PHOTOELECTRIC MEASUREMENTS OF SUNSPOT MAGNETIC FIELDS

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Photoelectric polarization measurements in a stable sunspot (type H) with a particularly dark umbra, where 'umbral dots' were virtually lacking, have been carried out with the Capri magnetograph (Deubner, 1969). The measurements were evaluated in terms of Unno's theory to give the value and direction of the magnetic field vector. The parameters $\eta_0 = 5$, $\beta_0 = 2.5$ and $\Delta\lambda_D = 40$ mÅ have been adopted for the Fe I 5250 line. Taking the configuration of the sunspot into account as well as simple conditions of steadiness of the distributions to be obtained, it is possible to derive the magnetic vector field from two-dimensional records of circular and linear polarization without ambiguities.

Since the ratio of circular and linear polarization is only little influenced by stray light, the photoelectric method gives the angular distribution with particular accuracy. A linear increase of the inclination angle with distance from the spot center up to $r \geqslant 1.2 R_0$ results, as originally found by Hale and Nicholson (1938) with a different procedure. At the penumbral border an inclination angle of 75° is observed.

If the measured values are corrected for unpolarized stray light ($\approx 40\%$ in the umbra, cf. Kneer and Mattig, 1968), a maximum field strength of 3250 G is obtained, which agrees well with the amount of splitting of the σ-Components in the control spectra. At the penumbral border the value is 15% of the maximum field strength, still continuously decreasing outside the spot.

In several parts of the spot regions where the projected field direction deviates considerably from radial symmetry, the azimuthal component of the magnetic field nearly equals the value of the radial component. The direction of field is always in good agreement with that of the overlying chromospheric structures.

References

Deubner, F.-L. and Liedler, R.: 1969, *Solar Phys.* **7**, 87.
Hale, G. E. and Nicholson, S. B.: 1938, *Magnetic Observations of Sunspots 1917–1924*, Part I, Publ. Carnegie Inst. No. 498.
Kneer, F. and Mattig, W.: 1968, *Solar Phys.* **5**, 42.

Discussion

Giovanelli: (1) It is interesting to note that the magnetic field is inclined to the horizontal by some 15° at the penumbra-photosphere boundary, since Hα fibrils in such regions can also be seen inclined at rather similar angles for sunspots near the limb. This is in accordance with the general view that Hα fibrils mark out lines of magnetic force.

Howard (ed.), Solar Magnetic Fields, 190–191.

(2) The sunspot examined showed a bright Hα marking across the middle. Does this not mean that the spot was far from being simple and structureless?

Deubner: The marking was the remainder of an Hα flare, which took place in this spot group on September, 28. The analysis carried out and presented here was based on data of October, 1, when the spot group was pretty calm and did not show any umbral structure, as also in the first figure. This does not imply, that the spot was 'simple'.

Brueckner: How did the maximum field strength in the spot change when the spot changed its position on the disk?

Deubner: The maximum field strength has only been evaluated for this particular position.

Wiehr: Have you any explanation for the fact that the discontinuity of the field strength only appears at the one but not at the other penumbra-umbra border?

Deubner: It is possible that instrumental effects, e.g. the time constant of the intensity compensator produced this asymmetric discontinuity.