Hera
Saturn
Entry Probe
Mission

A Proposal in Response to the ESA Call for a Medium-size mission opportunity in ESA's Science Programme for launch in 2029-2030 (M5)

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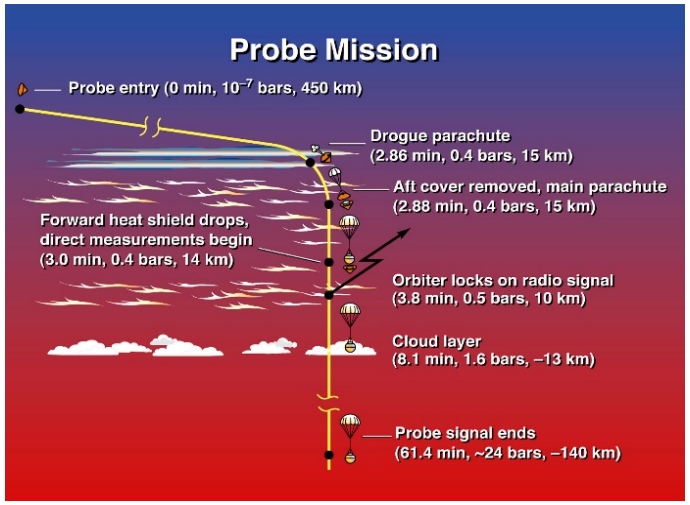
esa NASA

Suite of scientific instruments

Instrument	Measurement
Mass Spectrometer (MS)	Elemental and chemical composition Isotopic composition High molecular mass organics
Atmospheric Structure Instrument (ASI)	Pressure, temperature, density, molecular weight profile, lightning
Radio Science Experiment (RSE)	Measure winds, speed and direction Chemical composition
Nephelometer	Cloud structure, solid/liquid particles
Net-flux radiometer (NFR)	Thermal/solar energy
Helium Abundance Detector	Helium abundance

Core mission profile modeled after Galileo probe

NASA provided HEEET would enable significant mass savings over CP for range of EFPAs



Galileo entry, descent and deployment sequence shown above will be the basis for the proposed Saturn mission.

Table E.1 Entry System Mass Estimates

Entry Flight Path Angle (EFPA), degrees	-8		-19	
TPS Material	Mass, kg			
	HEEET	Carbon Phenolic	HEEET	Carbon Phenolic
Entry System (total mass)	215	255	199	223
Deceleration module	92.6	132.6	76.6	100.6
Forebody TPS (HEEET)	40	80	24	48
Afterbody TPS	10.5	10.5	10.5	10.5
Structure	18.3	18.3	18.3	18.3
Parachute	8.2	8.2	8.2	8.2
Separate Hardware	6.9	6.9	6.9	6.9
Harness	4.3	4.3	4.3	4.3
Thermal Control	4.4	4.4	4.4	4.4
Descent Module	122.7	122.7	122.7	122.7
Communication	13	13	13	13
C&DH Subsystem	18.4	18.4	18.4	18.4
Power Subsystem	22[1]	22[1]	22[1]	22[1]
Structure	30	30	30	30
Harness	9.1	9.1	9.1	9.1
Thermal Control	4.3	4.3	4.3	4.3
Science Instrument	25	25	25	25
Separate Hardware	0.9	0.9	0.9	0.9

Note. *Deceleration of (or Entry System) module 1m diameter aeroshell, 36 km/s inertial velocity, 10 deg latitude). The descent module mass estimate, except for the Science Instruments, are the same as that of Galileo Probe. Additional mass savings are likely when the descent system structure is adjusted for reduction in scale as well as entry g-load. Galileo design-to g-load was 350. Saturn probe entry g-load with 3-sigma excursions will be less than 150 g's.*

Future developments in Europe

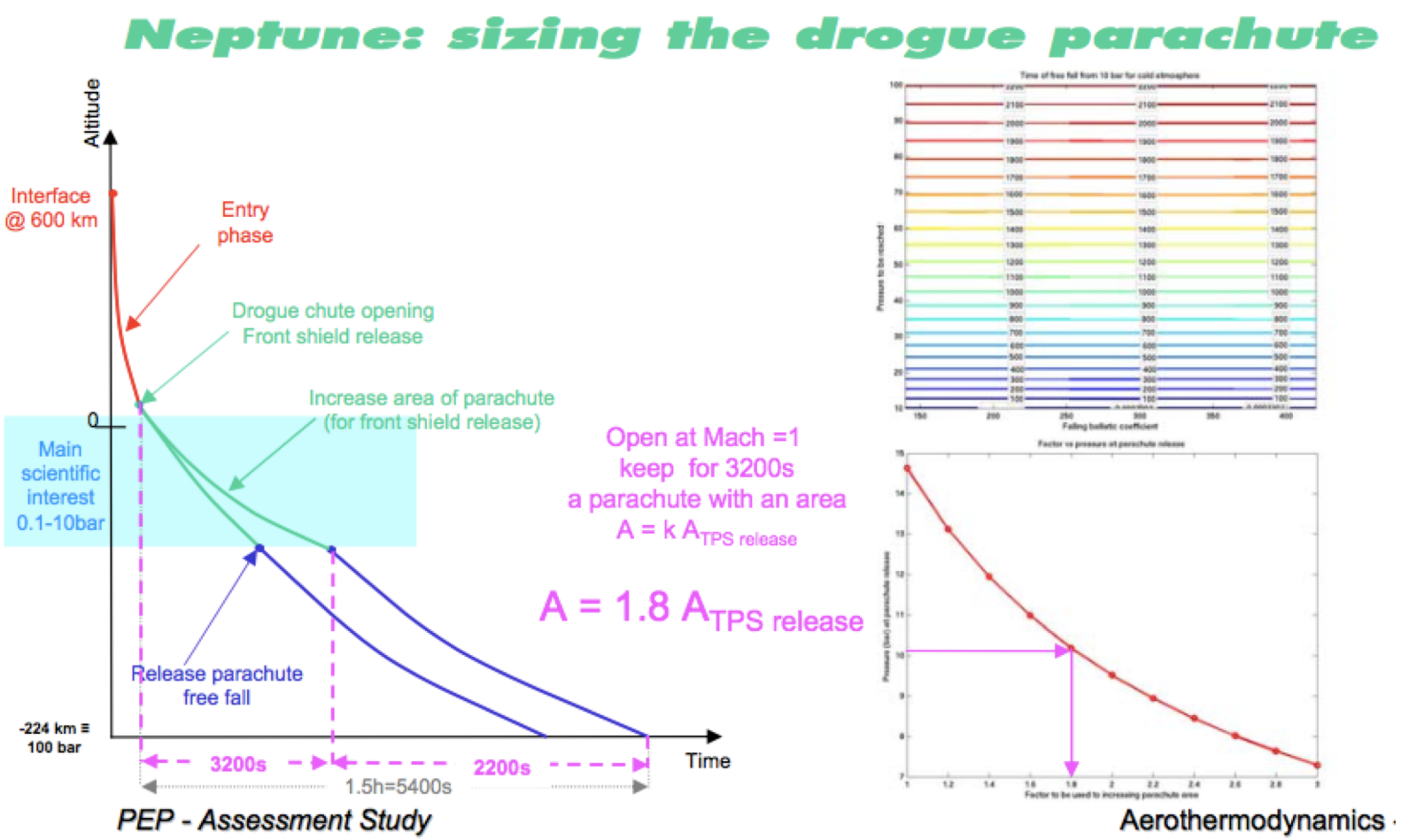
Giant Planet Probes require development of entry technology (Thermal Protection System)

- represents a significant probe mass fraction
- requires multi-year development since TPS materials and testing facilities do not exist

Entry Technology for Giant Planet Probes includes:

- Thermal Protection Systems materials
- Facilities (Arcjet; Laser ablation; etc)
- Analysis and codes to calculate ablation of TPS

Future developments: new probe designs for going deeper



To go deep, key enabling technologies are needed:

- Thermal Protection Systems (materials, facilities, analysis codes)
- Pressure vessel designs and materials (including thermal management)
- Telecom between probe and S/C (significant atmospheric absorption)

ESA Planetary Entry Probe 2010 study

When and how?

- Partnership with NASA: small probe in piggyback on a New Frontier mission (DragonFly?)
- NASA/ESA flagship mission toward Uranus or Neptune
- Standalone L-class mission toward Saturn or the Ice Giants?