VENUS EXPRESS SCIENCE GOALS, PAYLOAD, AND PLANNED OBSERVATIONS D. V. Titov[1], H. Svedhem[2], and L. Marinangeli[3]. [1]Max-Planck Institute for Solar System Studies (Max-Planck-Str. 2, Katlenburg-Lindau, 37191 Germany, titov@mps.mpg.de), [2]ESA/ ESTEC (Keplerlaan 1, 2200 AG Noordwijk, The Netherlands, Hakan.Svedhem@esa.int), [3] IRSPS, Universita d'Annunzio, Pescara, Italy.

Introduction: The first phase of Venus spacecraft exploration by the Venera, Pioneer Venus, and Vega missions in 1960-90 established a basic description of the physical and chemical conditions prevailing in the atmosphere and at the surface of the planet. At the same time, they raised many questions on the physical processes sustaining these conditions, most of which remain unsolved to this day. The fundamental mysteries of Venus are related to the global atmospheric circulation, the atmospheric chemical composition and its variations, the surface-atmosphere physical and chemical interactions including volcanism, the physics and chemistry of the cloud layer, the thermal balance and role of trace gases in the greenhouse effect, the origin and evolution of the atmosphere, and the plasma environment and its interaction with solar wind. Besides, the key issues of history of Venusian volcanism, global tectonic structure of Venus, and important characteristics of the planets surface are still unresolved. Re-use the Mars Express spacecraft and existing instruments gave Europe an excellent chance to have an almost fully equipped orbiter mission and to make a breakthrough in Venus exploration in a very short time frame.

Science Goals and Payload: Venus Express will aim at a global investigation of the Venus' atmosphere and plasma environment from orbit, and will address important aspects of the geology and surface physics. The instruments inherited from the Mars Express and Rosetta missions form the core of the Venus Express payload. They are: SPICAV/SOIR – a versatile UV-IR spectrometer for solar and stellar occultation and nadir observations, PFS – a high-resolution IR Fourier spectrometer, ASPERA – a combined energetic neutral atom imager, electron, and ion spectrometer, VIRTIS – a sensitive visible and near infrared spectro-imager, a radio science experiment VeRa. This payload set is complemented by two newly developed instruments: the miniature four-channel digital camera VMC and the magnetometer MAG [1].

Compared with the earlier spacecraft missions, Venus Express will make a breakthrough by fully exploiting the existence of spectral "windows" in the near-infrared spectrum of Venus' nightside, discovered in the late '80'-s, in which radiation from the lower atmosphere and even the surface escapes to space and can be measured. A combination of spectrometers/spectro-imagers covering the near-UV to mid-IR range and plasma instruments onboard an orbiter can provide global study of the Venus surface and atmosphere up to about 200 km. The whole set of the Venus Express investigation tools is such that observing the same target at the same time with different instruments provides a comprehensive, versatile and complete view of the phenomena taking place at Venus.

Mission Scenario and Operations: The Venus Express spacecraft will be launched between 26 October and 25 November 2005 by the Russian Soyuz-Fregat launcher from the Baikonur cosmodrome in Kazakhstan. After about five months of cruise Venus Express will be inserted in a polar elliptical orbit around Venus with apocentre distance of about 66,000 km, pericentre of 250-350 km, and revolution period of 24 hours. The nominal mission will last for two Venus sidereal days (~500 Earth days) with possible prolongation for another 500 days. The science operations will include high-resolution observations from the pericentre, global views from the apocentre, limb sessions, stellar, solar, and radio-occultation [2].

Surface studies: Several open questions on the geological evolution of Venus have been raised by the Pioneer-Venus, Venera, and Magellan investigations. The complex stratigraphical sequence observed on Magellan SAR images implies an internally active planet with extensive volcanism and tectonic activity, even in geologically recent time. There is still a debate whether Tessera highlands are different in composition from the Planitiae. Moreover, the peculiar environmental characteristics at the surface have produced unique weathering processes of the primary rocks, processes which are still not well understood. Venus Express will contribute to the surface studies in several ways: bi-static radar and gravity experiments by the radio-science (VeRa) instrument and the night side thermal sounding in the near-infrared spectral windows by the spectrometers and imagers [2]. The spectrometers and imagers onboard the orbiter will obtain critical measurements of the gas species and their distribution in the lower atmosphere providing clues on the redox state in equilibrium with surface minerals and eventually detect anomalies due to volcanic emission. Recent modeling demonstrates the capabilities of mapping the FeO distribution on the surface of Venus from the emissivity in the NIR range. The classification map derived from NIR observations will complement the radar reflectivity and radiothermal emissivity derived from Magellan and Pioneer datasets. Additional information on the nature of the surface material, will be provided by the

bistatic radar VeRA and the dielectric measurements will be compared with previous results from the Magellan bistatic experiment. The figure shows the surface targets and area that would be covered by these investigations.

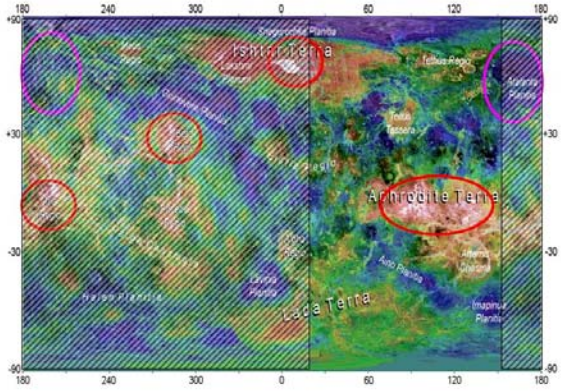

Figure. The Magellan map of Venus with the surface targets and area that would be covered by the Venus Express observations: red circles – bi-static radar, magenta ovals – gravity experiment, hatched area – sounding of the lower atmosphere and the surface in the near-IR transparency "windows" on the nightside.

Thanks to the complementarities between the Venus Express and Magellan observations, some critical aspects of the evolution of the planet will be better assessed in the coming years.

References: [1] Svedhem H. et al, (2005) *Planet. Space Sci.*, in press. [2] Titov D. V. et al. (2005) *Planet. Space Sci.*, in press.