

MF/HF RADIO EMISSIONS FROM THE AURORAL IONOSPHERE
AND THEIR CONNECTIONS TO PLASMA INSTABILITIES

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Among the possible consequences of ionospheric plasma instabilities is transport of energy out of the local plasma in the form of electromagnetic radiation. The observation of electromagnetic emissions from auroral ionosphere strongly suggests that this process plays a role there. At medium and high frequencies (MF/HF), three types of radio emissions of auroral origin are observed: auroral hiss, MF-burst, and roar. There is strong evidence that auroral roar and much auroral hiss arise from plasma instabilities; that is, from collective processes in the plasma which result in conversion of free energy stored in plasma particles into the observed electromagnetic radiation. The amount of energy emitted in electromagnetic radiation is small compared to that stored in the plasma particles, but sufficient knowledge of the generation mechanism implies that these radiations may be used to diagnose ionospheric conditions using passive ground-based measurements. Some examples of these diagnostic methods will be discussed. The connection of the MF-burst emissions to plasma instability is less well understood. However, based on elementary considerations of wave intensity and frequency range, some constraints can be placed on the generation mechanism, and two or three possible mechanisms have appeared in the literature. A brief review suggests that some of these warrant deeper consideration. In conclusion, the generation of MF/HF radio emissions of natural auroral origin has a close connection to ionospheric plasma instabilities, and observations of these radio emissions from ground-based and spacecraft-borne sensors can play a significant role in identifying and understanding the plasma instabilities occurring in the Earth's ionosphere and magnetosphere.

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