Density cavity and ion acceleration in the magnetotail reconnection

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We present an analysis of a fast flow reversal event encountered by the Cluster spacecraft across the magnetotail current sheet on August 6, 2003. An earthward fast-flowing density cavity with intense electric field fluctuations nearby the separatrix is reported here. Some intriguing features are revealed from the hot ion measurements. In the cavity the lower energy ions exhibit apparently the trapped characters. Higher energy ion beams and counter-steaming beams can obviously be seen; also the distribution functions show some "hole" structures in phase space. It is inferred that there is an electrostatic potential, and abundant ion "holes" associated with electron "holes" can form in this cavity. The interactions of those small scale coherent structures and their turbulent electric fields are responsible for the ion acceleration in the parallel direction of the magnetic field. These observations give an insight into the crucial mechanism of the ion scattering and energization in the collisionless magnetic reconnection.