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Distribution of MHD waves in two solar active regions observed with Hinode/EIS

Naomasa Kitagawa[1*]

[1]Department of Earth and Planetary Scienc

The coronal heating problem, what heats the solar corona to several million K, is one of the outstanding issues in the solar physics.
Until today, two major mechanisms have been proposed: wave heating and nanoflare heating.
The waves with sufficient energy flux to heat the corona have not been observed yet except for those excited by the solar flares.
However, even if the Alfven waves exist, there is a problem that the Alfven waves are difficult to dissipate so they may not contribute to the heating in the open magnetic field lines.
In the closed coronal loop, the observed temperature profile is consistent with the heating concentrated toward footpoints of the loop, which gives a disadvantage to the Alfven wave heating.
The spatial scale of nanoflare is likely smaller than the resolution of current telescope, though the signature of the tiny flare-like events were studied statistically.
The coronal heating problem is still open.
Our motivation is to investigate the oscillation of EUV intensity/Doppler velocity interpreted in terms of MHD waves and identify the mode of them to seek any signatures of the coronal heating by MHD waves.
In this study, we used Fe XII 195.12 angstrom spectroscopic data observed with EUV Imaging Spectrometer (EIS) onboard Hinode.
The 1'' slit of EIS was pointed at solar active region during the observation, which cut across some loops and moss regions.
Moss is a bright, reticulated pattern seen in EUV images, which is located at footpoint of a hot loop.
We analyzed the time series of EUV intensity and Doppler velocity by using Fourier transform.
There were intensity and Doppler velocity oscillations at moss regions, while fewer oscillations at apices of loops.
The amplitude of intensity and Doppler velocity were compared to identify the MHD wave modes.
The phase delay between intensity and Doppler velocity is also investigated at the location where both intensity and Doppler velocity oscillations are found.
The results are following:
(1) Kink mode (only Doppler velocity oscillation) were less seen in any locations.
(2) Upwardly propagating and standing slow mode (Both intensity and Doppler velocity oscillations) were found at moss regions.
(3) The energy flux of slow mode waves were several orders of magnitude lower than the requirement for the coronal heating in active regions,
which is consistent with previous studies.

Keywords: Sun, coronal heating, MHD waves