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Formation of Transient Foreshock Structures Upstream of Mars and Earth: A Comparative Study

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In the foreshock region of planetary and terrestrial bow shocks, interaction of reflected solar wind ions with the incident solar wind and the interplanetary magnetic field gives rise to a variety of transient plasma structures and instabilities, and the ion dynamics and ion kinetic scale processes drive the foreshock environment. In this comparative study, we consider specific examples of transient foreshock structures upstream of Mars and Earth and contrast differences between their formation process, contributing ion populations, and source region of ion populations. Due to the smaller size of Mars and its bow shock compared to Earth and with respect to upstream ion convective gyroradius, reflected ions with hybrid trajectories that straddle between the quasi-perpendicular and quasi-parallel bow shocks can contribute to formation of foreshock transients. The size of transient foreshock structures upstream of Mars differs compared to Earth, which influences their propagation and impact through the magnetosheath and lower plasma boundaries.