Height structure of solar surface convective velocity from absorption line profile

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Convection phenomenon in the star is responsible for a energy carrier in the interior and its atmospheric activity. The internal structure of stars depends on how the energy created by nuclear fusion is transported toward outer space. The sun, the nearest star for us, is a good target in terms of understanding the convection phenomenon of the star. In the case of the sun, the energy created in the core part is carried by radiative effect. In the outer part of 30 % of the radius, energy transport mechanism changes to convective motion. The convective motion penetrates to the solar surface, which is seen with visible light. It is the important energy source of the upper atmospheric heating and its dynamics. The solar surface convection is considered as a energy carrier for the outer atmosphere, however we are still lack of understanding it. The solar surface, the photosphere, is covered with numerous bright ”granules”, which are separated dark ”intergranular lanes”. The granular regions show going upward materials coming from the interior, while the intergranular regions represent going downward gas. Some authors have been tested the phenomenon with their numerical simulations, while an actual process to decelerate the gas motion is still unclear observationally. It is important to derive the height structure of velocity field because the deceleration is being caused during ascending gas motion. Nevertheless we are lack of observational velocity field with enough time- and spatial-resolution for this analysis.In this study, we investigated the height structure of velocity field, using the spectral data for the analysis of absorption line shape acquired with the Spectro-Polarimeter (SP) of the Hinode / Solar Optical Tele- scope (SOT). It is possible to derive the velocity field for continuous height in the photosphere, calculating Doppler velocity for each intensity in the absorption line. This method is based on the fact that observed light at each intensity reflects different height. Hinode/SP is suited to this analysis because it provides high signal-to-noise data contributing to good accuracy for shape of absorption line with high spatial resolution. Our result, focusing on the height structure difference between on granules and intergranular lanes, shows that materials going upward accelerate with height until a certain level and decelerate in the higher layer, while submerging materials accelerate with depth. The latter accelerating process is cannot explained by the conventional 1-dimensional steady model. We are going to discuss some candidates to solve it in my talk.

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