

Recent Results of Stimulated Electromagnetic Emission Measurements at HAARP

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Stimulated Electromagnetic Emissions SEEs have been routinely observed during ionospheric modification experiments since the early 1980s and SEE was considered a relatively mature field until fairly recently. This renewed interest has been due in large part to the increased capabilities of the HAARP facility (primarily transmit power) which have allowed new SEE spectral lines to be observed and opened the door for new diagnostic capabilities. Several of these new spectral lines have also recently been reproduced with the EISCAT heating facility. This presentation will first give a very brief summary review of the new SEE spectral lines that have been discovered at HAARP (and reproduced at EISCAT) over the past 7-8 years. The importance of the observed spectral lines will be discussed as well as basic theory of generation through nonlinear wave-wave interaction processes. Recent progress on modeling SEE generation using computational plasma models will also be discussed and the insights into understanding the associated particle energization. Implications of upshifted SEE spectral line nonlinear evolution on interpreting recent measurements of GPS phase scintillations produced during ionospheric heating experiments will also be discussed. The most recent SEE experiments were performed at HAARP during Winter (February) and Fall (September) 2017. Objectives of these experiments included consideration of generation of SEE at the second harmonic of the pump frequency, more careful determination of thresholds for newly discovered SEE spectral lines during gyro-harmonic heating for diagnostic purposes, and finally further exploration of the linkages of upshifted SEE spectral lines with GPS phase scintillations. These latest SEE observations will be discussed and contextualized with irregularity observations obtained using SuperDARN radar and GPS TEC observations.