ON FACULAR MODELS

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Abstract. Weakenings of 14 Fe I lines observed in photospheric faculae by Chapman and Sheeley (1968) have been analyzed using Unno's (1956) LTE theory of Zeeman triplet formation. These observations can be explained by a facula-photopshere temperature excess of $\lesssim 250$ K in the layers ~ 100–400 km above $\tau_{5000} = 1$. The inferred magnetic field in the faculae is ~ 1000 G.

Such a temperature model is not consistent with the center-limb variation of the continuum contrast between faculae and the photosphere observed, for example, by Chapman (1970). In calculating the facular intensity it is necessary to take account of the small horizontal width of the faculae granules, especially near the limb where the light path traverses the photosphere as well as the facular granules. This has been done for a simple model of an isolated facular granule having vertical sides and a width of 760 km. The temperature excess required to explain the observed contrast near the limb is ~ 800 K.

The discrepancy between the facular temperature excesses derived from line and continuum data probably can be reconciled to some extent by varying the geometry and including the effect of clustering of the facular granules. Work on this is in progress.

The facular granules usually are not resolved. Coupled with the effects of scattered photospheric light, this indicates that the true weakenings and contrasts exceed those observed. Therefore higher temperatures would be favoured.

References

Chapman, G. A.: 1970, *Solar Phys.* **14**, 315.
Chapman, G. A. and Sheeley, N. R.: 1968, *Solar Phys.* **5**, 442.
Unno, W.: 1956, *Publ. Astron. Soc. Japan* **8**, 108.

DISCUSSION

Zirin: Since we know about the filigree in the photosphere and since we know that in off-band Hα the network spreads out by about 1000 km in the line wings; what do you think you would get if all of these things looked like cones?

Rees: This would tend to reduce the temperature for the line model.

Beckers: I completely agree with Dr Zirin's remarks. Also in the Magnesium b_1 line do we see the line center faculae to lie immediately above the photospheric filigree as seen 0.8 Å from the b_1 line center. The increase in size of the subgranular filigree elements ($\leqslant \frac{1}{2}''$) to the $\frac{1}{2}$–1″ line center facular elements really shows the faculae to have a conic structure which has to be taken into account in your modelling.

Rees: I think the geometry is the fundamental thing and until we do a more detailed calculation we can't put a number into this effect in the facula model.

Meyer: I would like to ask whether temperature structure in the vertical direction would have an influence on your contrast from center to limb. In the downward directed shock flow model one expects

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higher temperatures in the regions behind the shock front, and lower temperatures as the gas moves downward and cools by radiation. It would be interesting to know how this fits to the empirical models.

Wiehr: I think that the theoretical shock flow model is in good agreement with out model which requires a temperature excess exclusively in the high facula layers ($h > 250$ km) whereas the deeper layers show photospheric temperatures. The temperature excess in the high layers increases with height. Furthermore the downward flow is an observed fact, as I pointed out.

Rees: The temperature excess is greater in higher layers also in our models.

Thomas: I am curious as to what controls the line intensity – is it collisions or photo-ionization or what?

Athay: Which lines have you used in the analysis?

Rees: The line with the greatest change in central intensity is the 5250 line of Fe.

Athay: In my computations with Lites on Fe this line is collisionally controlled at these depths and should be in LTE.

Wilson: I am sure this would be important and this was my pont with Dr Wiehr if your excess temperature occurs in a very shallow layer and of course increases upward then the contrast that you would see if you looked directly through this would be less. But you can't really answer the question until you play around with different geometries and trey to construct theoretical profiles.

Brueckner: In the ultraviolet continuum around 1600 to 1700 Å Tousey and Purcell placed an upper limit on the temperature excess of about 200°. But one has to keep in mind that these observations were done with quite low spatial resolutions so if you go to smaller structures this result may change. We have recently obtained a rocket spectrum which seems to fall on a facula area which seems to show that the temperature change was around 200° at 1700 Å, it also showed considerable change in the shape of the spectrum between the silicon triplet and silicon doublet continuum. In their words the opacity in this optical depth has changed considerably from the photosphere to the facula. I don't know how to explain this but I think photo-ionization needs to be taken into account. This coud modify the line profile calculations considerably and this may be a way out of the difficulty.

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