

MEASUREMENTS OF ELECTROSTATIC AND ELECTROMAGNETIC EMISSIONS FROM HIGH POWER RADIO WAVES IN THE F-REGION OVER HAARP

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In February 2005, high power radio wave experiments were conducted to diagnose the HF heating of the ionosphere over HAARP. The experiments used ground diagnostics to detect the nonlinear wave interactions in the F-Region. The measurement approach used three simultaneous radio/radar techniques. For stimulated electromagnetic emissions (SEE) that radiate from the modified plasma the Stimulated Ionospheric Electromagnetic Radio Receiver Array (SIERRA) was set up in a five receiver array extending from Fairbanks in the north to Valdez and Cordova Alaska in the south. Enhanced ion and plasma lines were observed using the eight-panel version of the Advanced Modular Incoherent Scatter Radar (AMISR). Backscatter from the heater induced field aligned irregularities was monitored by the Super Dual Auroral Radar Network (SuperDARN) in Kodiak Alaska. Many types of HF transmission modes were scheduled for the radio/radar Measurements with HAARP operations. The results of these experiments have provided an integrated view of simultaneously produced photons (electromagnetic waves), plasmon (plasma waves), phonons (ion sound waves), and density irregularities. The observations have been used to validate theories on high power wave interactions in the F-Region. The HAARP simultaneous radio measurement (SRM) campaign yielded several new discoveries and observations including (1) duty cycle dependence of Doppler spread of SuperDARN backscatter, (2) spatial dependence of relative downshifted maximum (DM) and broad upshifted maximum (BUM) SEE intensities, and (3) the first enhanced ion and plasma lines recorded at UHF at the HAARP site. The results of these experiments are explained using mode conversion of the electromagnetic pump wave to generate electrostatic waves, parametric decay of the pump and electrostatic waves to generate frequency shifts, Bragg scatter of the radar signals and mode conversion to yield radiated electromagnetic waves.

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