

Conjugacy in VLF Emissions

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Abstract: VLF emissions observed simultaneously in opposite magnetic hemispheres of the earth often show marked similarities. The correlation is best when the receivers are close to the opposite ends of a magnetic line of force. Echoing emissions show the same travel times as associated whistlers, indicating that they travel over the same discrete paths.

Conjugacy in VLF emissions is observed most commonly with periodic and quasi-periodic emissions which appear most frequently in the 1 to 10 kc/s range. Polar chorus, in the range 500 cps to 1000 cps, and auroral hiss, appearing above 4 kc/s, are less likely to be observed simultaneously at conjugate points.

“Periodic” emissions appear alternately in opposite hemispheres and may or may not show dispersion. Their similarity in strength and spectral shape as observed at conjugate points indicates that they are produced by a mechanism that is equally effective in both directions. It has been suggested that the transverse resonance instability operating with trapped electrons at the top of the path may account for periodic emissions.

Quasi-periodic (QP) emissions (also called long-period pulsations) on the other hand appear approximately in-phase at conjugate points, suggesting modulation of the emission process by an external agency, such as hydromagnetic waves. In some cases, QP emissions are found to consist of two bands of periodic emissions that interact in such a way as to account for the observed modulation of intensity and spectral shape.

Conjugate VLF emission phenomena show promise of providing new data on energetic particle streams and on the properties of the ambient propagation medium.