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Power Gap Formation at ~0.5f_{ce} of Chorus Waves Caused by Electron Plateau Distribution: Van Allen Probes Observations

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The power gap at ~0.5 f_{ce} of chorus wave is ubiquitously detected near the magnetic equator in the Earth's inner magnetosphere (Tsurutani & Smith, 1974; Li et al., 2011). Although several efforts have been made to uncover the gap formation, its generation mechanism is still under debate. Recently, via particle-in-cell simulations, Chen et al. (2022) have proposed that the gap is caused by the electron plateau component via the cyclotron resonance, known as "spectrum bite". In this study, with Van Allen Probes data, we distinguish the banded chorus events (the events containing a gap at ~0.5f_{ce}) and no-gap events (with a continuous band across 0.5f_{ce}), and compare the plateau shapes in their velocity distributions. We find that the number density of the plateau component in banded events is typically one order larger than that in no-gap events. Besides, the observed gap frequency is roughly consistent with the theoretical one by assuming the cyclotron resonance with the plateau component. Our study provides not only the observational evidence for the "spectrum bite" mechanism, but also a more comprehensive understanding of how the evolution of electron distribution affects chorus waves.

Figure 1a shows the global distribution of the two types of chorus events in the L-MLT plane, where both types of events can be detected at L=4-6. However, their preferred MLTs are different. The banded events (red circles) typically occur in the midnight and dawn sectors with MLT=00-07, while no-gap events (blue circles) are mainly in the dawn and morning sectors with MLT=05-09.

The plateau distributions along with two types of chorus events are further investigated. Figure 1 shows the distribution of event numbers as a function of n_p/n_0 in the (b) banded and (c) no-gap events. For banded events, the n_p/n_0 covers a wide range from 10^{-5} to 10^{-2}, and peaks around 10^{-3} (with 60.1% of the events in the two adjacent bins around 10^{-3}). While, the n_p/n_0 for no-gap events is much smaller, covering 10^{-6}-10^{-3} and concentrating on ~10^{-4} (with 61.9% of the events in its two adjacent bins). Therefore, the n_p/n_0 in banded events is approximately one order larger than that in no-gap events, indicating that the banded events typically have a more pronounced plateau shape in the velocity distribution.

References
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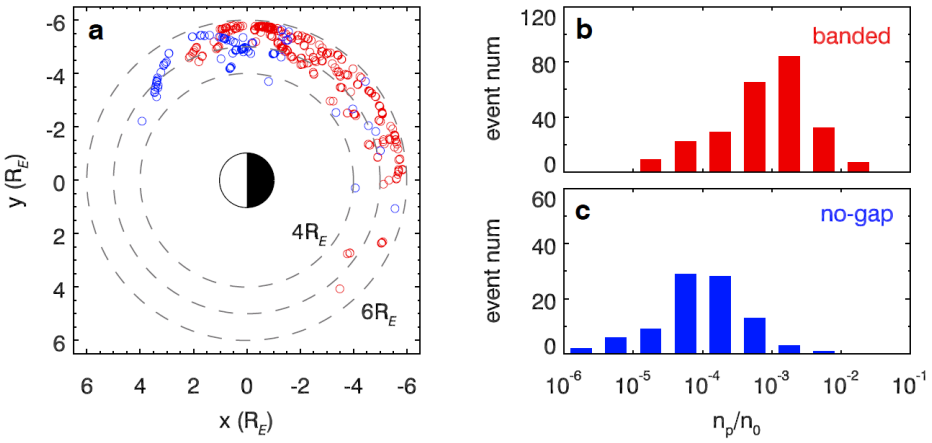

Figure 1. (a) The global distribution of the events with (without) a power gap in the L-MLT plane, denoted by red (blue) circles. The distribution of event number as a function of the np/n0 in the (b) banded events and (c) no-gap events.