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Outflow jets from lobe reconnection: Roles of shear flow in reconnection

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One of the key parameters controlling magnetic reconnection is the bulk flow that is predominantly aligned with the reconnecting magnetic field. Several simulation studies and theoretical predictions have suggested that the reconnection rate and the outflow jet speed can be reduced as flow shear in the bulk flow increases. More recent simulations have indicated that the reconnection rate is not necessarily affected by the presence of shear flow. Further studies need to be done to clarify the role of shear flow in the reconnection process. For the northward interplanetary magnetic field, reconnection can occur at high latitudes of the Earth's magnetopause, where the magnetosheath flow in the tailward direction acts as shear flow. In this study, we investigate the role of shear flow in reconnection on a basis of data from high-latitude lobe reconnection events observed by spacecraft. We first devised an automated lobe reconnection detection routine that can apply for data from Cluster spacecraft, and then collected the lobe reconnection events by examining data obtained by Cluster-3 spacecraft for more than 5 years. The statistical analysis revealed that the ion outflow jet tends to increase as the velocity of the magnetosheath flow tangential to the current sheet increases. This indicates that a process is occurring that ion acceleration is enhanced as the shear flow increases. It was also found that the ion temperature in the outflow jets tends to be higher in the earthward flow region than in the tailward flow region, suggesting that the conditions under which flow shear is occurring act to heat the ions. We will discuss these tendencies in terms of the turbulent nature of the Hall electric field which is caused by complicated counterstreaming ion distribution consisting of the downstream-flowing magnetosheath ions and the earthward-flowing ions from reconnection.