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Sheerin, J. P.[1]; Watkins, B. J.[2]; Bristow, W. A.[2];
1. Eastern Michigan Univ.
2. U. Alaska-Fairbanks

Experimental Studies of RF Generated Ionospheric Turbulence

Abstract:
The high power HAARP HF transmitter is employed to generate and study strong Langmuir turbulence (SLT) in the interaction region of overdense ionospheric plasma. Diagnostics included the Modular UHF Ionospheric Radar (MUIR) sited at HAARP, the SuperDARN-Kodiak HF radar, and HF receivers to record stimulated electromagnetic emissions (SEE). Dependence of diagnostic signals on HAARP HF parameters, including pulselength, duty-cycle, aspect angle, and frequency were recorded. Short pulse, low duty cycle experiments demonstrate control of artificial field-aligned irregularities (AFAI) and isolation of ponderomotive effects.

For the first time, simultaneous multi-angle radar measurements of plasma line spectra are recorded demonstrating marked dependence on aspect angle with the strongest interaction region observed displaced southward of the HF zenith pointing angle. For a narrow range of HF pointing between Spitze and magnetic zenith, a reduced threshold for AFAI is observed. High time resolution studies of the temporal evolution of the plasma line reveal the appearance of an overshoot effect on ponderomotive timescales. Numerous measurements of the outshifted plasma line are observed.

Experimental results are compared to previous high latitude experiments and predictions from recent modeling efforts.