Roles of electrons and ions in formation of the current in mirror mode structures in the terrestrial plasma sheet: MMS observations

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Currents are believed to exist in mirror mode structures and to be self-consistent with the magnetic field depression. Here, we investigate a train of mirror mode structures in the terrestrial plasma sheet on 11 August 2017 measured by the Magnetospheric Multiscale mission. We find that bipolar current densities exist in the cross-section of two hole-like mirror mode structures, referred to as magnetic dips. The bipolar current in the magnetic dip with a size of ~2.2 \( \rho_i \) (the ion gyro radius) is mainly contributed by variations of the electron velocity, which is mainly formed by the magnetic gradient-curvature drift. For another magnetic dip with a size of ~6.6 \( \rho_i \), the bipolar current is mainly caused by an ion bipolar velocity, which can be explained by the collective behaviors of the ion drift motions. These observations suggest that the electrons and ions play different roles in the formation of currents in magnetic dips with different sizes.