Stirring the Base of the Solar Wind

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Résumé

Current models of the solar wind must approximate (or ignore) the small-scale dynamics within the solar atmosphere, however these are likely important in shaping the emerging wave-turbulence spectrum and ultimately heating/accelerating the coronal plasma. In this talk, I will make connections between small-scale vortex motions at the base of the solar wind and the resulting heating/acceleration of coronal plasma. We use the Bifrost RMHD code to produce realistic simulations of the solar atmosphere that facilitate the analysis of spatial and temporal scales which are currently at, or beyond, the limit of modern solar telescopes. The simulation is configured to represent the solar atmosphere in a coronal hole region, from which the fast solar wind emerges. The simulation extends from the upper-convection zone (2.5Mm below the photosphere) to the low-corona (14.5Mm above the photosphere), with a horizontal extent of 24Mm x 24Mm. Photospheric flows are found to efficiently twisted the coronal magnetic field, with Poynting fluxes of up to 2-4kW/mˆ2 commonly observed inside the twisted structures. Stronger whirlpool-like flows in the convection, concurrent with magnetic concentrations, launch torsional Alfvén waves up through the magnetic funnel network, which are expected to enhance the turbulent generation of magnetic switchbacks in the solar wind. Temperature and density contrasts form between regions with active stirring motions and those without. Therefore, stirring motions in the low-corona could explain the patchy nature of switchbacks in the solar wind, observed by Parker Solar Probe.

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