



# Days and Inauguration of the MOSAIC platform

Conception and realization of a plasma space thruster demonstrator

September 25, 2024 – Romain BELLET

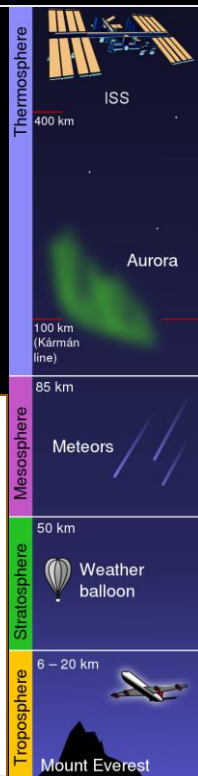
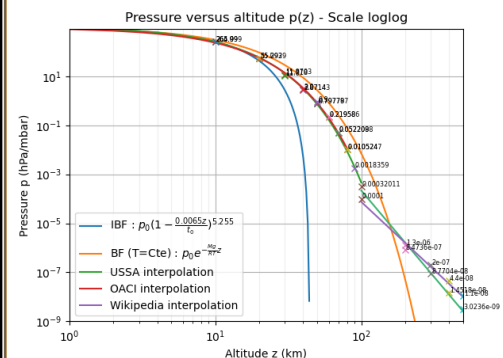
OSMOSX



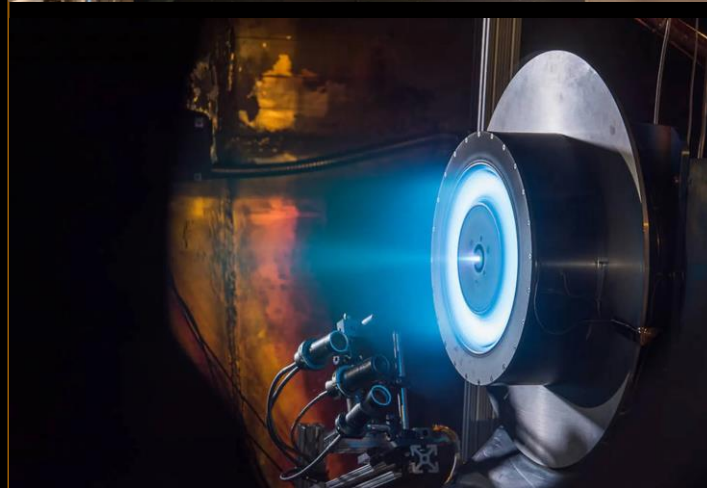
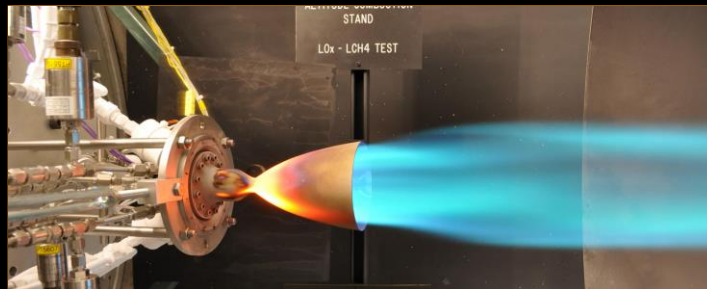
# Space Electric Propulsion

## Space

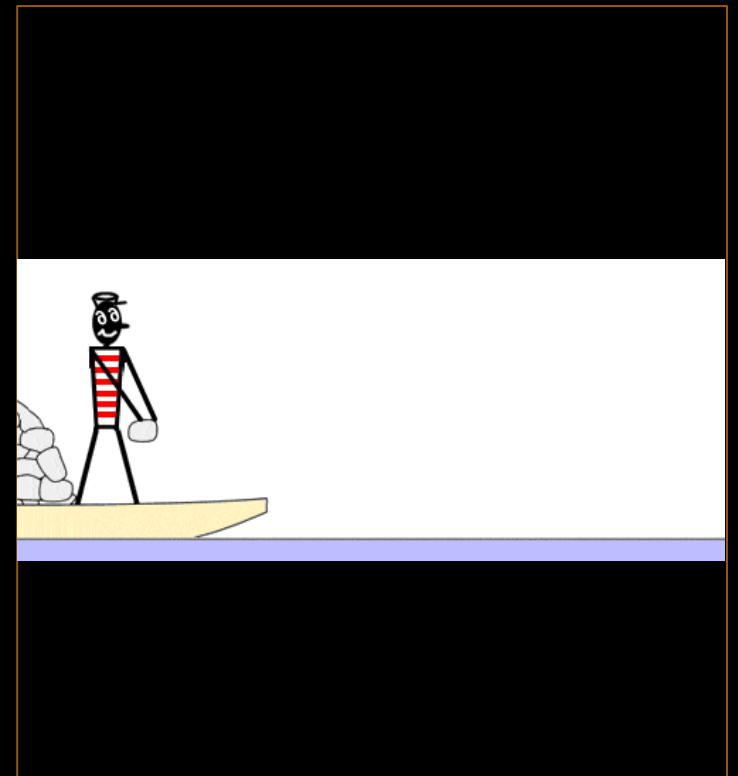
- $z_{EP} \geq 350 \text{ km}$
- $(\theta \approx 850^\circ\text{C})$
- $p \leq 10^{-7} \text{ mbar}$



## Electric



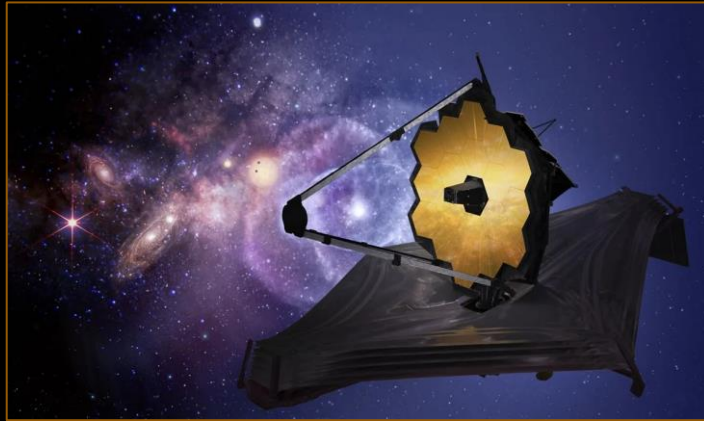
## Propulsion







# Outlook



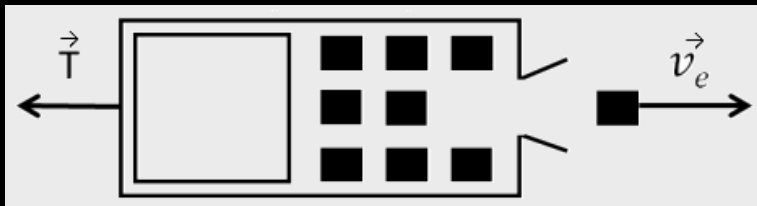


# Performance criteria

## Thrust

$$\vec{T} = \frac{dm}{dt} \vec{v}_e$$

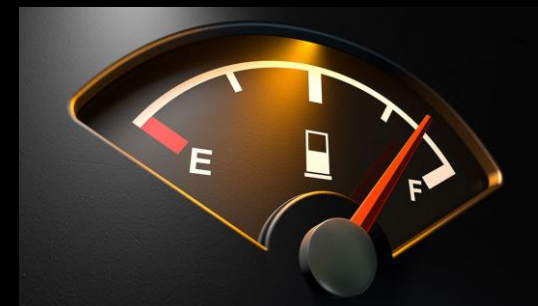
- Reaction force (Newton's 3<sup>rd</sup> law)



## Specific Impulse

$$I_{sp} = \frac{\text{Impulse}}{\text{Weight}} = \frac{v_e}{g_0}$$

- “How many **seconds** a given propellant, when paired with a given engine, can accelerate its own initial masse at g.”







## Project reminder

Thesis : Conception and realization of a plasma space thruster demonstrator

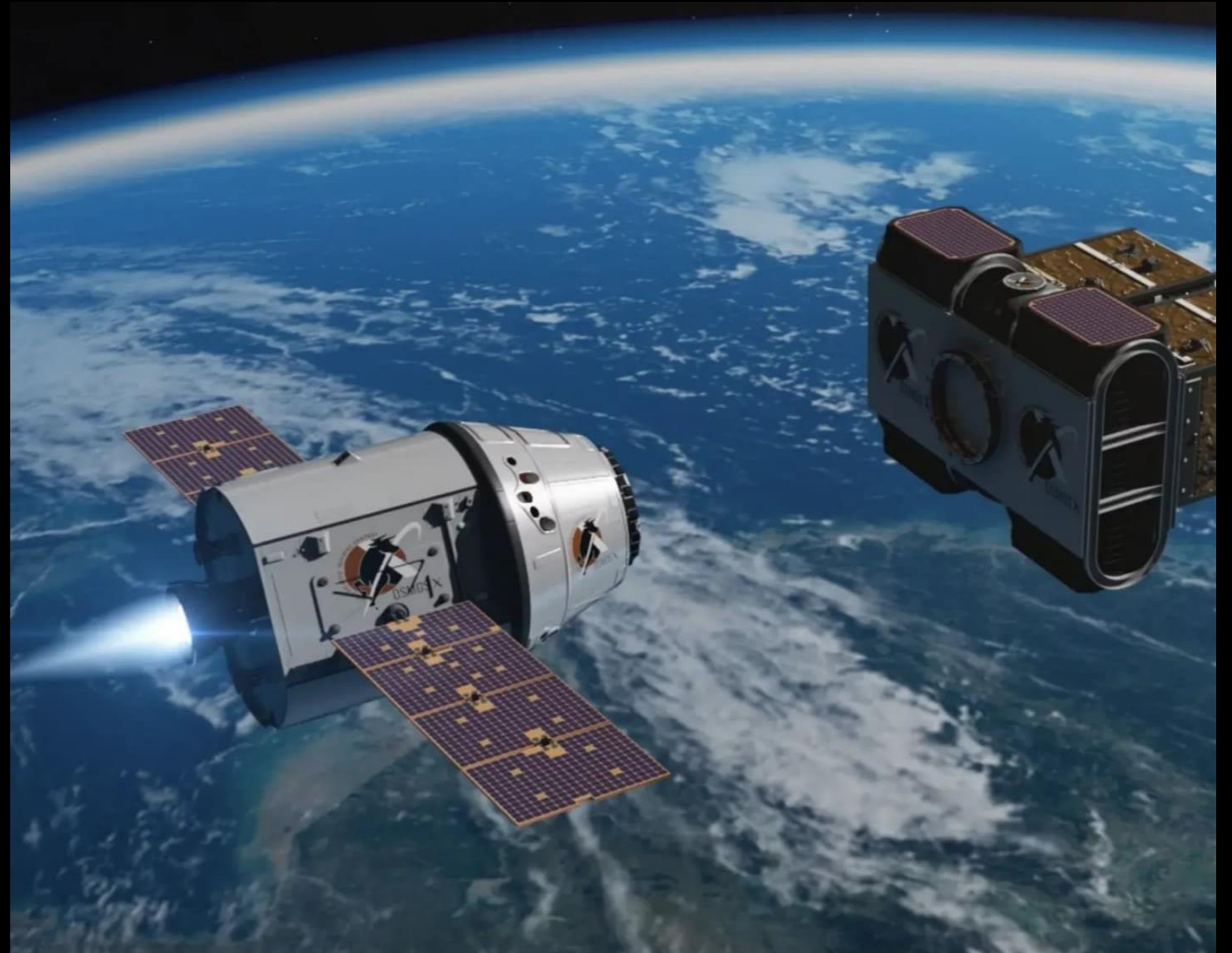
**Multicharged Ion Source Thruster (MIST)**

$$[T = 1 \text{ N}; I_{sp} = 100\,000 \text{ s}]$$

(17 000 s)

Based on ECR ion sources

- From particle accelerator physics
- High current intensities of multicharged ions

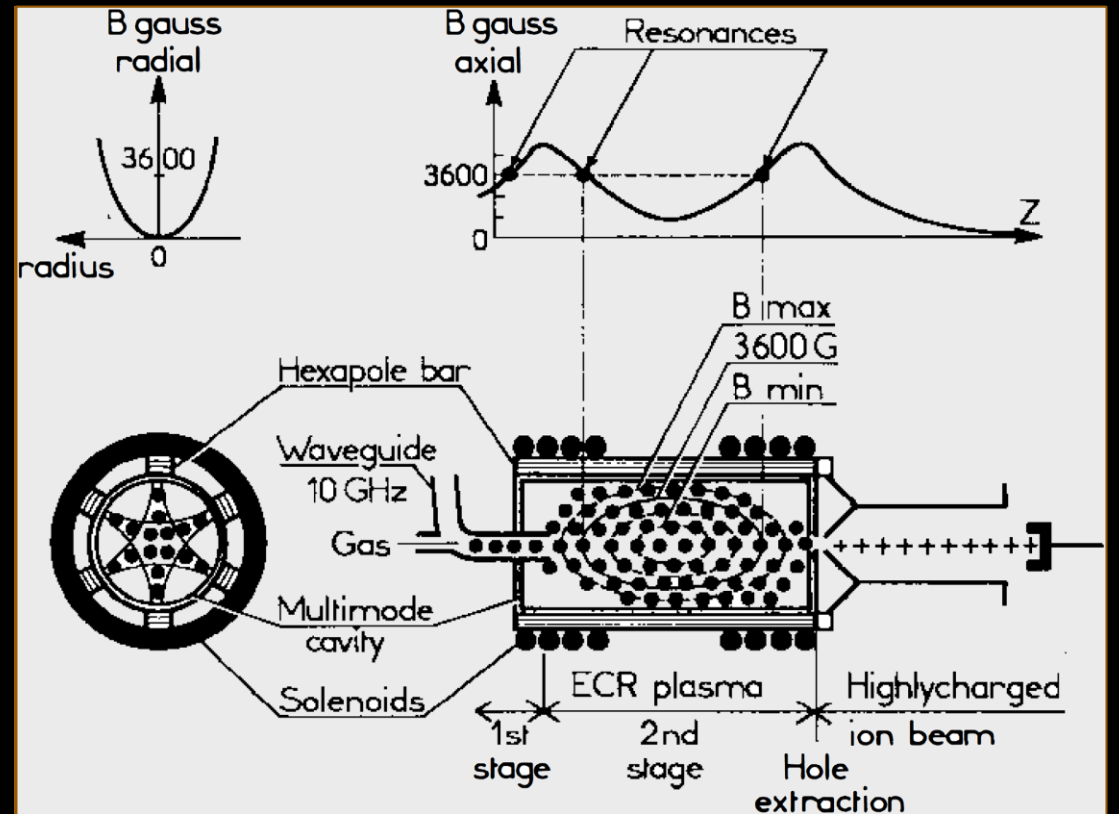
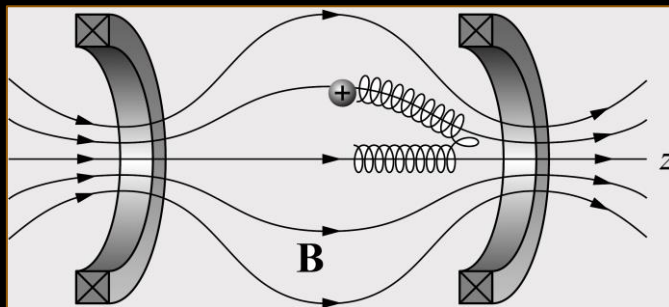


# ECR Ion Source (ECRIS)

## Electron Cyclotron Resonance

$$\omega_c = \frac{eB}{m}$$

$$\rho_L = \frac{mv_{\perp}}{eB}$$





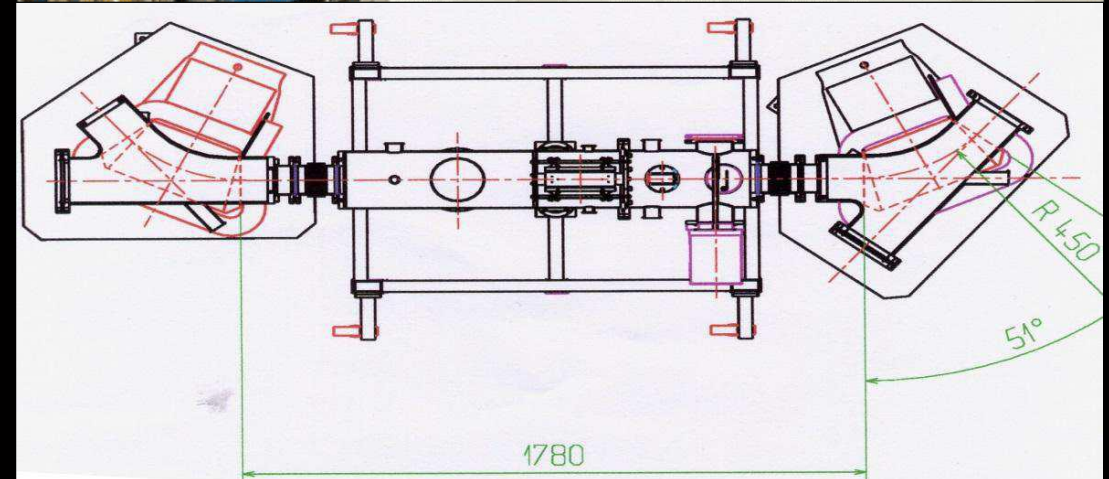
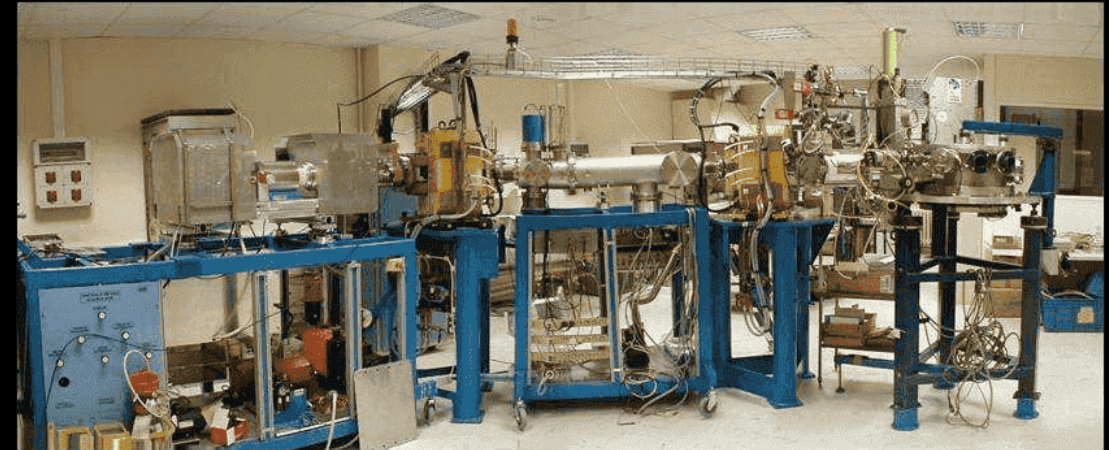
# Tancrede



- Multicharged ion probe **30 kV**
  - PhdC training
  - First studies

ECRIS → Einzel → Dipole  
↳ Faraday Cup ( $0^\circ$ )  
↳ Diag. ( $51^\circ$ )

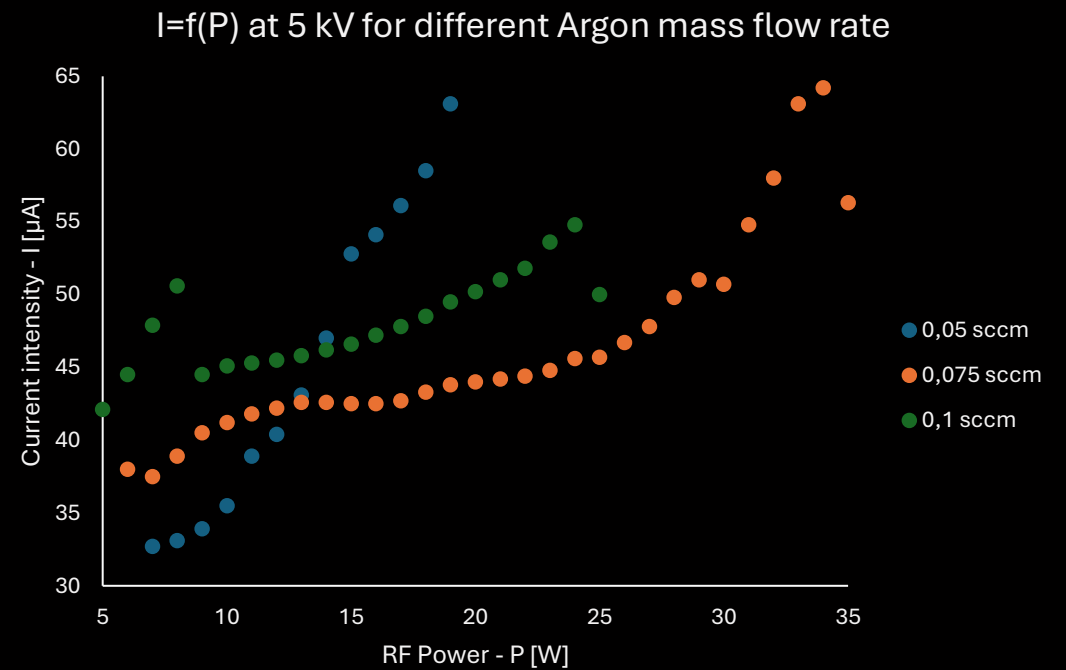
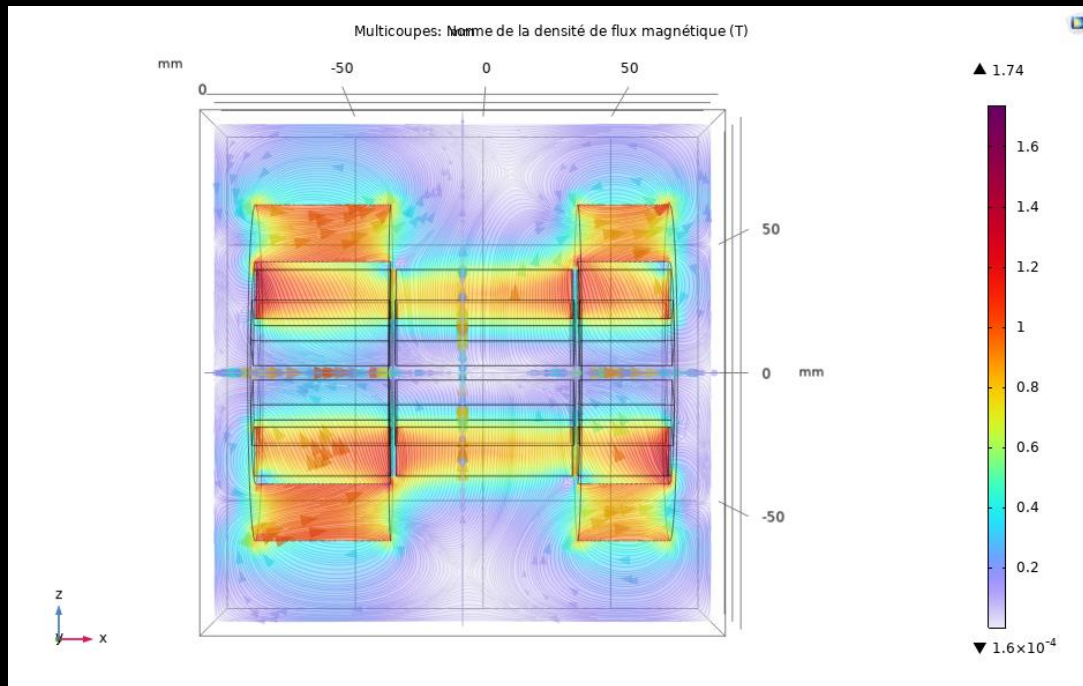
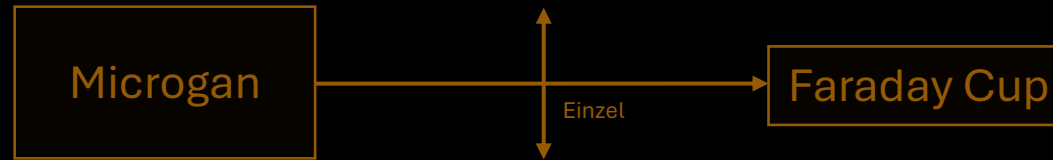
- Microgan ECRIS 10 GHz







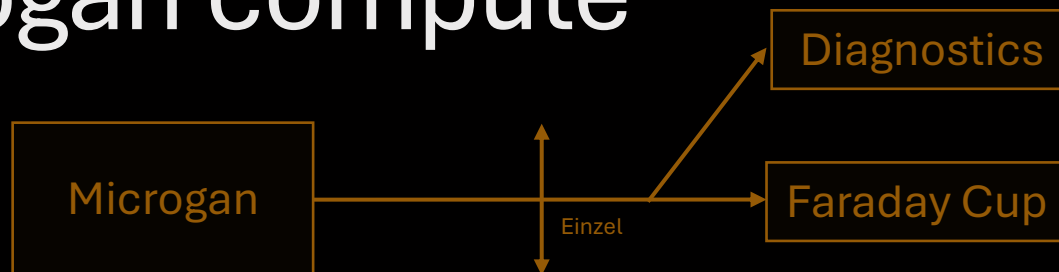
# Microgan characterization



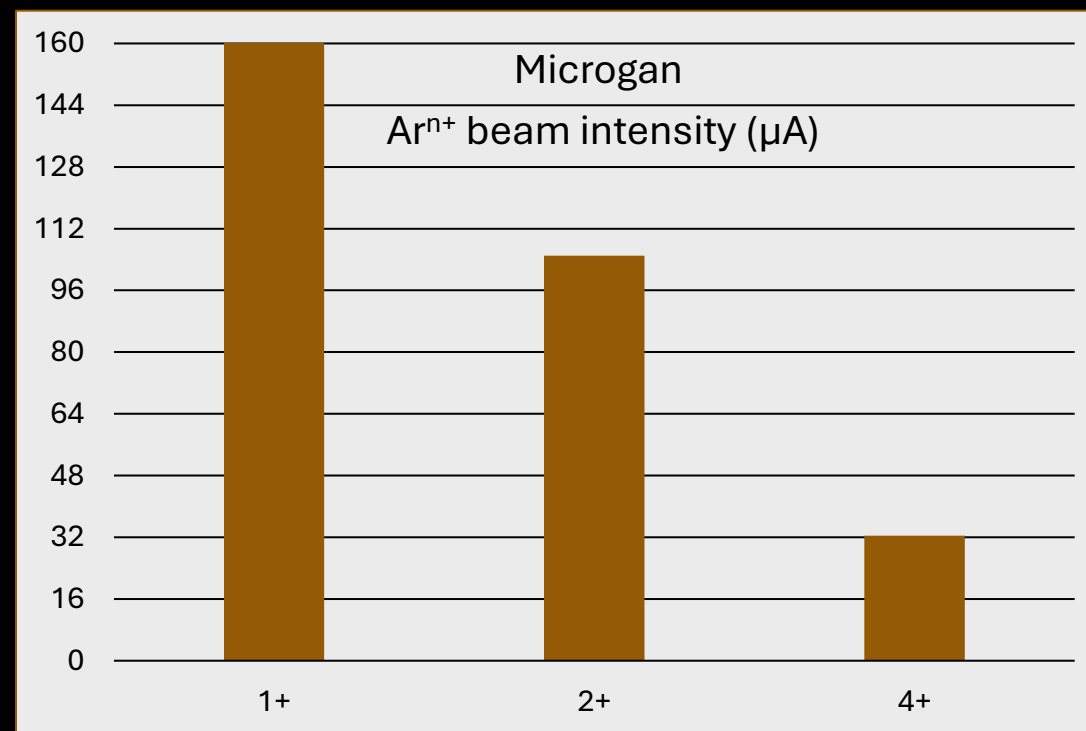




# Microgan compute

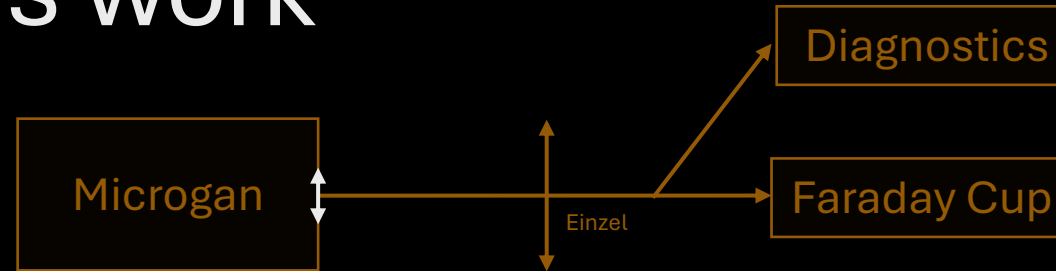


Microgan first starts	Full Power Microgan
0,075 sccm	→ 1,00 sccm
34,0 W	200 W
5,00 kV	30,0 kV
64,2 $\mu\text{A}$ ( $\text{Ar}^{1+}$ )	See fig. →
4,1 $\mu\text{N}$	35,2 $\mu\text{N}$
15,8 ks	38,7 ks
$\eta \sim 0,10$	$\eta \sim 0,10$

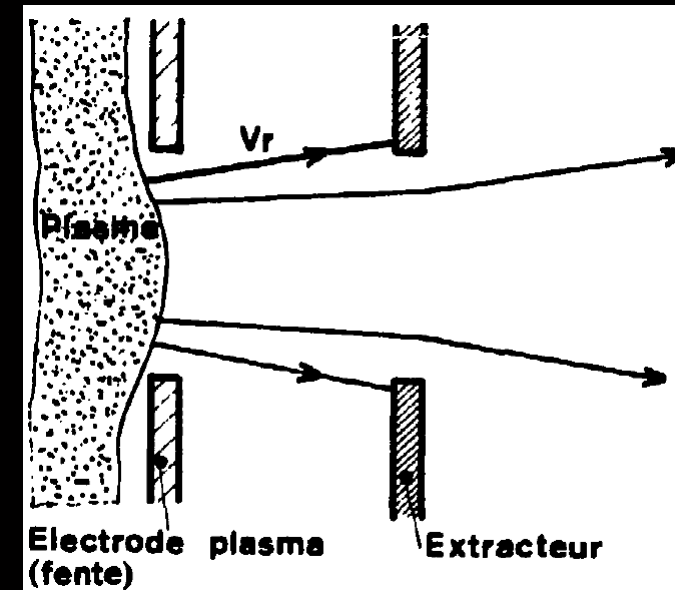




# Thesis work



- Increase extracted current
  - ↳  $I \propto \varnothing_{\text{extraction}}^2$
  - ↳ Plasma meniscus behavior
- Measure Thrust from ECRIS





# Conclusion

- Space Electric Propulsion
- Multicharged Ion Space Thruster based on ECR Ion Source
- Tancrede to compute Thrust by ECRIS