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Influence of Ion Nonlinear Polarization Drift and Warm Ions on Solitary Kinetic Alfvén Wave

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Abstract: Considering the effects of ion nonlinear polarization drift and warm ions, we adopt two-fluid model to investigate the character of low-frequency Solitary Kinetic Alfvén Wave (SKAW hereafter) in a magnetic plasma. The results derived in this paper indicate that dip SKAW and hump SKAW both exist in a wide range in magnetosphere (for the pressure parameter $\beta \sim 10^{-5} \sim 0.01$, where β is the ratio of thermal pressure to magnetic pressure, i.e. $\beta=2\mu_0 nT/B_0^2$). These two kinds of SKAWs propagate at either Super-Alfvénic velocity or Sub-Alfvénic velocity. In the inertial region $\beta << m_e/m_i$, the Sub-Alfvénic velocity dip SKAWs and hump SKAWs both exist; in the transmittal region $\beta \sim 2m_e/m_i$, dip SKAWs and hump SKAWs propagate at Super-Alfvénic velocity or Sub-Alfvénic velocity; Super-Alfvénic velocity hump SKAWs and Super-Alfvénic and Sub-Alfvénic velocity dip SKAWs are in the kinetic region $1 >> \beta >> m_e/m_i$. These results are different from previous ones. That indicates that the effects of ion nonlinear polarization drift and warm ions are important and they cannot be neglected. The SKAW has an electric field parallel to the ambient magnetic field, which makes the SKAW take an important role in the acceleration and energization of field-aligned charged particles in magnetic plasmas. And the SKAW is also important for the heating of a local plasma. So it makes a novel physical mechanism of energy transmission possible.

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Key words: ion nonlinear polarization drift, effect of warm ions, solitary kinetic Alfvén wave, Sagdeev potential

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