Imprints of Coronal Temperature Variations on Type III Solar Radio Bursts

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The electron temperature T_e and ion temperature T_i in the corona vary with time and location, due to transient and persistent activity on the Sun. The effects of both monotonic variations and spatially localized disturbances in T_e and T_i on type III solar radio bursts are simulated. Spatially localized disturbances are found to have stronger effects than monotonic variations. Disturbances in T_e and T_i lead to qualitatively and quantitatively different imprints on the curve of maximum flux versus frequency of type III bursts. In the presence of monotonically varying T_e the frequency drift rate agrees quantitatively with the standard prediction, which quantitatively relates the drift rate with plasma density profile and a characteristic beam speed v_b. In addition, v_b was found to vary with position and to scale with T_e via $v_b \sim T_e^{1/2}$. Importantly, localized temperature disturbances may be responsible for some fine structures in type III bursts, e.g., striae in type IIIb bursts in the presence of multiple, localized temperature disturbances. The results indicate that nonthermal type III bursts offer a new tool to probe monotonically varying T_e profiles, and to diagnose and distinguish between spatially localized structures in T_e and T_i along the path of type III beams in the corona.

Keywords: Solar type III radio bursts; corona; electron beams; plasma waves; electromagnetic radiation; radiation propagation; numerical simulation.