Planetary probes: ESA Perspective
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International Planetary Probe Workshop#6
June 23-27, 2008, Atlanta, CA
• Latest organigramme;
• Highlight SER, HSF, TEC, OPS
• Science and Robotic Exploration programme
• Aurora programme
• Technology Research Activities; including technology demonstration missions
ESA’s science programme
sci.esa.int

- Solar System missions *(planetary missions in read)*
  - Cluster (4-spacecraft flotilla, ESA/NASA, 2000-)
  - SOHO (ESA/NASA, 1995-)
  - Cassini-Huygens (NASA/ESA, 1997-2010; 2010 + ?)
  - Mars Express (2003-ESA/NASA)
  - Venus Express (2006-, ESA/NASA)
  - Bepi-Colombo (ESA/JAXA, in development; under review)
  - Exomars (ESA/NASA, in development, launch planned in 2013)
ESA’s science programme
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- Astronomy Mission
  - Herchel/Planck (launch planned end 2008; ESA/NASA)
  - LISA Pathfinder (ESA/NASA, launch planned in 2010-11)
  - JSWT (NASA/ESA, launch planned in 2012)
  - Gaia (ESA, launch planned 2012)

- Missions in cooperation
  - Hinode (JAXA/ESA)
  - Corot (CNES/ESA)
  - Microscope (CNES/ESA)
ESA Planetary Probe History.. a selection

• Cassini-Huygens (24 years of my career… still counting): highly successful international collaboration; demonstrated beautifully probe/orbiter (in situ/remote sensing) complementarities
• MEX/Beagle-2: Mars Lander… lost but good heritage in terms of small probes and miniaturized instrumentation
• Exomars: Mars Rover and Geophysical Package; the great ESA Mars challenge
• MEX used as Phoenix radio relay: operational aspects
• Huygens Probe Tracking from Earth’s Radio telescopes: opened window to DtE
Christiaan Huygens (1629-1695) Dutch scientist, who discovered the true nature of Saturn’s rings, and in 1655, Titan.

Giovanni Domenico Cassini (1625-1712), Italo-French astronomer, who discovered several of Saturn’s satellites: Iapetus, Rhea, Tethys and Dione. In 1675, he discovered what is today called “Cassini Division” the gap in-between the two main rings of Saturn.
Huygens Mission

December 25, 2004
Cassini releases the Huygens probe. The two spacecraft travel in tandem.

December 17, 2004
Cassini maneuvers, causing its trajectory to intersect with Titan.

January 14, 2005
Cassini continues around Saturn while Huygens beelines for Titan’s surface.
Images and other data through Cassini during 2h28min of descent and 1h12min on the surface. Radio telescope detection of signal during descent and 3h14mn on surface.
Temperature: -180 C
Pressure: 1.5 bar

14 January 2005
ESA’s COSMIC VISION PROGRAMME
Missions relevant to IPPW
Cosmic Vision – Science Themes

1. What are the conditions for life and planetary formation?

2. How does the solar system work?

3. What are the fundamental laws of the universe?

4. How did the universe begin and what is it made of?
Cosmic Vision Phase-1
Missions and Timeline

• The current studies prepare the final selection (in 2011) of two missions:
  • 1 medium “M” Mission (ESA’s share <300 M€)
  • 1 large “L” Mission (ESA’s share <650 M€)
    • Launch in 2017 & 2018.
  • Available budget: ~ 950 M€.
ESA CV at a glance

• Call for Mission issued in 2007. 8 Missions selected for studies in Oct.
• L-Class Missions (< 650 M€, 2006 EC)
  • Laplace or TandEM: EJSM or TSSM down-selection in Nov ‘08
  • XEUS (ESA-JAXA X-ray Observatory); Possible collaboration with NASA
  • LISA (ESA-NASA Gravitational Wave Observatory)
• M-Class Missions (< 300 M€ *)
  • Cross-Scale (ESA-JAXA, Multi-scale plasma processes in Space)
  • Marco-Polo (ESA-JAXA, NEO sample return)
  • Plato (ESA-only, Planetary Transits and Oscillations of Stars)
  • SPICA (JAXA-ESA, Japanese Infrared Observatory, 5-250 μm)
  • Euclid (mapping the geometry of the dark universe)
• Current plan: select one M- & one L-Class mission in ‘11 for launch in ‘17/’18
NASA/ESA are investigating extension of Cassini-Huygens collaboration to two new Outer Planet Flagship Missions:
TSSM and EJSM
Next milestone: ESA-NASA bilateral in mid-July
TSSM: Titan Saturn System Mission

Explore Titan, an organic-rich, Earth-like moon and Saturn system as related to Titan
TSSM Reference Mission

- NASA/ESA Mission
- Merging of ESA’s TandEM proposal (lead by Athena Coustenis, obs de Paris-Meudon) and NASA’s 2007 Flagship Titan Orbiter
- Titan Orbiter (assumed to be provided by NASA; Study nearing completion). It carries and delivers two ISE’s (assumed to be provided by ESA; under study in ESA’s CDF);
  - Montgolfiere
  - Descent probe/lander, either
    - Long-lived lander (dry landing site)
    - Short-lived lander (lake/mare landing)
Marco Polo

- Sample return from a *primitive* asteroid
- Collaboration with Japan
- Proposed by Antonella Barucci, Obs. Paris (+ ca. 400 scientists)
Cosmic Vision Phase 2-3

- Technology Preparation for future Missions (e.g. for future Venus Missions)
  - European Venus Explorer Proposal (EVE)
  - VEXAG activities
European Venus Explorer
A proposed mission for ESA’s Cosmic Vision 2015-2025

**Why EVE?**

In situ measurements needed for many purposes e.g.:
- Isotopic ratios of noble gases,
- Cloud/lower atmosphere chemistry cycles...

**How?**

- **Orbiter** (2 years)
- **Balloon** (7 days)
- **Lander** (1h30)

**With which goals?**

- Unified model of the formation and evolution of terrestrial planets
- Stability of the current climate
- Chemical/radiative processes in and below the clouds
- Geological history of Venus
- Atmospheric dynamics
- Electrical processes
# International cooperative scheme

- 170 Co-I's from 70 laboratories
- 18 countries including Russia, Japan, USA and Canada

<table>
<thead>
<tr>
<th>EUROPE</th>
<th>JAPAN</th>
<th>USA &amp; CANADA</th>
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<tr>
<td>The spacecraft,</td>
<td>A small balloon for low altitude studies (option),</td>
<td>Comprehensive science and instrument hardware involvements and</td>
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<td>the balloon platform,</td>
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<td>the possibility of using</td>
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<td>the Kourou element of the launch costs and</td>
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<td>NASA/JPL developed</td>
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<td>the science payload under national</td>
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<td>Venus balloon technology</td>
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<tr>
<td>contribution.</td>
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<td>through international collaboration, under NASA's</td>
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<pre><code>                                                                                                   | Mission of Opportunity (MoO) program.                      |
</code></pre>
<p>| RUSSIA                                     |                                           |                                                           |
| The dry Soyuz launcher,                    |                                           |                                                           |
| the descent probe,                         |                                           |                                                           |
| the entry/descent systems for both         |                                           |                                                           |
| balloon and descent probe and              |                                           |                                                           |
| a contribution to the science payload      |                                           |                                                           |
| and data analysis.                         |                                           |                                                           |</p>
• ESA’s Aurora Programme
  • Robotic Exploration of Mars
    • Exomars (implementation phase)
    • Mars-Next (study phase)
  • Mars Sample Return
  • Manned Mission to Mars
Conclusions

• Exciting programme in front of us that includes mission with planetary probes to Venus, Mars, Titan and earth (sample return)
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  • €
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