高速太陽風の三次元磁気流体シミュレーション

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Three-dimensional magnetohydrodynamic simulation of the fast solar wind

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Using a three-dimensional compressible magnetohydrodynamic (MHD) simulation, we have reproduced the fast solar wind in a direct and self-consistent manner, based on the wave/turbulence-driven scenario. As a natural consequence of Alfvenic perturbations at the coronal base, highly compressional and turbulent fluctuations are generated, leading to heating and acceleration of the solar wind. The analysis of power spectra and structure functions reveals that the turbulence is characterized by its imbalanced (in the sense of outward Alfvenic fluctuations) and anisotropic nature. The density fluctuation originates from the parametric decay instability (PDI) of outwardly propagating Alfven waves and plays a significant role in the Alfven-wave reflection that triggers turbulence. Our conclusion is that the fast solar wind is heated and accelerated by compressible MHD turbulence driven by PDI and resultant Alfven-wave reflection.