#39 Received 01/16/2015

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Recent Advances In Stimulated Electromagnetic Emission Observations with HAARP HF Heating

Abstract:
High power HF radio waves interacting with the ionosphere provide aeronomers with a unique space-based laboratory capability. The High-Frequency Active Auroral Research Program (HAARP) in Gakona, Alaksa is the world's largest heating facility, producing effective radiated powers in the gigawatt range. Experiments performed at HAARP have allowed researchers to study many non-linear effects of wave-plasma interactions. Stimulated Electromagnetic Emissions (SEE) are of interest to the ionospheric community for its diagnostic purposes. Typical SEE experiments at HAARP have focused on characterizing the parametric decay of the electromagnetic pump wave into several different wave modes such as upper and lower hybrid, ion acoustic, ion-Bernstein and electron-Bernstein.

Recent HAARP experiments have used both conventional and novel techniques to excite ionospheric disturbances at gyroharmonic frequencies. Recent observations have employed a phasing technique on the HAARP array to modify the antenna beam pointing and the beam shape. Frequency sweeps through the 2nd, 3rd, 4th and 6th gyroharmonics have produced several previously uncatalogued SEE modes. There is large variability in the spectral width and frequency offset from the pump wave. In addition, some SEE lines change frequency in cycles with a fixed pump frequency. All of the phenomena can be explained by considering the resonant modes supported in the plasma and the dynamical density variations produced by the high-power HF pump. These emissions are under study to be linked with other heating phenomena such as enhanced density and optical emissions, ion and plasma line generation, HF radar backscatter and enhanced electron acceleration.

This research is sponsored by the NRL 6.1 base program.