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Planetary Core Sounding with the Solar Wind Interaction: Application to Venus

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Abstract

When the solar wind interacts with a planetary ionosphere, the interplanetary magnetic field can diffuse into the ionosphere at a rate dependent on the collision frequency if the ionopause is sufficiently low. The magnetic field is carried by the ionospheric circulation, which is downward near the subsolar point for these conditions. This magnetic flux is deposited at low altitudes building up a magnetic layer at about 170 km altitude, which, at most, slowly diffuses into the neutral atmosphere below. Pioneer Venus has also mapped this Venus dayside low latitude layer near the midnight equatorial region. Venus Express measurements complement those of PVO with data at low altitudes solely over the north pole, providing coverage between the subsolar and wake regions. At the terminator, the field begins to dip into the atmosphere, with the tilt increasing toward midnight, and if the PVO holes are connected, the field rises out of the atmosphere almost vertically in the wake region (Figures 1 and 2). When we compare these observations with MHD models, we can improve the models where we find inaccuracies and improve our understanding of both the observations and the models. To the accuracy in which we can determine the geometry of the field relative to the radial direction over the bottom of the ionosphere, we should be able to determine the size of the core of Venus. If this is not possible to the required accuracy, measurements in the ionosphere and from balloons beneath the ionosphere could be combined to provide the needed measurements.

Figures

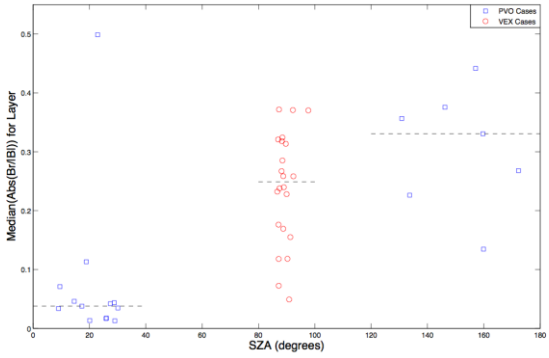

Figure 1: The median values for |Br/B| for the duration of each layer. Dots indicate individual cases while dashed lines represent the median value for each region. Dayside cases are almost purely horizontal while terminator and nightside regions have a noticeable radial component. [1]

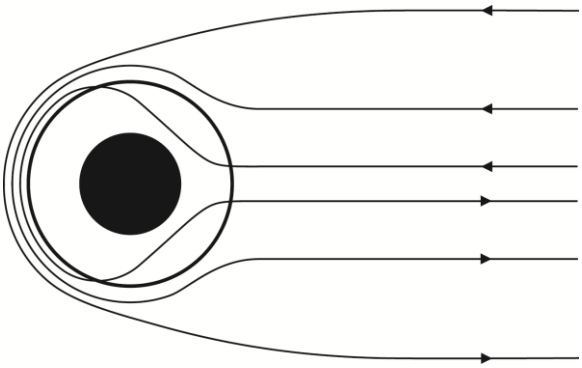

Figure 2: Modified picture of the draping of the magnetic belt around Venus as inferred from the Br component. The field is horizontal in the dayside region, but starts to dip into the atmosphere near the terminator. [1]

Reference

[1] Villarreal, M.N., et al. (2014), Characterizing the Low Altitude Magnetic Belt at Venus: Complementary Observations from the Pioneer Venus Orbiter and Venus Express, currently in preparation for submittal.