Global characteristics of electron and ion temperatures in the plasma sheet

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The Earth's magnetosphere is filled with plasma originating from the solar wind and those from the ionosphere. Plasma in the magnetosphere are heated up to 1-10 keV and stored in the plasma sheet in the magnetotail. The magnetotail plasma can be accelerated by magnetic reconnection, which occurs to release the magnetic field energy. The accelerated plasma are transported to both earthward and tailward as fast flow with a speed of several hundred kilometers per second or faster. It has been reported that properties of plasma sheet plasma (density, temperature, etc.) depend on solar wind conditions and vary with time and space. However, it is not well understood how transport and acceleration of the magnetotail plasma depend on mass and charge.

In this study, we first examine the ion-to-electron temperature ratio by using plasma data from the FPI instrument on board the MMS spacecraft. We use data for the period from June to August 2017, when MMS was flying in the near-equatorial magnetotail. We divide observations into four categories: $\beta>10$, $1<\beta<10$, 0<Ygsm<10, -10<Ygsm<0, and investigate occurrence distribution of the temperature ratio. We also investigate the difference in the ratio between fast flow events (ion speed greater than 100km/s) and no fast-flow conditions.

The results show that Ti/Te<2 events are often observed around the boundary of the plasma sheet ($1<\beta<10$) and that this trend is more pronounced on the dusk side than on the dawn side. Around the center of the plasma sheet ($\beta>10$), the ratio is distributed around 3 and there is no dawn-dusk asymmetry. Low Ti/Te (<2) is not observed inside fast flows. According to the velocity distribution function averaged over the events in each category, the phase space density inside fast flows is lower than that without fast flows at <1 keV for ions and <500 eV for electrons.

We suggest that cold plasma around the plasma sheet boundary originate from the ionosphere. The absence of cold plasma inside fast flows indicates that the magnetic reconnection accelerates the cold plasma. We will examine how the temperature ratio changes with the distance from the reconnection point. We will also discuss the transport of cold plasma and the mass and/or charge dependence of plasma heating and acceleration.

