MESSENGER operations at Venus

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• Mercury Dual Imaging System (MDIS)
• Gamma-Ray and Neutron Spectrometer (GRNS)
• X-Ray Spectrometer (XRS)
• Magnetometer (MAG)
• Mercury Laser Altimeter (MLA)
• Mercury Atmospheric and Surface Composition Spectrometer (MASCPS)
• Energetic Particle and Plasma Spectrometer (EPPS)
• Radio Science (RS)
North ecliptic pole view

Over 15 trips around the Sun

VENUS FLYBY II
**No Venus I Flyby operations:** Instrument operations will stand-down since the spacecraft will be in solar conjunction for this event.
**MESSENGER**

**Venus II Flyby**

- **Spacecraft Time Shown**: 15 minutes
- **View from Earth to Venus**
  - **North**: 15-minute time ticks
  - **June 5, 2007**: 8:48 pm EDT (closest point)
  - **View from Sun to Venus**
  - **North**: Spacecraft time shown
  - **Enter Eclipse**: June 5, 2007 8:41 pm EDT
  - **Exit Eclipse**: 9:01 pm EDT
- **View from Above Venus North Pole**
  - **June 5, 2007**: 8:42 pm EDT
  - **300 km (186 mi) Altitude**

**Image Notes**
- NASA logo
- Venus II flyby illustration
Venus II Flyby Operations

- Venus Express will be in orbital operations by MESSENGER Venus II Flyby
- Venus II Flyby operations are divided into following categories:
  - Calibration operations
  - Mercury operations practice
  - Science of opportunity
  - Venus Express support
• MDIS
  – Practice representative sets of image mosaics that will be taken during Mercury flybys
    » Time and geometry prohibit a full dress rehearsal
    » These will encompass the range of observation types:
      – Color photometry
        ➢ At Mercury this will be used for compilation of global map
        ➢ At Venus may yield constraints on cloud particle sizes
      – Color mosaic
      – Global color image
      – Incoming and outgoing NAC mosaics
      – Movies (Approach/Departure)
      – OpNavs
  – Other essential imager calibrations

MDIS filter wavelengths (bandpass) in nm:
  » WAC: 415 (40), 480 (10), 560 (5), 630 (5), 700 (5), 750 (5), 700 (600), 830 (5), 900 (5), 950 (7), 1000 (15), 1020 (40)
  » NAC: 700 (100)
Reanalysis of ground-based telescopic observations of Venus by Hashimoto and Sugita (2003) suggest that crude compositional information might be derived from 1 µm images:

- Technique removes topography derived from Magellanic data, resulting in crude emissivity map.
- Broad-scale composition may be inferred from this emissivity map.

This technique has not yet been applied to spacecraft data*; MESSENGER’s Venus flyby would be an ideal opportunity to test this technique using MDIS data:

- Current ground track goes over Ovda Regio, a particularly interesting place on Venus’ surface.
- MDIS can image on dark side for up to ~75 minutes - resulting in a range of resolutions.

* Gilmore, Hashimoto and Sugita plan to apply this technique to recently-released Cassini VIMS Venus data.


- **MASCS**
  - UVVS (115-600 nm) atmospheric profiles
    - Dayside and nightside
    - NO, O\textsuperscript{i}, H\textsuperscript{i}, O\textsubscript{2}, and SO\textsubscript{2}.
  - UVVS observations of Venus exosphere on departure
    - travel “downwind” through the exosphere’s tail
    - O\textsuperscript{i}, H\textsuperscript{i}
  - VIRS (300-1450 nm) observations of disk from VIS to IR near close approach
    - cloud chemistry
    - view down through IR atmospheric windows

- **EPPS**
  - Observe acceleration of energetic charged particles at Venus bow shock
  - In style of Galileo encounter of Venus
    - persistence
    - Change in acceleration with position and conditions
• MAG (+ EPPS)
  – Venus has a purely solar wind - ionosphere planetary interaction: global and crustal magnetic fields play no role.
  – Direction of interplanetary magnetic field (IMF) controls and orders interaction and intensity of the atmospheric mass loss
  – MAG measurements before, during and after fly-by:
    » IMF monitor for Venus Express measurements over an interval of +/- 1 month of MESSENGER closest approach.
    » First 2 point measurements of IMF penetration into and draping about Venus' ionosphere
    » First 2 point measurements of the primary plasma boundaries - bow shock (and foreshock particle acceleration), magnetic pile-up boundary and ionopause
    » First 2 point measurements of the near-tail and its contribution to the maintenance of the nightside ionosphere
    » First 2 point measurements of "clouds" and "streamers" of ionospheric plasma being "pulled" away from the flanks of the ionosphere by the IMF
    » First 2 point measurements of the "pick-up" of newly ionized exospheric neutrals by the solar wind
• MLA
  – Laser sounding to clouds (terminator crossing at ~1000 km altitude
  – Passive radiometry (1064 nm)
• NS
  – Orientation of MESSENGER s/c during Venus flyby can be optimal to use simulated neutron spectra to evaluate multiply scattered Venus Neutrons from s/c to NS counting rates.
December 2005
DSM 1

October 2006
Venus I Flyby

June 2007
Venus 2 Flyby
QuickTimeª and a YUV420 codec decompressor are needed to see this picture.

http://messenger.jhuapl.edu