M14a Doppler velocity differences between ions and neutrals in a solar surge

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In many astrophysical systems, the plasma is partially ionized, in which neutral atoms feel Lorentz force indirectly through the collisional friction from charged particles. Therefore neutrals may diffuse across the magnetic field in a process called ambipolar diffusion and there exist velocity differences between ions and neutrals. This diffusion process plays a key role in modifying important physical process such as magnetic reconnection, damping of megneto-hydrodynamic waves, transport of angular momentum in plasma through the magnetic field, and heating.

In the previous studies, Khomenko et al (2016) detected Doppler velocity differences in a prominence of the order of 0.1 km/s, while T.Anan et al (2017), also targeting a prominence, interpreted the difference of Doppler velocities as being a result of motions of different components in the prominence along the line of sight. In our study, we analyzed an off-limb surge, in which a violent acceleration of plasma by the Lorentz force took place. The observation was carried out on May 8th 2015 simultaneously in He I 706.5 nm, Ca II 849.8 nm and O I 777.2 nm, using the high dispersion horizontal spectrograph of Domeless Solar Telescope in Hida observatory. We found that, the Doppler velocity difference between He I and Ca II is significant, at an order of 5-10 km/s, while the velocity difference between O I and Ca II is smaller than that between He I and Ca II, suggesting an ion-like behavior of line O I 777.2 nm.