



## **The excitation and the source location of the long-duration EMIC waves in the dayside outer magnetosphere**

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Electromagnetic ion cyclotron (EMIC) waves are known to play important roles in transferring energy from anisotropic energetic ions into cold ions and/or electrons. In this paper, we present a long-duration (12h in UT) EMIC wave event observed by MMS in the off-equatorial outer magnetosphere. Based on local magnetic field and plasma velocity distribution measurements, we test the linear threshold of proton cyclotron instability and find that the threshold is satisfied inside the magnetopause for nearly 9 hours. Furthermore, the growth rates estimation closely resembles the H<sup>+</sup> band features of the observed EMIC waves. The analysis of the Poynting vectors has shown that the wave propagation directions change from anti-field-aligned, to field-aligned, to multiple bidirectional while MMS approaches the magnetopause. By comparing the relative locations between the spacecraft and the field-aligned  $B_{min}$ , we suggest that these waves are possibly excited near the equator at middle L-shells and off the equator at large L-shells, which enrich the knowledge of EMIC wave sources in the outer magnetosphere.