SOME COMMENTS ON THE MEASUREMENT OF SMALL SCALE STRONG MAGNETIC FIELDS ON THE SUN

E.Wiehr
Universitäts-Sternwarte Göttingen, GFR

Since Dr.Harvey has already mentioned the main results of my observations, I want to restrict myself to two topics:
i) a brief description of the improvements of my method as compared to that used by Stenflo (1973),
ii) some puzzeling aspects of my results which might be discussed in this meeting.
The main differences between the two methods of simultaneous Zeeman polarization measurements used by Stenflo (1973) and by myself are based on suggestions by Schröter (1973):

a) use of three instead of only two differently split lines;
b) use of less temperature sensitive lines;
c) use of model atmospheres instead of a Milne-Eddington model for the calculation of the 'calibration curves';
d) observation ofselected $Ca^{+}K$ features in order to avoid the statistical method with the scatter-plot diagram,

Items a) and b) lead to the construction of a three-channel magnetograph for the Fe-lines 6302.5, 6336.8 and 6408 (Fig.1) at the Locarno station of the Göttingen observatory. According to Stellmacher and Wiehr(1970) these 3.6 eV lines remain unchanged going from photosphere to umbra. However, they show a reduced central depth going from photosphere to faculae (Stellmacher and Wiehr,1971). Because of the rather equal strength (W_λ = 103 , 138 and 125 mÅ ,resp., according to the 'Liège atlas') this 'rest intensity effect' is almost equal for all three lines as has been verified by calculation with the 'Zeeman lines computer program' by Wittmann (1974).
Concerning item c), it has already stated by Stenflo (1975) that the approximation by a M.E.atmosphere does not alter significantly the 'calibration curves' $P_{circ}(B_{long})$ Fig.2

The investigation of individual network points (item d) resulted in some puzzeling facts which I would like to bring to your attention:

Edith A. Müller (ed.), Highlights of Astronomy, Vol. 4, Part II, 251-254.

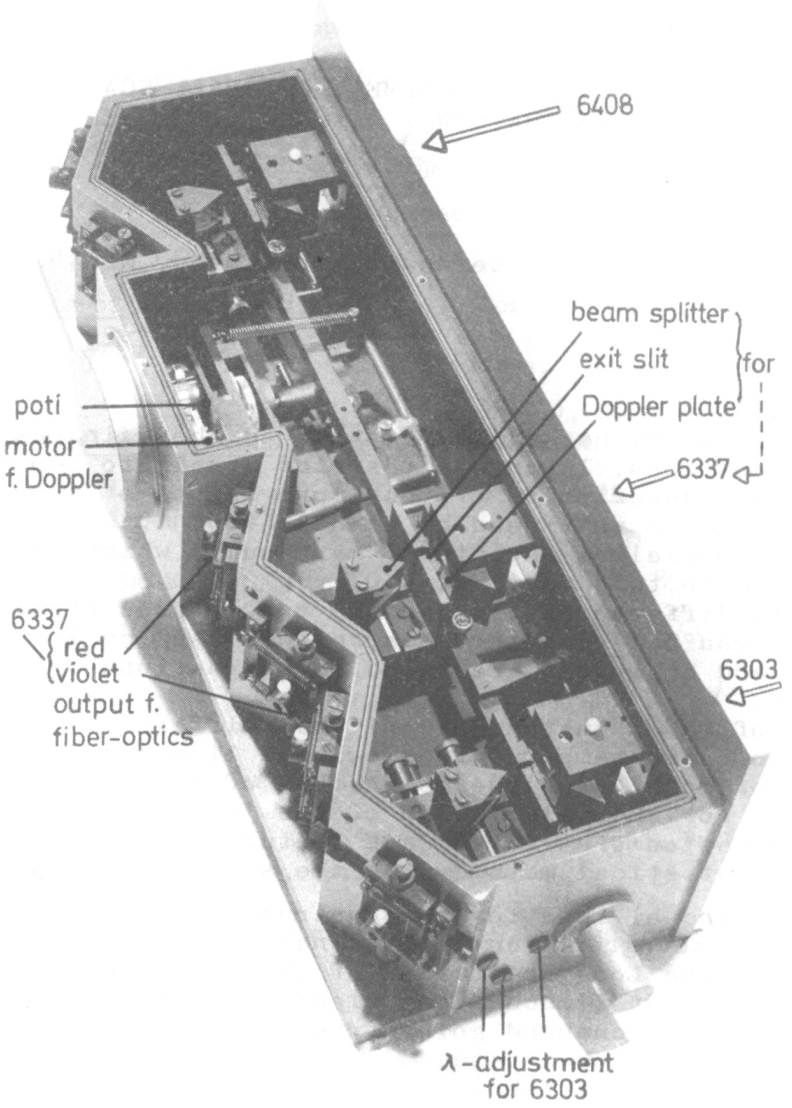

Fig.1: Three-channel magnetograph output adapted for the plate holder of the Locarno spectrograph.

https://doi.org/10.1017/S153929960000335X Published online by Cambridge University Press

As reported by Dr.Harvey, my observation of various bright Ca^+K features mainly confirm Stenflo's (1973) results for quiet network and furthermore indicate their validity also for enhanced network, faculae and (probably) pores. However, a certain number among each of these features yield no 'true' field strength since either the apparent P_{circ}-ratios 6303 : 6337 : 6408 exceed the possible upper limit 2.5 : 2.0 : 1.0 (which represents the case $B_{long} \longrightarrow 0$; c.f. Fig.2) or the P_{circ}-ratios 6303:6337 , 6303:6408 and 6337:6408 yield three different values for B_{true}. These cases of 'not fitting polarization' cover about 10 - 20% of the Ca^+K features observed. Possibly they are equivalent to those points in Stenflo's scatter-plot diagram which largely differ from the average slope. Similar difficulties were reported by Semel (1976) from an extended study of a large number of Zeeman lines.

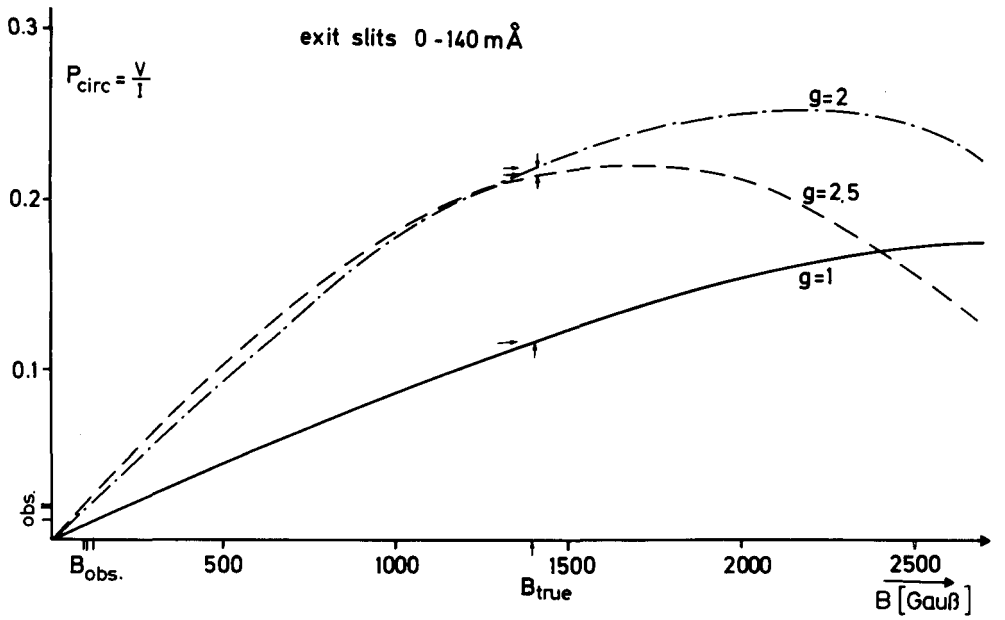

Fig.2: Calibration curves for Fe 6303, 6337, 6408 calculated for the apparent line profiles and the facula model by Stellmacher/Wiehr(1973)

Another point I would like to mention concerns the basic idea behind the whole measuring method used by Stenflo and by myself: the independence of the P_{circ}-ratios on seeing. This pre-condition seems to be severely violated for a considerable number of Ca^+K points where with increasing image quality and hence larger apparent field strength the P_{circ}-ratios vary in such a way that the finally deduced 'true' field strength decreases (as compared to bad seeing).

https://doi.org/10.1017/S153929960000335X Published online by Cambridge University Press

These effects have to be investigated in detail before considering the (preliminary) concept of a 'limided range of true field strengths' for all solar magnetic fields outside sunspots.

References:
Schröter,E.H. 1973, priv.comm.
Stellmacher,G., Wiehr,E. 1970,Astron.Astrophys.7, 432
Stellmacher,G., Wiehr,E. 1971, Solar Phys.18, 220
Stellmacher,G., Wiehr,E. 1973,Astron.Astrophys.29, 13
Stenflo,J.O. 1973,Solar Phys.32, 41
Stenflo,J.O. 1975,Solar Phys.42, 79
Wittmann,A. 1974,Solar Phys.35, 11

https://doi.org/10.1017/S153929960000335X Published online by Cambridge University Press