

On Alfvénic waves in chromospheric multi-component spicules

by:

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Abstract : A large percentage of spicules shows a surge-like behavior on the solar limb, consistent with a multi-component model with twisted strands. The on-disk counterpart of limb spicule foot-points is investigated using excellent SOT (Hinode) observations taken in the H α line. This re-examination indicates that the transverse motion of off-limb spicules could directly be related to rotational motion at the feet of disk spicules. Related bright elements (Call brightening) move and vary in brightness on the timescales of chromospheric oscillations and shorter. The motions are similar to random displacements of the bright elements along the network boundaries with amplitudes of about 200 to 400 km, with evidence of “spinning” or vortex motion. In several cases a splitting process was detected and suggests a formation mechanism for doublet (or multi-component) spicules. In this paper a helical- kink mode propagation consistent with the new evidence of spicule multiple structure is presented and provides an explanation for the origin of the Alfvénic wave propagation along the spicule strands. We analyzed several long spicules and found additionally that (i) the upward and downward flows are similar for lower and middle levels but the rate of upward motion is slightly larger for higher levels (not illustrated in this poster); (ii) the shearing motion in left and right directions is equal at all levels; (iii) the medians of the amplitudes are increasing with heights; (iv) the left and right-hand velocities are also increasing; (v) a larger number of multi-component spicules showing the left and right hand shearing motion occur simultaneously and close to each other that might be understood as twisting strands. The twist number depends of the diameter of the whole component and changes from less than 1 turn for very fine structure to more than 2 or 3 turns for surge-like broader structure; the curvature shape corresponding to a low twist number is similar to the transverse kink mode oscillation along the strands.

Figure 1. Negative and processed SOT/Hinode (22 Nov 2006) image taken from the time sequence we studied. Only results dealing with the feet of spicules are discussed in this poster. 3 examples of spicules with feet coming from the disk are shown magnified and inserted above the chromosphere with colors (the long fine vertical line at the middle of the image is an artifact due to the read-out of the CCD).

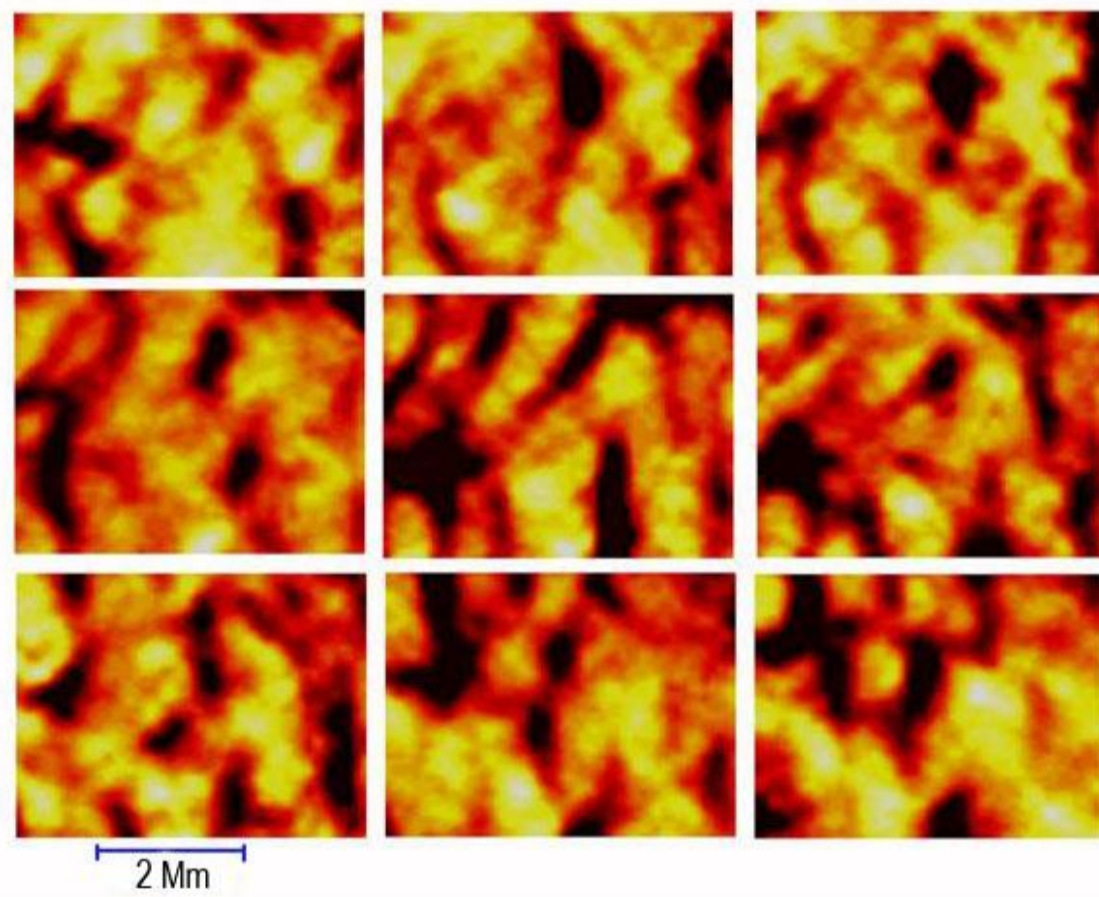


Figure 2. Consecutive negative snapshots shown at a cadence of 40.5 sec. Time is 00h24m U.T. and the region is at top left in Fig. 1. Several spicule foot points are seen as Call brightenings and the splitting processes with a random motion along the network cells is illustrated

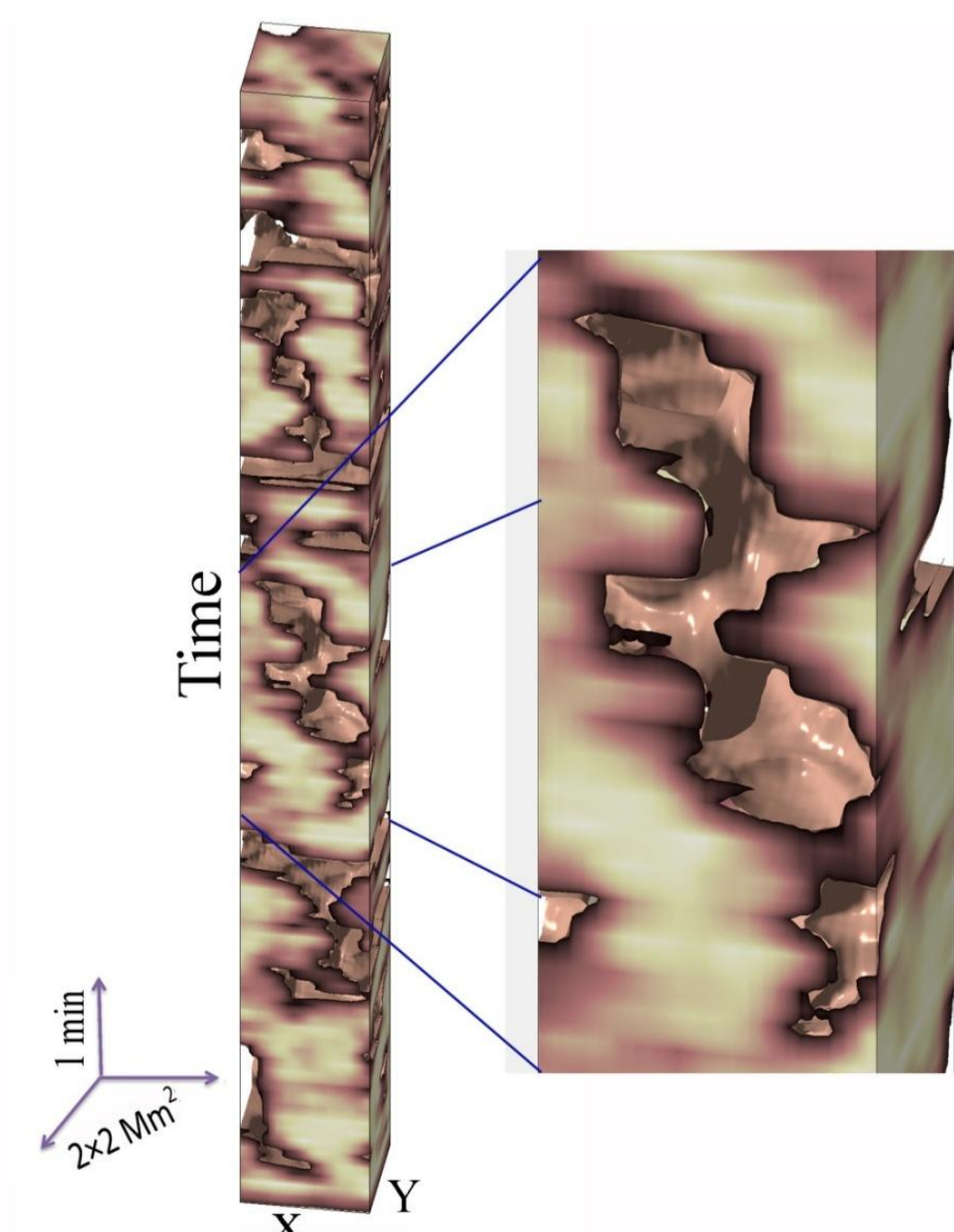


Figure 3. Display showing the time slice (x-t) variations for a part of selected sub-FOV suggesting a rotational velocity of order of 20 kms⁻¹.

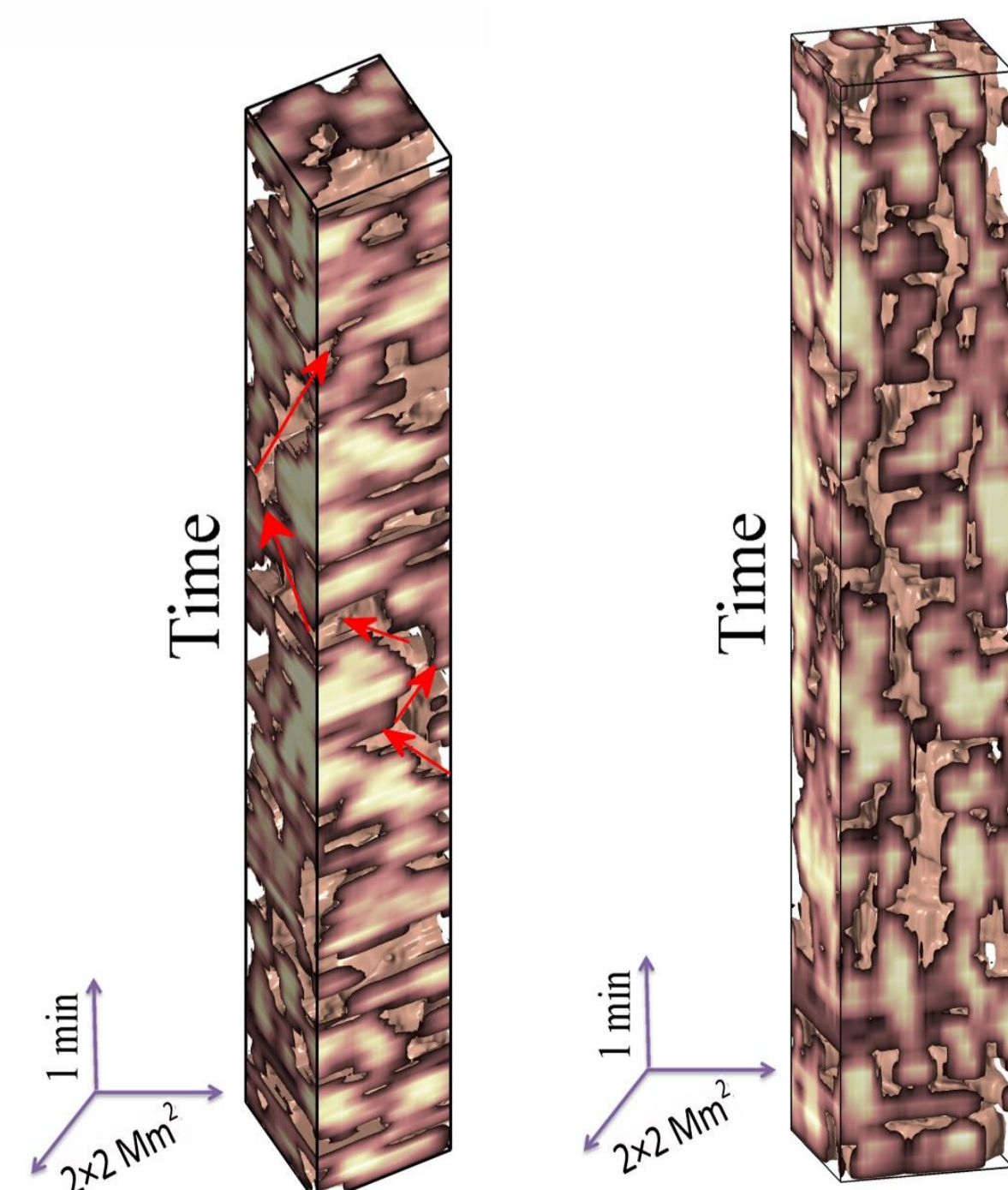
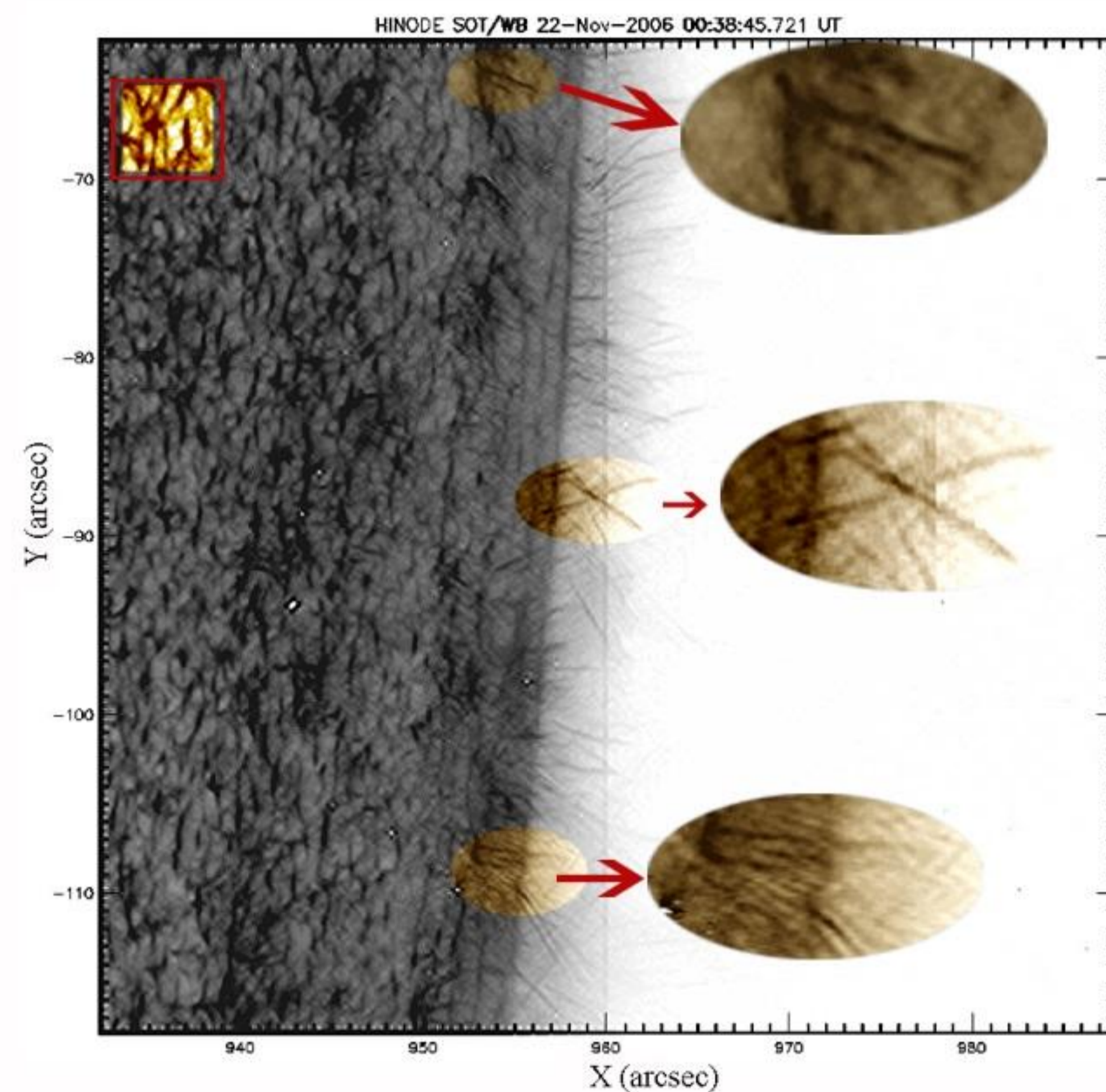


Figure 4. As Fig. 3 but with 2 orthogonal time slices (x-t and y-t) put together. Two different locations on the disk are shown. A rather long life-time of the rotational behavior is obtained at right suggesting that several turns occur.

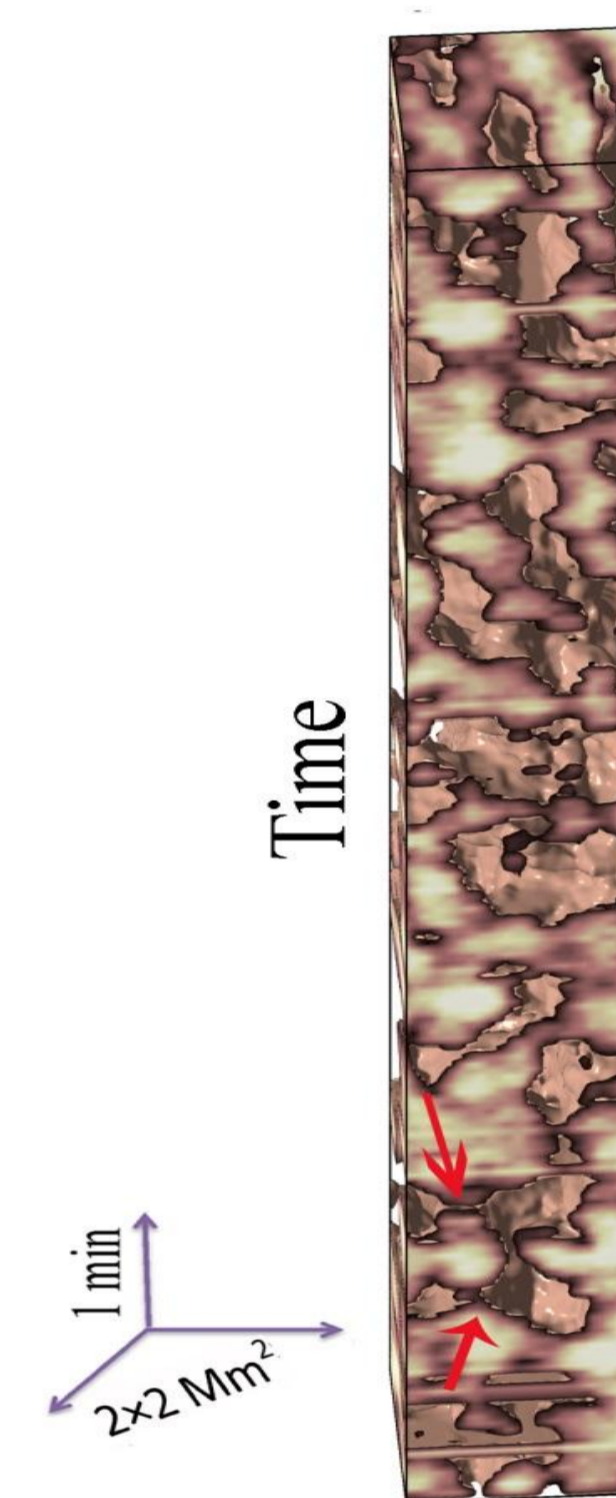


Figure 5. Two examples (red arrows) illustrating the splitting mechanism. The analysis is also carried out in two-dimensional images by looking at the time evolution series .

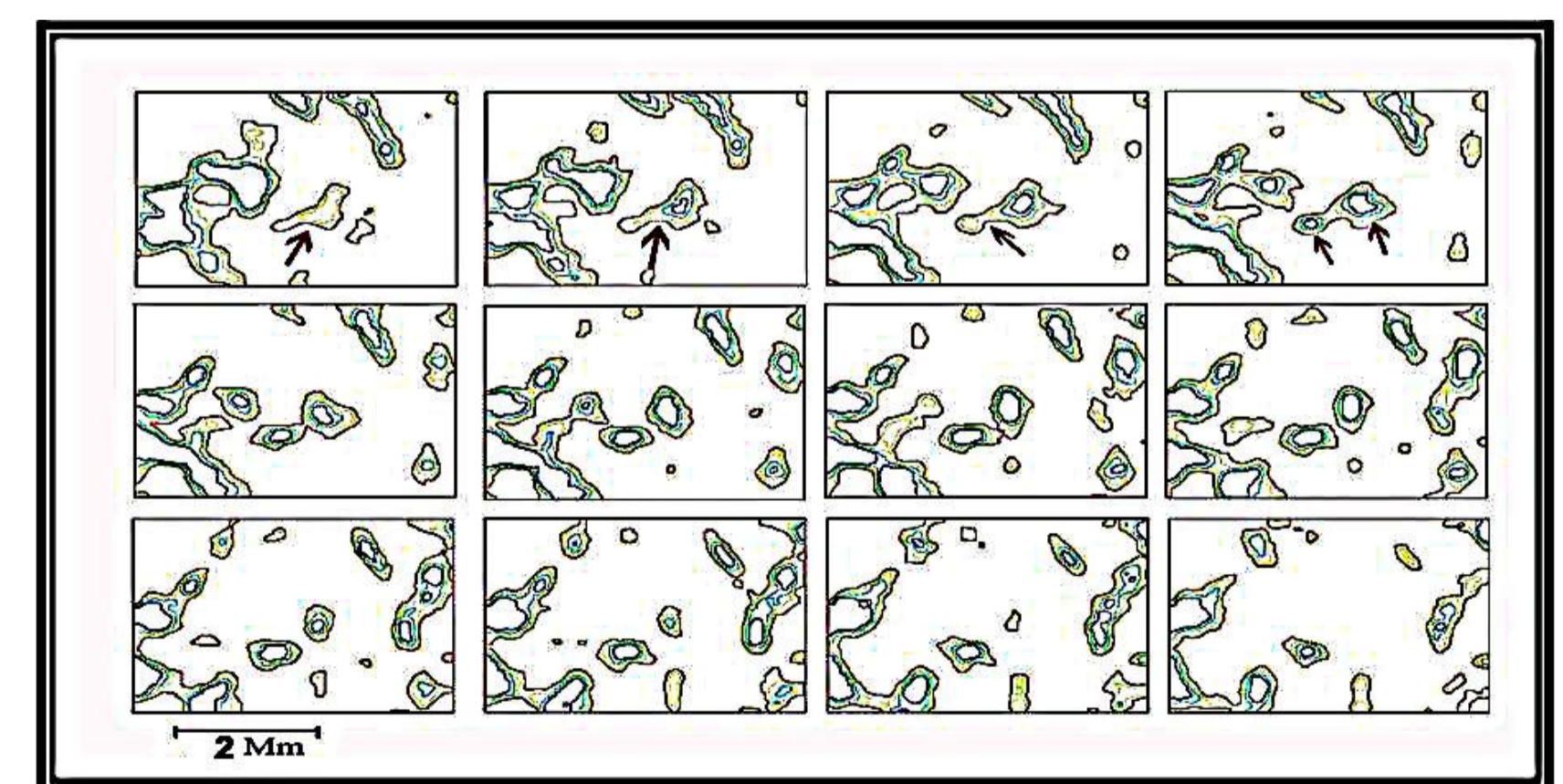


Figure 6. Contour plots of Call intensities showing the splitting progress of one magnetic bright point (arrows) becoming a doublet; the cadence is 8s and observations were taken on 22 Nov 2006 at 00h45m UT.

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