Source plasma ECR dipolaire et son application dans les réacteurs SCHEME-II et II+

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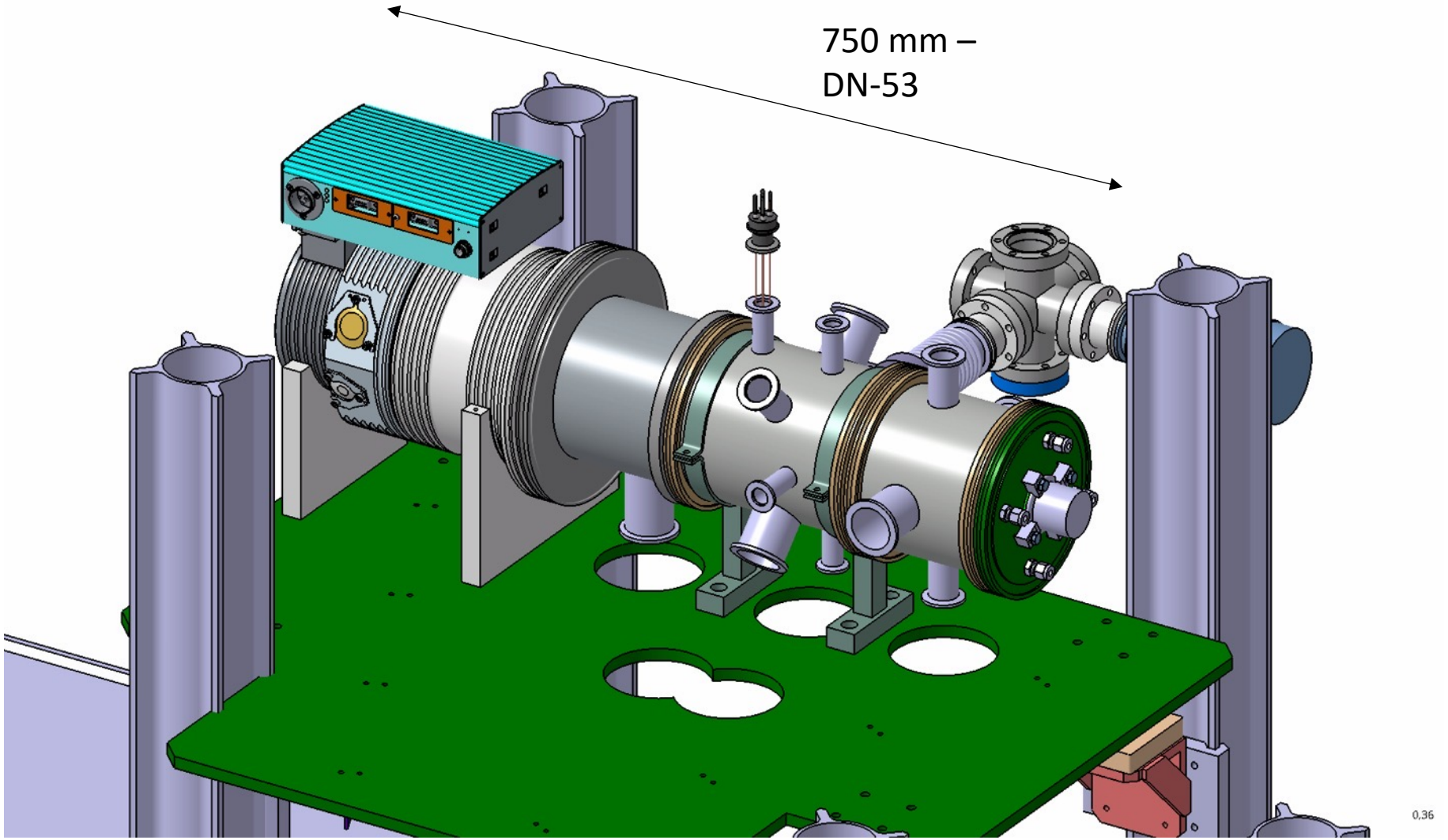
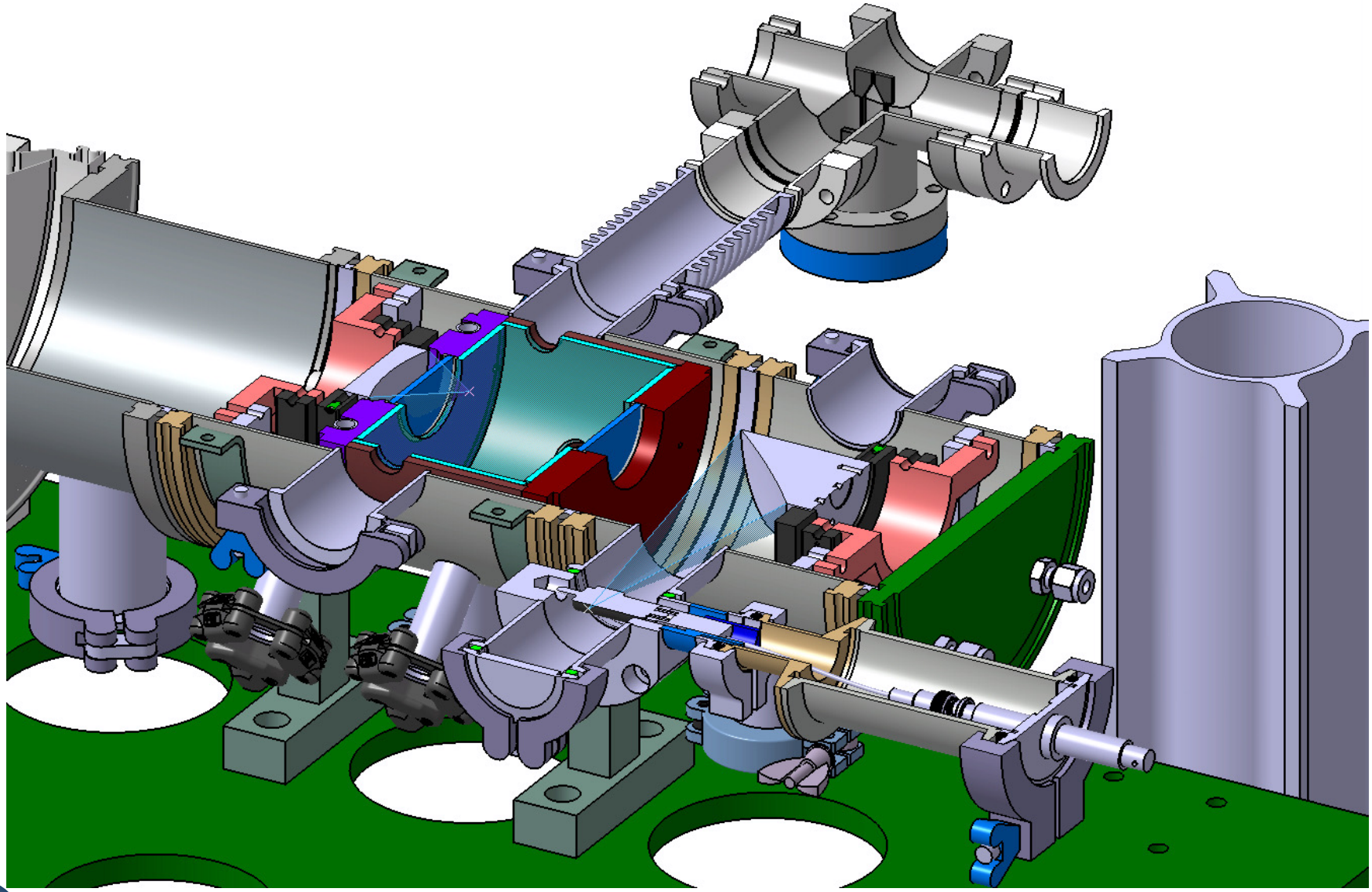
SCHEME reactor

Source of exCited HydrogEn MolEcules

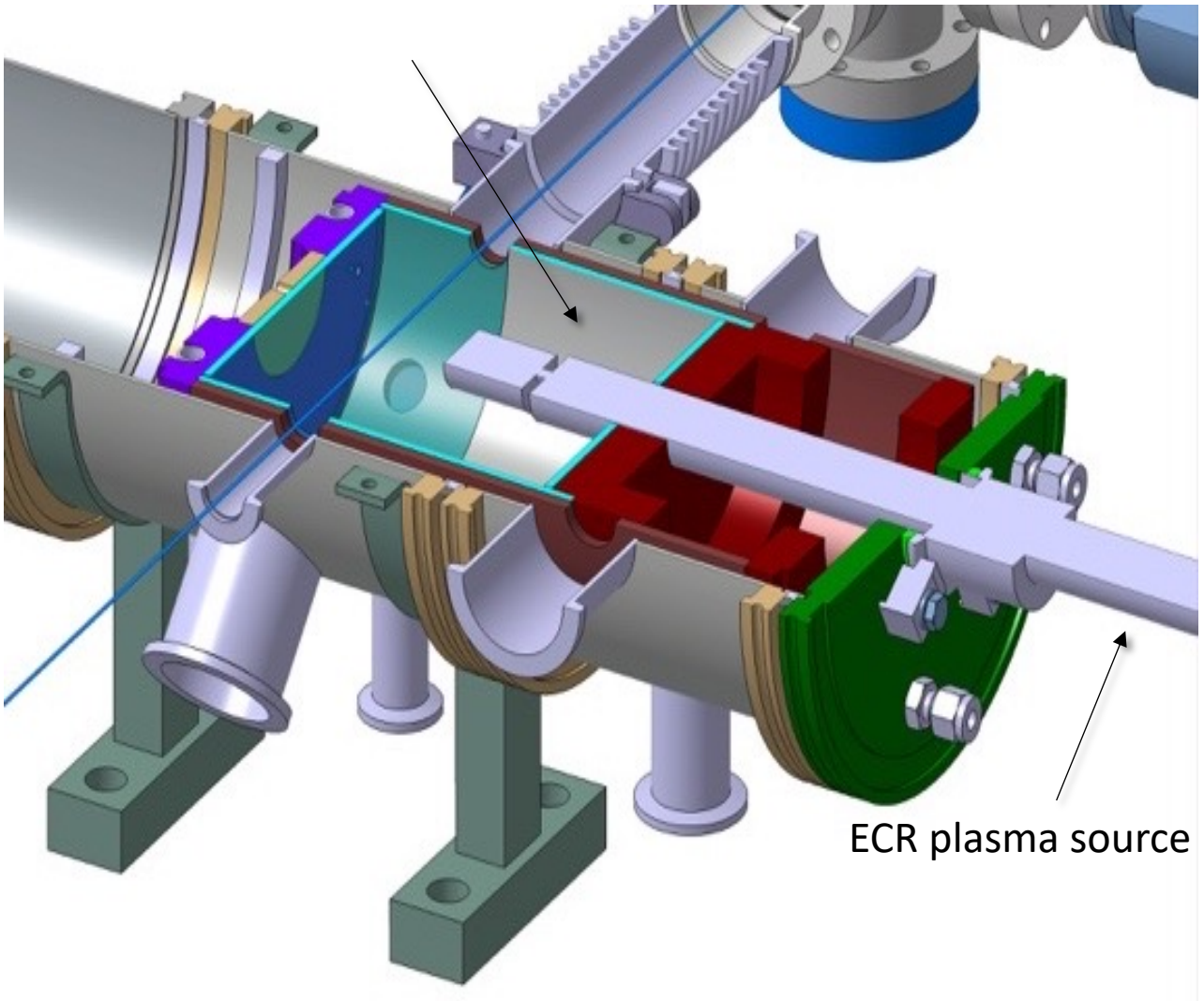


SCHEME-I reactor



SCHEME-II reactor

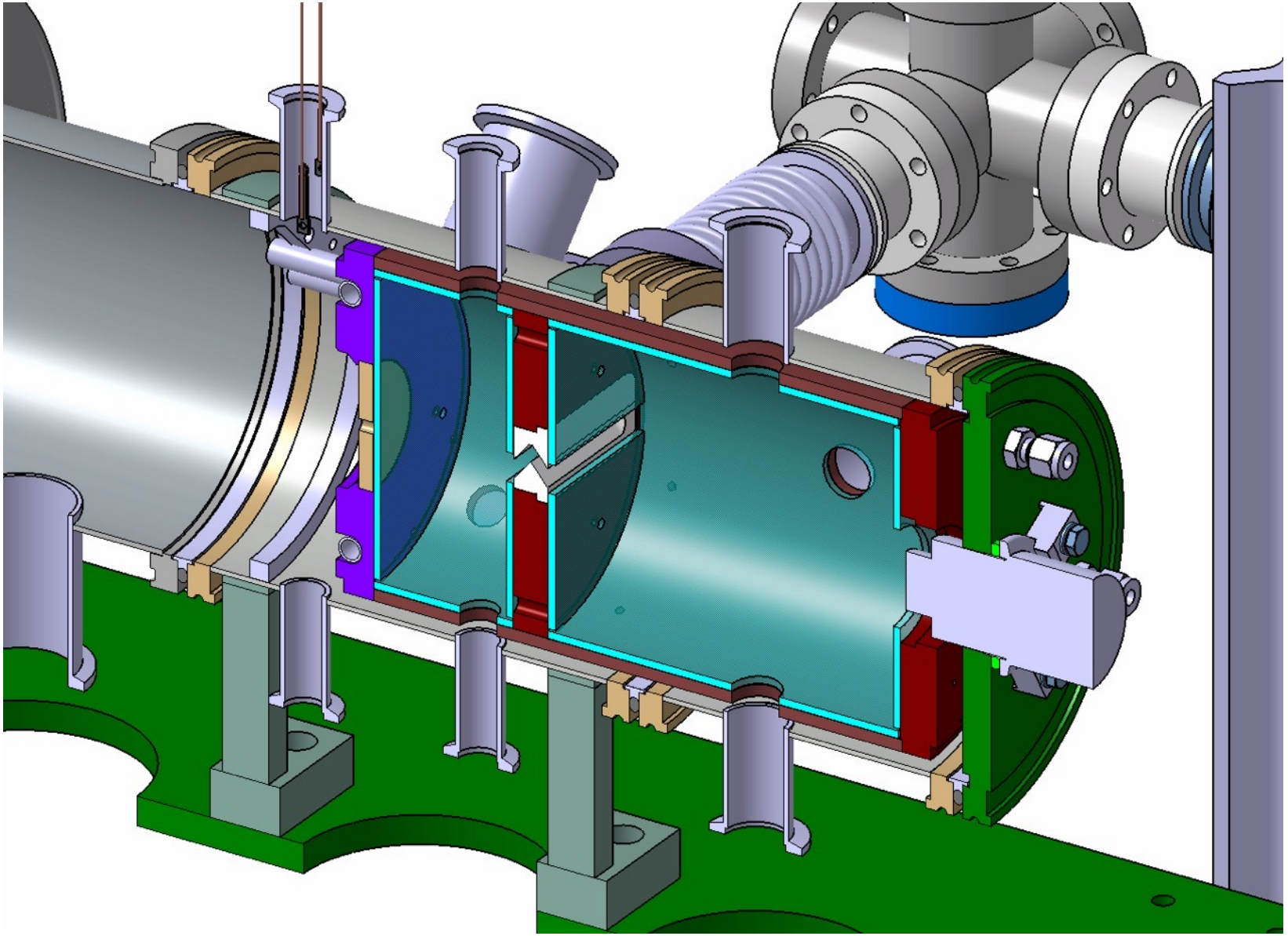
Tested material



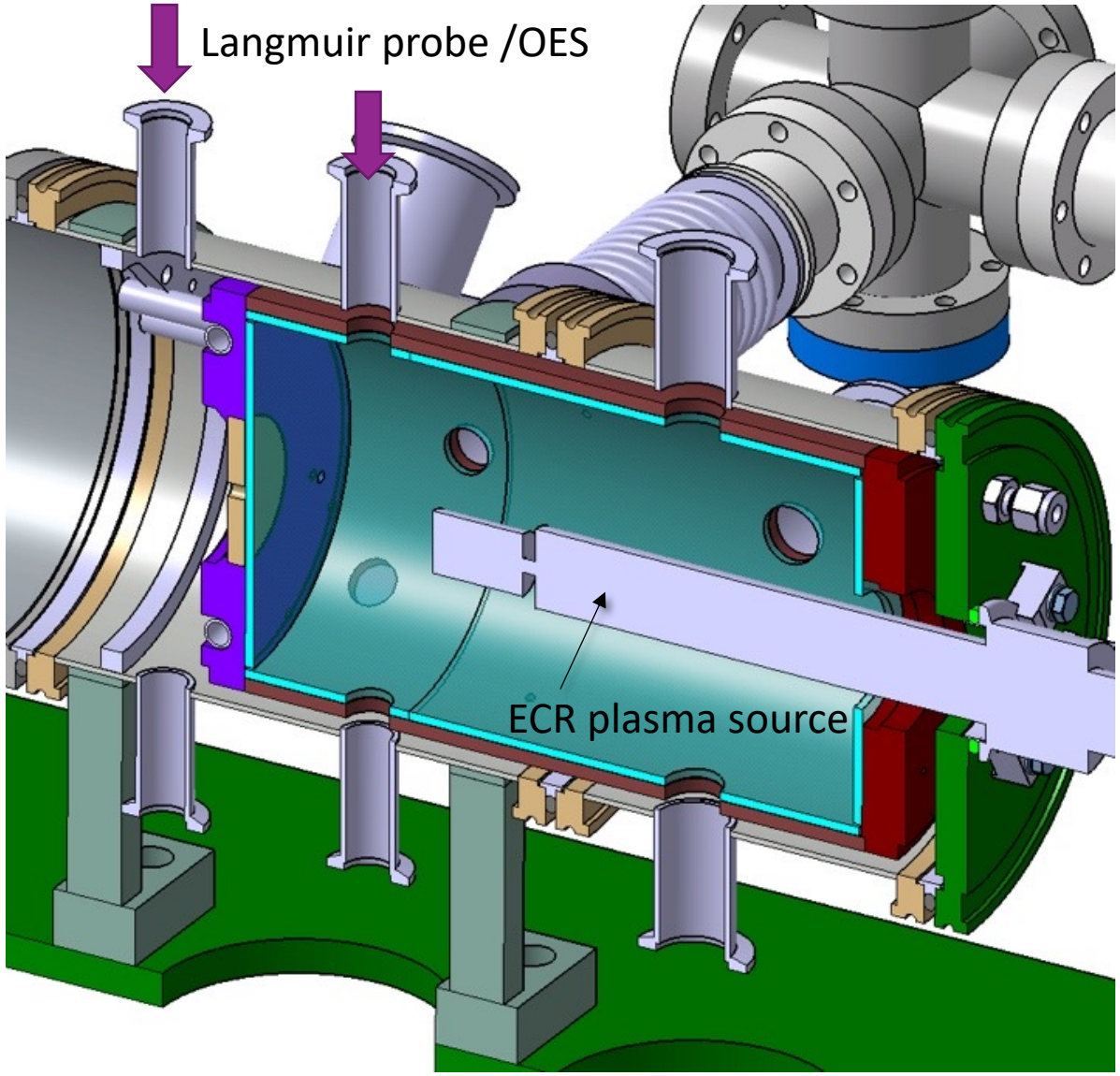
SR beam

ECR plasma source

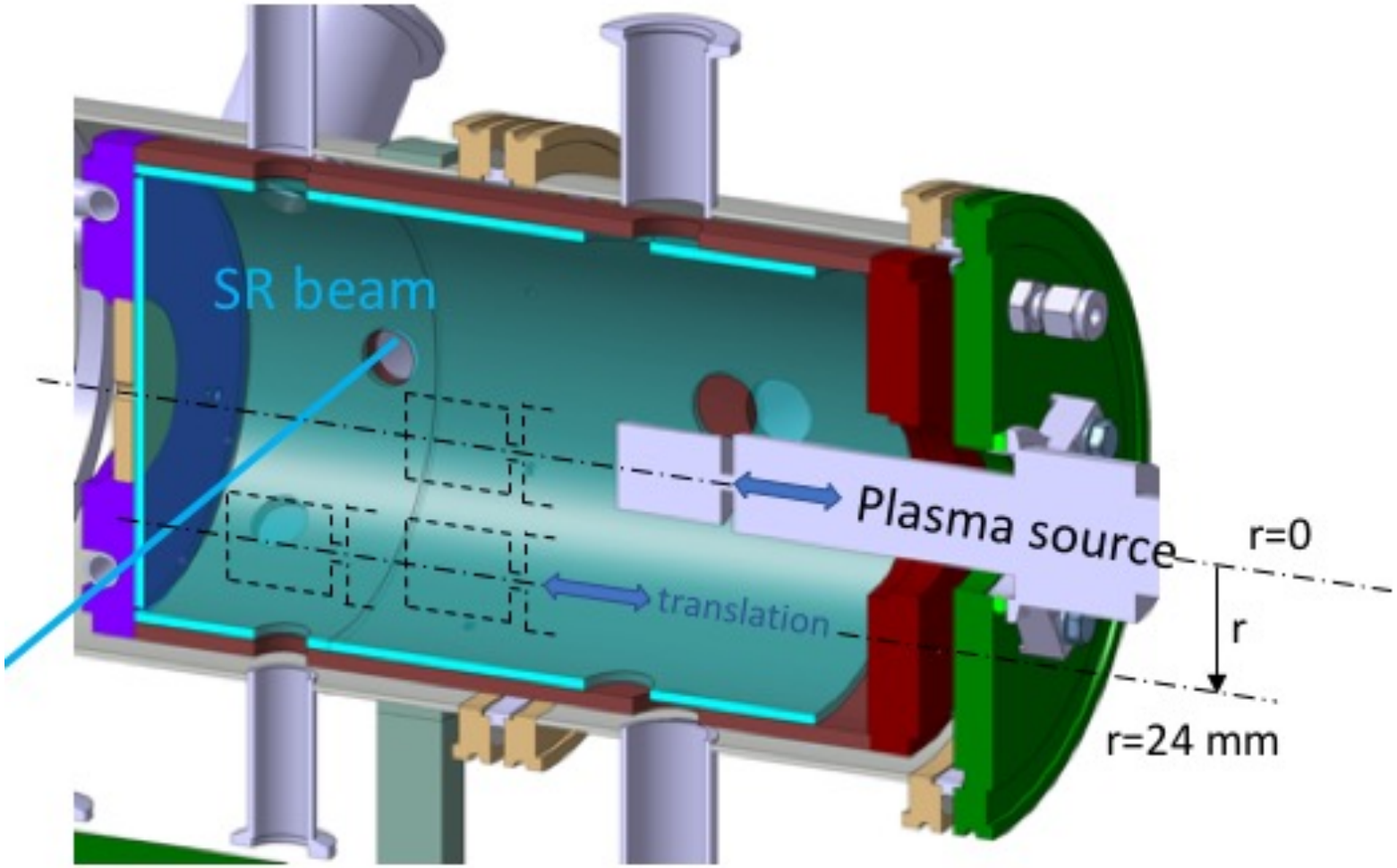
SCHEME-II reactor



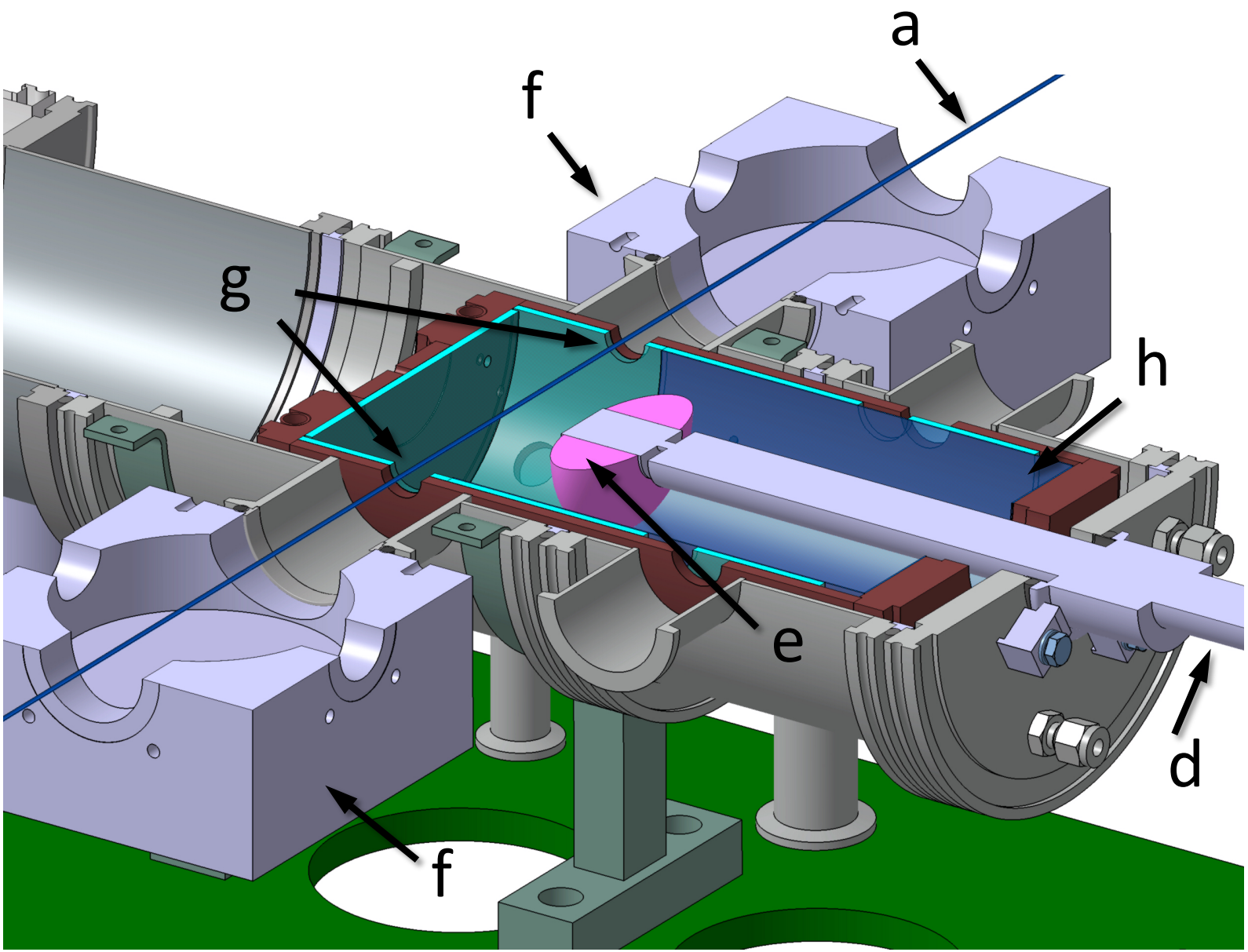
SCHEME-II reactor



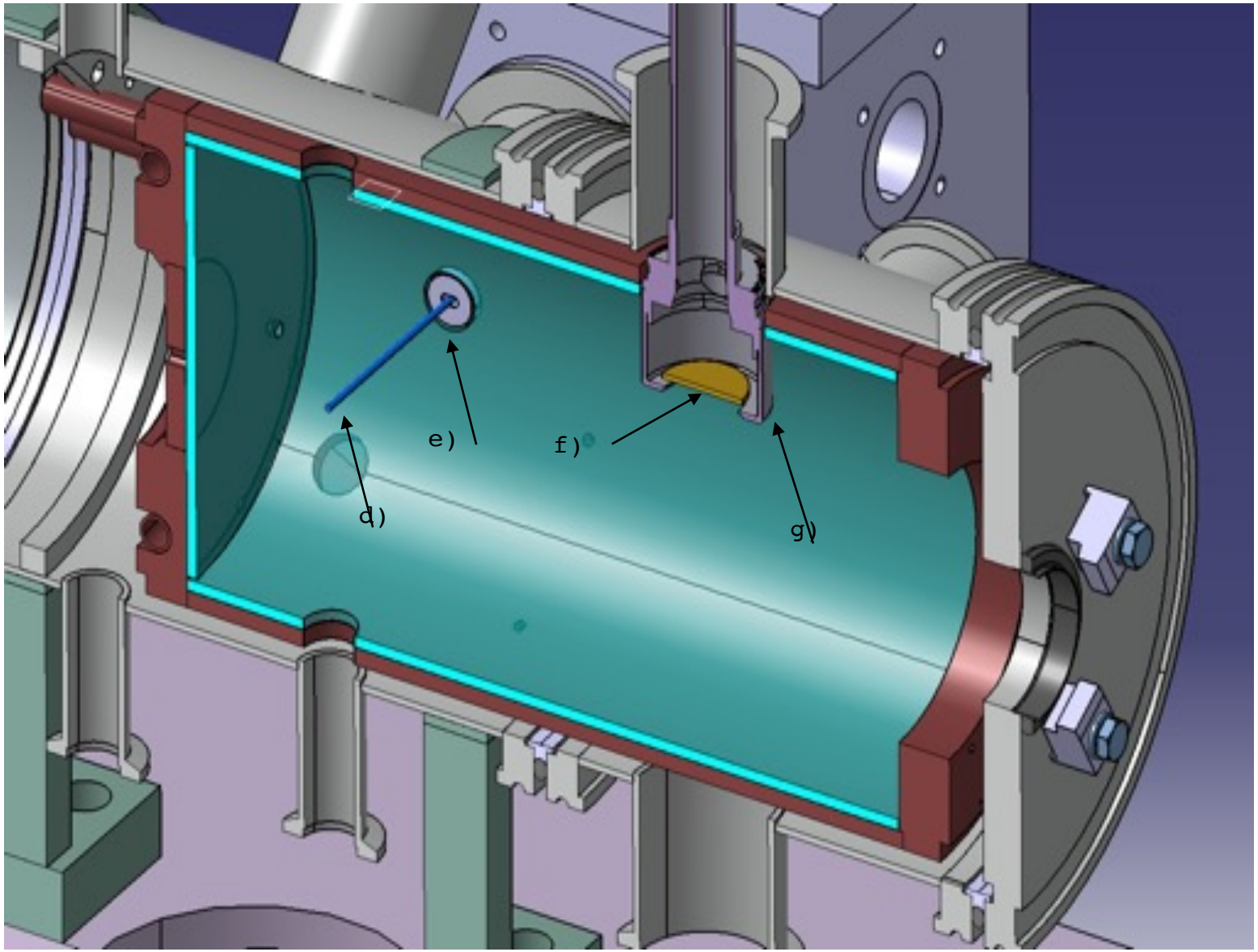
SCHEME-II reactor



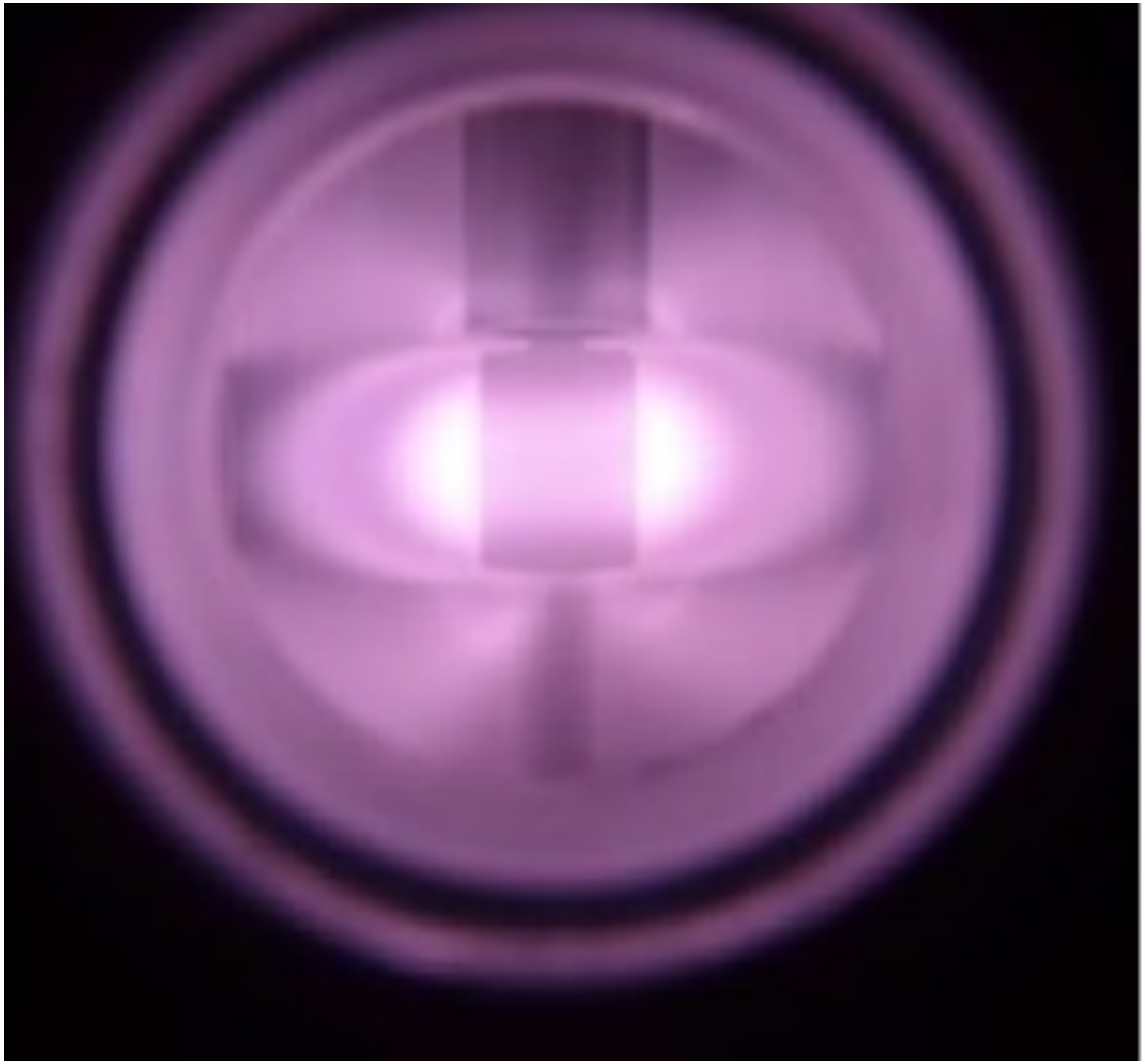
SCHEME-II+ reactor



SCHEME-II+ reactor

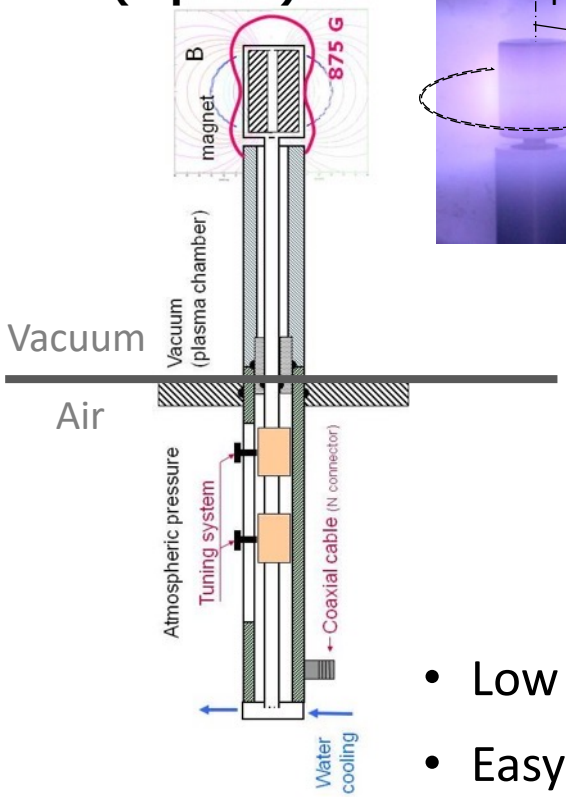


ECR-Plasma

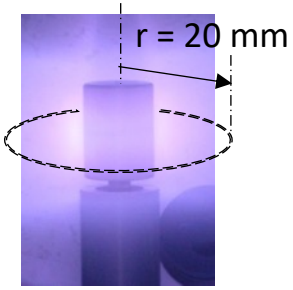


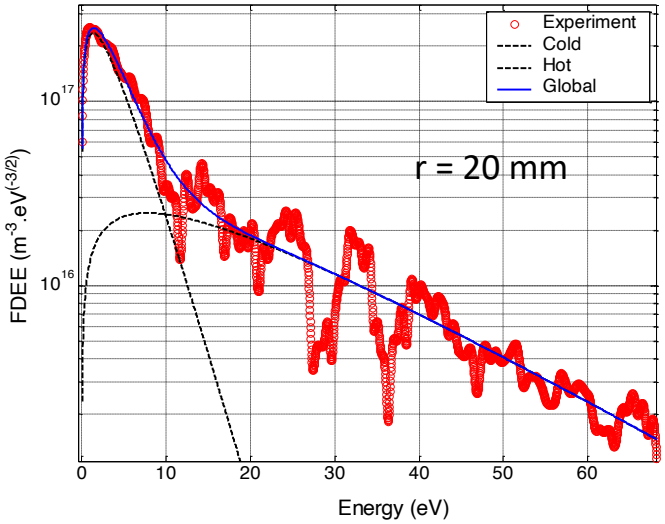
ECR plasma – Dipolar source

Magnet-ended (dipolar)

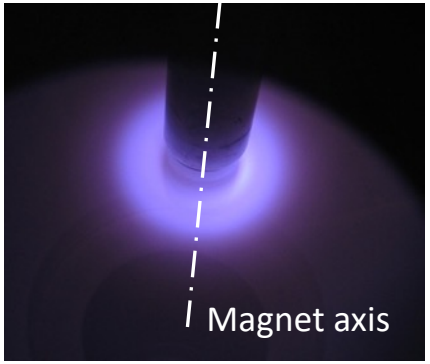


Lateral view

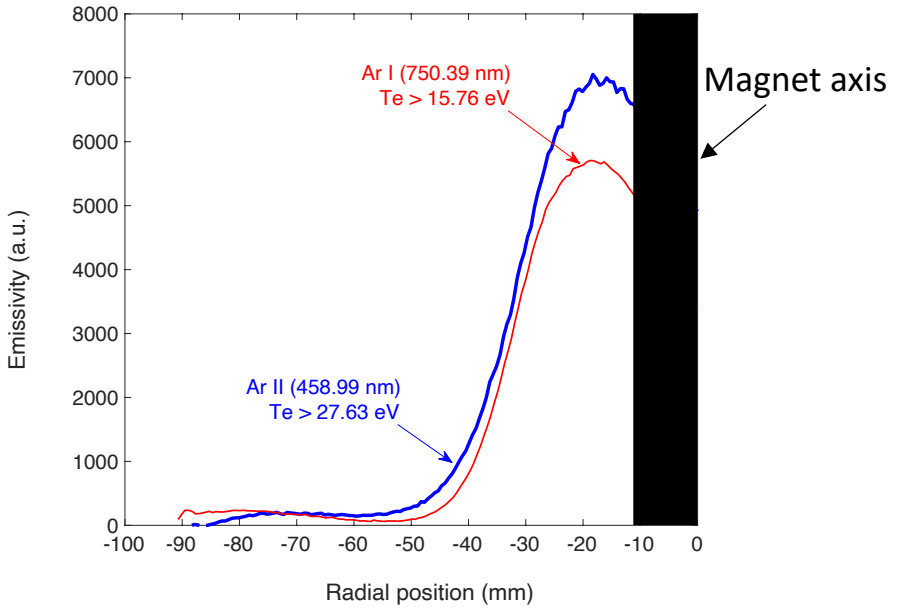




Top view

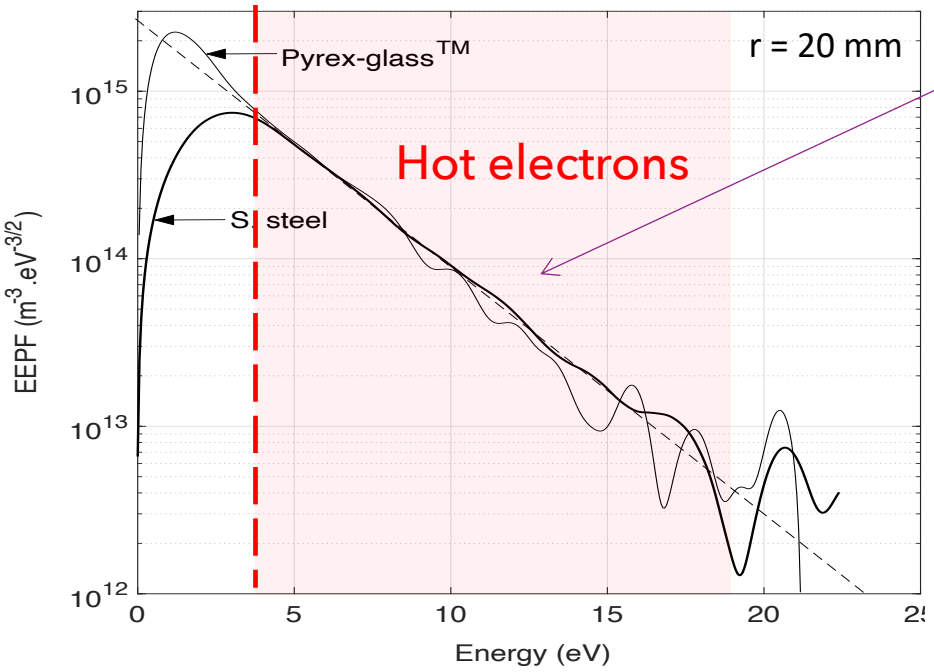


- Low power (< 250 W)
- Easy to handle
- Similar plasma in comparison with RAID

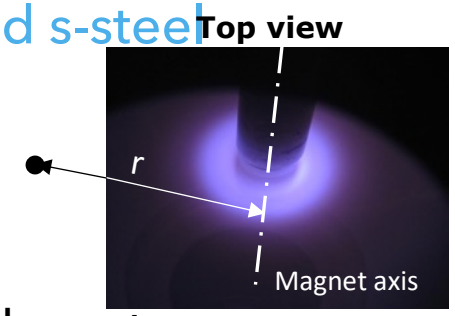


S. Béchu, et al. (2013) *Phys. Pl.*, *20*(10), 101601–101608.
S. Aleiferis, et al. (2018). *Plasma Sources Sci. Technol.*, *27*(7), 075015.

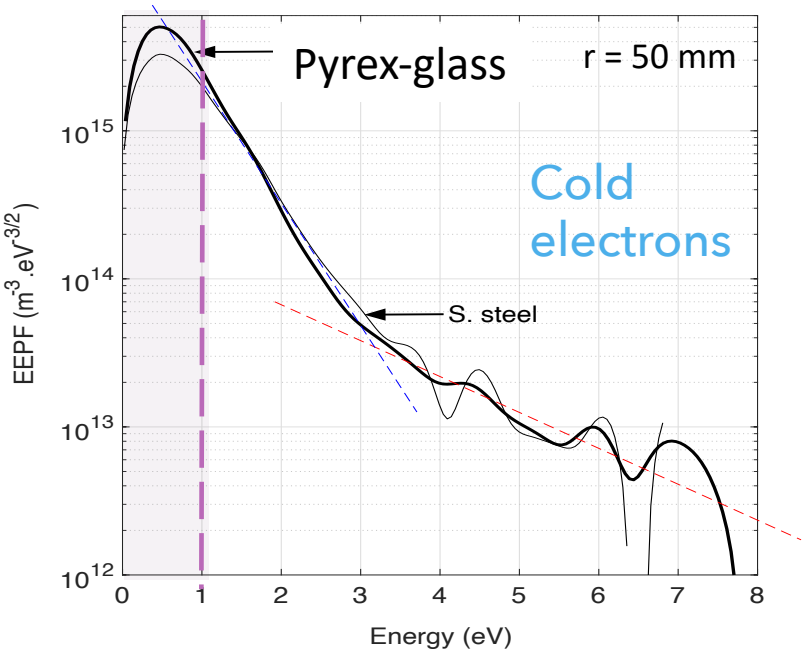
Comparative study Pyrex-glass *vs*. Stainless steel



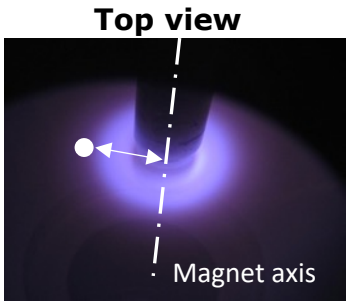
eV and EV excitation region : same for glass and s-steel



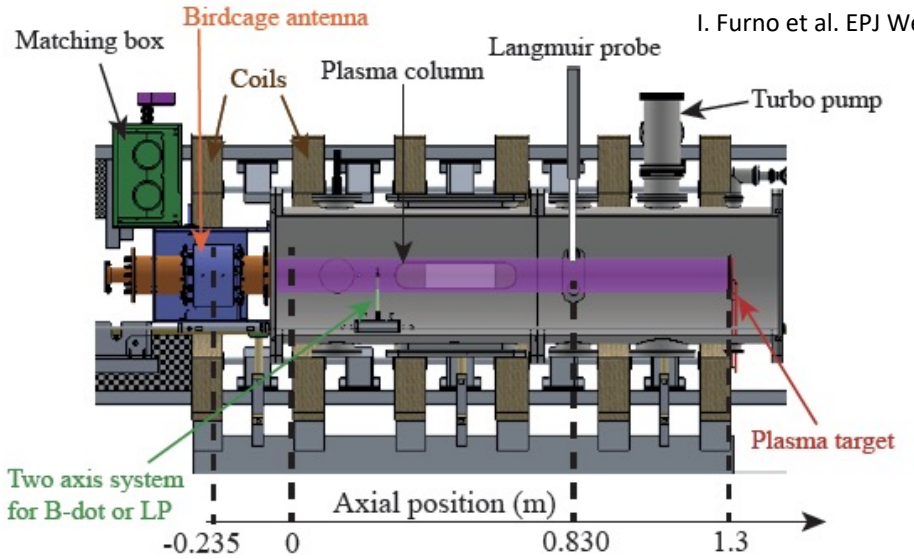
Diffusion region
dissociative attachment
=> H^- formation



ECR plasma production region H_2 dissociation => Singlets states (B, C, …) and triplet states (d, a, b, …) creation & excitation

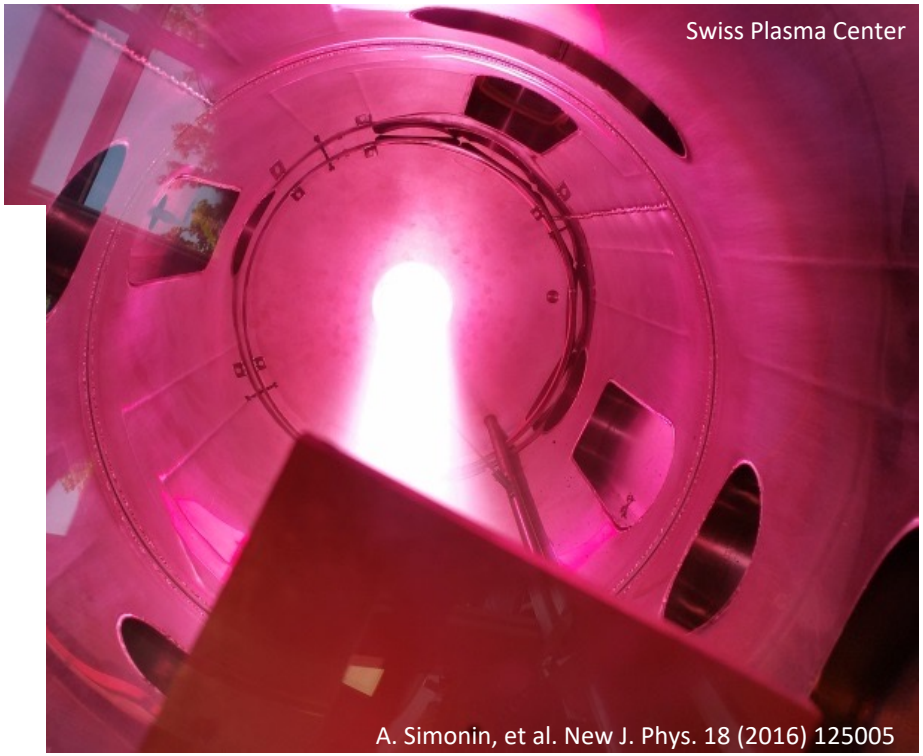


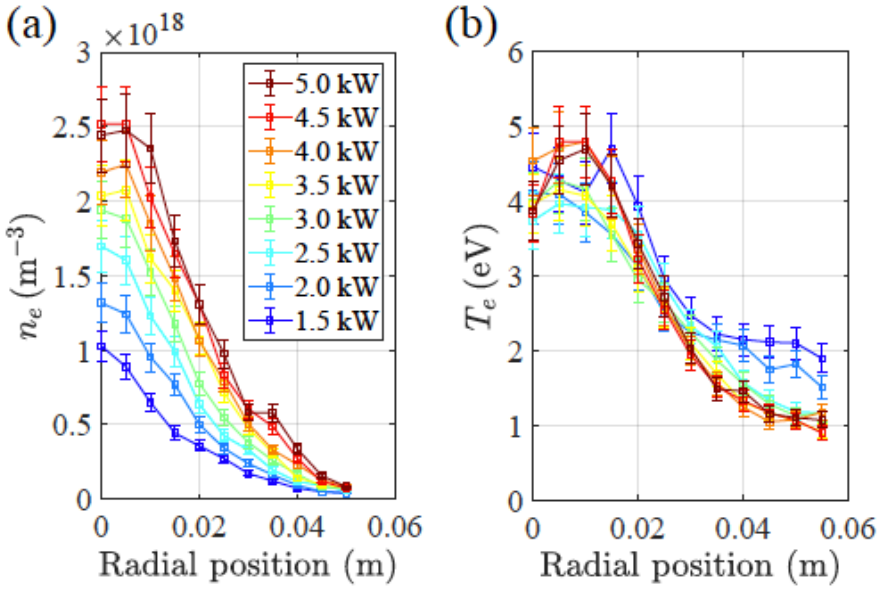
RAID reactor – EPFL Swiss Plasma Center



I. Furno et al. EPJ Web of Conferences 157, 03014 (2017)

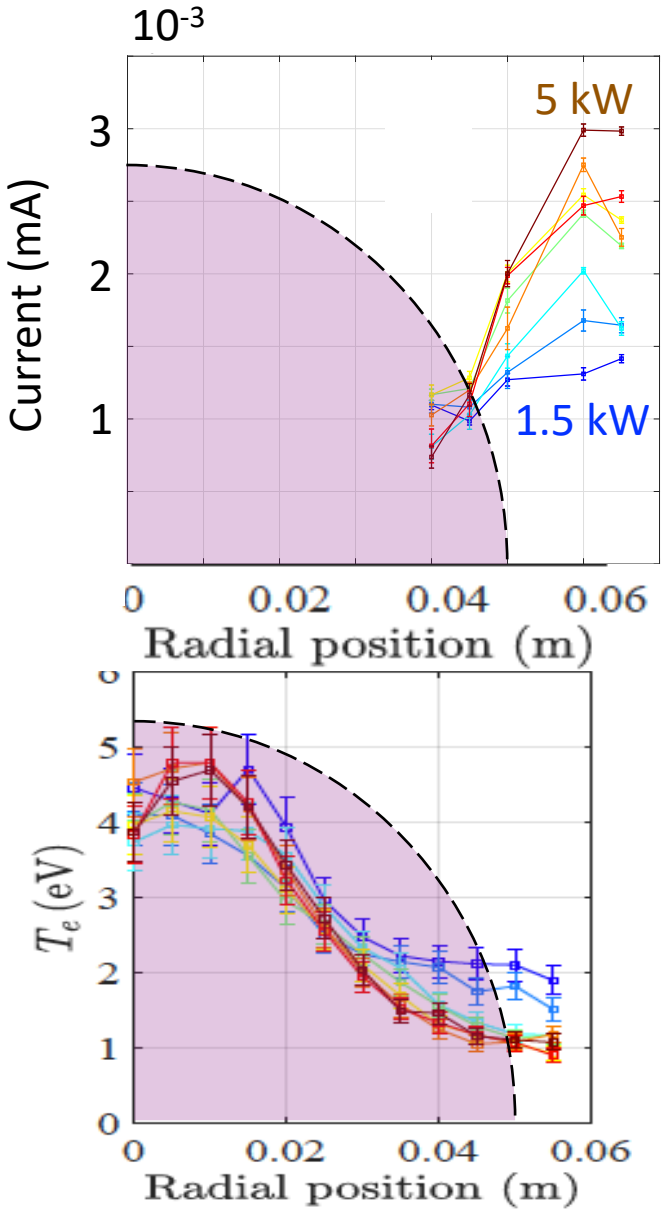
Helicon plasma discharge on RAID (EPFL)
RF power 3-5 kW,
pressure 0.3 Pa,
Magnetic field: 10 mT

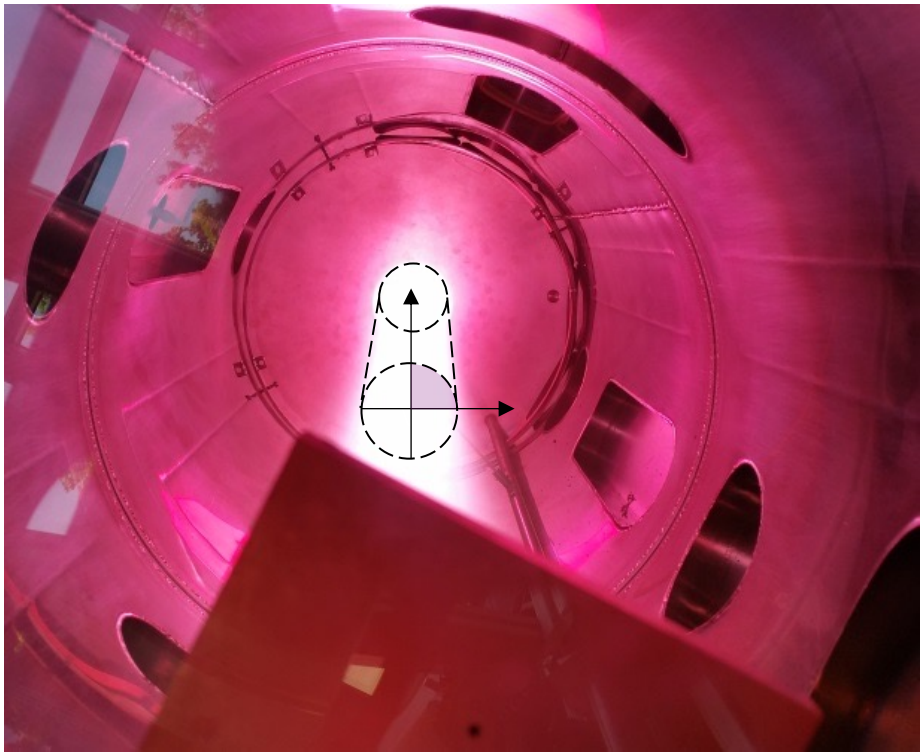




Submitted to Nuclear Fusion revue

Laser photodetachment on RAID reactor



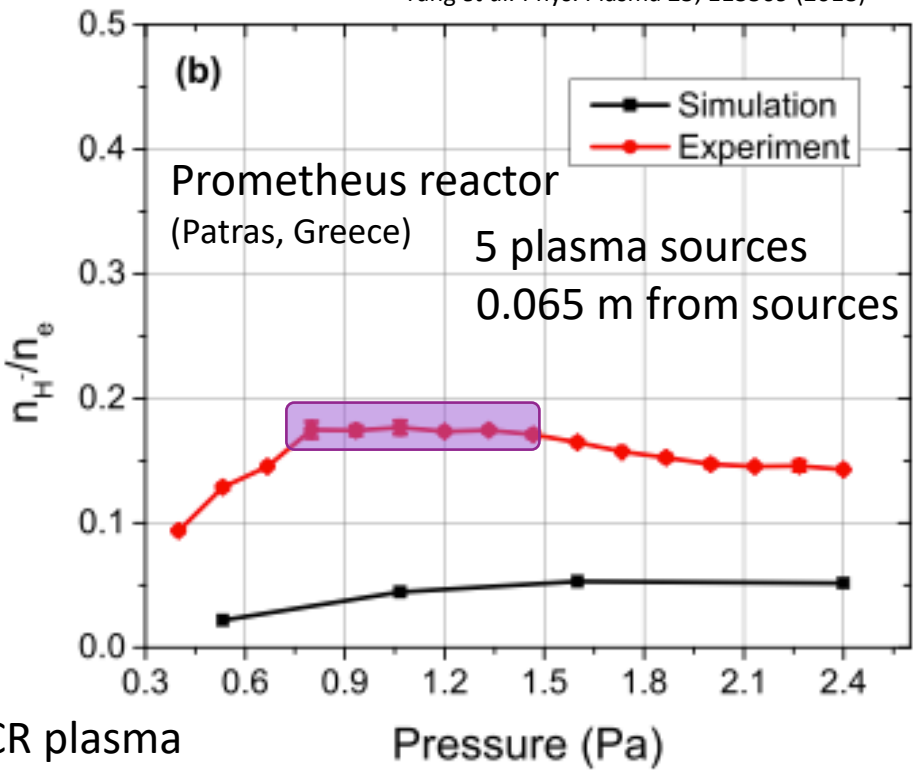


High temperature / density peaked in the center
Negative ions created at the column edge

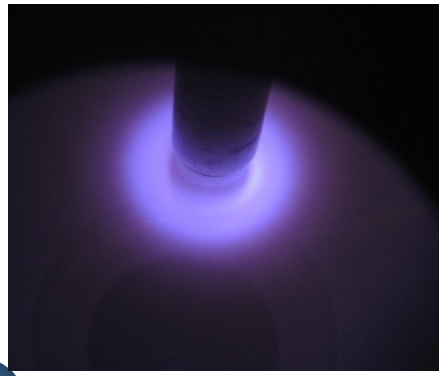
R. Jacquier, (2019). *Fusion Eng. Des.*, *146*, 1140–1144.
K. Ahmed, (2019). *Plasma Sources Sci. Technol 28*(9), 095005.

ECR *vs.* Helicon a comparison (laser photodetachment)

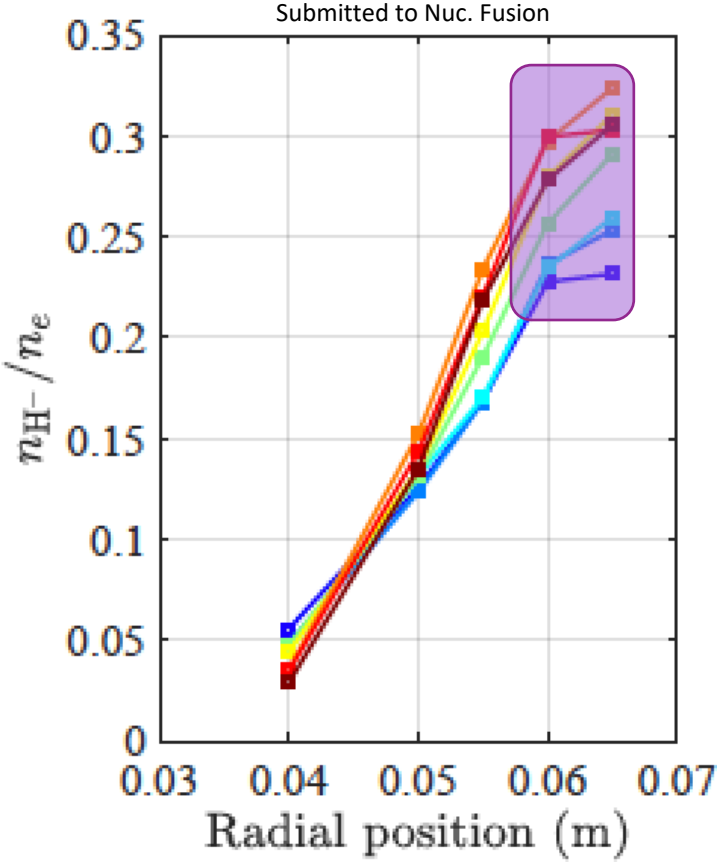
Yang *et al.* Phys. Plasma 25, 113509 (2018)

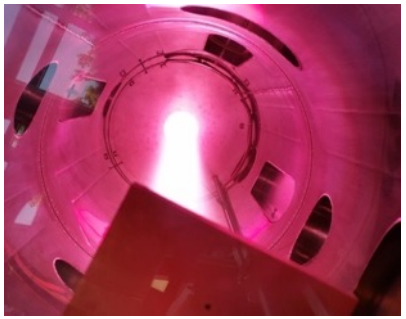


ECR plasma



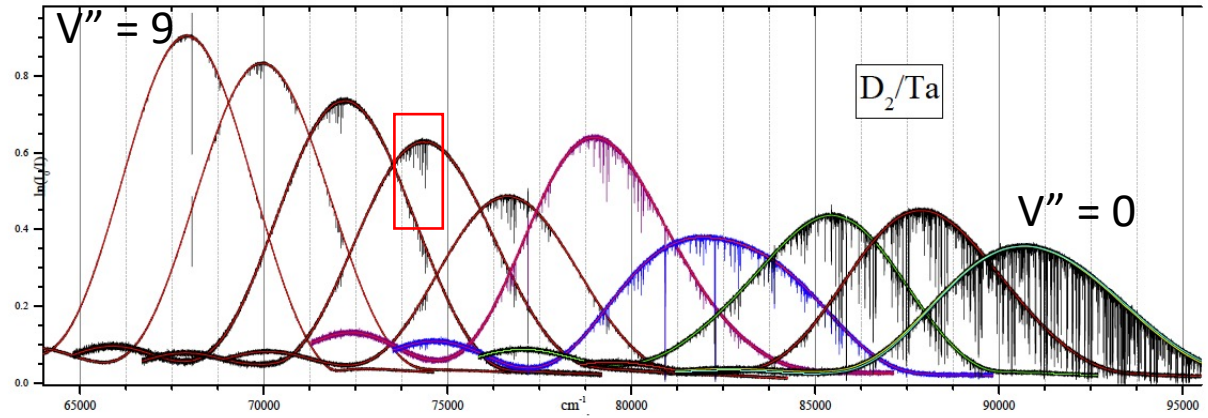
Submitted to Nuc. Fusion





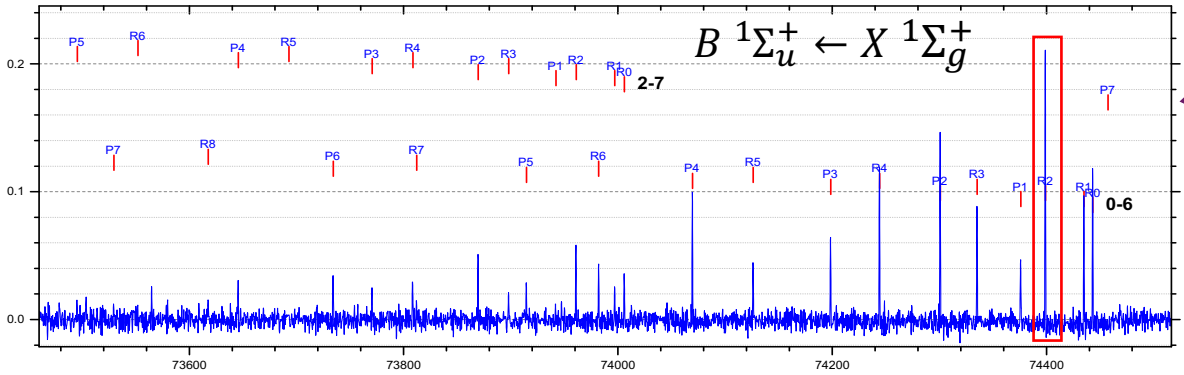
RAID reactor

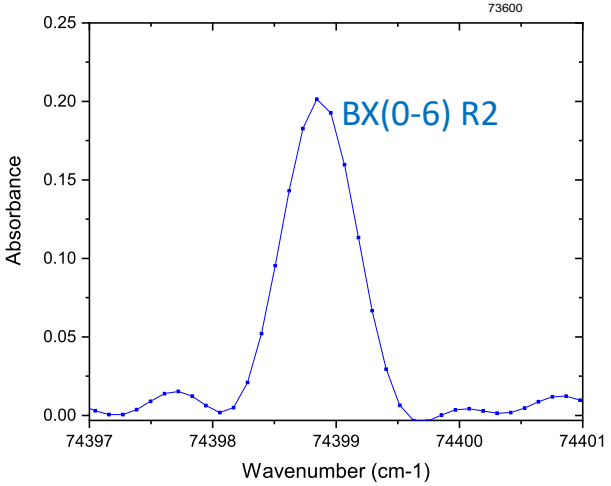
VUV-FTS measurements



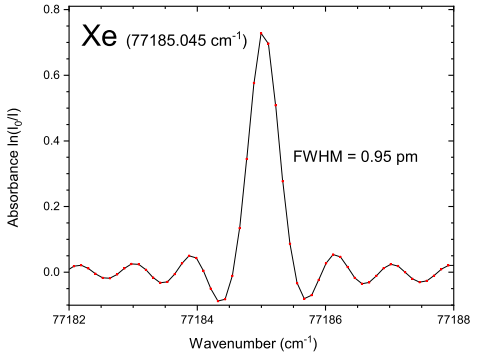
9 undulator settings to cover the vibrational levels from v”=0 up to v”= 8 (90 – 165 nm)

In one undulator setting different ro-vibrational transitions appear well separated, here BX (0-6) and BX(2-7)
Res. Power ~ 150 000

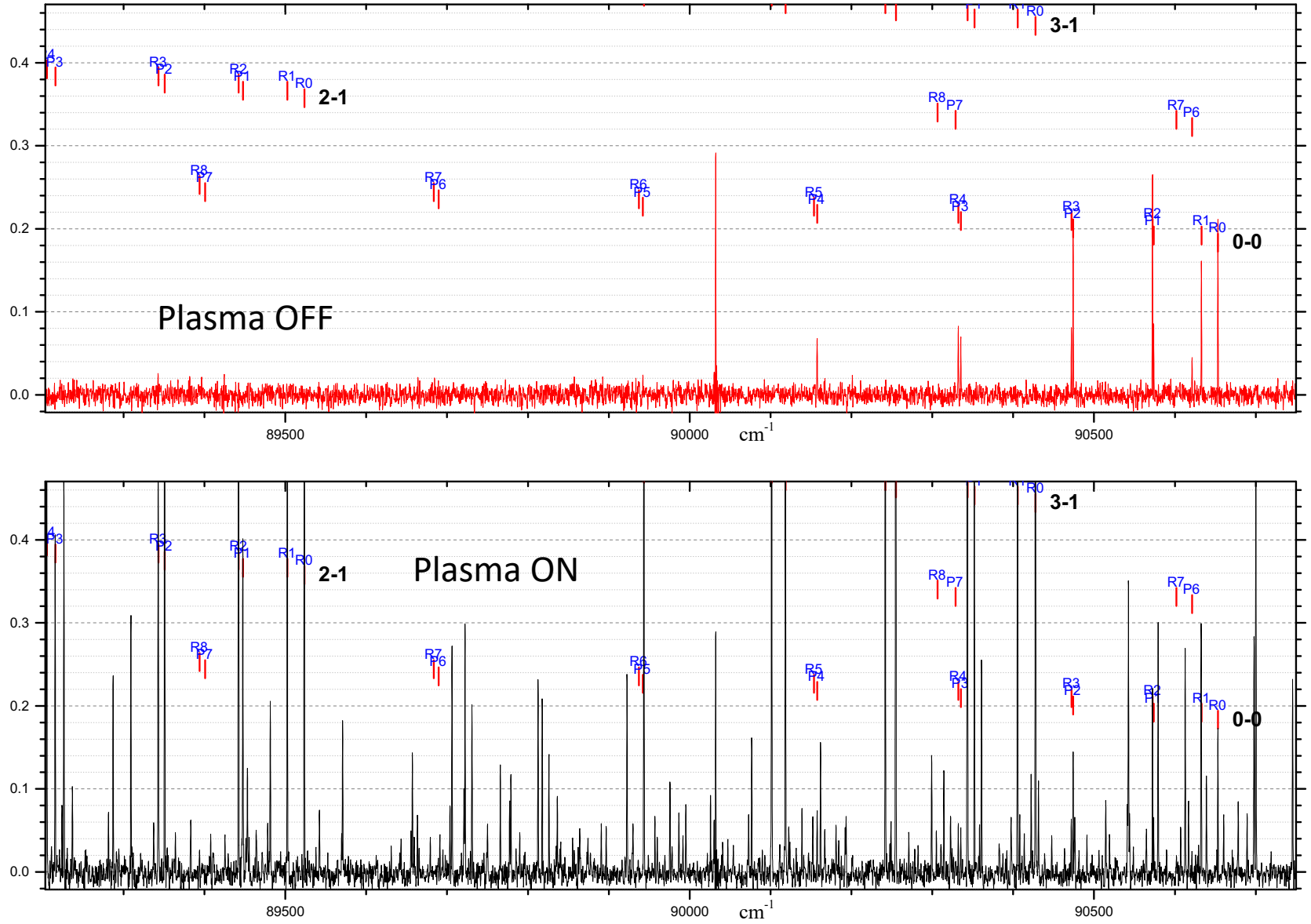




High resolution of the FTS allows an accurate measurement of each peak (FWHM of 0.95 pm)



Effect of plasma excitation on BX(0-0)

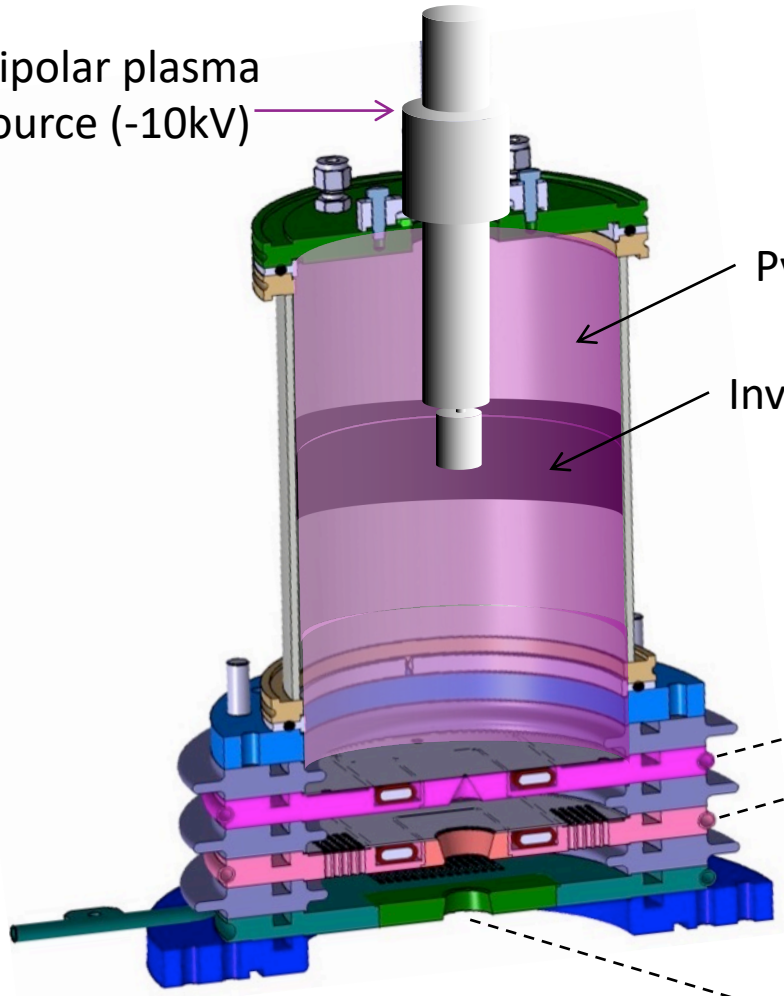


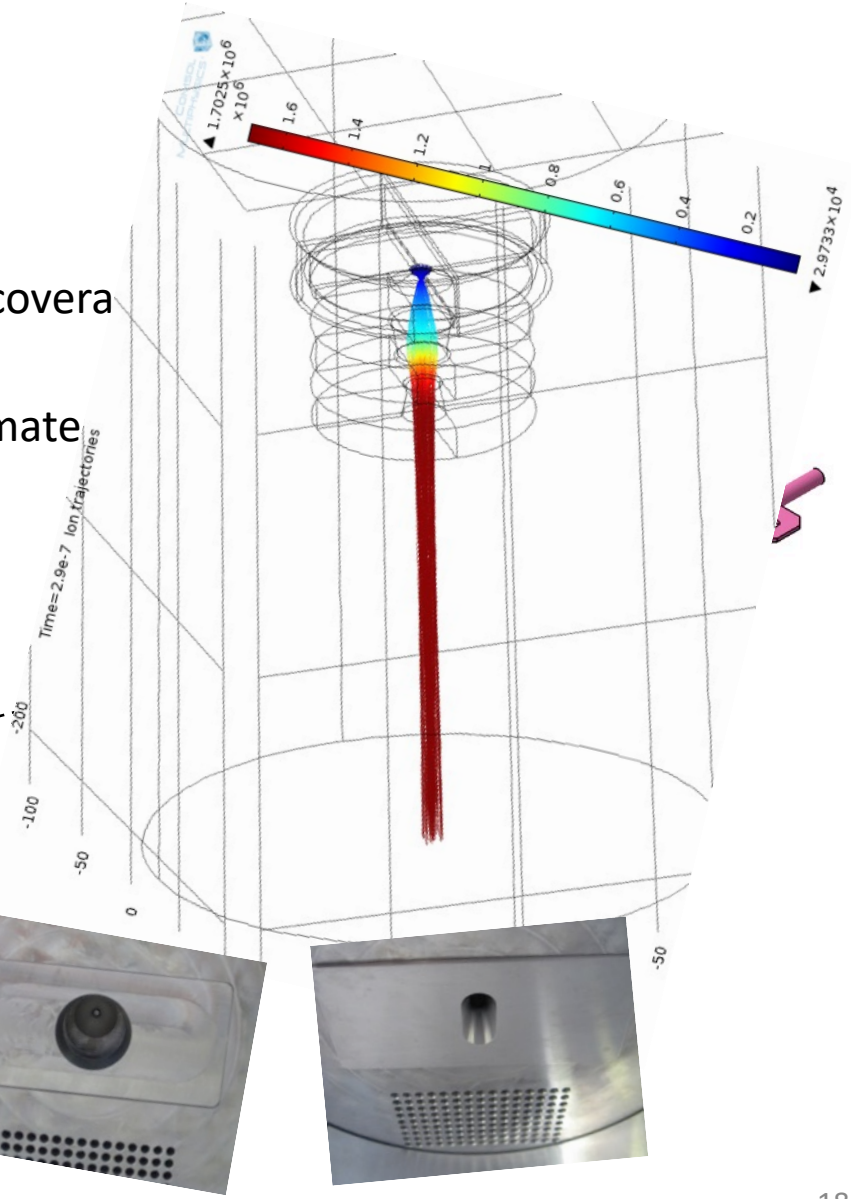
Design of the extracting device parts

Dipolar plasma source (-10kV)

Pyrex-glass covera

Investigated mate

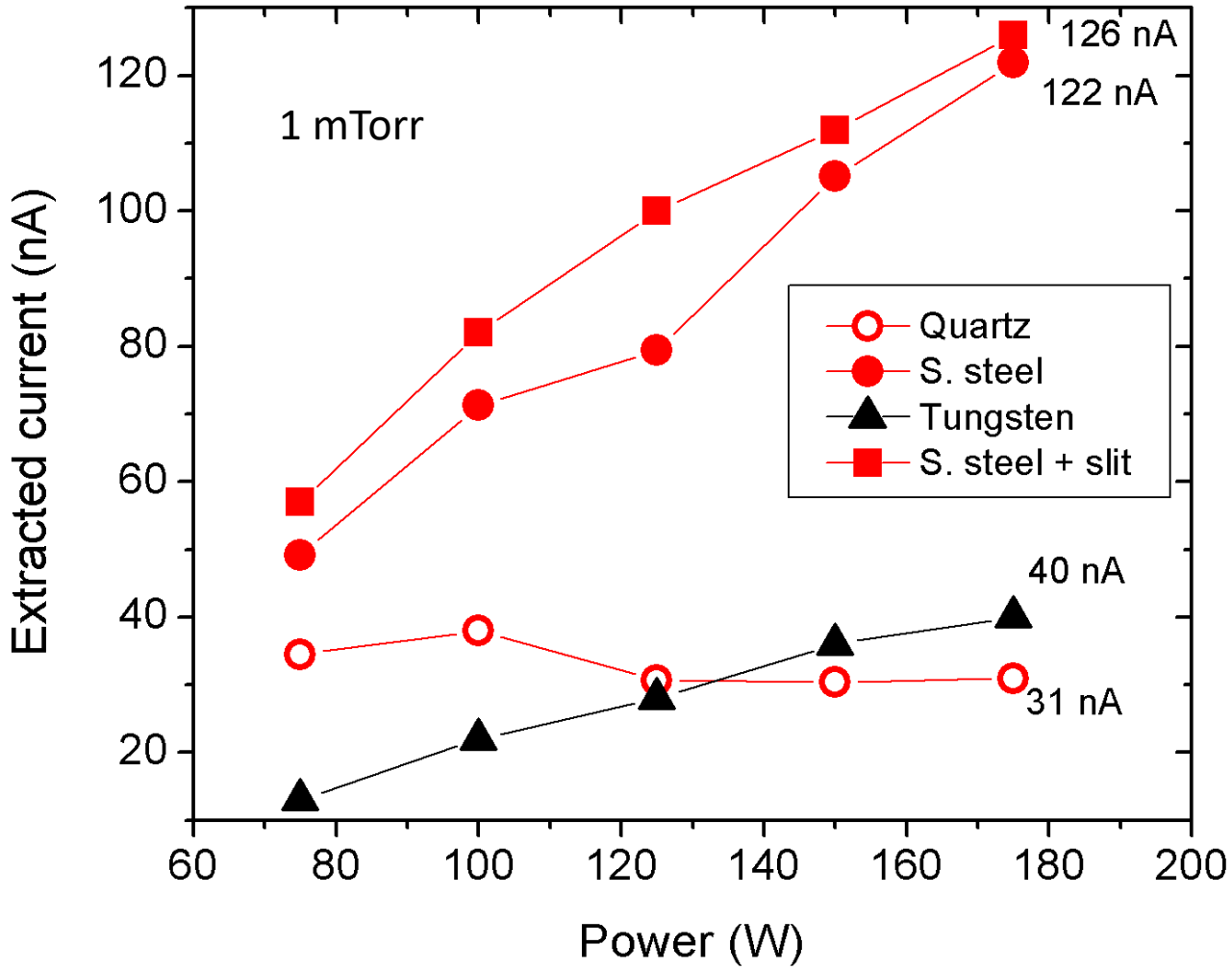




PE ≈ 3 mA
Extracting electrode ≈ 3 µA
Negative ions ≈ 30 nA

Extraction of H^-/D^- negative ions

- Modification of the extracted current with W is not obvious
- Aperture geometry modification (circular to slit) gives a weak increase of I_{neg}



Thanks for your attention !

It’s time for questions …