



DAVINCI

Deep Atmosphere Venus Investigation
of Noble gases, Chemistry, and Imaging

Entry and Descent Modeling for DAVINCI

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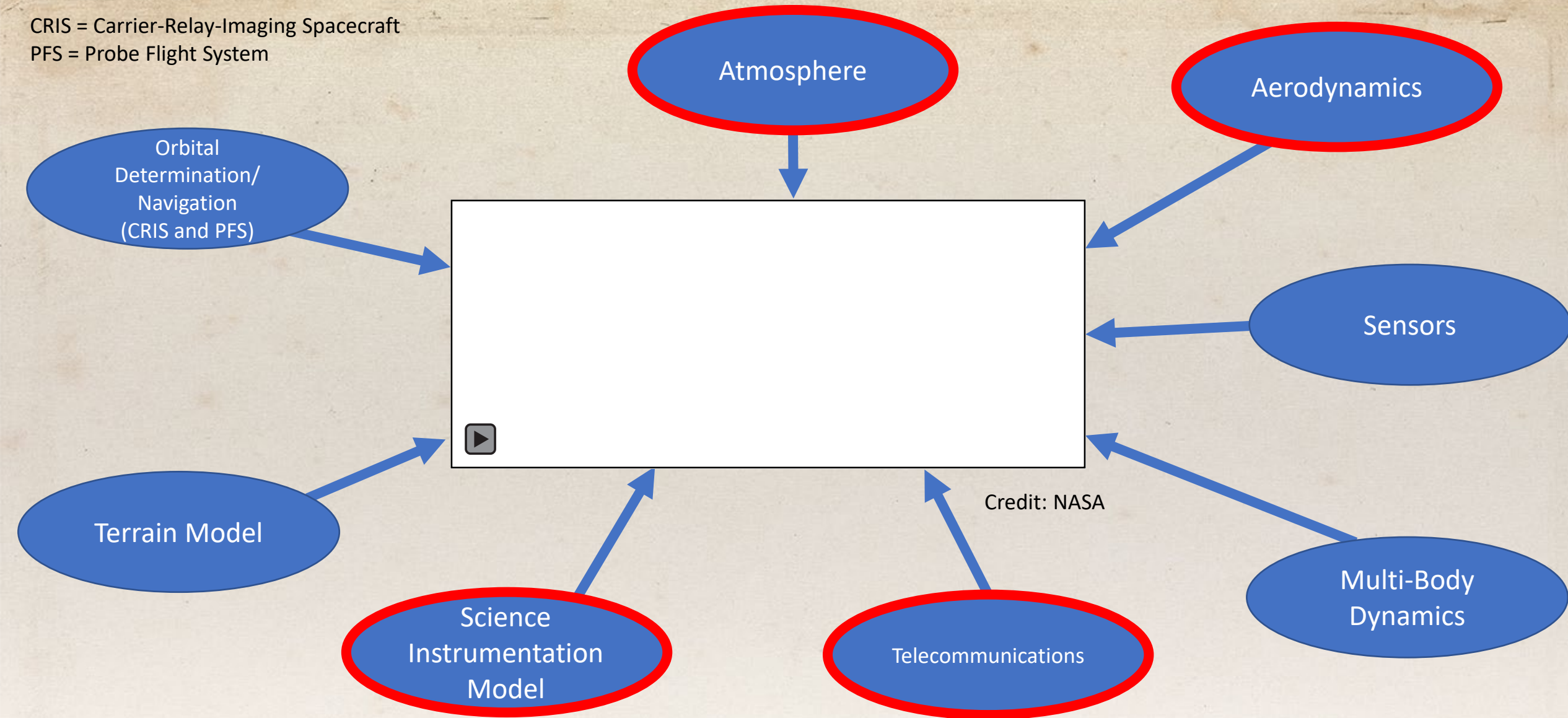
Langley
Research
Center





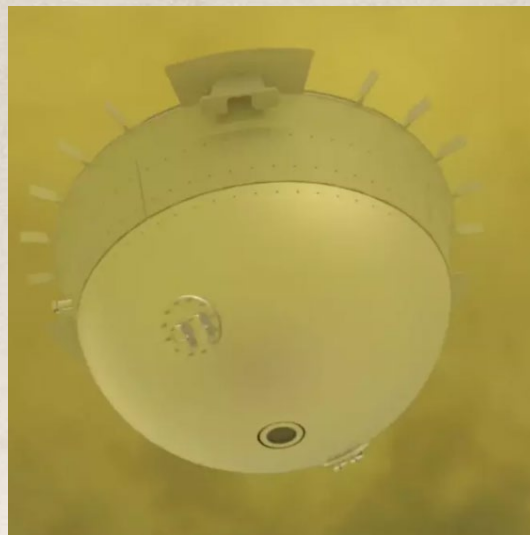
DAVINCI Models for Simulation

CRIS = Carrier-Relay-Imaging Spacecraft
PFS = Probe Flight System

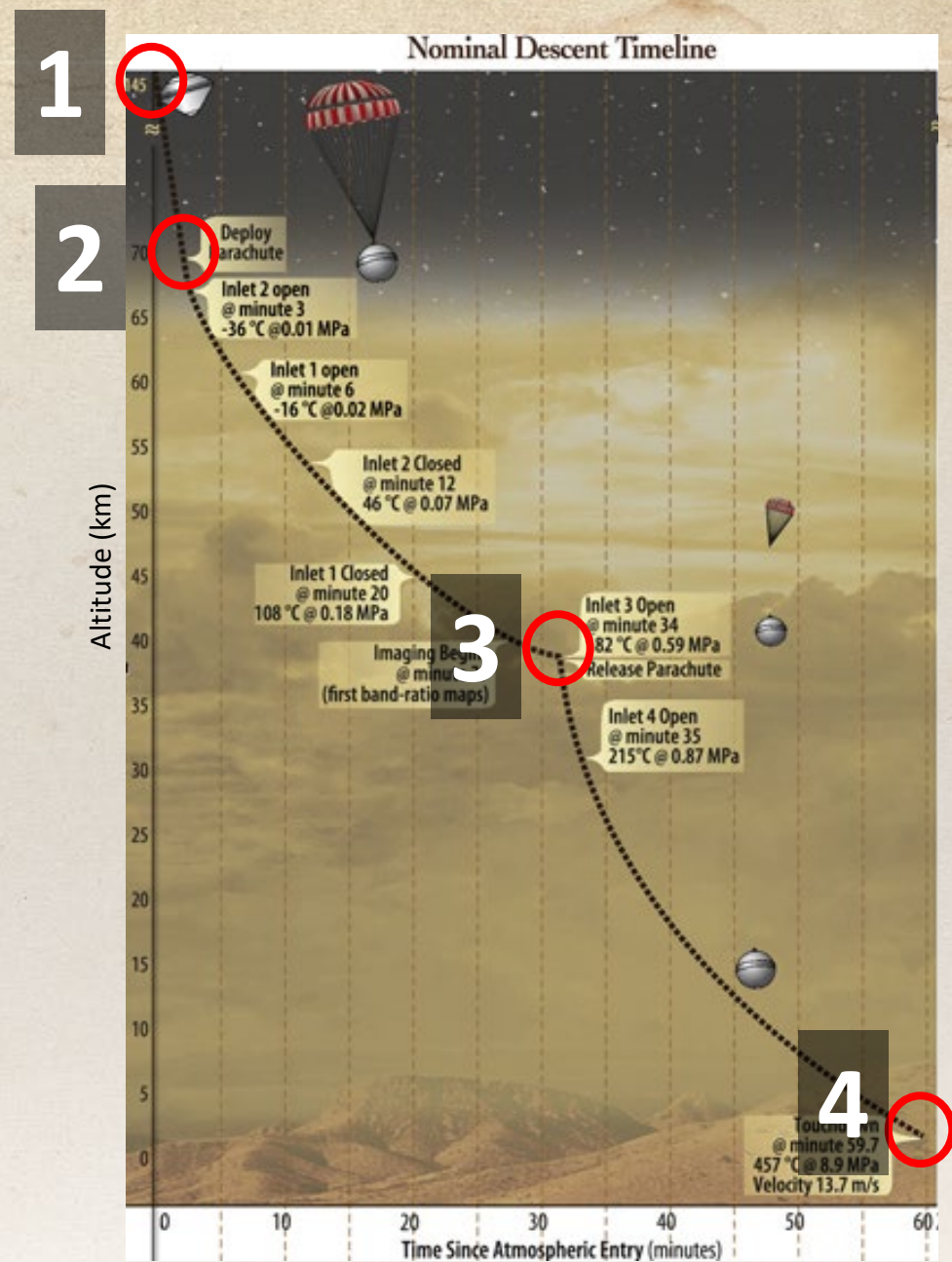


DAVINCI Overview

- DAVINCI to launch 2029 explore Venus via 2 flybys and a probe descent in 2031
- Began development with Pioneer Venus modeling
- Using Entry vehicle heritage



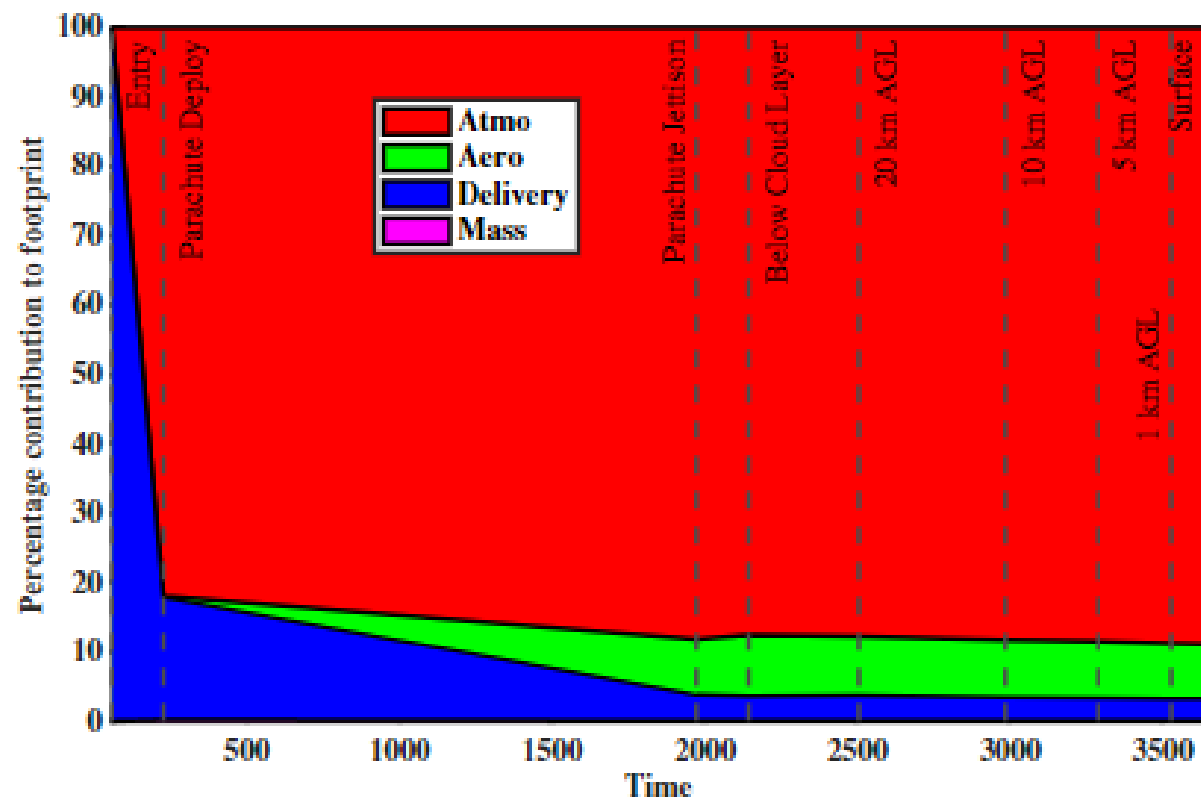
GSFC rendition of CRIS/PFS DAVINCI system (left) and Zephyr (right)



Source: J. Garvin

DAVINCI Atmosphere

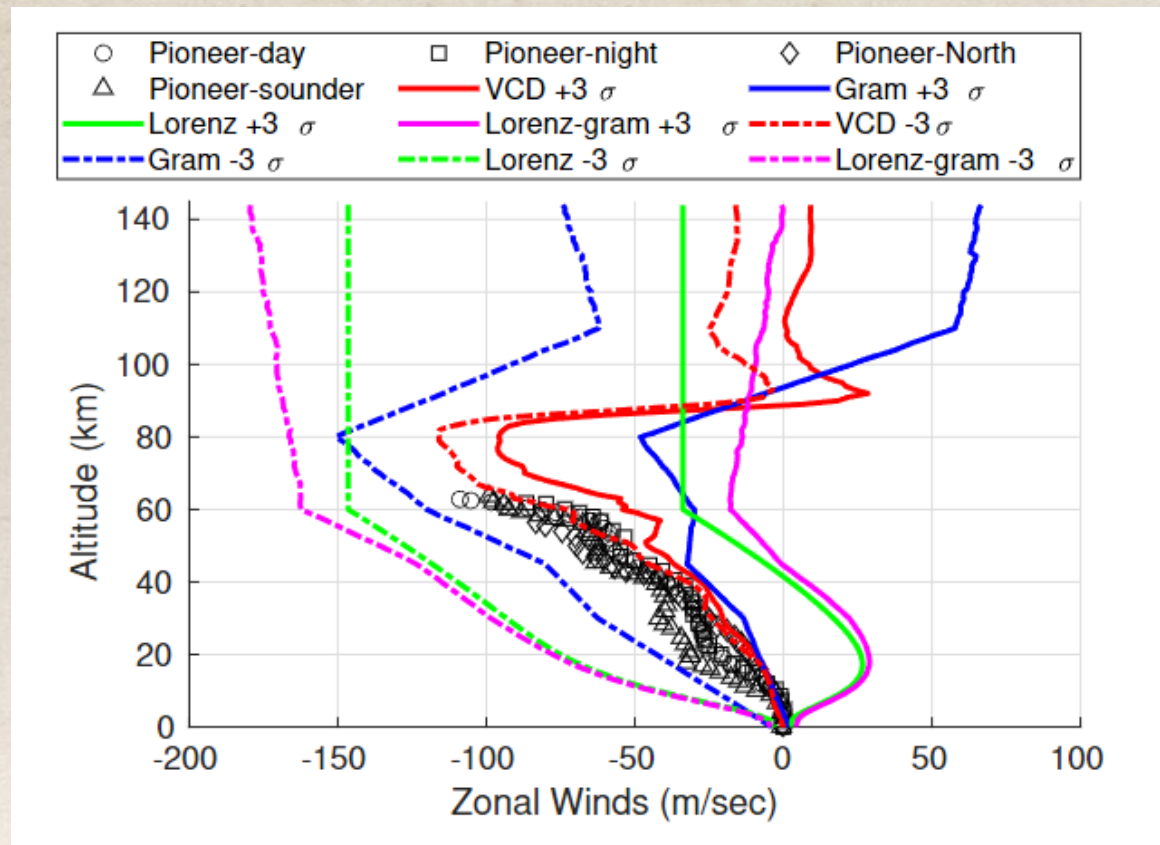
- Majority of the uncertainty for imaging zone due to atmospheric uncertainties
- Must image over Alpha Tesserae region and have overlapping images to meet scient requirements



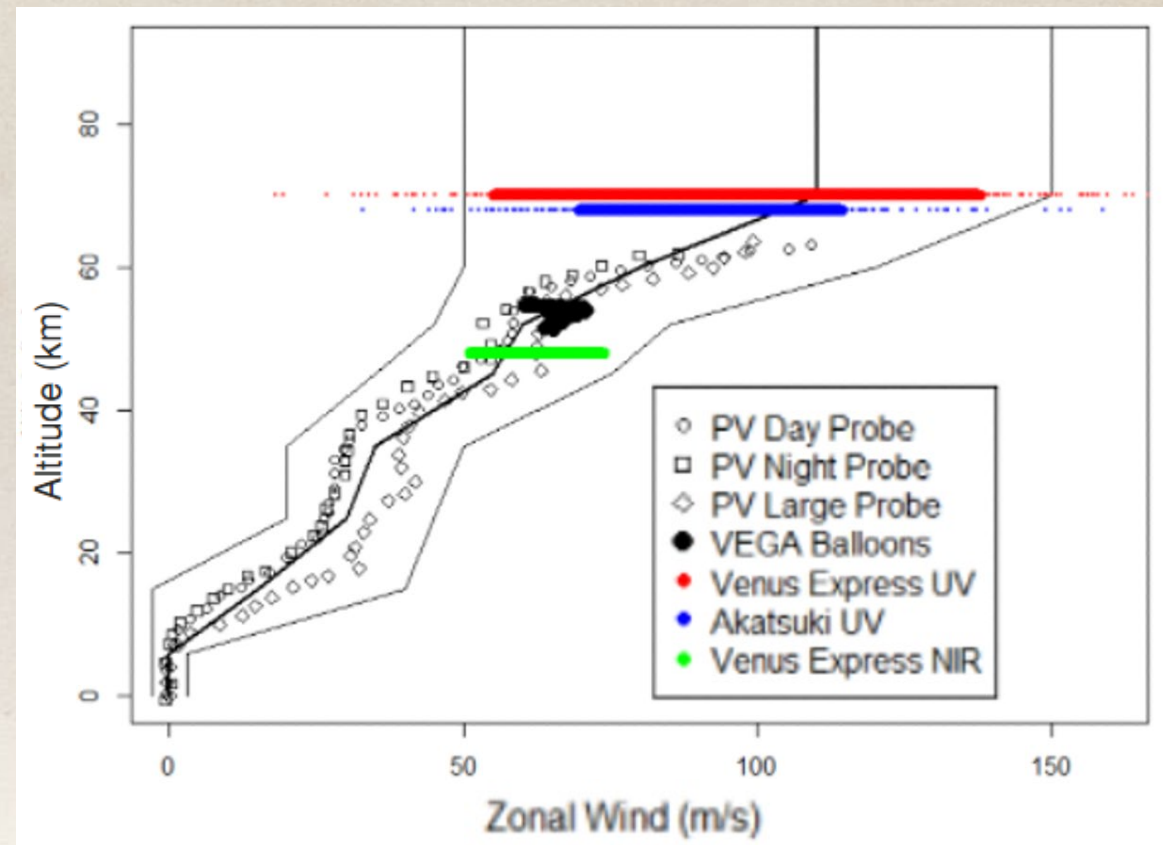
(a) Major Axis

DAVINCI Atmosphere

- Council of Atmosphere assembled
- Design Reference Atmosphere produced
 - Venus-specific wind and atmosphere models



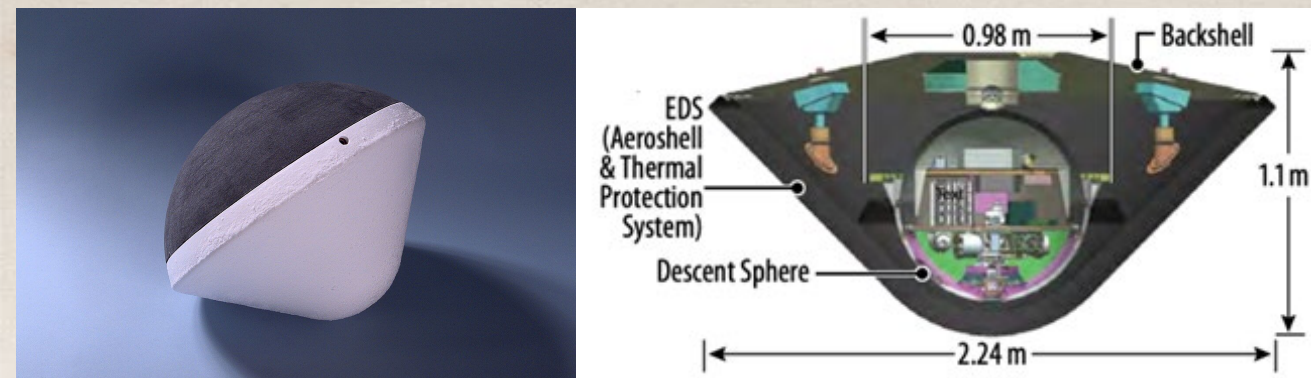
Source: Chadalavada 2024



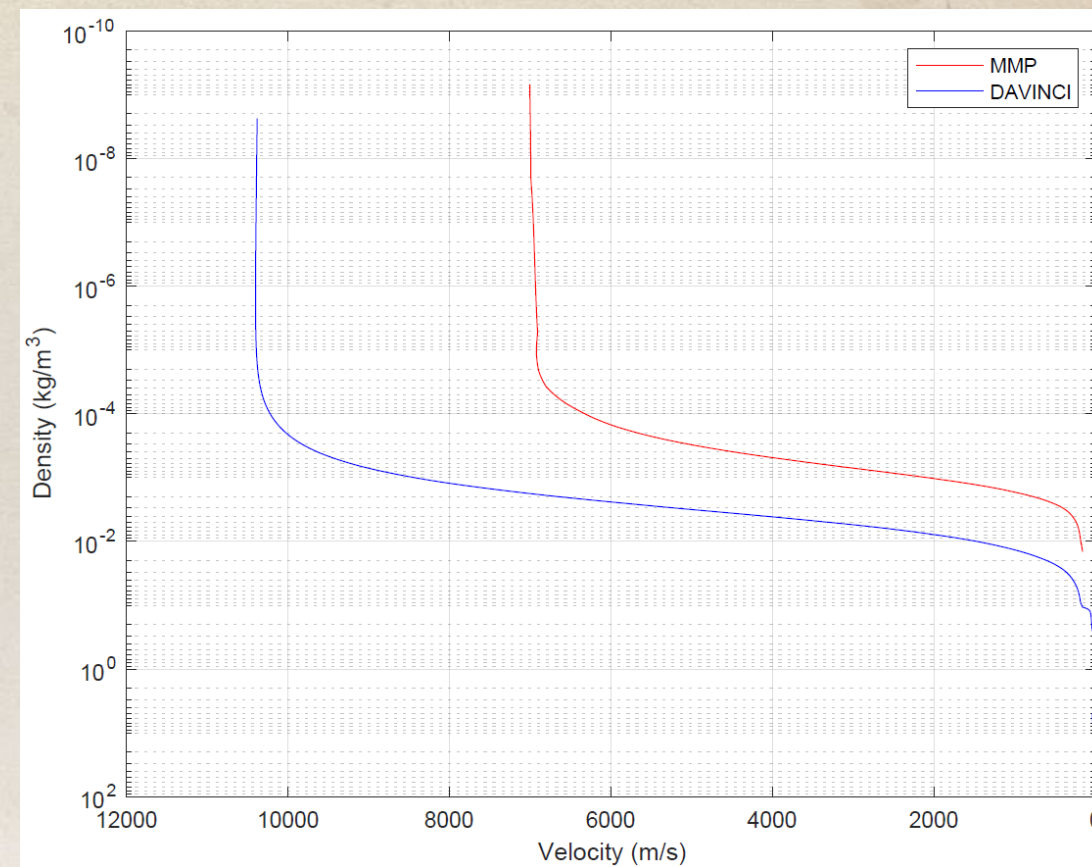
Source: DRA / R. Lorenz

DAVINCI Aerodynamics 1 – Entry Phase

- Started with Mars Microprobe and Pioneer Venus heritage
 - Both 45 deg sphere cones
 - Different backshell
 - Different entry trajectories
- New Aerodatabase built for DAVINCI



Comparison of Mars Microprobe (left) and DAVINCI (right) entry systems

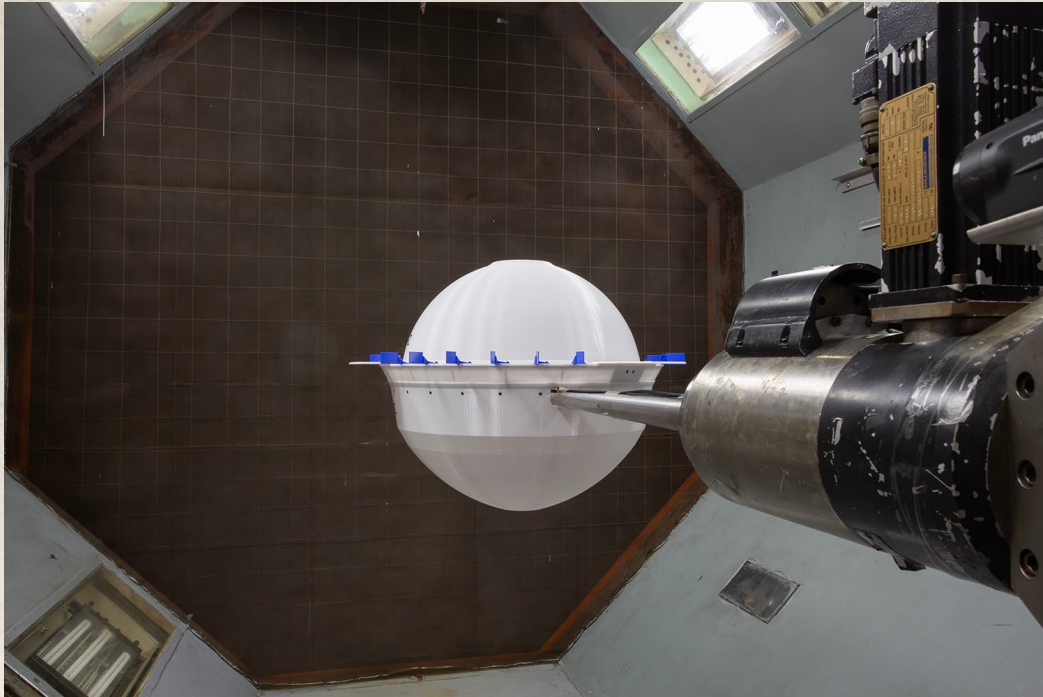


Density - Velocity profile

DAVINCI Aerodynamics 2 – Descent Phase

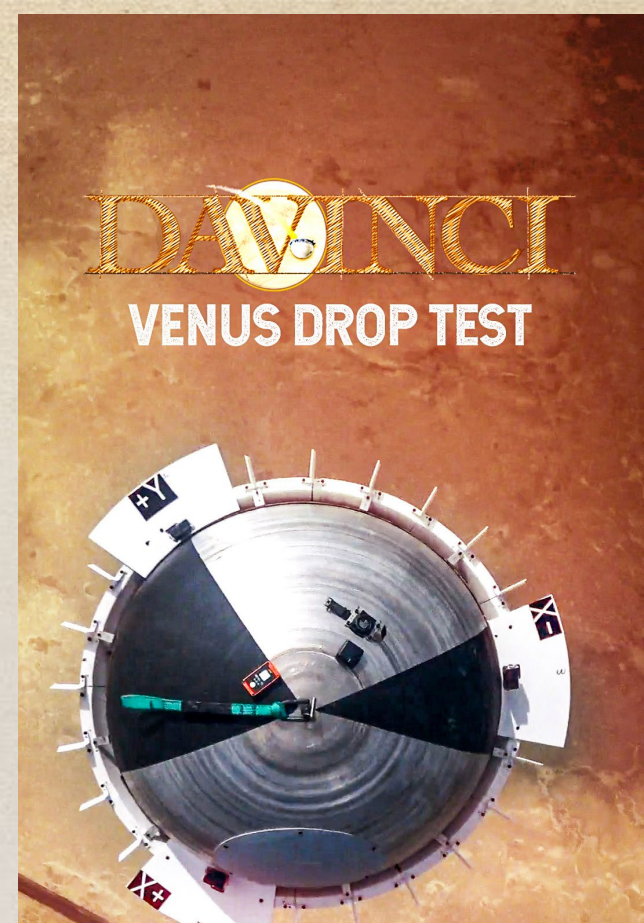
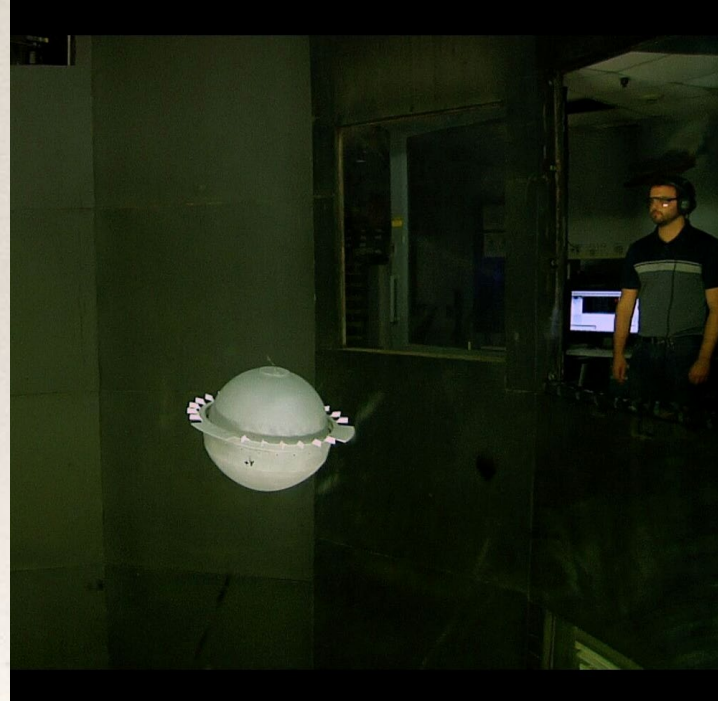
- Descent Aerodynamics

- Using VISAx model developed from Pioneer Venus wind tunnel tests
- Descent aerodynamics built from wind tunnel tests



12ft test, Mar 2024

Vertical Spin Tunnel Test, June 2023



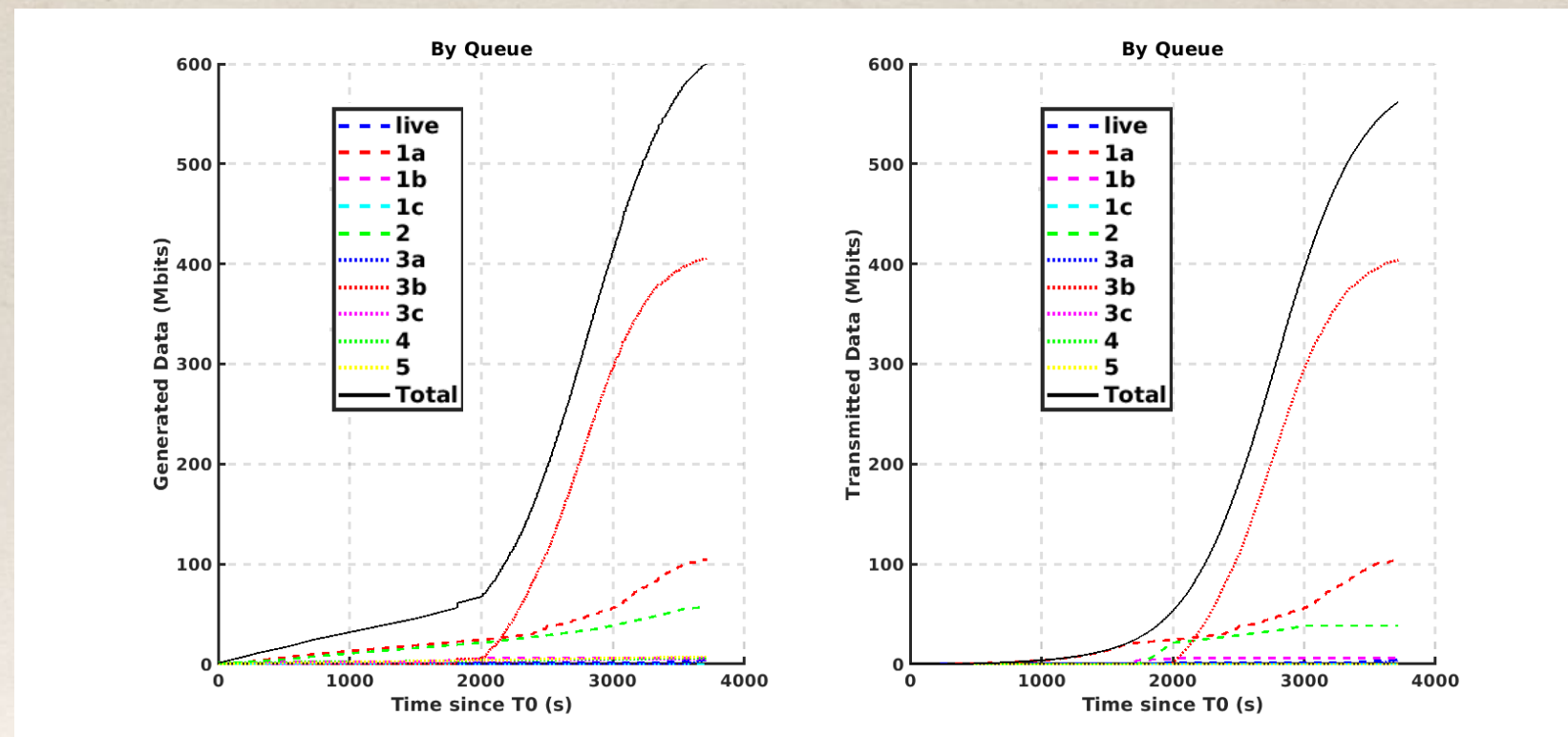
UTTR Drop Test, Oct 2023

DAVINCI Telecoms 1 – Science Goals

- DAVINCI must transmit all required science data before impact
- Close to surface
 - “Deep Atmosphere” area of interest
 - More uncertainties in trajectory
- The adaptive data rate determines how much data can be transmitted
- Descent Sequence describes what measurements will be taken and when
- Technical Allocations Requirement (TAR) document defines how much data these measurements will require

DAVINCI Data Prioritization 2 – Results

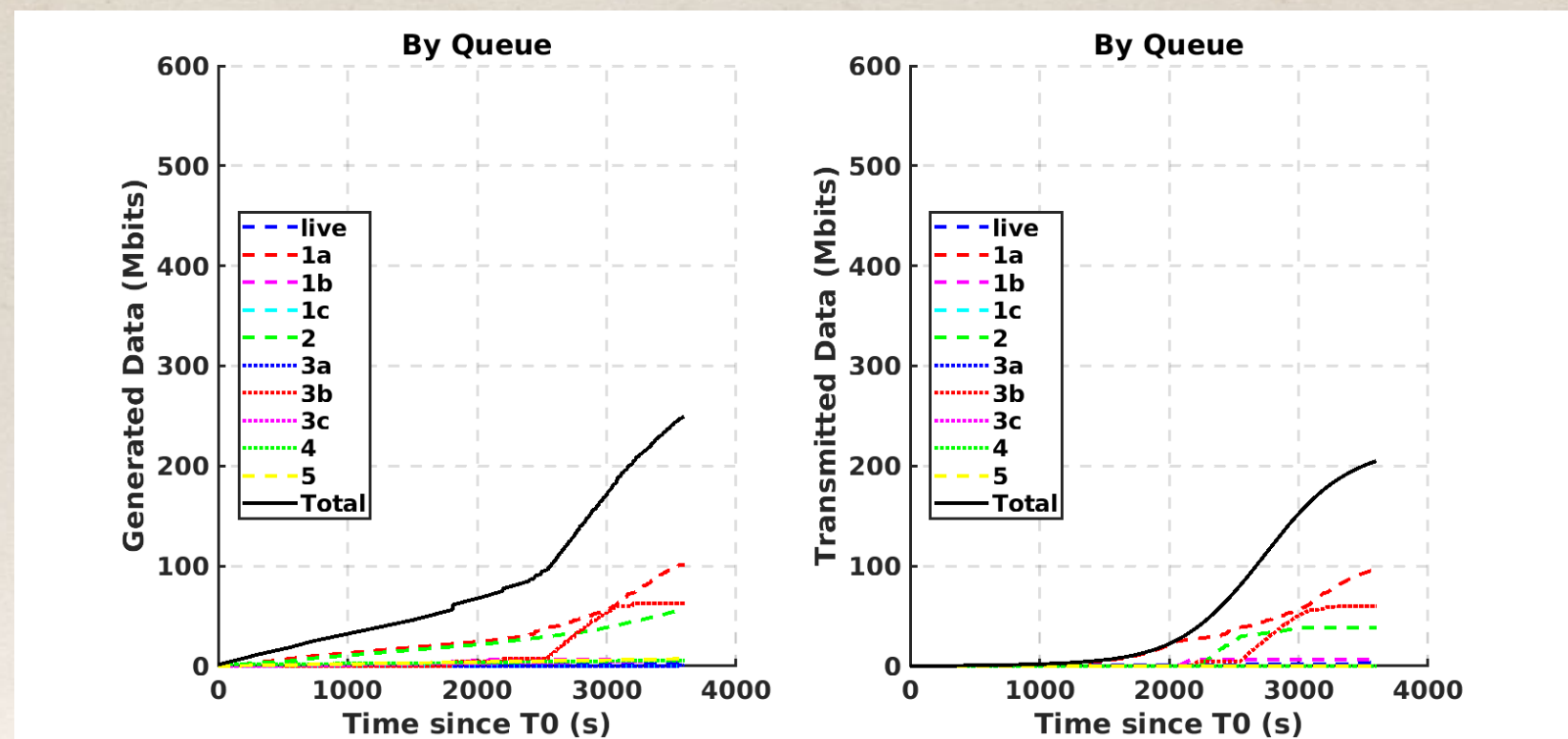
- Data Prioritization model described to prioritize data transmitted
- Model different operating modes
- Can predict the data obtained and track key science metrics



Nominal DB loss, nominal trajectory

DAVINCI Data Prioritization 2 – Results

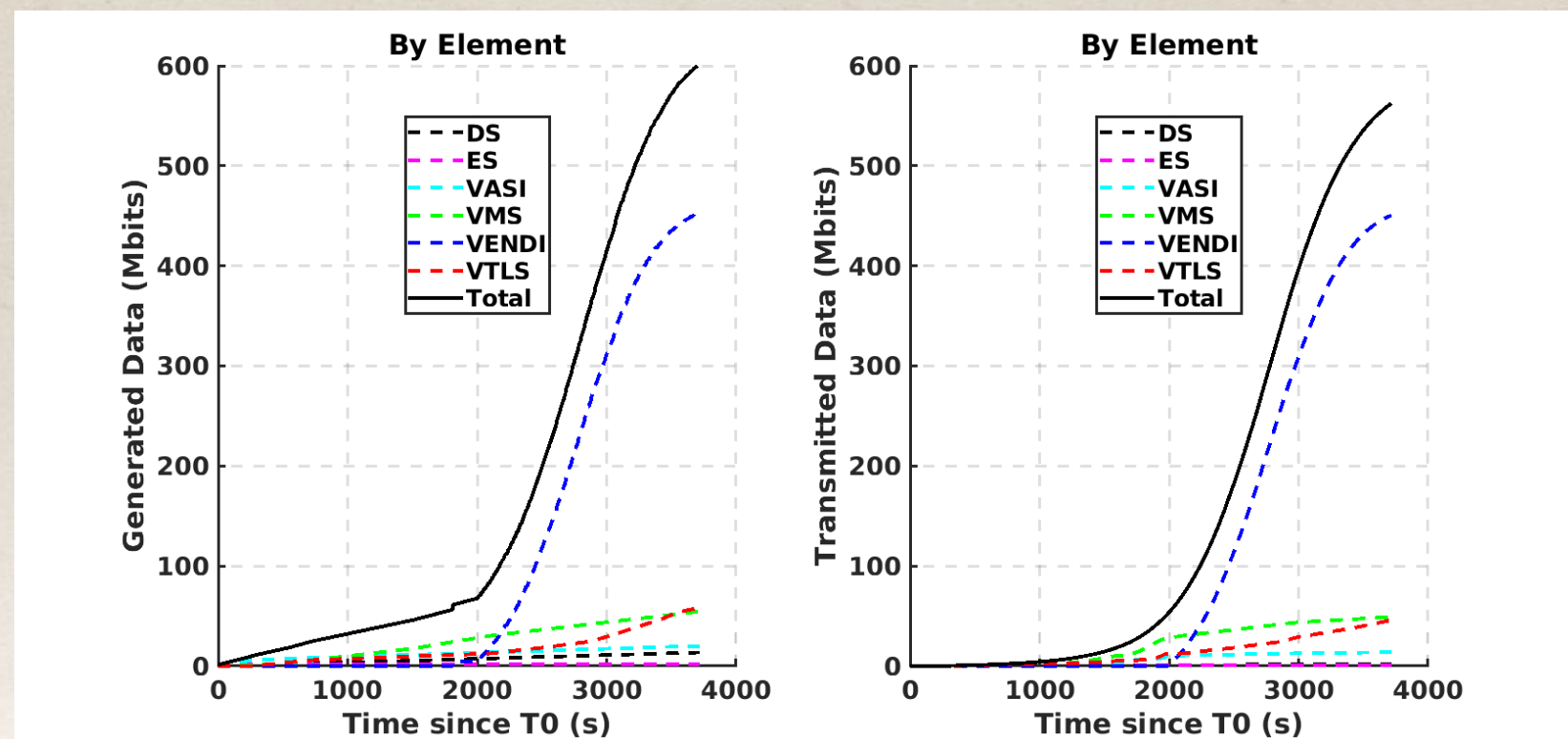
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Minimum Science Requirements, short trajectory

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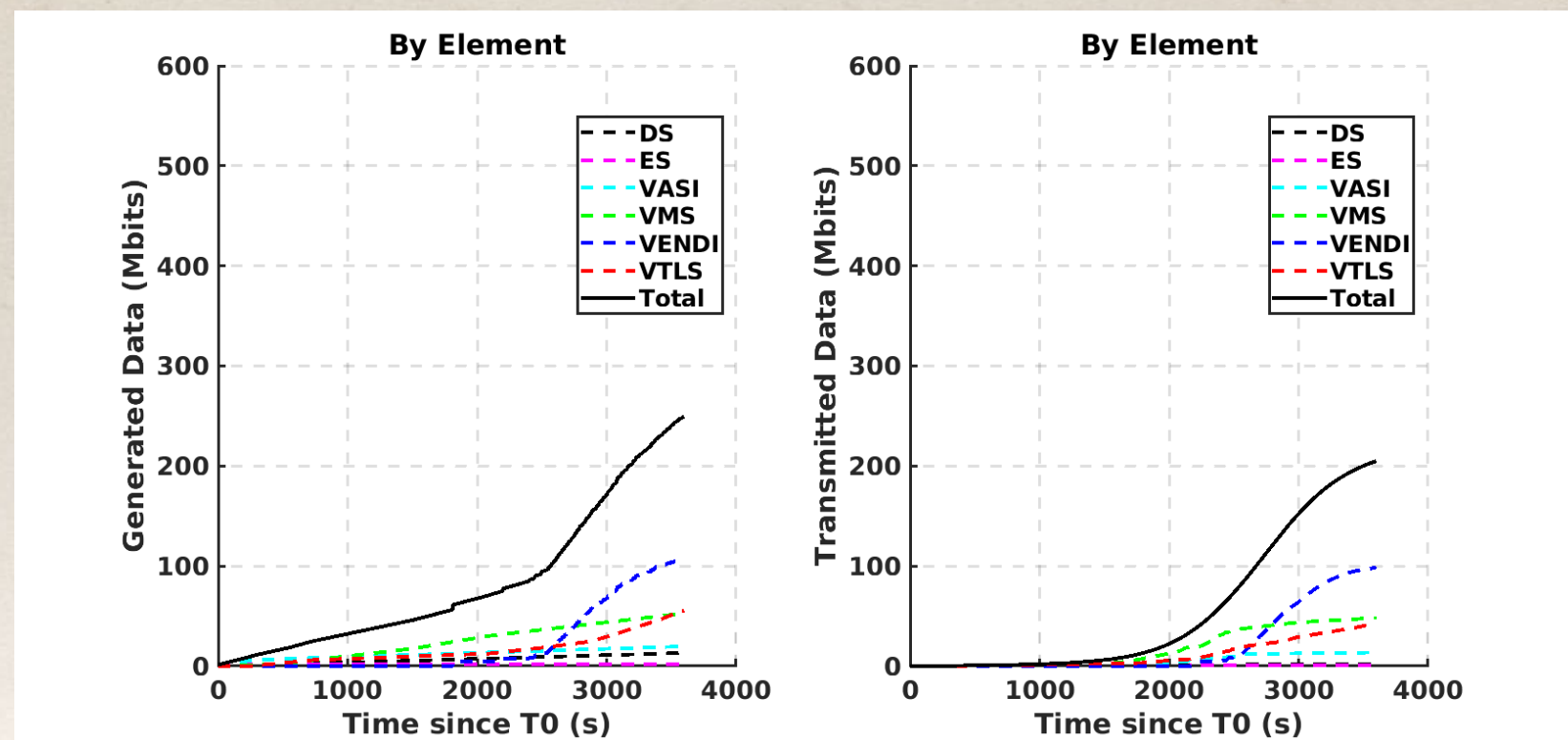
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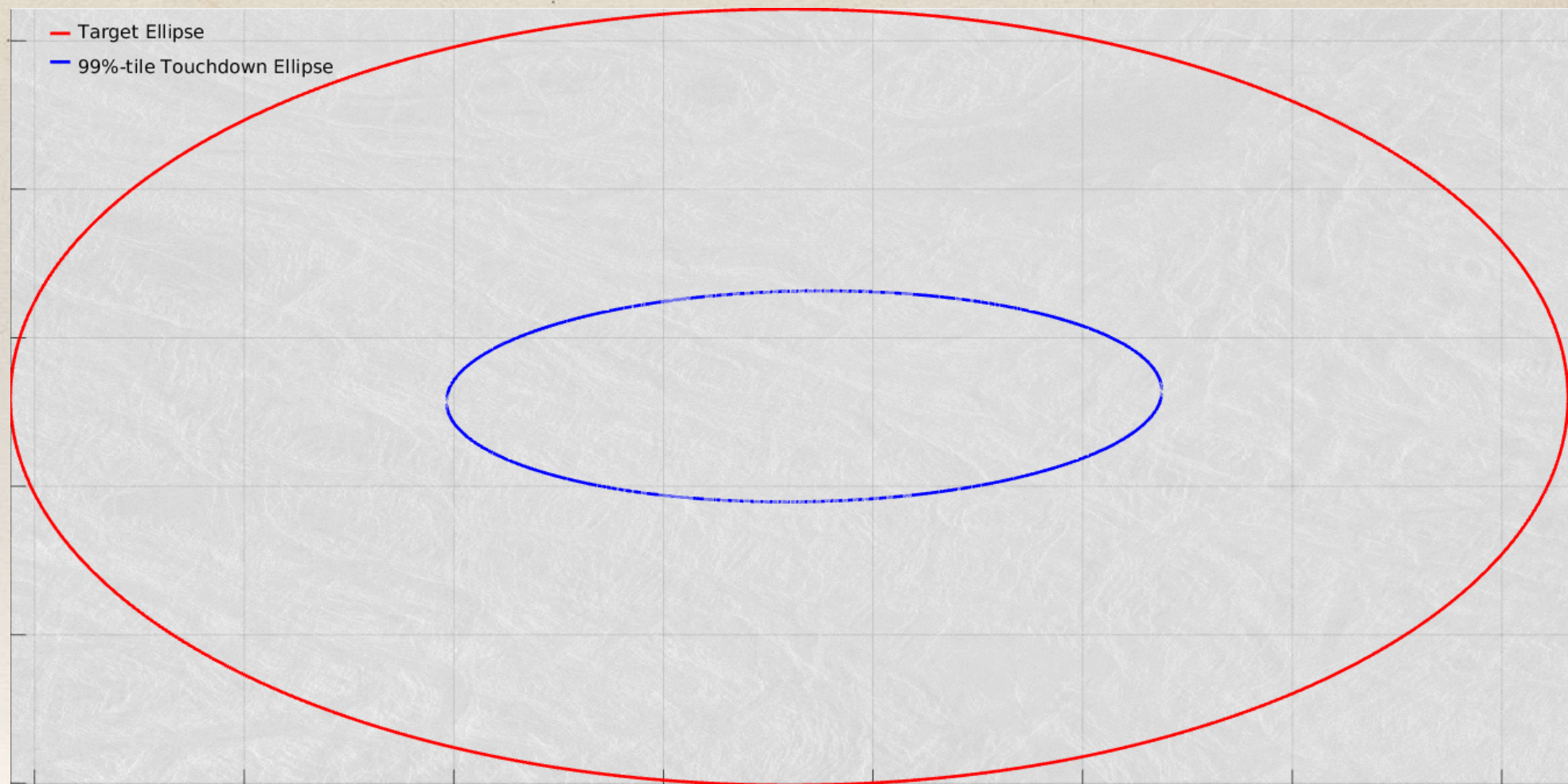
Minimum Science Requirements, short trajectory

Science Instrumentation - VenDI

- Track when VenDI takes images
- Model what and where VenDI will be able to see!

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DAVINCI Conclusion

- Updates to atmosphere modeling
 - CoA and DRA
 - Improved wind model
- Updates to aerodynamics
 - Entry ADB implemented
- Data prioritization model defined
 - Track instruments
 - Track data received
 - Compare with science metrics
- VenDI modeling
 - Images taken
 - What VenDI will see
- Future work
 - Atmosphere updates
 - Zephyr ADB in development
 - ADR model update

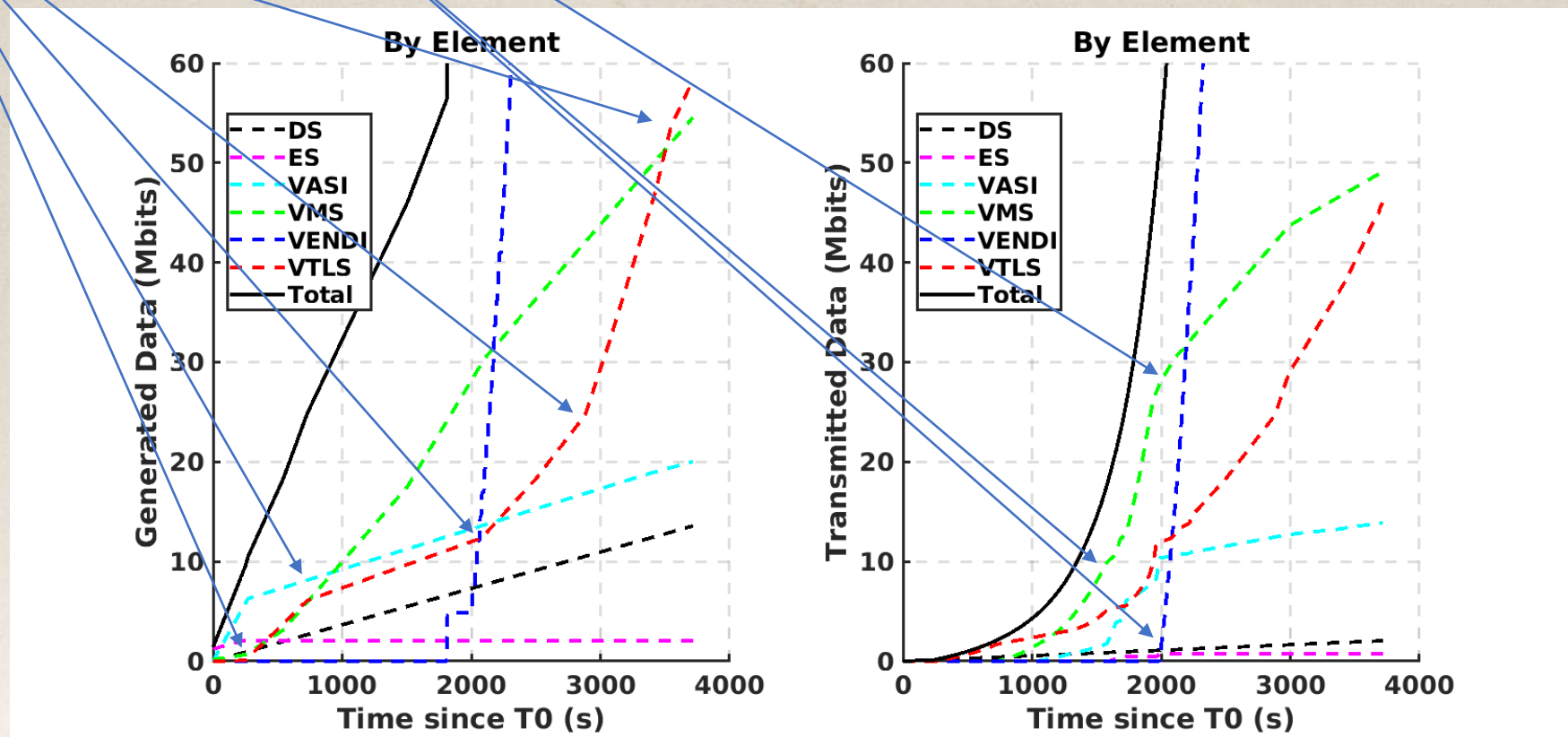


LaRC team at UTTR from left to right: Jamie Shiflet, N Giovanni Guecha-Ahumada, Matthew Andreini

DAVINCI Backup

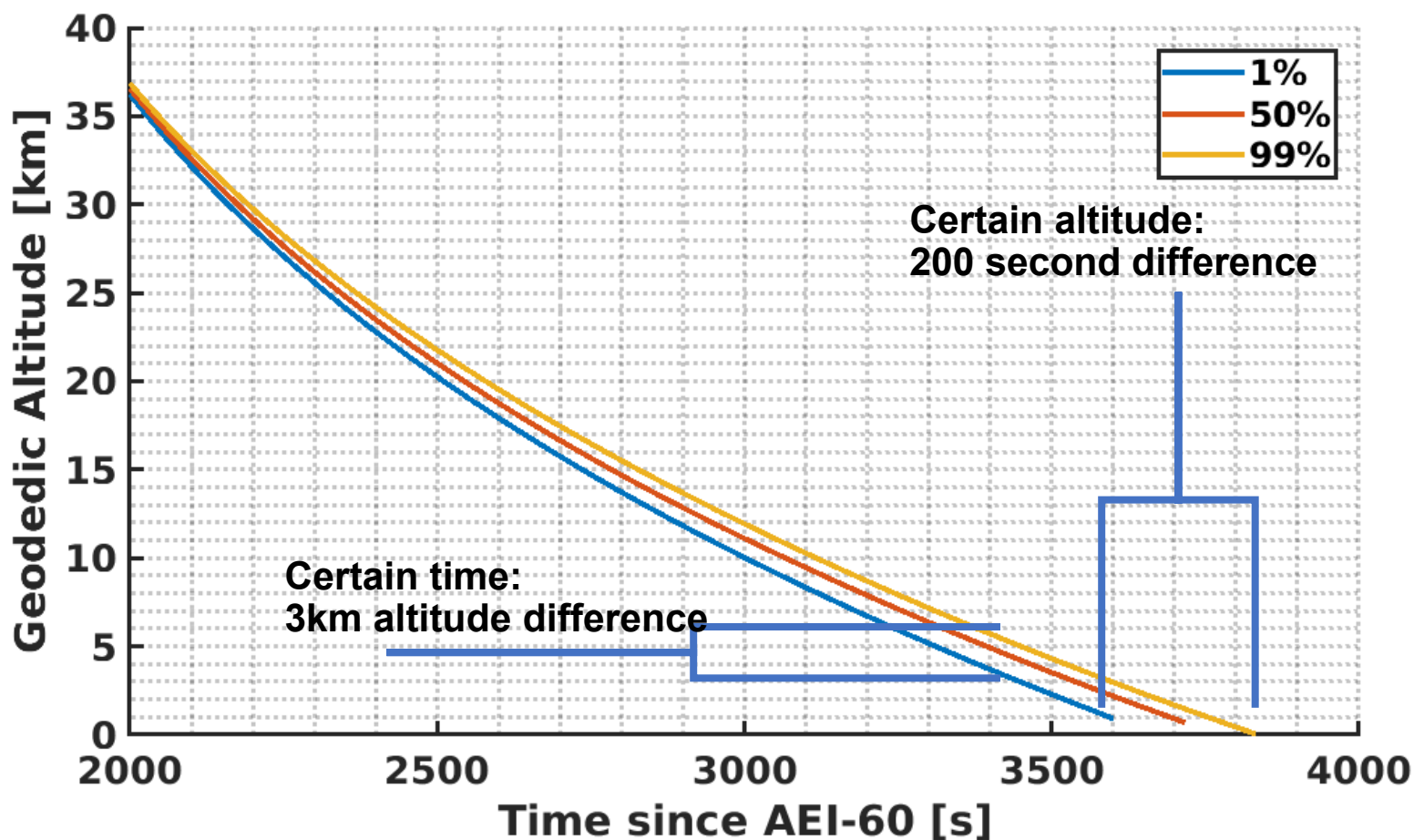
DAVINCI Visual check

- Noble Gas Retransmit
- VenDI extra images mode
- VTLS Samples



DAVINCI Atmosphere

- Mass and Density uncertainties lead to dispersion in descent sequence
- Due to the open-loop control of the descent sequence, this must be accounted for



DAVINCI ADR