Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PEM029-05 Room: 303 Time: May 25 10:04-10:17

Temperature structures of the solar chromosphere investigated by H-alpha wings

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The solar chromosphere is an interesting part of the solar atmosphere where active phenomena, prominences and spicules, for example, are seen. It is also important in the respect of the energy balance. However, the method for observing thermal structure of the chromosphere has not been established yet.
Cauzzi et al. (2009) did 2-D imaging spectroscopy in chromospheric lines, H-alpha (656.3 nm) and Ca II (854.2 nm; Ca IR), with IBIS (Interferometric BIdimentional Spectrometer) at NSO/ Sacrament Peak, and they pointed out that the line width of H-alpha reflects temperature of the chromosphere. They found that line width of H-alpha and minimum intensity of Ca IR have strong correlation to each other and concludes that it is because both of the two quantities are sensitive to the chromospheric temperature.
Based on their result, we observed the quiet Sun in H-alpha wings (+/-0.06 nm from the nominal line center) with Hinode Narrowband Filter Imager (HOP 135). We made line-width maps from the sum of the intensities of both wings, and Doppler-shift maps from the difference of the intensities. We made two types of observation: one is high-cadence (~10 sec) imaging with only H-alpha wings, and the other has simultaneous observation of photspheric magnetic fields with polarimetry with Fe-I (525.0 nm) shutter-less imaging (~50 sec cadence).
Line-width maps obtained by Hinode resembles closely to those by IBIS, which revealed that Hinode can take movies of chromospheric temperature maps with much higher stability and uniformity than those of the data by IBIS. These chromospheric temperature maps shows various characteristic structures which vary with the time scale of ~10 sec and the spatial scale of ~1 arcsec. The most outstanding feature is radially-spread structures with length of 5-10 arcsec and width of about 1 arcsec varying with the time scale of tens of seconds. This indicates that intensive heating and diffusion of the heat occurs continuously along the magnetic canopies.
We introduce the movie of chromospheric temperature maps and discuss the relation to Doppler shift or horizontal magnetic fields, and the possibilities of magnetic heating and sonic heating along magnetic tubes.

Keywords: solar chromosphere, H-alpha, chromospheric heating, Hinode