

Some Analysis and Responses to Papers

Several ideas and models have been postulated to describe the nature of these high-speed phenomena in the chromosphere. Perhaps most popular is the model proposed by De Pontieu et al (2012) that describes these phenomena as standing waves of plasma within magnetic flux tubes. This is backed up by Sekse et al (2013) as well as Okamoto et al (2011), where the different components of this propagative motion are outlined. From having read several papers by these main proponents of the flux tube model describing Type II Spicules we have gathered what we believe to be a comprehensive understanding of what they are propositioning. However, even after all this, we maintain that their model still poses multiple questions that are left unanswered.

Roupe van der Voort et al (2009) decided that Rapid Blue Excursions were a phenomena comparable to the mysterious high-speed Type II Spicules we are studying. This study discusses how both phenomena exhibit properties of high-speed and accelerated plasma as a central link to the connection between the two. Far more blue-shifted phenomena were observed than red-shifted phenomena. **These two observations are in contrast to what we have observed ourselves/ We found a much higher population per image of red-shifted phenomena than blue-shifted phenomena and we could certainly not make the conclusion that ‘type II spicules only demonstrate upward flows’. We also did not observe such plasmatic accelerations, as seen earlier with the discussion of the subtraction of Ca II images from H-Alpha images.**

Roupe van der Voort et al also found that H-Alpha RBEs have higher Doppler velocities and widths than do Ca II RBEs, which corresponds to that observed with Type II spicules. This observation actually has been confirmed by us. Phenomena has been observed to absorb radiation from H-Alpha but not in Ca II with an appropriate corresponding Doppler wavelength shift. Roupe van der Voort et al ascribe this to H-Alpha transition-enabled atoms having a far higher opacity to incoming radiation than Ca II transition-enabled atoms. This is a thought we had as well. In this sense, Type II spicules might share a similar property with RBEs, but we are not convinced that RBEs are a surefire model for Type II spicules as there are many aforementioned discrepancies.

On that note as well, we have observed many discrepancies regarding the flux-tube plasma standing wave model proposed by De Pontieu et al. From the paper published by Okamoto and De Pontieu in 2011, we were made to understand that these Type II spicules are dominated and composed of propagating Alfvénic waves that become reflected near the transition region. These standing waves are described as being a fortunate result of ‘the superposition of the upward and downward propagating packets’ (Okamoto and De Pontieu, 2011) and thus seem to be rather precarious. **What was unanswered was how these standing waves are set up and the reason why we should see *multiple* incidences (89) where an upwards propagating and downwards propagating Alfvénic wave managed to both have appropriate frequencies and amplitudes so to consistently meet up and display this phenomena. As has been mentioned earlier, we**

failed to notice any evidence of the accelerations implied by a plasmatic standing wave in our comparisons with H-Alpha and Ca II data. Our data analysis with the H-Alpha and Ca II wavelength scans has thus undermined the conclusions reached by Rouppe Van der Voort et al, 2009 and De Pontieu and Okamoto, 2011.

The proponents of the flux tube model keep putting out papers which *describe* their model in further detail yet continue to pose even deeper questions about the validity of the evidence they consider to be irrefutable. We have yet to hear some of the deeper *reasons* for why their model should be correct and about its groundings in theoretical solar physics. Judge et al, 2012, brought some of the fallacies of the flux tube model to light, namely in addressing the issue that this phenomena implies super-Alfvenic speeds, which grossly exceed the Alfven speeds of this region. Judge et al proposed an alternative model to this high-speed phenomena: that in which the seeming flux tubes are actually optical results of the fluctuations of plasmatic sheets in the chromosphere.

Exploring the plasma sheet picture has its disadvantages and difficulties, namely in the sense that it is rather difficult to ‘prove’ or ‘disprove’ anything. Some of the data we would like to have is not very much feasible to collect with out current solar technology: direct images from within the chromosphere and measurements of the magnetic field at different locations in the chromosphere. As our current work with our 2010 data of the chromosphere above an active region near the Sun’s disk has shown, it is an endeavor in just realizing where to begin! We cannot simply just venture to the chromosphere and settle once and for all what it is we are seeing there on Earth. **However, just by putting the claims by De Pontieu and associates to the test, we did raise some questions that are not at all answered by the flux tube model: namely, the prevalence of spicules absorbing in the red wing vs the blue wing**;** the lack of observations of accelerated plasma; the difference in appearance between red wing fibrils and blue wing fibrils; and fact that some moving fibrils absorb H-Alpha at an appropriately shifted wavelength but do NOT absorb at the corresponding Ca II wavelength. We have found a good deal of broken symmetries between red and blue wings, Ca II and H-Alpha and that certainly does not fit in to the picture of standing waves of plasma in a flux tube- a picture that implies randomness and perhaps symmetry.

****NOTE: The prevalence of spicules absorbing in the red vs blue wing might be possibly attributed to pressure variations in the chromosphere and corona that favor a certain direction of motion and wavelength absorption.**

IMPORTANT: We did not observe characteristics within the supposed ‘flux tubes’ that hinted at the standing waves described in De Pontieu et al, 2012. A standing wave should have nodes and varying velocities along the flux tube. We did not observe the resultant gradient in absorption indicating these characteristics of such a wave- the ‘flux tubes’ are rather uniformly dark logs!

We believe our model deserves far more recognition and appreciation from the solar physics community than it currently gets as it is rooted very firmly in theoretical solar physics. As Judge et al, 2012 mentioned, weak solutions in magnetohydrodynamics equations may result in tangential discontinuities that allow for such plasmatic sheets. Perhaps more deeply, we have a rooting in the principles of scientific discovery. The plasma sheet picture is a potential Occam's Razor to this entire question regarding the high-speed phenomena- a relatively simple model rooted in theoretical magnetohydrodynamics and the ideas of Parker. Instead of drawing upon more and more elaborate explanations to model what we see (at the moment, de Pontieu and associates maintain that this phenomena has three components: field aligned flows, swaying motions, and torsional motions), why should we not go with a *theoretically sound* explanation of optical manifestation and see where we can go with it?

Unfortunately, we have yet to be firmly disproved by our rival model's proponents. In addition to ignoring the theoretical roots of the sheet model (and perhaps exploring the theoretical basis of the flux tube model), our rival model's proponents seem that they would rather *deny* our sheet model without giving some firm disproof and continue to *describe* their own model. (As a side note, we are afraid this *denial and describing* is in opposition to the true nature of scientific inquiry and is repressing open dialogue and further scientific discovery).

here is where the response to the Sekse et al 2013 paper comes in

Demonstrating this is evident in a 2013 paper published by Sekse et al. where a third type of motion of the Type II Spicules is explored: torsional motion. Rouppe Van der Voort et al in 2009 explored the comparison of this high-speed phenomena to RBEs. Here, the RRE and RBE properties of the spicules are explored in depth and the torsional rotational properties of these spicules is described. This paper may be seen as a small example embodying our reservations regarding the flux tube model and its hold on the solar physics community. Our response to this paper has three components of its own.

(1) It appears that the scientists working on this project *began* with the assumption that these Type II Spicules *will* have properties comparable to RBEs and RREs. A detection routine *designed* for finding RREs and RBEs was used to analyze the data. It is fine to make an assumption, but the theoretical rootings of said assumption were never discussed. As with the 2009 paper discussing RBE, Type II Spicule correspondence, the connections between the two phenomena were purely observational. Furthermore, it is understandable that one might find such a connection between two phenomena, especially if the whole game is rigged towards making such a connection!

Red vs Blue

(2) There was some broken symmetry described within this paper, namely that RRE components had a lower average Doppler width than RBEs and the number density of RREs compared to RBEs varies around certain regions of the Sun observed. The reason for this broken symmetry is explored by invoking different types of motion in the flux tube spicules over

different areas of the Sun. We failed to understand, from the results of this paper, the exact equations and physics that results in this motion. Results were certainly descriptive and comprehensive. However, it did seem at times that some ‘explaining away’ was occurring as the theoretical groundings for these very complicated motions and the equations of magnetohydrodynamics that might produce them were never explored! The flux tube model implies a certain randomness from fibril to fibril. Sekse et al implied that there was a systematic difference between RRE comparable phenomena and RBE phenomena. We have similarly observed a red and blue wing discrepancy (red wing fibrils are more elongated than blue ones). Unfortunately, the question still remains of why such a red and blue discrepancy and, most importantly, does it reject or confirm the flux tube model. We gathered possible reasons for such a discrepancy in terms of complex motion, but we failed to see an analysis of the implications for this discrepancy in terms of disproving or proving the model. It appears that the flux tube model has been taken for granted and results are fit into the model! As far as we can see, the flux tube model implies randomness and an equal distribution of RBE-like phenomena and RRE-like phenomena. The possibly contrary implications were ignored all together in favor of ‘making things fit’. Sekse et al mention that there must be more plasma upflows than downflows. The reasons for this (in terms of the model- why must this be so?) are not clearly presented.

- (3) Finally, what never was explored was *why* is it better to invoke more and more complicated motions to explain this phenomena? Again, going back to Occam’s Razor, why is it better to introduce yet another component of motion and yet more limitations, considerations, qualifications to a model just to make it fit in with new observations. We failed to see, in this paper, the reason WHY the flux tube model is desirable (again, why not discuss its rootings in magnetohydrodynamics). We did not see any mention of why torsional motion HAD to be the reason for what we are seeing and why apparent motion could be completely ruled out. Why is it better to add multiple components of motion to a phenomenon where it could quite simply be explored as an optical manifestation and apparent motion!

What we are afraid is happening regarding the flux tube model is that it has been accepted with minimal reservations despite the fact that we have not seen very strong mention of its theoretical groundings. We are afraid that new observations and data are being fit into the model, where what should be happening is the model being revised in light of new observations and data. We are afraid that our sheet model is being rejected out of convenience despite its validity in magnetohydrodynamics. We want open scientific dialogue and to further discovery and that cannot happen provided that other scientists are not open to discussing alternative possibilities. We want answers to the questions we have ourselves posed, and, perhaps most importantly, models and claims to be rooted in theoretical solar physics. Otherwise, science deviates from the scientific method and simply becomes description.