Mode Conversion of Alfven Waves Propagating in the Solar Chromosphere and Contribution to the Heating

*Shunya Kono[1], Takaaki Yokoyama[1]

1.The University of Tokyo

Alfven waves, which are generated in the solar photosphere and propagate along magnetic flux tubes, have been suggested to carry sufficient energy to the upper solar atmosphere and heat the atmosphere through wave dissipation. The chromosphere is an intermediate layer connecting the photosphere to the corona. Propagation and dissipation of waves in the chromosphere regulate the energy flux penetrating the corona. The chromospheric heating by waves is important for understanding the mechanism of solar atmospheric heating and solar wind acceleration. In this presentation, we report on our numerical works of Alfven wave propagation along open flux tubes from the solar convection zone to the corona. In 1.5-dimensional magnetohydrodynamic (MHD) numerical simulations, it is shown that 60-90% of the upward-propagating Alfvenic pulse with frequencies of 3-100 mHz are reflected at the transition region, which is the top boundary of the chromosphere. Meanwhile, most of the waves reflected at the transition region penetrate the convection zone without being reflected at the bottom of the photosphere. These results suggest that Alfven waves are unlikely to be trapped in the chromosphere. During the wave propagation in the chromosphere, Alfven waves exhibit nonlinear effects with longitudinal wave generation. The mode conversion rate is calculated with different plasma beta in the chromosphere. In the case with low plasma beta (~ 0.1-1), 0.01-1% of input Alfven wave energy is converted to the longitudinal wave energy. This energy is almost comparable to the required energy for the chromospheric heating. As plasma beta becomes larger and background Alfven speed becomes smaller in the chromosphere, more longitudinal wave appears due to increase of nonlinearity of the Alfven wave. In the case with high plasma beta (~ 1-10), the mode conversion rate becomes 1-10%. The generated longitudinal waves carry sufficient energy to heat the chromosphere.

Keywords: chromosphere, wave, nonlinear, heating

