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A Systematic Study of Lasting Time and Sweep Rate for Lower Band Rising Tone Chorus Elements

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Chorus emissions are usually generated outside the plasmapause in the equatorial region of the magnetosphere. The characteristics of chorus elements can be quantified by four parameters: lasting time, sweep rate, repetition period, and amplitude. A systematic study on lasting time and sweep rate has not been performed in the past. Here we use the burst mode waveform data from the Time History of Events and Macroscale Interaction during Substorms (THEMIS) probes to systematically investigate relationships among these two chorus parameters and background plasma and magnetic fields using the random forest method of machine learning and Pearson's correlation analysis. We find that the lasting time is longer and the sweep rate is smaller when the ratio of plasma frequency to electron gyrofrequency is higher. A large anisotropic level can shorten the lasting time and enlarge the sweep rate. These relationships can be well explained by the optimum amplitude in the nonlinear wave theory by Omura et al. [2008]. The findings derived from this analysis can be used to serve as a guideline for a deep understanding of the generation mechanism of chorus elements and as input for a modeling of wave-particle interactions in the radiation belts.

Omura, Y., Katoh, Y., & Summers, D. (2008). Theory and simulation of the generation of whistler-mode chorus. Journal of Geophysical Research, 113, A04223. https://doi.org/10.1029/2007JA012622