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Solar Wind Interaction with Venus

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Abstract

Venus Express, which was inserted into orbit in mid-2006, has added significantly to the knowledge gained from Pioneer Venus from 1978 to 1992. This observational database interpreted in terms of modern multi-fluid codes and hybrid simulations has deepened our understanding of Earth's very different twin sister planet. Furthermore, the very different orbits of VEX and PVO has allowed the more complete mapping of the volume of space around the planet. Now the bow shock has been probed over its full surface, the ionosphere mapped everywhere, and the tail studied from the ionosphere to 12 Venus radii. Some unexpected discoveries have been made. The exospheric hydrogen at Venus, unlike that at Mars, does not produce ion-cyclotron waves, perhaps because the stronger gravity of Venus produces a smaller geocorona. The solar wind interaction drapes the magnetic field around the planet, and a strong layer of magnetic field builds up at low altitudes. While the layer does not appear to penetrate into the dayside atmosphere (perhaps diffusing only slowly through the low atmosphere), it does appear to dip into the atmosphere at night. Surprisingly, over the poles, this layer is most strongly seen when the IMF B_Y component has a positive Y-component in Venus-Solar-Orbital coordinates. Multi-fluid simulations show that this result is consistent with the pressure of significant ion densities of ions with quite different mass which causes magnetic polarity control of the ion flow over the terminators. Reconnection is found in the tail close to the planet, and the structure of the outer tail found by PVO is confirmed to exist in the inner tail by VEX. When combined, the VEX and PVO Data provide a very comprehensive picture of the physics of the solar wind interaction with the ionosphere of Venus.