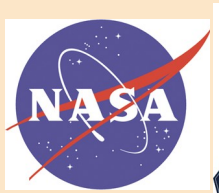

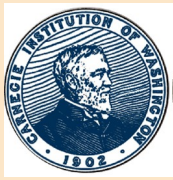

MESSENGER operations at Venus

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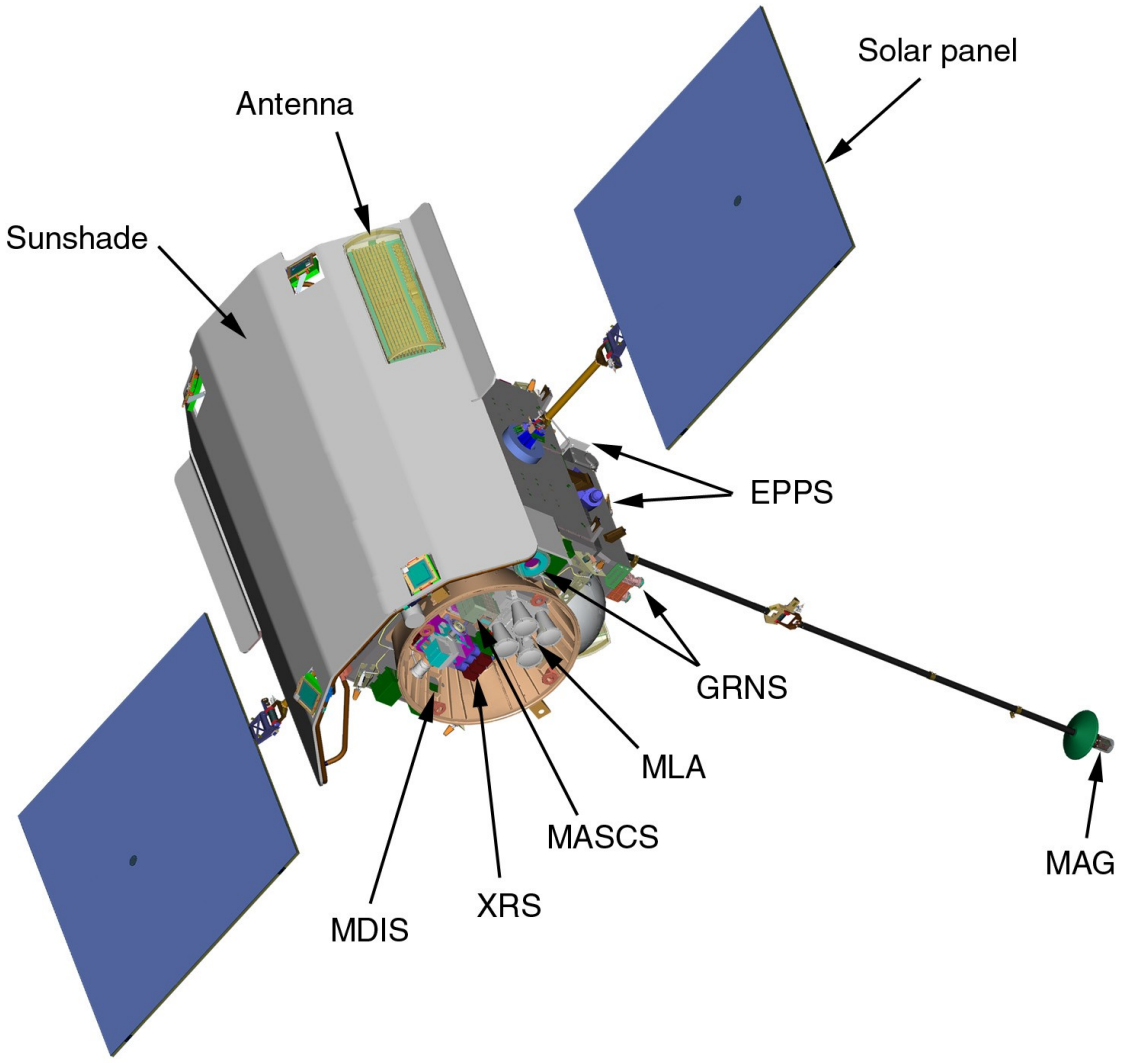
VEXAG **4 November, 2005**

MESSENGER

Science Payload

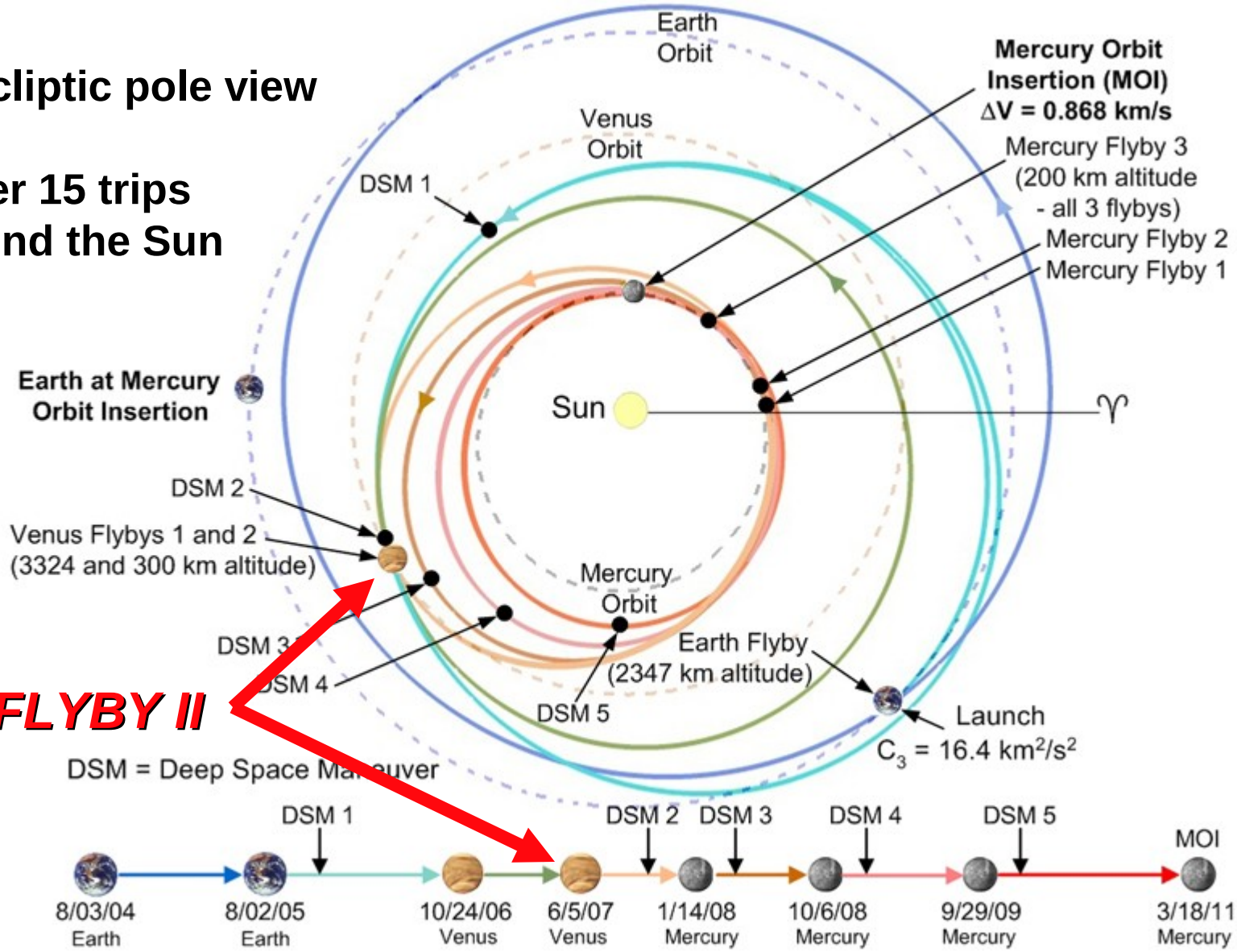
- Mercury Dual Imaging System (MDIS)
- Gamma-Ray and Neutron Spectrometer (GRNS)
- X-Ray Spectrometer (XRS)
- Magnetometer (MAG)
- Mercury Laser Altimeter (MLA)
- Mercury Atmospheric and Surface Composition Spectrometer (MASCS)
- Energetic Particle and Plasma Spectrometer (EPPS)
- Radio Science (RS)



MESSENGER
Trajectory

North ecliptic pole view

Over 15 trips around the Sun

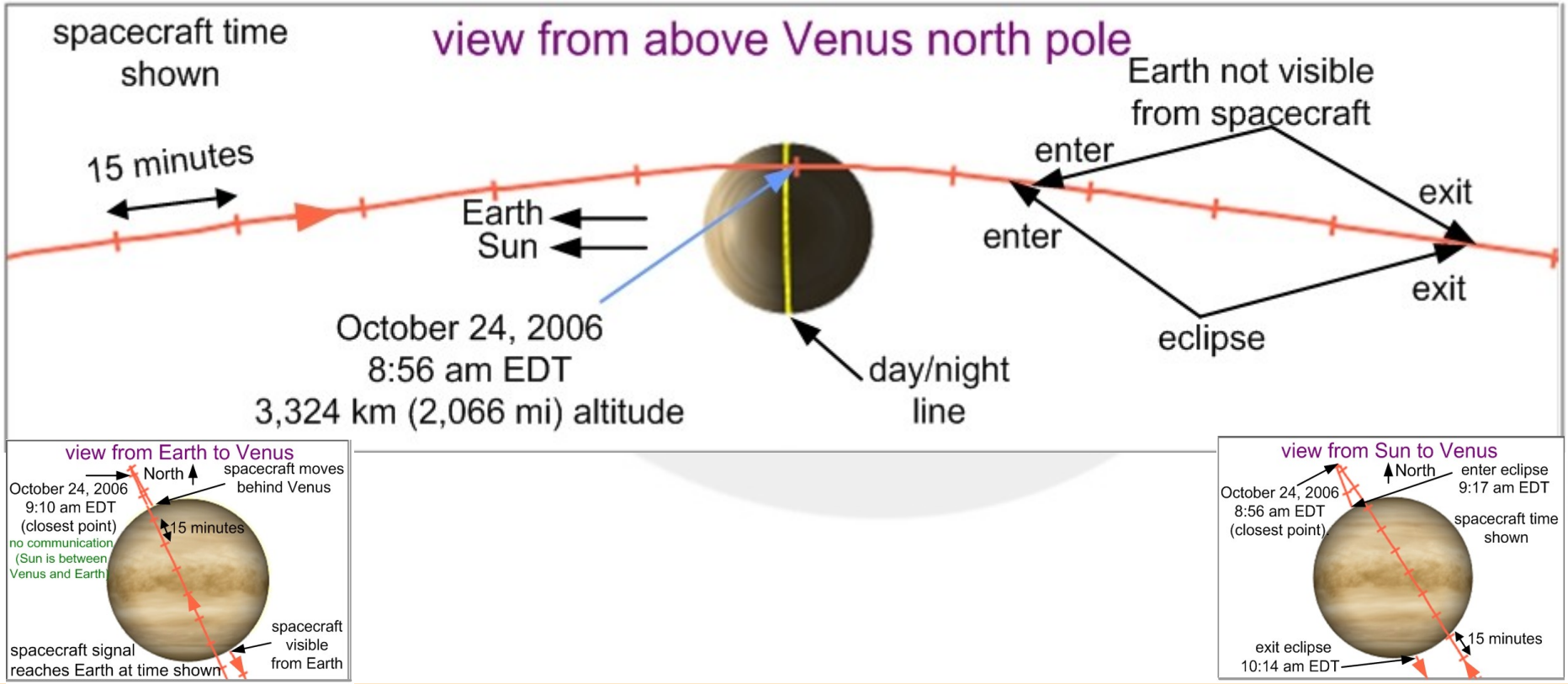


VENUS FLYBY II

MESSENGER

Venus Flyby Operations

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



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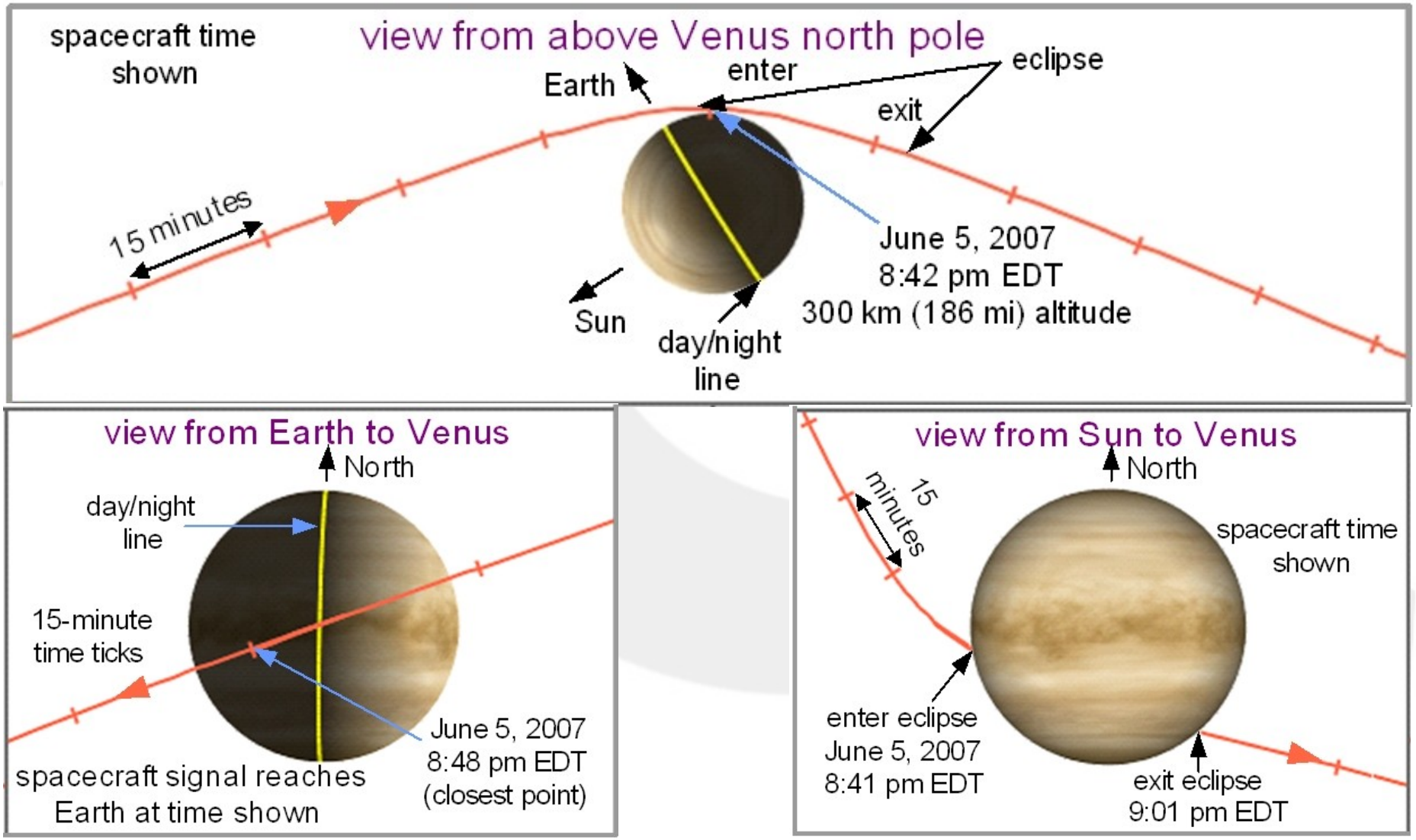
Venus II Flyby



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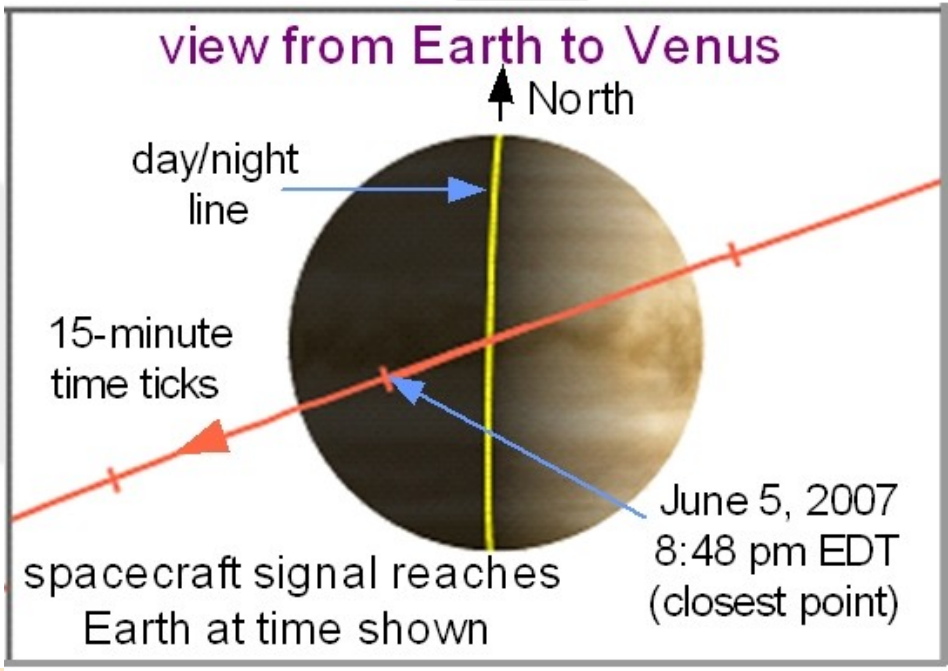
Venus II Flyby Operations

- Venus Express will be in orbital operations by MESSNGER Venus II Flyby
- Venus II Flyby operations are divided into following categories:
  - Calibration operations
  - Mercury operations practice
  - Science of opportunity
  - Venus Express support



Venus II: Science of Opportunity I

- 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)

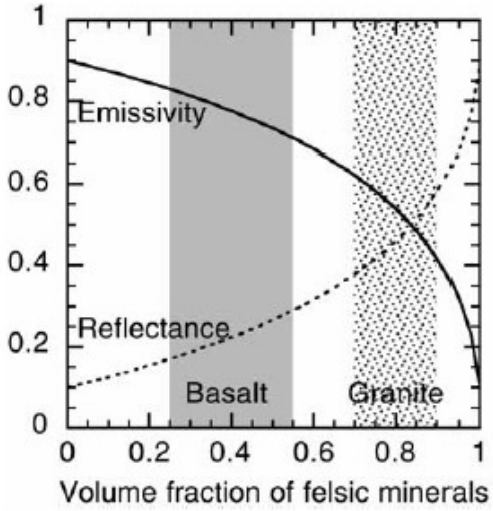
MESSENGER

Venus Darkside Imaging

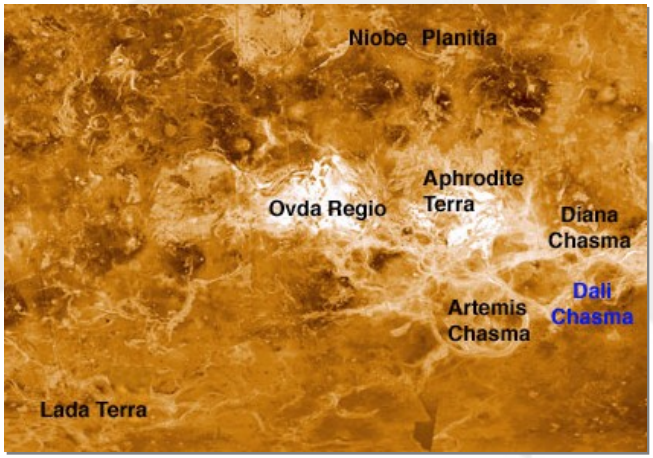
(M. Gilmore, Wesleyan)

- 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 Magellan 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



[Rogers and Hawkesworth, 2000]



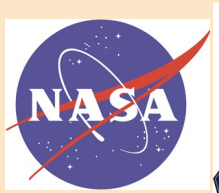
MESSENGER

Venus II: Science of Opportunity II

- MASCS
  - UVVS (115-600 nm) atmospheric profiles
    - » Dayside and nightside
    - » NO, O^{I}, H^{I}, O_2, and SO_2.
  - UVVS observations of Venus exosphere on departure
    - » travel “downwind” through the exosphere’s tail
    - » O^{I}, H^{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

Venus II: Science of Opportunity III

- 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




MESSENGER

Venus II: Science of Opportunity IV

- 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.

MESSENGER
Timeline

December 2005
DSM 1

October 2006
Venus I Flyby

June 2007
Venus 2 Flyby

http://messenger.jhuapl.edu