

Solar Cycle Dependence of High-Latitude Solar Wind

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We have studied how the properties and structures in the high-latitude solar wind change with the solar activity.

(1) How does the latitudinal structure of the solar wind speed change? (2) Is the N-S asymmetry of the speed stable structure? (3) How does the bimodal structure change with solar activity?

Ulysses has found in its first rapid latitudinal scan that the high-latitude solar wind has a speed in range of 700-800 km/s and the speed increases slightly with a latitude. Furthermore it has been found that the high-latitude solar wind in the northern hemisphere has a higher speed than in the southern hemisphere. Ulysses and IPS observations have also reported that the solar winds in the solar activity minimum phase have bimodal structure. We have studied how these properties and structures in the high-latitude solar wind change with the solar activity.

For these studies we analyzed IPS data obtained at STELab during years of 1985--1998 using tomography analysis method. A synoptic map of velocity distribution in the heliographic coordinate was made from data of consecutive three Carrington rotations, and total 122 maps were made for this study. Since the high-speed region shrinks to higher latitudes, we analyzed the latitudinal structure of the high-speed wind at latitudes of 70--80 deg. Comparing years of 1995--1996 and 1997--1998, the speeds at 80 deg were not largely different but difference was in latitudinal gradient: as the solar activity increased, the latitudinal gradient became steeper.

N-S asymmetry of the speed was stable structure for three years of 1995--1997, and the similar asymmetry was also observed one solar cycle before with the same sense, that is, the northern hemisphere has higher speeds than in the southern hemisphere.

In the solar minimum phase, the high-speed wind and the low-speed wind are separated with a sharp velocity gradient (bimodal structure). We have investigated how this structure changed when the low-speed region expanded to higher latitudes with the solar activity. We counted how many bins in the synoptic map were occupied with intermediate speeds (500-700 km/s) and found its percentage for a total bin number did not change largely with the solar activity. This indicates that the solar wind is in bimodal through the solar cycle.