Electromagnetic Diagnostics of Atmospheric Plasmas

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Abstract: This research program addresses fundamental issues related to the interaction of a high-power, high- frequency (3 - 10 MHz) radio wave with the ionosphere. Data acquired at the High-Power Auroral Stimulation (HIPAS) observatory in Fairbanks, Alaska was used to study the formation of artificial periodic inhomogeneities (API) in the lower and upper atmosphere. Quite remarkably, the API echoes are observed as low as the polar stratopause near 45 km altitude. The meteor-like nature of the echoes open new vistas for atmospheric research in the middle atmosphere. A second investigation focused on the physics of missile plumes in the lower atmosphere. This can be viewed as a lower atmosphere modification experiment in which missile fuel generates a highly collisional plasma. Plumes from Aries rockets launched from NASA Wallops Island Flight Facility, Virginia were simultaneously monitored with radars operating at 139 MHz, 50 MHz, 430 MHz, and 2840 MHz. Absolute plume cross section and spectral signature were the measured quantities of primary interest. Additional research entailed studies of the equatorial ionosphere, investigations of upper atmosphere lightning flashes, and an examination of ion and Langmuir oscillations excited by the high-frequency, ionospheric modification facility at Tromso, Norway.

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