ULF WAVE POLARIZATION DYNAMICS AS A KEY TO UNDERSTAND WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE

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Polarization is an important parameter of ultralow frequency (ULF) waves since it significantly affects wave-particle interactions in the magnetosphere. This interaction mostly occurs through the azimuthal electric field of the wave, that is the largest for poloidal waves (magnetic field oscillates in the radial direction) and the smallest for toroidal waves (magnetic field oscillates in the azimuthal direction). Poloidal and toroidal waves in the magnetosphere are of Alfvén wave origin. Nevertheless, it is not yet clear whether poloidal and toroidal waves have linear or elliptical polarization, and if it is possible for ULF waves to have circular polarization. ULF waves are eigenoscillations of magnetic field-lines and play crucial role in large-scale energy transport across the magnetosphere. Thus, understanding the dynamic behavior of ULF waves will advance our possibilities to forecast space weather and radiation conditions in near-Earth space.

Most studies assume ULF waves observed by a spacecraft to have a constant polarization, but some other works suggest mechanisms of polarization change in time or space. From the theoretical point of view, poloidal Alfvén waves can change their polarization to toroidal while propagating in radial direction (e.g., [Leonovich & Mazur, 1993]). A recent statistical study, analyzing the average amplitudes during wave observations, reported results hinting at a regularity of the polarization change process [Rubtsov et al., 2023].

In the present study, we show the method to analyze the wave polarization dynamics with a few case studies to demonstrate the importance of polarization change process. These results will be verified on a large statistics of ULF wave observations, and then may be used for space weather models.

REFERENCES

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