HELMET AND ACTIVE STREAMERS FROM RADIO OBSERVATIONS

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ABSTRACT

Large coronal regions disconnected from any calcium plages and identified by their thermal emission at 169 mHz play a basic role in the sector structure of the interplanetary medium. We now conclude that these coronal regions are to be interpreted as streamers.

We have shown that the basic structure of helmet and active streamers would be traced by the presence, length, and orientation of filaments, the structure of both types of objects being determined by magnetic fields. Here we present some properties of active and helmet streamers based on radio observations, in particular some consequences concerning the medium corona and the interplanetary medium [*Axisa et al.*, 1971].

At 169 mHz, the slowly varying component of thermal origin is best explained in terms of emission by streamers at a typical altitude of 0.4 solar radius (fig. 1). A plasma frequency of 169 mHz corresponds to an electron density of 3.5×10^8 e/cm^3. Therefore, at an altitude of 0.4 $R_\odot$, the quiet sun can be considered practically transparent for such a frequency. So a value of 3.5×10^8 e/cm^3 may be considered as an upper limit for the actual density in streamers at 0.4 $R_\odot$. In any case, it is seen that the electron density as deduced from our ratio data will be higher than proposed in Newkirk's model. It is in agreement with the electron density deduced from radio burst observations. At the same frequency, similar altitudes have been found for the sources of type III emission [*Mercier*, 1971].

As seen at 169 mHz, streamers schematically may be considered as dense plates extending from the filaments, with roughly the same length. The actual width of such plates cannot be estimated because of the limited resolving power of our instrument. But a recent study relative to type III bursts obtained with the Nancay radioheliograph leads to an estimation of 20,000 km [*Mercier*, 1971]. Koutchmy deduced similar results from the March 1970 eclipse [*Koutchmy*, 1971].

We would like to discuss some implications concerning the coronal expansion. Independently, Schatten and Newkirk pointed out that through the medium corona, a very important filtering effect occurs and therefore the knowledge of coronal structure at a typical altitude of 0.6 $R_\odot$ is of great importance [*Schatten*, 1968; *Newkirk et al.*, 1968]. The coronal structures observed in radioastronomy at this level after the filtering effect have the same stability and longitudinal extent as the underlying filaments. Because large filaments reflect large regular magnetic field structures, it may help to understand physically why a relatively good correlation between interplanetary and photospheric large scale patterns has been found [*Wilcox and Ness*, 1965].

In connection with this problem, *Martres et al.* [1970] have emphasized that large coronal regions disconnected from any calcium plages and identified by their thermal emission at 169 mHz play a basic role in the sector structure of the interplanetary medium (fig. 2). In the light of our present results, we now conclude that these coronal regions are to be interpreted as streamers. This result is in full agreement with *Bohlin's* [1970] paper showing the connection between an asymmetrical helmet streamer and the interplanetary magnetic field.

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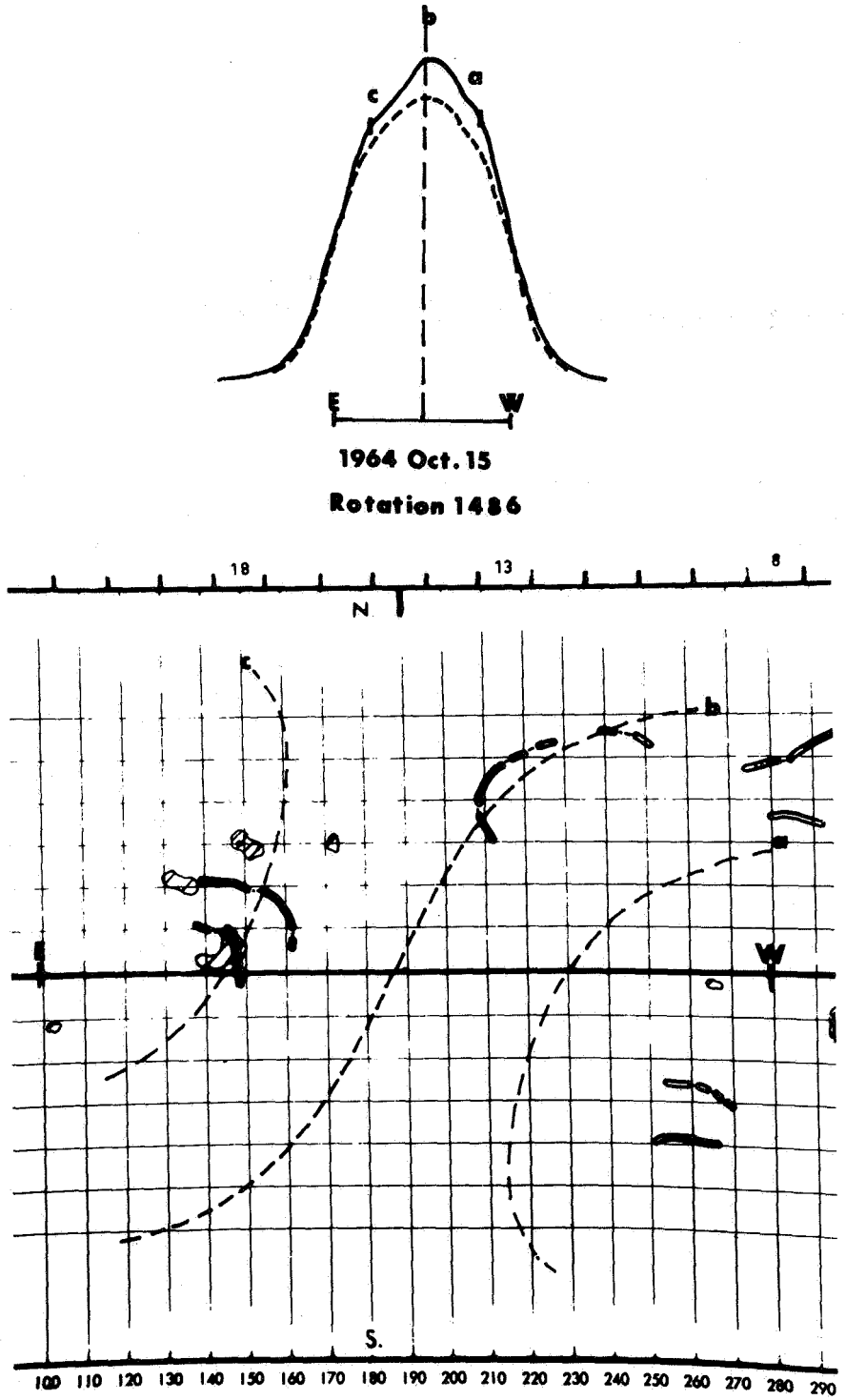

Figure 1. *Correlation between RFIs and optical features. The upper part of the figure shows an RFI (b) which crossed the meridian on October 15, 1964. Other RFIs (a) and (c) are distinguishable on the flanks. In the lower part, the synoptic map of Meudon is reproduced. The dashed line (b) is the plot of the meridian trace which crosses a high latitude filament. Dashed lines (a) and (c) represent the traces of the scans corresponding to RFIs (a) and (c) [Axisa et al., 1971].*

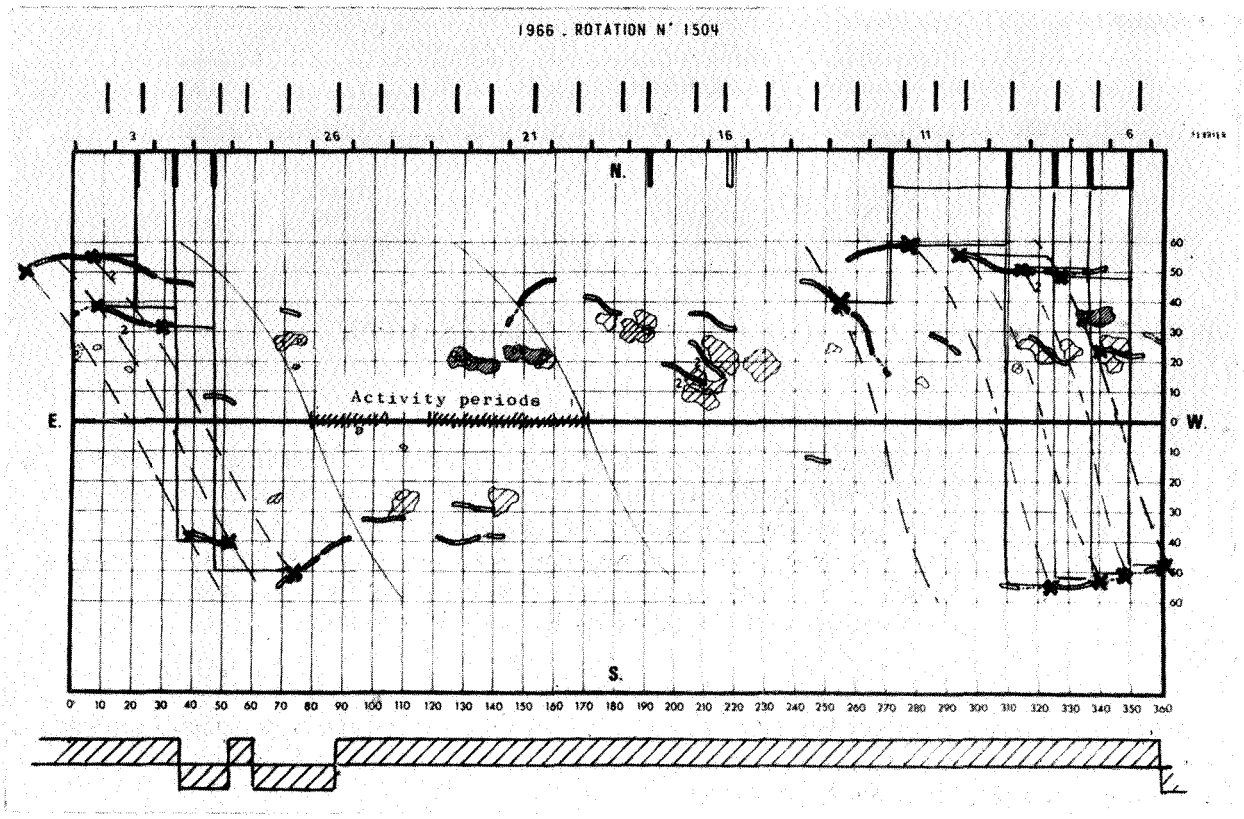

Figure 2. *Comparison between the streamers positions and the inversion of interplanetary magnetic field (taking into account the velocity of solar wind).*

Finally, we would like to emphasize that as the slowly varying component observed near 169 mHz, contrasting with higher frequencies, is not at all representative of the solar activity (eruptive centers, calcium plages, coronal condensations, coronal enhancements), the pattern of the interplanetary sectors would not be simply linked to calcium plages.

We now come to the solar wind expansion. Referring to the theoretical work of *Pneuman* [1969], we think that it is not so much the streamer itself that is of crucial importance, but the surrounding region. It is quite clear that solar activity will have a basic role to play by supplying energy. For the transfer of that energy throughout the medium corona, active streamers and helmet streamers will play an important role.

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