Session 2

Spectral line broadening associated with the turbulence in fading granules

R.T. Ishikawa, Y. Katsukawa
NAOJ

In the quiet region in the solar photosphere, turbulent convective motions of the granular flows play important roles in driving subgranular-scale flows via turbulent cascade from the energy injection at granular scales. Such subgranular-scale flows are critical in creating small-scale magnetic structures through a local dynamo mechanism. We found that the spectral line width broadens significantly when granules fade out (Ishikawa et al. 2020a). We performed radiative transfer calculations to interpret this line broadening and found that there are two solutions: one explains the broadening with a microturbulence term of about 1 km/s, and the other explains it with a large velocity gradient and temperature gradient without the microturbulence term. We cannot distinguish between the two scenarios only with the Fe I lines observed by Hinode-SOT/SP. To discuss the possibility of turbulence development associated with fading granules, we analyzed MURaM simulation data. Numerical calculations were performed with a horizontal grid size of 10.4 km, and spectral line profiles were calculated using the SIR code. The spectral lines obtained were used to investigate the correspondence between changes in atmospheric structure and changes in spectral line shape during the fading of granules. The turbulent velocity of the photosphere was defined by using the response function for FWHM and the point-spread function of Hinode-SOT. As a result, the line broadening accompanying the fading granules was reproduced. The turbulent motion was found to originate from the granulation boundary when a granule fades out. These turbulent flows can interact with small-scale magnetic fields in the intergranular lanes and they are predicted to be observed with the Fe I 15654 nm line.