HF-driven Plasma Turbulence and Artificial Ionospheric Layers

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High-power high frequency (HF) radio beams efficiently produce artificial ionization in the F-region ionosphere at the European Incoherent SCATter (EISCAT) and High-frequency Active Auroral Research Program (HAARP) facilities. We summarize the salient features of HF-driven plasma turbulence and descending layers (DLs) of freshly ionized plasma, give an assessment of pertinent theoretical/numerical studies, and compare the theoretical and experimental results. A concept of an ionizing wavefront created by accelerated suprathermal electrons appears in accord with the observations. The SLT and cyclotron acceleration mechanisms contribute to the formation of non-maxwellian tails of the electron population. The strong Langmuir turbulence (SLT) regime is witnessed by the spectral features of plasma/ion line (PL/IL) radar backscatter and stimulated electromagnetic emissions. The large altitudinal spread of the descending PL/IL signal returns indicate scattering off small-scale irregularities. We argue that at high powers characteristic of the DL events the superstrong LT regime takes place and that anomalous absorption is subdued.