3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Impulsive Auroral Hiss and Medium Frequency Burst Emissions

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Radio emissions of natural auroral origin, observable at ground level, include cyclotron harmonic emissions ("Auroral Roar"), Auroral Kilometric Radiation, continuous and impulsive auroral hiss, and Medium Frequency Burst (MFB). MFB and impulsive hiss are closely associated with auroral activations including substorm onsets. These two emissions often turn on promptly at the same time as other substorm onset features such as prompt riometer absorption and negative bays in magnetometer traces; they have been proposed as markers for timing and location of substorm onsets. On >1 s time scales, both emissions appear broadband and impulsive, hiss at frequencies up to approximately 1 MHz and MFB in the frequency range 1.5-4.5 MHz. On these time scales the emissions appear highly correlated with each other. On shorter time scales, however, the emissions appear quite different. Impulsive hiss consists of broadband pulses of duration 10s to 100 ms, whereas MFB consists of a variety of fine structures intrinsically narrow-band but shifting across frequency ranges up to hundreds of kiloHertz. Direction-finding measurements suggest that both emissions usually come from the same direction. The polarization of the emissions is opposite: auroral hiss is right-elliptically polarized, consistent with propagation in the whistler mode in the ionosphere; and MFB is left-elliptically polarized, consistent with mode-conversion radiation resulting from auroral Langmuir or upper hybrid waves, although its exact origin is uncertain. The correlation between these emissions, or lack thereof, provides important hints about the generation mechanisms of both emissions, their relationship to auroral activations such as substorm onsets, and their possible application for remotely sensing auroral electron density profiles, substorm onset timing and location, or auroral acceleration processes.