

WE LOOK AFTER THE EARTH BEAT

CESMA 1st International Symposium on Hypersonic Flight

Thales Alenia Space Experience and Perspectives in Hypersonic Flights

Rome
June 30 – July 1, 2014

OPEN

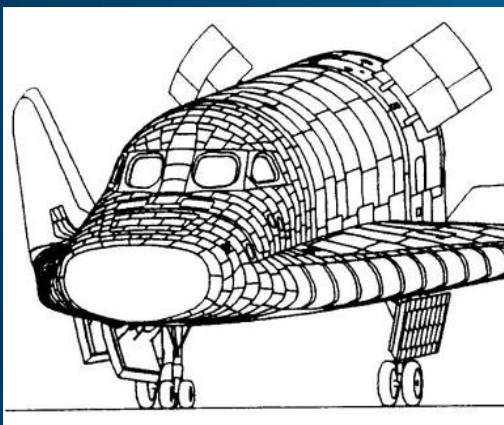
ThalesAlenia
A Thales / Finmeccanica Company *Space*

TAS HERITAGE IN TRANSPORTATION SYSTEM

Initial experience was Hermes.

After that, a series of studies were performed about crew & cargo transportation and re-entry systems (CRV, CTV, X-38). These studies always saw Thales Alenia Space in a major role.

In addition Thales Alenia Space was involved in some cooperation with US industries.



HERMES



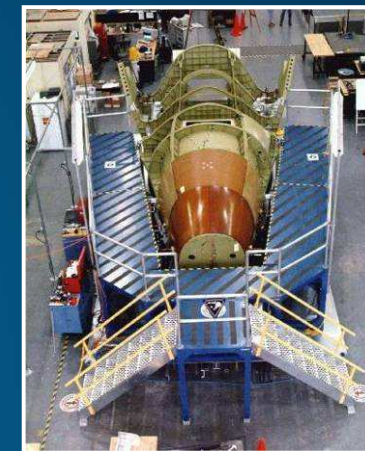
CTV / CTRV / OSP



CSTS / CLIPPER



CREW EXPLORATON VEHICLE



X-38



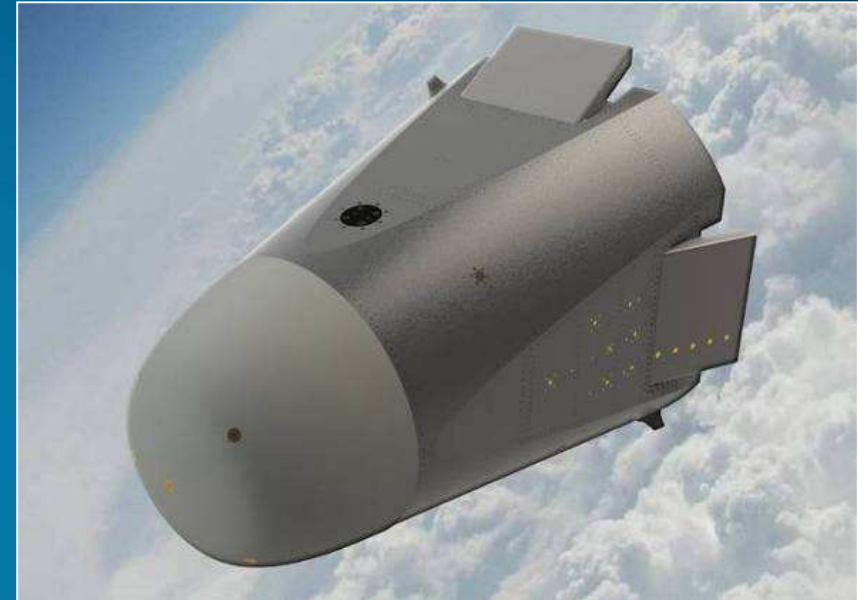
ARD

ATMOSPHERIC RE-ENTRY – EUROPEAN CONTEXT

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In the last years Italy has emerged as major player in Europe on re-entry technology

Thales Alenia Space is now leading the ESA EXPERT and IXV projects



Atmospheric Re-entry Technology Demonstrators - EXPERT

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**Flight Unit accepted in October 2011
Launch Service Procurement (ESA) on-going**

**Sub-orbital ballistic trajectory
Entry velocity: 5 km/s
Mission duration: \approx 1000 s**

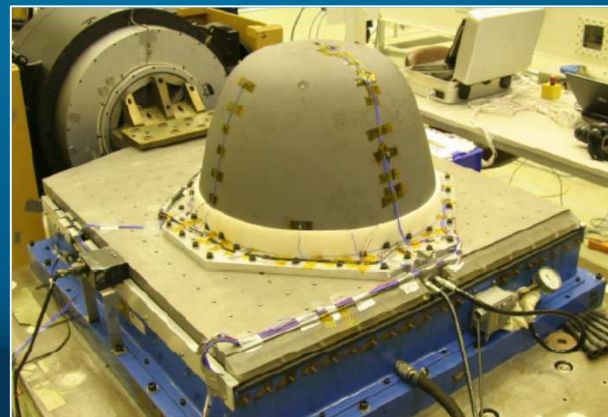
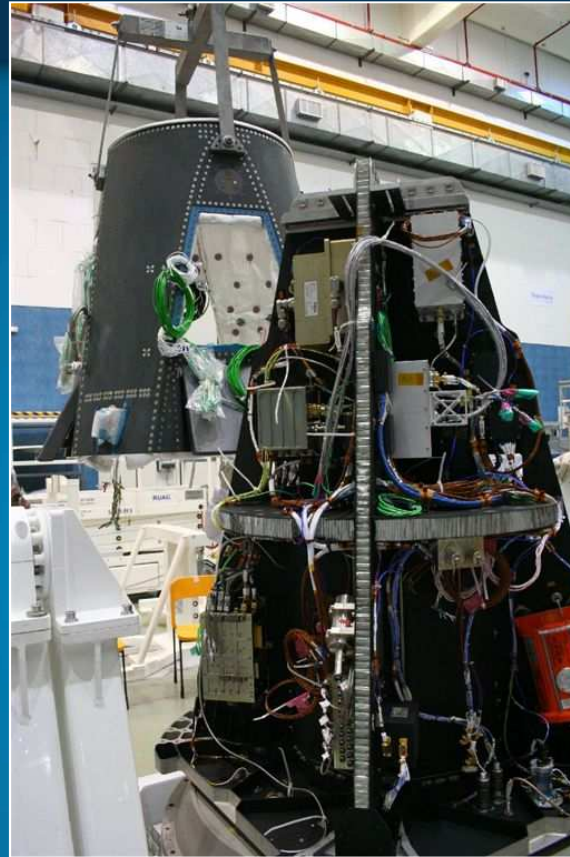
**Demonstration of re-entry technologies: metallic
TPS, solutions for sealing, steps/gaps control,
hot/cold structures interface**

**Acquisition of in-flight measurements through 14
scientific experiments**

**Validation of CFD tools and WTT facilities;
consolidation of ground-to-flight extrapolation
methodologies**

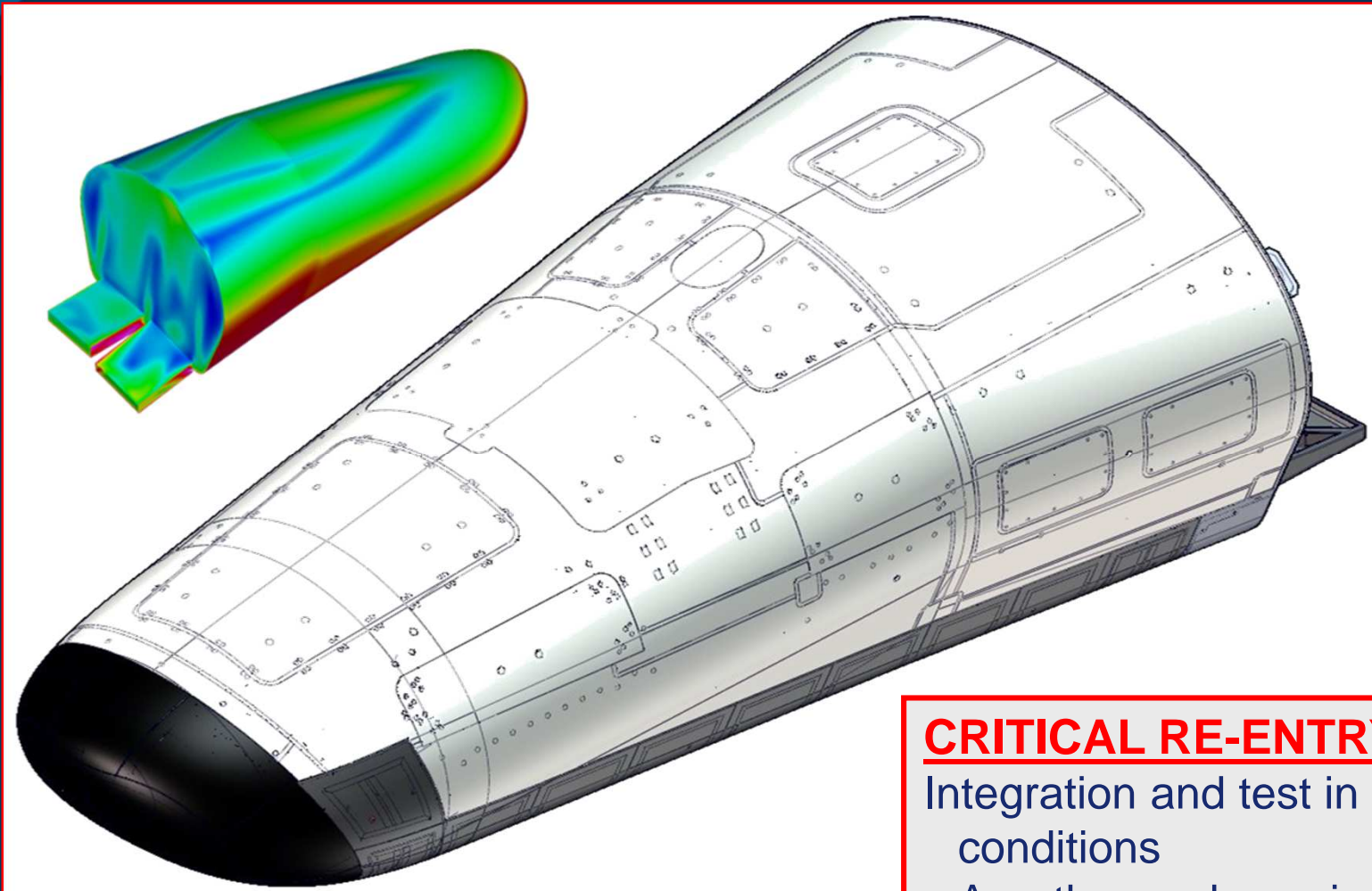


Atmospheric Re-entry Technology Demonstrators - EXPERT



Atmospheric Re-entry Technology Demonstrators - IXV

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SYSTEM DEMONSTRATION

Master the complete design, development, verification loop of an aerodynamically controlled re-entry system

CRITICAL RE-ENTRY TECHNOLOGY

Integration and test in realistic flight conditions

- Aerothermodynamics
- Thermal Protection System
- Guidance Navigation Control
- In Flight Experimentation
 - 20 experiments
 - ~300 sensors

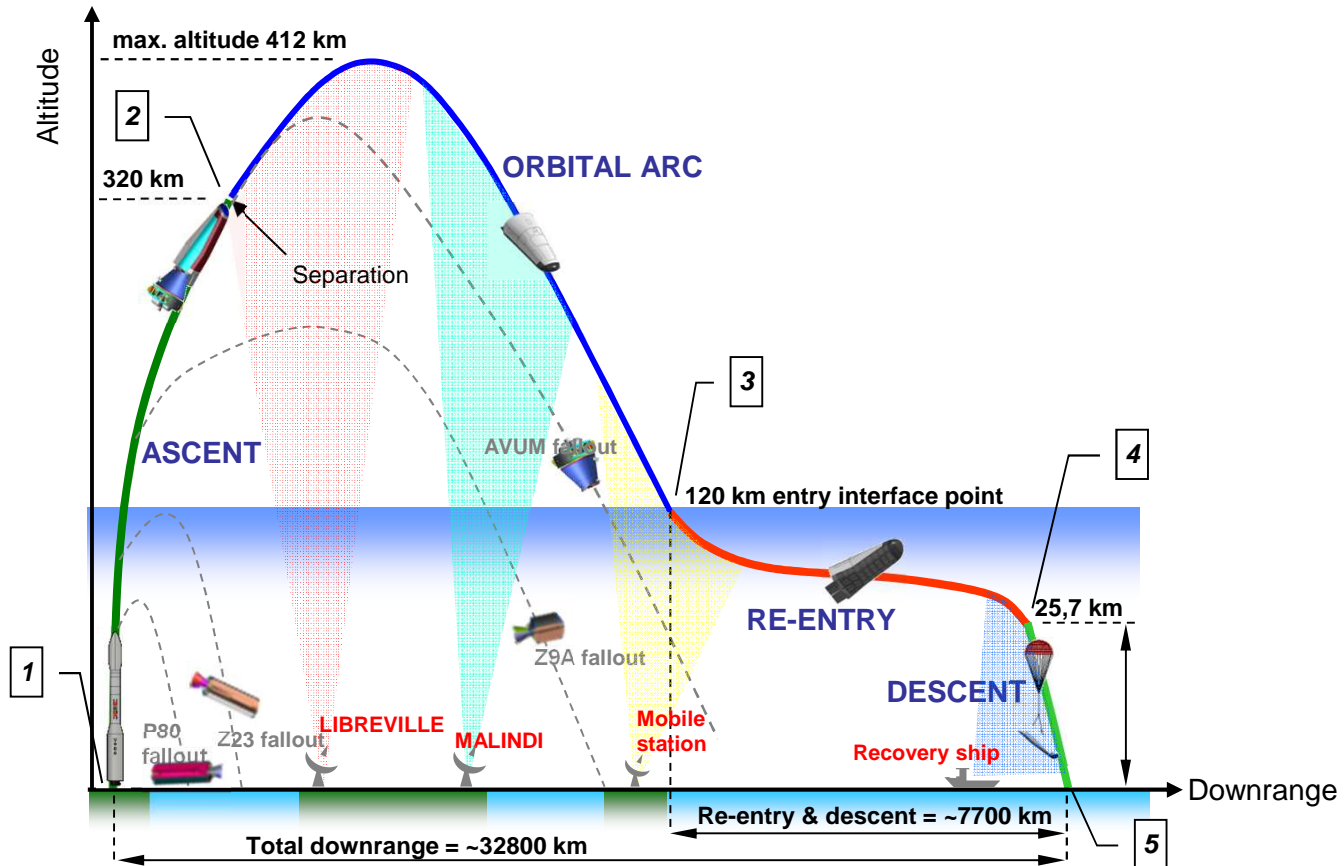
TECHNOLOGY VALIDATION

Investigation in the hypersonic regime and verification and improvement of design

methodologies and standards

- Vega launch with VEGA from Kourou (CSG)
- Atmospheric re-entry with automatic guidance and control
- Recovery in Pacific Ocean
- Around 101 min. mission duration (from lift-off to splash down)

- Orbital arc trajectory (≈ 412 km max altitude)
- 7,7 km/s velocity and $-1,2^\circ$ flight path angle at entry interface



Reference Timeline

1 – Lift off	T = 0 [s]	
2 – Separation	T = 966 [s]	→ Ascent segment 966 [s]
3 – Entry gate	T = 3857 [s]	→ Orbital segment 2891 [s]
4 – Descent gate	T = 5180 [s]	→ Re-entry segment 1323 [s]
5 – Splashdown	T = 6061 [s]	→ Descent segment 881 [s]

Atmospheric Re-entry Technology Demonstrators - IXV

IXV Prime Contractor



Descent System



Recovery System



Drop Test



Mission Analysis & Trajectories



RCS / FGSE



Cold Structure & Mech.



GNC



TPS & HS



Recovery & Transport.



AED/ATD



IFE



MGSE/EGSE



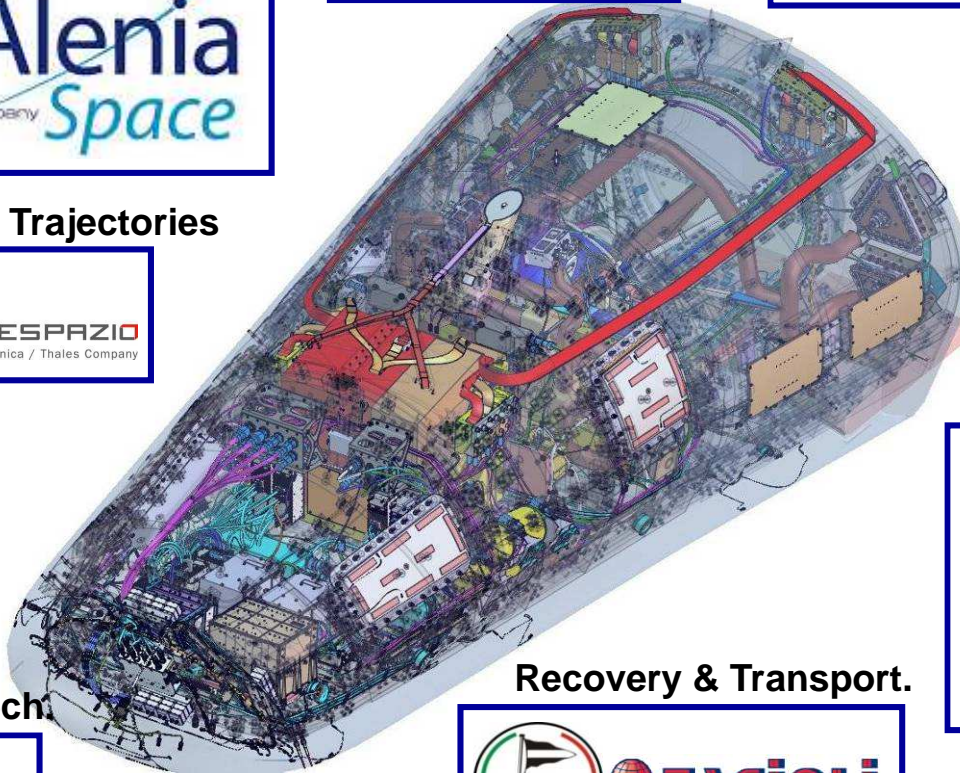
Operations & Ground Segment



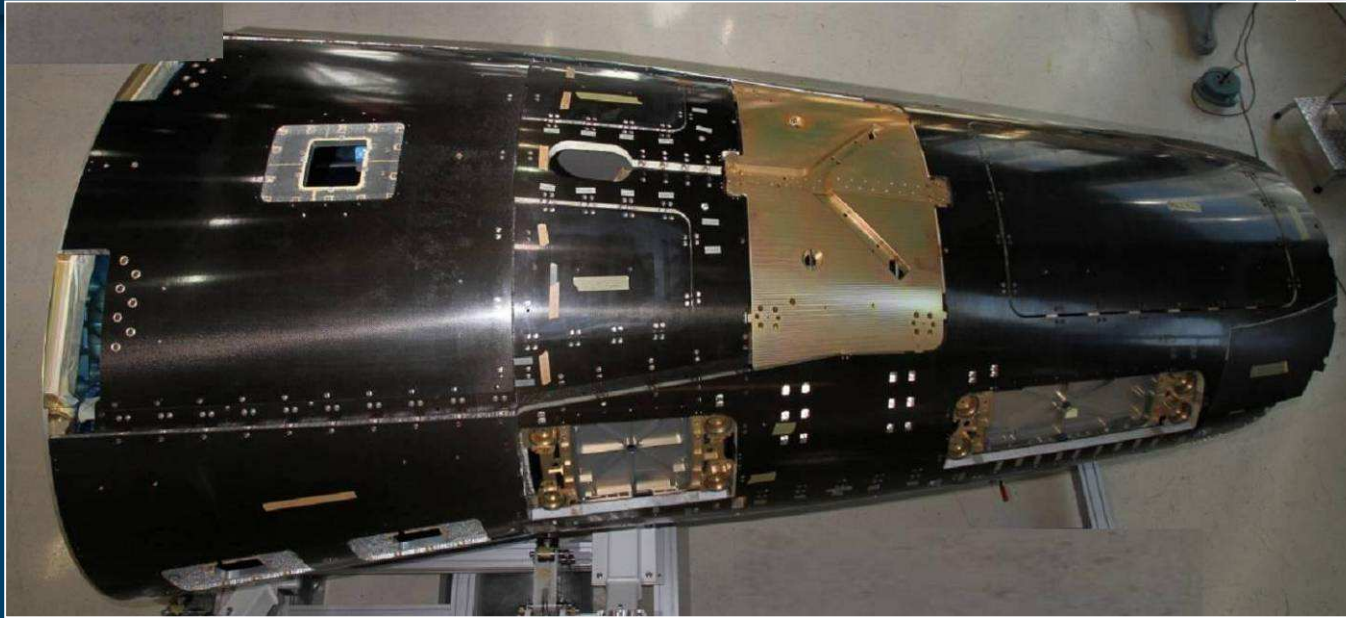
Avionics & SW



Flap Control



Atmospheric Re-entry Technology Demonstrators - IXV



Mass ~1900 kg;
Size: 5.00 x 1.54 x 2.22 m



Atmospheric Re-entry Technology Demonstrators - IXV

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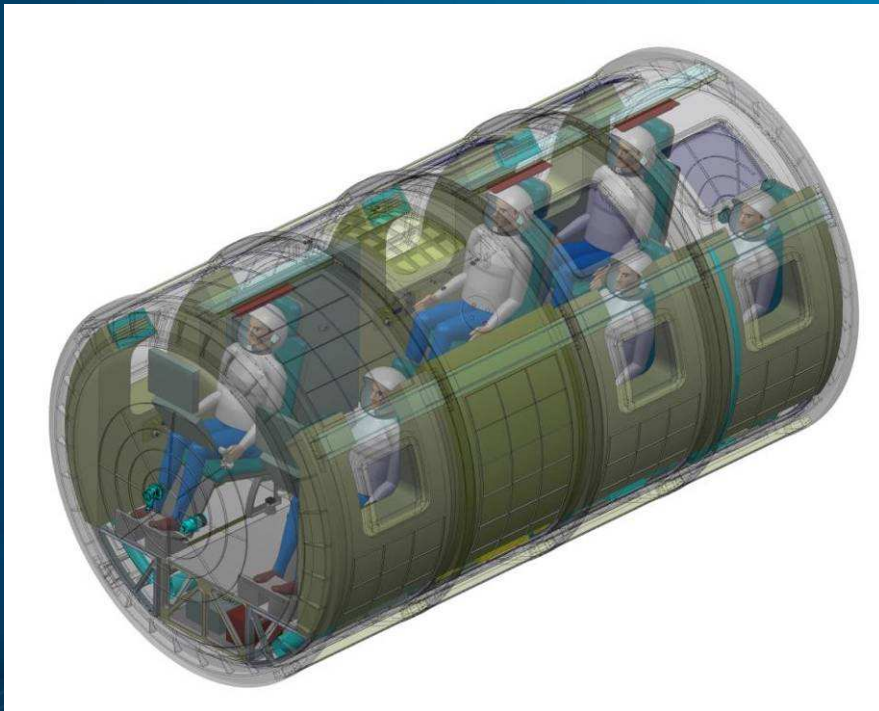
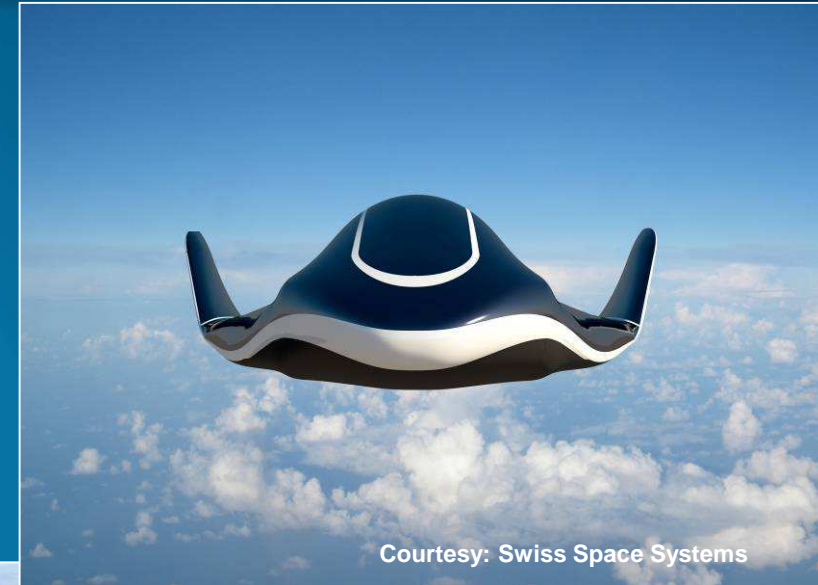
- IXV is a valuable asset for Europe in the in hypersonic re-entry systems field
- Experimental data gathered during the mission will constitute a sound basis to improve the knowledge in atmospheric re-entry phenomena and on the behavior of a complex re-entry system
- A further step, capitalizing the experience gained, may be envisaged with the objective to further develop European competences and technologies for atmospheric entry
- Such a further step may be oriented towards a future space transportation system capable to support several multipurpose applications in Exploration, Science, Earth Observation, Micro Gravity and Clean Space

Sub-Orbital Vehicles – SOAR by S3

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Thales Alenia Space has an Agreement in place with Swiss Space System (S3) for the development of the SOAR Pressurized Compartment.

The Compartment is intended to house scientific experiments and astronauts of the SOAR suborbital vehicle



Initial study phase completed

Level reached: SRR

Transportation & Reentry – Ongoing R&D

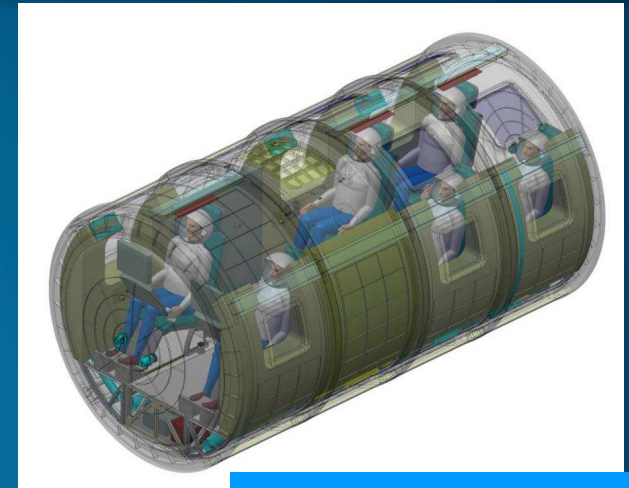
A significant R&D program is on-going in Thales Alenia Space to support next steps in transportation & re-entry technology



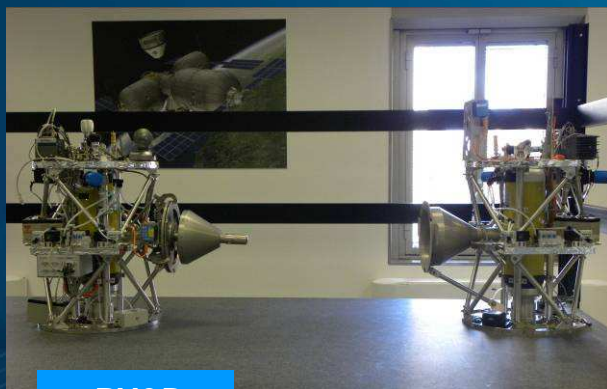
MPO METHODS AND ATD



HEALTH MONITORING



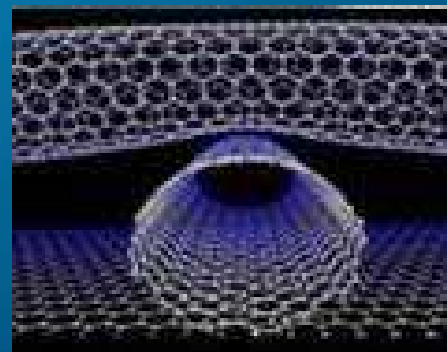
ERGONOMY & ADVANCED PRESSURIZED COMPARTMENTS



RV&D



ADVANCED TPS (ABLATIVE)



NANO, SMART STRUCTURES AND SENSORS



TCS & CSS COMPONENTS

Technology

- Ceramic Matrix Composites

Target Key operational requirement

- Design to re-usability for LEO re-entry vehicles

CMC sandwich panel

- External sheet: oxidation protection vs plasma environment
- Foam core: high thermal capacity, structural stability, low conductivity
- Inner sheet: tailored thermal conductivity for stress gradient relief
- Sneak flow inter-tiles seals
- 'Plug and Play' concept for external accessibility to inner interfaces



- Italy, through the latest development of EXPERT and IXV, has become a major player in Europe on hypersonic re-entry systems & technologies, leading the major projects currently running
- Thales Alenia Space in this context has matured a significant experience and is ready to contribute to the preparation of the next steps towards several multipurpose application fields.
- Under this view, IXV is an extremely valuable asset Europe and Italy can count on