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The solar wind interaction with Iapetus

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On September 10, 2007, Cassini flew past Iapetus at a closest approach distance of about 1645 km while Iapetus was well upstream of Saturn's bowshock. During the flyby, when Cassini was primarily in the region downstream of Iapetus, the Radio and Plasma Wave instrument detected broadband waves at frequencies below about 100 Hz as well as a series of Langmuir waves. According to magnetometer observations, the solar wind field near Iapetus does not approach Saturn's bow shock, hence, the Langmuir waves are not associated with electrons from the bow shock. Further, the broadband waves are clearly isolated to the region near Iapetus and do not seem to be a normal solar wind phenomenon. There appears to be a local enhancement in the electron density of a factor of about 2 and an enhancement in the flux of solar wind energetic particles, the latter suggesting some local ion acceleration. The plasma wave signatures observed near Iapetus are similar to those associated with the solar wind interaction with Earth's moon. In such an interaction, a cavity is formed behind the moon and electrons, being more mobile, fill the void most easily. This process leads to a charge separation and an ambipolar electric field. Magnetic field lines connecting Cassini to this solar wind wake are the site of low frequency electrostatic ion acoustic waves. Further, the electric field can reflect electrons back into the solar wind, resulting in electron beams that are unstable to Langmuir waves. However, the density enhancement and increased flux of energetic ions may suggest other processes at work, perhaps even a source of plasma at Iapetus.