

## **Anti-phase oscillations of Ha line Doppler velocity and width in chromospheric limb spicules**

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### **Abstract**

Spectroscopic observations of limb spicules were carried out during September 25 and October 17-19, 2012 in Ha line using large 53-cm non-eclipsing coronagraph of Abastumani Astrophysical Observatory (Georgia). The spectrograph slit was located at the height of about 7500 km above the solar limb. Spectrograms in Ha line were obtained in a second order of the spectrograph, where reversed dispersion equal to 0.96 Å/mm. Doppler velocities and FWHM of 35 spicules were measured with the average cadence of 4.5 s and standard error equal to  $\pm 0.3$  km/s and 0.03 Å, respectively. Lifetimes of almost all measured spicules were 12-16 min, therefore they resemble type I spicules. We studied the temporal variations of Doppler shift and width of Ha line using the Lomb periodogram algorithm for unevenly distributed time series. We found the oscillations in both, velocity and width, with periods of 4-9 min (240-540 s) at confidence levels of 95% and clear anti-phase relations (stronger Doppler velocity - weaker Doppler width and vice versa) between Doppler velocity and FWHM in all 35 spicules. The observed anti-phase oscillation can be explained by helical motion of spicule axis formed after superposition of two linearly polarised magnetohydrodynamic kink waves in spicules