MAGNETIC TOPOLOGY AT VENUS: NEW INSIGHTS INTO THE VENUS PLASMA ENVIRONMENT.

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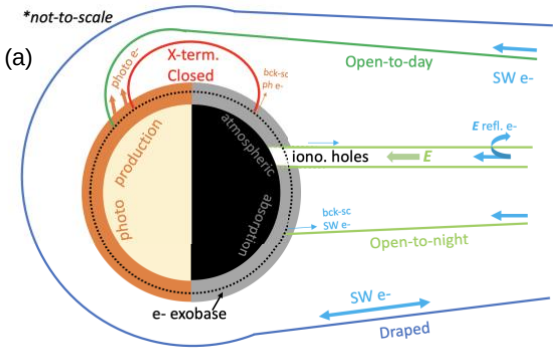
Introduction and Methodology: Venus lacks significant intrinsic magnetic fields and thus its atmosphere and ionosphere interact directly with the solar wind flow and magnetic fields. Interplanetary magnetic fields (IMF) can penetrate into the ionosphere when the upstream solar wind dynamic is stronger than the ionospheric plasma pressure. Magnetic topology can be inferred at Venus if it is defined as the magnetic connectivity to the collisional atmosphere/ionosphere, rather than connectivity to the planet's surface. Utilizing electron and magnetic field measurements from the Venus Express mission, this study provides the first characterization of magnetic topology at Venus by examining the pitch angle and energy distribution of superthermal (> ~1 eV) electrons. More specifically, the presence of loss cones in electron pitch angle distributions infers the connectivity to the *nightside* collisional atmosphere and the presence of ionospheric photoelectrons (identified from electron energy distributions) indicates the connectivity to the *dayside* collisional ionosphere.

Results: We show case examples of various magnetic topology types at Venus, including the most expected draped IMF, open field lines connected to the *nightside* atmosphere, open field lines connected to the *dayside* ionosphere, and, most surprisingly, cross-terminator closed field lines. More interestingly, during one of the ionospheric hole



events identified by [1], we discover not only the expected open magnetic topology but also a field-aligned potential drop, which has implications for its formation mechanism. The characterization of magnetic connectivity could provide new insights to many important topics on Venus, such as planetary ion outflow, energetic electron precipitation (possible auroral emission), and the formation mechanism of Venusian ionospheric holes.

Broad Impact: This study thus raises interesting questions related to important Venus science questions such as the history and current nature of its magnetism, and how possible coupling from the ionosphere to the interior as a whole might affect its interaction with the solar wind, and/or the history/evolution of its atmosphere. Similar but more complete measurements on future orbiters with electron instruments with full 4pi FOV and magnetometers, coupled with sub-exobase magnetometer observations (on balloons or even on the surface) can help to explore this uncharted territory.

Acknowledgments: Venus Express Magnetometer and ELS data are publicly available in the ESA Planetary System Archive (https://www.cosmos.esa.int/web/psa/venus-express).

References:

[1] Collinson, G., Fedorov, A., Futaana, Y., Masunaga, K., Hartle, R., Stenberg, G., et al. (2014). The extension of ionospheric holes into the tail of Venus. Journal of Geophysical Research: Space Physics, 119(8), 6940–6953.