General properties in the ion composition and energy in the plasma sheet observed during March to July in 2016 by the MMS mission

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We survey for the recent high-quality data obtained in the near- and mid-distant plasma sheet by the HPCA (Hot Plasma Composition Analyzer) on the MMS (Magnetospheric Multiscale) mission of NASA. The MMS mission is the most recent mission in the Solar-Terrestrial physics for studying magnetic reconnection processes in the terrestrial magnetosphere with four identical spacecraft (Burch and Torbert, SSR, 2016; Burch et al., SSR, 2016; Fuselier et al., SSR, 2016), and the HPCA is the ion energy-mass spectrometer consisting of a top-hat electrostatic energy analyzer and a time-of-flight mass spectrometer, covering the energy range from 10 eV to 40 keV for typical ion species in the magnetosphere (Young et al., SSR, 2016). We report the general properties of hot and beam components of the ions and their dependence on the mass composition. Most of the observational periods used in our survey from March to June of 2016 were in the southern plasma sheet and the boundary adjacent to the lobe because of the orbital elements of MMS. According to our quick survey of the energy-time (E-t) spectrograms of the HPCA data, the hot O+ component intensities in the keV range in the plasma are strongly correlated with the geomagnetically disturbed times while the beam-like O+ signatures at lower-energies could be seen even under mid and low active conditions. It should also be noted that the low-energy beam-like H+ signatures could be seen inside and vicinity of the plasma sheet also during the quiet times, and the intensity ratios of H+ to O+ are clearly anti-correlated with geomagnetic activity. The other types of H+ signatures, e.g., the very low-energy H+ population at less than 100 eV and the energy-dispersive band-like H+ structures whose energies monotonically decreases with the distance from the Earth, were often observed in the near-Earth orbits, particularly under quiet conditions. These facts indicate that the energization mechanisms acting on the outflowing and plasma sheet heavier ions may be more effective with increase of geomagnetic activity while some processes driving the outflows of the ionospheric ions were always engaged more and less. The beam-like O+ energy distributions found in the E-t spectrograms tend to have slower variations particularly in and near the plasma sheet boundary layer, than those of H+. These slower variations could be a consequence of the mass-dependent energization processes. Also in our presentation, we discuss how similar and different the mass-resolved signatures in the hot/beam components are among the four MMS satellite measurements.