Variations of the dayside magnetosheath and the cusp and their relations to the substorm

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We discuss formation of a transient shock in the magnetosheath during the growth phase of a substorm, and its collapse after the growth phase by using a global MHD simulation and its relation to the substorm sequence. A bulge of high pressure plasmas (the pressure bulge) extended from the cusp into the magnetosheath is formed after southward turn of the interplanetary magnetic field (IMF). The plasma bulk flow in the magnetosheath becomes super-magnetosonic during its passage from the low-latitude magnetosheath to the upstream region of the pressure bulge; the acceleration mechanisms are both the Lorentz force and the perpendicular pressure-gradient forces in the magnetosheath. As this super-magnetosonic flow collides with the pressure bulge extended from the cusp to the magnetosheath, a shock is formed in the magnetosheath. After the formation of the shock, the simulation indicates collapse of this shock about 20 minutes after the auroral breakup associated with the onset of the substorm. We find that high-pressure plasmas are transported from the nightside magnetosphere to the cusp region through the cleft and arrives at the cusp at about 10 minutes after the onset. Behind this high-pressure plasmas, low-pressure plasmas are followed. When this low-pressure plasmas arrive at cusp, the cusp pressure is reduced. Then the magnetosheath shock is collapsed. Thus, formation and collapse of the shock in the magnetosheath-cusp region is related to the sequence of the substorm. However, as long as we know, no observational evidences supporting this formation and collapse of the magnetosheath shock. This is a future work.

Keywords: shock, magnetosheath, substorm

