Nonlinear evolution of modified two stream instability above ionosphere of Titan: comparison with the data of the Cassini Plasma Spectrometer. and application to Mars and Venus.

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Abstract. The ionosphere of Titan, moon of Saturn is directly exposed to the streaming plasma either of magnetospheric or solar wind origin. A turbulent interaction region between the two different plasma types is formed, called here flowside plasma mantle, where both ionospheric and hot streaming plasma are present at comparable densities. In order to study the microphysics of the collective plasma phenomena taking place within the flowside plasma mantle of Titan, a one dimensional electromagnetic hybrid simulation was constructed, retaining the inertia of the electrons. Within the framework of this model we study the wave particle interaction created by the relative drift between the streaming ion flow and the ionospheric ions.

It is shown that the excited waves are very effective in generating “anomalous viscosity” type interaction between the hot plasma flow and cold ionospheric ions, leading to significant bulk velocity loss of the proton component of the external plasma flow and turbulent heating of the ionospheric ions. The waves are excited due to a modified two-stream instability, the free energy source for the instability is in the streaming ion flow. The stochastic energy transfer from the streaming plasma to the ionospheric ions may also increase the tailward planetary ion escape by collective pick-up mechanism enhancing the rate of erosion of the atmosphere of Titan (sputtering).

We make predictions for the characteristic frequency range and saturation energy level of the excited wave electric field, and the energy range where superthermal charged particles of ionospheic origin can be detected by the charged particle analyzers onboard of Cassini spacecraft near Titan.

Mars and Venus show many similarities with Titan, the model prediction for those planets this will be discussed as well.

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