

# The IXV Program

1st International Symposium

“Hypersonic flight: from 100.000 to 400.000 ft”

Rome, 30 June

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# Background

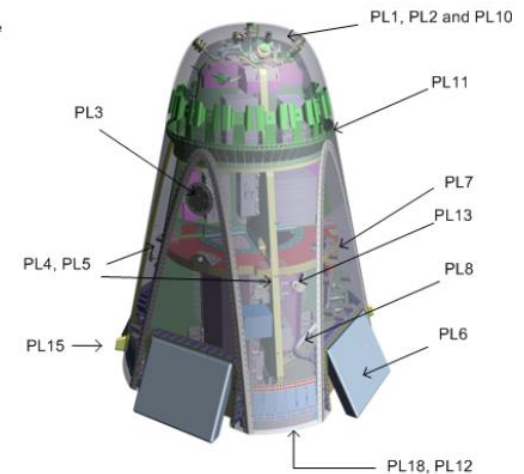
- ASI has contributed to the advancement of Italian know-how in Hypersonic Space Flight mainly with 2 ESA missions:
  - European eXPERimental Reentry Testbed
  - Intermediate eXperimental Vehicle
- This background has produced new ideas and concepts (Example: IRENE)

# EXPERT (European eXPERimental Reentry Testbed)

- Expert has led to the development of a ballistic re-entry capsule.
- The project was carried out in the frame of ESA GSTP-3.
- Italy has a leading role with a contribution about 50%,
  - *Prime Contractor: Thales Alenia Space Italy*
  - *CIRA is responsible to manage the P/L act's*
  - *other PS are: B, CH, NL and A*
- Vehicle ready to flight (waiting for launcher)

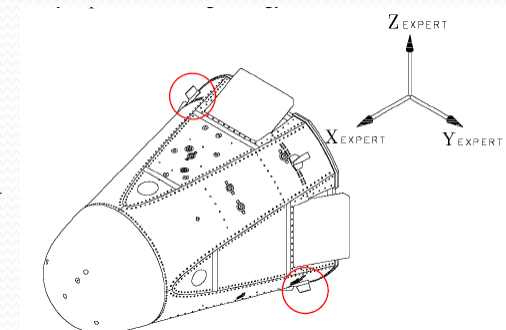
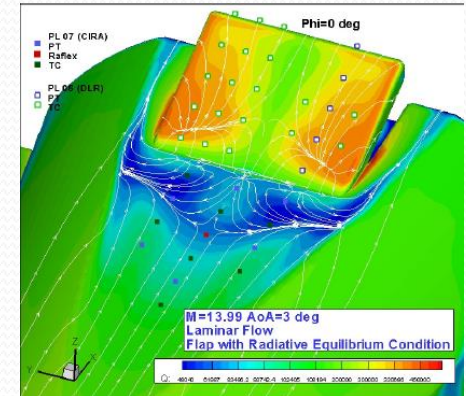
# EXPERT (European eXPERimental Reentry Testbed)

- EXPERT is designed to:
  - acquire quality data of critical aerothermodynamic phenomena encountered during hypersonic flights
  - provide industry with system experience of re-entry vehicle manufacturing and development of hypersonic materials and instrumentation.
- Expert is equipped with 18 experimental P/L



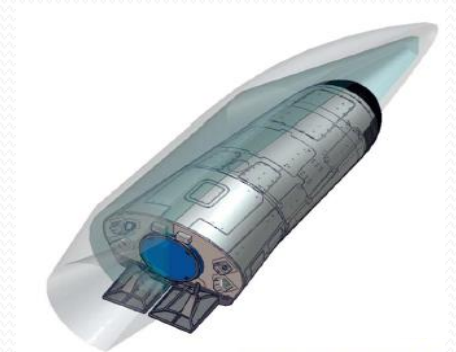
# EXPERT (European eXPERimental Reentry Testbed)

- Prime Contractor: Thales Alenia Space Italy – Turin
- CIRA
  - *Payloads Coordinator* with the main objectives to:
    - supervise all scientific aspects of embarked experiments
    - harmonize/optimize their integration on the EXPERT vehicle and their interfaces from mechanical, electrical and software point of view
  - *Direct Responsible of 3 Payloads corresponding to the following experiments:*
    - SWBLI Shock Layer – Boundary layer Interaction ahead the ceramic flaps
    - Natural LTT Laminar-To-Turbulent Transition,
    - Flying Winglet – UHTC Sharp Hot Structure “SHS”



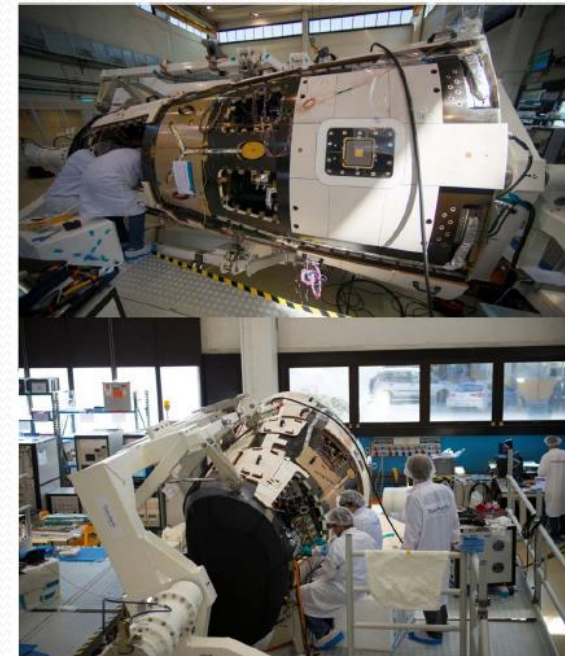
# IXV (Intermediate eXperimental Vehicle)

- IXV is an ESA FLPP project aimed at developing and testing technologies in the field of atmospheric re-entry through a sub-orbital flight of the test demonstrator
- Italy has the leading role with the contribution of about 36%
  - *Prime Contractor: Thales Alenia Space Italy*
  - *other PS are: Belgium, France, Ireland, Portugal, Spain, Switzerland*
- VEGA Launch slated for October 2014



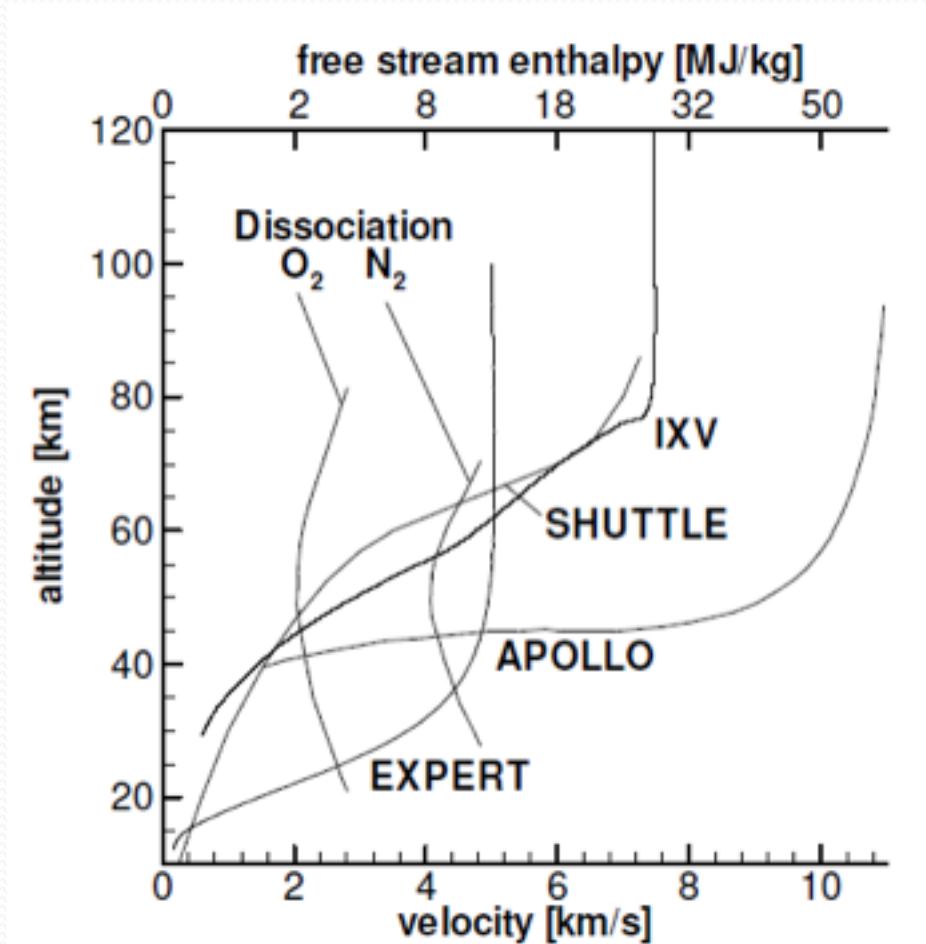
# IXV (Intermediate eXperimental Vehicle)

- IXV objectives are:
  - TPS, for verification and characterization of thermal protection technologies in representative operational environment;
  - AED-ATD, for understanding and validation of aerodynamics-aerothermodynamics phenomena and improvement of design tools (i.e. CFD and WTT);
  - GNC, for verification of guidance, navigation and control techniques in representative operational environment (i.e. re-entry from LEO);
  - Flight dynamics, to validate the vehicle model during actual flight, focused on stability and control derivatives (VMI experiment).



*ESA Courtesy*

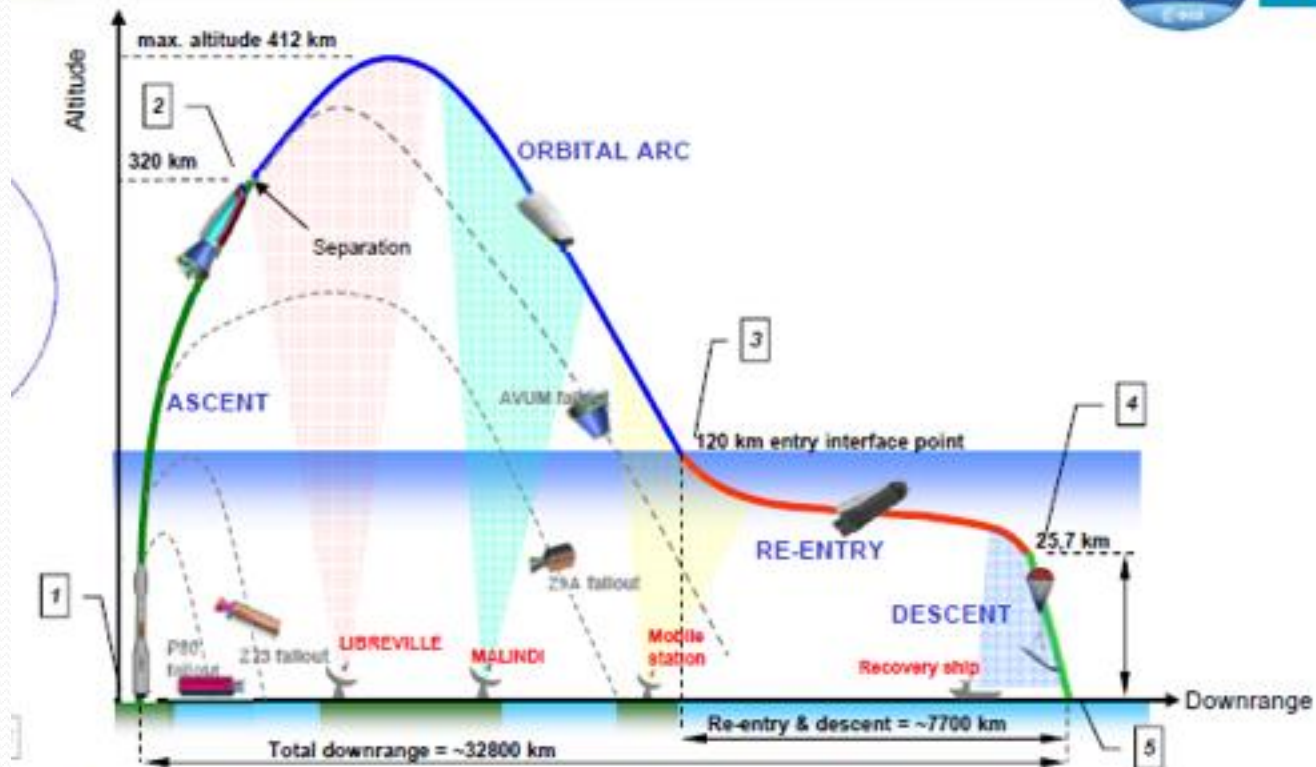
# IXV (Intermediate eXperimental Vehicle)



ESA Courtesy



# IXV (Intermediate eXperimental Vehicle)



## Reference Timeline

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

ESA

# IXV (Intermediate eXperimental Vehicle)

- **Industries**

- Thales Alenia Space – System\* design authority, synthesis, integration, testing (including experimentation, aerodynamics, aerothermodynamics, trajectories, GNC, software, thermal, mechanical, avionics...)
- Alenia Aermacchi – Avionics and Software Subsystem
- Selex – Power Distribution Unit
- Avio – Thermal Protections (cork base and silicon base ablative materials)
- AeroSekur – Recovery Subsystem
- Altec – Mission Control Centre and Ground Segment
- TelematicSolutions – Ground Stations, Antennas and Telemetry
- Telespazio – Communication Network
- Elv – VEGA Mission Analysis Support
- Neri – Recovery Operations
- DTM- Composite Thrust Cylinder

- **Research Centres**

- CIRA – Experimentation, Aerothermodynamics, Scirocco PWT, System Drop Test
- CNR/INSEAN – Water Impact Tests

- **Universities**

- UniRoma – Aerothermodynamics, Computational Fluid Dynamics
- UniNapoli – Aerothermodynamics, Wind Tunnel Tests
- UniPadova – Propulsion Components Tests

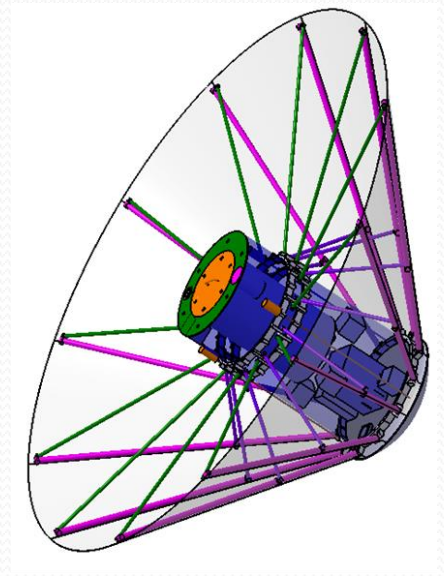
# IXV (Intermediate eXperimental Vehicle)

- Italian Space Agency supports the project:
  - Altec Mission Control Center : PMM/ISS MSC facility;
  - Malindi Ground Station and ASINET network;
  - Technical Assistance

ASI, through CIRA, supports ESA in the area of In flight Measurements, Aerodynamics and aerothermodynamics, Operations.

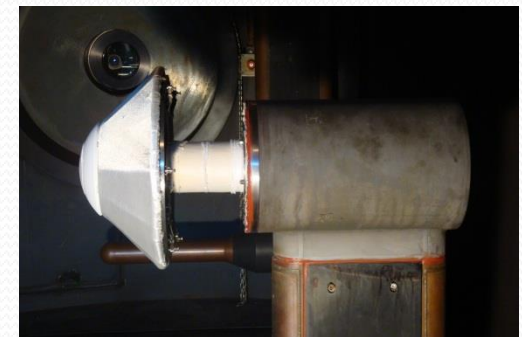
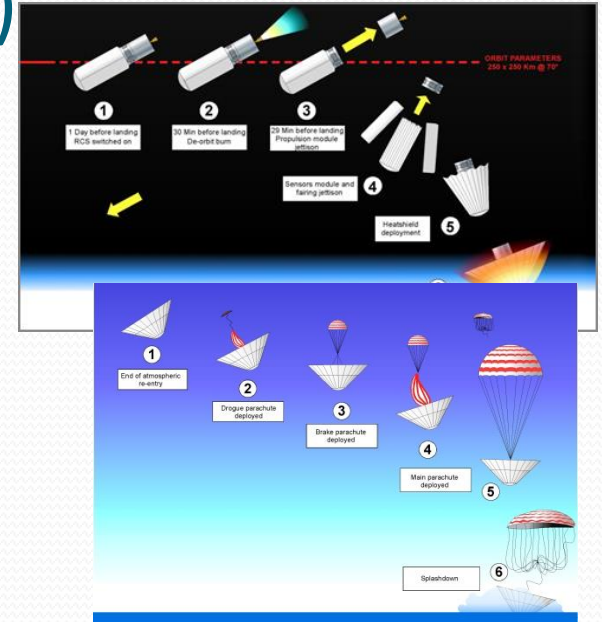
# IRENE (Italian Re-Entry Nacelle)

- The project IRENE (Italian Re-Entry Nacelle) is aimed at developing a small multipurpose platform with re-entry capability.
- IRENE, after an ASI-funded feasibility study, has been funded by ESA GSTP office



# IRENE (Italian Re-Entry Nacelle)

- The capsule is designed to be reusable, low cost and able to perform various types of missions.
- The capsule has the following layout:
  - Structure (cylinder)
  - Nose able to withstand heat fluxes (C-C and ceramic foam)
  - Deployable Thermal Protection System (umbrella like structure) realized with off-the-shelf high temperature fabric
- Thermal Protection System has been successfully tested in CIRA PWT Scirocco.
- It is under consideration the opportunity to launch the capsule with the Maxus sounding rocket mainly to assess mechanisms and flight-dynamics IOV.



# Conclusions

- Italy has a strong background in key fields of hypersonic flight
- National know-how well distributed in Research Centers, Academia and Industry
- New opportunities of technological advancement thanks to the synergy between Aeronautical and Space Systems: e.g. Materials, High fidelity Models, Actuators, CFD,
- IXV flight will be instrumental in collecting data.