Venus Express set for liftoff

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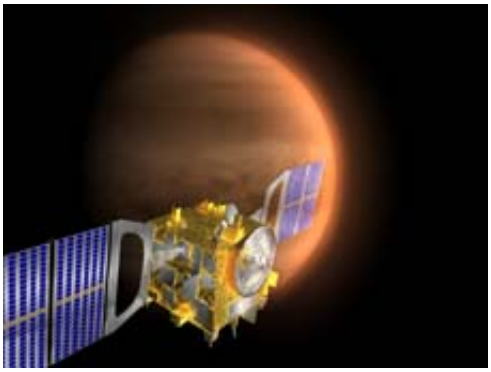

On 26th October the European Space Agency's Venus Express spacecraft is scheduled to launch from Baikonur Cosmodrome in Kazakhstan en route to Earth's closest planetary neighbour - the ultimate "greenhouse" planet, Venus. This is the first European mission to Venus, the nearest planet to the Earth and the brightest object in our night sky, apart from the Moon.

Whilst Earth and Venus share certain characteristics such as age, mass and diameter they are worlds apart in other respects. Venus has a very different climate to Earth's with a thick corrosive atmosphere giving rise to a run away greenhouse effect, crushing pressure and extremely hot surface temperatures. But why has it evolved this way? Venus Express will provide the answer.

Professor Fred Taylor from the University of Oxford, a member of the Venus Express Project team (and one of the proposers of the mission), explains the appeal of visiting Venus, "Whilst there have been several past missions to Venus by the Americans and Russians, Venus has always proved difficult to explore. Venus Express is equipped to peer beneath the thick clouds that encircle the planet and probe the mysteries of Venus with a precision never achieved before and find out why Venus evolved so differently to Earth."

Professor Keith Mason, Chief Executive Officer of the Particle Physics and Astronomy Research Council said, "With the Earth evolving to become much warmer and polluted, our sister planet, Venus, has much to offer us in terms of understanding our own climate. The science data set to return next year will have a huge impact on the way in which we deal with conditions on Earth demonstrating how the exploration of the Solar System has real impact on our daily lives."

Venus Express builds on the heritage of ESA's successful Mars Express mission by using not only the same spacecraft design but also making use of spares and copies of instruments from both Mars Express and Rosetta. This has enabled the project team to produce the spacecraft to a tight time schedule (less than 4 years) and with a modest budget of £140 million (200 million Euros).

Professor David Southwood, ESA's Director of Science said, "The launch of Venus Express marks a significant milestone for ESA's space science programme as our fastest (and one of the cheapest) mission implementation ever. Of course, it had to be simple and it slipstreamed on both Mars Express and Rosetta. However, against the sceptics' expectations, we stepped up to the challenge, started just about three years ago, and now we are off to Venus!"

UK scientists and industrialists have a strong involvement in the mission

with a team from the University of Oxford involved in the mission planning and science operations. University College London's Mullard Space Science Laboratory and CCLRC's Rutherford Appleton Laboratory both have roles in the building and operation of ASPERA-4, a plasma analyser which will investigate the interaction of the solar wind and the atmosphere. The atmospheric pressure on Venus is almost one hundred times that on Earth. ASPERA-4 will study the escape process and rates for the first time in detail at Venus, providing an intriguing comparison to our other near Earth neighbour, Mars, which is also unmagnetized.

Scientists from Imperial College were involved in the design and build of the Magnetometer and along with scientists from the University of Sheffield are co-investigators on this instrument which will study how the solar wind interacts with Venus's atmosphere to give unmagnetized Venus an induced magnetic field. Other instruments will study the atmosphere-surface interaction including possible, but as yet undetected, volcanism.

The instrument suite is completed by the Venus Monitoring Camera (to image the surface temperature composition), Venus Radio Science experiment, SPICAM (a UV and IR atmospheric spectrometer), VIRTIS (a visible-IR imaging spectrometer) and a Planetary Fourier Spectrometer (to make global 3D measurements of atmospheric temperature and composition to search for volcanic activity).

Lord Sainsbury, Minister for Science and Innovation said, "The UK is playing an important role in this exciting mission that will help us understand the full impact of climate change. The mission is made all the more cost effective by the fact that it has been put together efficiently by the re-use and recycling of existing space instrumentation."

EADS Astrium Ltd, Toulouse are the main contractor for the spacecraft with the propulsion system designed, built and tested at the company's UK site at Stevenage. SciSys Ltd, based in Chippenham, are responsible for the all important mission control software which supports the commanding of the spacecraft and the monitoring of the onboard spacecraft state.

After a 5 month journey to Venus the spacecraft will begin its science operations in April 2006. It will continue orbiting Venus for 500 days (2 Venusian days).

Mission Facts

The spacecraft mass is 1270 kg (93kg of payload and 570 kg of fuel. Spacecraft dimensions are 1.5 x 1.8 x 1.4 m (excluding the solar panels which add a further 8 m).

Venus Express will travel 26 million miles to reach Venus.

Every nineteen months Venus makes it closest approach to Earth (42,000,000 miles) and the launch of Venus Express will take place within one of these periods. Venus Express will be launched between 26th October and 25th November 2005 by the Russian Soyuz-Fregat launcher from Baikonur cosmodrome in Kazakhstan. The Soyuz rocket will lift the upper stage "Fregat", with Venus Express mounted on top, into a sub-orbital trajectory. Then, with two consecutive burns, Fregat will inject the spacecraft onto an interplanetary or "escape" trajectory that, with few corrections, will take it direct to Venus.

After about 5 months (162 days) of cruise Venus Express will be inserted in a polar elliptical orbit around Venus at a distance ranging from 250 km to 66,000 km. The nominal mission will last for 2 Venus sidereal days (~500 earth days) with a possible extension of a further 500

days.

Mission costs - £140 million (200 million Euros)

Scientific objectives

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 reactions 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 the solar wind. Furthermore, the key issues of the history of Venusian volcanism, global tectonic structure of Venus, and important characteristics of the planet's surface are still unresolved. Venus Express will aim at a global investigation of Venus' atmosphere and plasma environment from orbit, and will address several important aspects of the geology and surface physics.

Payload

Reuse of the Mars Express bus gives an excellent and appropriate opportunity to make a breakthrough in Venus exploration. The instruments inherited from the Mars Express and Rosetta missions form the core of the Venus Express payload. They are:

Instruments

SPICAV - a versatile UV-IR spectrometer for solar and stellar occultation and nadir observations. (Mars Express, SPICAM)
Principal Investigator - J-L Bertaux, SA/CNRS, Verrieres-le-Buisson, France

PFS - (Planetary Fourier Spectrometer) a high-resolution IR Fourier spectrometer (Mars Express, PFS)
Principal Investigator - V Formisano, IFSI CNR, Frascati, Italy

ASPERA -4 - (Analyser of Space Plasma and Energetic Atoms) a combined energetic neutral atom imager, electron and ion spectrometer (Mars Express, ASPERA-3)
Principal Investigator - S. Barrabash, IRF, Kiruna, Sweden

VIRTIS - a sensitive visible and near infrared spectro-imager (Rosetta, VIRTIS)
Principal Investigator - P Drossart, CNRS/LESIA and Observatoire de Paris, France and G Piccioni, IASF-CNR, Roma, Italy

VeRa - a radio science experiment (Rosetta, RSI)
Principal Investigator - B Hausler, Universitat der Bundewehr, Munchen, Germany

This payload is complemented by two newly developed instruments:

VMC - (Venus Monitoring Camera) a miniature four-channel camera which uses parts of Mars Express's High Resolution Stereo Camera and OSIRUS from Rosetta
Principal Investigator - W Markiewicz, MPAe, Katienburg-Lindau, Germany

MAG (Venus Express Magnetometer) which reuses sensors from the Rosetta lander (ROMAP).
Principal Investigator - T Zhang, OAW, Graz, Austria

Venus Facts

Venus is known as both the "Morning" Star and the "Evening" Star being

the third brightest object in our solar system after the Sun and the Moon. The planet is named after the goddess of love and beauty. An observer on Earth can see his or her shadow by the light of Venus on a clear moonless night. Venus is also observable during the day under some conditions.

Historical context

The first phase of Venus spacecraft exploration by the Venera, Pioneer Venus and Vega missions (1962-1985) 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 unresolved to this day. Extensive radar mapping by Venera-15, -16 and Magellan orbiters, combined with earlier glimpses from landers provided a major expansion of our knowledge of Venus' geology and geophysics; a similar systematic survey of the atmosphere is now in order. This particularly concerns the atmosphere below the cloud tops, which, with the exception of local measurements from descent probes, has not been observed by previous Venus missions.

Source: PPARC

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