

Review of ground-level interferometry applied to natural auroral radio emissions

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At least five types of naturally occurring radio emissions of auroral origin have been recorded by ground-level instruments in Arctic and Antarctic observatories, including auroral hiss at VLF-LF-MF, medium frequency burst at MF-HF, and cyclotron harmonic radiation at MF-HF. A number of experiments have involved deployment of arrays of antennas or other methods to investigate direction of arrival of these signals. Efforts to date have been relatively low resolution (typically one second and one kHz in time and frequency, respectively) and have concentrated on one of the three phenomena. Ongoing efforts have much higher resolution, often involving full sampling of the waveforms, and measure multiple types of emissions simultaneously to compare their directions of arrival. At these frequencies, refraction by density gradients in the ionosphere can strongly affect directions of arrival measured on the ground; if the ionosphere is expected to be disturbed, ray-tracing into model or measured ionospheric density is required to interpret results. Two recent observations will be highlighted. At Sondrestrom, a five-antenna array has obtained many examples of simultaneous measurements of directions of arrival of combinations of auroral hiss, burst and cyclotron harmonics, in some cases coincident with operations of the Sondrestrom incoherent scatter radar in a scanning mode providing electron density measurements. At Toolik Lake, a four-antenna array has obtained many examples of auroral medium frequency burst and cyclotron harmonics with full resolution potentially allowing fine structures to be independently measured. Preliminary results of these experiments will be presented, and their relationship to previous lower-resolution measurements discussed.