

Papers I Read and Some Analysis

2011 Paper Okamoto

- Seems rather complicated idea. Like they have to add qualifications and explain things away- force things to fit.
- Downward propagating waves and upward propagating waves affected by the medium in which they are propagating.
- Eliminated the irregular spicules.

2013 Paper Sekse

- Lot of mention of swaying and the like. Not very well explained. Lot of description of what is happening; not much mention of why/possible causes.
- They interpret the sudden appearance/disappearance of thread-like structures as standing waves with high speeds within the spicules- torsional modulation.
- They say that this motion is very complicated: field-aligned flows, torsional motion, and transverse swaying. And standing waves.

Evidence for Sheets 2011 Paper

- They appear as sheets (fluted)
- Begin in photosphere and extend into chromosphere and corona.
- Dynamical timescales and fluctuations.
- Could explain rapid variations, disappearance suddenly of the spicules.
- Deal with force balance issues.
- Why straws? Why are they so popular?

- Definitely possible that plasma 'may naturally accumulate in such sheets, either by the heating associated with the dissipative relaxation of the sheet and/or as different magnetic flux bundles are brought together'
- There is an equation, and it doesn't mathematically reveal tubes or straws!
- Will work with the Alfvénic fluctuations idea.

- 'Slow modulation of warped sheets can lead to supersonic apparent motion seen in some off-limb data.' APPARENT MOTION.
- Parker's theory of tangential discontinuities, it would work.
- 'Warps (sheets) have an advantage in that one need not perform theoretical contortions to make thin straws out of the observed photospheric sheets.'

2012 Paper Judge

- Chromospheric fine structure (spicules, limb structures) have generally been seen to be straw-like jets or tubes of plasma. Flow along tubes, fill volume of magnetic fields in the chromosphere, sometimes (as spicules) extending into the corona.
- Parker argued that the Sun's low-Beta atmosphere must spontaneously produce tangential discontinuities as current sheets.
- Sheets will work as 'weak' solutions to magnetohydrodynamics equations (called TDs).
- CFS: appear and disappear along their entire length in a few seconds.

- Moving very fast these disturbances are. Phase speeds greater than 5000 km/s.
- Possibility for oblique propagation.
- Wave propagation, changes most simply explained with idea of 2-D structures. Not standing waves, too complicated.
- Likely plasma sheet structures? Plasma sheets embedded in Parker's tangential discontinuities are perturbed and they produce warps which, when aligned along the line of sight, result in the rapid appearance (or disappearance) or CFSs reported. Some, not all, can be explained by this.
- Maybe tubes too.
- Help explain energy transported from corona to chromosphere: a greater surface area.
- Cross-field energy transport via the sheets.
- IDEA: some CFS are better interpreted as line-of-sight integrations of 2-D sheets of plasma embedded in 3-D magnetofluid. Sheet plasma collects in TDs formed according to Parker's fundamental theorem of magnetostatics.
- Possible a better, (Occam's Razor) explanation of rapid variations and high-speed phenomena. An optical result of thinking we see a 1-D tube where it might actually be a 2-D sheet in the 3-D magnetofluid.

Technical Summary: The PAPER to be written.

- Tube picture is inconsistent with a lot of what we see.
- Why sheets? Force balance and magnetic topology and not generally consistent with the smooth solution model.
- Ultrafine tubes not explainable (straw-like)
- How are the standing waves produced?

Spicules: Type 1 has an acceptable physical interpretation (slow shocks propagating up tubes of magnetic field),

type 2 is theoretical- opposing team's idea: it is still a flux tube standing wave thing!

- brightness of proportional to density of plasma to a + power (1).
- A tube!
- Kink, torsional tube waves of Alfvénic character (magnetic tension is the restoring force).
- Motions in excess of the estimated Alfvén speeds are attributed to waves reflected from the transition region which is somewhere above the top of the spicule.

PROBLEMS

- Waves are not undisturbed in the background: what if not easy propagation and reflection?

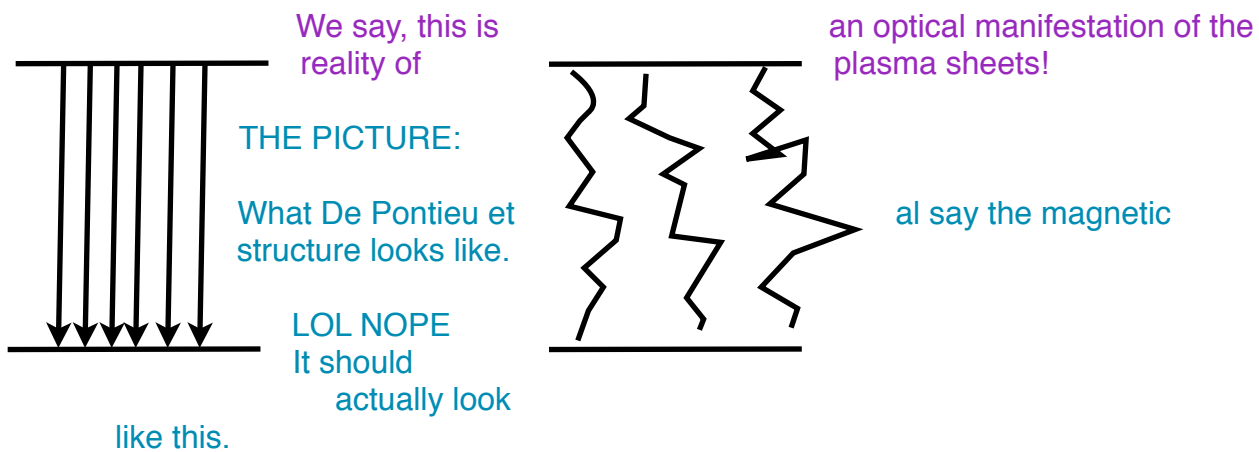
-Explain high phase speeds, need two oppositely phase coherent similarly amplituded waves to interact- not likely to occur consistently!

-If we say it happens when upward wave is generated in underlying atmosphere and downward wave is generated by reflection in transition region, will that still work well with losses due to energy>

-Also, no found steep gradient at a transition region (where is the surface at which the downward waves reflect?)

-ALSO: no curvature along the lengths of the fine structures. If standing wave model is correct, waveforms would have Doppler shifts that depend on position along the tube, or, curved features that fade to nothing at ends as we can no longer see them (middle region). We do not see such curvature!!

Also, speeds indicate that tube must be huge- out of accepted region!



This comes from Parker. The two ends of the sandwich are the photosphere and these extend into the chromosphere. It really looks like this: (a hoop)

We are not denying the existence of the 'tubes' (although apparently De Pontieu likes to say that he never said there were tubes!)

Photosphere is the base. Actual picture is way more wibbly wobbly if tubes are not neat.

The solutions to the magnetohydrodynamics equations can result in a neat tube structure where blocks of plasma can move (funnel). But present also are weak solutions and tangential discontinuities. Basically, the magnetic fields can get all twisted and angsty and thus can cross in a way that will result in a plasma sheet like structure.

I mean, there is differential rotation in the Sun and general rowdiness and it is definitely possible that these bad boys are going to get twisted.

And when they snap (poking out of the photosphere), Parker proposes that the pent-up magnetic energy might get released in solar flares and these things called nanoflares.

We are saying at the moment that the flashes of brightness (like 3 s in duration) are due to the sheets predicted by the tangential discontinuity idea. Normally, they are like a veil blowing the wind: we cannot see them as we see through them! But occasionally, they will orient so bunched up that we can see them!

The opposing side argues that introducing the sheet idea is far too complex and that the high-speed 'flash' phenomena we are seeing actually results from plasma propagating up the tube-y structures. 20 percent of the time, it will work out to a standing wave and other times it moves upwards. Basically, it is a wave phenomenon going on that they argue. Somehow, either through reflection at a transition region of one wave or two waves originating at opposite ends, a standing wave can be formed and the flash of brightness we see is it doing its 'standingness' before it dissipates.

That model introduces a good deal of complexities: how do we deal with energy losses (where/how does the energy go?) and how do we ensure that the transition region CAN reflect things? Or that two disturbances will just happen to occur at either end? And if we do actually run through the wave model, it seems that what we are observing happens just too FAST!!!!!! for it to be explained by a standing wave/wave-thing!!!

So that is where we stand now, we still hold that what we see (the high-speed phenomena) could be caused by us 'finally seeing' the plasma-containing sheets as they orient themselves like curtains blowing in the wind.

PROGRESS

We discussed further the theory behind this project. Regarding the standing wave flux tube idea, it seems as if we would need to have a shock happening above and below the standing wave region in order to generate two waves that will move in opposite directions and be standing waves. And they need to have roughly the same amplitude and properties. It rather seems strange that this is going to happen at the same time in order to generate such a wave! And then there is the claim that there is a steep pressure gradient at the top of the region where the waves are reflected (we would need this pressure gradient or some sort of change to ensure such a reflection could happen). We just don't seem to observe such a pressure gradient or change as modeling and calculations show (the temperature, pressure relationships with physics).