Physics of Spicules

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Since their initial discovery in the 1870s, spicules have attracted much increased attention as being the potential energy/mass links between the dense and dynamic solar photosphere and the tenuous and hot magnetised solar corona. The kinetic energy of photospheric random and coherentmotions can be guided and channelled by magnetic structures, spanning from the deep interior through the photosphere-corona even in the outermost parts of the solar atmosphere. Most likely the energy transport of this magnetic coupling is by means of waves and oscillations. Since spicules are one of the ubiquitous, dominant and pronounced magnetic features of the chromosphere, the energy transport they participate in has to be traced and investigated through observations of their physical properties, e.g. by determining their various oscillatory motions.
Here we review the major developments made in recent years in observing spicules and modelling the physics of spicules. First an account of their imaging and spectroscopic observations available by means of high spatial and time resolution observations offered by ground-based (e.g., ROSA, IBIS) and space-based (SOHO, TRACE, Hinode, etc) instrumentation, with a particular focus on waves and oscillations found in spicules, will be addressed. Next, we embark on recent particular developments made about the presence and role of Alfven and kink waves in spicules. We also address the extensive debate made on Alfven vs kink waves in the explanation of the observed transverse oscillations of spicules. Finally, within the framework of 3D numerical modelling we will summarise the progress made in linking wave energy transport, spicule formation and dynamics governed by the whirly photosphere into the solar chromosphere and corona within magnetic bright points, the possible building blocks of solar spicules.

Keywords: Solar spicules, Solar MHD waves, magneto-seismology, Alfv´en waves, kink waves, longitudinal waves, numerical modelling.