BepiColombo
Project Status

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Presentation for MESSENGER Science Team Meeting

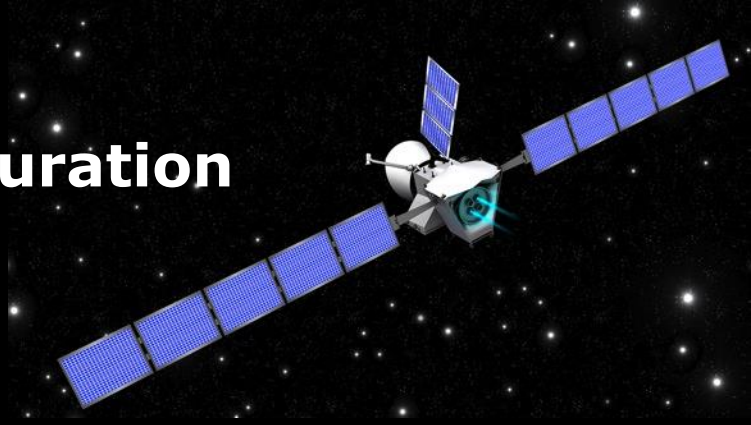
Via-Skype, 27th March 2015

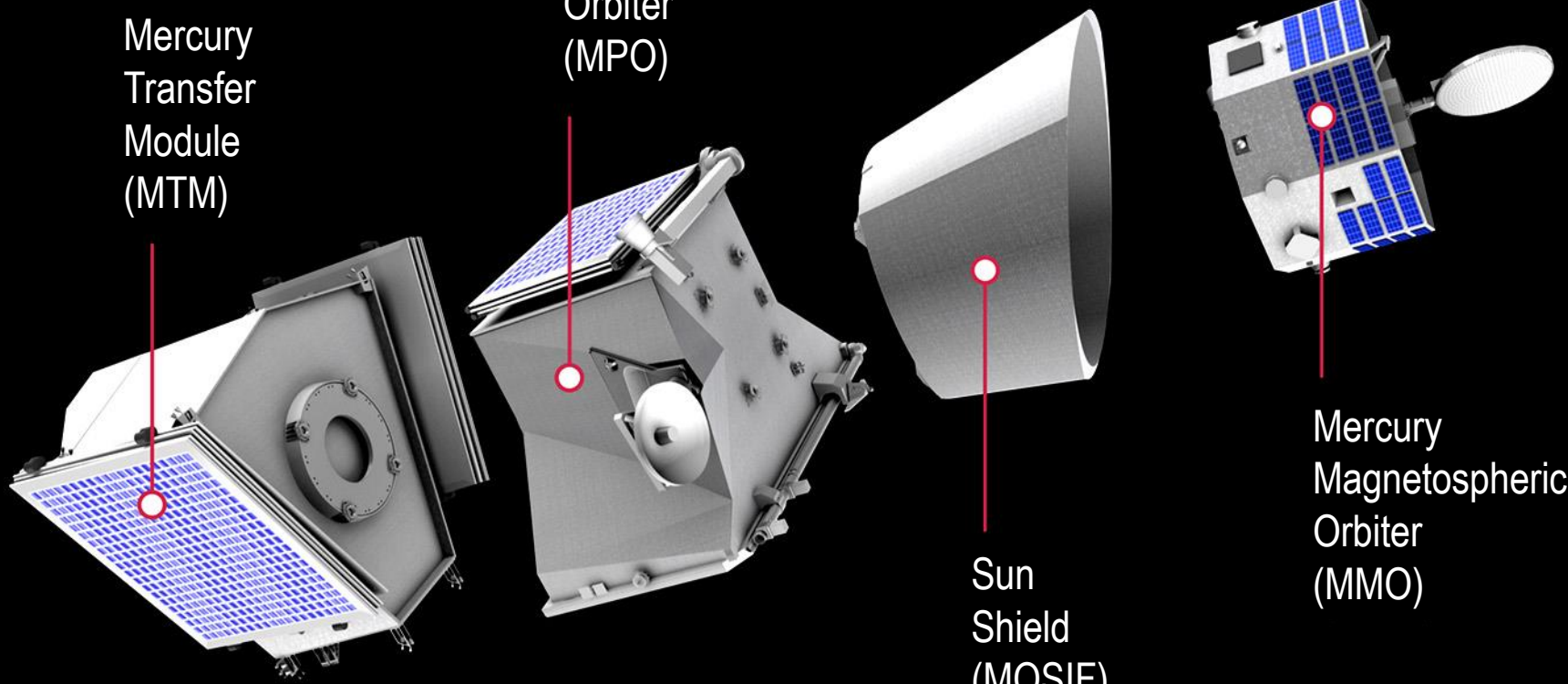
Project status

The purpose of this presentation is to give an overview on the

- **actual spacecraft status and schedule**
- **Present some idea's for Venus Fly-by activities**
- **Promote the up-coming MESSENGER-BC Workshop in Berlin, Germany**

BepiColombo Spacecraft Configuration

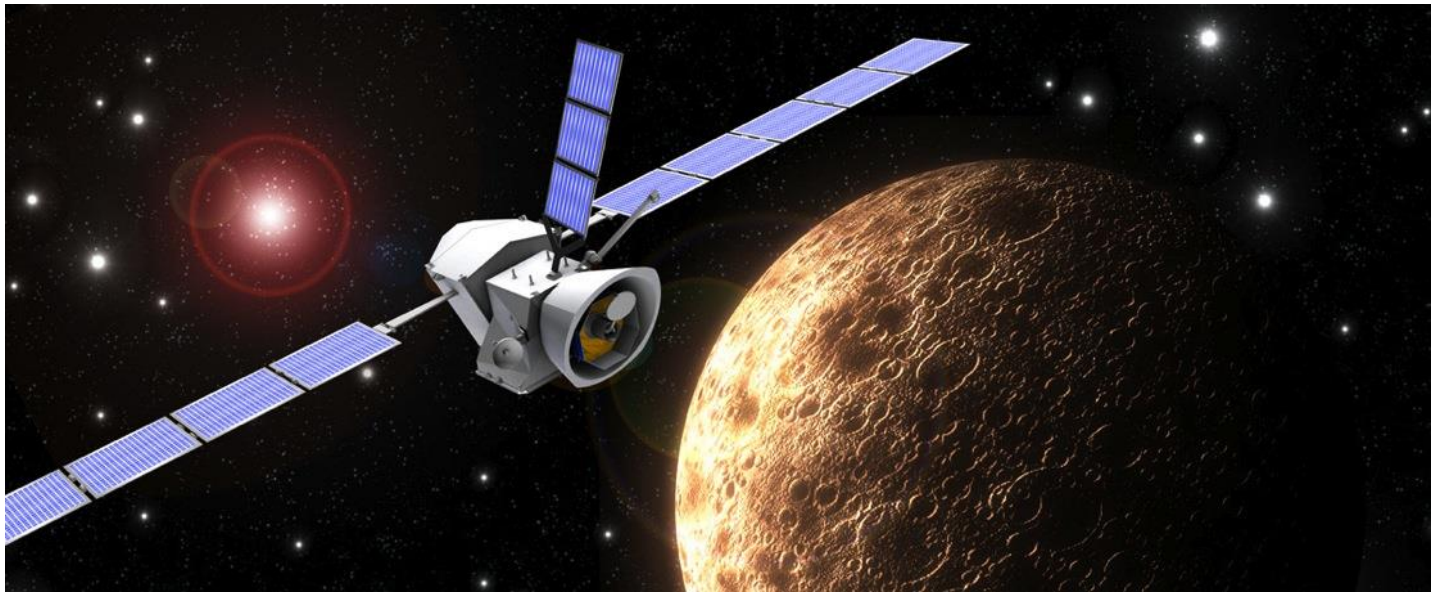




Mercury Composite Spacecraft (MCS)

BepiColombo – General Status

- Mercury Planetary Orbiter (MPO) successful completion of TB/TV in Dec 2014
- Mercury Transfer Module (MTM) integration progressing, awaiting late deliveries

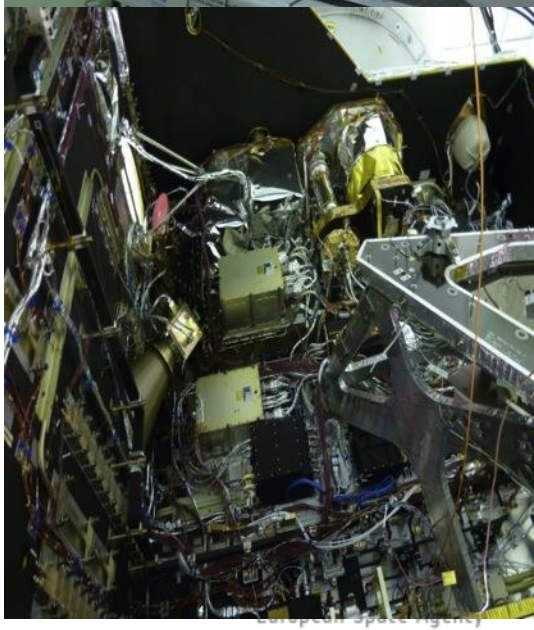


- **Schedule critical for some Payload FM**
- Mission Schedule remains very critical
  - launch readiness July 2016 no more feasible
  - launch date shifted to 27 January 2017

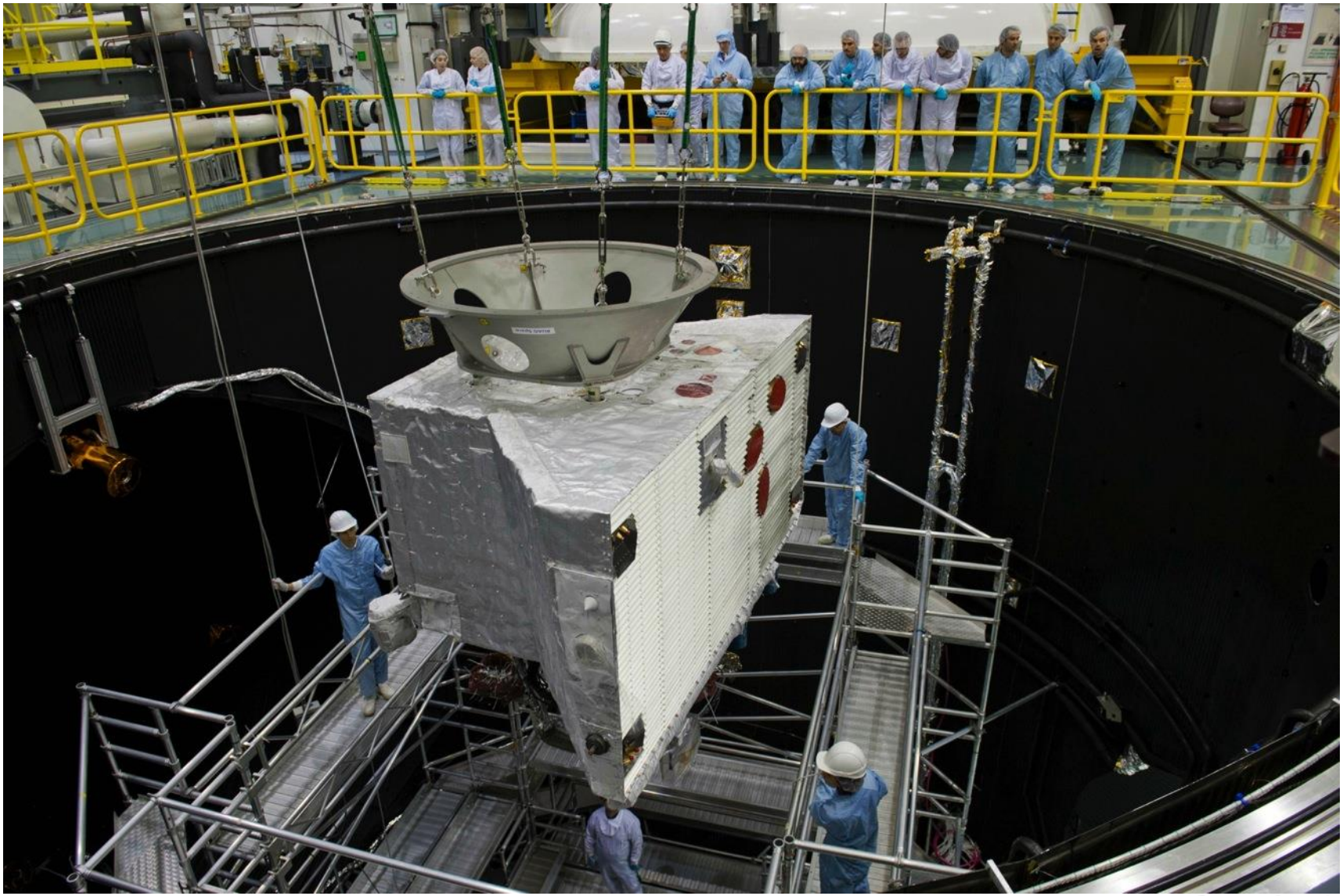
BepiColombo – Mission Status – Spacecraft

Spacecraft Proto-Flight Model

- Mercury Planetary Orbiter (MPO):
  - Module in ESTEC since early August 2014
  - MPO TB/TV completed in early December 2014; initial assessment confirms that thermal performance matches prediction – final report April 2015
  - Alignment activities proceeding nominally; some Payload exchanges needed;
    - full FM payload integration to be completed in June
  - Mechanical testing first half 2016



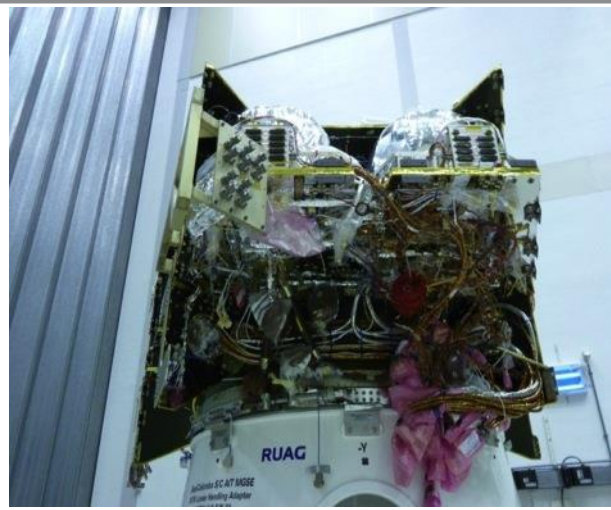
BepiColombo – Mission Status – Spacecraft



BepiColombo – Mission Status – Spacecraft

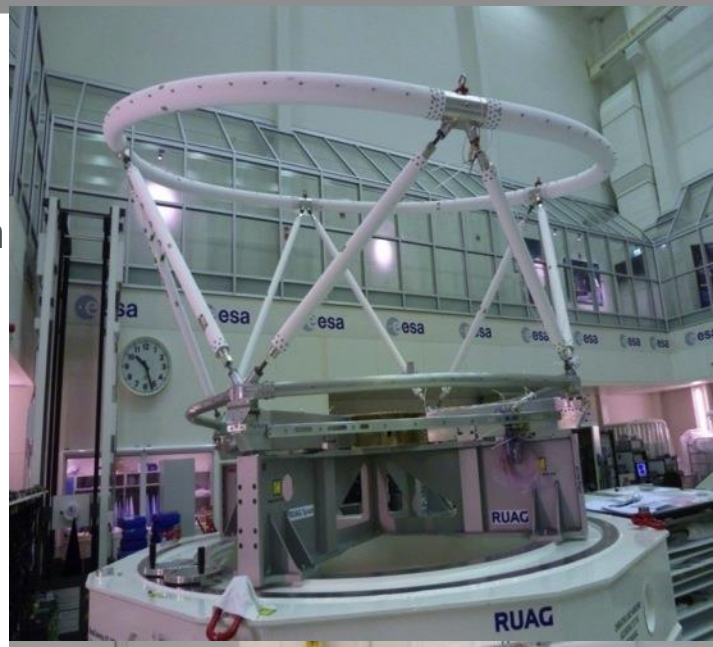
Spacecraft Proto-Flight Model

- Mercury Transfer Module (MTM):
  - Module installed in ESTEC since July 2014
  - Chemical Prop. System installation complete
  - System harness integration complete; SEPS flight harness delivered and fit check successfully completed



BepiColombo – Mission Status – Spacecraft

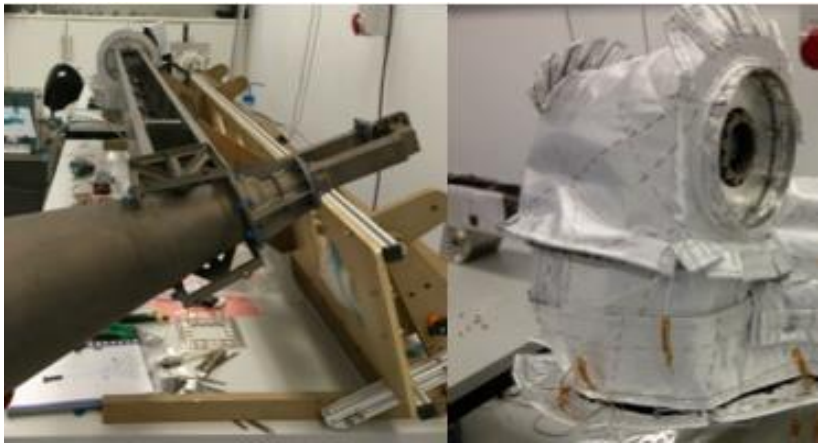
- MOSIF
  - PFM structure in ESTEC awaiting MLI Integration
  - MLI completely manufactured
- Engineering Test Bench
  - Progressing nominally

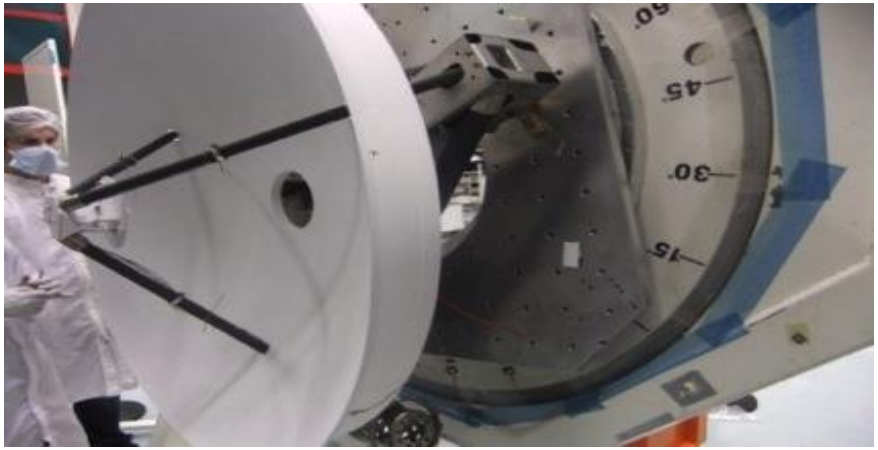


BepiColombo – Critical Developments

High Gain Antenna

- **Alignment issue on reflector**
- **Thermal Vacuum and balance test on EQM starts in May 2015**
- **PFM HGAMA delivery on critical path for MPO schedule**

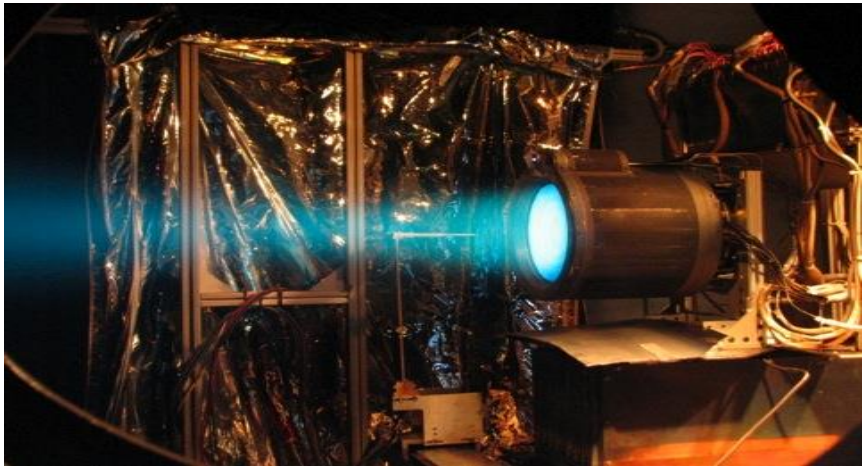


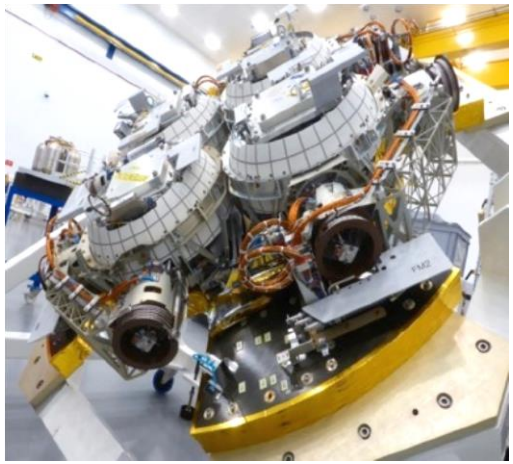


BepiColombo – Critical Developments

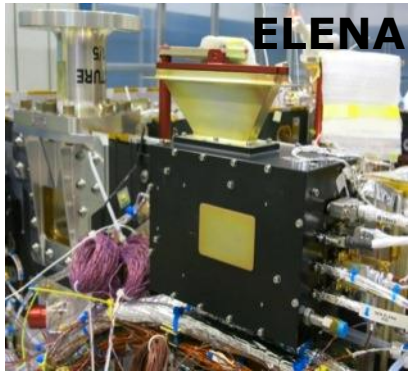
Solar Electric Propulsion:

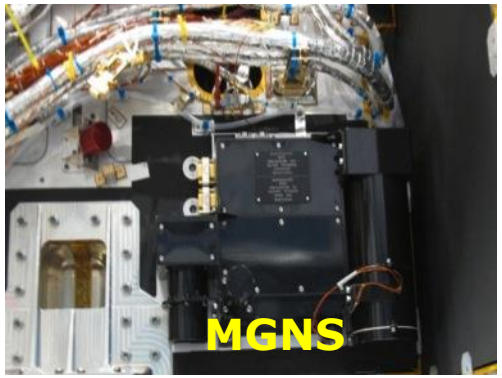
- SEPS EQM full end to end testing successful; FM thruster acceptance tested; SEPS endurance test in progress
- Issues: PPU relay failure; manufacturing issues => intense repair measures
- **PPU schedule critical**

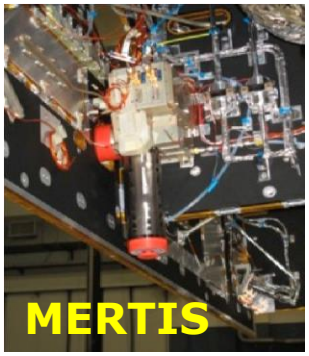


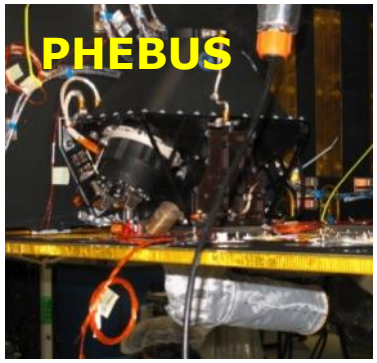


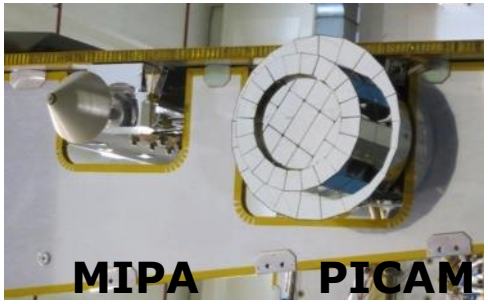
BepiColombo - Payload integrated on MPO











BepiColombo – Status

MMO Status

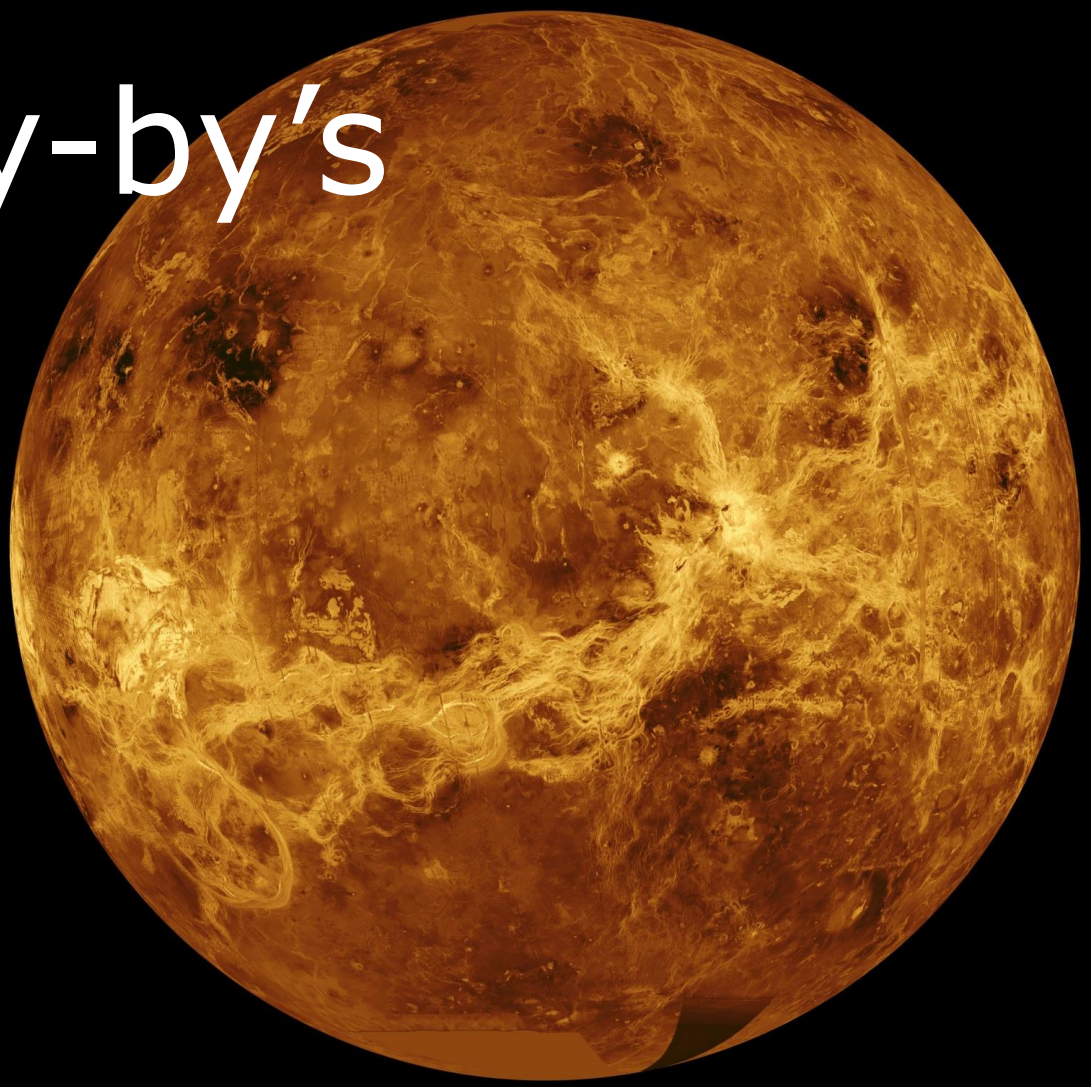
- MMO FM environmental acceptance test campaign completed;
- Delivery to Europe planned for April 2015; handover scheduled for June 2015 with comfortable margin to system AIT need

Overall

- Due to ongoing procurement delays, the Launch Readiness could not be kept in July 2016- moved to December 2016 (launch 27 January 2017)
- Upcoming tests – sequence:

  - MTM Thermal Test
  - MCS Mechanical Tests
  - Deployments tests
  - Final functional tests
  - Launch campaign

VENUS fly-by's



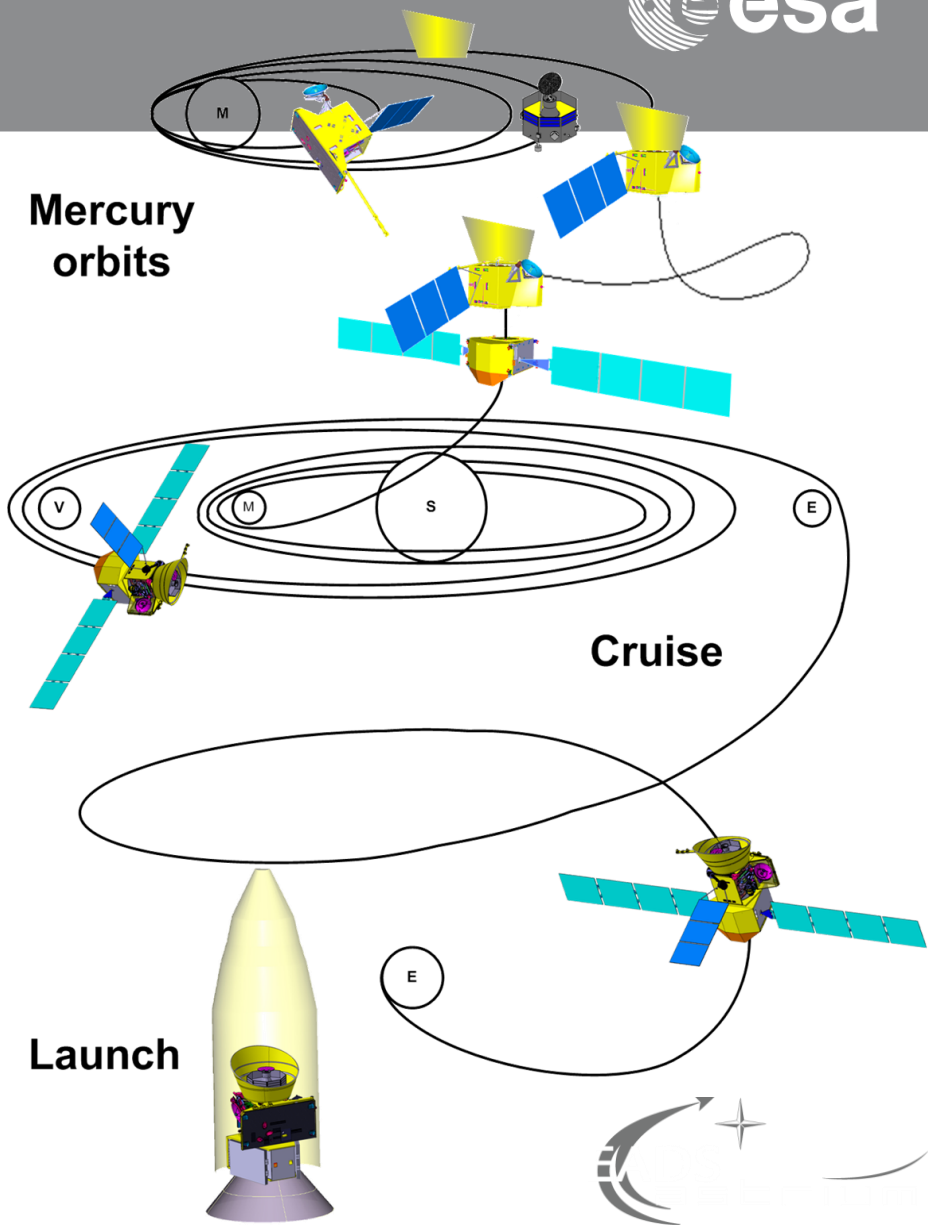
Mission Concept

Interplanetary Cruise Phase

- Electric propulsion acceleration
- Electric propulsion braking
- Earth, 2x Venus, 4x Mercury gravity assist maneuvers
- Separation of Transfer Module

Mercury Approach Phase

- Orbit maneuvers
- MMO separation (into MMO orbit)
- Sunshield separation
- Descent to MPO orbit



BC fly-bys info

	Earth	Venus 1	Venus 2	M1	M2	M3	M4	M5
Flyby Date	2018- 7-18	2019- 9-22	2020- 5- 4	20-7-23	21-4-14	22-7-6	22-12-28	23-2-4
MJD2000	6773.5	7204.7	7429.4	7509.7	7774.6	8222.3	8398.0	8435.7
Solar Longitude	-64.4°	-155.1°	-155.2°	0.6°	5.7°	48.9°	47.0°	-133.8°
Flyby velocity	4.33 km/s	9.30 km/s	9.29 km/s	5.90	5.52	2.86	2.61	1.82
Flyby altitude	3521 km	1500 km	307 km	200	200	200	40000	300
Deflection angle	86.1°	38.8°	43.6°	22.3°	24.9°	60.7°	8.1°	90.1°
Pericentre								
Declination	22.7°	71.5°	-19.0°	-1.8°	-5.9°	-29.9°	-3.6°	-45.5°
Right ascension	46.7°	52.3°	66.0°	33.3°	55.3°	87.6°	-174.3°	-6.1°
Incoming velocity								
R-component	4.18 km/s	9.20 km/s	8.00 km/s	-2.20	-3.69	-0.48	-0.34	-0.02
S-component	-0.17 km/s	0.26 km/s	-1.28 km/s	5.46	4.07	2.47	-0.06	-0.06
T-component	1.10 km/s	1.31 km/s	-4.55 km/s	0.41	0.50	1.36	2.58	-1.82
Declination	14.7°	8.1°	-29.3°	3.9°	5.2°	28.4°	82.3°	-88.1°
Right ascension	-2.3°	1.6°	-9.1°	112.0°	132.2°	101.0°	-170.9°	-108.9°
Outgoing velocity								
R-component	0.45 km/s	8.01 km/s	5.35 km/s	-4.11	-5.04	-0.58	0.02	-1.82
S-component	-4.14 km/s	-1.29 km/s	-7.25 km/s	4.21	2.13	-0.04	-0.02	0.14
T-component	-1.18 km/s	-4.55 km/s	-2.30 km/s	0.48	0.74	2.80	2.61	0.02
Declination	-15.9°	-29.3°	-14.3°	4.7°	7.7°	78.2°	89.3°	0.6°
Right ascension	-83.8°	-9.2°	-53.6°	134.3°	157.1°	-176.5°	-38.2°	175.7°

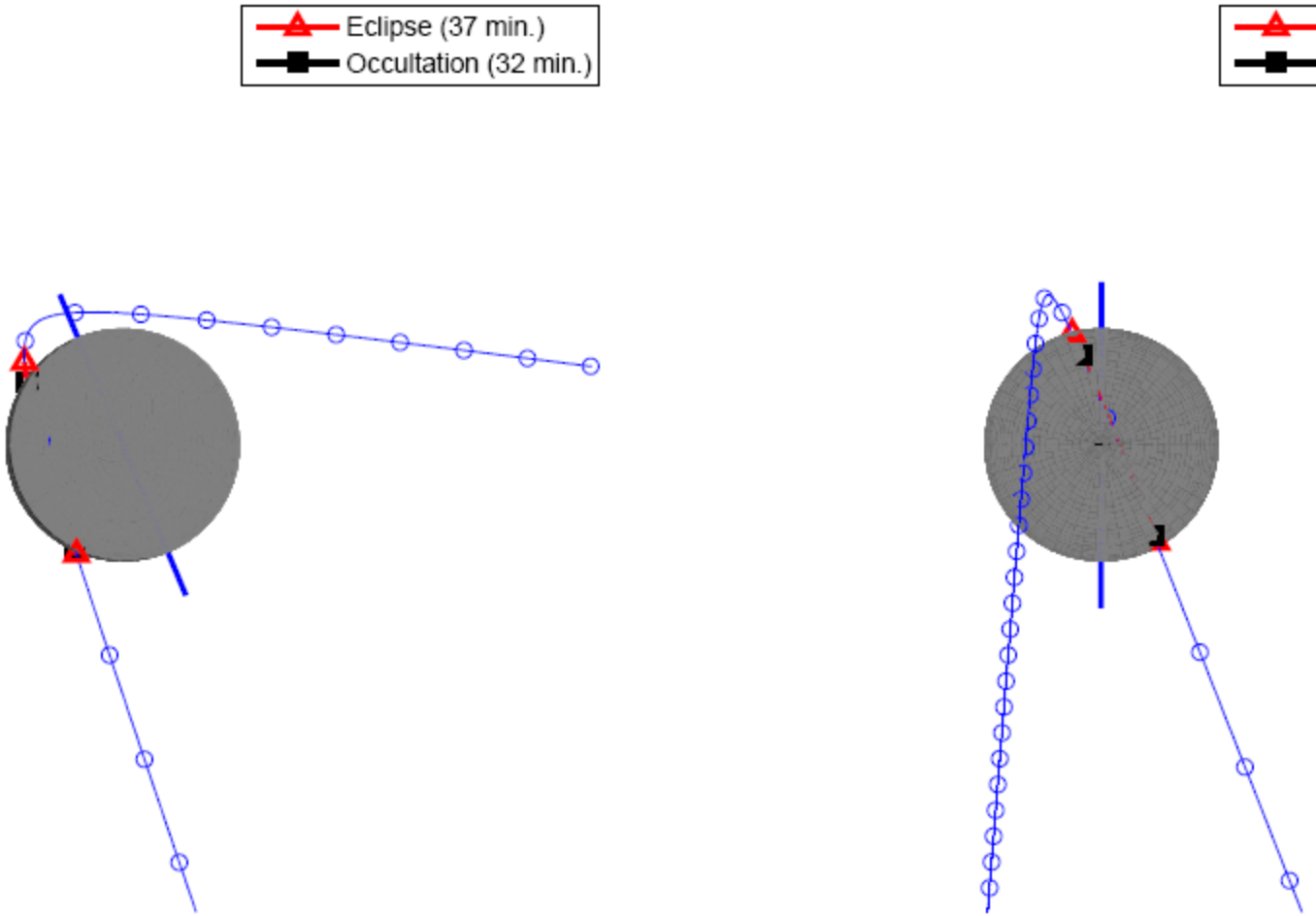


Figure 20: Venus 1 flyby as seen from Earth (left) and from the Sun (right). Tick marks are drawn every 20 minutes. The flyby height was limited to less than 1500 km in order to reduce the eclipse duration.

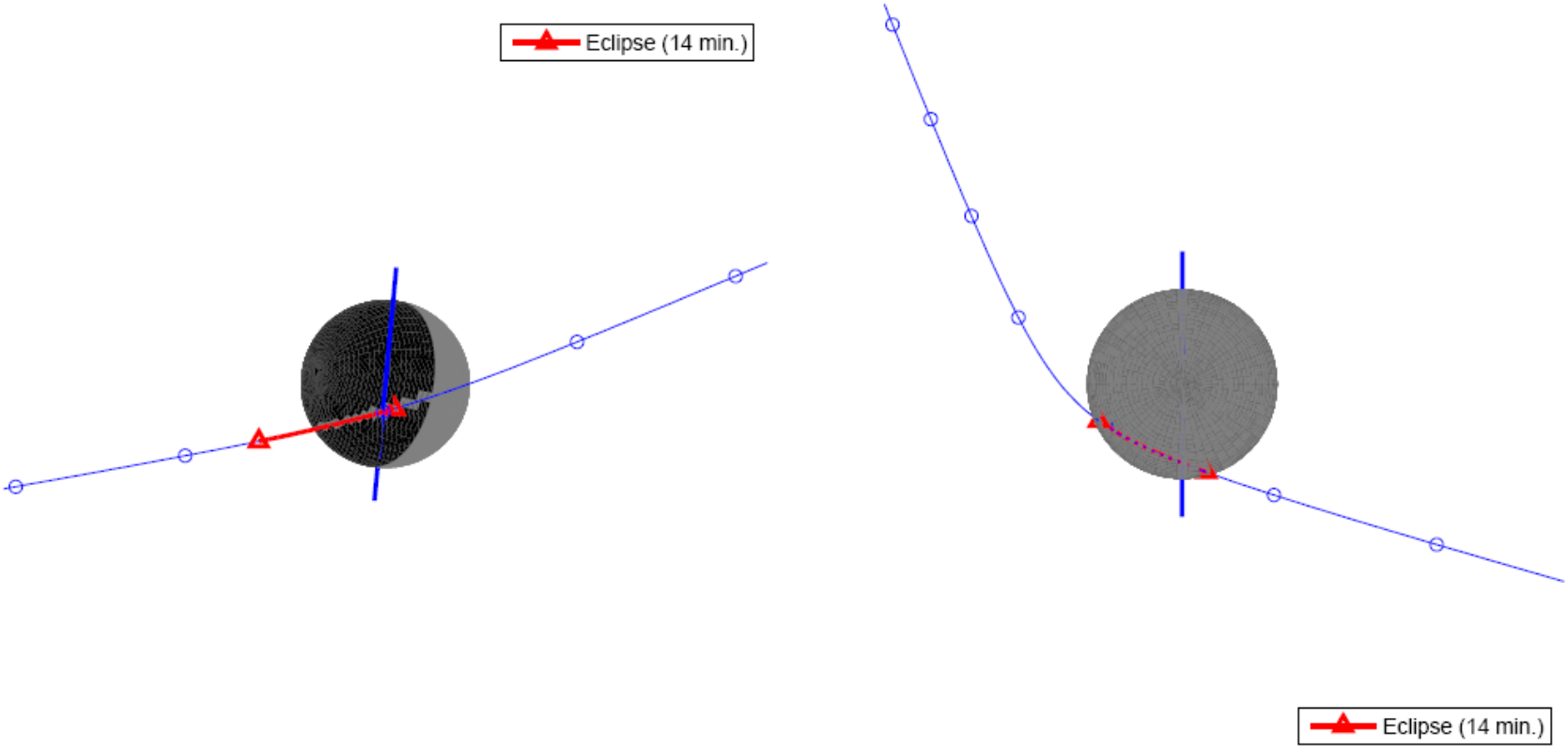


Figure 21: Venus 2 flyby as seen from Earth (left) and from the Sun (right). Tick marks are drawn every 20 minutes.

MPO payload operational @ Venus

Name	Pointing direction
BELA	+ Z (Nadir)
ISA	+ X (with rotations in the three axes)
MERMAG	Top of radiator (with rotations in the three axes)
MERTIS	2 cones (+ Z, Nadir and – Y, radiator)
MGNS	+ Z (Nadir)
MIXS	+ Z (Nadir)
MORE	Radio science Ka-band transponder
PHEBUS	- Y (radiator)
SERENA	ELENA: + Z; STROFIO: + Z; PICAM: + X ; MIPA: + X
SIMBIO-SYS	HRIC: + Z; STC: + Z; VIHI: + Z
SIXS	Solar monitor

MESSENGER – BC Workshop

http://www.cosmos.esa.int/web/bepicolombo/m-bc-meeting-details

MESSENGER – BEPICOLOMBO JOINT SCIENCE MEETING

DLR Berlin, Germany

16-18 June 2015

USEFUL LINKS

- REGISTRATION PAGE
- Announcements
- Program
- Hotel information and Map
- Local weather
- Travel information
- Organising Committee
- Abstract upload (Deadline April 15)

MINI AGENDA

Tuesday 16th June

09:15 - Introduction
09:30 - 13:00 - Interior
13:00 - Lunch
14:00 - 18:00 - Surface

Wednesday 17th June

09:30 - 13:00 - Exosphere
13:00 - Lunch
14:00 - 17:30 - Magnetosphere
19:30 - Dinner/Social event

Thursday 18th June

09:30 - 13:00 - The big picture
13:30 - End of meeting

Agenda

Tuesday 16th June		
09:15	Welcome/Introduction/Logistics	J. Helbert/J. BENKHOFF
Block 1 Interior		
09:30	Invited talk 1	Invited speaker 1
10:00	Invited talk 2	Invited speaker 2
10:30	***Coffee break***	
11:00	Contributed Talks (6 x 10 mins)	Various
12:00	Discussion	All
13:00	***Lunch***	
Block 2 Surface		
14:00	Invited talk 3 (Geology)	Invited speaker 3
14:30	Invited talk 4 (Geochemistry)	Invited speaker 4
15:00	Invited talk 5	Invited speaker 5
15:30	***Coffee break***	
16:00	Contributed talks (6 x 10 mins)	Various
17:00	Discussion	All
18:00	End	

Agenda

Wednesday 17th June		
Block 3 Exosphere		
09:30	Invited talk 6	Invited speaker 6
10:00	Invited talk 7	Invited speaker 7
10:30	***Coffee break***	
11:00	Contributed talks (6 x 10 mins)	Various
12:00	Discussion	All
13:00	***Lunch***	
Block 4 Magnetosphere		
14:00	Invited talk 8	Invited speaker 8
14:30	Invited talk 9	Invited speaker 9
15:00	***Coffee break***	
15:30	Contributed talks (6 x 10 mins)	Various
16:30	Discussion	All
17:30	End	
19:30	***Social event/dinner***	
18:00	End	

Agenda -- Thursday 18th June

Block 5 "The Big Picture"

09:30	Invited talk 10	Sean Solomon
10:00	Invited talk 11	Tilman Spohn
10:30	Coffee break	
11:00	Contributed talks (6 x 10 mins)	Various
12:00	Discussion	All
13:00	Close out summary	All
13:30	End of meeting	

BepiColombo Schedule

Launch January 2017 (repeating **opportunities in March 2017, July 2017)**

Arrival January 2024 (1 Earth, **2 Venus and 5 Mercury fly-bys)**