iFACT-
iodine Fed Advanced Cusp Field Thruster

EASN Conference 2021

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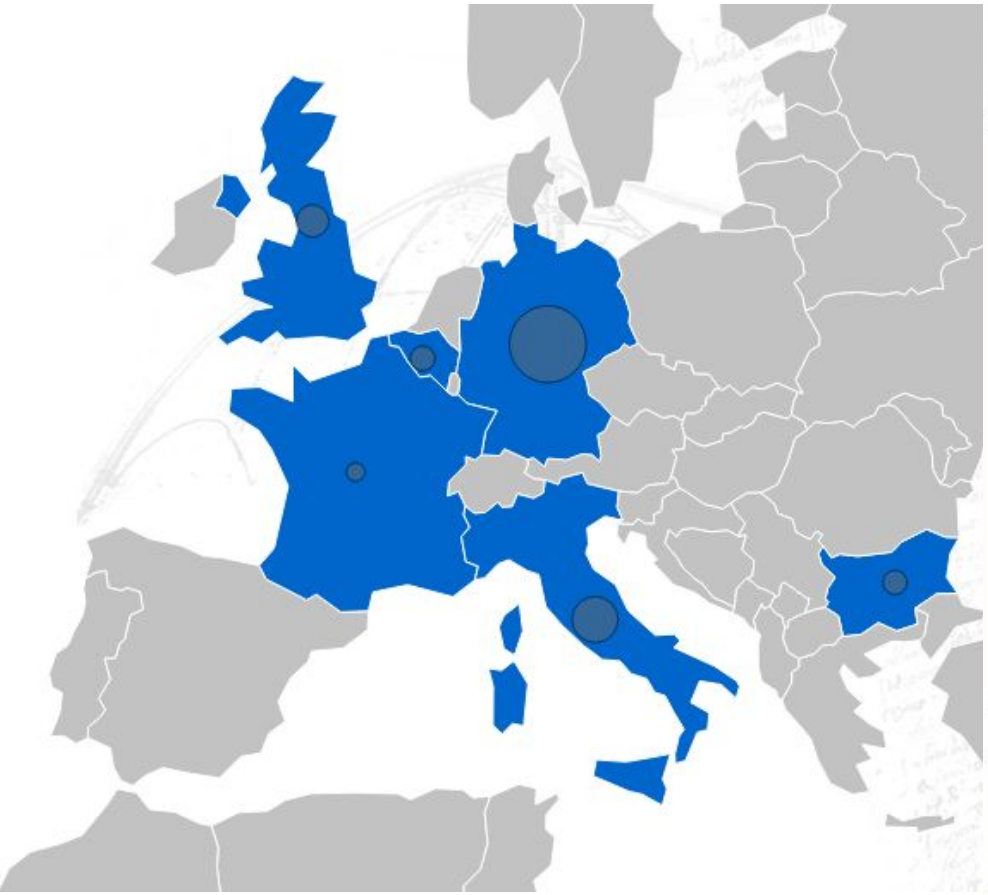
iFACT Consortium



WP1 - Management

WP3 - Specification Business Plan and Market Analysis

WP2 – Subsystem Development

WP8 – Low Thrust In-flight Test Preparation

WP 4 – Hollow Cathode Development

WP5 - C12A7 Emitter Development

WP6 - Facility Development and Thruster Testing

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Airbus FDH | Airbus TLS | JLU | Aerospazio | IKTS | EASN | UoS | ESat

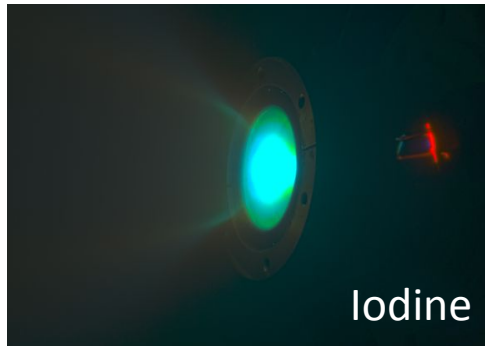
iFACT Main Objectives

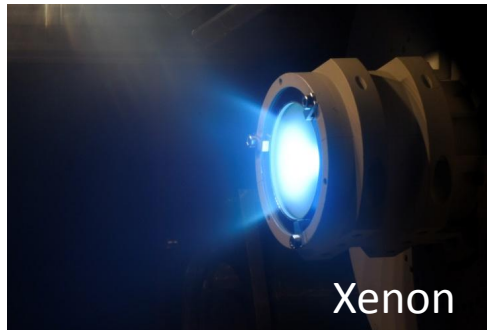
Our Mission:

- **Iodine** as disruptive propellant for electric thruster
- Maturation of the **Advanced Cusp Field Thruster** (ACFT) as disruptive thruster principle, in three different power classes
- Calcium aluminate (**C12A7**) as disruptive, low-work function emitter material for cathodes
- Significant reduction and **simplification** of the PPU required
- Establishing an **independent European** long time firing **test facility** which is compatible with iodine.

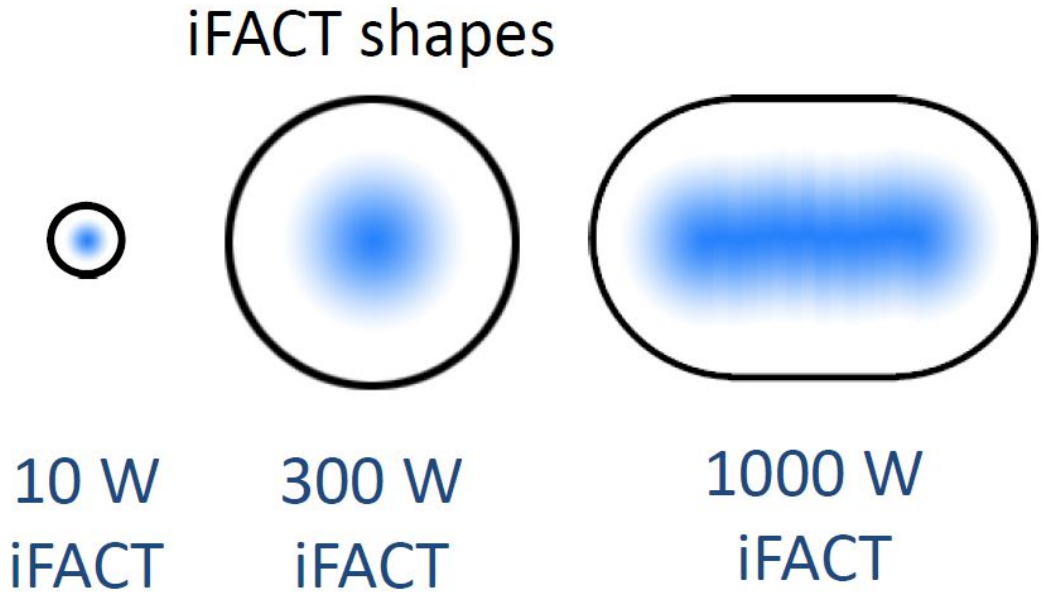
What is the iodine Fed Advanced Cusp Field Thruster

- Thruster principle has been developed by Airbus to create a most simple but Efficient thruster
- Thruster has been tested with iodine, krypton and Xenon
- A most simple PPU has been developed.



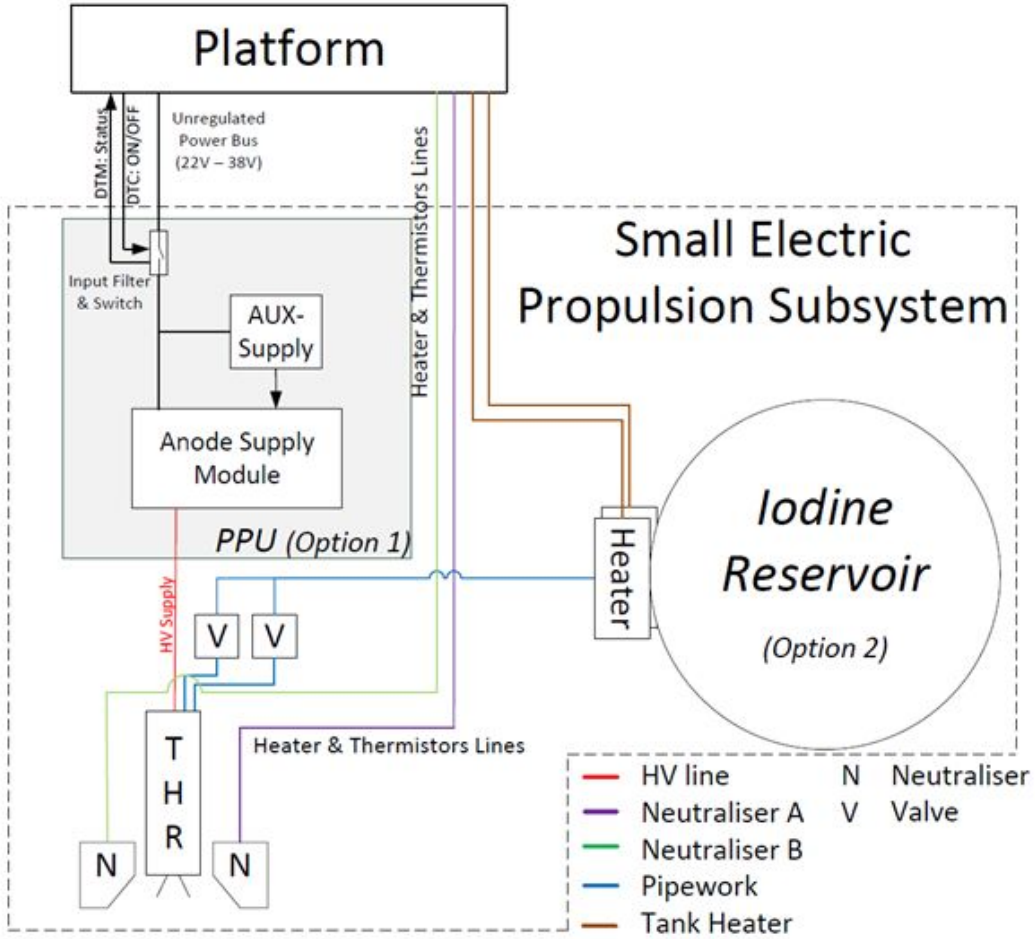


- Within the programme we will demonstrate that it can be used in three different power classes



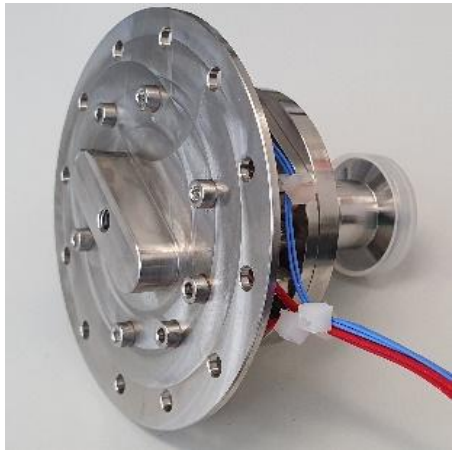
iFACT System architecture

- **Iodine as propellant** → Saves propellant costs and simplifies feeding architecture
- **Most simple but efficient EP thruster** → more efficient than other disruptive techs (high Isp and lower PTTR)
- **Extremely low subsystem costs** → cheaper than state of the art technologies
- **Use of rad hardened components for the PPU** → disruptive electronic design makes it cheaper but usable even at higher altitudes
- Being disruptive!
  - **Focus on 300 W** thruster subsystem
  - But:
    - Investigations towards low power (10 W) for CubeSat and flight demonstration
    - And 1000 W subsystem shall be also introduced



300 W Overview

- 300 W anode input power
- 12 mN nominal thrust
- 5 % to 135 % throttle range



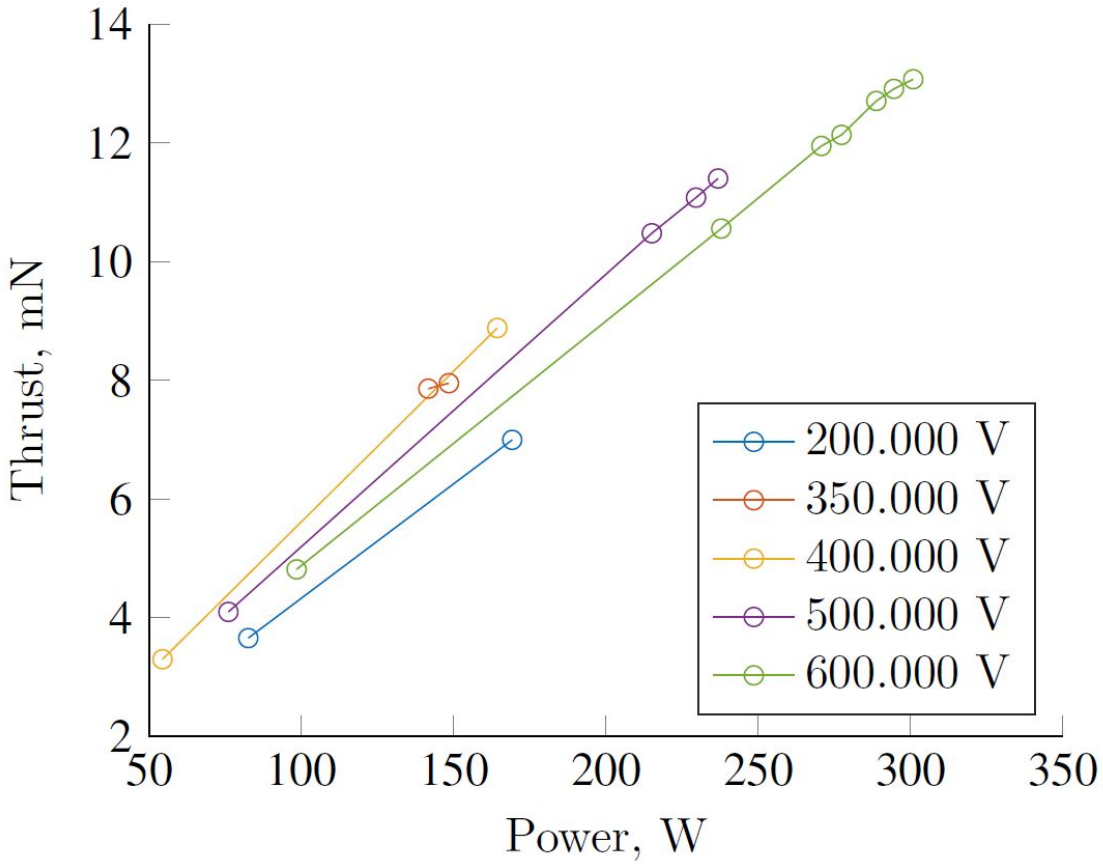
- Iodine compatible
- Clogging free design
- designed for 1 MNs total throughput
- Passive valves do not required electrical actuations

- Iodine compatible design, but krypton fed
- Operable with different low function emitters
- > 1 A discharge current possible

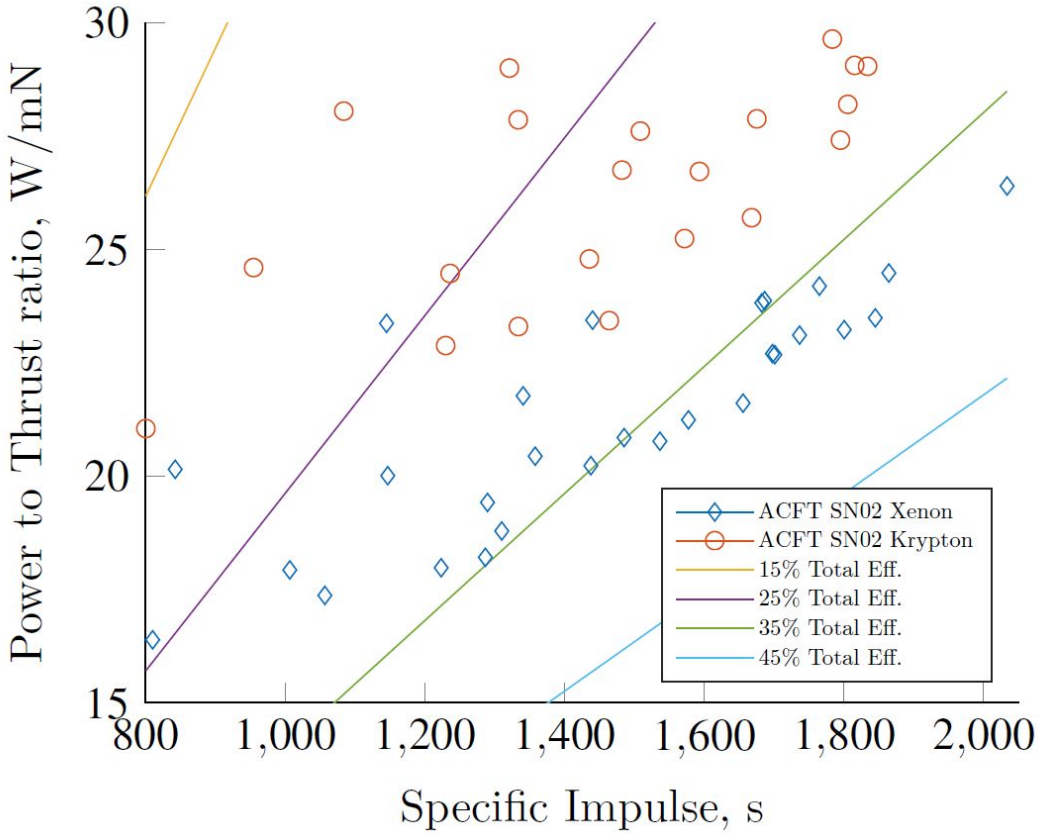
- Full planar design
- Minimum number of electrical components used
- Input Voltage 28 V to 35 V
- > 92 % efficiency
- > 300 W output power

Performance

Iodine



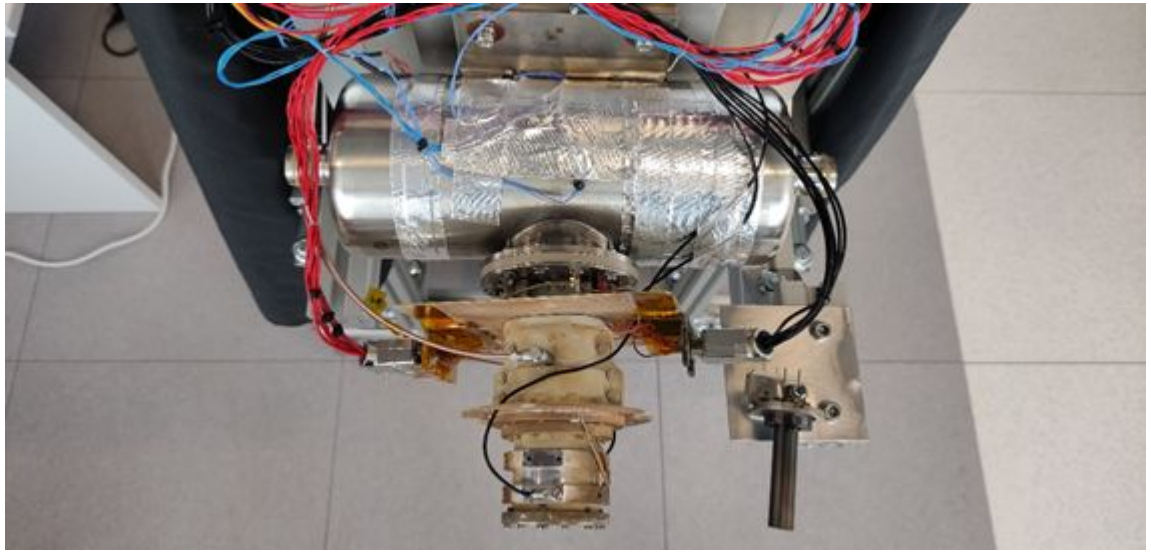
Xenon and Krypton

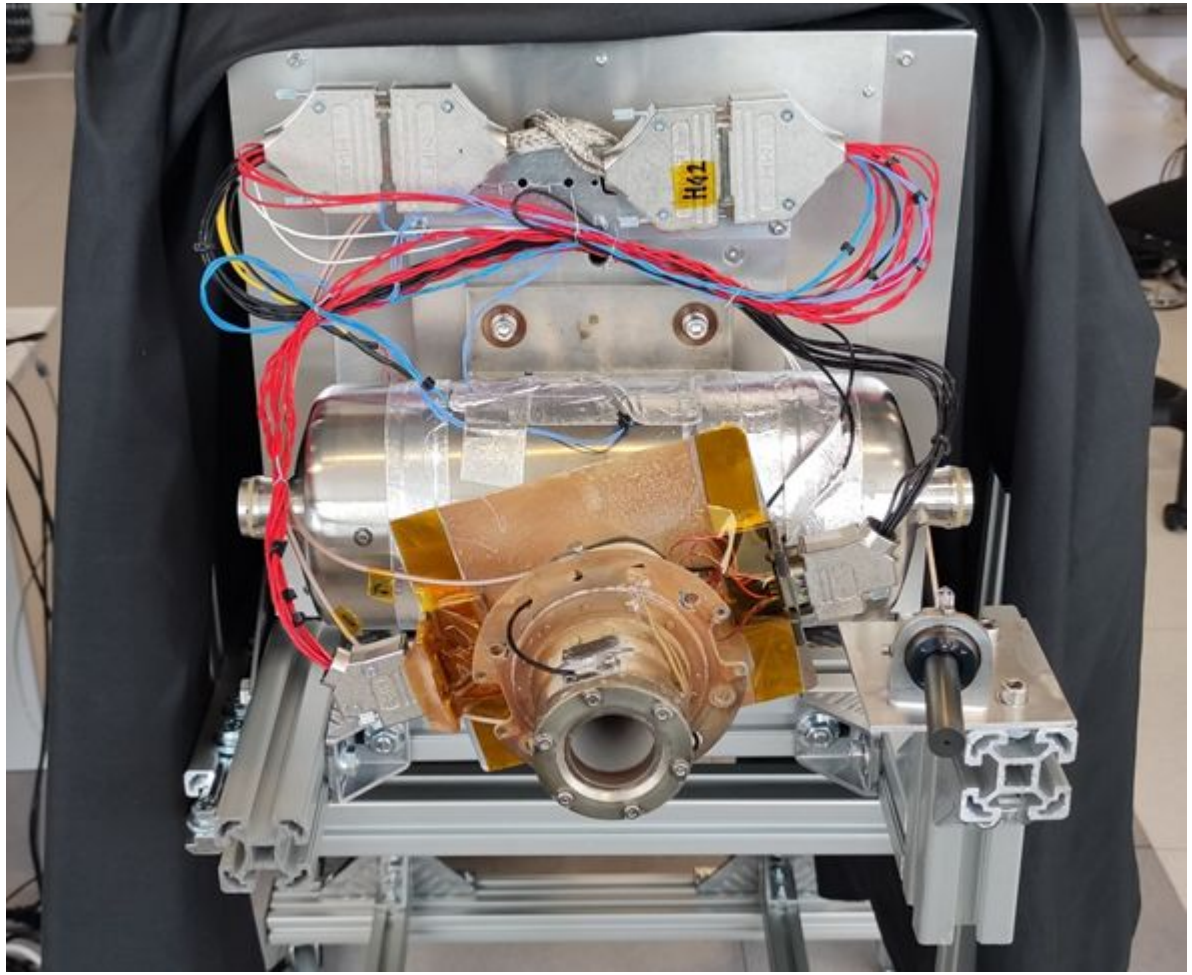


300 W Thruster Endurance Test

Integrated thruster and iodine feeding

- Shown mounted on the thrust balance
- Tank loaded with 7.32 kg of iodine
- Redundant heaters for valves and tank
- 3x PT100 for each tank and thruster (TMR)

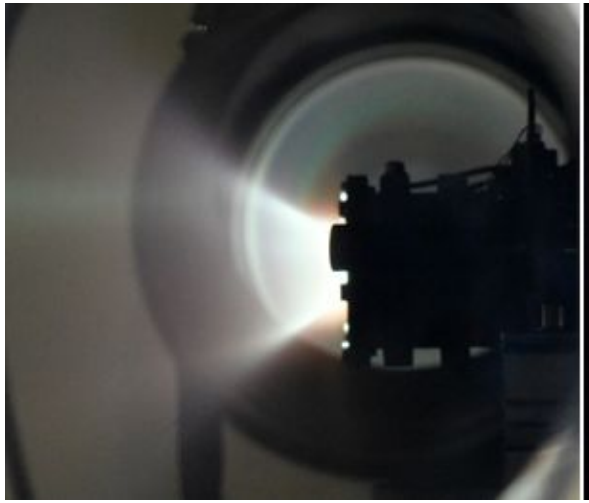


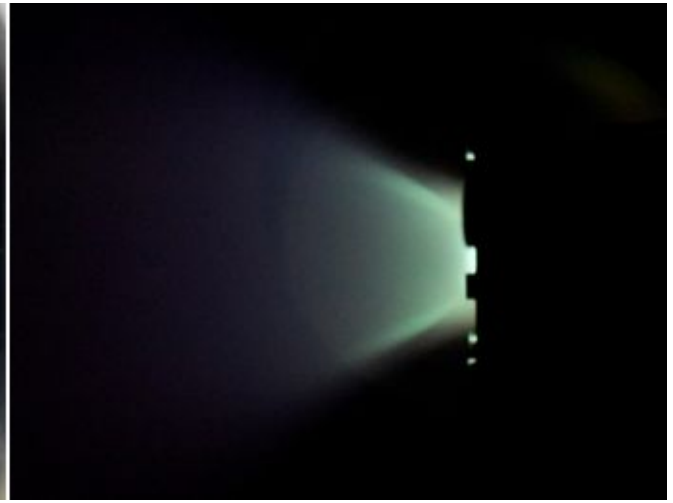


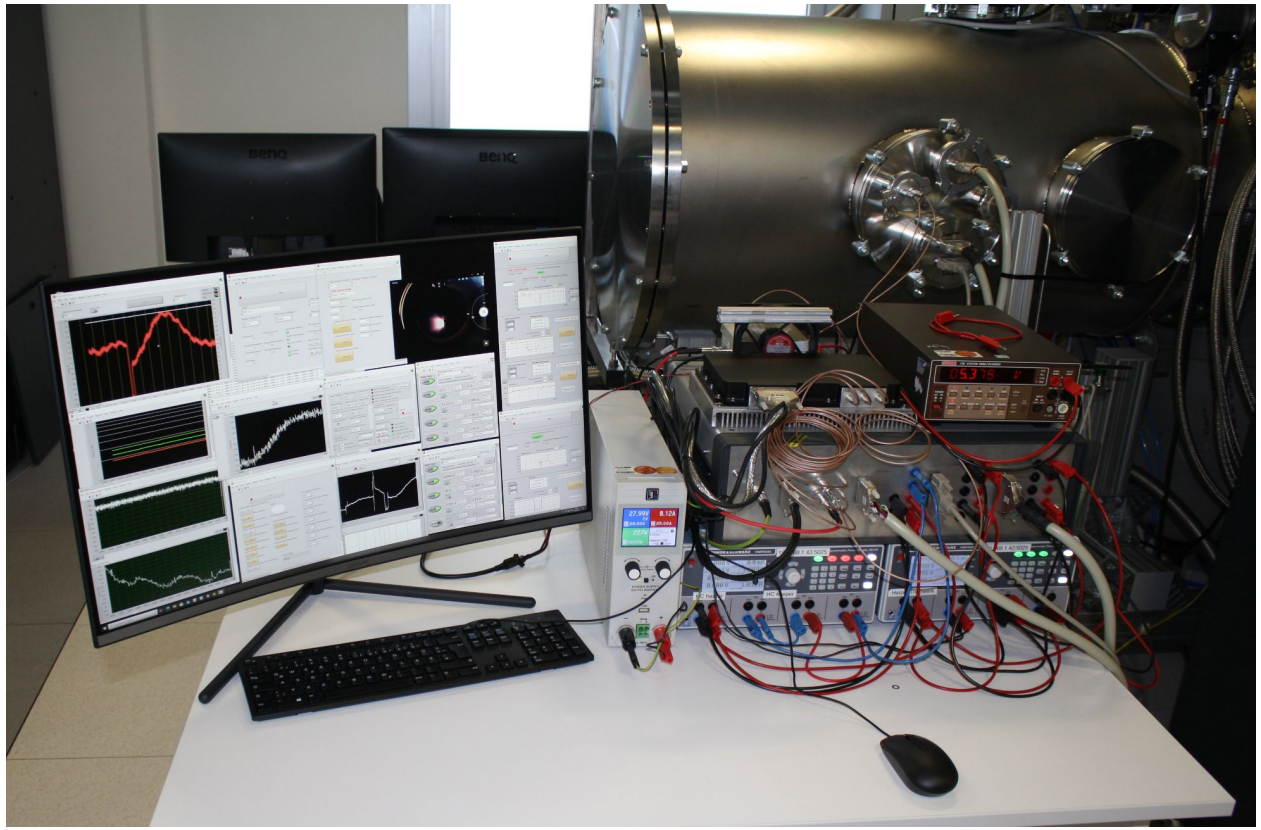
300 W Thruster Endurance Test

Thruster operation:

- Thruster control and FDIR handling done in LabView using state machines
- Automatic hourly status updates via email, or immediate message in case of Warning or Error
- Remote control and live view from office
- More than 1400 hours achieved (Status of 29.09.2021)

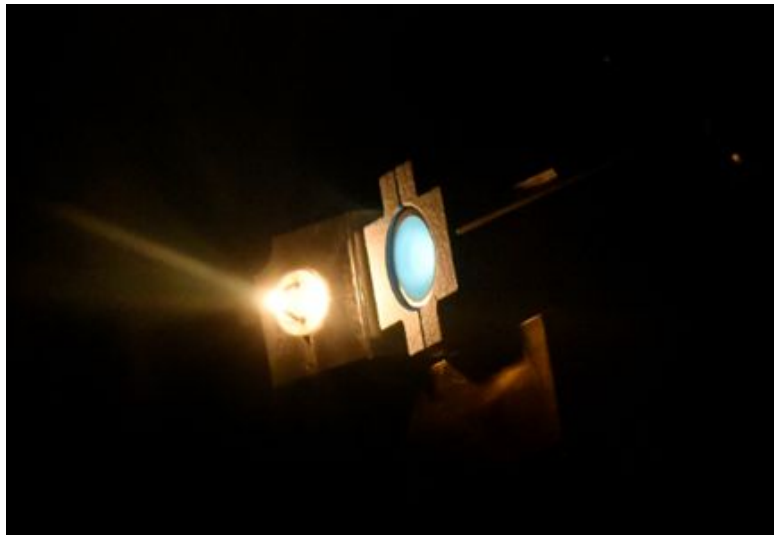






10 W iFACT Development Status

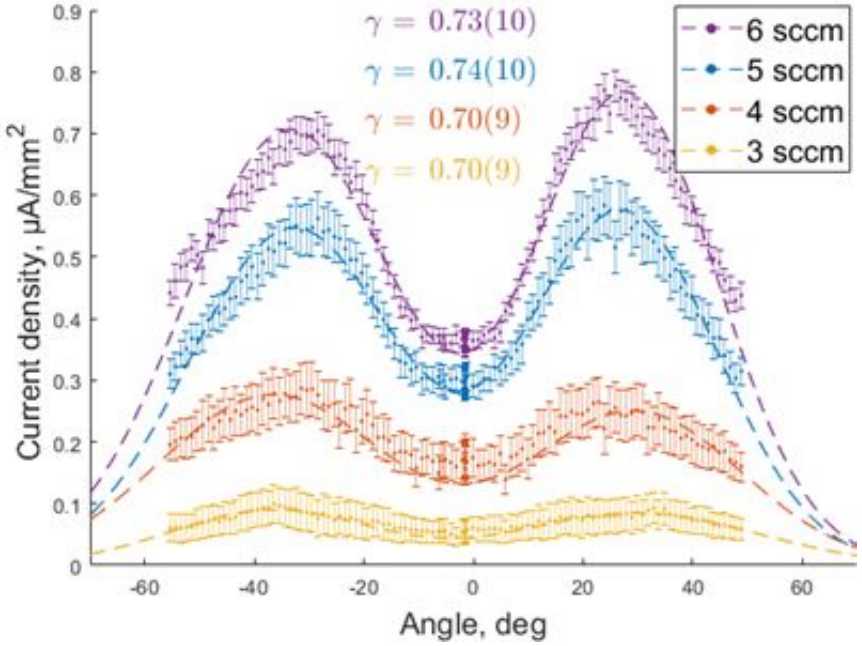
- 10 W CubeSat Thruster and cathode has been built
  - Designed for 6 U or larger
  - Subsystem fits in a single U
  - Overall Subsystem consumption is up to 30 W and delivers up to 1 mN with an Isp of 1000 s
- Next step:
  - Coupling test with Endurosat Electrical Power System Two
  - Detailed performance measurements



1000 W iFACT

- Actual Status:
  - First version of the 1000 W thruster has been built and tested
  - Testing with xenon shows good mass utilization, but larger beam divergence
  - Thermal limitations confine measurements to operation points below

- Next Steps:
  - Improvement of magnetic topology to improve performance
  - Test of another iteration until the end of the project



Conclusion and Outlook

- Conclusion:
  - iFACT enables iodine as propellant for electric propulsion
  - Different power classes and subsystem components are being developed
  - In addition material testing and test facility development is executed
  - iFACT power classes are 300 W, 10 W and 1000 W.
  - 300 W, 10 W and 1000 W thruster successfully fired
- Outlook
  - iFACT will be executed until end of 2021
  - A 3000 h endurance testing for the iFACT facility and thruster will be finished until Nov. 2021
  - The 10 W thruster will be coupled to an Endurosat CubeSat platform
  - Iodine hollow cathode testing will be performed
  - A library of iodine compatible material are created until the end of iFACT

www.epic-ifact.eu

https://www.youtube.com/channel/UC6Edpw9u0NOX0lEIMcZWz6w

Thank you!

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