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Theoretical Studies of Fast Stochastic Electron Heating near the Upper Hybrid Layer

Abstrac:
It is well-known that high-frequency (HF) heating of the ionosphere can excite magnetic field aligned density striations (FAS) in the ionospheric plasma. Furthermore, the pump wave can excite upper hybrid and lower hybrid turbulence in the striations. We have used a Vlasov simulation with one spatial dimension and two velocity dimensions, to study the effects of ionospheric heating when the pump frequency is in the vicinity of the upper hybrid resonance, employing parameters con- sistent with high-latitude ionospheric heaters such as HAARP. We have found that by seeding the plasma with a meter-sized FAS with a 10% density depletion, and applying a spatially uniform HF dipole pump electric field, the pump wave gives rise to upper hybrid and lower hybrid turbulence, as well as to large amplitude electron Bernstein waves. The latter gives rise to stochastic, collisionless, bulk electron heating when the electron Bernstein waves amplitude exceeds a threshold of stochasticity. This leads to a rapid increase of the electron temperature by several thousands of Kelvin within the striation.