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Multi-diagnostics system in the Jumbo space simulation test facility in Giessen

Motivation

Thrusters have to prove their performance in tests

Diagnostic measurements enable the monitoring of thruster parameters

Thruster parameters can be used for optimisation and model validation

Example results using the case study of ECOMODIS

- Model validation and investigation of facility effects
- PIC code for plume characterisation

Jumbo test facility

2,6 m diameter

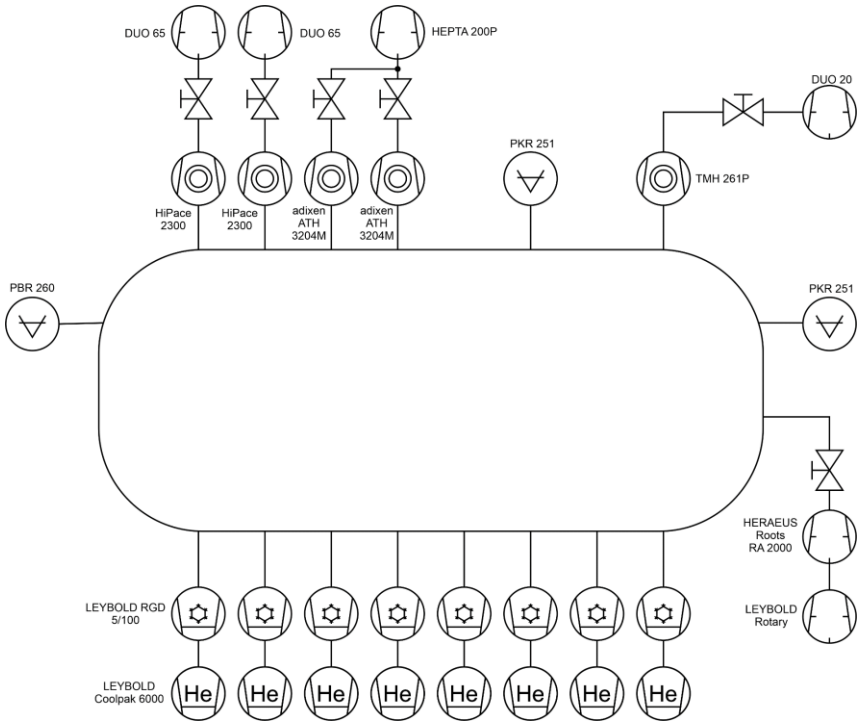
6 m length

30 m³ volume

Up to 150 000 l/s pumping speed

Base pressure < $2 \cdot 10^{-7}$ mbar

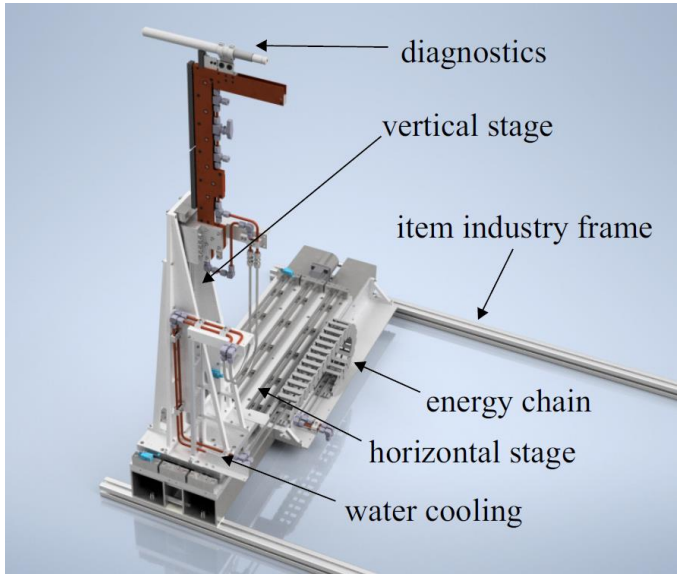
Beam Dump tested with more than 4 kW Beam power



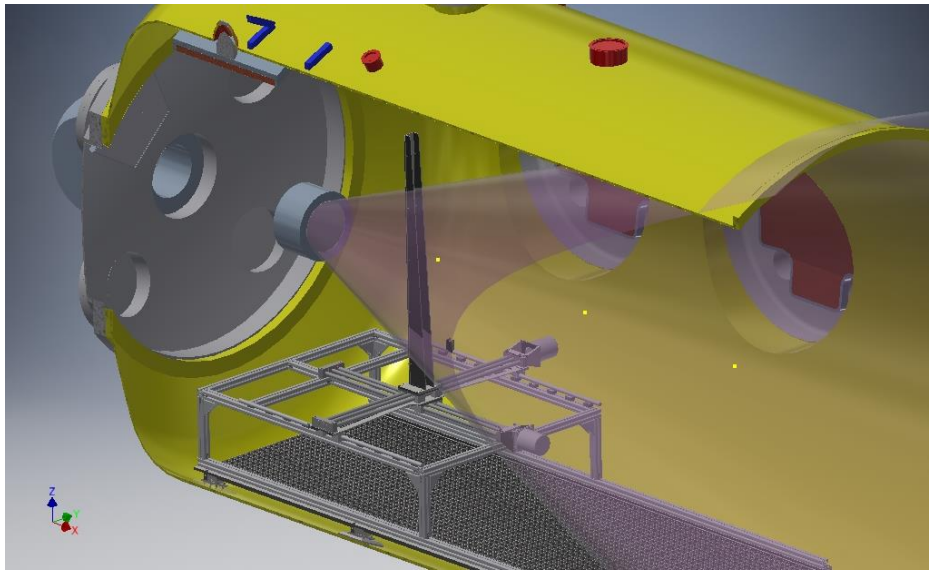
Vacuum system of the Jumbo test facility [1]

[1] K. Holste et al. *ECOMODIS Test Plan*, October 2023

Diagnostic mounts



y-z near-field translation stage [1]



Faraday array with x-y translation stage [1]

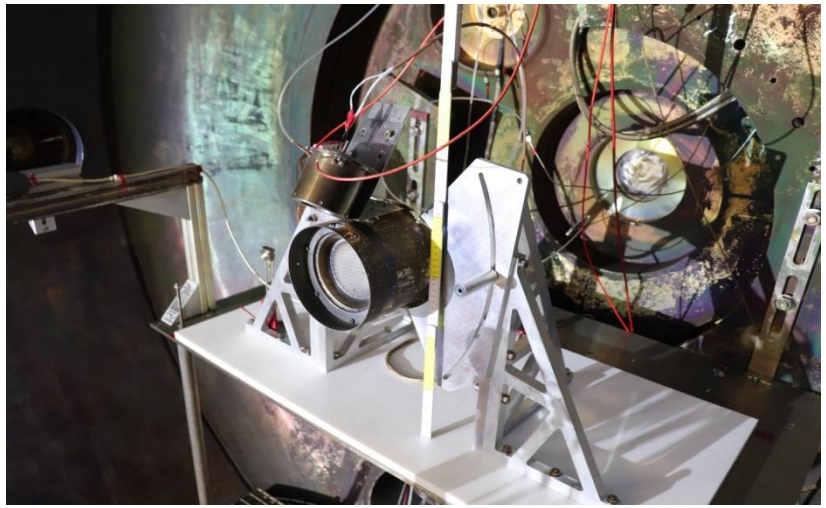
[1] K. Holste et al. *ECOMODIS Test Plan*, October 2023

Device under test

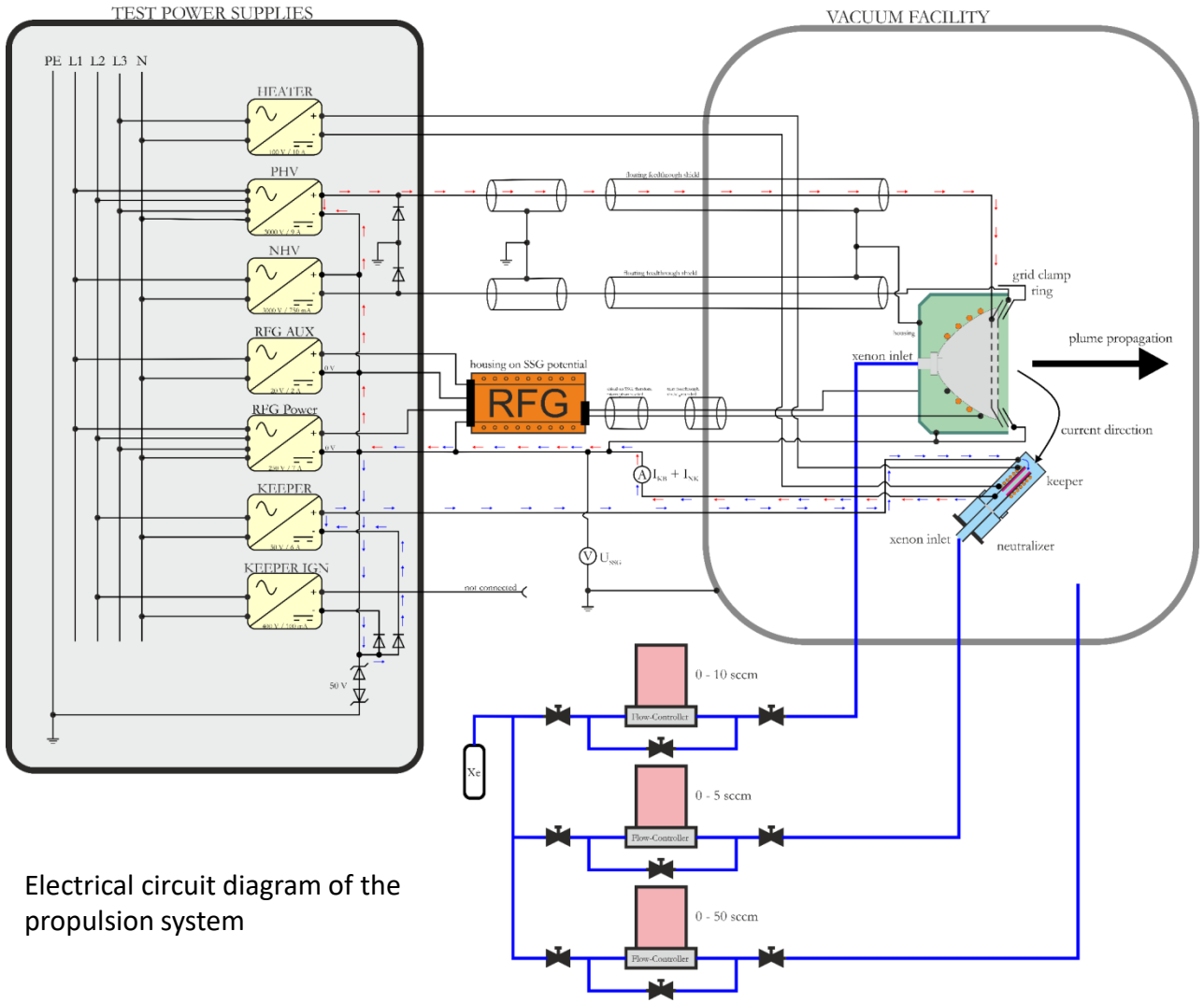
RIT 10 EVO with RF-neutralizer

Operated in secondary star ground (SSG)

Plume diagnostics

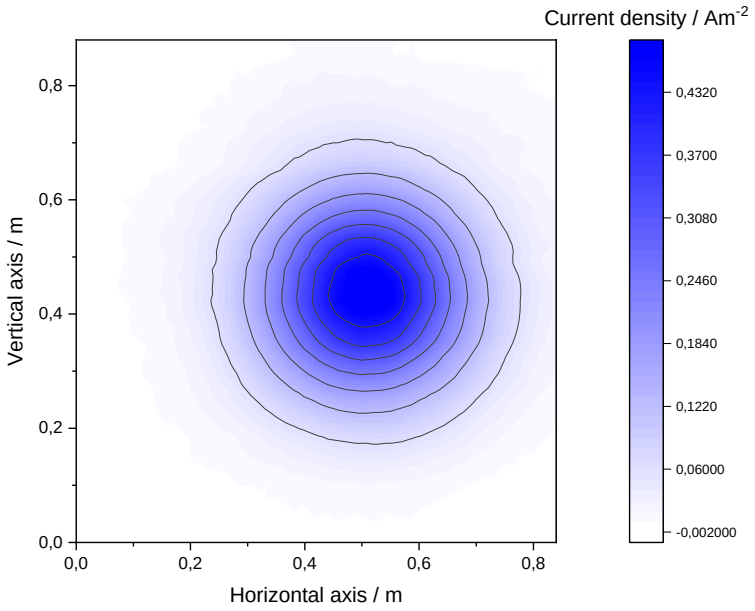


Propulsion system in the test facility

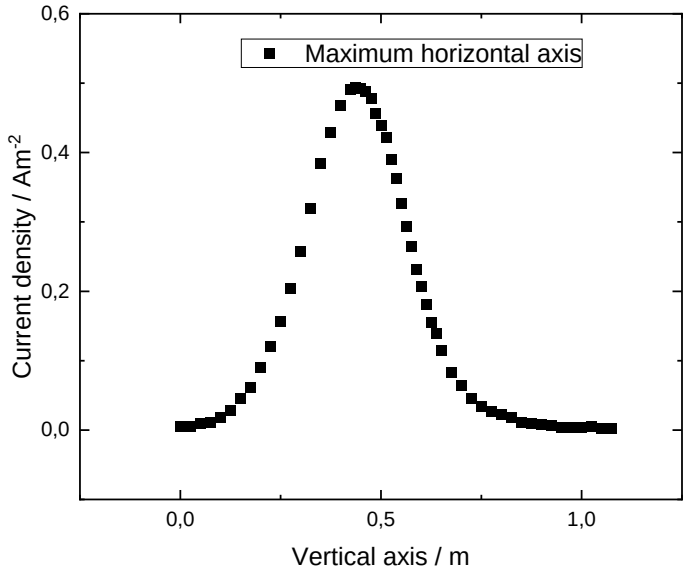


Electrical circuit diagram of the propulsion system

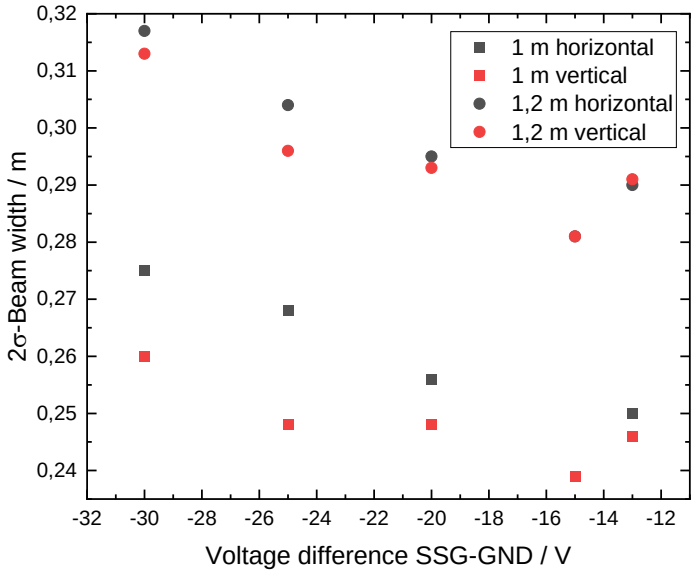
Faraday array



2D ion current density plot

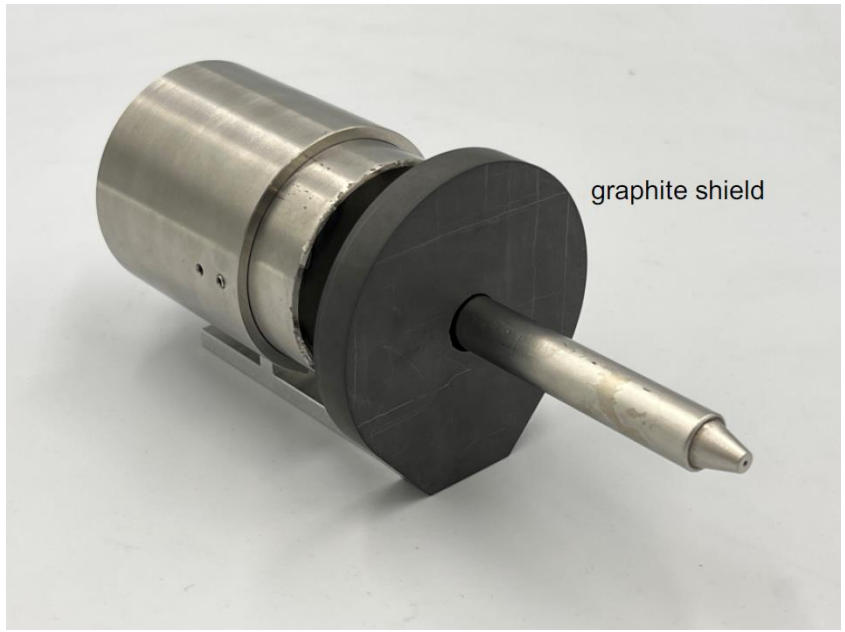


Ion current as a function of position

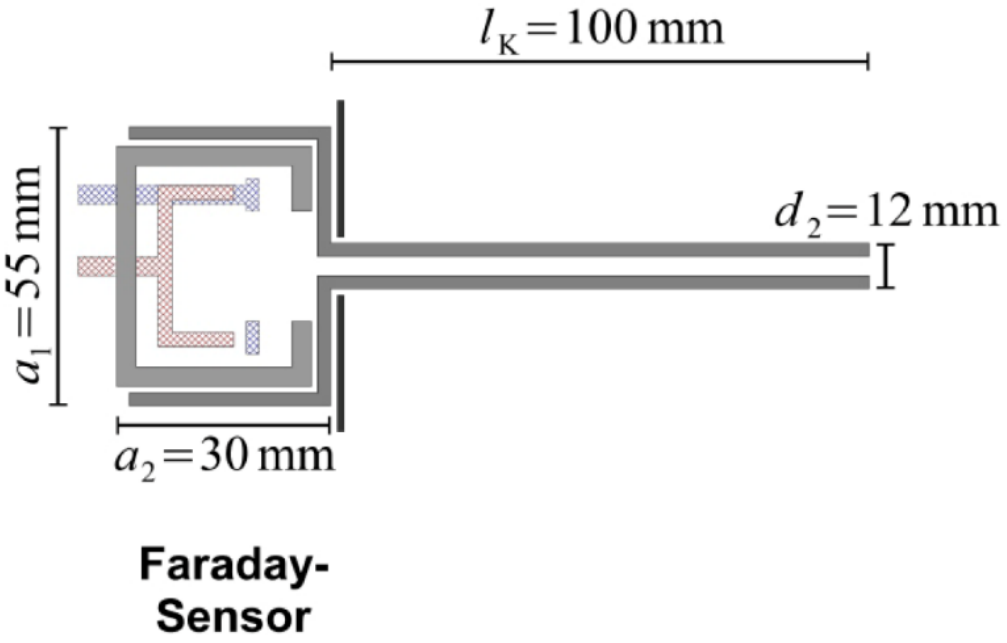


2σ-Beam width as a function of voltage between SSG and GND

Near-field Faraday cup

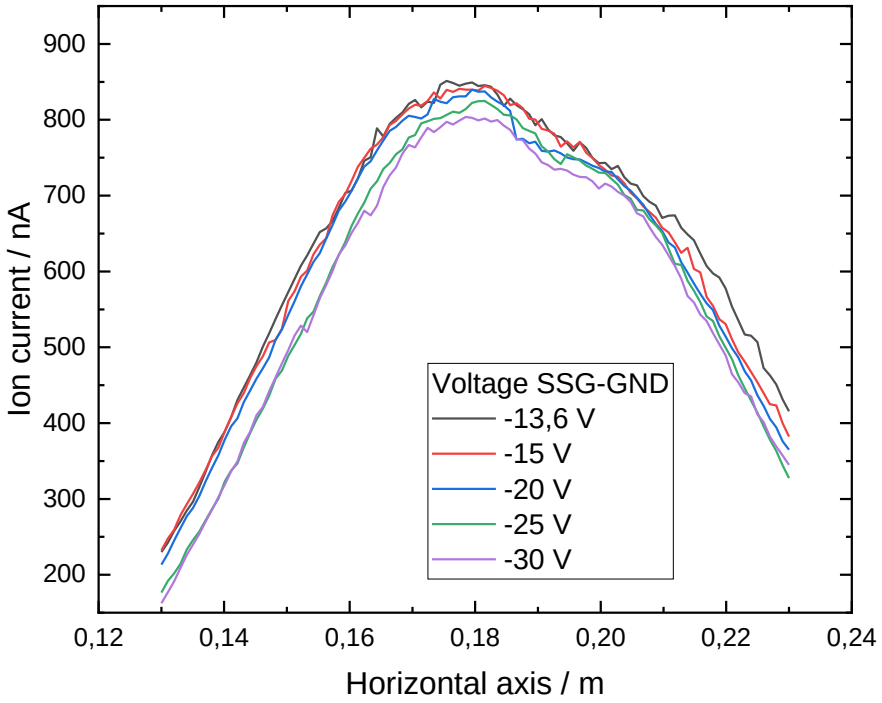


Faraday cup with high collimation

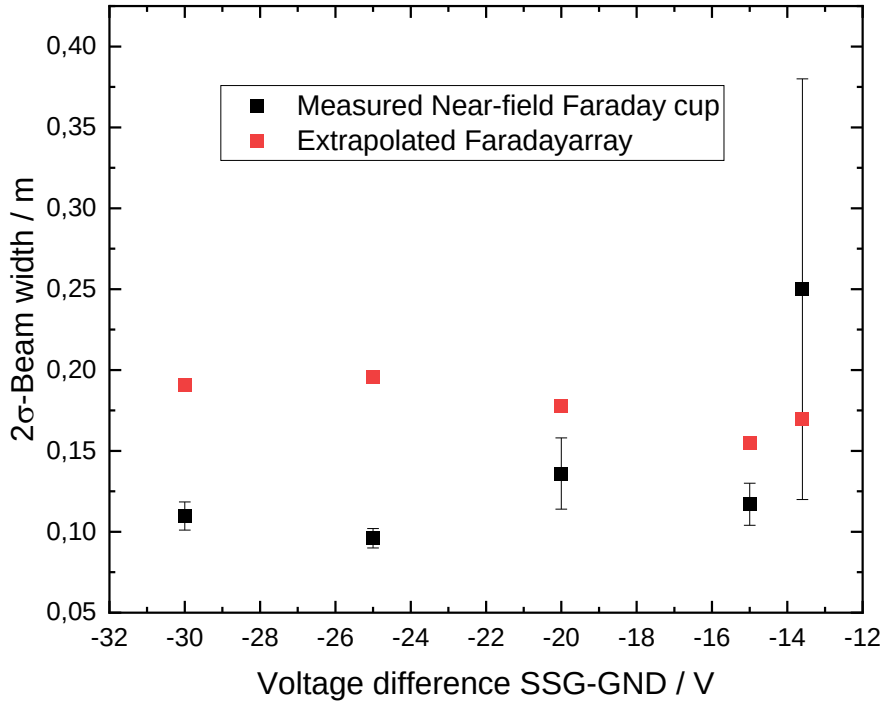


Faraday cup half section view

Near-field Faraday cup

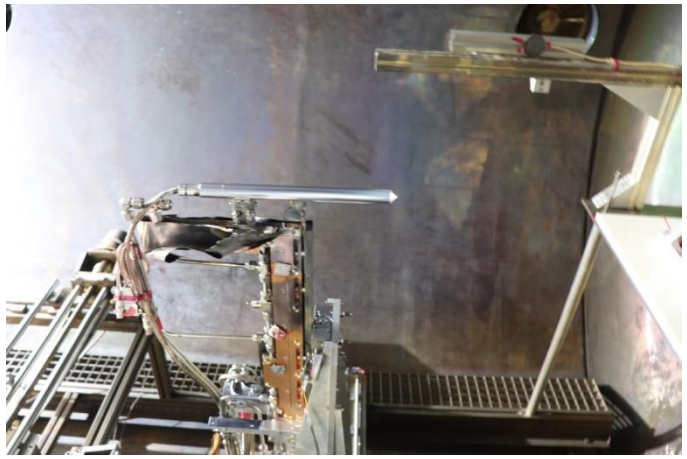


Ion current as a function of position

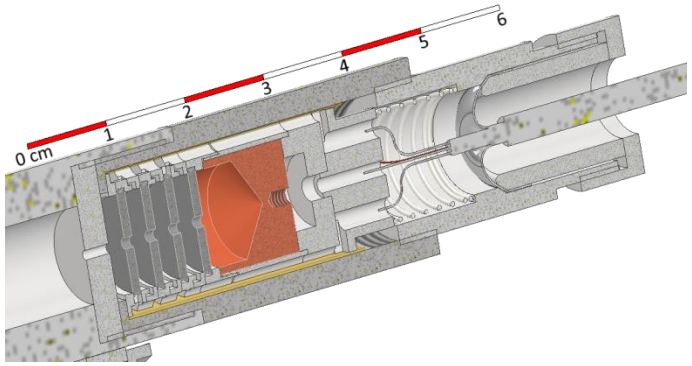


2σ-Beam width as a function of voltage between SSG and GND

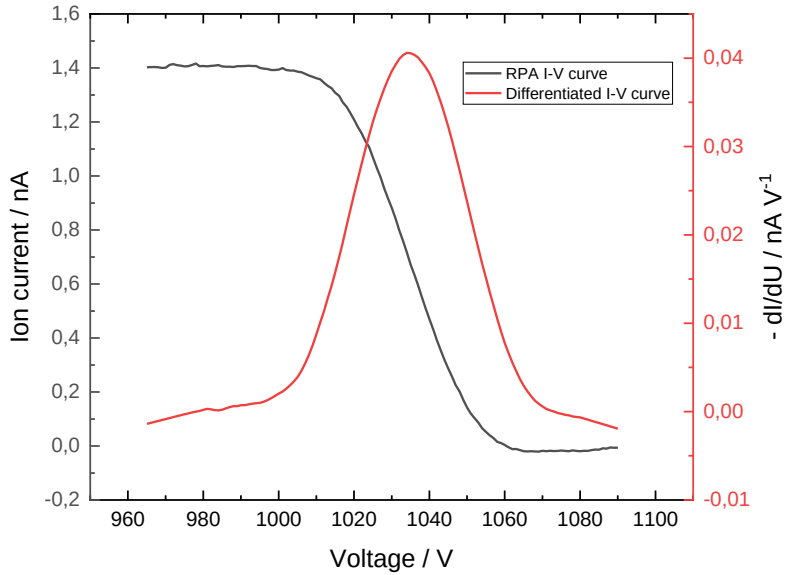
Retarding Potential analyzer for plume diagnostics



Retarding Potential analyzer on translation stage

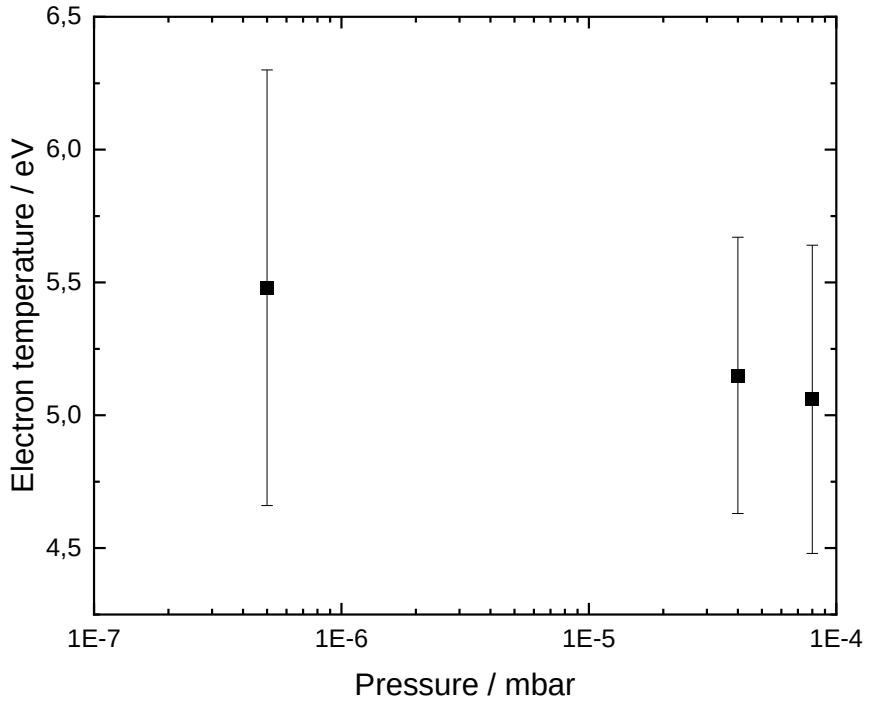


Retarding Potential analyzer half section view

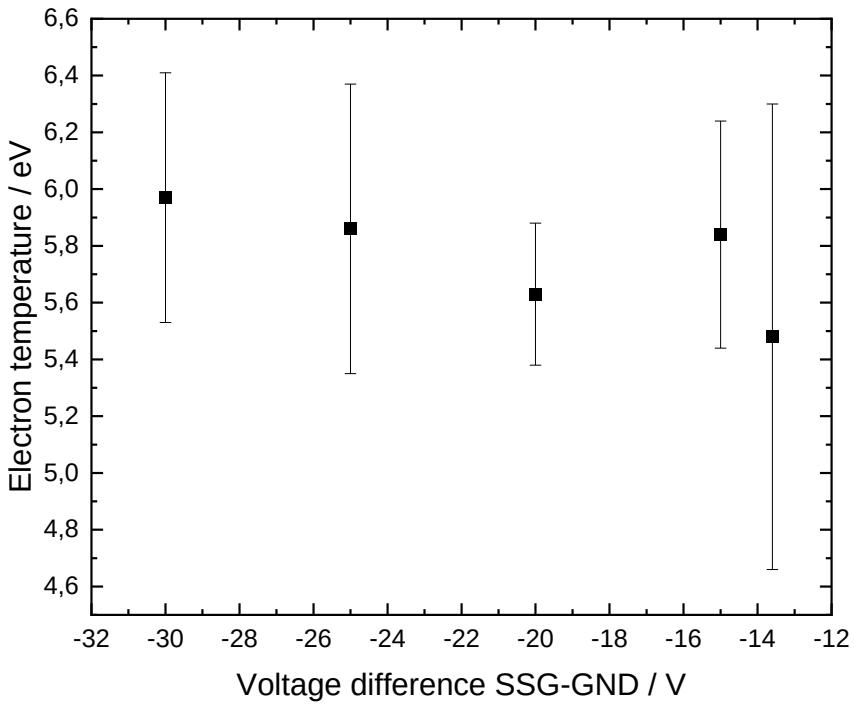


Ion beam current on the collector as a function of the repelling voltage and negative first derivative

Retarding Potential analyzer for plume diagnostics

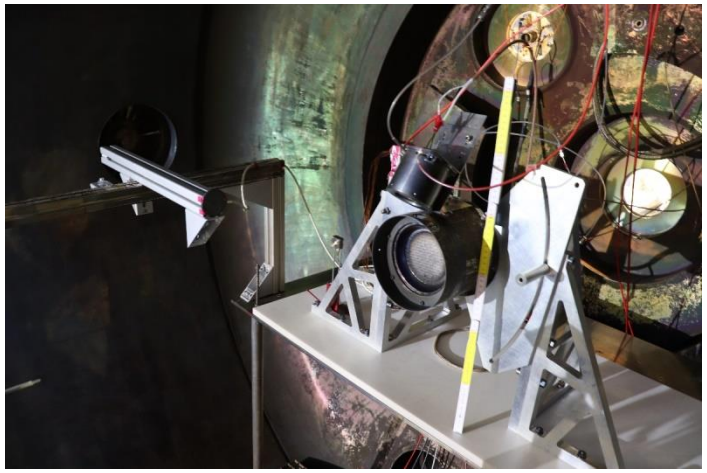


Electron temperature as a function of background pressure

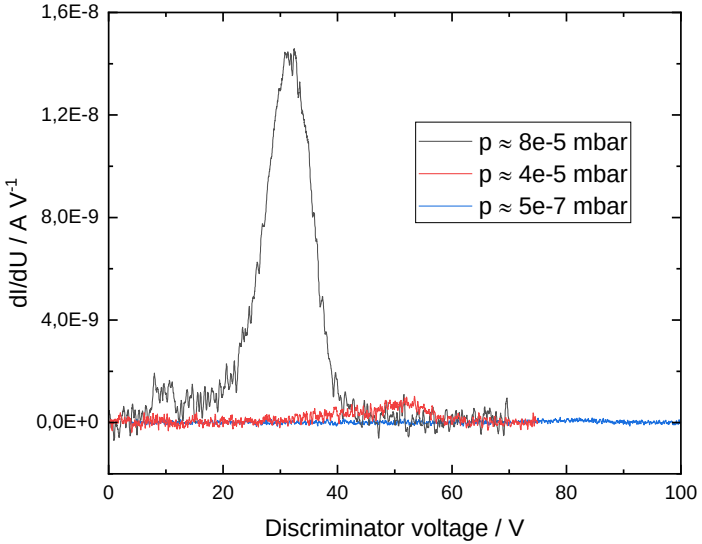


Electron temperature as a function of voltage between SSG and GND

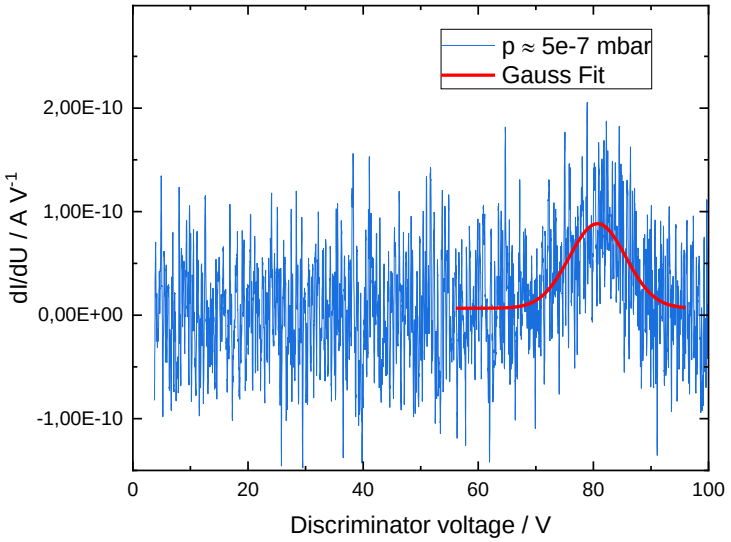
Retarding Potential analyzer for backflow diagnostics



Retarding Potential analyzer next to propulsion system

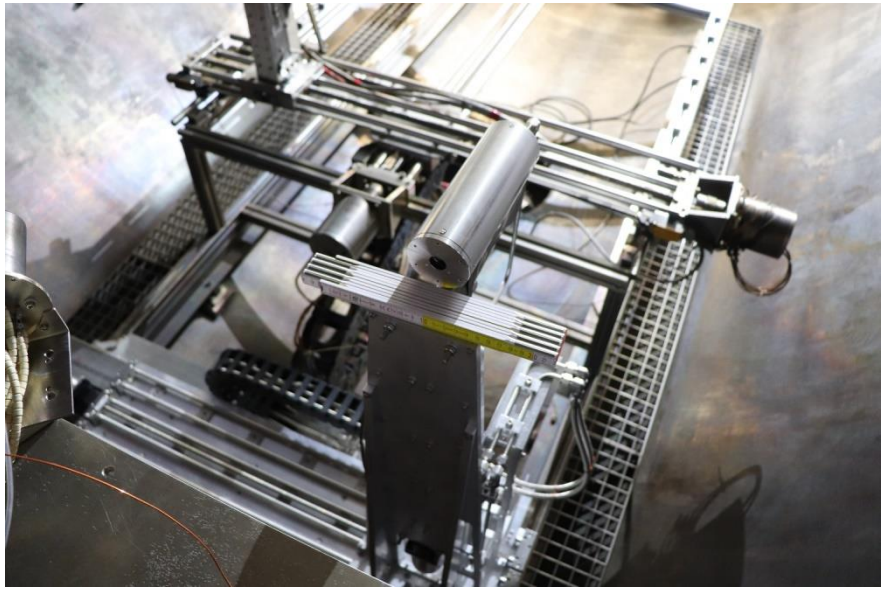


Charge exchange ion energy at different background pressure levels

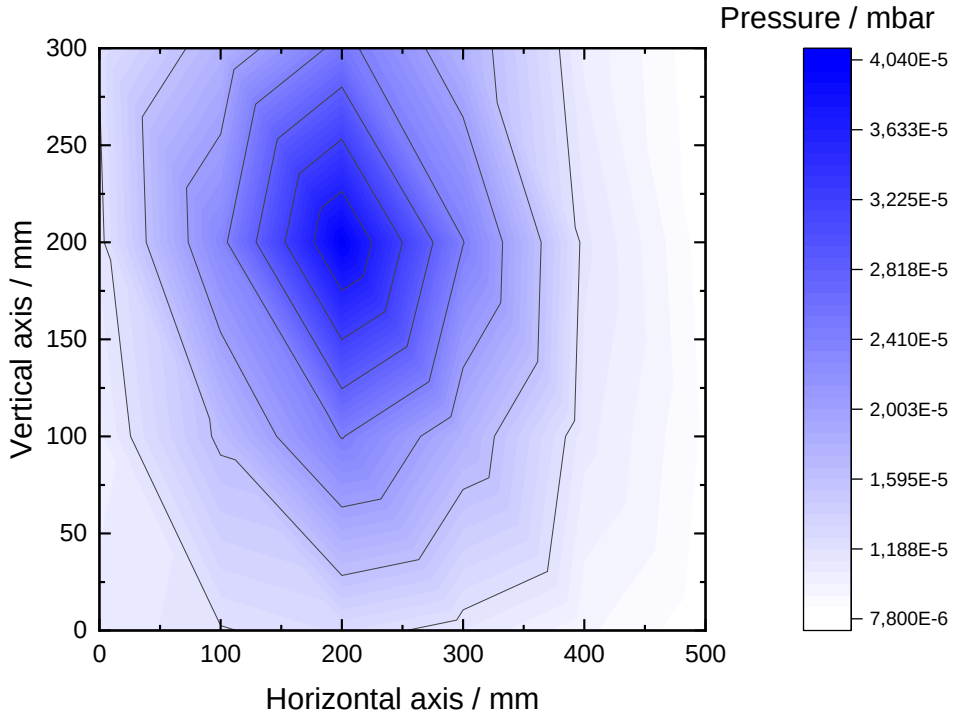


Charge exchange ion energy at low pressure

Neutral flux probe



Neutral flux probe on translation stage



2D neutral gas pressure plot

Summary and Outlook

Successful data acquisition with various diagnostics during thruster operation

Measurements with other diagnostics planned

Comparison with plume model to come

Diagnostic measurements of interest in context of Ref4EP

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Thank You