Voyager Interstellar Mission Science Notes

Solar Control of the Solar Wind Speed at 54 AU

- Two great strengths of the Voyager mission are the reconnaissance of unexplored regions of the heliosphere and its longevity which allows comparison of data over almost 2 complete solar cycles. An interesting question for understanding the solar wind structure is how strongly does the tilt of the heliospheric current sheet affect solar wind conditions in the outer heliosphere.

- The solar wind from near the heliospheric current sheet (HCS) is generally slow, 400 km/s, while that at high latitudes is fast, 700 km/s. If the solar wind flow were strictly radial, the percentage of fast and slow wind observed by a spacecraft would depend on the tilt of the HCS and the latitude of the spacecraft. Of course by the time the solar wind reaches Voyager's distance (now 54 AU) the fast and slow streams have interacted so the observed velocities are between the fast and slow stream speeds.

- Many other physical processes may occur between the Sun and 54 AU. It has been suggested that the magnetic field pressure gradients cause poleward flow. Pickup ions dominate the solar wind pressure. Kelvin-Helmholtz instabilities may mix the fast and slow stream plasmas. With these various processes occurring it is interesting to see if the tilt of the HCS retains any control over the observed solar wind plasma.

- The figure shows the plasma velocity (red line) and tilt of the HCS (black line) for the 1986 solar minimum and the current solar minimum. In both cases Voyager 2 solar wind speeds are time-shifted back to the Sun. The correlation is quite striking, although the behavior is different at the two solar minima. In 1986 Voyager 2 was at low latitude, so when the HCS tilt increased Voyager saw higher latitude, faster flow. In 1995-1998, Voyager 2's latitude is about 18 degrees South. From the bottom panel of the figure it is clear that at this latitude tilt and velocity are anti-correlated. As the tilt increases, Voyager 2 observes a larger percentage of slow speed wind and thus slower solar wind speeds. This plot provides convincing evidence that even as far out as 54 AU the HCS tilt has a strong influence on plasma velocity observed at a given latitude. Based on the most recent HCS data we can predict the solar wind speed should soon decrease.

- We thank T. Hoeksema and the Wilcox solar observatory for providing HCS tilts on their web page.

Contributed by John Richardson for the PLS team
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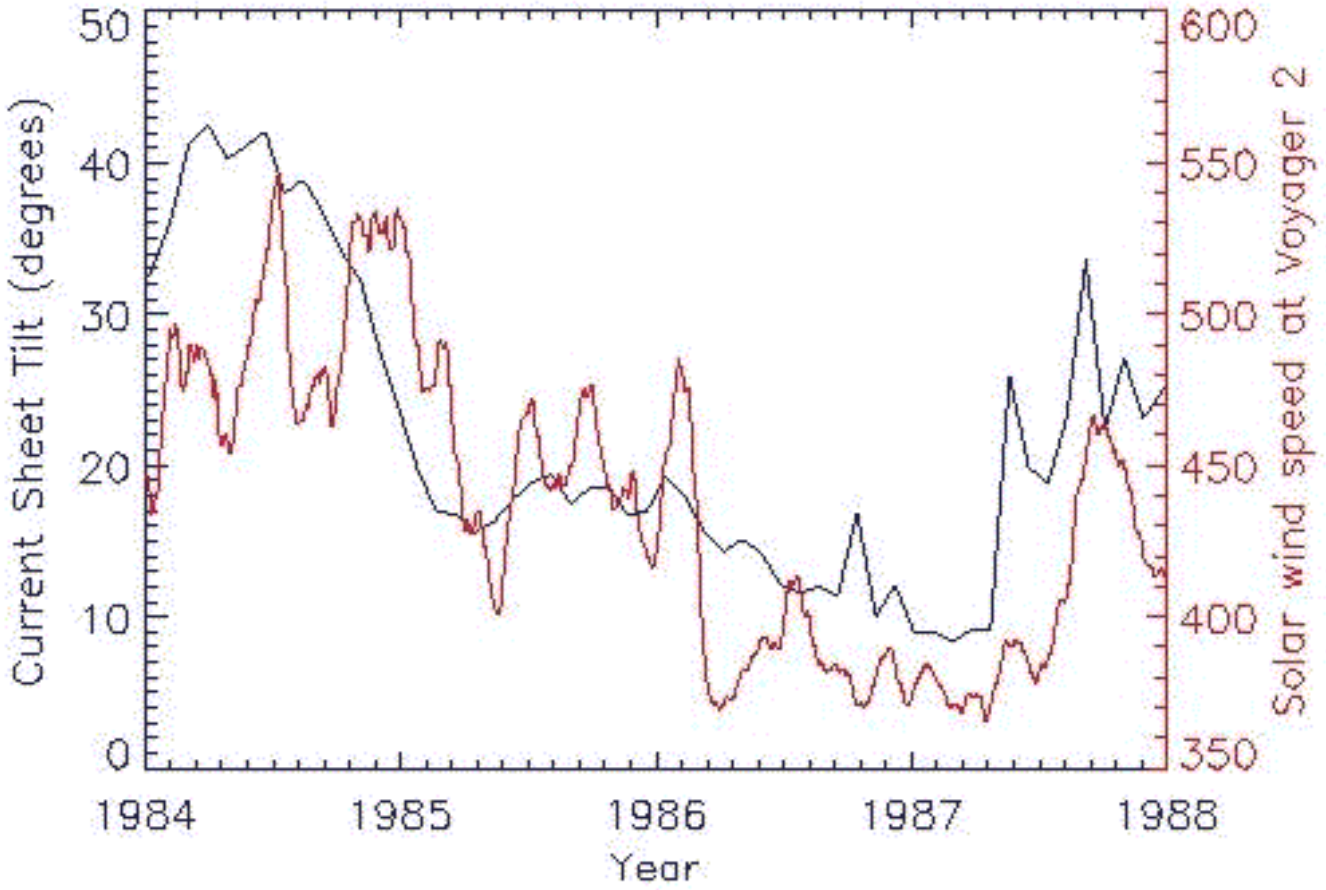
Plasma Velocity - HCS Tilt



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