Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM07-20 Room:302 Time:May 25 14:30-14:45

Shock formation of Alfven waves in a non-uniform medium

SHODA, Munehito[1*] ; YOKOYAMA, Takaaki[1]

[1]Department of Earth and Planetary Science, University of Tokyo

Alfven waves, generated by photospheric granule motion, are considered to play a significant role in the energetics of coronal heating and solar wind acceleration. In many theoretical Alfven wave models, coronal high temperature is supported by continuous energy supply by Alfven waves and the ponderomotive force due to the local dissipation of Alfven waves is responsible for solar wind acceleration. In linear theory dissipation due to viscosity and diffusivity is the only way to take out wave energy, which is too inefficient for coronal heating. Therefore some nonlinear processes such as phase mixing, shock formation and turbulent heating are the promising mechanisms for coronal heating and solar wind accelerations.

In this study we concentrate on shock heating among some nonlinear processes. The aim of our research is to estimate the shock formation time of Alfven waves in a non-uniform medium. In case of uniform media, shock formation time is estimated analytically, while in non-uniform case it is not yet investigated sufficiently. We perform one-dimensional magnetohydrodynamic simulations for the estimation of shock formation time. A rightward-going Alfvenic wave packet of single wavelength is set initially and we calculate its nonlinear propagation. Background magnetic field is assumed to be uniform and only the density is set to be non-uniform in our simulation. The shock formation time is obtained by Fourier spectrum evolution. Due to the non-uniformity of the background, nonlinearity of Alfven waves decreases as they propagate, which leads to the retardation and prevention of shock formation. We compare our numerical results with weakly nonlinear analytical results and show its validity. Analytical results, expressed by Lambert's W function, indicates that in the corona Alfven waves hardly steepen, whereas in the interplanetary space the background condition is favorable for shock formation.

Keywords: Alfven wave, coronal heating, solar wind