Understanding of solar wind structure might be wrong

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Los Alamos scientist suggests new approach to measuring flow from the sun

LOS ALAMOS, New Mexico, September 9, 2010—A scientist examining the solar wind suggests that our understanding of its structure may need significant reassessment. The plasma particles flowing from the Sun and blasting past the Earth might be configured more as a network of tubes than a river-like stream, according to Joseph Borovsky of Los Alamos National Laboratory's Space Science and Applications group.

In a paper in this week's *Physical Review Letters*, "Contribution of Strong Discontinuities to the Power Spectrum of the Solar Wind," (*Physical Review Letters* 105, 111102 [2010]), Borovsky challenges the concept that the solar wind is of fairly uniform structure, and therefore, our entire interpretation of spacecraft data may not be correct.

“For decades we have been interpreting the spectrum of fluctuations in the solar wind as a measurement of turbulence in the wind. However, it turns out that impurities (discontinuities) in plasma dominate the signal. Hence, the spectrum is not a clean measurement of turbulence, and it may not even be a measurement of turbulence,” Borovsky said. In simpler terms, perhaps, we couldn’t see the forest for the trees.

“Because we might be misunderstanding the solar wind, we might be misunderstanding its impact on the Earth’s environment. Understanding solar wind allows us to understand the initiation and evolution of geomagnetic storms,” said Herbert Funsten, chief scientist for the International, Space & Response Division at Los Alamos.

Borovosky argues that the discontinuities are part of a structure to the solar wind that looks like spaghetti, with the discontinuities being the boundaries between adjacent noodles (magnetic tubes). In this concept, the wind plasma is structured rather than being homogeneous. He suggests that the spaghetti structure of the solar-wind plasma reflects the “magnetic carpet” on the surface of the Sun, with the spaghetti in the wind being loose strands of the magnetic carpet.

“We have also argued that the spectrum measured in the wind is a ‘remnant’ of the carpet on the Sun rather than a signature of turbulence in the wind plasma,” he says.

The research data came from NASA’s ACE satellite, which has been operating upstream of the Earth since 1998. A satellite “sits” in the wind and makes measurements as the wind blows past supersonically (typically Mach 8 or so, typically 300 - 700 km/sec). The information about the measurements is telemetered to Earth and delivered to institutions such as Los Alamos, where data-analysis software converts the satellite readings into physical measurement quantities such as wind speed, wind density, wind temperature, magnetic-field direction. Those physical quantities are put into publicly available data sets, which researchers can use to interpret the space weather, to make comparisons with theoretical models, and generally try to better understand the space environment surrounding the planet.

Los Alamos National Laboratory **www.lanl.gov** **(505) 667-7000** **Los Alamos, NM**

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