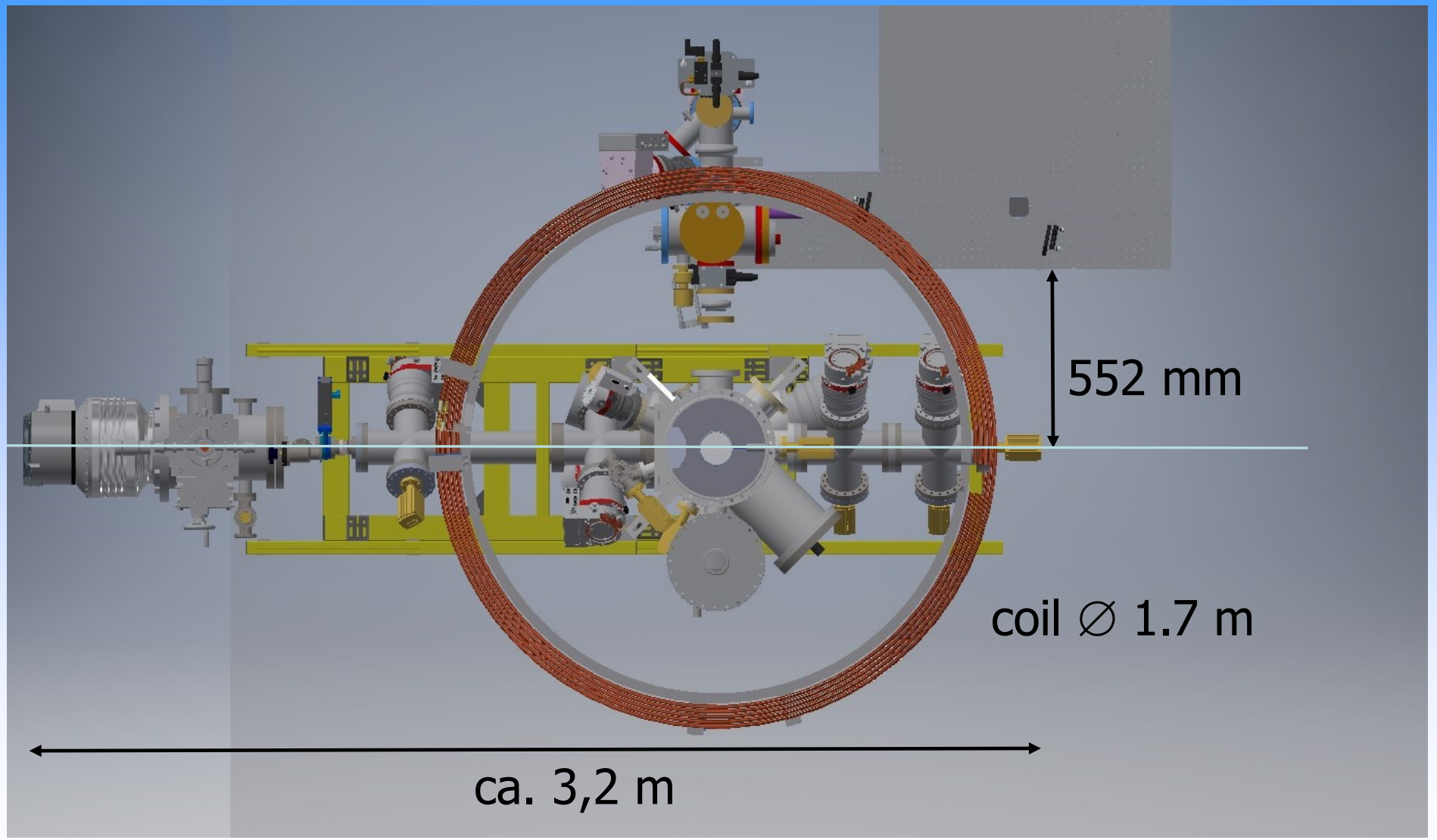
Acknowledgement

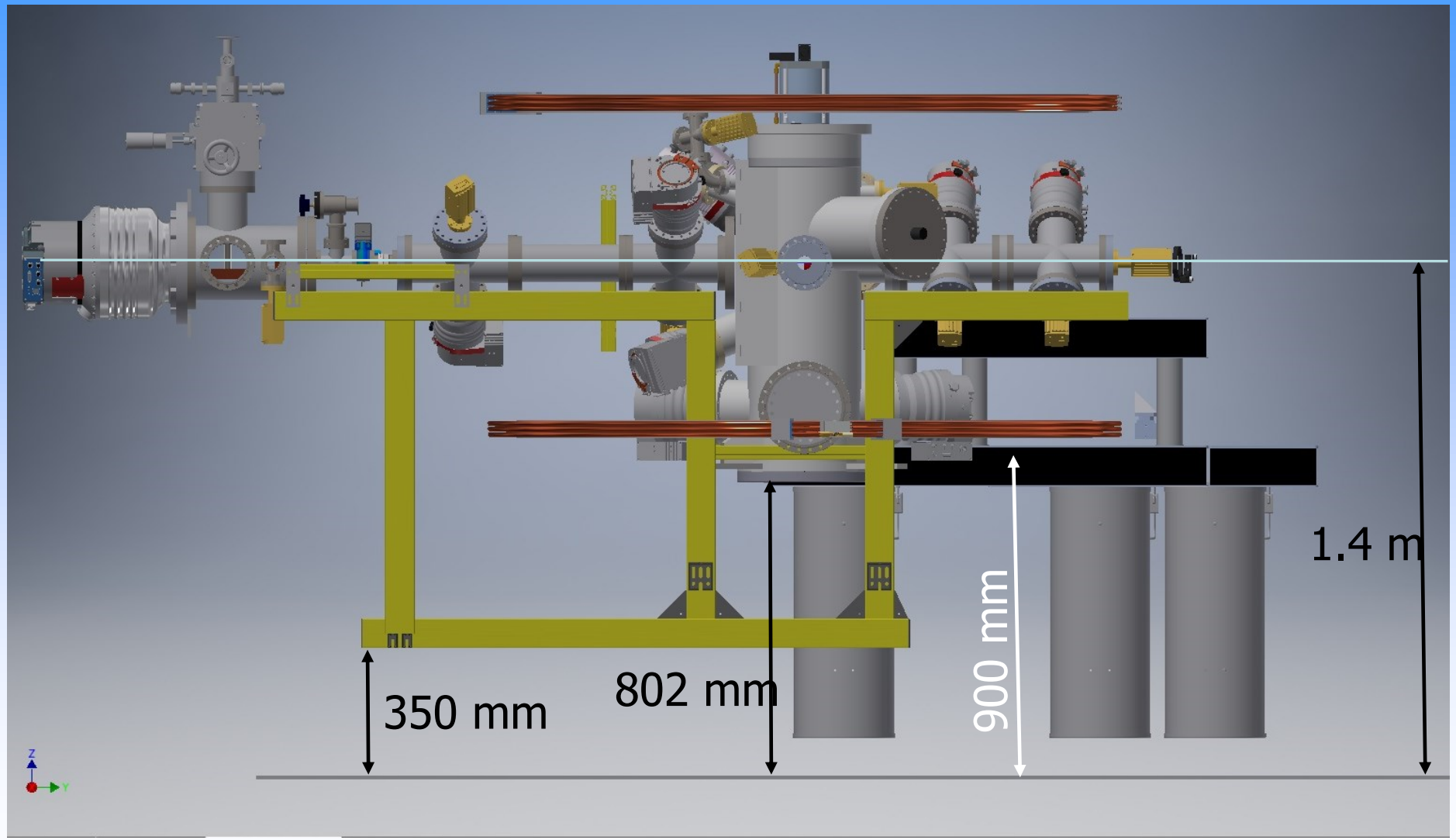
Frankfurt group (Sept. 2016)

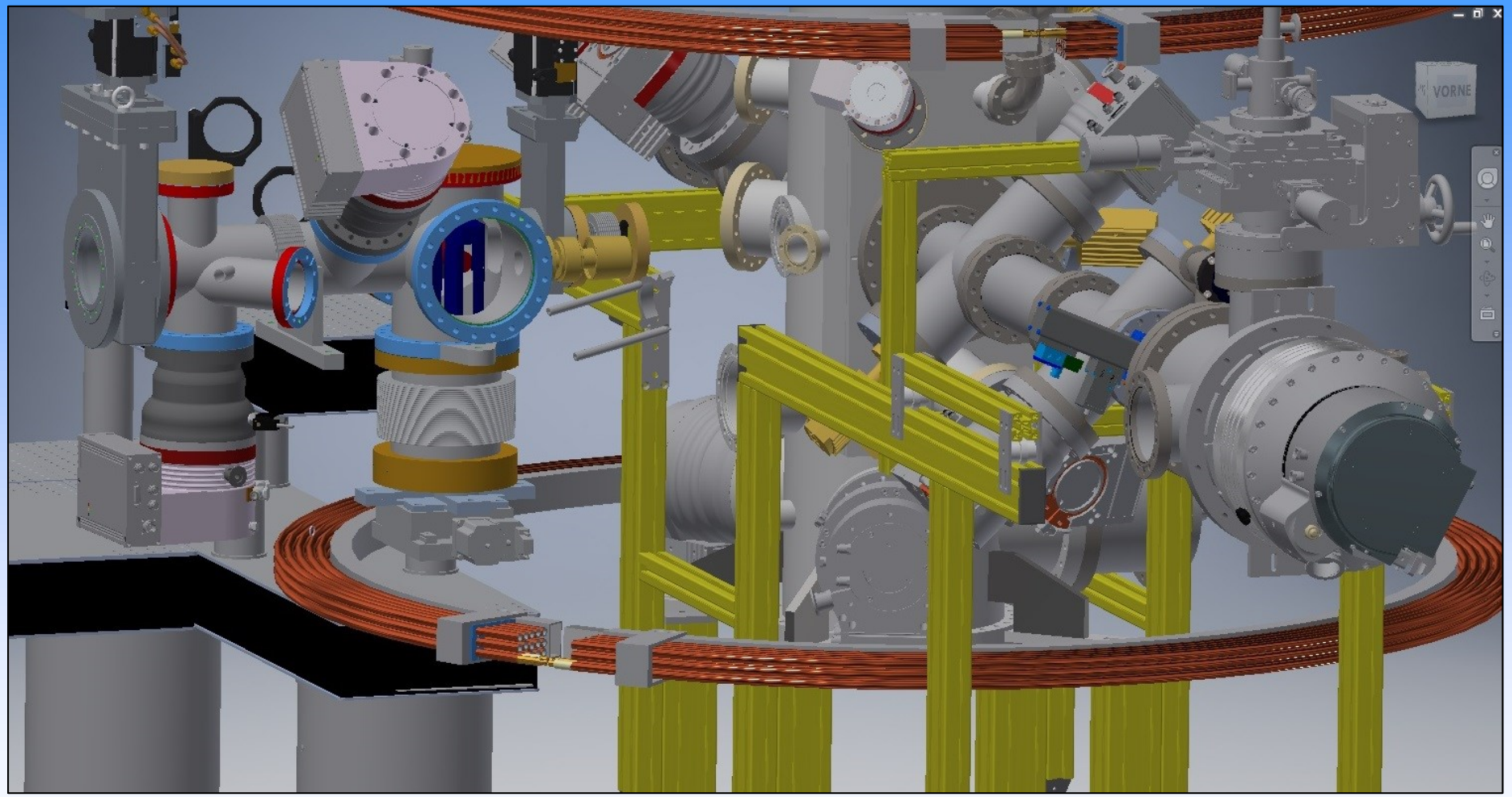
Acknowledgement

thanks for your attention

FSP-302


552 mm
coil ∅ 1.7 m
ca. 3,2 m


350 mm
802 mm
900 mm
1.4 m


VORNE