The Magnetic Connectivity of the Sun to the Heliosphere

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A prime research focus of the upcoming Solar Probe Plus and Solar Orbiter missions will be to determine how the heliospheric magnetic field and plasma connect to the Sun's corona and photosphere. For much of the heliosphere this connection appears to be well understood. The quasi-steady fast wind emanates from so-called coronal holes, which appear dark in X-rays and are predominantly unipolar at the photosphere. However, the connection to the Sun of the slow, non-steady wind is far from understood and remains a major mystery. We review the existing theories for the sources of the non-steady wind and demonstrate that they have difficulty accounting for both the observed composition of the wind and its large angular extent. A new theory is described in which this wind originates from the continuous opening and closing of narrow open field corridors in the corona, which gives rise to a web of separatrices (the S-Web) in the heliosphere. Note that in this theory the corona — heliosphere connection is intrinsically dynamic, at least, for this type of wind. We present numerical simulations of the model and describe observational tests. We discuss the implications of our results for the competing slow wind theories and for understanding the corona — heliosphere connection, in general.

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