

**In this issue...**

VEXAG at LPSC - 1

Reflections from the Chair - 2

Commentary by *Bob Grimm* - 2

Venus Coronagraph Network - 3

Transit of Venus by *T. Widemann* - 5**Future Meetings** 7European Geosciences Union
General Assembly, Vienna

Workshop on Planetary Dunes

International Planetary Probes
WorkshopComparative Climatology
Conference

COSPAR

Europlanets

Division for Planetary Sciences

Venus in the NewsVenus Express sees plasma
reconnection- 4**Venus Missions Update**

Venus Express - 5

Akatsuki - 5

Welcome to this update from VEXAG on topics dealing with Venus research and exploration. Your contributions, comments and suggestions welcome.

Sanjay Limaye, VEXAG Chair

VEXAG at Lunar and Planetary Science Conference, the Woodlands, Texas

The session "Venus Volcanism – Vague or Viable" was well subscribed with oral and poster presentations. Kudos to the organizers and the presenters. A highlight was the presentations by students indicating the continued interest in Venus. The meeting also featured a "NASA Night" evening session on Monday focused on the FY2013 budget for NASA submitted by the President to Congress in February with presentations by Dr. John Grunsfeld, Associate Administrator for NASA/Science Mission Directorate (SMD) and Dr. James Green, Director, Planetary Science Division, NASA/SMD. Earlier, a ROSES update was given by Jonathan Rall (NASA/SMD) during the lunch hour which provided an update on the research proposal programs funded under various elements. Another special session on the reaction to the proposed NASA budget was held during the lunch hour on Tuesday featuring representatives from the Division for Planetary Sciences (American Astronomical Society), American Geophysical Union (Planetary Science), the Planetary Society.

A VEXAG townhall meeting was held on Wednesday. Dr. Jim Green presented the implications of the FY2013 and notional budgets for future years for Venus exploration. This was followed by a presentation by Kristen Erickson (NASA/SMD Outreach) on outreach efforts being planned for the transit of Venus in June. Danielle Piskorz and Stephanie Johnston (Co-leads, Young Scientist Focus Group) described the efforts for networking among graduate students and younger scientists working on Venus. A brief presentation on updating the Venus International Reference Atmosphere and developing a Reference Model for the solid planet was followed by announcements for coming conferences and meetings of interest to the Venus community were given. In view of the short time available for the townhall meeting, very little time was regrettably left for community discussion. This was pointed out towards the end was an appropriate criticism and resulted from not altering the meeting agenda in view of available time. Bob Grimm has been gracious enough to write a commentary on the Venus exploration in this issue.

Finally, presentations at the townhall meeting have been posted at the VEXAG URL.



Reflections from the VEXAG Chair

The central issue for VEXAG remains the same – a mission to Venus. In recent years, a Venus flagship mission was studied (2008), and several significant Venus missions were proposed to the New Frontiers-3 (2009) and Discovery-12 (2010) competitions. Although a Venus flagship mission was recommended by the Planetary Science Decadal Survey, the evolving projected budgets for this decade may preclude any flagship mission. Regrettably, none of the Discovery or New Frontiers proposed missions resulted in a selection for launch. Since the selection announcements for Discovery-12 and NF-3 were made, the VEXAG co-chairs have been analyzing the situation and have had discussions with the Discovery Program Scientist at HQ, with the SMD/PSD Director, and the Discovery/NF PIs.

This being an election year, predicting the NASA budget for FY2013 is going to be a challenge. However, community and individual input to congressional leaders may influence the outcome. Therefore, it is important for the entire Venus community to take an interest and do what they are comfortable undertaking.

The VEXAG Steering Committee continues to monitor developments in the FY13 NASA budget discussions. In addition, I represent VEXAG on the Planetary Science Subcommittee (PSS). The PSS meetings are open to all (you may need to register in advance) and are announced through the Federal Register (you can also find the dates on nasawatch.com). The next meeting will be held at NASA HQ in Washington, DC on May 8-9, 2012.

Finally, VEXAG is considering an international Venus workshop in the Washington, DC metropolitan area for early November 2012. One of the key activities of the 2012 VEXAG meeting will be to update the Goals and Objectives for Venus Exploration. Everyone interested in shaping the future of Venus science and exploration should plan to attend.

In the mean time please continue to visit the VEXAG URL (www.lpi.usra.edu/vexag) for periodic updates (e.g., VEXAG Newsletter, and upcoming events) and Discussion Boards.

* * * * *

VEXAG Commentary

Robert E. Grimm, Southwest Research Institute, Boulder.

I have always been a fan of a line in the opening of Marc Reisner's *Cadillac Desert*: "anyone who flies in an airplane and doesn't spend most of his time looking out the window wastes his money." At 11,000 m, I easily become absorbed in contrasts in rock, rolling landscapes, endless processions of clouds, the glint of water, or the marks of humanity. And as a planetary scientist, I am easily transported to imaginary views of other worlds from above. Venus, of course, is the only extraterrestrial body that has been explored from the air, by the Vega balloons in 1985. Modern balloon systems could circumnavigate the planet—perhaps the mission name "Magellan" was premature. Other compelling investigations can be performed at the surface, during descent, or from orbit. The fact that no fewer than seven such missions were proposed during the last Discovery opportunity—fully one-quarter of all proposals!—indicates to me that the broader Venus scientific community has not languished, but has eagerly been waiting to mobilize. I've heard it said after the Discovery evaluations that the Venus community was somehow disjointed. I view the simultaneous submittal



of seven flight proposals on Venus as an amazing exercise in self-organization by natural selection. PIs came forward, teams were built, NASA and industry partners were integrated, all with the integrity that competition sensitivity requires. We are Venusians: hear us!

Venus science and VEXAG's themes were well-represented on the recent Decadal Survey. We all recognize that the origin and evolution of the atmosphere, the history of volatiles, and the enigmatic geology hold clues to understanding our unique terrestrial environment and habitability. But we haven't been able to get enough traction, compared to exciting discoveries elsewhere in the Solar System on potential past or presently habitable environments, to get new missions selected. I suggest we leap past the entire Solar System and frame Venus as an accessible exoplanet. As of boarding time for my flight today, my smartphone app tallied 760 exoplanets discovered from earth-based telescopes and orbiting observatories, with some 2000 more candidates under study by Kepler. Exoplanets are the most exiting contemporary topic and frontier in space science, with the pace accelerating us toward answers to fundamental questions: are there other planets like ours? Are there signatures of habitability, or even of life itself?

Due to observational considerations, most of the exoplanets discovered by Kepler lie close to their stars, many too close to be in the habitable zone. Here lie the exoVenuses. Our closest neighbor and so-called twin may be representative of a population of planets whose evolution diverged from Earth. We can expand the basic planetary science question "Why are Earth and Venus so different" to "what does Venus tell us about the geological and habitability pathways of terrestrial planets beyond our Solar System?"

The exoplanet theme was indeed advanced in the VEXAG goals document and in the Decadal Survey. But I believe this should become the organizing principle for promoting new Venus missions, because the impact of earlier themes has faded. At LPSC this year, Jim Green came right out and said that we were in this business to find life beyond Earth. Of course he recognizes the huge portfolio of investigations it takes across planetary and space science to approach this question, but this comment drives home that we have to establish astrobiological relevance from every R&A proposal through missions. "Venus is an accessible exoplanet" links comparative planetology, astrobiology, and the newest frontier in space exploration.

Bob Grimm is a geophysicist who began working on the structure and geodynamics of Venus in the 1980s. He recently described how to use ambient electromagnetic waves to probe the lithosphere of Venus from a balloon.

* * * * *

Venus Coronagraph network for learning about Venus before and after the transit

For the first time since the history of Venus transits, we are embarking on an effort to learn something about Venus itself after the initial discoveries of its atmosphere and its relative size. In 2004 two amateur astronomers in France Alain and Sylvain Rondi (www.astrosurf.com/rondi/venus2004/) demonstrated that home built coronagraph can be successful in observing a Venus transit, capturing movies of the aureole. This provided the inspiration at a meeting during the EPSC/DPS joint meeting in Nantes to start an effort to assemble several of such coronagraphs and deploy them around the world to observe the transit for widely separated locations to capture the dynamic event. The coming transit observations will employ filters to see if the wavelength leads to different information being retrieved about the Venus atmosphere. Thomas Widemann (Paris Observatory) and

Paolo Tanga are leading an effort to assemble a few such “Cytherographs” to deploy at several locations around the world to capture the Venus aureole at different times and at from different perspectives. The analysis of the aureole data yielded some information about the atmospheric thermal structure. This is a crucial advance that may be useful for studies of extra-solar terrestrial planets with atmospheres.

Following is a tentative list of observers and locations. Images from these sites will be collected at a central location and will be made available to the NASA/SMD global outreach event planned for the Venus transit (venustransit.nasa.gov).

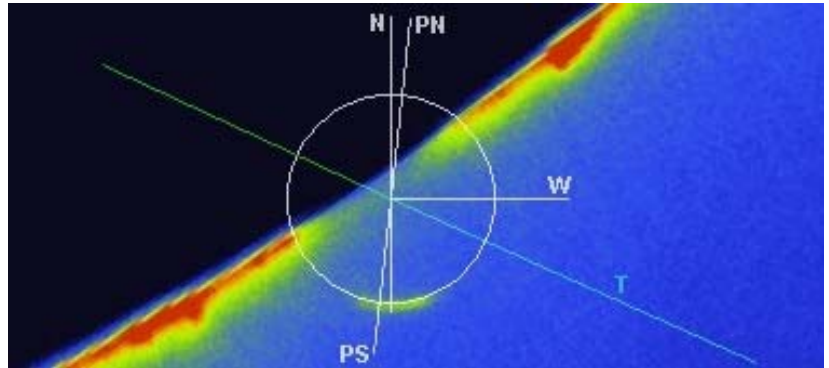


Figure 1. These are photographs made with the homemade Juillan’s H-alpha coronagraph in order to observe Venus’s atmosphere during the egress. The photographs were taken with a modified VestaPro webcam (RAW mode with B&W sensor (credit: www.astrosurf.com/rondi/venus2004/)).

Global Coronagraph Network for Observing Venus before and after the transit

Observatory	Location	Observers	Filter
Mees Solar Obs., Haleakala	Maui, HI	Jay Pasachoff, Bruce Babcock	B (450 nm)
Mobile station	Hokkaido, Japan	Thomas Widemann	V (535 nm)
Moondara Obs.	Mount-Isa, QLD, Australia	Len Fulham, Felipe Braga-Ribas	I (760 nm)
Tien Shan Obs.	Kazakhstan	François Colas, Frédéric Vachier	B
Khurel Togoot Obs.	Ulaanbaatar, Mongolia	Sylvain Boulay, Lucie Maquet	I
Lowell Obs.	Flagstaff, AZ	William Sheehan, visual obs.	V
Lowell Obs.	Flagstaff, AZ	Paolo Tanga	V
Taiohae, Nuku Hiva	Marquesas Is.	Christian Veillet	R (607 nm)
Mobile station, Svalbard Is.	Norway	Arnaud Mahieux and VEX team	I
Udaipur Solar Observatory	Udaipur, India	Ashok Ambastha, Pedro Machado, Limaye	R

All filters have a 10 nm FWHM. "R" and "V" correspond to PICARD/SODISM instrument filters while "I" is similar to one of the filters for the HST observations.

Venus in the News

Venus Express Magnetometer reveals Magnetic Reconnection in the Near Venusian Magnetotail

Analysis by Tielong Zhang and colleagues of observations with the Venus Express magnetometer and low-energy particle detector have revealed magnetic field and plasma behavior in the near-Venus wake symptomatic of magnetic reconnection, a process that occurs in the Earth's magnetotail but is not expected in the magnetotail of a non-magnetized planet like Venus. On 15 May 2006, the plasma flow in this region was toward the planet and the magnetic field component transverse to the flow was reversed. Magnetic reconnection is a plasma process that changes the topology of the magnetic field and results in energy exchange between the magnetic field and the plasma. Thus, the energetics of the Venus magnetotail resembles that of the terrestrial tail where energy is stored and later released from the magnetic field to the plasma. The results are presented in a paper published on-line by Science on 5 April 2012.

Current Venus Missions

Venus Express

Spacecraft is in excellent condition, sufficient fuel for coming operations. Approximately 4 tera bytes of data downloaded to ground. There have been 12 Earth occultation seasons to date, and Radio science observations are being carried out every 1-3 orbits. The current occultation season is an extraordinarily long one. The 8th atmospheric drag campaign is underway.

Data archive (PSA) is in reasonably good state, with 2 exceptions. VIRTIS will submit a major data set in mid May 2012 to the archive. For VeRa alternative solutions are being looked at. The cumulative number of referred publications related to Venus Express is now approximately 285.

Akatsuki

After confirming that the main insertion motor was broken, the AKATUSKI team will use Reaction Control System (RCS) for orbit maneuvers. Three minor maneuvers were performed successfully in November 2012 to put the spacecraft on a path to meet Venus in 2015. We are considering several scenarios only using RCS for VOI. It will be hard to achieve the planned equatorial orbit with Venus orbit insertion (VOI) in 2015, but if the team waits another year and perform do the VOI in 2016 there is a chance to have an equatorial orbit. Preferable orbit and the life time of the spacecraft is the trade off.

The team is being very careful about the thermal conditions experienced by the spacecraft during the extended cruise phase. AKATSUKI expected about 2600W/m² solar flux in the Venus orbit, but it is exposed to more than 3600W/m² at perihelion (0.6AU from the sun). The temperatures of the instruments exposed to space gradually increased as the spacecraft approaching the perihelion. The operations team is acting to minimize the number of instruments whose temperatures exceed the allowed upper limits by letting only a certain face of the spacecraft face to the sun.

Transit of Venus 5/6 June 2012 - T. Widemann, Paris Observatory

As Venus moves onto the solar disk at the start of a transit, the portion of the planet protruding above the limb is encircled by a bright ring, an effect often reported as far back as the 1761 transit by Lomonosov. After the first digital recordings of the aureole at the 2004 transit (Pasachoff, et al., 2011), Tanga et al. (2012) performed a quantitative examination of the spatial structuring of the aureole. They found that refraction is the predominant cause of aureole, with the background solar illumination bent through the mesosphere of Venus.

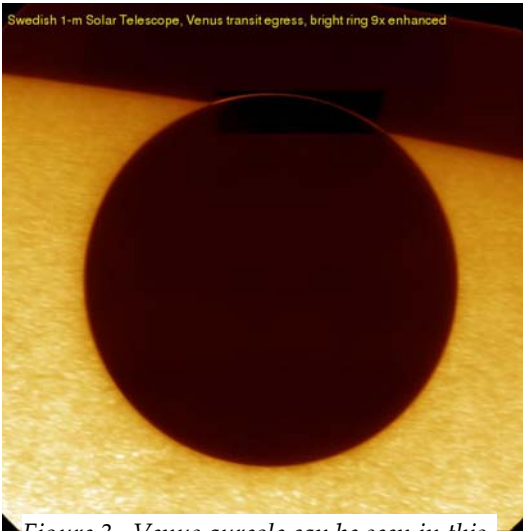


Figure 3. Venus aureole can be seen in this image taken from the Swedish Solar Telescope during the 2004 transit.

elevation of 47° (at an airmass of 1.35). Venus's angular diameter will be $57.8''$ and will be moving relative to the Sun at a rate of 0.0667 arcseconds/s (geocentric). First contact will occur on the northeast limb of the Sun. The entire ingress, the time between first and second contact, will last 18 minutes. At this particular facility, IBIS will allow us to study atmospheric dynamics at small spatial and temporal scales (the $0.1''$ pixel scale of IBIS corresponds to 21 km on Venus); and compare the characteristics of the equatorial and polar regions, valuable in interpreting the measurements made in situ by Venus Express. These data will be analyzed in the same manner as Heldelt et al. (2011) to infer information on the temperature, density, and bulk velocities as a function of latitude. The observation of the atmospheric profiles around the full circumference of the planet will also provide valuable in validating models of transiting planets, as discussed in Ehrenreich et al. (2012).

The scale height and altitude are parameters that can be adjusted to reproduce the observed intensity profile of the arc, this property they discovered will be exploited in coordination with a simultaneous solar occultation observed by the SOIR instrument from ESA's Venus Express orbiter, at the time the spacecraft will be on the face of the Sun. The transit observations thus serve as a useful probe of the upper atmosphere of Venus, allowing a pole-to-pole determination of the meridional thermal profile at terminator.

The transit of Venus as seen from Sacramento Peak will begin shortly after 16:00 local time on June 5 (22:05 UT), with the Sun at an

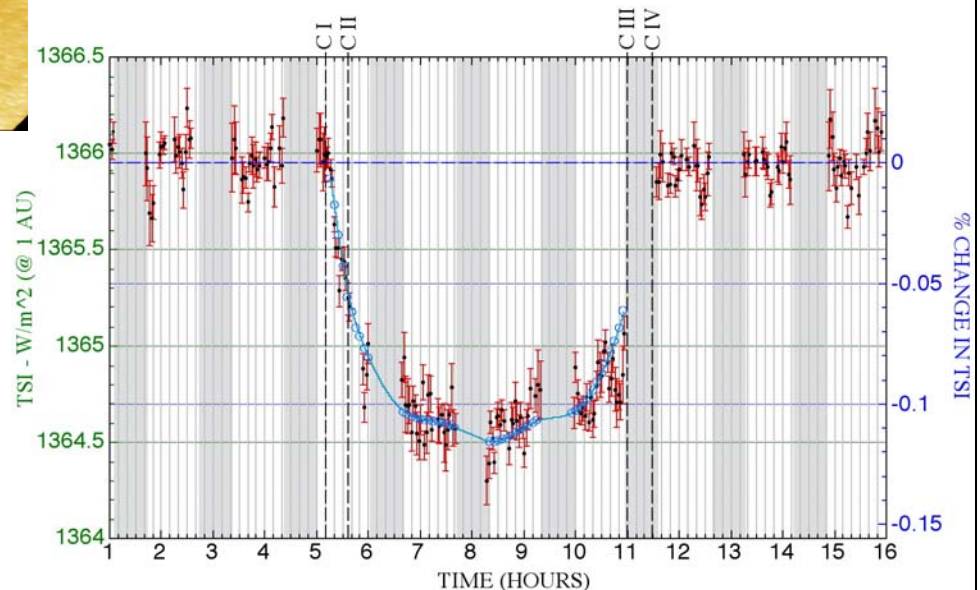


Figure 2. Observed Total Solar Irradiance during the 2004 Venus transit from ACRIMSAT



Planets transiting across their host stars are now routinely observed throughout our galactic neighborhood. The signature of the geometric transit in the light curve has been used to identify more than a thousand extra-solar planet candidates with observations from the Kepler satellite (with the number still growing). In order to provide a “truth test” for these detections, the comparable measurement was performed during the 2004 transit using the sun-as-star irradiance measurement of the ACRIMsat satellite (Schneider et al. 2006; Pasachoff et al. 2011). In the eight years since that first transit, however, the goal of detecting the exoplanet atmospheric signature through transmission spectroscopy has now become practical. The strong molecular bands in planetary atmospheres produce broad absorption features that can be detected, with sufficient integration, during the planetary transits. These atmospheric signatures have been detected for hot Jupiters (e.g., Charbonneau et al. 2002; Vidal-Madjar et al. 2003, 2011; Snellen et al. 2010). Similar signatures are expected for Earth-sized planets, though with a reduced magnitude because of the smaller size of the planet and atmosphere with respect to the host star..

References :

- Charbonneau et al., *The Astrophysical Journal*, Volume 568, Issue 1, pp. 377-384 (2002).
Ehrenreich et al., *Astronomy & Astrophysics*, 537, L2 (2012)
Pasachoff et al., *The Astronomical Journal*, 141:112 (9pp), 2011 April
Schneider et al, [The Astrophysical Journal](#), 641:565-571, 2006 April 10
Snellen et al., *Nature* 465, 1049–1051 (24 June 2010)
Vidal-Madjar et al., *Nature*, Volume 422, Issue 6928, pp. 143-146 (2003).

Future Meetings

Venus Sessions at the European Geophysical Union General Assembly, Vienna and Townhall Meeting - International Venus Exploration Focus Group, 25 April 2012

Workshop on Planetary Dunes, Flagstaff, Arizona, 12-15 June 2012, flagstaff, Arizona

9th International Planetary Probes Workshop, Toulouse, France, 18-22 June 2012

Comparative Climatology of the Terrestrial Planets, Boulder, Colorado, 25-28 June 2012

COSPAR 2012, Mysore, India, 14-22 July 2012

European Planetary Science Congress, Madrid, Spain, 23-28 September 2012

Abstract deadline: 23 May 2012

Division for Planetary Sciences, Reno, Nevada, 14-19 October 2012

Tentative: VEXAG Workshop, Washington DC area, second week of November 2012.