Abstract
This study analyzes the first observations of heliospheric pickup ions beyond the orbit of Jupiter. The Cassini Plasma Spectrometer observes H+, He+, He++, and O+ pickup ions of interstellar origin between 6.4 and 8.2 AU. Cassini's trajectory carries it through the downstream direction where we observe enhancements in the pickup He consistent with gravitational focusing by the Sun. We also show the first direct, *in situ* observations of an "interstellar hydrogen shadow" where pickup H is depleted in the region behind the Sun relative to the local interstellar flow. Most H atoms cannot penetrate into this downstream shadow region both because the outward force due to radiation pressure exceeds gravitational attraction at this time and because H atoms trying to enter the shadow must pass close by the Sun where they have a high probability of being ionized and swept out with the solar wind.