The solar wind that streams out of the Sun to fill the heliosphere is divided into “fast” and “slow” wind streams. The origin of the slow solar wind remains enigmatic, hampering efforts to predict conditions in near-Earth space. The most popular current hypothesis for the origin of these slow wind streams involves a dynamic magnetic phenomenon known as “interchange magnetic reconnection”. Here we discuss ongoing research efforts to test this hypothesis through large-scale, adaptive-mesh, magnetohydrodynamic simulations.

We have performed a number of simulations of the global corona with varying magnetic geometries [1, 2, 3, 4]. Energy is injected into the magnetic field by plasma flows at the photosphere which transport the footpoints of field lines. We find that the total reconnected magnetic flux of numerous localized vortices representing supergranules exceeds that of a global differential rotation profile. The simulations also predict that an imprint of the photospheric granulation pattern should be present in the heliospheric solar wind. In addition, we find systematic differences in the interchange reconnection rates based on the length of the closed field lines involved [2, 3]. Our simulations show that shorter closed field lines of pseudostreamers reconnect more readily than the longer field lines of helmet streamers. Consequently, we predict smoother coronal hole boundaries in the vicinity of pseudostreamers than other coronal structures [4]. We have identified signatures of these processes which may be detected in-situ by spacecraft such as Parker Solar Probe, and remotely by telescopes such as the AIA Instrument.