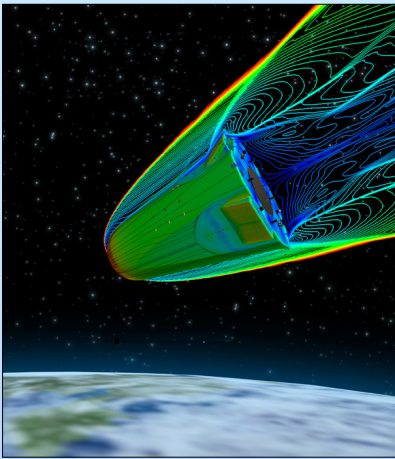


# IRS Payloads on EXPERT

## EXPERT – European eXPERimental Re-entry Testbed

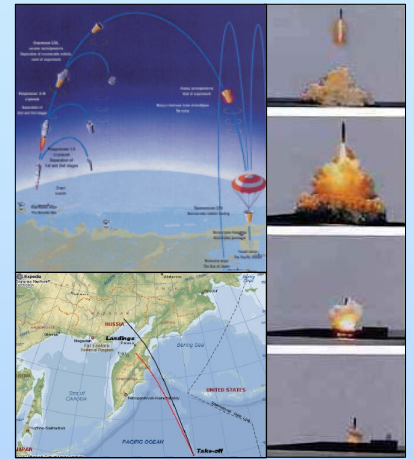


### Objectives

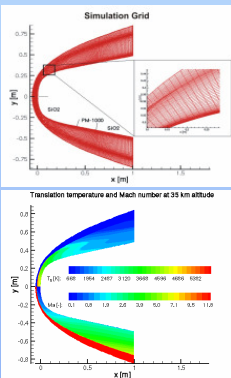
- ESA project to examine various critical phenomena related to atmospheric re-entry:
  - Real gas effects (shock wave boundary layer interaction)
  - Transition
  - Plasma
  - Catalysis properties
  - Aerothermodynamic measurement techniques

### Outline

- Capsule dimensions: 1.6 m length x 1.2 m diameter
- Launch from submarine on top of Russian Volna rocket
- Parabolic suborbital flight path
- Re-entry conditions:  $v_e = 5 \text{ km/s}$ ,  $m_e = 436 \text{ kg}$ ,  $\gamma_e = -7,4^\circ$

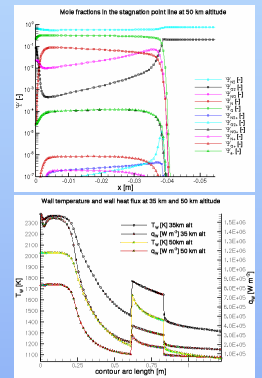


## Numerical Simulation



- Numerical calculation of thermo-chemical nonequilibrium flow around EXPERT using axisymmetric URANUS code
- Simulation on adapted structured 116x90 cells mesh
- Calculations for a chosen set of altitudes (e.g. point of max. thermal load, point of max. plasma radiation)

- Air model:
  - 11 components ( $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{NO}$ ,  $\text{N}$ ,  $\text{O}$ ,  $\text{N}_2^+$ ,  $\text{O}_2^+$ ,  $\text{NO}^+$ ,  $\text{N}^+$ ,  $\text{O}^+$ ,  $e^-$ )
  - 6 temperatures ( $T_{tr}$ ,  $T_{vib,N_2}$ ,  $T_{vib,O_2}$ ,  $T_{vib,NO}$ ,  $T_{rot}$ ,  $T_e$ )
- Detailed  $\text{SiO}_2$  catalysis model for SiC surfaces and global catalysis model for PM1000 surfaces
- CVCV model used for modelling the energy exchange between inner degrees of freedom and chemistry

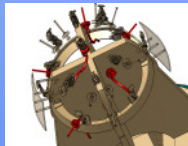


## IRS Payloads on EXPERT

### PYREX Nose Heating Experiment

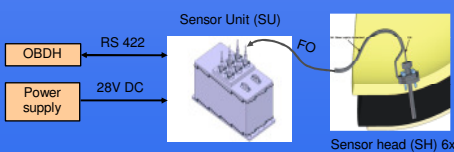
#### Objectives:

- Temperature and heat flux measurement inside nose cone
- Validation of numerical models/ codes



#### System consists of:

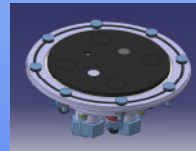
- 6 PYREX sensors (SH 1-6)
- Mounting on cold structure
- Fiber optics and holding brackets
- Sensor Unit (SU)
- Interface to Onboard Data Handling Unit (OBDH)



### PHLUX Catalysis Experiment

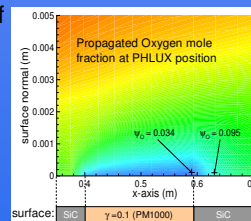
#### Objectives:

- Determination of local dissociation degree
- Investigation of relaxation effects of the plasma based on the heat flux measurement of materials with known catalytic properties
- Validation of the numerical codes and models for the determination of the catalytic effects



#### Measurement principle:

Experiment is based on measurement of different heat fluxes on samples due to material selection of different, but known catalytic behavior.

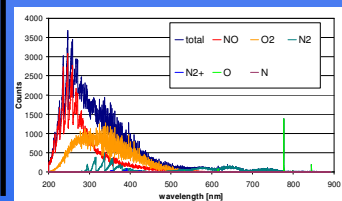
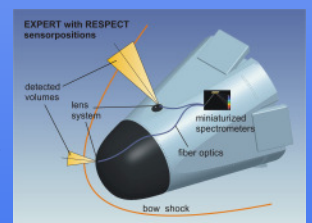


### RESPECT Reentry Spectrometer

#### Objectives:

- Spectrally resolved measurement of plasma radiation
- Validation and improvement of numerical methods and analysis tools, especially of chemical models and radiation mechanisms

EXPERT capsule with positions of sensor heads and spectrometer units



Expected spectro-spectrometer signal and contribution of single species

## Contact



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