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H^+ and O^+ dynamics during ultra-low frequency waves in the Earth's magnetotail plasma sheet

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The concentration of ionospheric oxygen (O^+) in the magnetotail plasma sheet can be relatively elevated depending on, for instance, the geomagnetic activity as well as the solar cycle. The dynamics of the tail plasma sheet can be affected by the presence of O^+ via for example the generation of instabilities such as the Kelvin-Helmholtz instability. However, the O^+ is not always taken into account when studying the dynamics of the tail plasma sheet. We investigate proton (H^+) and O^+ during ultra-low frequency waves (period $>$ 5 min) in the mid-tail plasma sheet (beyond $10R_E$) using Cluster data. We observe that the velocity of O^+ can be significantly different from that of H^+. When occuring, this velocity difference always seems to be in the direction parallel to the magnetic field. The parallel velocity of the two species can be observed to be somewhat out of phase, meaning that while one species flows in the parallel direction, the other flows in the anti-parallel direction. Possible causes for such large discrepancies between the dynamics of O^+ and H^+ are discussed.