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Two-fluid magnetohydrodynamic effects in the high-temperature atmosphere of the sun and their new perspectives

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The magnetohydrodynamic model of solar high-temperature atmosphere is an important plasma model, which can reproduce many important features in simulating solar coronal plasma and magnetic field processes. However, the assumption of MHD model may fail during the highly dynamic and transient events, such as magnetic reconnection, plasma heating, and in partially ionized structures such as the chromosphere, sunspots, and coronal rain. Therefore, two-fluid MHD model with ions and neutral components can simulate many new phenomena. This study considers the two-fluid effects of solar plasma, and investigate the modification to traditional MHD models by including neutral components. We simulated MHD waves, loop top turbulences in partially ionized plasma in sunspots or chromospheric flows. We focus on the separation of ions and neutral components in energy transfer processes, and the potential contribution of neutral components to the nascent solar wind. Our simulations shows two-fluid effects would contribute significant to solar plasma heating by collisional friction, and lead the leakage of neutral component across the magnetic field lines and escape to the corona, it completely revolutionized our understanding of the corona, in which the role of neutral component were neglected.