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Seismic sounding of convection in the Sun

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Thermal convection is the dominant mechanism of energy transport in the outer envelope of the Sun (one-third by radius). It drives global fluid circulations and magnetic fields observed on the solar surface. Convection excites a broadband spectrum of acoustic waves that propagate within the interior and set up modal resonances. These acoustic waves, also called seismic waves, are observed at the surface of the Sun by space- and ground-based telescopes. Seismic sounding, the study of these seismic waves to infer the internal properties of the Sun, constitutes helioseismology. Here we review our knowledge of solar convection, especially that obtained through seismic inference. Several characteristics of solar convection, such as differential rotation, anisotropic Reynolds stresses, the influence of rotation on convection and supergranulation, are considered. On larger scales, several inferences suggest that convective velocities are substantially smaller than those predicted by theory and simulations. This discrepancy challenges the models of internal differential rotation that rely on convective stresses as a driving mechanism and provide an important benchmark for numerical simulations.

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