



Welcome to the CHEOPS Medium Power Newsletter!

Consortium for Hall Effect Orbital Propulsion System (CHEOPS)

The overarching goal of CHEOPS MEDIUM POWER, an EU Horizon 2020 project, is to build upon the initial phase activities of CHEOPS, advancing technologies to attain a TRL6/7 at the system level for Electric Propulsion Systems (EPS).

As the satellite market expands and evolves, Europe's capability to provide competitive and dependable propulsion solutions becomes increasingly vital. CHEOPS MEDIUM POWER aims to address this demand by developing a European dual-mode thruster with sufficient power for electric orbit raising and station keeping, thereby enhancing Europe's standing in the space propulsion arena.

To meet the demands of upcoming telecommunications satellite missions, whether for replacing outdated networks or integrating new technological advancements, Europe must furnish its satellite industry with cost-effective and highly reliable propulsion systems.

The CHEOPS Medium Power project is focused on cultivating the essential technologies to equip Europe with a competitive and dependable European dual-mode thruster capable of satisfying the requirements for electric orbit raising and station keeping.

Focus of CHEOPS Medium Power

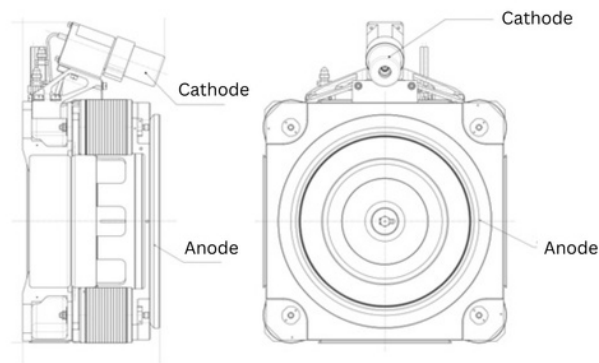
CHEOPS is developing a PPS@500-X Hall Effect Thruster Electric Propulsion System:

- Featuring a dual-mode, medium power configuration optimised for GEO GOMSAT applications, this system is also tailored for future emerging markets, such as on-orbit logistic services, IoT, and life extension projects. It offers enhanced total impulse and greater flexibility to meet diverse requirements.
- Optimised both for high thrust for EOR and high Isp for SK.
- Considering the development and in-flight heritage of the PPS@500.

- Electric Propulsion System delivers a minimum total cost reduction of 30% at the platform level.
- Advances significantly in both intrusive and non-intrusive diagnostic methods, enhancing ground testing techniques and enabling their use in space on future On-Orbit Demonstrators.

How Hall Effect thrusters work

Thrust is generated by the high-speed ejection xenon ions. The ions are accelerated by an electrical field obtained by the magnetic containment of electrons: the Hall effect. The ejected ions are neutralized to avoid transferring an electrical charge to the satellite. Test with Krypton is also included in the studies of CHEOPS Medium Power.



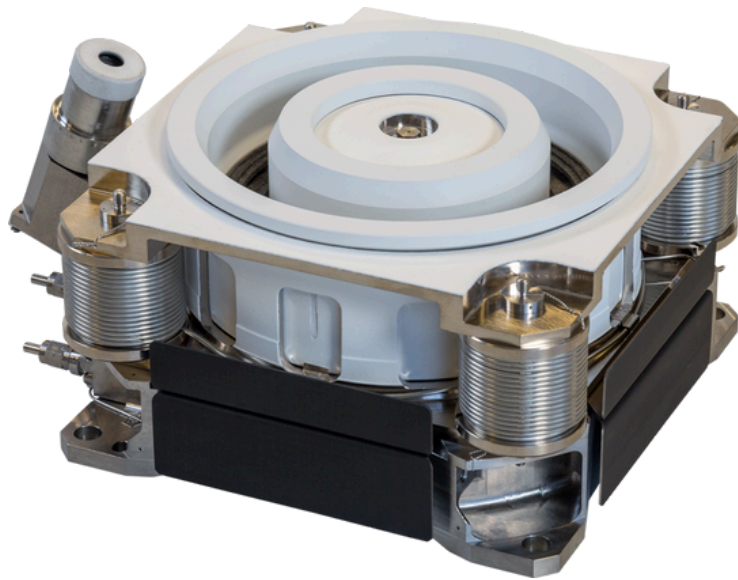
CHEOPS Medium Power objectives

The development of the CHEOPS Medium Power system encompasses the following key elements:

- A Thruster Unit (TU) including cathode
- A Power Propulsion Unit (PPU)
- and a Fluid Management System (FMS)

The objective is to reach at system level completion of the following elements by the end of the CHEOPS MP by 2024:

- An EPS of TRL6-7 for dual mode Medium power
 - A TU of level TRL 7
 - A FMS of level TRL 7
 - A PPU of level TRL 6
-



Achievements of CHEOPS Medium Power Propulsion Unit for 5-7kw HET

- Full PPU breadboard with thruster, cathode and FMS supplies
- Anode module with high capability and good measured efficiency in both configuration
- Digital control of converter validated
- Digital control of FMS validated
- Successfully coupled with 7kw HET in March 2021 at DLR Gottingen Facilities
- CHEOPS MP paves the way for the development of the PPU Mk4

2024 Space Propulsion Calendar

Below there is a list of key conferences in 2024 focusing on the topic of Electric Propulsion Systems:

Space Propulsion Conference 2024: Happening from May 20 to May 23 in Glasgow, Scotland, this event is organized by the Association Aéronautique et Astronautique de France along with agencies such as ESA, CNES, and UK SA. It's a gathering for discussing technical and programmatic aspects of space propulsion technologies. Link: [here](#)

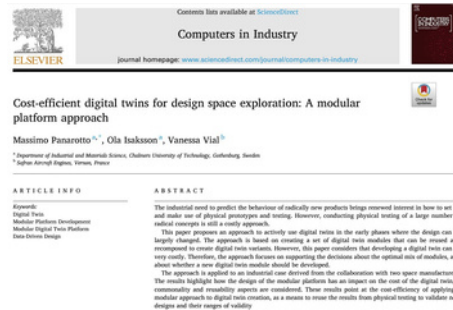
International Electric Propulsion Conference (IEPC) 2024: This conference will be held from June 23 to June 28 in Toulouse, France, and focuses on the latest advancements in electric propulsion. The IEPC is known for bringing together experts from around the world to discuss the future of electric propulsion. Link: [here](#)

International Astronautical Congress (IAC) 2024: Although broader in scope, the IAC (taking place from October 14 to October 18 in Milan, Italy) features significant content on space propulsion among its wide range of topics related to the space industry. It's one of the largest gatherings in the space sector, attracting thousands of professionals. Link: [here](#).

SpaceOps 2024 Workshop: Hosted by CNES in Toulouse, France, from June 18-20, 2024. This workshop will explore new subjects and paradigms in space

systems operations, including discussions on new operations paradigms, solutions for operations, challenges for exploration, a zero-debris approach, and the operations of in-orbit services missions . Link: [here](#).

Highlighted Publications

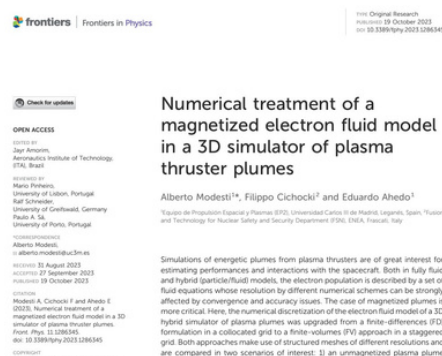


"Cost-efficient digital twins for design space exploration: A modular platform approach"

- This paper proposes an approach to actively use digital twins in the early design phases.
- The approach is applied to an industrial case from the space sector. The results point at
- the cost-efficiency of using modular digital twins for design space exploration.

Link: [here](#)

Authors: Massimo Panarotto, Ola Isaksson (Chalmers University of Technology) Vanessa Vial (Safran Aircraft Engines)



"Numerical treatment of a magnetized electron fluid model in a 3D simulator of plasma thruster plumes"

KEYWORDS magnetized electron fluid, hybrid PIC-fluid simulations, plasma plumes, finite volumes, finite differences

Authors: Alberto Modesti (University Carlos III de Madrid), Filippo Cichocki (ENEA Frascati Research), Eduardo Ahedo (University Carlos III de Madrid)

Link: [here](#)

A 3D electron fluid model with energy balance for plasma plumes

IEPC-2022-321

Presented at the 37th International Electric Propulsion Conference
Massachusetts Institute of Technology, Cambridge, MA, USA
June 19-23, 2022

Alberto Modesti¹ and Jacek Zhou² and Eduardo Ahedo³
Equipo de Propulsión Espacial y Plasmas (EP2), Universidad Carlos III de Madrid, Leganés, Spain

Filippo Cichocki⁴
Istituto per la Scienza e Tecnologia dei Plasmi, Bari, Italy

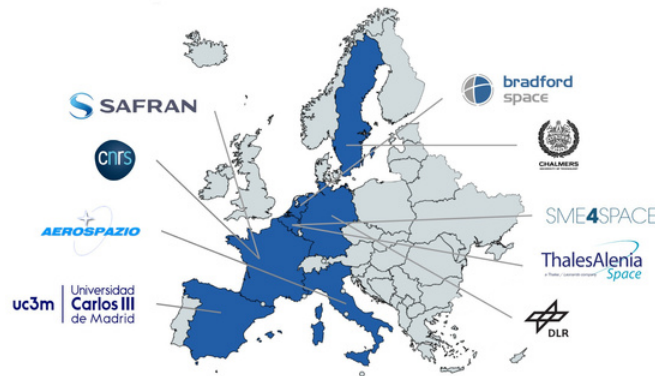
EP2PLUS is a 3D hybrid simulation code designed to analyze the expansion of energetic plasma plumes and its interaction with nearby objects, which is a subject of high interest. Heavy species are treated with a particle-in-cell formulation while a fluid model is used for electrons. The electron model is able to deal with moderate magnetic field but the momentum equation is closed with a polytropic relation for the electron temperature. This is inadequate for magnetized, mildly collisional regions of the plume. This paper presents work in progress to add the electron energy equation to the model with a Fourier's closure law for the heat flux. An example with a magnetically-guided plume shows the differences between the two approaches.

"A3Delectron fluid model
with energy balance for
plasma plumes"

Presented at the 37th
International Electric
Propulsion Conference
Massachusetts Institute of
Technology, Cambridge,
MA, USA June 19-23, 2022
Authors: Alberto Modesti
(University Carlos III de
Madrid), Filippo Cichocki
(Istituto per la Scienza e
Tecnologia dei
Plasmi), Eduardo Ahedo
(University Carlos III de
Madrid)
Link: [here](#)

Meet our team

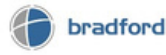
CHEOPS MediumPower is a collaborative project that involves a mixture of 9 industrial and academic partners across 6 European countries, each of them bringing specialised skills and experience to develop a Medium Power Electric Propulsion System.



Safran Spacecraft Propulsion, a subsidiary of Safran Electronics & Defense, is the European leader in plasma propulsion. Safran Spacecraft Propulsion offers a complete range of electric motors and propulsion subsystems for more sustainable satellites and spacecraft.

AEROSPAZIO Tecnologie was founded in the year 2000 with the aim of providing high qualified testing and engineering services in the fields of vacuum technology and Electric Propulsion for spacecraft.





Bradford Engineering is a Netherlands based supplier of Attitude and Orbit Control Systems (AOCS), Propulsion systems as well as, Avionics and Thermal solutions for spacecraft. Bradford manufactures components such as pressure transducers, flow meters, cold gas systems, xenon feed systems, sun sensors and reaction wheels prime manufacturers. Bradford furthermore delivers turn-key the complete design, manufacturing, testing solutions for propulsion subsystems and launch preparation.

Chalmers University of Technology has developed leading research in the areas of life sciences, materials science, nanotechnology, environmental sciences and energy. The university offers PhD and Licentiate programmes as well as MScEng, MArch, BEng and nautical programmes.



The Institute of Combustion, Aerothermics, Reactivity and Environment – ICARE, was created on 2007 by the merger of the Combustion and Reactive Systems Laboratory and the Aerothermics Laboratory. ICARE is located on the CNRS campus at La Source. ICARE's two fields of intervention, namely "Energy & Environment" and "Propulsion & Space", are divided into 3 Thematic Groups: "Combustion and Reactive Systems", "Atmosphere and Environment" and "Space Propulsion and High-Speed Flows".

Thales Alenia Space is the largest Belgian manufacturer of Space electronics and, as Thales Alenia Space Power lead center, the European leader of power supplies for satellites and control units for the Ariane 5 launcher. It is also specialised in electronic power conditioning for travelling wave tube amplifiers. TAS-B also develops its own range of custom Hybrid microelectronics and digital ASICs.



DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Role within project: DLR's part in the project is to perform a test campaign on the PPS thruster. DLR has experience in EP thruster testing and with this project the portfolio of test knowledge and diagnostic upgrade will be enlarged

Universidad Carlos III de Madrid (UC3M) is a public university with around 20,000 students, characterised by its strong international focus, the quality of its faculty, excellence in research and commitment to society. UC3M is listed in the QS World University ranking among the top 400 universities in the world and the top 50 universities under 50 year-old.



SME4SPACE, the representative organisation of SMEs in Europe's space industry, is a private not-for-profit organisation, dedicated to advocating for SME interests to public authorities such as the ESA, the European Union and its related agencies. S4S presently gathers cumulatively more than 800 SMEs active in space.



The CHEOPS Medium Power project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004226.

Copyright © 2024, All rights reserved.

Our mailing address is:
contact@cheops-2020.eu