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# Properties of magneto-convection on the solar surface revealed with HINODE

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In the solar atmosphere, interaction between magnetic fields and surface convection produces varieties of structures over the broad spatial scale from 100 to 10^5 km. The energy produced by the interaction is transferred to the upper solar atmosphere, and causes coronal heating and solar wind acceleration. Spatial power spectra of velocity and magnetic fields on the solar surface provide a clue to understand in which scale kinetic and magnetic energies are generated, transferred, and dissipated in the solar atmosphere. HINODE is the most suitable instrument to study it observationally because of high and stable image quality and precise measurements of velocity and magnetic fields. We present results of the power spectral analysis of two dimensional fluctuations of surface temperatures, velocities, and magnetic fields, and their implication on properties of magneto-convection in the solar atmosphere.

The two dimensional spatial power spectra of the surface temperatures and velocities clearly exhibit a peak at the granular scale (around 1000km) and a power-law at the spatial scale smaller than granules, which indicates that kinetic energies are injected at the granular scale because of the thermal convection, and they cascades into smaller scale through turbulent action of convection. But the power-law slope of the kinetic energy is stepper than the Kolmogorov's slope of -5/3 in the isotropic turbulence. A power spectrum of magnetic energies has very broad spectrum between super-granular (10000 km) and granular scales (1000 km). The slope of the magnetic energy spectrum is less steep than that of kinetic energies, and it is found that there is a signature of deviation from the power law at the spatial scale smaller than 300km. It suggests that coupling among convection, magnetic fields and radiation becomes important at that scale. The power spectra do not depend on mean magnetic flux in the regions, which suggests that they are universal properties of magneto-convection on the solar surface.

It is suggested that magnetic fields in the quiet Sun is created by local dynamo due to convective turbulence. In order to operate the local dynamo efficiently, kinetic and magnetic energies have to be enhanced at the smaller scale. However the study of the power spectra indicates that these energies are rather suppressed at the smaller scale, and no evidence to support the local dynamo as the origin of magnetic fields in the solar atmosphere.

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