# Supplementary Information

Phase-synchronized chorus-driven electron precipitation and diffuse aurora during geomagnetic pulsations

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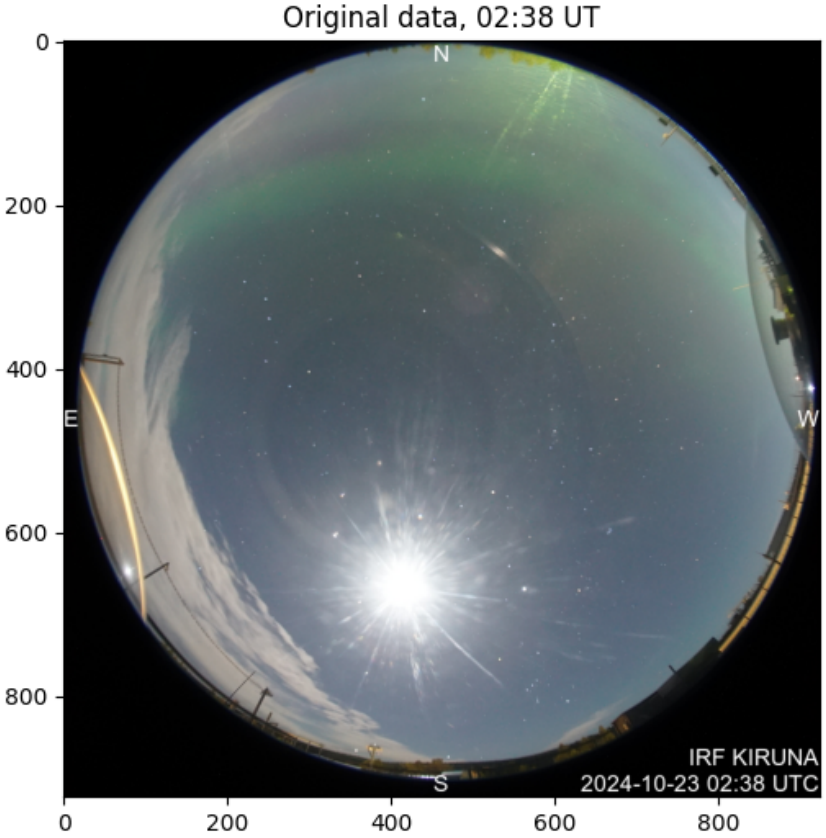
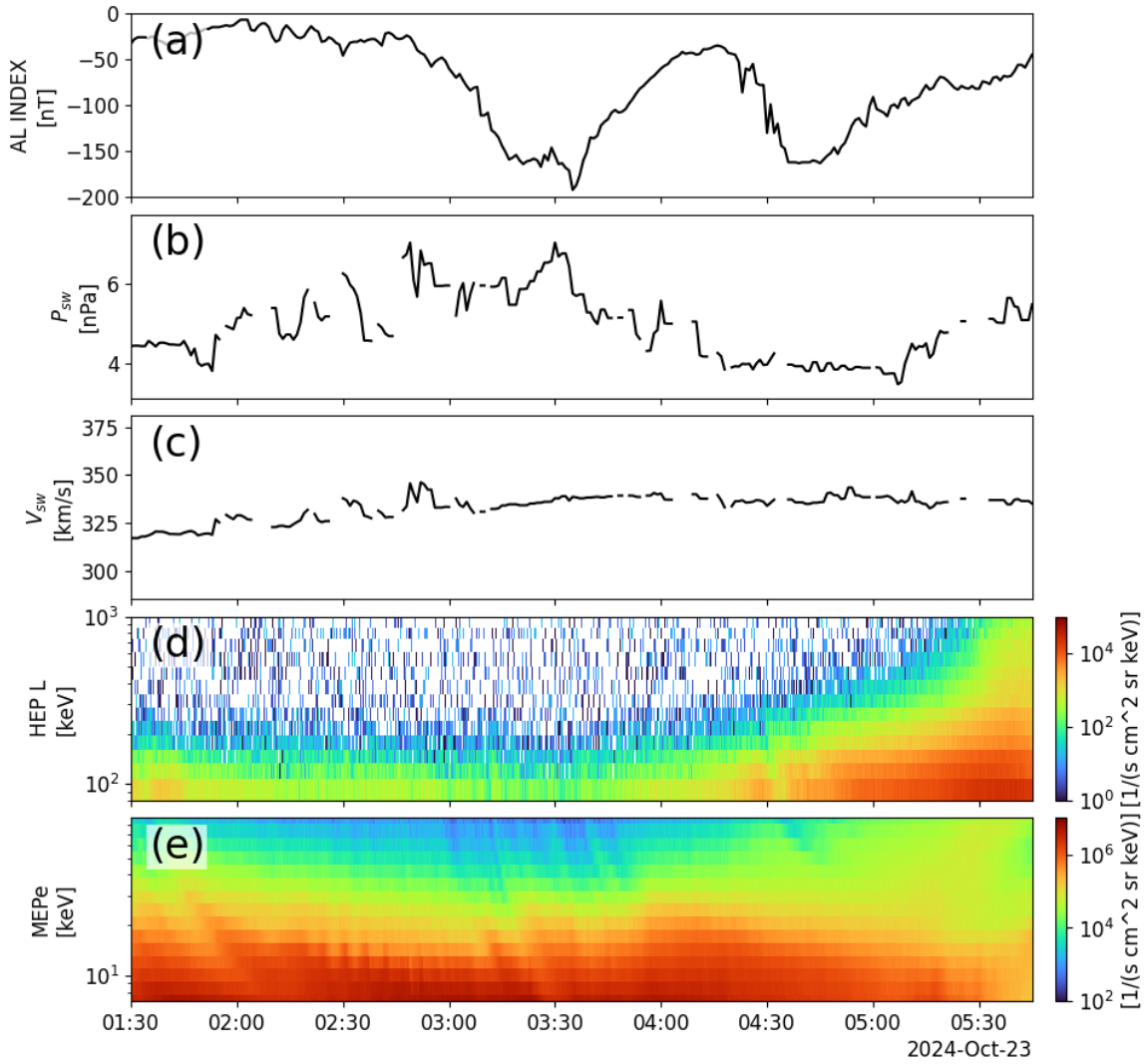
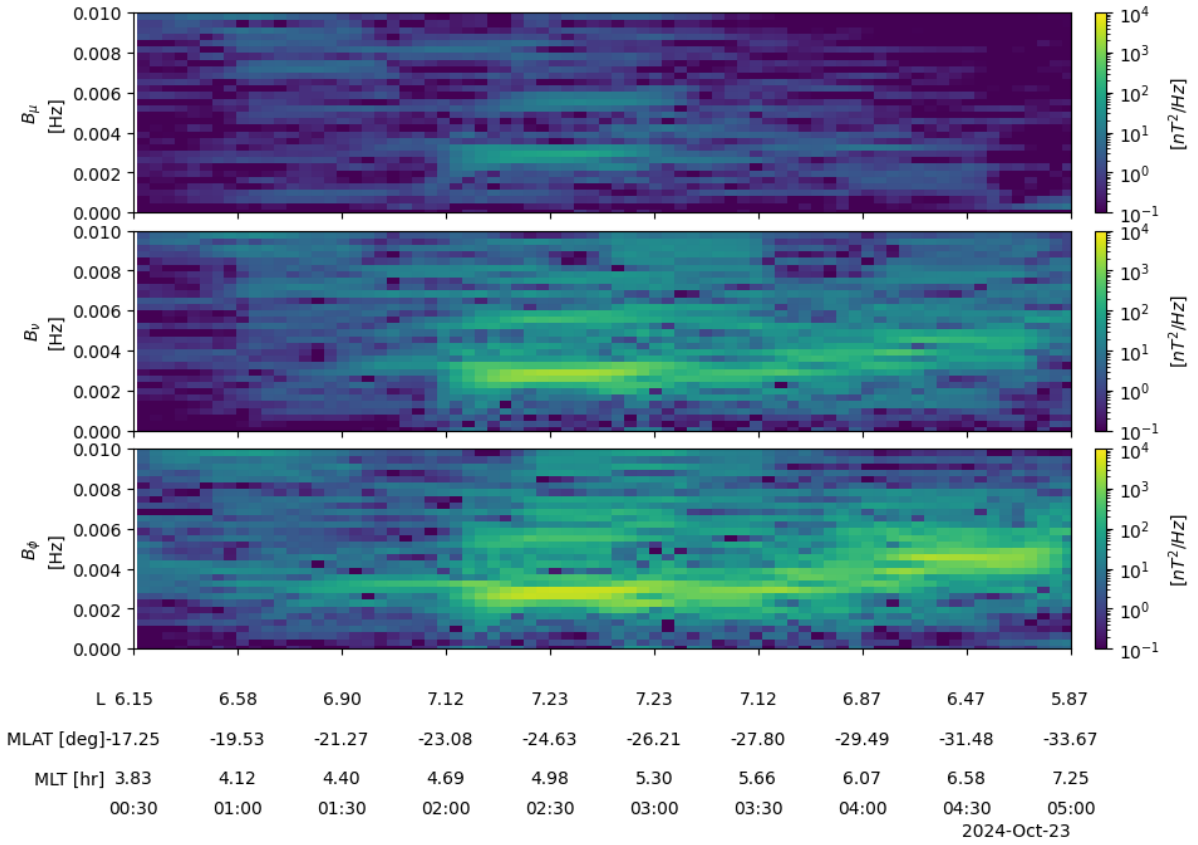


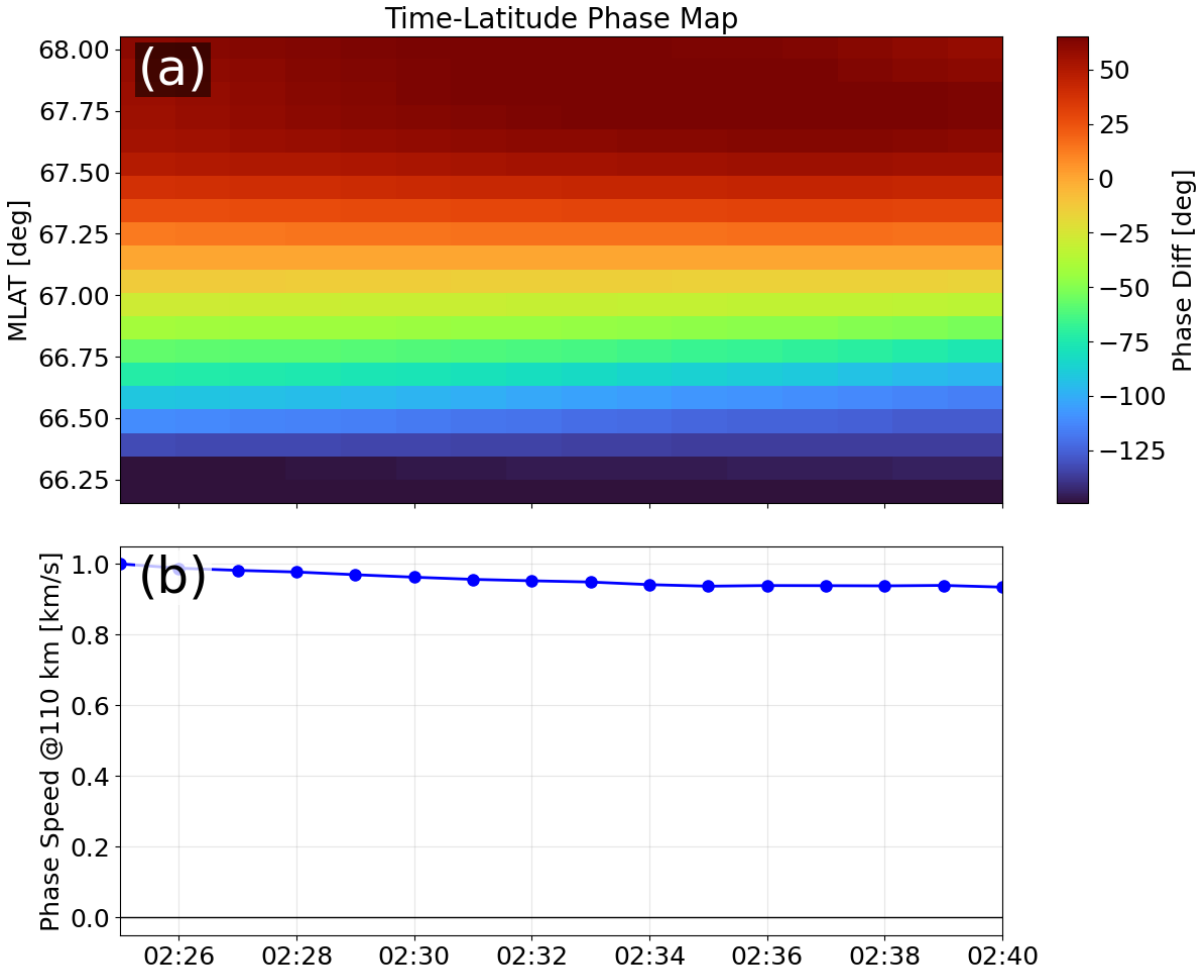

Supplementary Figure 1: All-sky RGB image acquired by the color all-sky camera at Kiruna, Sweden (67.83°N, 20.42°E) on 23 October 2024.




Supplementary Figure 2: (a) AL index shows a substorm onset around 02:00–03:00 UT during the event. (b) Solar wind dynamic pressure is relatively high at about 4–7 nPa. (c) Solar wind speed remains relatively low. (d–e) Energy-dependent electron fluxes observed by Arase: panel (d) shows high-energy electrons, which are sparse above 200 keV during 02:00–03:00 UT but increase after 05:00 UT, suggesting that Arase was outside the radiation belt during the event. Panel (e) shows energy dispersion in which higher-energy electrons arrive earlier than lower-energy electrons, indicating multiple injections, and the modulated electron flux in the period of the geomagnetic pulsation.




Supplementary Figure 3: Power spectrograms of ULF wave components observed by Arase. The ULF frequency increases with decreasing $L$ shell, consistent with the fundamental property of field line resonances (FLRs): shorter field lines at lower $L$ have shorter Alfvén travel times and thus resonate at higher frequencies. This $L$-dependent frequency structure provides independent in-situ evidence supporting the FLR interpretation.




Supplementary Figure 4: Latitudinal phase structure and propagation of the auroral emission. (a) North–south phase difference of the auroral intensity modulation and (b) propagation speed of the auroral structure at 110 km altitude. The analysis region is centered on Tromsø (magnetic latitude 67.10°, magnetic longitude 100.46°) with a latitudinal half-width of 1.0° and a longitudinal half-width of 0.4°. The auroral structure propagates poleward, and the phase of the auroral intensity changes by approximately 90° per degree of latitude. This steep latitudinal phase gradient is consistent with the hallmark signature of an FLR, in which a rapid phase reversal occurs across the resonance latitude.