Generation of solar spicules and subsequent atmospheric heating

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Rapidly evolving fine-scale jets known as spicules are the most prominent and dynamical phenomena observed in the solar chromosphere. At any given instant, around a few million of these spicules shoot plasma material out from the Sun's surface. Despite intensive delving in the past decades, still there is no clear consensus on how these small-jets of magnetized plasma originate from the solar surface, nor we understand how exactly they transfer energy into and possibly heat the solar atmosphere. The exact source of these small-scale jets is hard to observe due to the resolution limitations of earlier telescopes. Therefore, they remain poorly understood. Using unprecedented multi-wavelength and high-sensitive magnetic field observations from the Goode Solar Telescope at the Big Bear Solar Observatory and the Solar Dynamics Observatory (Fig. 1), we strive to reach conclusions on the possible scenario among the many proposed hypotheses of spicule's origin. We found that the dynamical interaction of magnetic fields in the partially ionized lower solar atmosphere is the precursor of many of these high-speed jets which subsequently energizes the upper solar atmosphere.

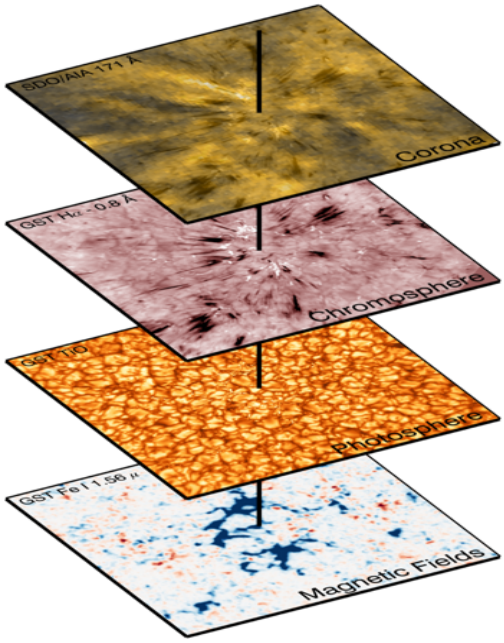

Fig. 1. Images of a quiet-Sun region showing (from bottom to top) the photospheric magnetic field as well as emission from the photosphere, chromosphere and corona.

Reference:
T. Samanta, H. Tian, V. Yurchyshyn, H. Peter, W. Cao, A. Sterling, R. Erdélyi, K. Ahn, S. Feng, D. Utz, D. Banerjee, Y. Chen, ***Science,*** 366, 890 (2019).