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DEMETER Observations of ELF/VLF Signals from HAARP and VLF Transmitters

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With its excellent complement of ELF/VLF receivers, DEMETER has been an excellent platform for the in-situ measurement of ELF/VLF signals artificially injected into space, with the HAARP HF heater and with conventional VLF transmitters. The High-frequency Active Auroral Research Program (HAARP) HF heating facility has recently undergone a major upgrade, bringing its total radiated power capability to an unprecedented 3.6 MW. The facility provides for extremely agile generation capability of ULF/ELF/VLF waves ranging in frequency from .1 Hz to 30 kHz. Burst mode observations carried out during DEMETER overpasses of HAARP have revealed surprising results, including an intense columnar beam of radiation that is launched along the field lines, over a region of ˜40 km in lateral extent. DEMETER observations both overhead HAARP and above its conjugate region have also shown the presence of discrete VLF emissions triggered by the HAARP-injected ELF/VLF signals, exhibiting coherent amplification and growth. DEMETER has also been instrumental in other controlled wave-injection experiments carried out with a powerful VLF transmitter facility in Lualualei, Hawaii, where the 21.4 kHz NPM transmitter was keyed in specialized ON/OFF patterns during DEMETER passes overhead of above the conjugate region. In addition to the occasional observation of NPM-induced electron precipitation, a large variety of injected VLF signal properties are observed at 700-km altitude, involving large Doppler-shifted signals (electrostatic waves) correlated with density irregularities. In several DEMETER overpasses of HAARP, evidence of HAARP-

generated ULF signals at 0.2 Hz and 0.1 Hz has also been observed on DEMETER.