Title: Reflection-Driven MHD Turbulence in the Inner Heliosphere

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Abstract:

Transverse, non-compressive turbulence (Alfven-wave turbulence) is likely an important mechanism for heating the corona and inner heliosphere. Turbulent heating relies upon the cascade of fluctuation energy from large scales to small scales, and in Alfven-wave turbulence this energy cascade arises from nonlinear interactions between counter-propagating fluctuations. Because the Sun launches only outward-propagating Alfven waves, a turbulent energy cascade in open-magnetic-field regions requires some source of inward-propagating waves. One of the most important sources of such inward-propagating waves is non-WKB reflection. In this talk I will briefly review some of the key properties of Alfven-wave turbulence and non-WKB wave reflection. I will then describe recent work by Dr. Jean Perez and myself, including a new direct numerical simulation of reflection-driven Alfven-wave turbulence from the Sun out to a heliocentric distance of 65 solar radii. The numerical domain for this simulation consists of 512x512x32769 grid points that span a narrow magnetic flux tube centered on a radial magnetic field line with periodic boundary conditions in the plane perpendicular to the radial direction. This flux tube extends from the photosphere, through the chromosphere and corona, and into the solar wind. Our simulation accounts for the radial inhomogeneity in the solar-wind outflow velocity, density, and background magnetic field strength. I will describe the basic properties of the turbulence in this simulation as well as the key phenomenologies that control the radial evolution of the amplitudes and power spectra of both inward and outward-propagating Alfven fluctuations. I will also discuss predictions from the simulation that can be tested by Solar Probe Plus and Solar Orbiter.