THE MAGNETIC FIELD FLUX IN FACULAR REGIONS

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1. Introduction

The solar magnetic field ($\vec{B}$) is usually studied by observation of the value of the line-of-sight component ($B_{\parallel}$), (Harvey, 1977). In the present note we give preliminary results of another approach ; the study of the flux of the line- of-sight component (ϕ) of magnetic structures. Our study is statistical.

2. Data

To carry out this investigation, we used observations taken with the Kitt Peak magnetograph (Pecker et al., 1977). Maps (512" x 450") of $B_{\parallel}$ were obtained with the FeI λ 868,86 nm line and with an observing aperture of 1" x 1". The spatial resolution was about 1",5 to 2",5. We measured the flux (ϕ) of the magnetic structures limited by the isogauss 25, where

$$\phi = \int_S B_{\parallel} \, dS \qquad \text{for } B_{\parallel} \geqslant 25 \text{ gauss}$$

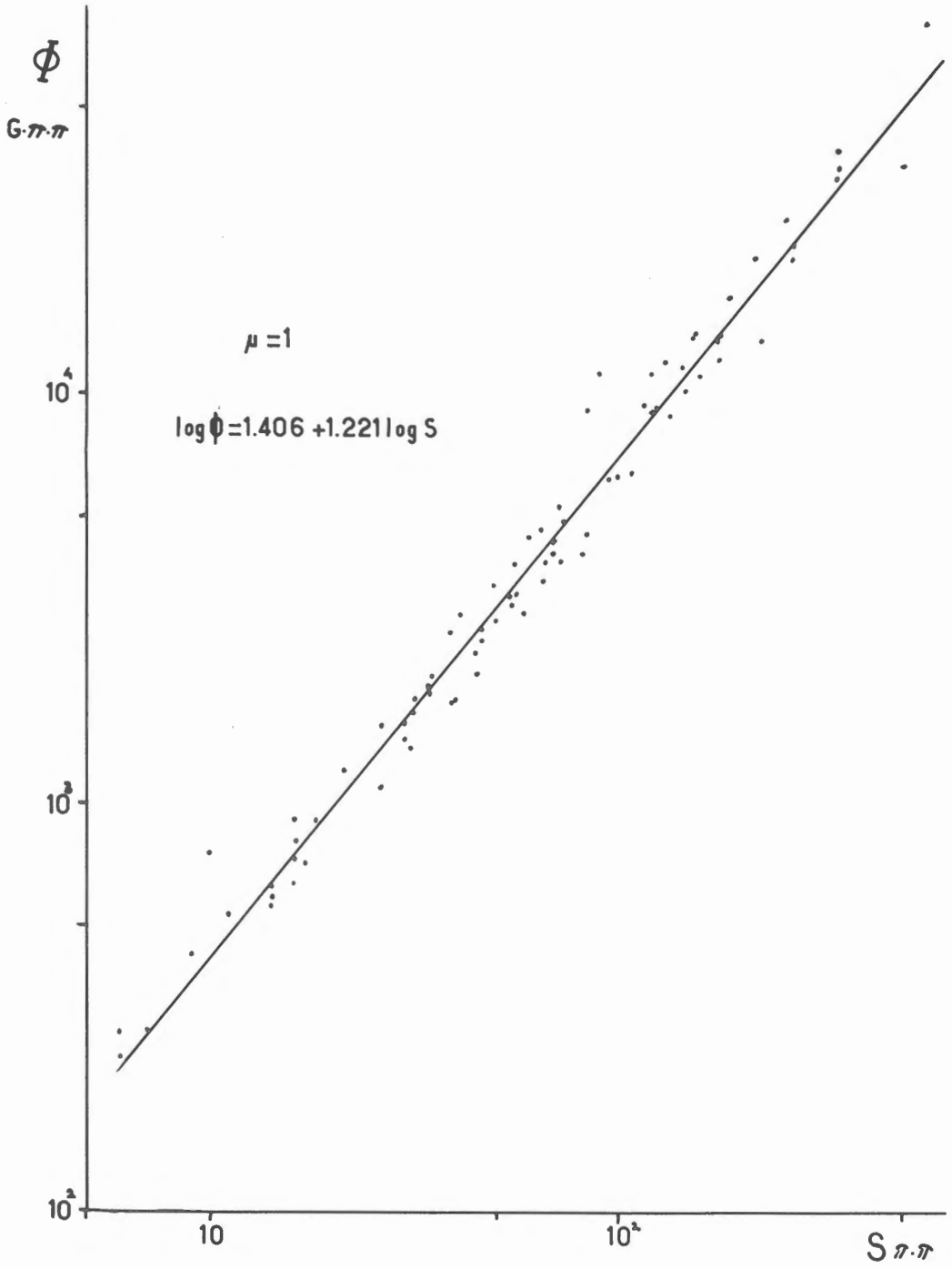
The surface (S) of the structures is between 6 and 2000 " x " The experimental error is less than 10 gauss for the given aperture.

3. Results

For each magnetic structure, we measured the flux (ϕ) through the surface (S) and obtained an empirical relation of the forme

$$\log \phi = c + d \log S \qquad (1)$$

The figure shows an example for the center of the solar disk. Two conclusions may be drawn : i) there is no basic difference between the magnetic field in faculae


Φ
G·π·π
μ =1
log Φ=1.406 +1.221 log S
10⁴
10³
10²
10
10²
S π·π

and in plages, and ii) a very strong relationship exists between the flux of $B_{\parallel}$ and the occupied surface.

In our study, we do not take into account sunspots and pores, or peculiar regions such as bright X points, etc.

The relation (1) remains valid over the whole solar disk, only the constants changing :

μ	$\Delta\mu$	N	c	d	r	σ
1	1 -0.97	83	1.406	1.221	0.992	0.072
0.71	0.88-0.37	79	1.421	1.275	0.984	0.082
0.60	0.71-0.48	45	1.529	1.139	0.990	0.063
0.35	0.47-0	27	1.488	1.164	0.992	0.050

In the table, N represents the number of measured structures, r is the correlation coefficient and 6 is the standard deviation.

Two corrections can be applied to the relation (1) ; the first is a correction for the seeing influence and the second is for the influence of choice of the boundary of the structure, i.e. $B_{\parallel} \geqslant 25$ gauss, instead of the isogauss curve $B_{\parallel} = 0$.

The effect of the image quality is studied in two successive observations of the same region, one with good seeing and the other with bad seeing. The results show a "tilt" of the logarithmic relationship between ϕ and S, when the seeing is bad.

IQ	N	c	d	r	σ
good	63	1.399	1.228	0.997	0.061
bad	90	1.397	1.317	0.987	0.087

From the relation (1) and an examination of the choice of contours, we see an important change in the value of the c constant. The relation (1) becomes :

$$\log \phi_c = 0.34 + 1.44 \log S \qquad (2)$$

This is the true relationship between ϕ and S for the center of the solar disk. From the relation (2) we can compute the flux through a surface of 5" x 5" as done

by Wiehr (1979) for the Fe I λ 525,02 nm line. In the present study, we obtained a value of 1.2 10^{18} Mx, which is half of the value obtained by Wiehr. This discrepancy can be explained by the fact that the two sets of observations were performed for different lines.

We would also point out that the Meudon observations give the same relation (1) and same constants, even when the technique of observation and the spectral lines used are entirely different.

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