Fast Z-Mode Propagation Observed on OEDIPUS C

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The OEDIPUS-C (OC) rocket double payload carried a transmitter High-frequency Exciter (HEX) on its forward subpayload and a synchronized Receiver for EXciter(REX) on its aft subpayload. The HEX and REX had three different frequency modes: a 0 - 8 MHz sweep, a 0.5 - 2.1 MHz sweep and fixed-frequency operation at 4.5 MHz. For the measurements discussed here, the separation vector between the transmitter and receiver had a magnitude of about 1200 m and lay along a direction at about 5° from the axis of the Earth's magnetic field **B**. Whistler, ordinary and extraordinary waves modes were propagated between the two subpayloads. One important feature was that fast Z-mode signals, left-hand polarized propagation occurring in CMA region 4, were strong compared to the adjacent wave modes. In particular, the intensity of the Z-mode signals was enhanced at frequencies just below the plasma frequency f_p for low f_p values but enhanced at frequencies just above the Z-mode cut-off frequency f_Z for high f_p. Calculations were made combining the fast Z-mode dispersion relation for a cold plasma, HEX and REX characteristics, and theories for dipole radiation and impedance. Calculated values of transmitted electric fields are presented for zero and non-zero values of stray capacitance, with better agreement with observations with zero stray capacitance.

The relatively strong Z-mode transmissions on OC may have some relevance to other space radio research. The ability of sounders like the IMAGE/RPI to stimulate guided propagation giving rise to "epsilon" echo signatures may be explained with reference to the antenna properties in CMA4. Antenna matching to the plasma may be aided by the dipole's inductive impedance in CMA4. The Z-mode refractive index surfaces have points of inflection. These lead to three separate wave vector directions for a single group direction, which may also play a role in enhancing Z-mode signals through a dispersion-based focusing of rays near the inflection point.