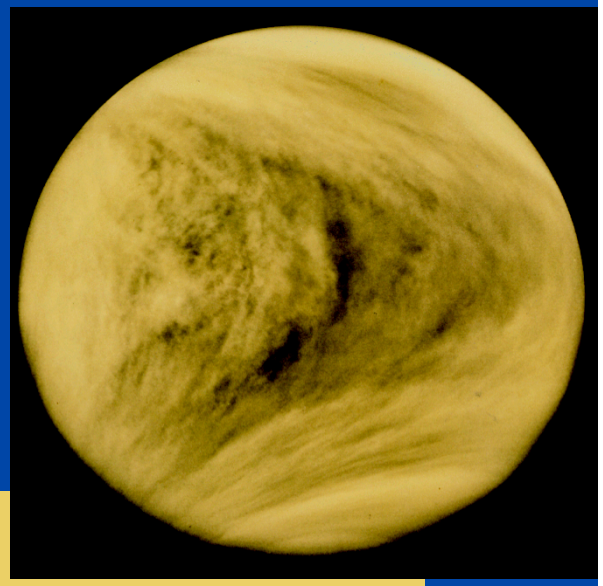
Human Exploration using Real-time Robotic Operations (HERRO) Venus

COMPASS team
NASA Glenn Research Center
Presented by Geoffrey A. Landis

Objective: analyze a flexible-path mission to a "stretch" objective:Venus

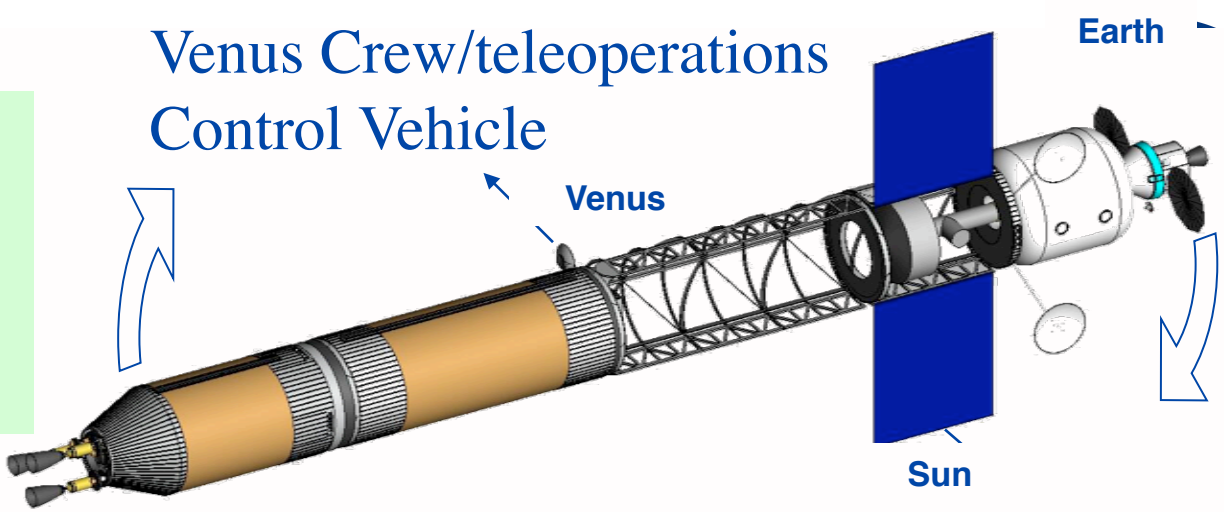


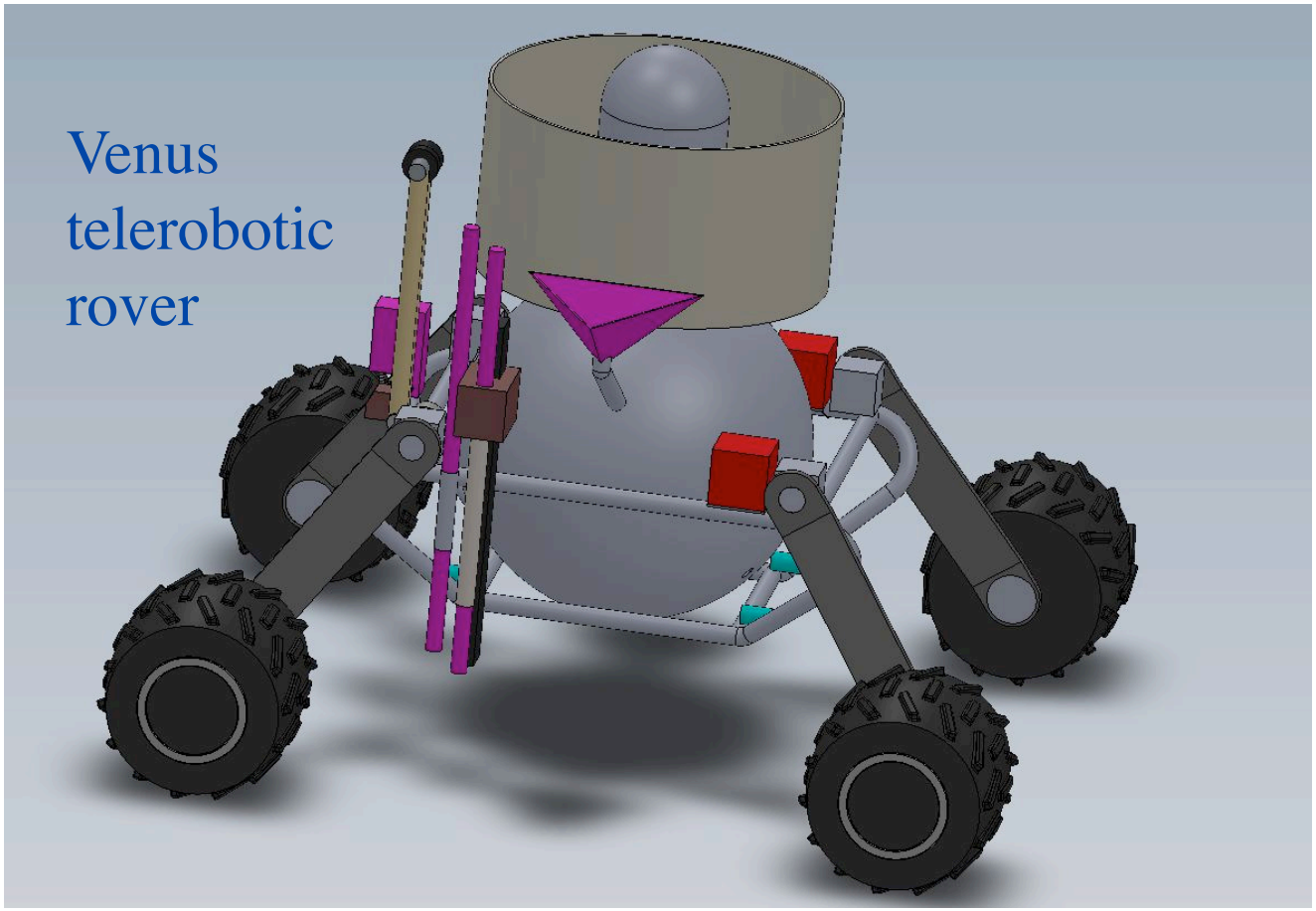
Method:

- human crew enters Venus orbit in Crew Vehicle
- Surface exploration done using telerobotic exploration vehicle
- "—an exploration strategy combining the best features of human and robotic spaceflight into a single architecture."

HERRO Venus Elements: Rover, Crew Vehicle

Venus Crew/teleoperations Control Vehicle





6 Crew total

Four geologists control 2 sets of telerobotic rovers (of the 4 total on surface)

Launch:

- Four Ares V with 42x12m fairing launches, 140 mt to 400 km assembly orbit

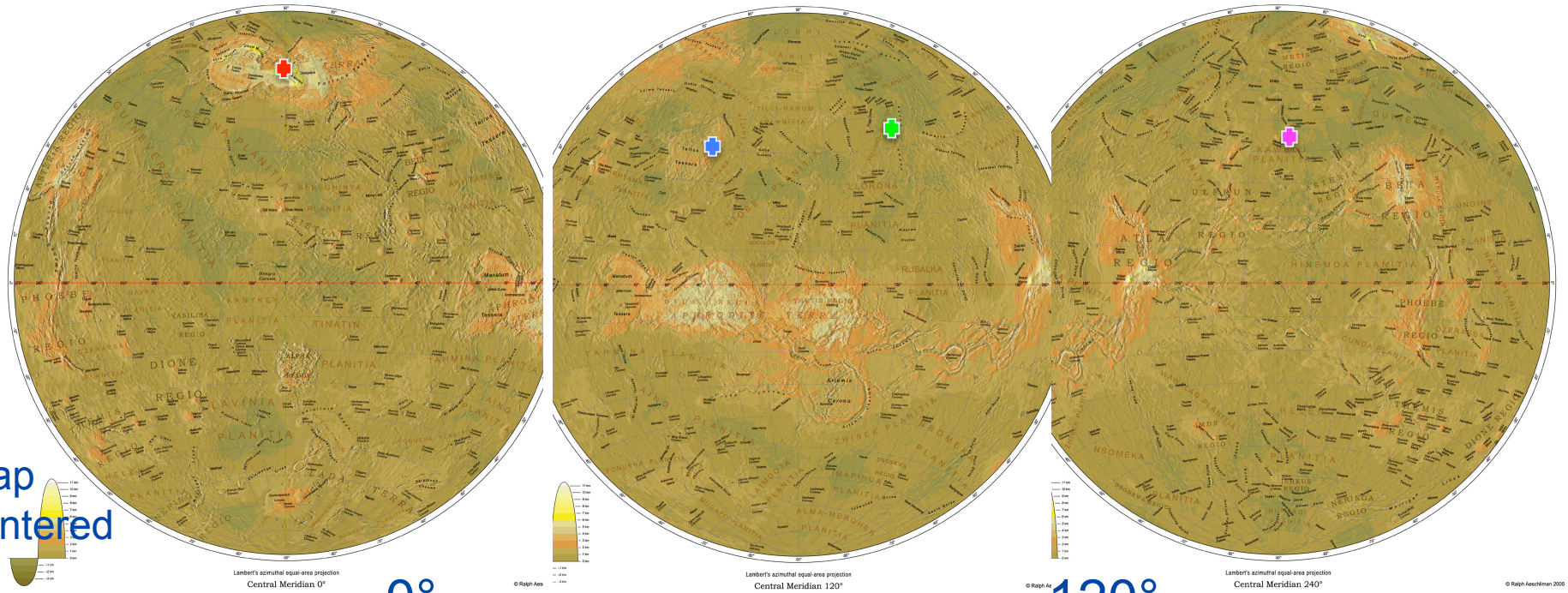
Cosmic and solar radiation protection:

- 12 mt of Water used to keep crew radiation dose
- Water shielding maximized by shielding sleeping and work quarters (2/3 of day)

Crew vehicle spun at 3 rpm at Venus

SCIENCE SITES

4 sites selected for elliptical orbit; apoapsis over northern hemisphere
At least one (nominally two) sites in daylight at every phase of mission



Map centered at:

0°

120°

240°

- **Ishtar - Maxwell Montes region** (65N, -1 E)
  - Ishtar is a continent-sized elevated region. The Maxwell Montes area chosen is a high altitude terrain site to probe a region of high radar-reflectivity (Leitner *et al.* 2006)
- **Khatun crater** (40.3 N, 87.2 E):
  - This is a “true tessera” site, representative of the oldest crustal units on Venus (Basilevski *et al.*)
- **Vellamo Planitia** (45.4N, 158.7°E)
  - This is a lowland site (proposed by Leitner *et al.* 2007; also Besilevski et al 2007).
- **Sekmet Mons** (47N 242.5E):
  - Mountain located on lobate plains, a site of high scientific interest (proposed by Basilevski *et al.*)

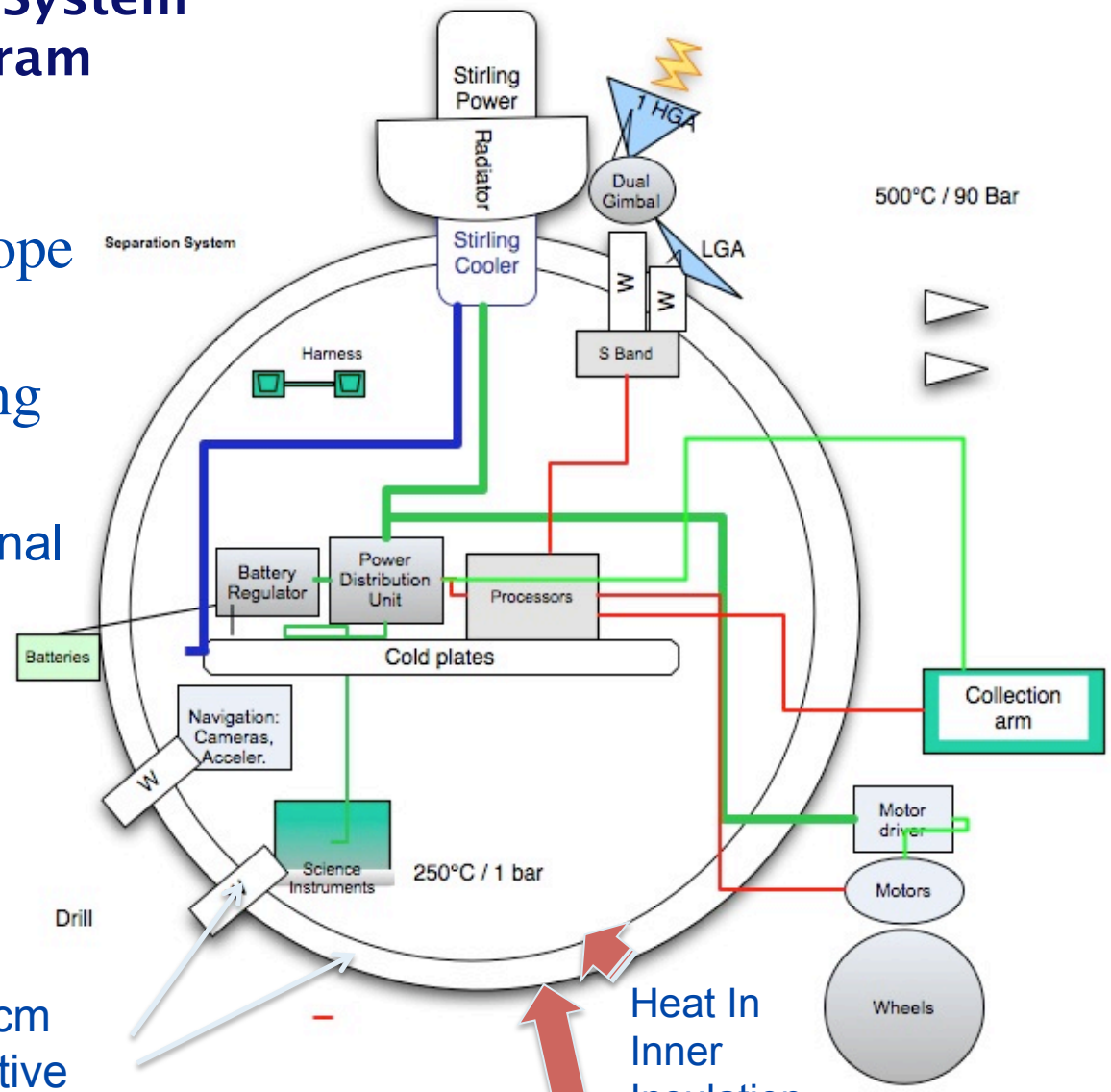
Venus maps from: http://ralphaeschliman.com/id25.htm See also http://maps.jpl.nasa.gov/venus.html

Rover Thermal System Block Diagram

Power source: Radioisotope Stirling Generator

Cooling: two-stage Stirling Cooler

1 m^3 internal volume



MLI: 25 layers (2 cm thick), 0.005 effective emissivity

Heat In Outer Insulation 221 W

Heat In Inner Insulation 76 W