THOR

THOR: Innovative Thermal Management Concepts for Thermal Protection of Future Space Vehicles
「将来宇宙輸送機のための革新的熱防御法の研究開発」

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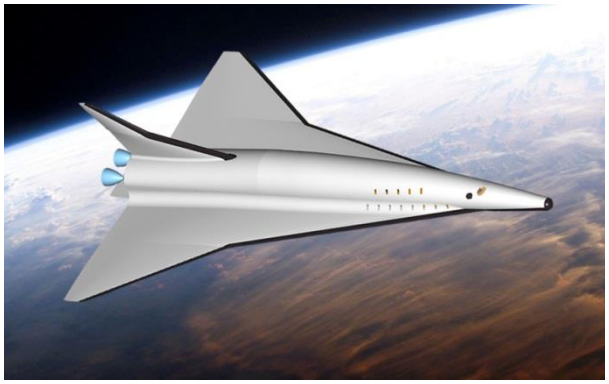
Motivation - Future Requirements

When entering a planetary atomosphere space vehicles are exposed to extreme themal loads. To protect the vehicles a thermal protection system (TPS) is required for successful mission.

Blunt body (At present)

- low aerodynamic performance
- Low aeroheating load



Slender body (Next Generation)

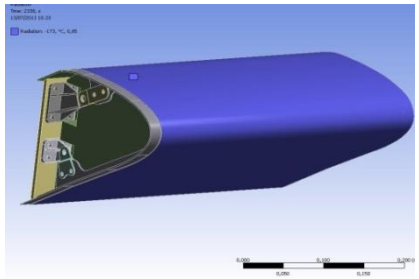
- High aerodynamic performance
- **<u>High aeroheating load</u>**

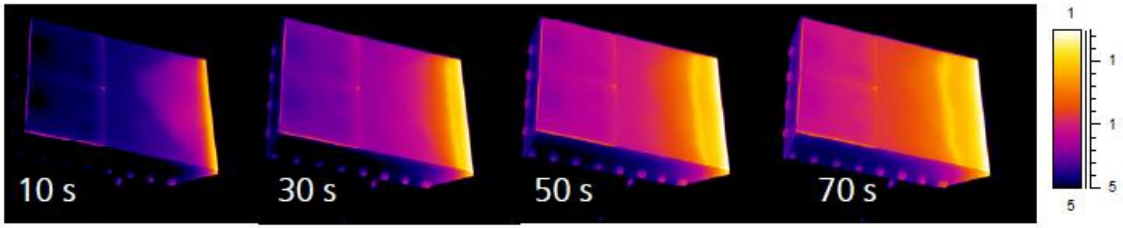
THOR project aim to develop brand-new thermal protection system (TPS) for the next generation reentry vehicles.

THOR Primary Objective & Strategy

- The main objective of the THOR project is to design, develop, implement, test, and validate new thermal management concepts for atmospheric entry of space vehicles.

- The technical considerations for each concept include
  - detailed elaboration of the thermal management approach,
  - technical implementation including
    - Sample (Prototype TPS) manufacturing,
    - material characterization
  - redundant consolidation of the concepts by
    - Experimental verification in high enthalpy wind tunnel facilities and numerical simulation.

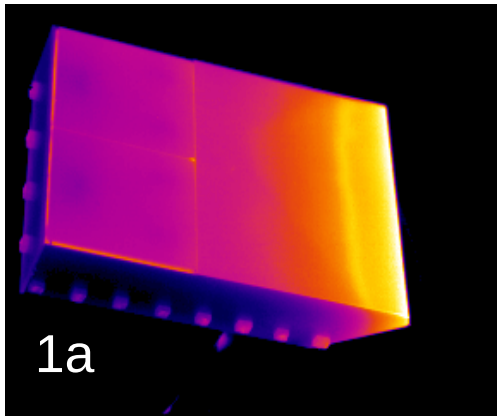




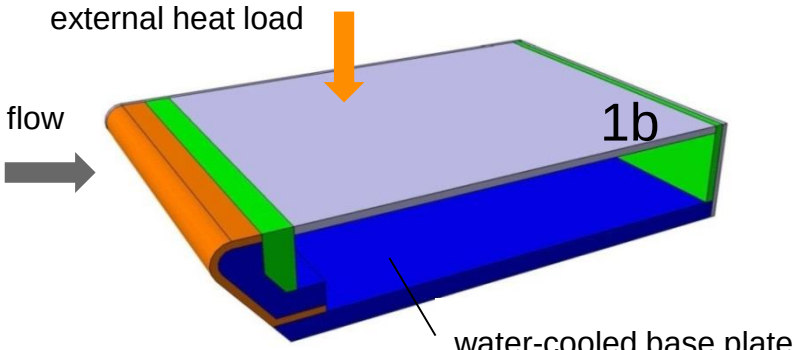
Passive and Active Cooling Concepts

Passive cooling

(1a) Innovative composite materials with integrated highly conducting fibres

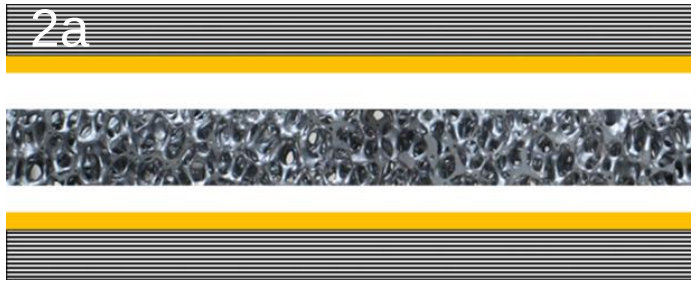


(1b) TPS structures with intensive radiative heat exchange.

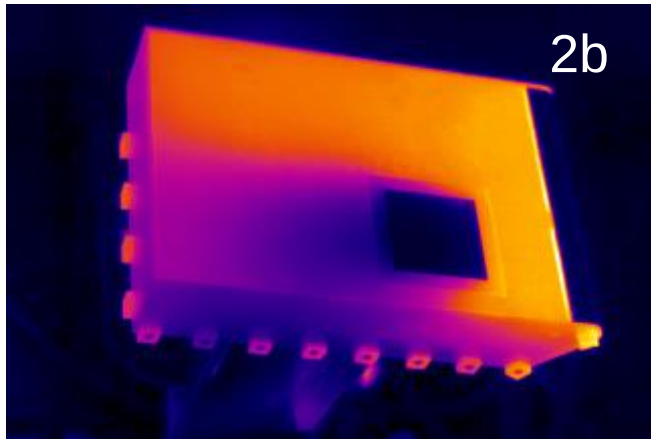


Active cooling

(2a) Sandwich-TPS with ceramic foams



(2b) Transpiration cooling of external surfaces

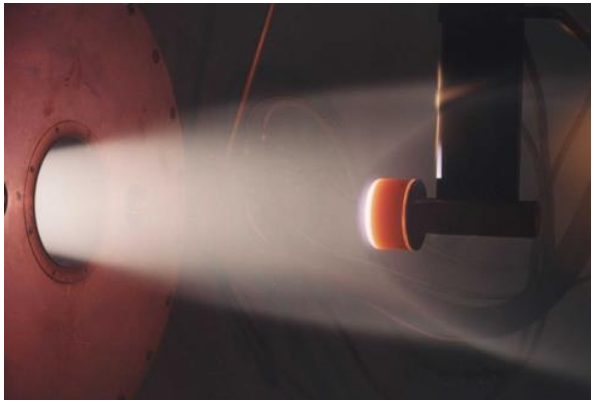


Experimental verification

Arc tunnel LBK (DLR Köln)

Thermal verification

Not real flight condition however long test time

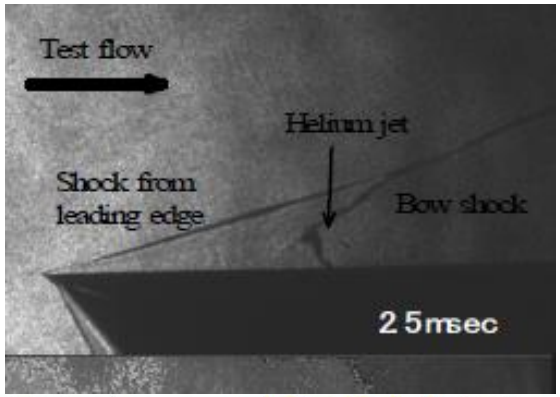


Complementary
Wind tunnel test

Shock tunnel HIEST (JAXA Kakuda)

Aerodynamical interference

Real flight condition however short test time (order of milli-second)



Kick-off meeting at DLR Köln Feb.2013

DLR tecnalia TÜBİTAK UZAY University of Applied Sciences and Arts of Southern Switzerland SUPSI

AAC aerospace & advanced composites JAXA Japan Aerospace Exploration Agency ThalesAlenia Space A Thales / Finmeccanica Company