

Overview of ESA activities in the areas of Flight Vehicle Engineering

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8th International Workshop on Radiation of High Temp Gases for Space Missions

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University Carlos III, Madrid, Spain

About the new TEC-MPA

- On October 1st, 2018 the Terms of Reference of TEC-MPA changed
- The Section was renamed as “**Flight Vehicles and Aerothermodynamics Engineering Section**”



Mission Statement



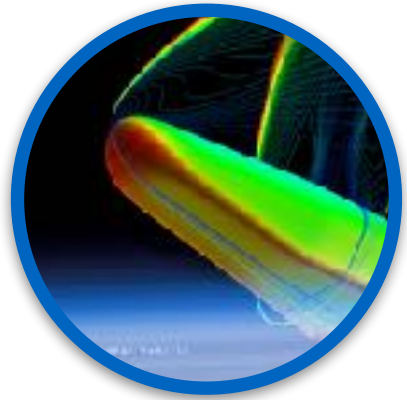
The Section starts to work on “flight vehicle engineering”

The Section maintains and keeps the ‘classic’ activities of aero, thermo, and fluid dynamics

Scope of the Section



Focal point for the architecture design, analysis and technical assessment of space transportation vehicles for suborbital, orbital and exploration applications, including upper stages, (re)-entry, expendable, and reusable vehicles



Overall feasibility and viability assessments, as well as quick design iterations with the support of the necessary TEC competences



Coordination of the specialised support and R&D initiatives with other D/TEC Sections in the frame of the relevant Competence Domains



Engineering support, research, development and testing activities related to flight vehicles, flight physics, aerodynamics, thermodynamics and fluid dynamics engineering and the architecture design and analysis of suborbital, (re)-entry, space transportation, and exploration vehicles

Activities of the Section: 4 main pillars



flight vehicle engineering; ascent, cruise and re-entry also through planetary atmospheres; plume analysis; multi physics modelling



fluid dynamics; ground testing, and ground-to-flight transposition methods; fluid-structure interaction phenomena



exploitation of flight data from flight experiments, specially involving aerothermodynamics and (re-)entry



computational facilities and and flight physics modelling tools; test facilities in propulsion, aerothermodynamics and flight physics

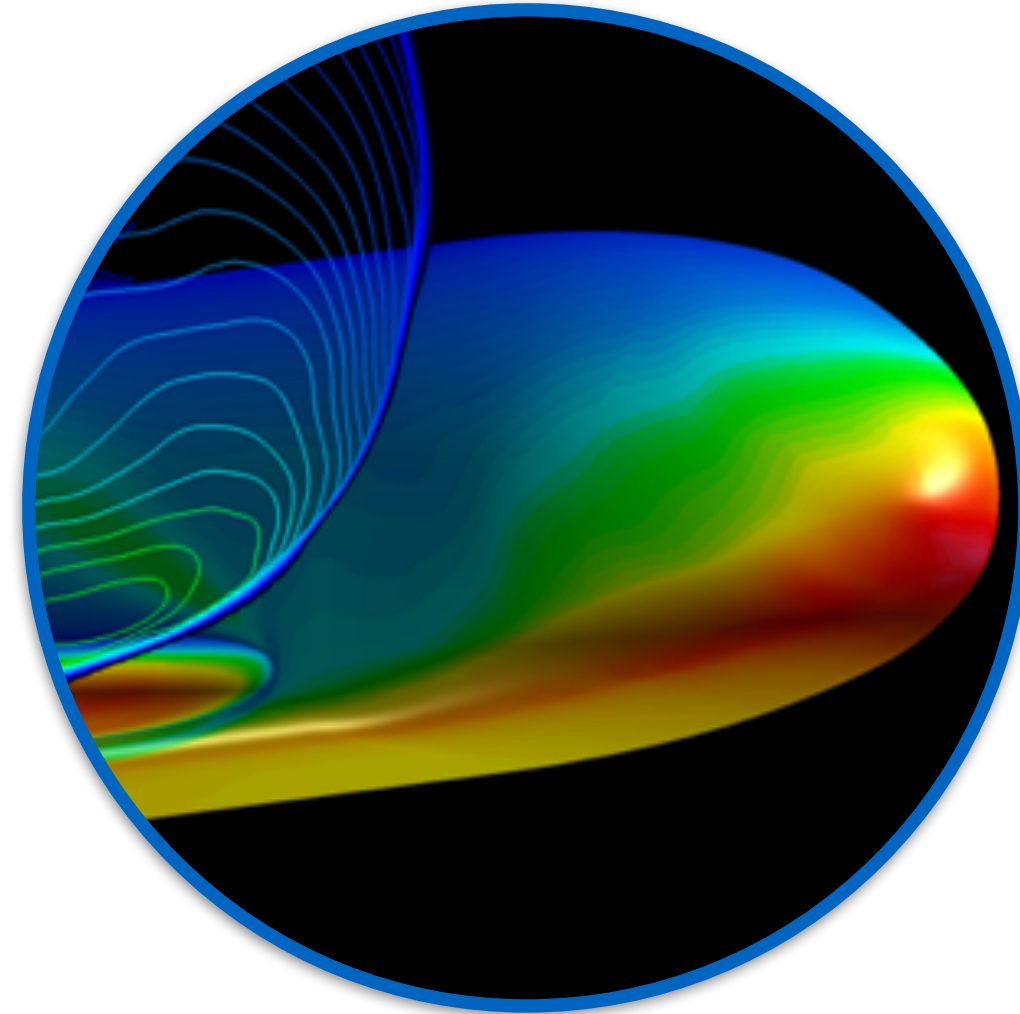
Services

Provision of Services to Projects: 4 main areas



Flight Vehicle Engineering

Vehicle performance, multi-disciplinary design, fast multi-physics design loop



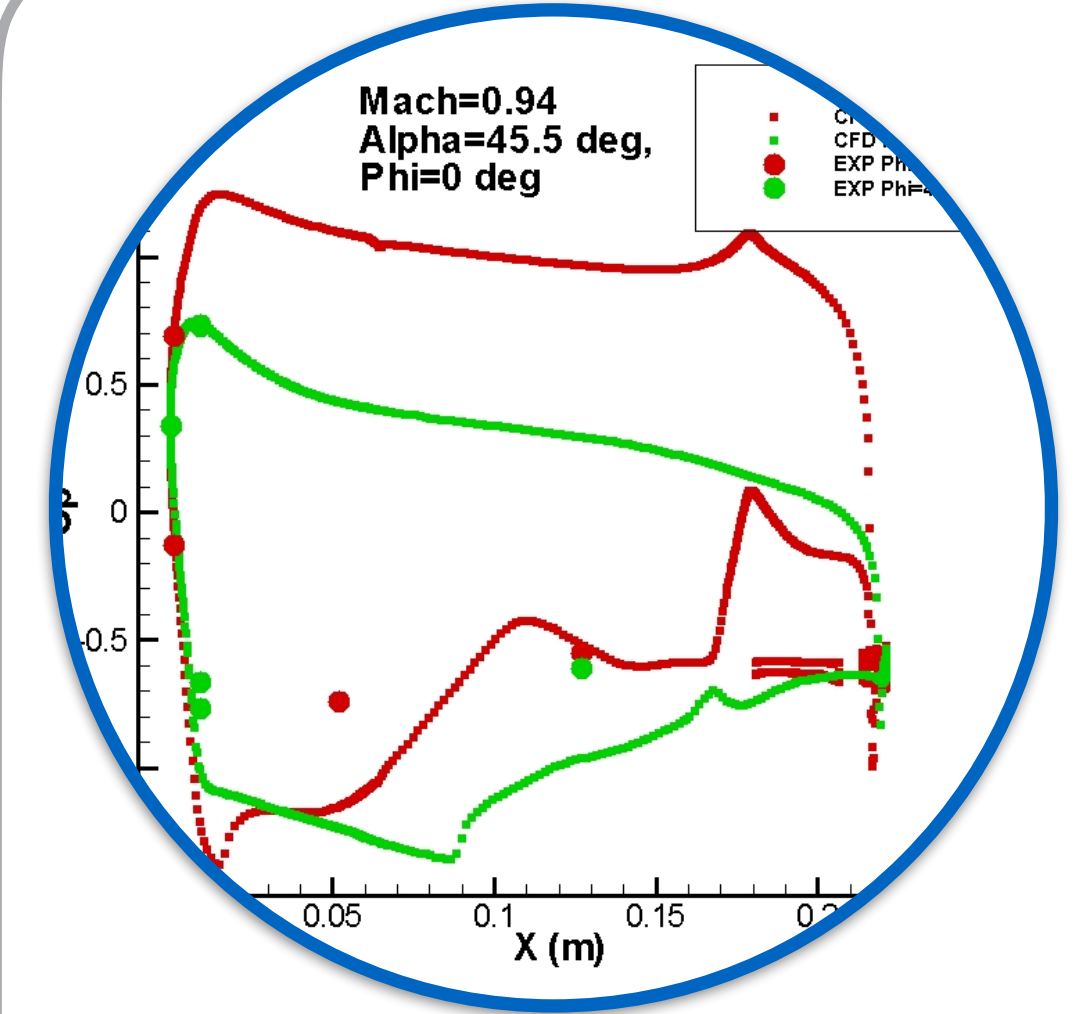
Assessments and Viability Investigations

Quick and accurate modelling and simulations on aerodynamics, fluid dynamics, contamination



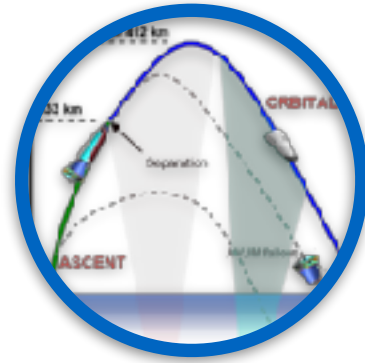
Testing and Verification

Testing of ATD of flight vehicles in facilities (external), and visualisation of missions performances



Post-Flight Data Analysis

Data analysis after flight, comparison of predicted vs actual flying qualities



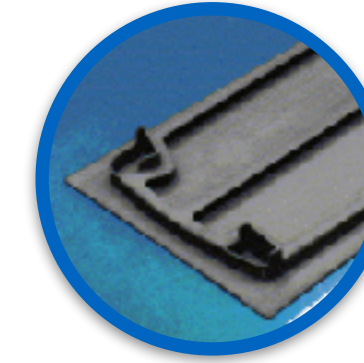
Flight Vehicle Engineering

Upper stages, Re-usability, Micro-launchers, Hypersonic flight



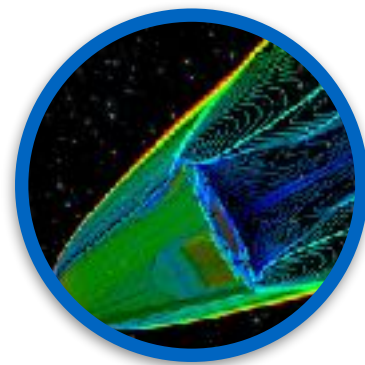
Decelerators

Parachute and parafoil, Inflatable Devices, Drogue Chutes



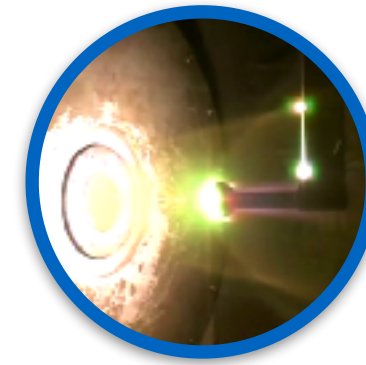
Design for Demise

Methods, techniques and technologies



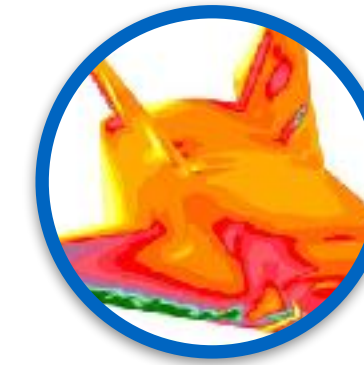
Aerodynamics

Shape optimisation, Loads Design, Computational methods, High Speed Atmospheric Flight



Technology Test Beds

Wind Tunnel Testing, Plasma Tunnels, Drop Tests, Avionics Test Beds



Post Flight Analysis

Tool-set for Post Flight Analysis, Exploitation of Flight Data



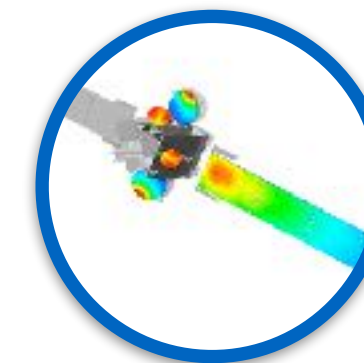
Thermodynamics

Computational Fluid Dynamics and Mechanics



Fluid Dynamics

Lattice Boltzmann Methods, Cryogenic Sloshing, Flows in Micro-gravity



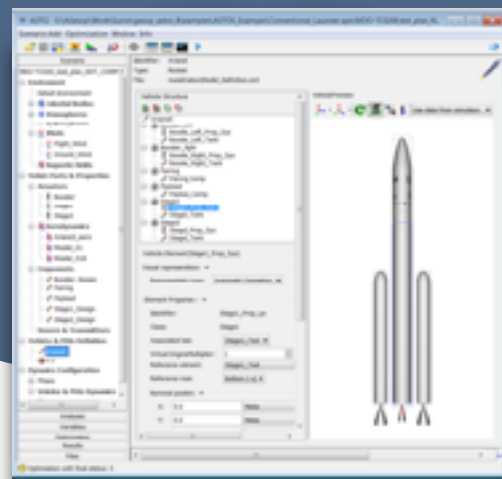
Contamination

Acoustics and Particle Contamination, Plume Contamination



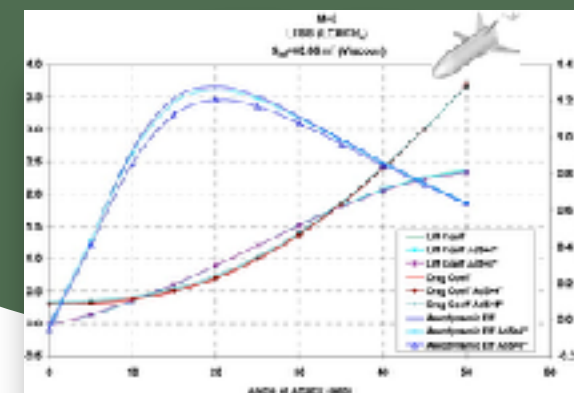
Laboratories

Testing facilities, engineering support tools, techniques



Assessments

Modular upper stage,
micro-launchers, etc



Conferences

FAR, HISST, Radiation workshop, Internal Flow Dynamics workshop

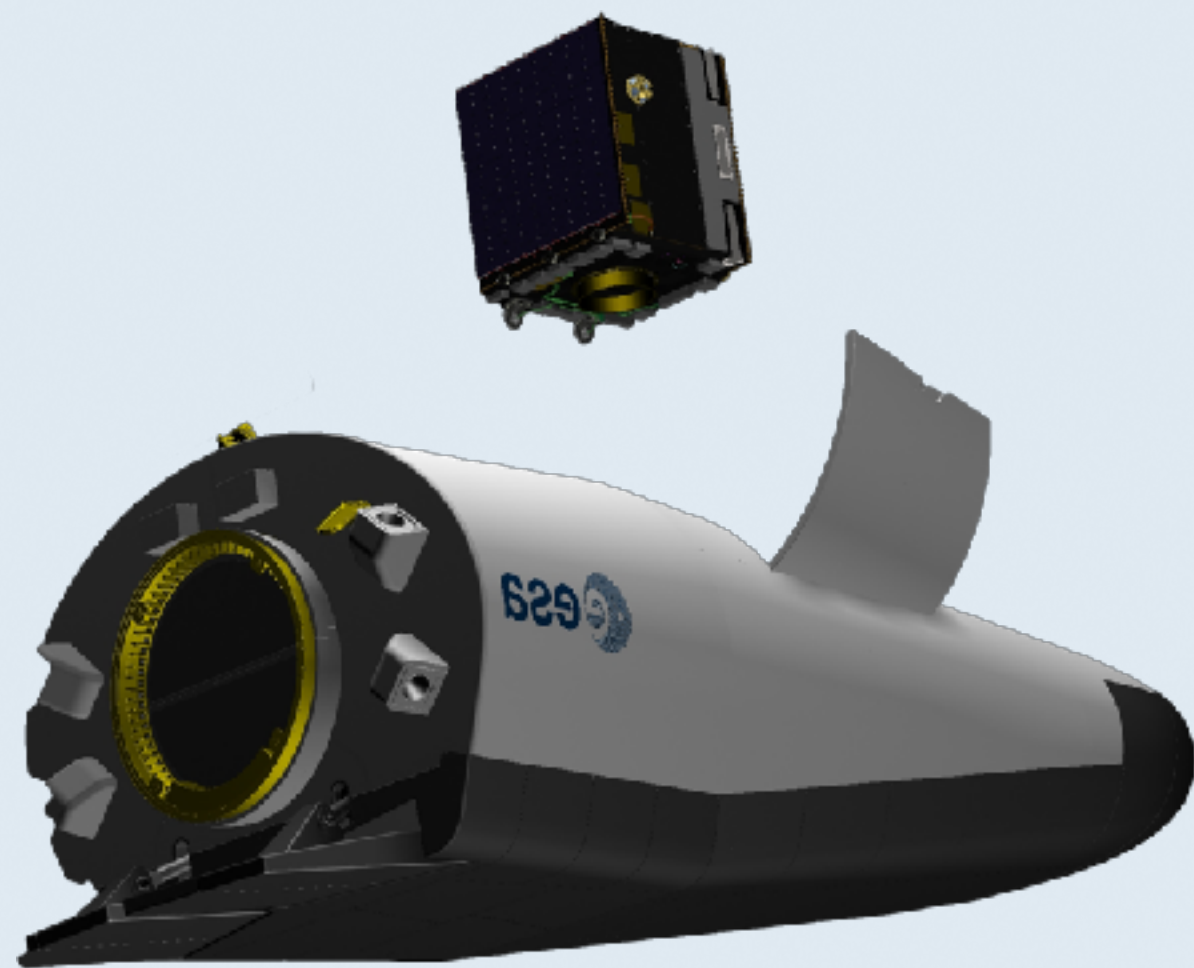


Activities: missions and R+D

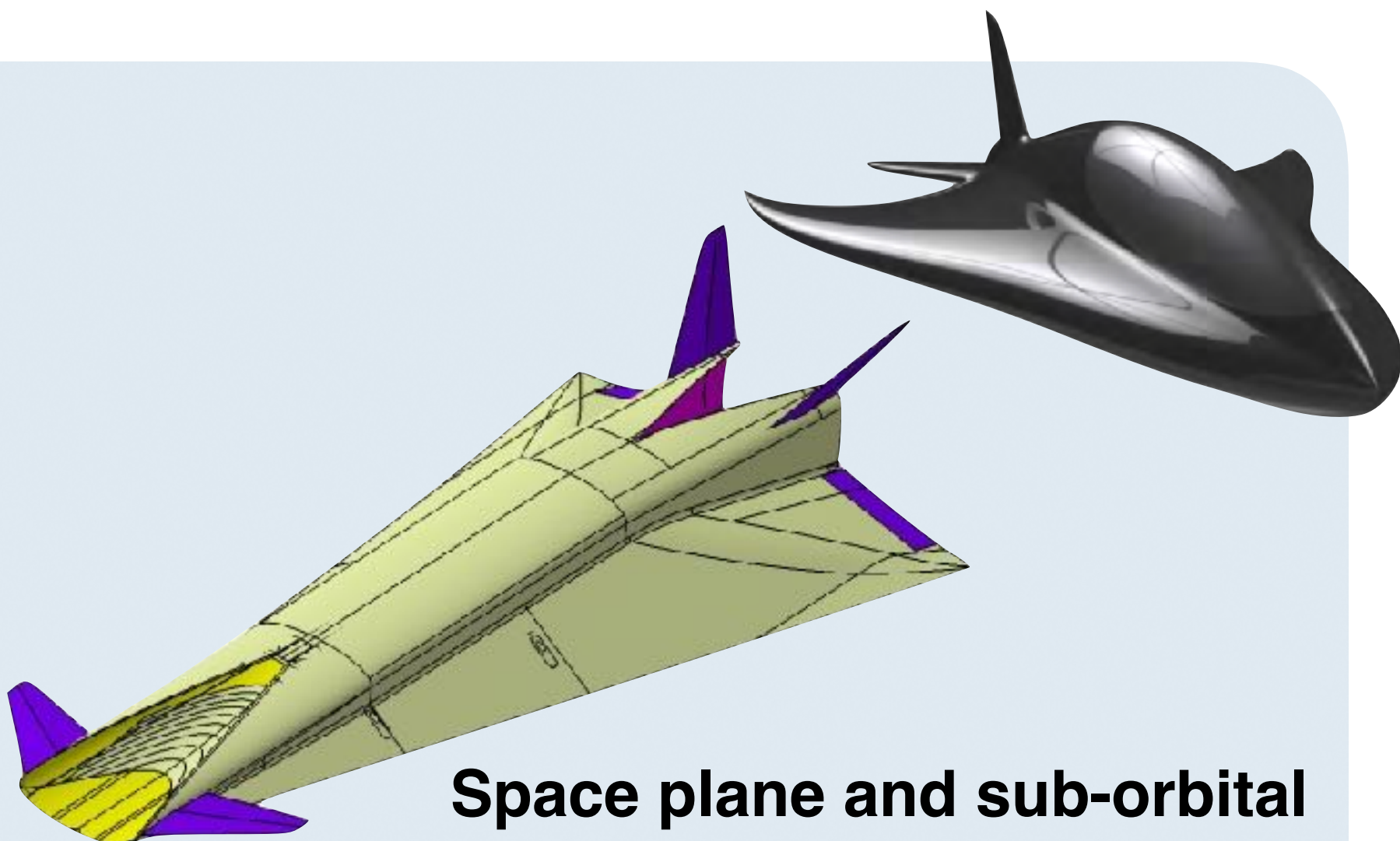
**Expendable launch
vehicles and ATD
engineering**



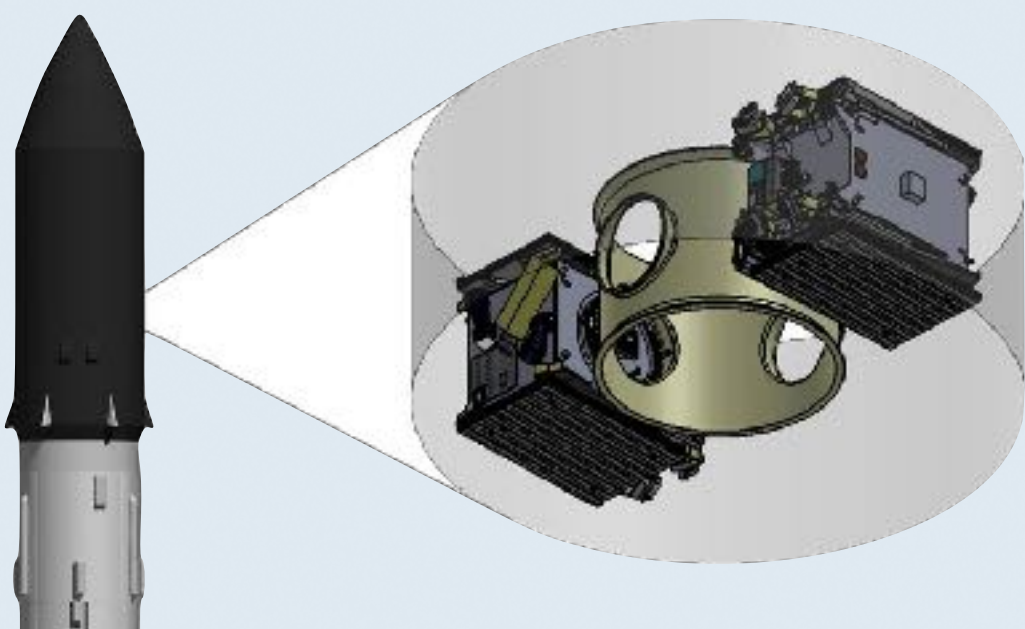
**Reusable launch
vehicles and ATD
engineering**



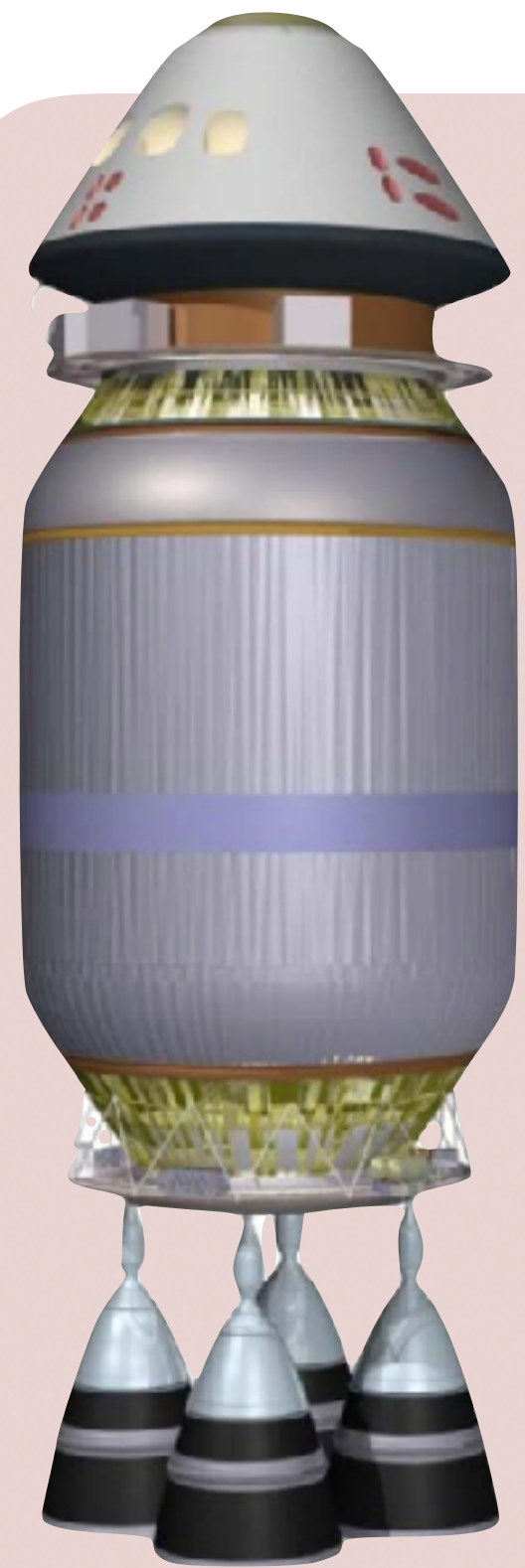
**Upper stages
vehicles engineering**



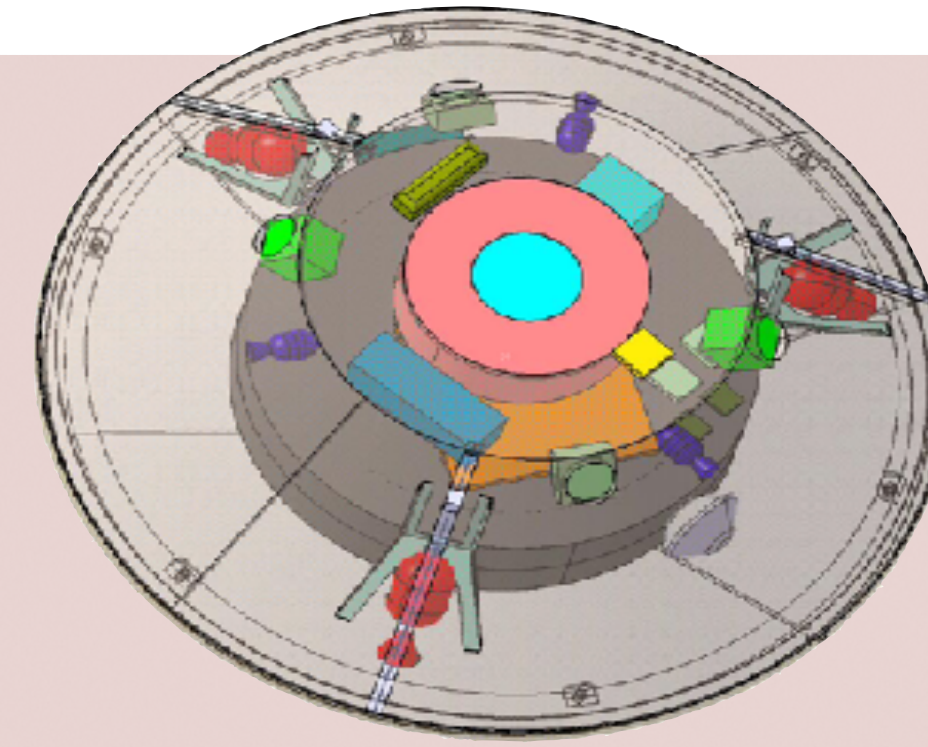
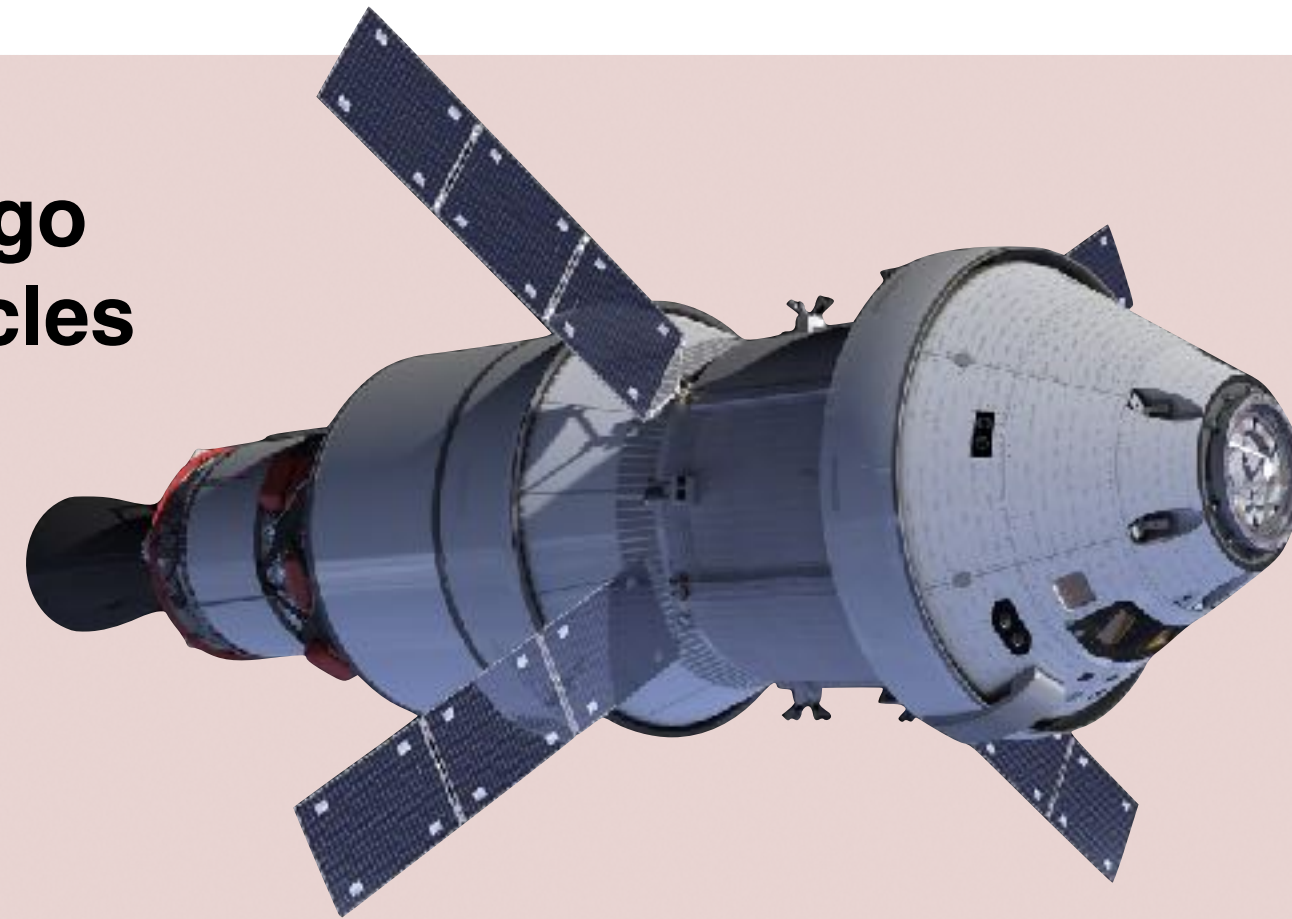
**Space plane and sub-orbital
vehicles engineering**



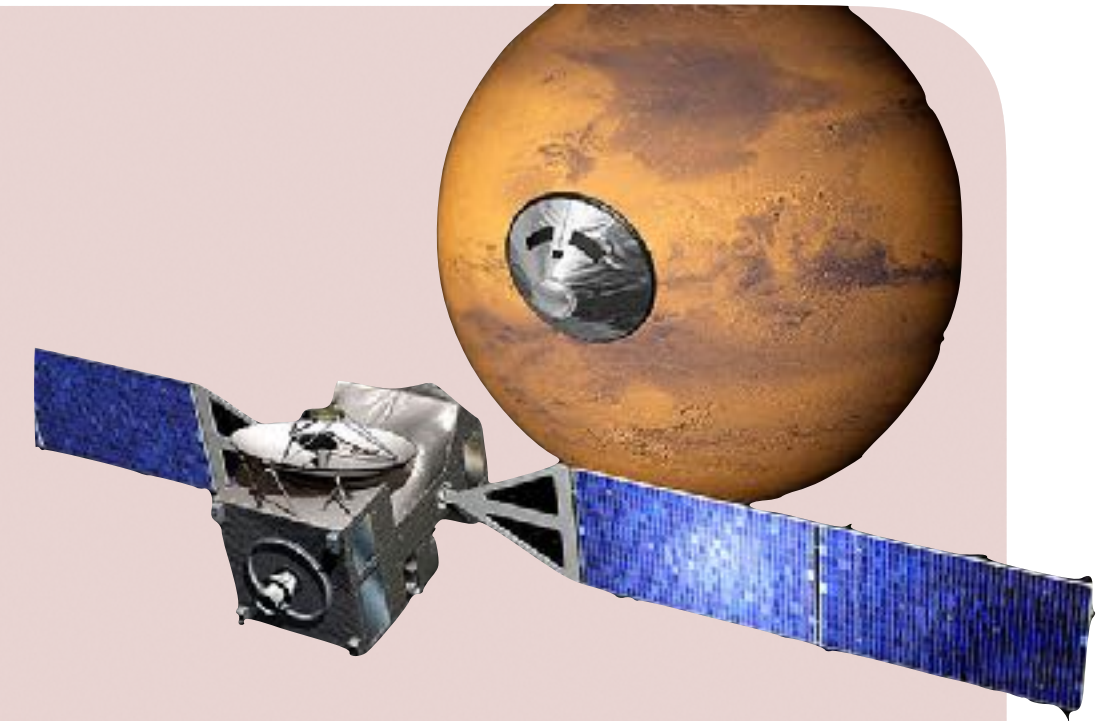
**Servicing
vehicles
engineering**



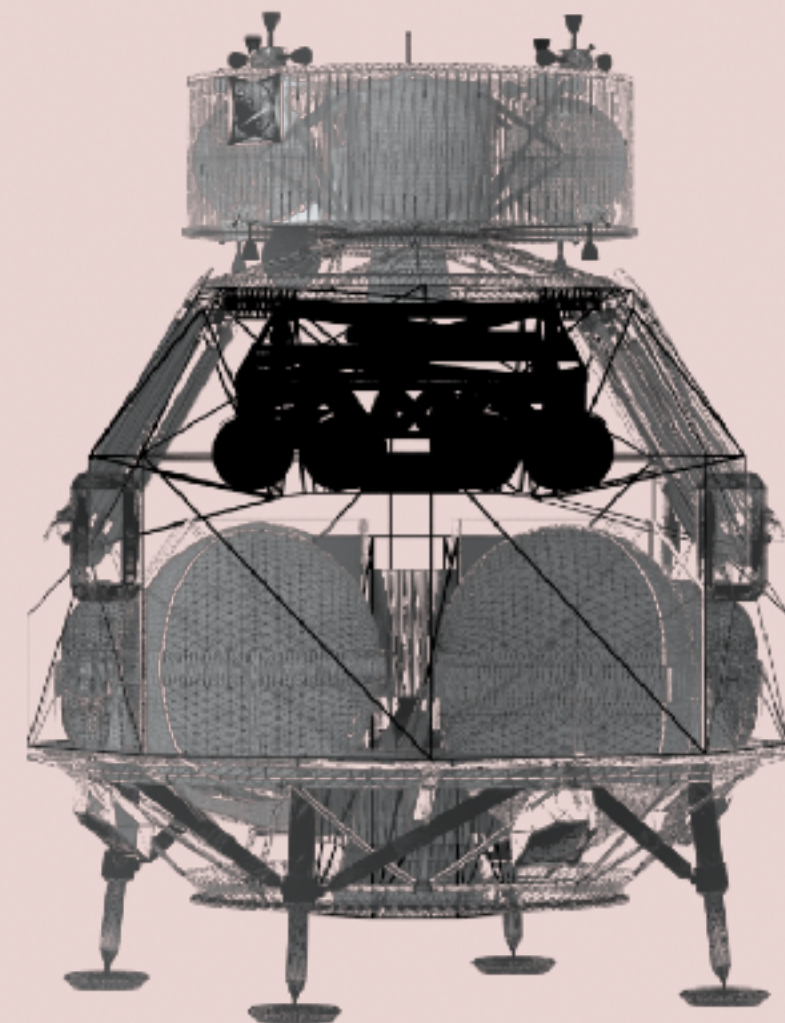
**Human and cargo
exploration vehicles
engineering**



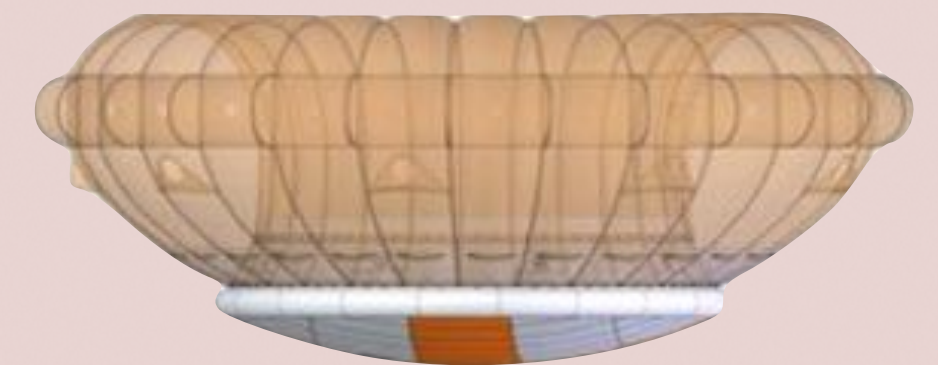
**Planetary entry probe
vehicles engineering**



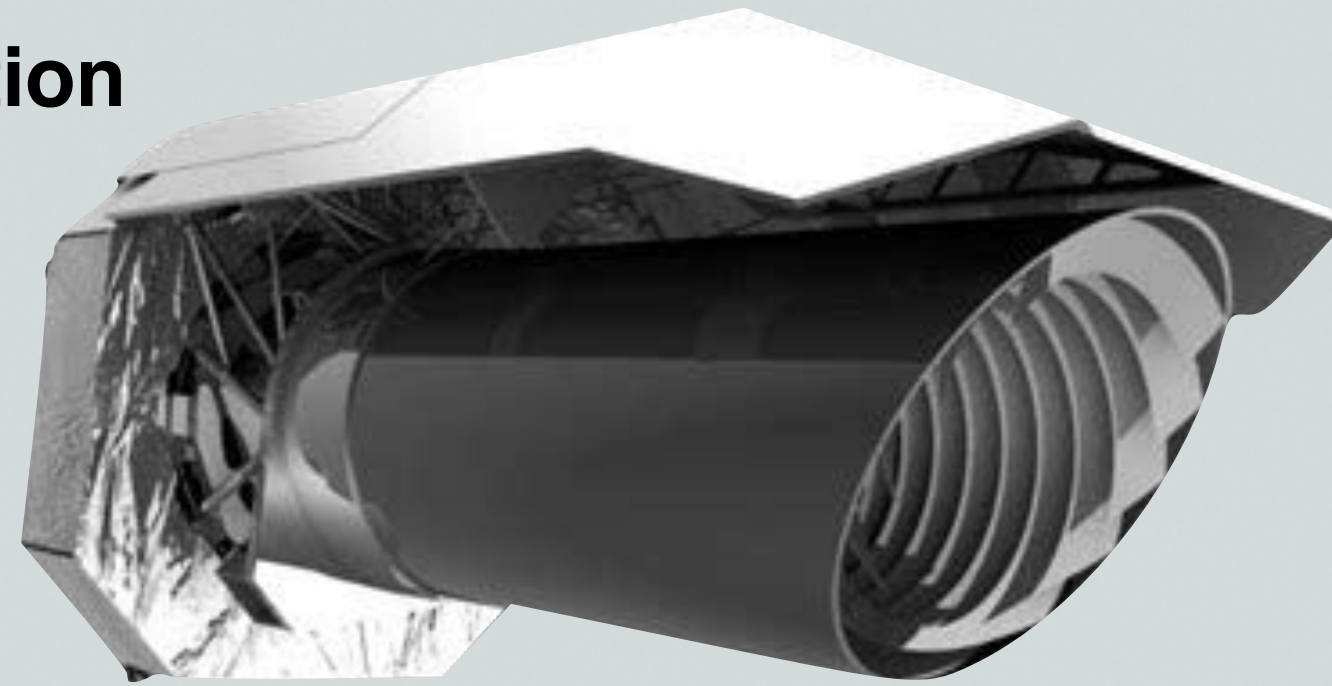
**Lunar descent and
ascent exploration
vehicles
engineering**



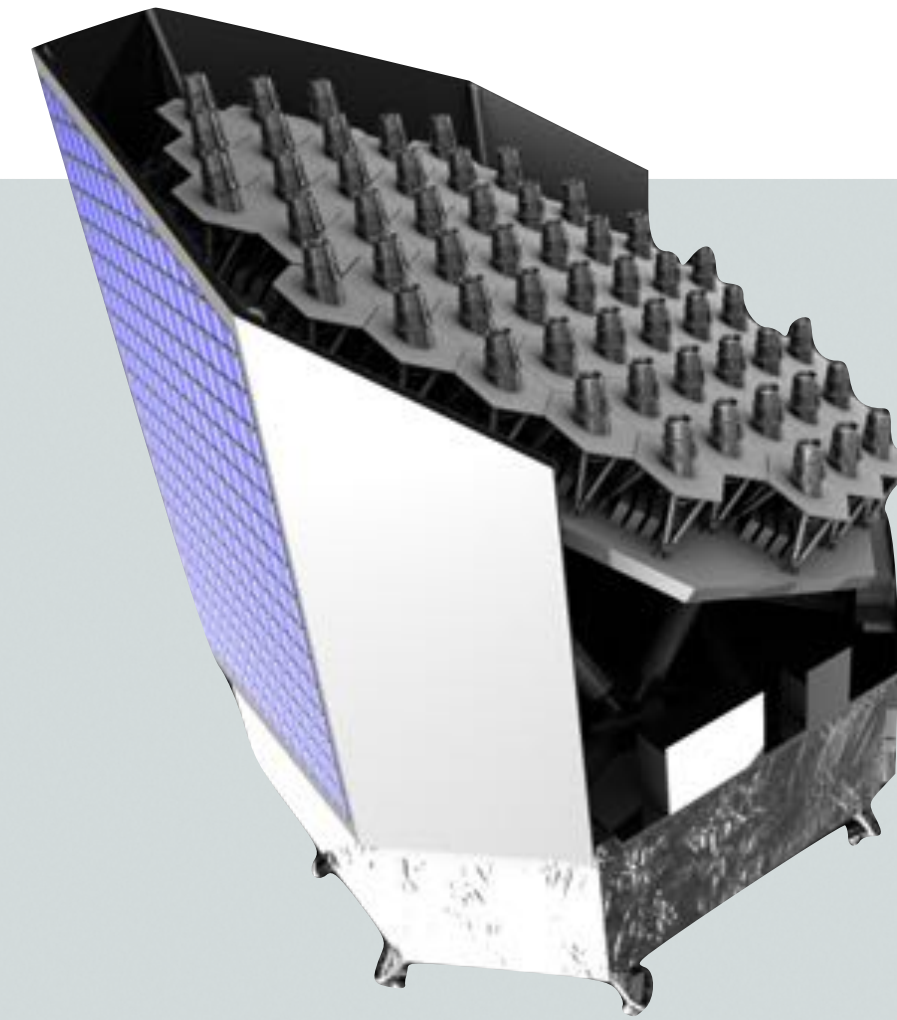
**Decelerators for
planetary
exploration**



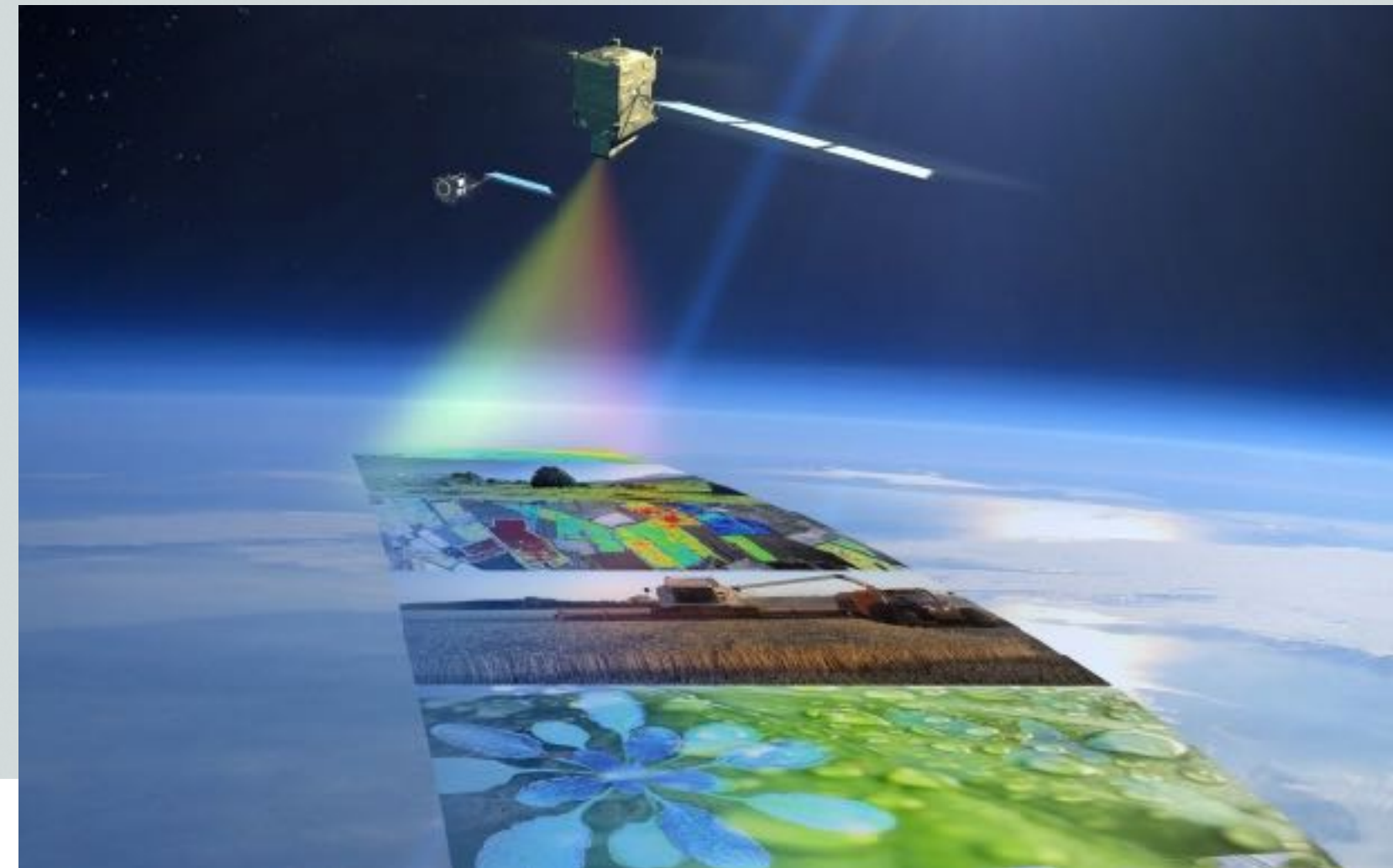
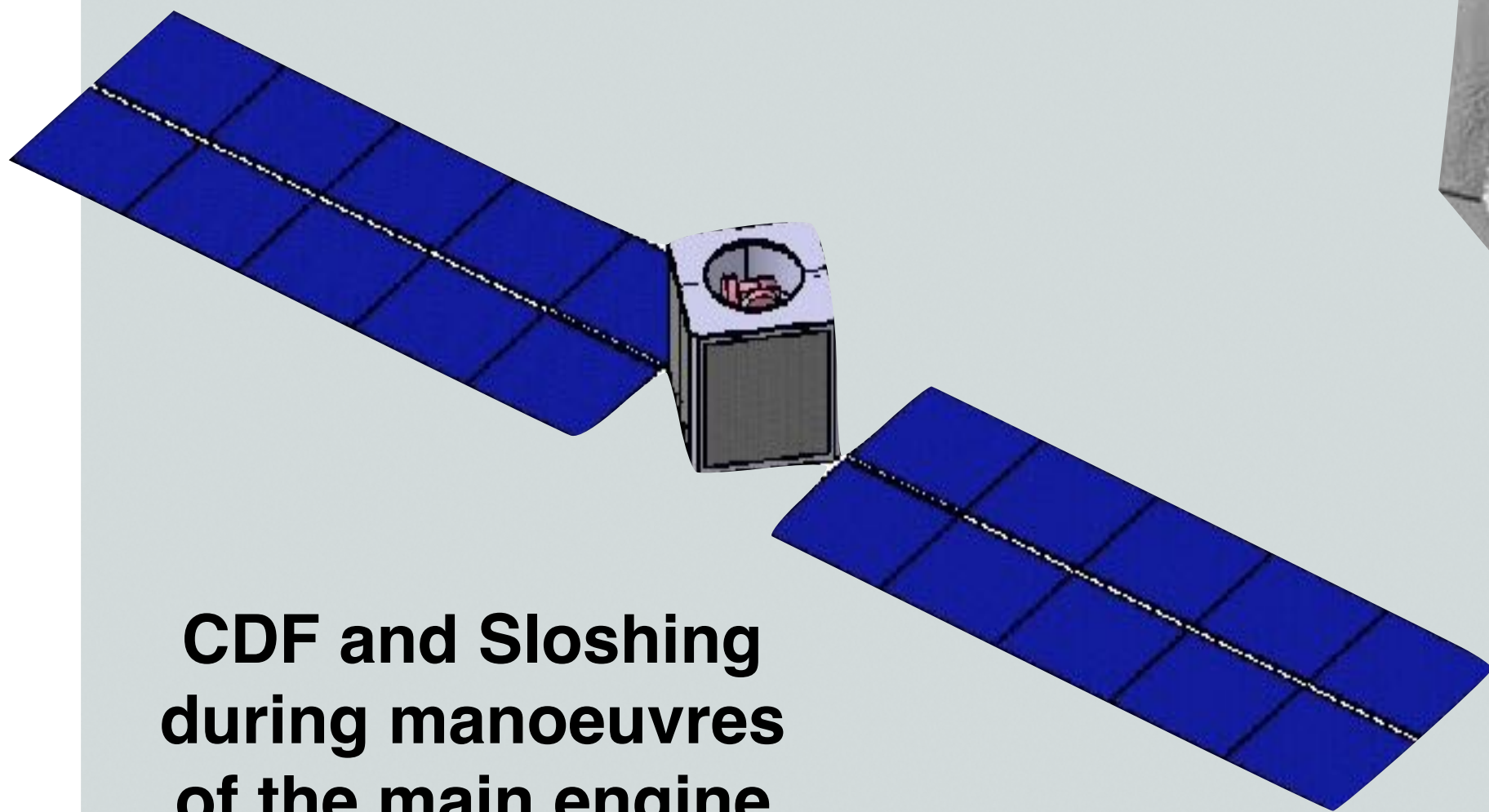
Fairing contamination analysis



Plume contamination analysis



CDF and Sloshing during manoeuvres of the main engine



Upcoming TRP activities

esa

TRP activities in 2019



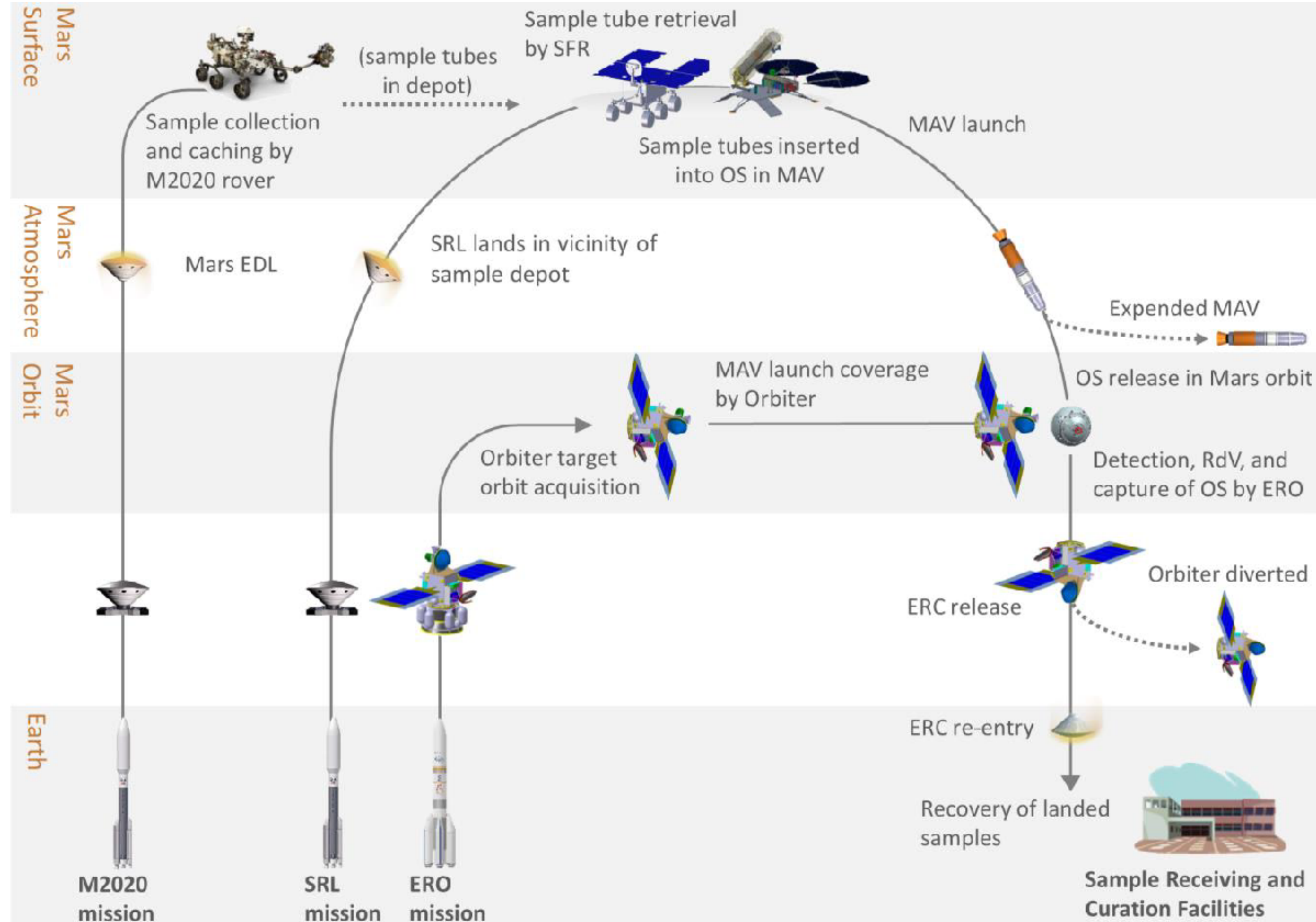
Ref.	Keuro	Title
T713-602MP	500	Prototyping of Spacecraft Re-fueling
T419-608MP	400	Technology Pre-development for Moon Transfer Stage in Support of Logistic Missions
T418-601MP	450	Re-usable concepts for space transportation flight vehicle engineering
T408-601MP	500	Toolset for Post Flight Analysis of ESA Missions
T318-602MP	500	Feasibility and Preliminary Design of a Moon Drone Vehicle
T318-601MP	300	Human-In-the-Loop Flight Vehicle Engineering for Exploration Missions
T314-606MP	600	Miniaturized Sensor Packages and Delivery Systems for In-Situ Exploration

TRP activities in 2020



Keuro	Title
300	Heat transfer enhancement in micro-channel heat exchangers
400	Ram-EP VLEO satellite mission design and integrated ram-EP ground testing
400	Investigation of Key Technologies for a Mars Positioning and Communication System using Small Satellites
300	Pulsed Detonation Thruster

Mars Sample Return (MSR) Overview



- Three missions to be separately launched in the 2020's
- Mars 2020's (M2020) Rover for samples acquisition and caching
- Sample Return Lander (SRL)
Surface platform, Sample Fetch Rover (SFR), and Mars Ascent Vehicle (MAV)
- Earth Return Orbiter (ERO)
Rendezvous and capture of the Orbiting Sample (OS), bio-sealing, Earth Re-entry Capsule (ERC)

- ESA Mars Sample Return in cooperation with JPL does not longer have the Earth Return Capsule ERC element
- TRP 200K Open Competition: “**Feasibility study of a Hyper-velocity Earth Re-entry technology Demonstrator (HEARTED)**”
- The objective of the activity is the definition of the technology assessment and feasibility study of the HEARTED mission covering the phases 0 and A. The phase 0 covers the analysis of the mission and the identification of the needs. The phase A covers the feasibility analysis.
- The feeling price foreseen by the Agency for the complete demonstration mission shall not exceed 50 MEuro
- This includes the cost of operation and post flight analysis but does not include the cost of the launch provider

FAR conference in Italy (end September 2019)



- International Conference on **Flight vehicles, Aerothermodynamics and Re-entry missions and engineering (FAR)**
- September 30th - October 3rd, 2019
- Outcome of the successful series of Symposia on Aerothermodynamics for Space Vehicles, the Workshops on Thermal Protection Systems and other international events organised by ESA in the last few years in the field of (Re)-entry and new Vehicles design and engineering
- <https://atpi.eventsair.com/QuickEventWebsitePortal/far2019/website>

International Conference on Flight Vehicles,
Aerothermodynamics and Re-entry Missions & Engineering

FAR 2019
30 September - 3 October 2019, Monopoli, Italy

Home Committee Calendar of Events Scientific Content Registration Further Information Contact

The International Conference on Flight vehicles, Aerothermodynamics and Re-entry Missions and Engineering (FAR) is the natural outcome of the successful series of Symposia on Aerothermodynamics for Space Vehicles, the Workshops on Thermal Protection Systems and other international events organised by ESA in the last few years in the field of (Re)-entry and new Vehicles design and engineering. In answer to the growing request of innovation and competitiveness dictated by the new space arena, the FAR conference aims at providing Space Agencies, Industry, Organizations, Universities and Research Institutes with a forum of excellence in the area of flight: vehicle design, aerothermodynamics, thermal protection, (re)-entry missions and their engineering processes.

Further to the specific subjects above indicated, the new conference format will be organised along several technical streams, encompassing the whole spectrum of institutional and commercial applications and services for expendable and re-usable flight vehicles in Earth or planetary atmospheres and surroundings. In addition to the individual technical areas, FAR will include plenary events of both Technical and Programmatic content, aiming to promote and advance ideas and initiatives, either institutional or private, in the areas of interest for the participants.

At the conference, the participants will also showcase the latest architecture designs, analysis and technical assessments with the aim to promote the exchange of ideas and the identification of new trends and required developments.

With an European initiative and accent, the events aims to attract a fully International span of participants, with the target to create a suitable forum of global exchange capable to support and boost steady progress for future space transportation and exploration vehicles and services.

The fields covered include, but are not limited to:

- The architecture design and analysis of current and future space transportation and exploration vehicles
- Flight vehicles engineering
- Flight physics, aerodynamics, thermodynamics and fluid dynamics, re-usability, demisability, hypersonic flight in atmosphere.
- (Re)-entry engineering and technologies, including TPS and decelerators
- Logistics, infrastructure and services enabling and supporting new transportation and exploration concepts.

In addition to the latest advances in those fields, FAR is also devoted to software and ground validation tools. Specific attention will be dedicated also to approved and proposed in-flight demonstrators ideas and projects.



**Thank you for
your attention**