Nonlinear Generation Mechanism of VLF Chorus Emissions Observed at Antarctica during Quiet Periods

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Whistler-mode chorus emissions are most common form of very low frequency (VLF) emissions in the Earth's magnetosphere. These emissions usually consist of a succession of discrete elements with rising frequency and occur at frequencies below the local electron gyrofrequency with typical duration of chorus events 0.5-1h [1]. Although it is generally accepted that the generation mechanism of these emissions is connected with the cyclotron instability of whistler-mode waves and radiation belt electrons [2, 3], the generation mechanism of these emissions and formation of spectrum of separate elements are still a subject of active experimental and theoretical research [3-5]. Observation of VLF chorus emissions recorded at Indian Antarctic station, Maitri (Lat = $70^0\,46^/$ S, Long = $11^0\,50^/$ E, L = 4.5) during a quiet period on 3th Feb. 2001 is reported. The detailed spectral analysis of recorded chorus emissions shows that each chorus element originates from the upper edge of the underlying hiss band. The observed mean chorus element parameters are as follows: lower band frequency f_{min} = 3.1 kHz, upper band frequency f_{UB} = 4.8 kHz, frequency sweep rate df/dt = 2.1 kHz/s and repetition period T = 1 s. To explain the observed dynamic spectra of these chorus emissions, a possible generation mechanism is presented based on the recent nonlinear theory [5]. It is observed that the seeds of chorus emissions with rising frequency are generated near the magnetic equator as a result of a nonlinear growth mechanism that depends on the wave amplitude. On the basis of this theory, frequency sweep rate of chorus emission is computed and compared with that of our experimentally observed values, which shows, in general, a good agreement.

References

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