CORONAL HOLES AND FLARE RELATED PHENOMENA

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ABSTRACT. We conclude that coronal holes exhibit differential rotation and they do not follow a specific polarity rule. Further, proximity of holes to type II burst rich active regions (ARs) indicates that shock waves propagate almost along the magenetic field of the holes.

1. INTRODUCTION

We discuss the validity of almost rigid body rotational behaviour of coronal holes (cf. Timothy et al.,1975; Wagner, 1975) and of the polarity rule for holes, namely that low-latitude holes (northern or southern) tend to develop in magnetic cells that have same polarity as of the polar cap in that hemisphere (cf. Bohlin and Sheeley,1978). We have also examined the proximity of holes to the type II burst rich ARs.

2. DIFFERENTIAL ROTATION AND MAGNETIC POLARITIES OF CORONAL HOLES

We assemble time sequences for $\pm 10^\circ$, $\pm 20^\circ - \pm 40^\circ$ and $\pm 40^\circ - \pm 60^\circ$ latitude zones of 10830 Å synoptic charts (cf. Figure 1). In Figure1, we recognise certain new patterns such as CH section, CH row (a sequence of CH sections) and CH stream (formed by several CH rows). CH streams are inclined to the west in equatorial zone and to the east in higher latitude zones. The zonal rotation periods determined from inclination angles give a synodic rotation rate of

$$\omega = 13.38 - (1.88 \pm 0.39) \sin^2 \phi \quad \text{deg/day}$$

for holes, However, holes near 30° S have a shorter rotation period ($\sim$27.7 days) than for the same latitude in the north ($\sim$ 28.1 days). The coefficient of $\sin^2 \phi$ in our rotation law is 4.5 times higher than that obtained by Timothy et al.(1975) for holes and only 0.66 times lesser than that given by Newton and Nunn (1951) for sunspots. Therefore we conclude that coronal holes exhibit differential rotation which is not in agreement with the conclusion drawn by earlier authors.

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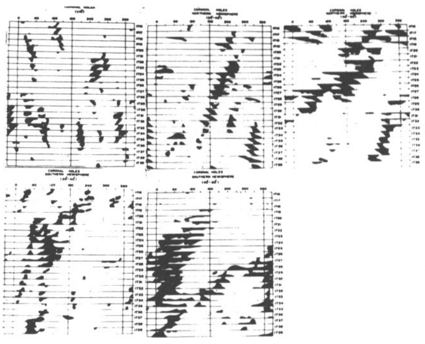

Figure 1. Coronal hole time sequences for $\pm 10^\circ$, $\pm 20^\circ - \pm 40^\circ$, $\pm 40^\circ - \pm 60^\circ$ latitue zones.

Regarding the polarity rule for holes we find that about 41% and 29% of total of mid-latitude holes of rotations 1716-1747 respectively in northen and southern hemispheres do not follow the specific polarity rule such as that given by Bohlin and Sheeley (1978).

3. PROPAGATION OF TYPE II BURSTS ALONG MAGNETIC FIELD

We find that out of 33 ARs which produce 84 type II bursts, only 25 ARs have holes in their vicinity at a longitudinal distance of $\sim 0.8^\circ$ to 10°.

Coronal magnetic and density structures refract propagating shock wave towards pre-existing low-Alfven velocity region (Uchida,1974). Therefore, open lined magnetic flux of holes may provide sites for type II bursts, since such structures provide lower Alfven velocity regions into which strength of weak shock is significantly enhanced due to refraction and focussing effect. The type II burst sources may be identified with such low Alfven velocity regions illuminated by such enhanced shocks. Type II burst event on 02 May 1978 (0122-0137 UT; AR No. 15266) may support this view, since it indicates that type II burst source was superposed on the hole.

Theoretically fast mode MHD waves propagate isotropically in the corona, and the direction of their propagation is sensitive to the Alfven speed distribution and not to the field direction. Thus, it seems that shock wave is not guided strictly along the open flux in the hole, but it is compelled to become inclined to get directed into such low Alfven velocity regions.

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