

Observation of Velocity Differences between Neutral Atoms and Ions in Solar Chromosphere
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Solar chromospheric plasma is collisional partially ionized plasma. If the velocity of neutral is different from that of ion, the multi-fluid effects may affect the dissipation of high-frequency waves and physics of reconnection, and break ideal MHD approximation on the dynamics of chromospheric plasma. When neutral atoms move across the magnetic field, electric field act on the neutral atoms. In order to diagnose the electric field, we observed the full Stokes spectra of the Paschen series of neutral hydrogen in chromospheric jets that took place at the solar limb on May 5, 2012, and we derived upper limits of electric field felt by neutral hydrogen. Because the velocity of neutral atoms of hydrogen moving across the magnetic field derived from these upper limits of the electric field is far below the bulk velocity of the plasma perpendicular to the magnetic field as measured by the Doppler shift, we conclude that the neutral atoms must be highly frozen to the magnetic field in the surge. On the other hand, we observed spectra of prominence in H alpha (neutral hydrogen), He D3 (neutral helium), Ca 8542Å (ionized Calcium) simultaneously with a cadence of 0.5 seconds for several hours by using Horizontal spectrograph of Domeless Solar Telescope at Hida observatory. Velocity differences between neutral atoms and ionized Calcium are significantly larger than the measurement error of Doppler velocity.