

# SHEFEX II

## A Mission report

SHEFEX Team



Knowledge for Tomorrow

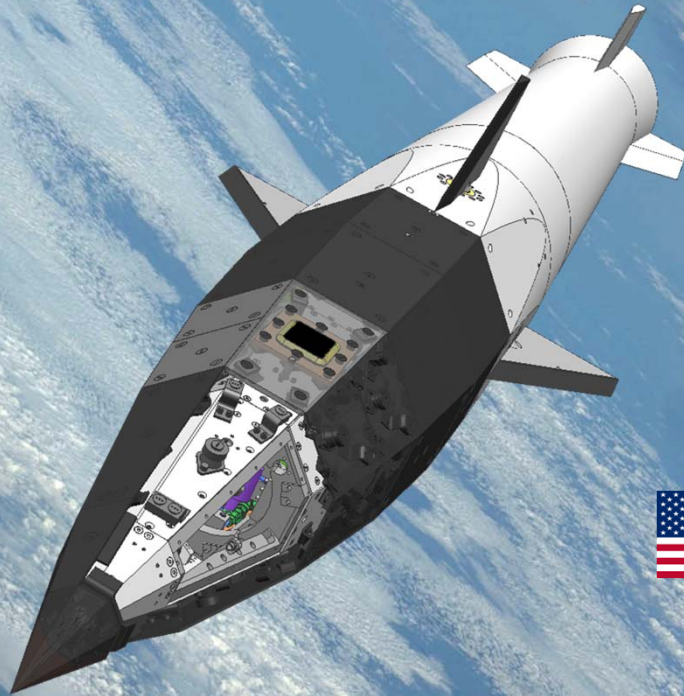
# Andoya, Norwegen

## June 22<sup>nd</sup>, 2012, 21.19 MESZ





# Partners of SHEFEX II



Australian Government  
Department of Defence  
Defence Science and  
Technology Organisation

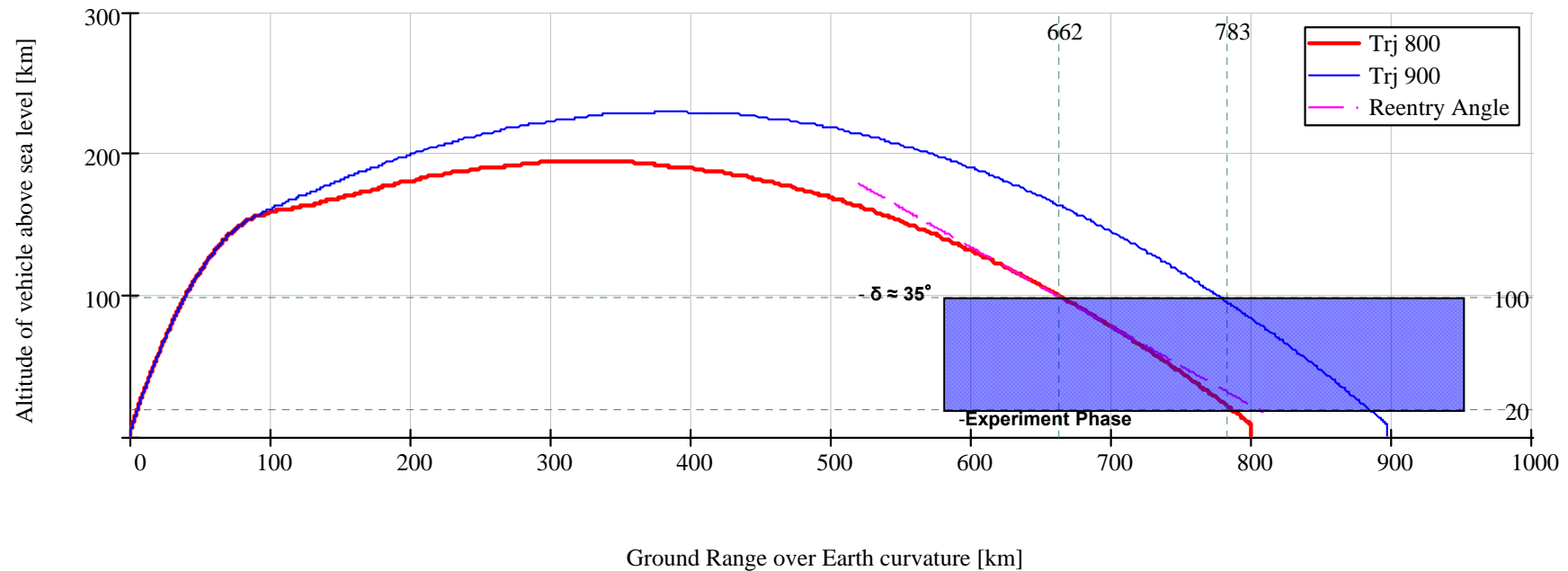


## SHEFEX I versus SHEFEX II

- Re-entry velocity rises from 1.4 km/s to 2.8 km/s
- Experiment duration rises from 15 s to 50 s
- Active flight control during entry phase (100-20 km)
- Faceted, symmetric payload tip
- Measurement also during ascent phase
- Extension of instrumentation and experiments



## SHEFEX 2 Expected flight path



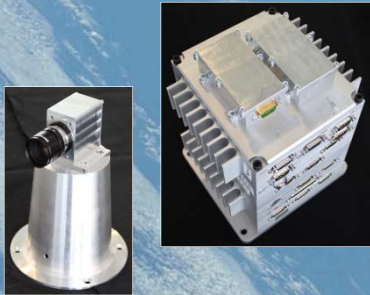
- Apogee Trj800 (Baseline)  $h \approx 194 \text{ km}$
- Ground range  $GR \approx 800 \text{ km}$
- Reentry angle  $\delta \approx 35^\circ$
- Ground range Experiment Phase  $GR_{\text{exp}} \approx 120 \text{ km}$



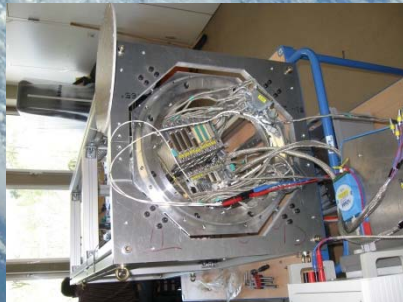


# Experiments on SHEFEX II

## Hybrid navigation system



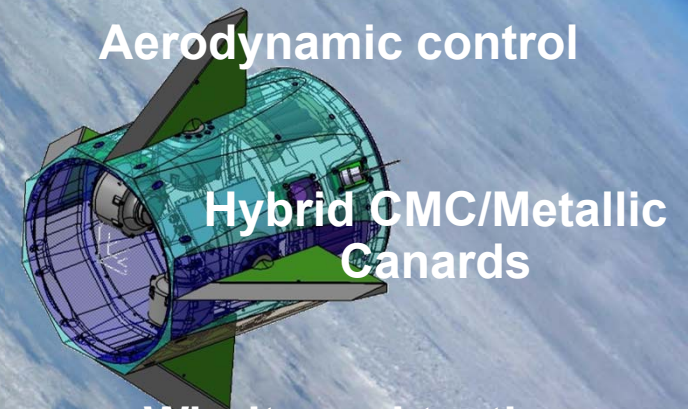
Instrumentation, TC,  
Heatflux, pressure,  
Pyrometer, Compare (IRS)



## New ablative fin structure

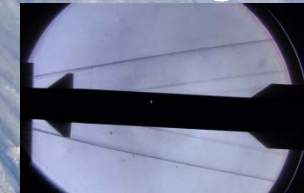


## Aerodynamic control



Hybrid CMC/Metallic  
Canards

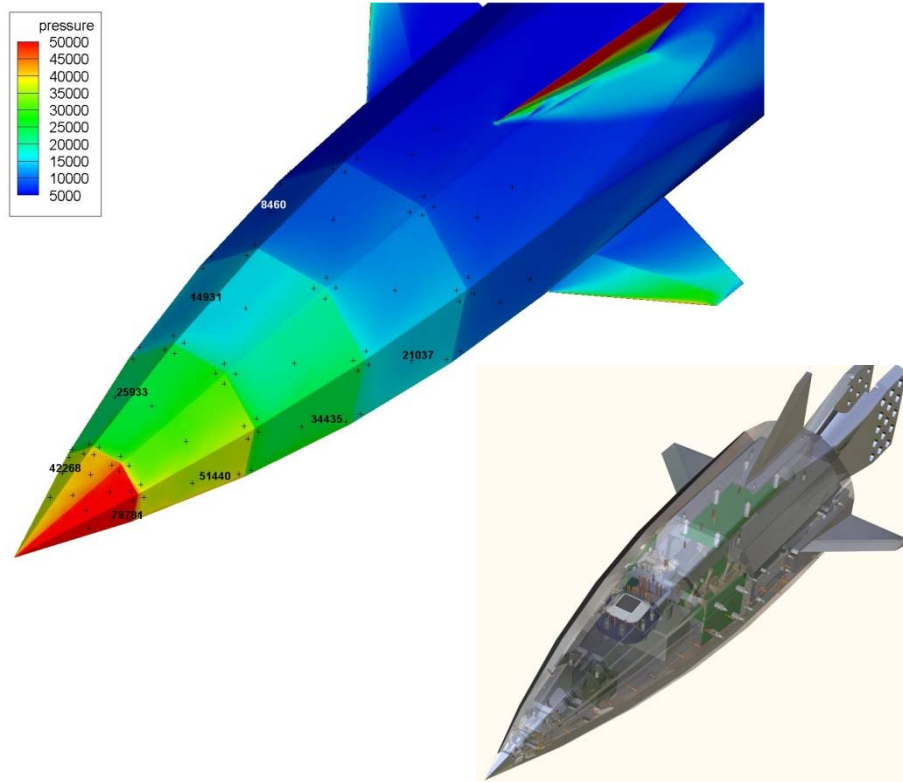
## Windtunnel testing



9 TPS Systems (ASTRIUM,  
MT-A, AFRL, DLR)

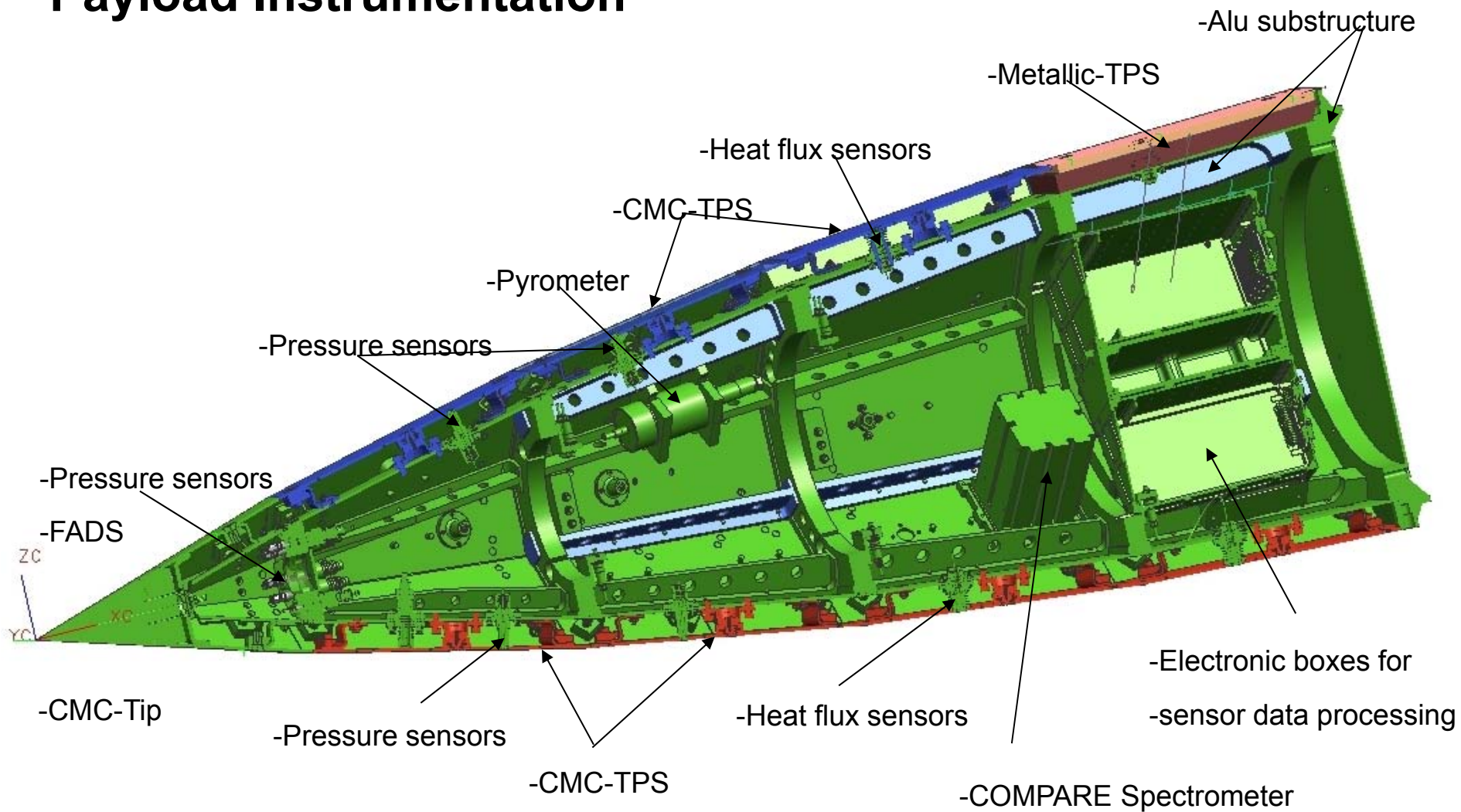
1 actively cooled segment  
4 „Hot“ Antennas

# SHEFEX II: Generation of aerodynamic data base





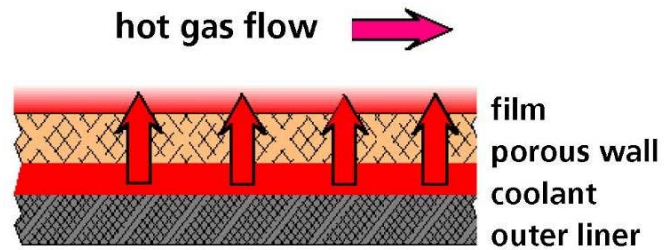
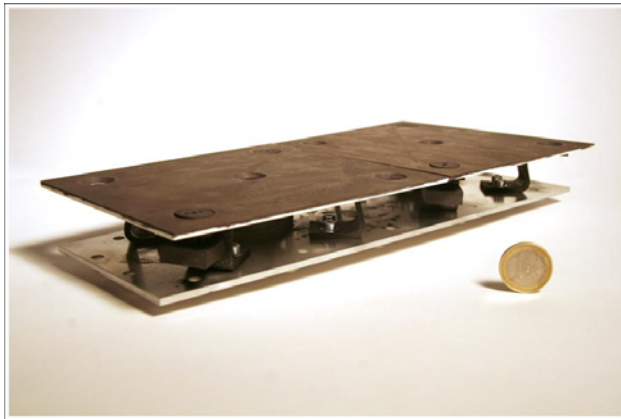
# Payload Instrumentation



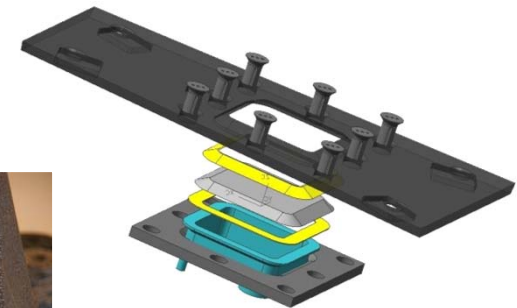


# Material and TPS Experiments

## Oxide based CMC Elements for hot antennas



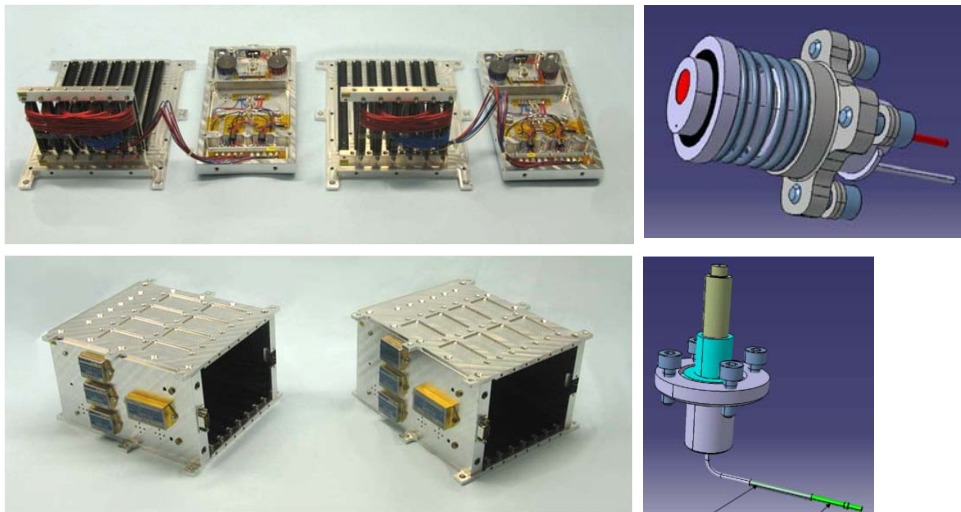
## Actively cooled TPS Element



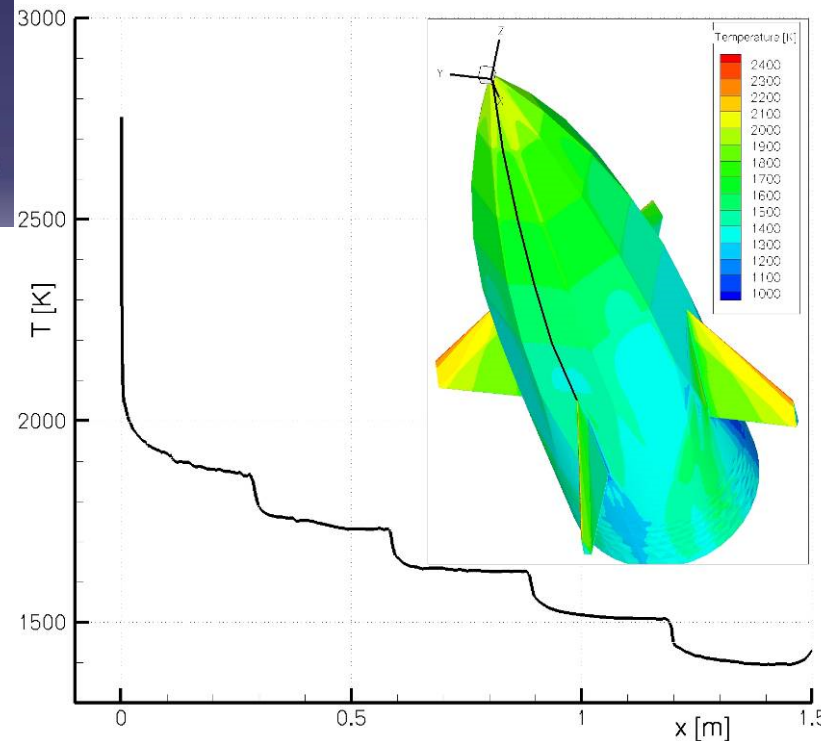
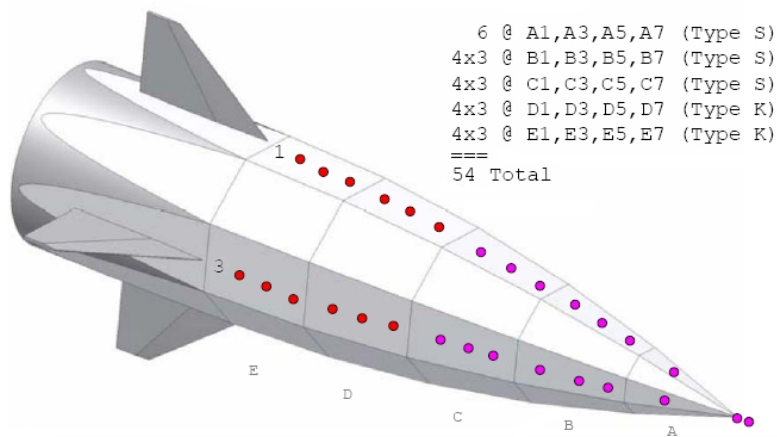
## CMC Serial production



# Instrumentation



-Surface thermocouples



**Temperature distribution of the vehicle using**  
**radiation adiabatic boundary condition**  
**turbulent boundary layer, Alt 20 km, Ma 8,  $\alpha$**   
**= 2.5°**

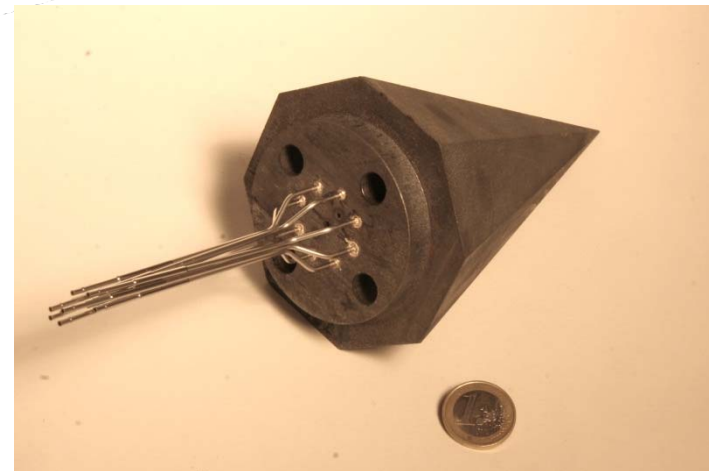
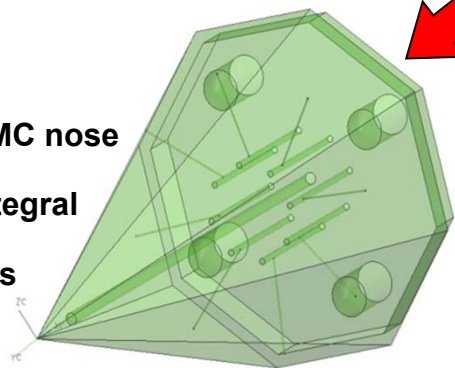




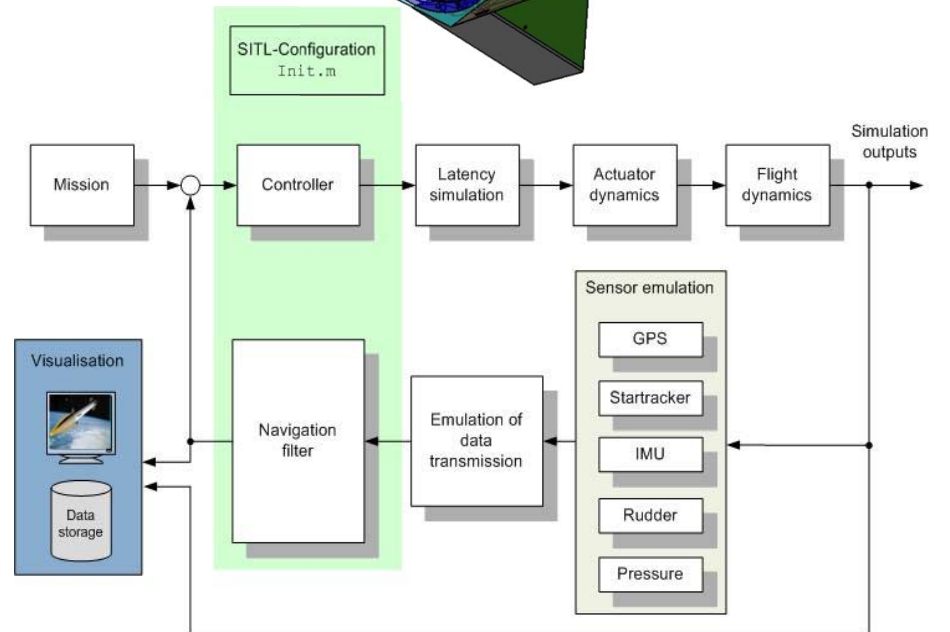
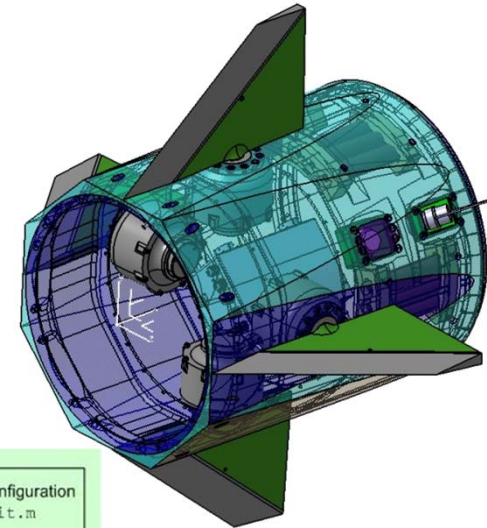
## Flush air data system (FADS) Experiment

- > Measurement of static pressure at 8 locations
- > Development of algorithm for determination of gas flow orientation
- > Calibration within hypersonic wind tunnel facility
- > Comparison to navigation platform results

**Monolithic CMC nose  
insert with integral  
pressure ports**

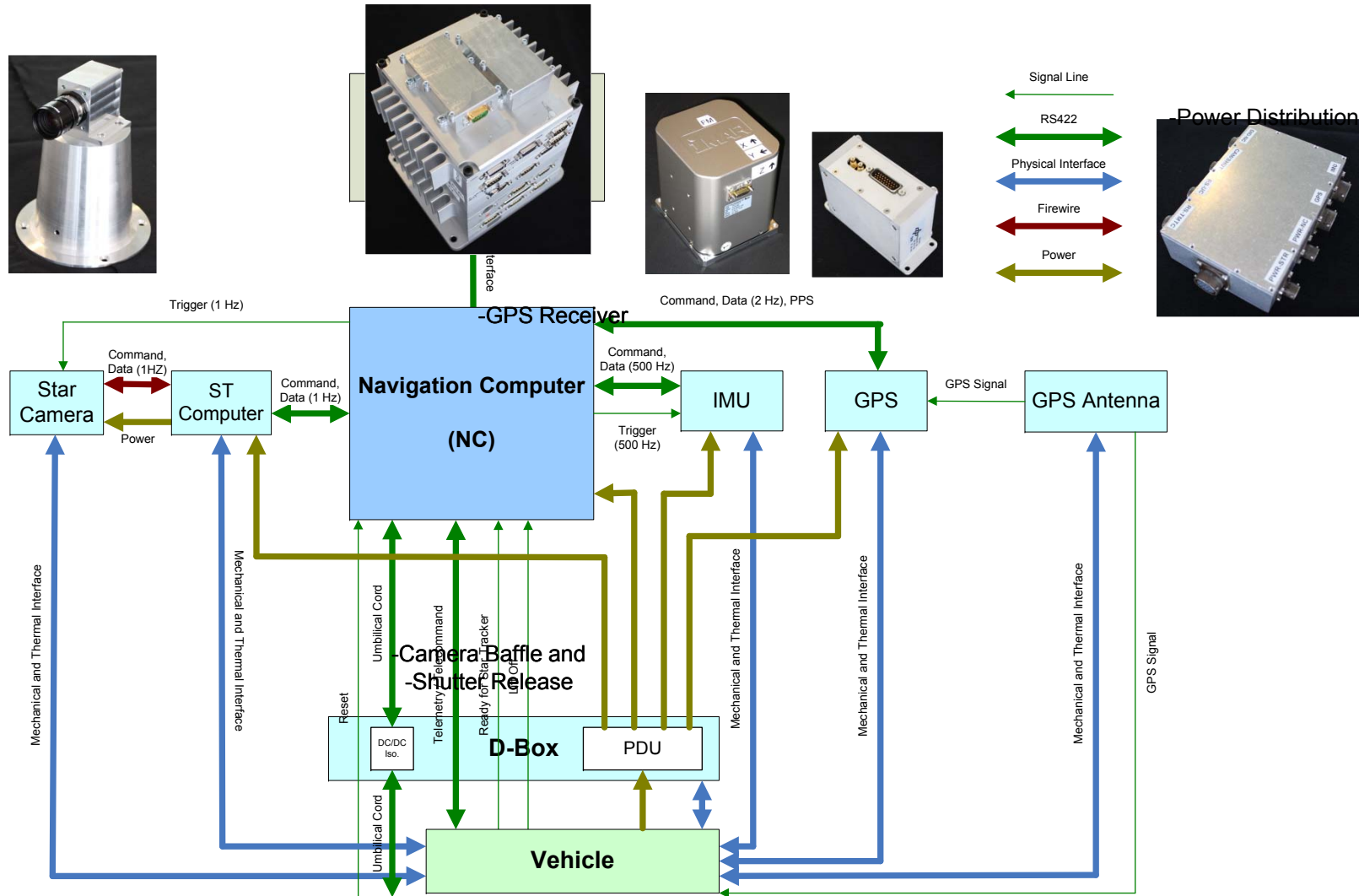


# SHEFEX II: Aerodynamic Flight control





# Hardware: Hybrid Navigation System (Experiment)



# SHEFEX: Secondary structural Experiments

**Ablative stabilizer fins**



**CFRP Fairing with integrated ablative TPS**



**Hybrid TI/CMC Canards**





# SHEFEX II on Tour





**Andoya Rocket Range, Norway**

payload assembly hall



control center

rocket assembly hall



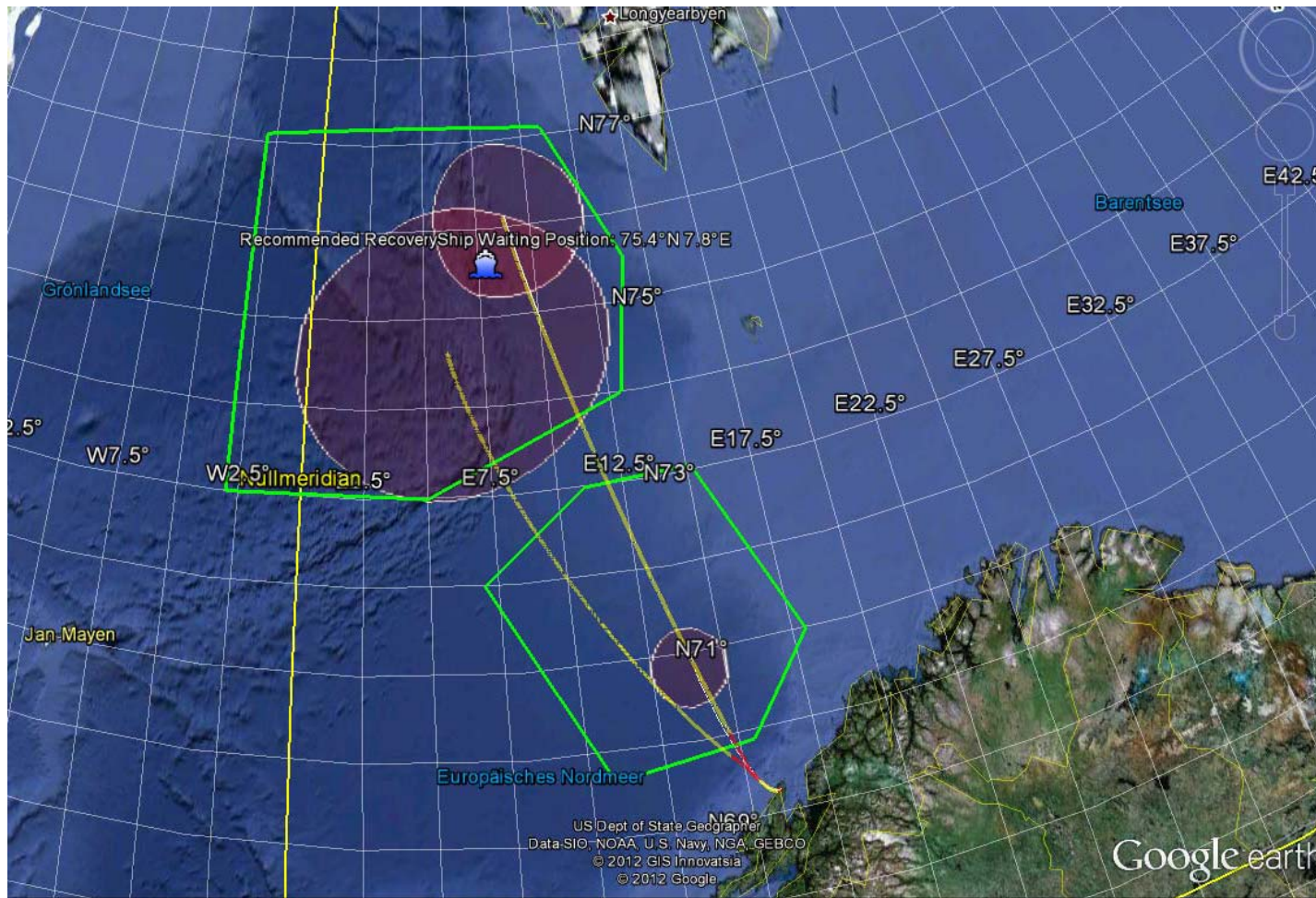
block house

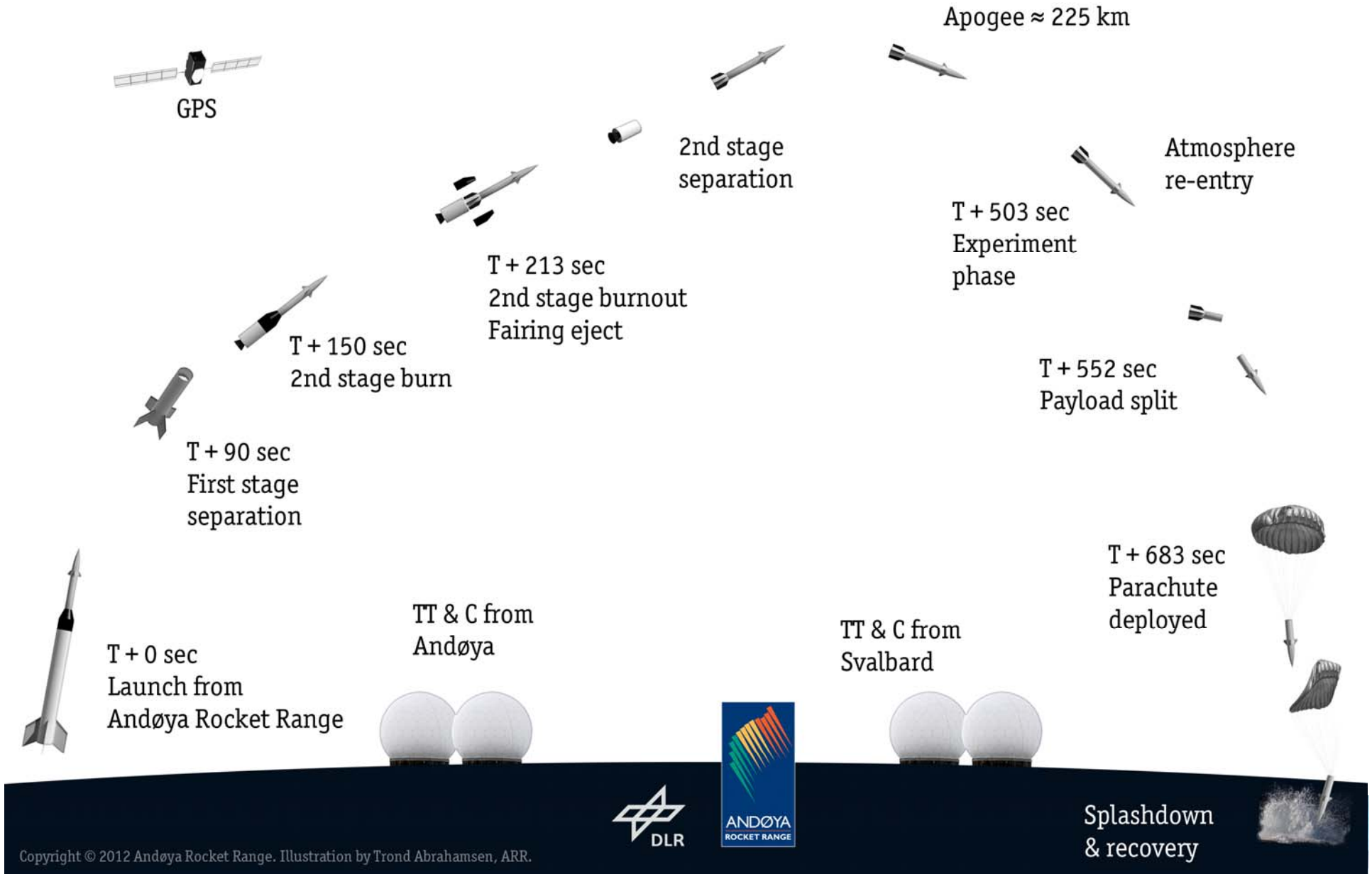
launch pad





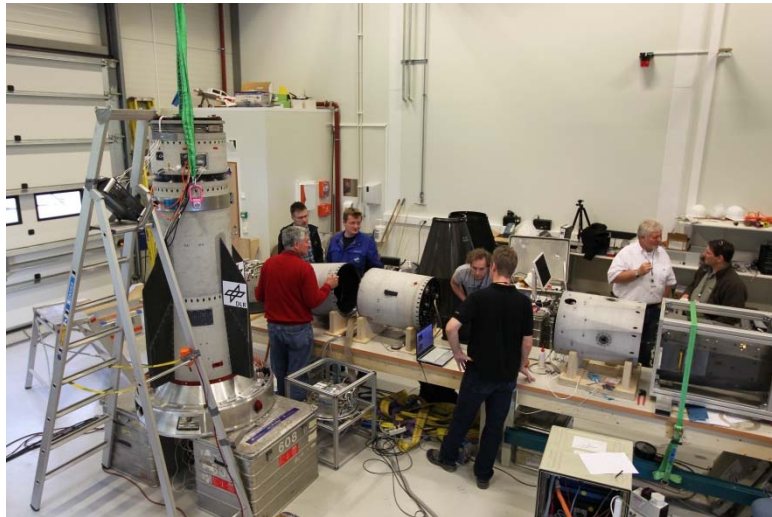
# SHEFEX II Trajectory and Impact Aeras







# Payload integration





# Motor preparation



1. Stage



2. Stage





# Preparation of the launch rail





After

- 5 hard Years of Development
- 16 Million Euros
- 20 `24 Hour` days at the range
- uncountable coffees, Pizza, bavarian and swabian Beer

SHEFEX II is ready for flight





# Final Count Down



System Control



Launch Control



Experiment Control

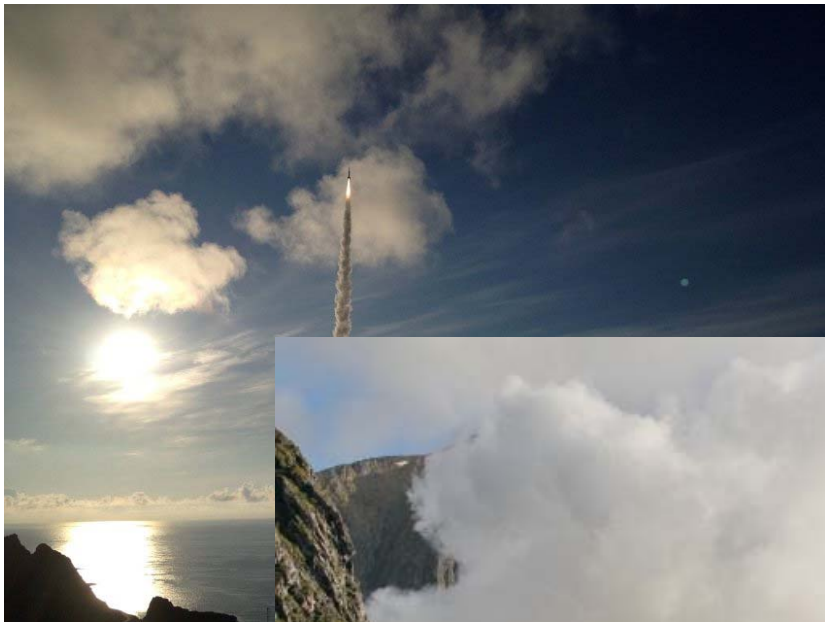


# 3, 2, 1, Ignition ...

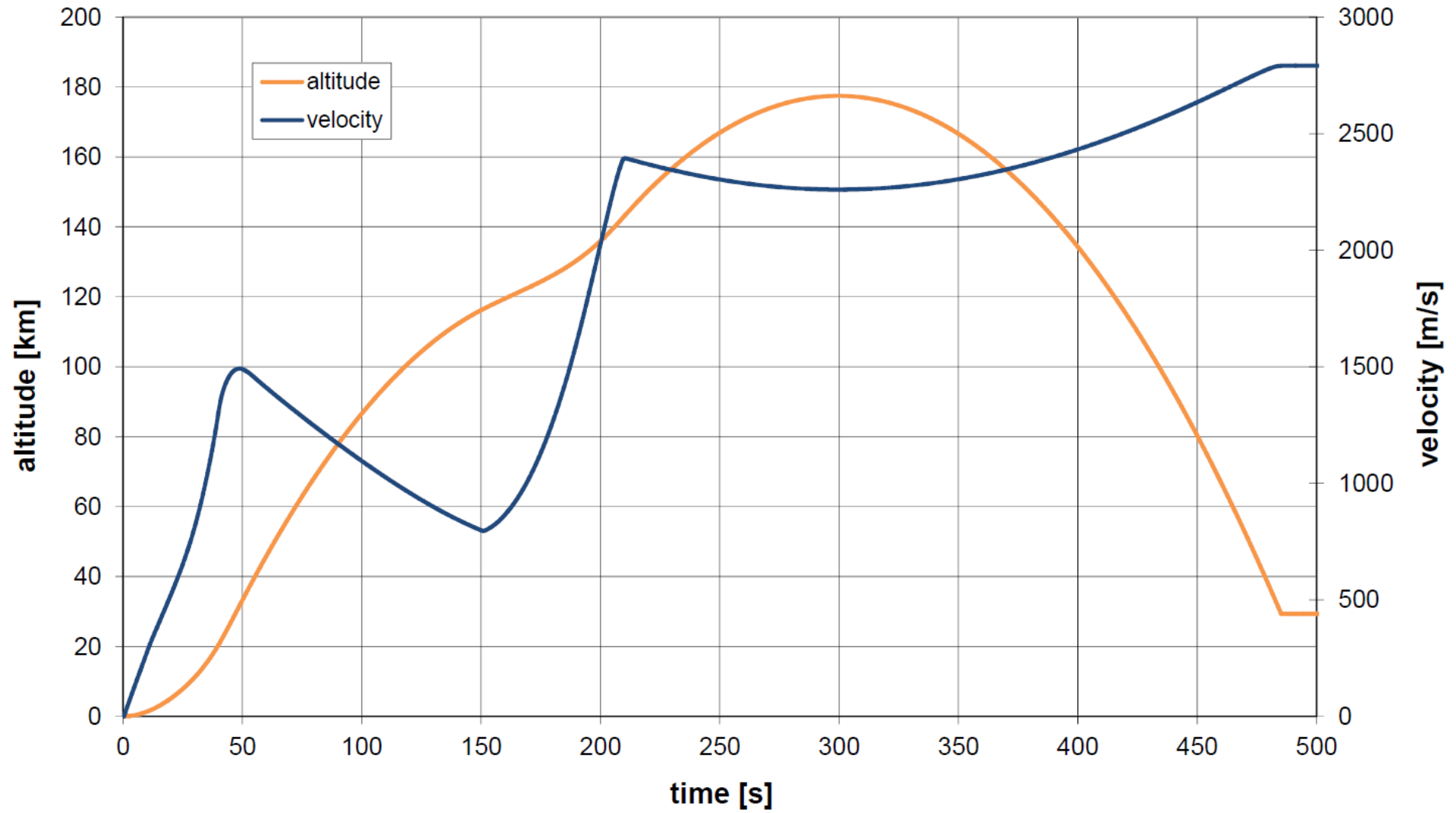




# Telemetry and Radar Tracking, 600 exciting Seconds



## Shefex II flown trajectory, GPS data





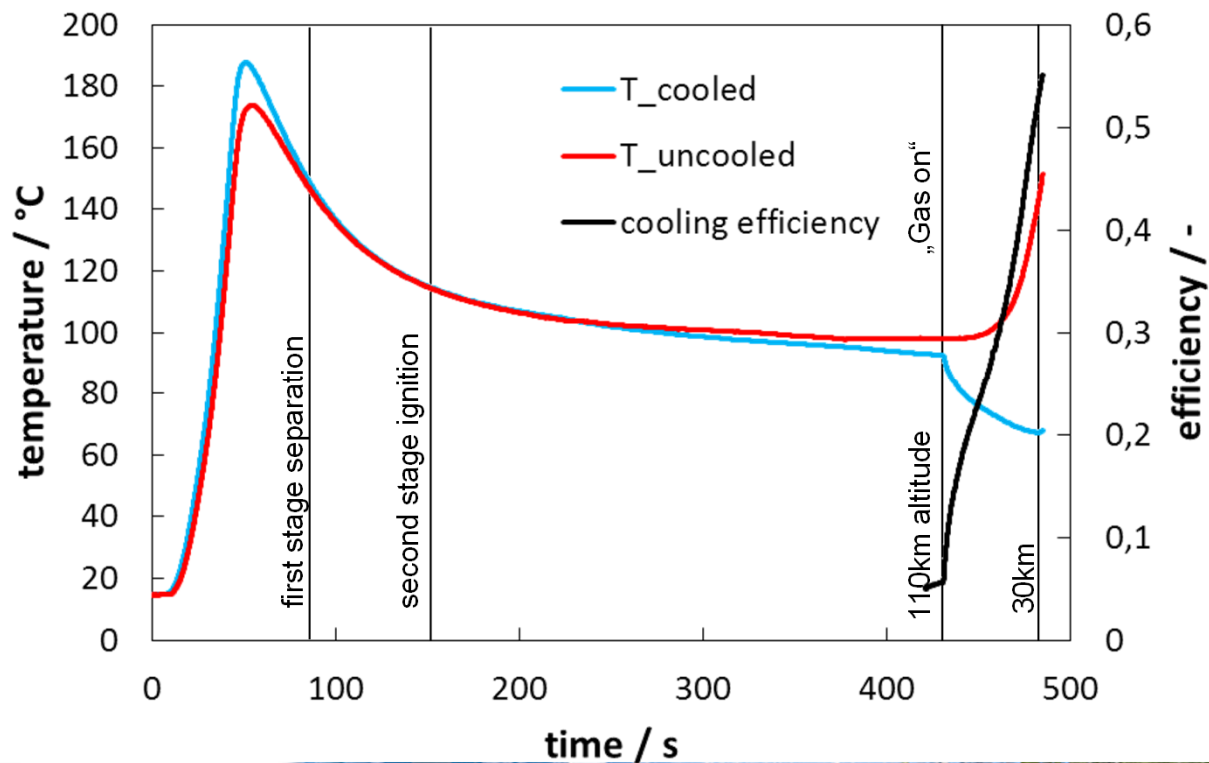
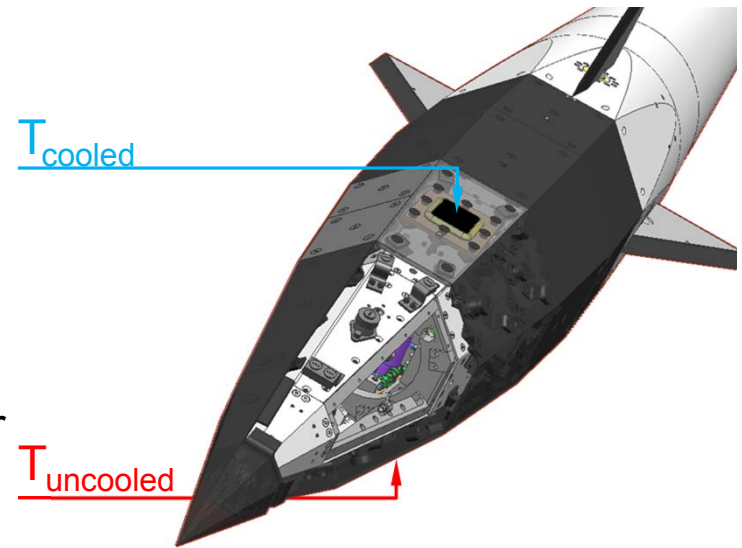


AKTIV Panel



## -Results: AKTiV

- Kühleffekt beim Wiedereintritt deutlich sichtbar
- Kühleffizienz  $\eta = (1 - T_c / T_{uc})$  bis zu ~50% in der Oberflächentemperatur





# Nose Tip Temperatures

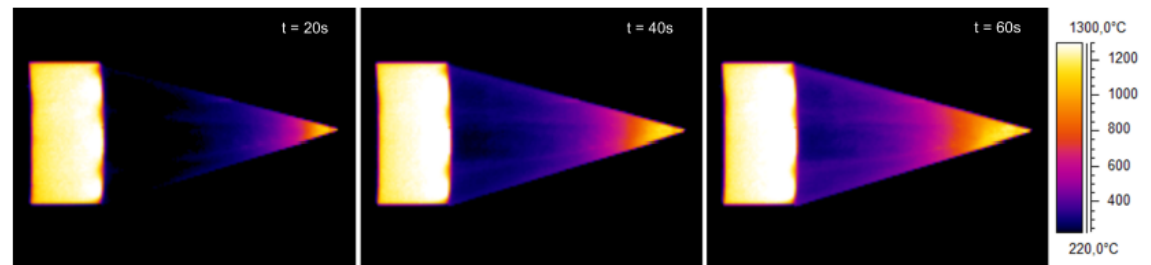
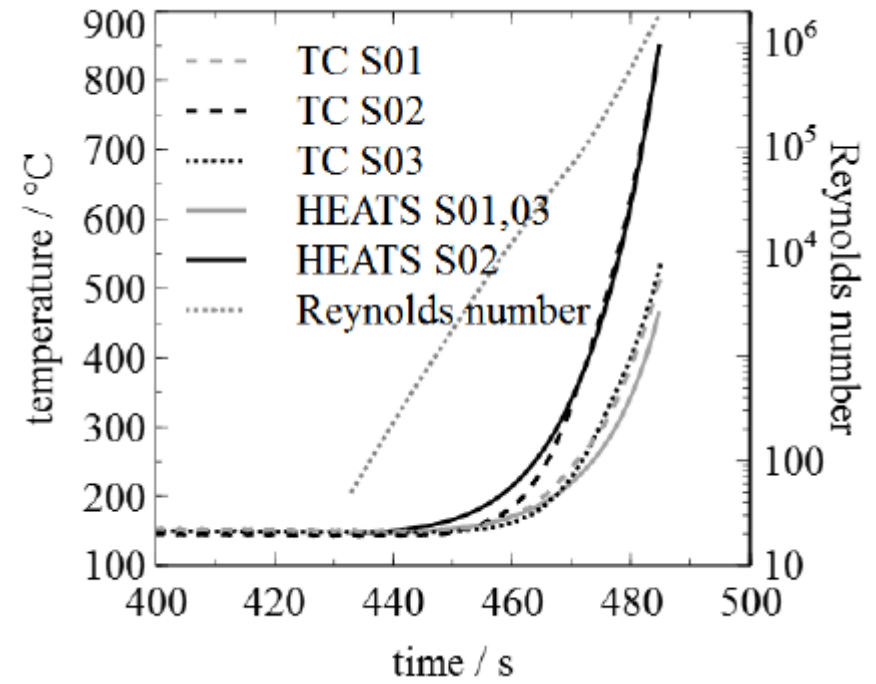
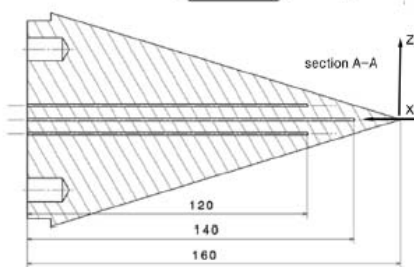
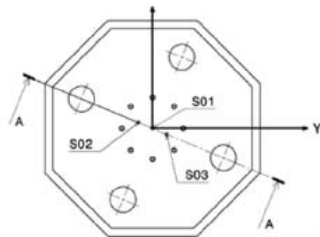
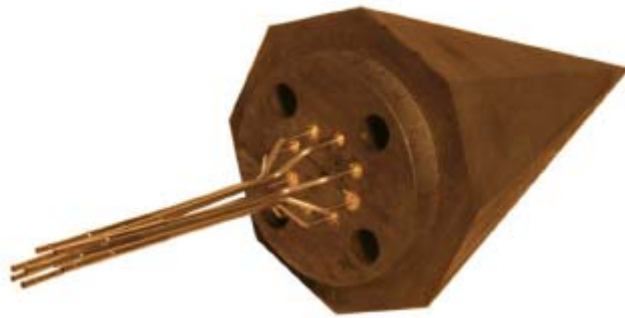


Figure 11: IR-thermography of the SHEFEX II-nose during L3K-test.





## SHEFEX II Mission accomplished

### First results:

- Trajectory flown as planned (deviation <1%)
- All vehicle maneuvers successful
- All experiments got data during ascent and re-entry
- Max. velocity 2.8 km/s
- Assessment of flight data will cover the next years

### However

- Hardware is lost due to changing weather conditions at landing site





**Thanks to the Team !!!**



**Danke fürs Zuhören und die Geduld !**

