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Interaction of the Saturnian Magnetospheric Plasma with Titan: Comparison Study with the Venus-Solar Wind Interaction

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Our early understanding of the interaction of the corotating magnetospheric plasma with Titan observed by early Voyager and recent Cassini magnetometer observations, Langmuir probe observations and limited plasma observations was strongly influenced by our understanding of the supersonically flowing solar wind with Venus but also comets and even Io. Titan is mostly embedded in the Saturnian magnetosphere and is in the magnetosheath for only a small portion of time, thus it almost always encounters a subsonic flow mainly in the corotation direction and relatively constant upstream field orientation compared with the situation of Venus. One aspect of the Venus interaction that was correctly not expected to arise at Titan was a bow shock. Nevertheless we do expect a compressional wave to arise as pressure builds up to deflect the flow. Both MHD simulation and Cassini magnetometer measurements demonstrate a compressional feature in the interaction and an induced magnetotail. The magnetotail at Venus is formed from a well-ordered slow-mode expansion waves. While Titan's tail has Alfvenic and slow-mode features which has strongly magnetized lobes in the dimension parallel to the upstream field direction and weak field region in the perpendicular dimension. Finally, Titan's ionosphere is magnetized and resembles the situation of Venus under high solar wind pressure. At Venus, large scale ionospheric fields with the same orientations as in the magnetosheath appear during high solar wind pressure, and these fields can diffuse into the lower atmosphere and reach an asymptotic value at the surface. The Titan ionospheric fields do not have the same orientations as in the

draped field region, and they change both magnitude and direction as they penetrate possibly due to drag by winds in the atmosphere or as a consequence of slow variations of the upstream magnetic field leading to “fossil” fields in the lower ionosphere. In the downstream ionosphere, plasma thermal pressure obtained from Langmuir Probe data balances magnetic pressure, consistent with a plasma temperature of the order of 1eV. Such pressure balance was also observed in the Venus ionosphere by Pioneer Venus.