



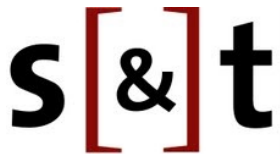
# Demise Observation Capsule (DOC) Development Status

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ESA Clean Space Days







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# Demise Observation Capsule

“Providing a clear perspective on stage re-entry”

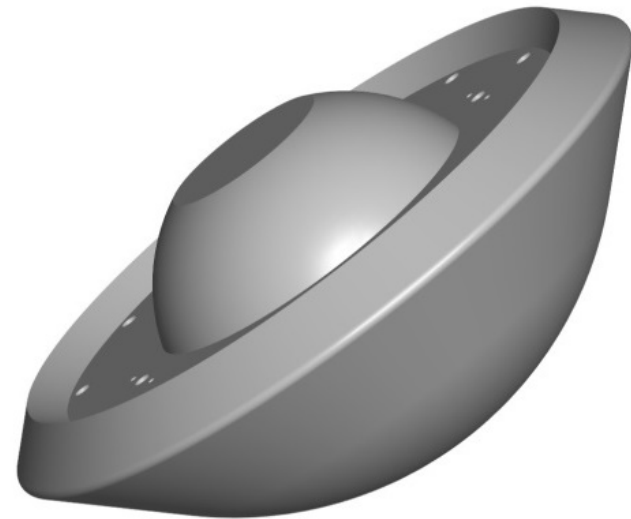


## What DOC records:

- Images of upper stage

- Measures break-up evolution

- Key disintegration events



# DOC-Parameters to be Recorded

- Data on its own trajectory (acceleration, position, angular velocities, aero-thermal data...).
- Data on entry parameters & thermo-mechanical of the Host Vehicle prior to its fragmentation (temperatures, vibrations & shocks).
- Detect the start of fragmentation and record as much as possible.
- Record data from after the fragmentation event (if possible).
- Record video/images of the Host Vehicle during its re-entry (if possible).

Notes:

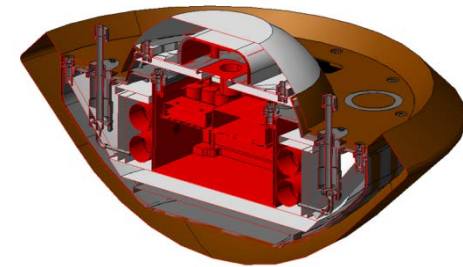
1. the data recorded should relate to the Host Vehicle, whenever possible
2. Important events:
  - Altitude of main fragmentation/explosion
  - Ejection velocity due to main fragmentation/explosion





# The Capsule

- Robust, optimized and modular design for a **multitude** of launch vehicles/stages: 3rd and 4th stage(s)
- **Rideshare** item: no impact on launcher payloads or operations
- **Safe & controlled** separation from the stage after its passivation
- On-board software design for **autonomous mission** performance & in-flight data transfer
- Flight-ready equipment: PFM + GSE:
  - Mass: **<10kg**
  - Diameter: **~350mm**
- **Miniaturized electronics and sensors**
  - Versatile and extendable sensor suite
- Observation **cameras** on host vehicle and capsule
- **IRIDIUM Modem** – Iridium 9523N
- **ITAR-free** equipment



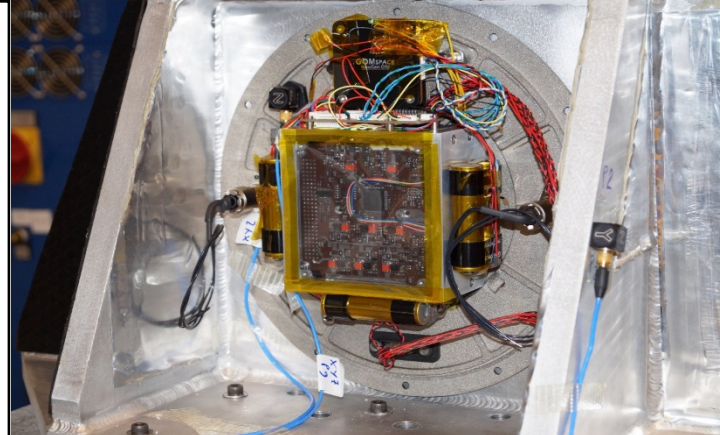
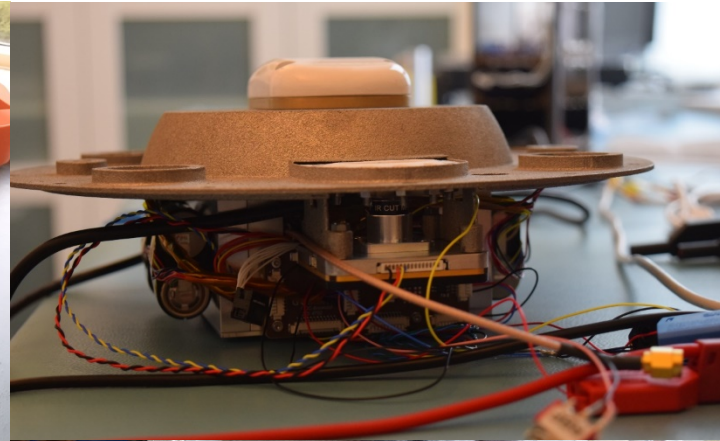
# The Capsule – Sensor Package

Instrument	Model	Delivers	Range
GPS	NovaTel OEM615	Time	
		Position	>7300 km ECEF
		Velocity	>8 km/s
IMU	ADIS16488	Acceleration	$\pm 18$ g
		Angular rate	$>\pm 480^\circ$ /s
		Magnetometer	$>\pm 0.18$ mT
		Temperature	-40° C - +85° C
		Pressure	120 kPa
Camera	C1U NanoCam		
Thermocouples	Type K	Temperature	-200° C— 1260° C
Accelerometers	ADXL375	High acceleration	$\pm 200$ g
Pressure sensor	Kulite XTEL-190M	External Pressure	170 kPa
Pressure sensor	MKS 905	Internal Pressure	120 kPa



# EQM Testing

## EQM (EBB) Test Campaign (GOMSpace & CIRA)



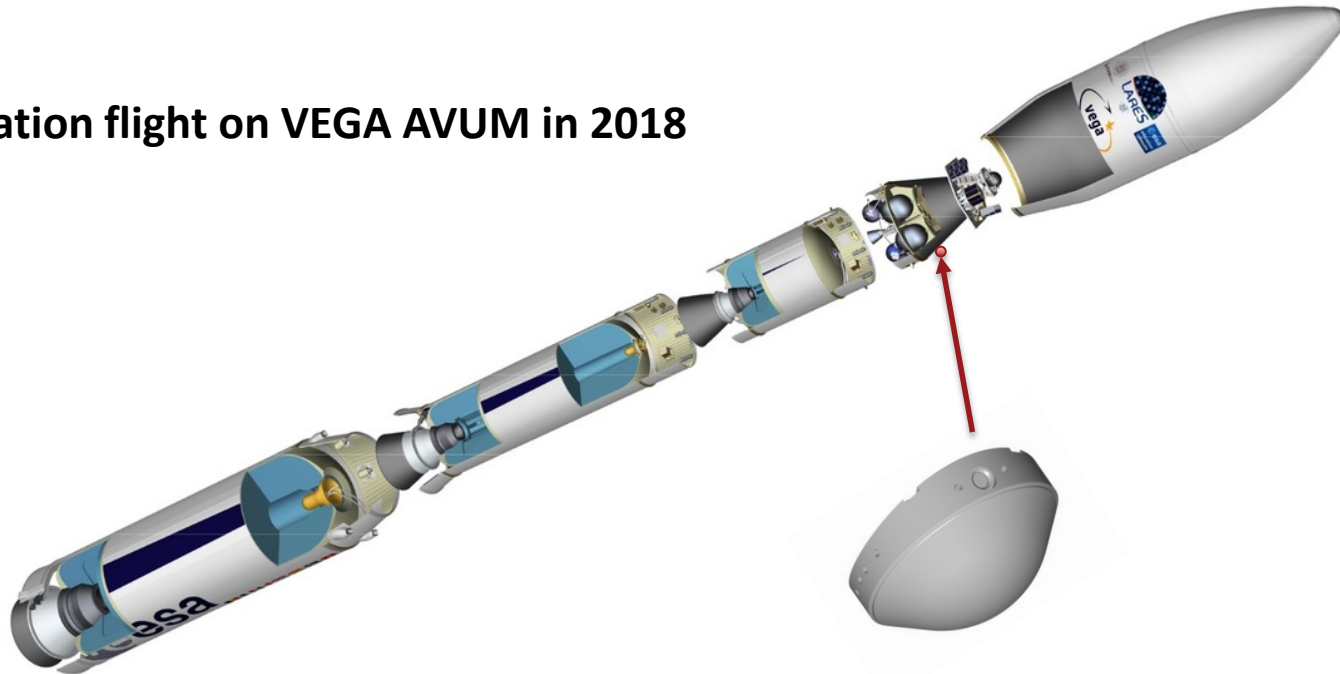


# EQM Testing



# Timeline & Consortium

Qualification flight on VEGA AVUM in 2018



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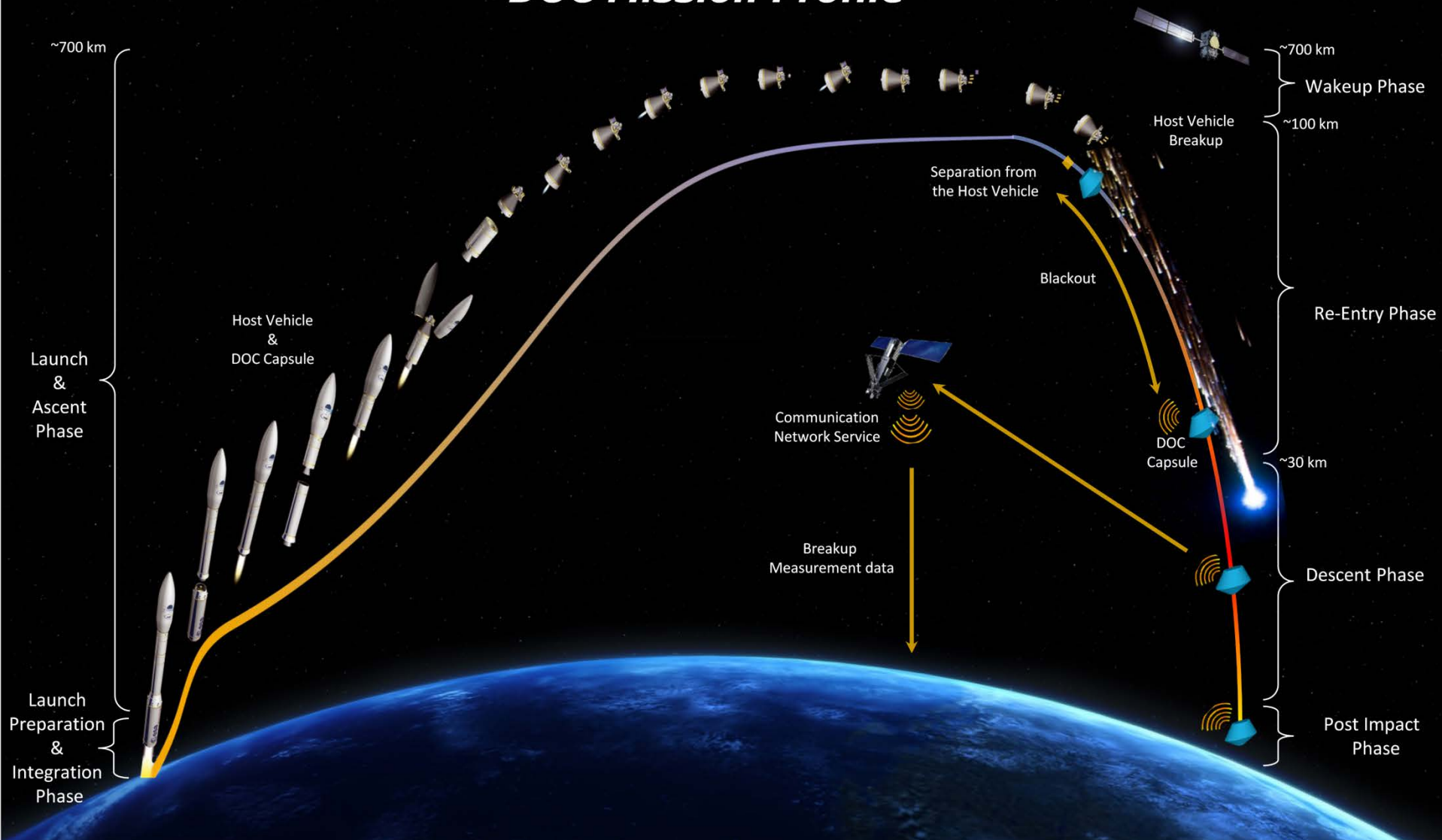
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# The Mission

## DOC Mission Profile







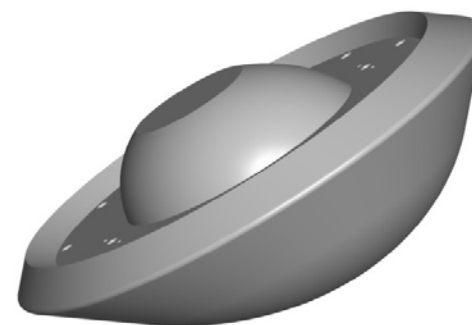


# Demise Observation Capsule (DOC)

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# Back-up Slides

## Back-up Slides





# Effect of DOC

## Footprint

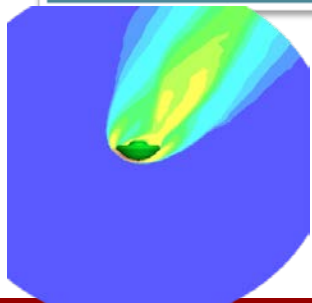
- Regulatory Compliance
- Reducing impact footprint
- Re-entry public safety

## Trajectory

- Validation of re-entry models
- Understand re-entry physics
- Obtain data to 'design for demise'
- Structural, aero-thermodynamical and material databases

## Breakup

- Document key disintegration events
- Stage, Payload and Instrument demise
- Complete health status



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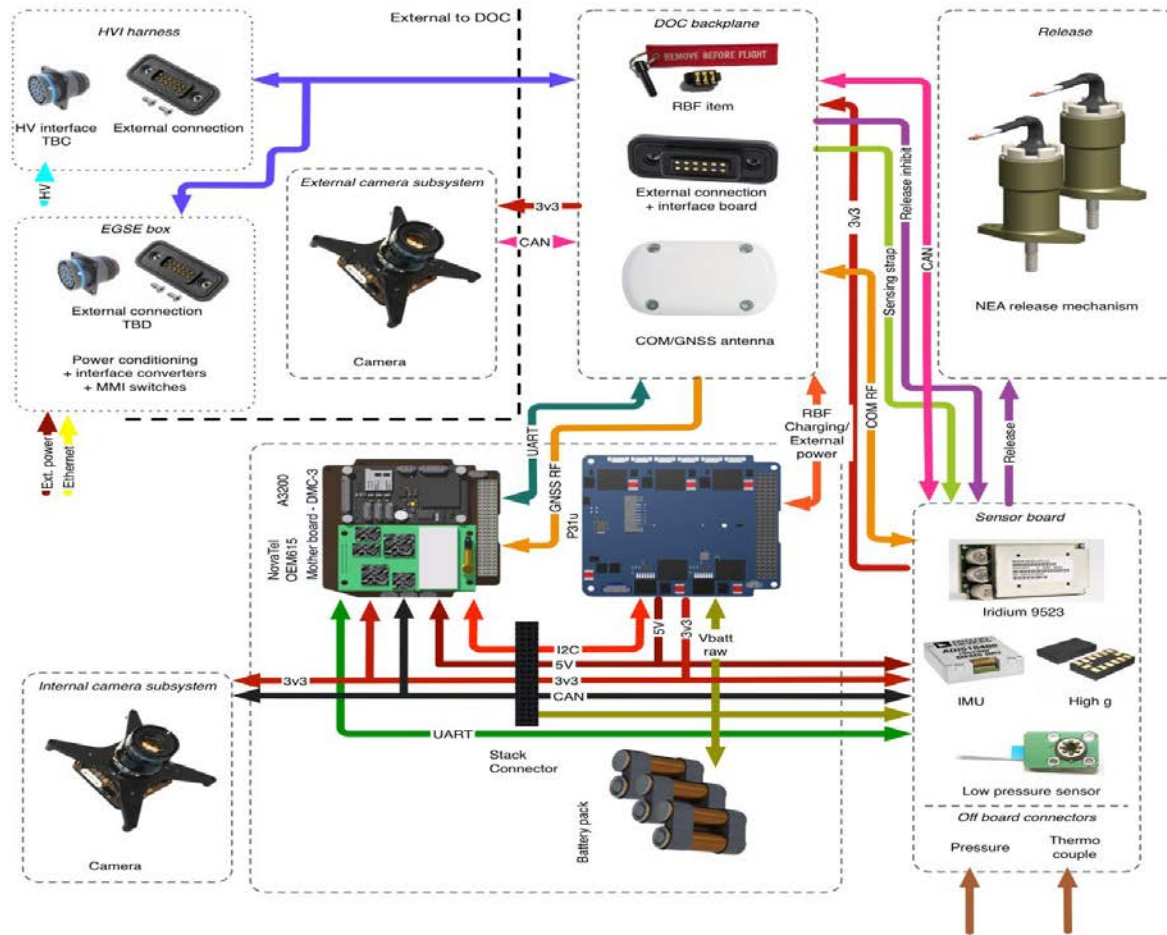


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# DOC Avionics

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