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

March 28th, 2019

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

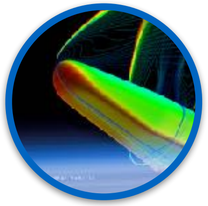
TEC-MPA mission statement

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

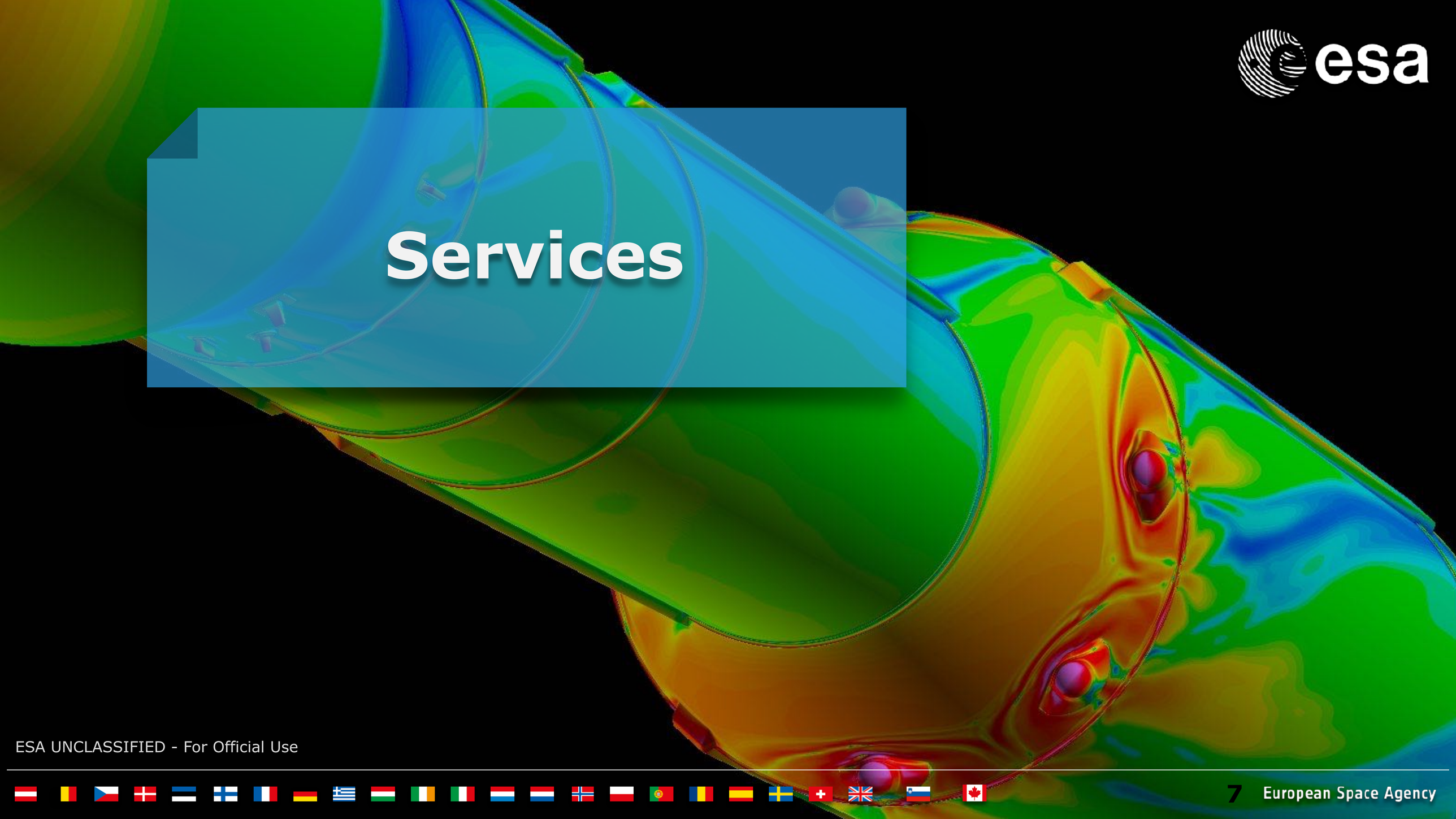
Activities of the Section: 4 main pillars

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

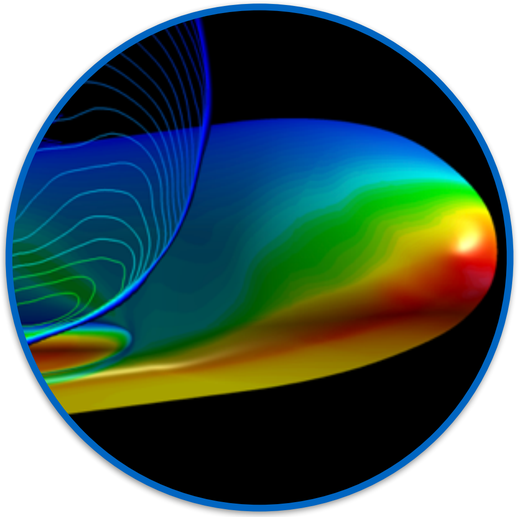


Services

Provision of Services to Projects: 4 main areas

Flight Vehicle Engineering

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

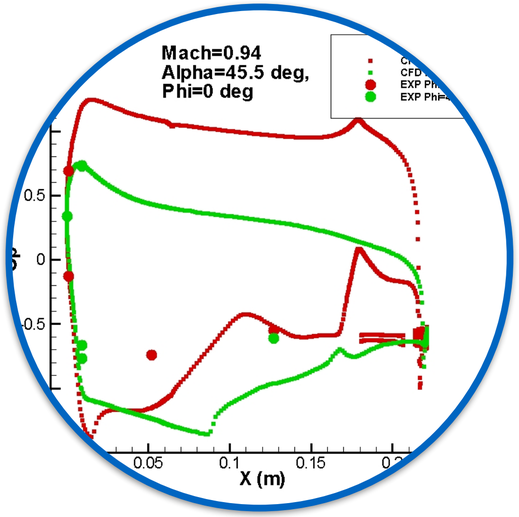


Assessments and Viability Investigations

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

Testing and Verification

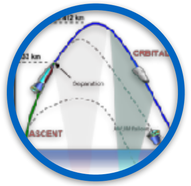
Testing of ATD of flight vehicles in facilities (external), and visualisation of missions performances



Post-Flight Data Analysis

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

Activities in technology

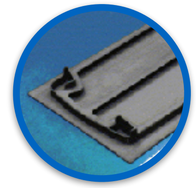


Flight Vehicle Engineering

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

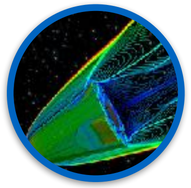
Decelerators

Parachute and parafoil, Inflatable Devices, Drogue Chutes



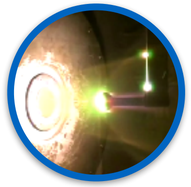
Design for Demise

Methods, techniques and technologies



Aerodynamics

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



Technology Test Beds

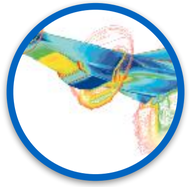
Wind Tunnel Testing, Plasma Tunnels, Drop Tests, Avionics Test Beds

Post Flight Analysis

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

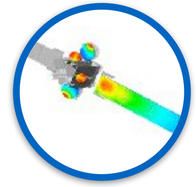
Thermodynamics

Computational Fluid Dynamics and Mechanics



Fluid Dynamics

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



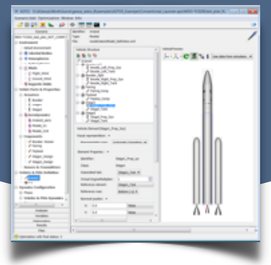
Contamination

Acoustics and Particle Contamination, Plume Contamination

Laboratories, assessments, and conferences

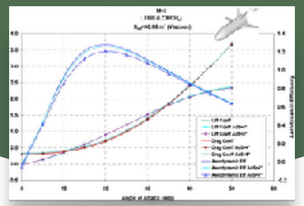
Laboratories

Testing facilities, engineering support tools, techniques



Assessments

Modular upper stage, micro-launchers, etc



Conferences

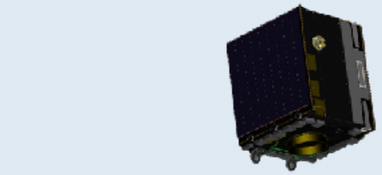
FAR, HISST, Radiation workshop, Internal Flow Dynamics workshop

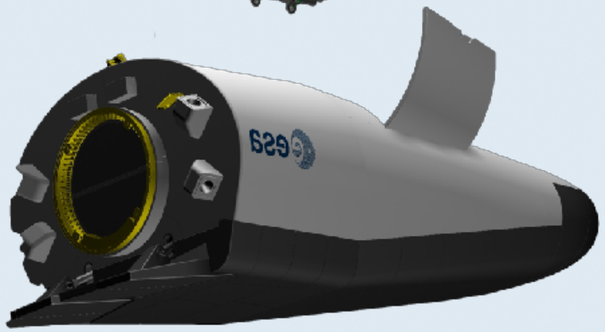
Activities: missions and R+D

Space Transportation

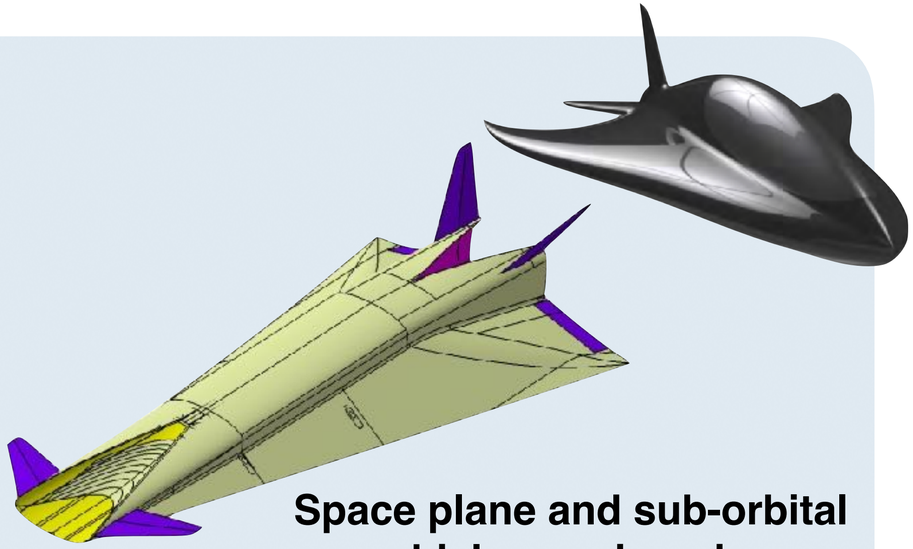
Expendable launch vehicles and ATD engineering

Reusable launch vehicles and ATD engineering

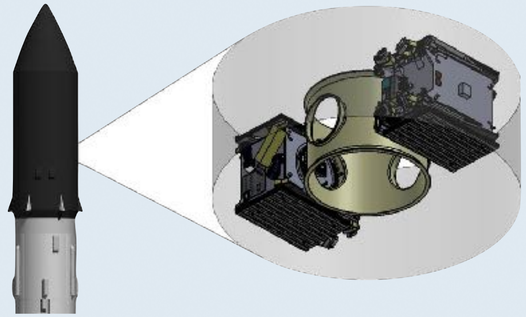




Upper stages vehicles engineering



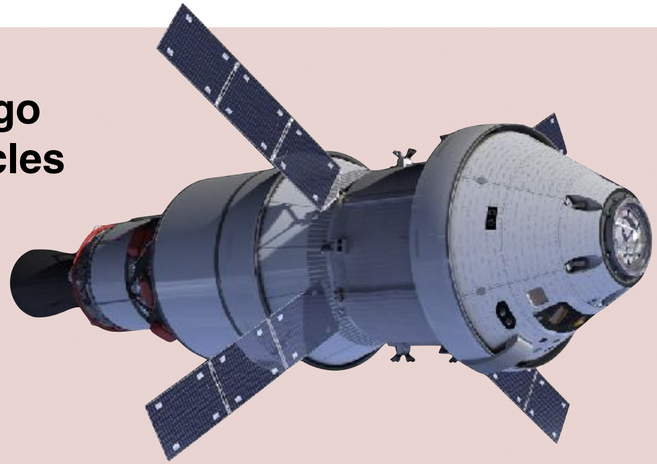
Space plane and sub-orbital vehicles engineering

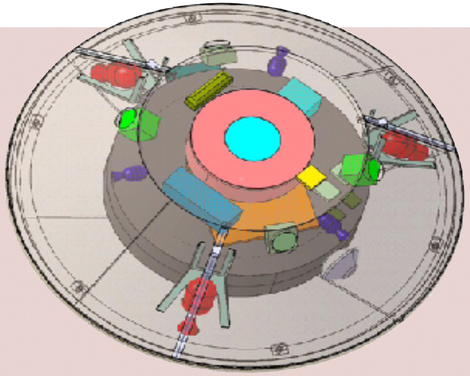


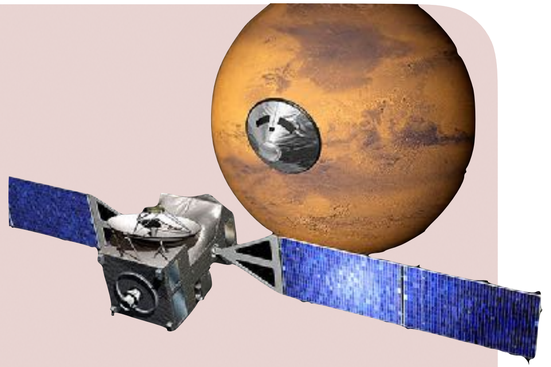
Servicing vehicles engineering

Exploration

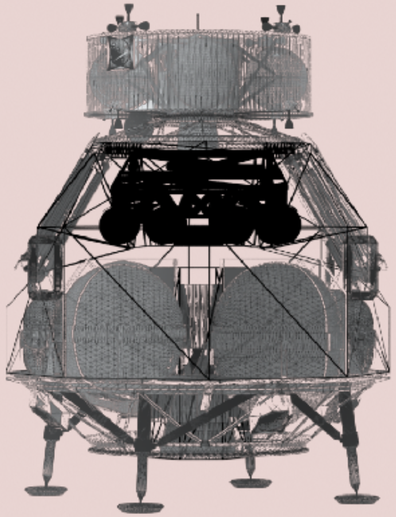
Human and cargo exploration vehicles engineering





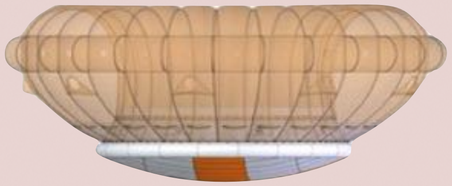


Planetary entry probe vehicles engineering



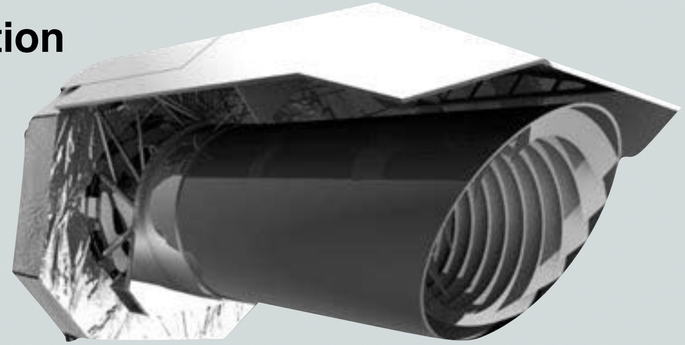
Lunar descent and ascent exploration vehicles engineering

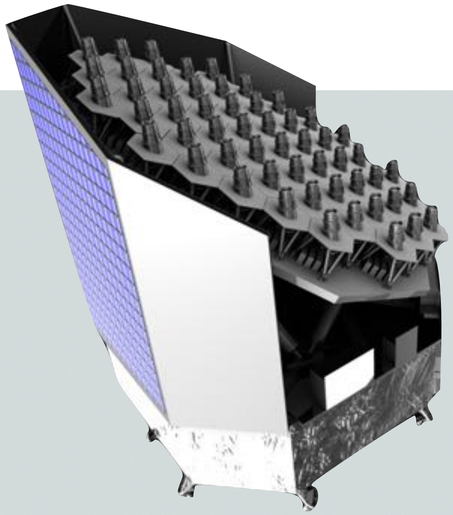
Decelerators for planetary exploration



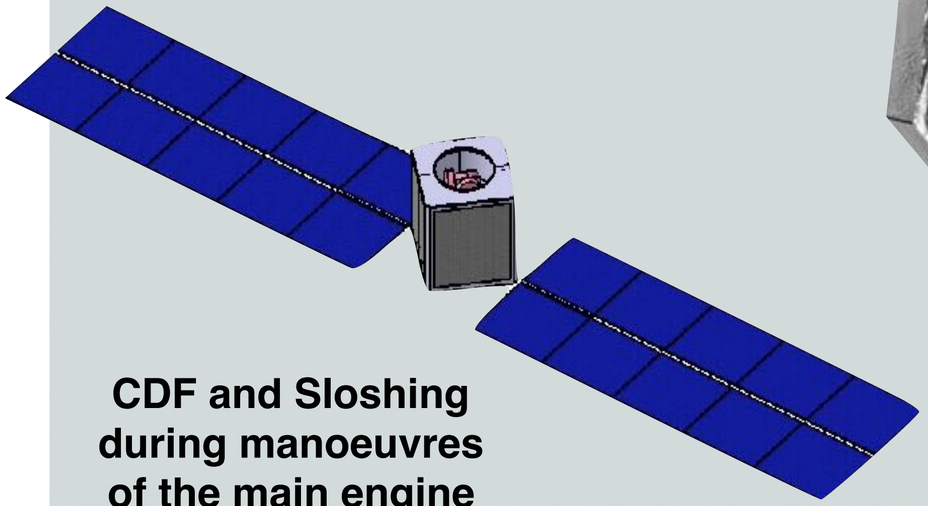
Science and Earth Observation

Fairing contamination analysis

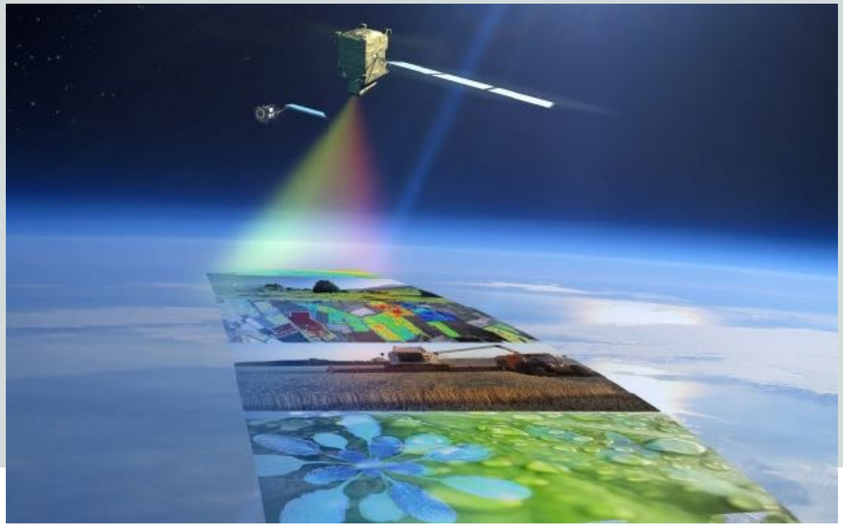




Plume contamination analysis



CDF and Sloshing during manoeuvres of the main engine



Upcoming TRP activities

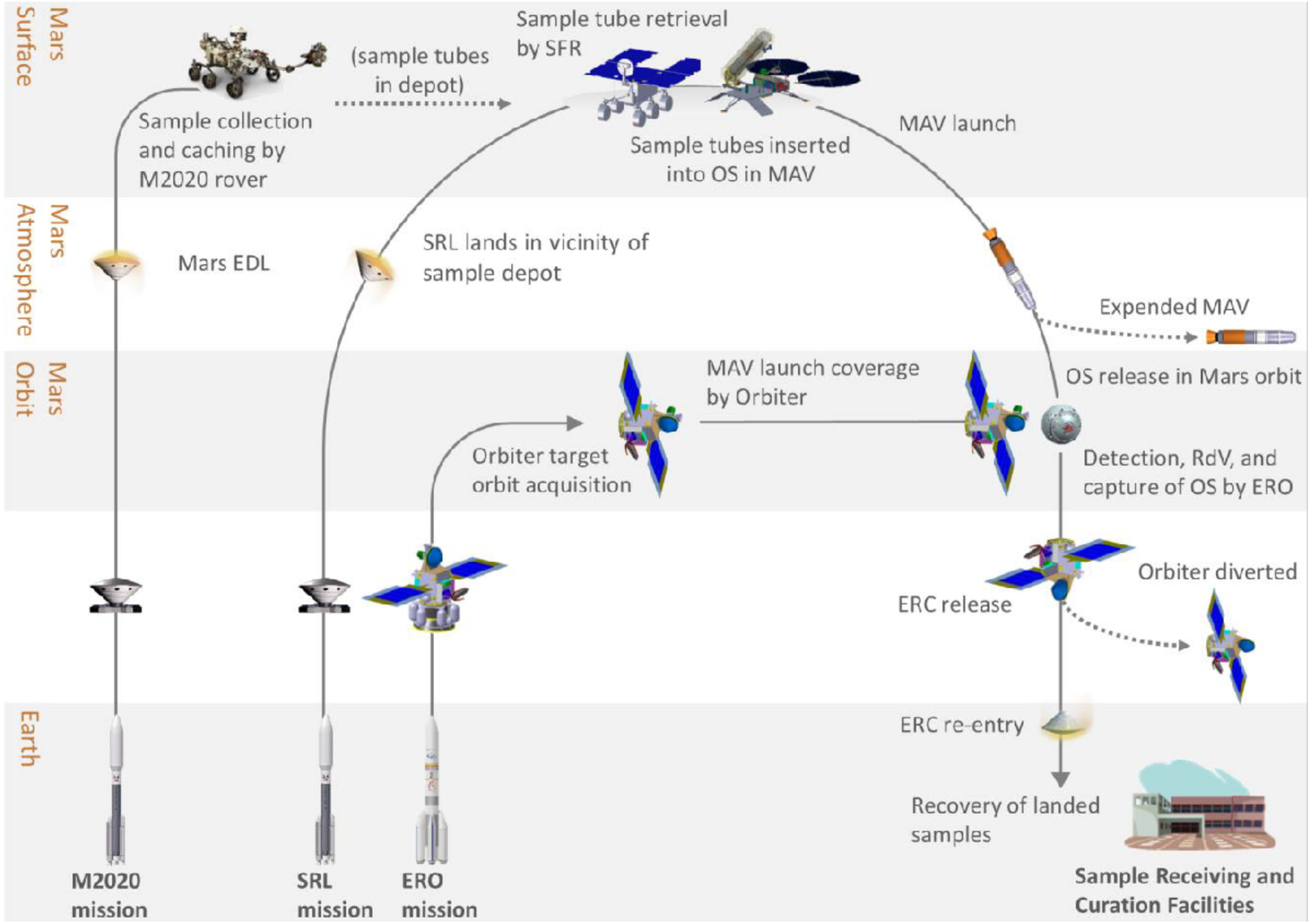
TRP activities in 2019

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)

Re-entry demonstrators: HEARTED

- 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


Thank you for
your attention