



Density holes observed in the solar wind upstream of Earth's bow shock

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The Cluster and Double Star satellites recently discovered density holes in the solar wind upstream of the bow shock. These holes have typical durations of ~8-20s (but as short as 4s), with ion densities depleted by more than an order of magnitude below that of the ambient solar wind. The density holes are accompanied by similarly shaped magnetic holes, indicating that the particles and magnetic field are strongly coupled. Multi-spacecraft timing analysis from Cluster and Double Star shows the holes have dimensions of about an ion gyroradius, are moving with the solar wind, and the edges are expanding and steepening. There is a small normal electric field pointing outward. Particle distributions show the steepened edge behaves like a shock. The density holes are observed only when upstream particles are present, suggesting that an interaction of the back-streaming particles with the solar wind is responsible.