1.5D Numerical Simulations of Alfven Waves in the Chromosphere: Reflection and Mode Conversion

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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. 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 energy required 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.