Solar Radio Asymmetry at 4-Metres Wave-length

In 1948, Hey, Parsons and Phillips[1] reported that at 4·1-metres wave-length bursts of radio emission, usually of a few minutes duration, occurred more often in association with flares on the eastern half of the sun's disk than on the western half. Subsequent observations have confirmed this conclusion. In a recent analysis of radio emissions at 1·5-metres wave-length, Dodson, Hedeman and Owren[2] could find no evidence of this asymmetry. The following reasons may explain why they failed to observe the effect.

Hey, Parsons and Phillips[1] suggested that the asymmetry they had observed might be due to radio absorption in ionized solar corpuscular streams, as the rotation of the sun causes the envelopes of such streams to drift eastwards relative to the active solar regions from which they emanate. They also pointed out that the longer the wave-length, λ, the greater would be the expected absorption. That this anticipated property provides a test of the absorption theory was emphasized by Unsöld and Chapman[3].

As the absorption coefficient is proportional to λ^2, it is approximately 7·5 times greater at $\lambda = 4 \cdot 1$ metres than at $\lambda = 1 \cdot 5$ metres. Further, if the electron density in the stream is sufficient, the refractive index, μ, may be appreciably less than unity at long wave-lengths, and the absorption coefficient would again be increased since it is inversely proportional to μ ; in addition to this, refraction might be expected to diminish radio intensities in the direction of the ionized streams by deviating the long radio waves out from them. It is consequently to be expected, on the hypothesis that solar radio asymmetry at $\lambda = 4 \cdot 1$ metres is due to asymmetrical absorption in an ionized stream, that the asymmetry might be difficult to detect at the shorter wave-length of 1·5 metres. The results reported by Dodson, Hedeman and Owren are therefore in accordance with this hypothesis, although the conclusion can scarcely be regarded as decisive yet as they analysed only about two hundred flares with associated radio measurements during 1948–50, whereas we found that ten times this number of observations obtained during 1947–50 were only just sufficient to establish the significance of the asymmetry at $\lambda = 4 \cdot 1$ metres at the 5 per cent level of chance probability.

Additional data at $\lambda = 4 \cdot 1$ metres obtained during part of 1946 and the first half of 1951 have increased the significance of the asymmetry observed at this wave-length. It is unfortunate that, owing to interference and other circumstances, radio measurements had to be discontinued in 1951, because a striking feature is the pronounced increase in the asymmetry during the second half of 1950 and the first half of 1951, just when the recurrent *M*-type magnetic storms were becoming prominent. This suggests the intriguing possibility that continuous *M*-type corpuscular streams may be more effective in producing absorption than are the spasmodic bursts of corpuscular emission from active flare regions.

A detailed analysis of the radio asymmetry with respect to terrestrial magnetic activity is now in progress. It is hoped that this may be decisive in establishing whether or not the interpretation in terms of the absorption of a corpuscular stream is correct. There is so little direct evidence of solar corpuscular streams, and especially of the nature of solar *M*-regions, about which there is yet uncertainty whether the terrestrial magnetic activity might be due not to corpuscular streams but to ultra-violet radiation, that any evidence which can be derived from radio phenomena is of importance.

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[2] Dodson, H. W., Hedeman, E. R., and Owren, L., *Astrophys. J.*, **118**, 169 (1953).
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Time of Flight of 14·1-MeV. Neutrons

The essential problem in utilizing the time of flight of fast neutrons for energy measurements is the rapid fall-off in efficiency of detection as the flight path D is increased, since the resolution is proportional to D, while the efficiency is proportional to D^{-2}. It is therefore desirable that a multi-channel time spectrometer be used when a neutron momentum spectrum is being analysed.

One such instrument is the high-speed triggered oscilloscope in which the first pulse triggers off the time base and the second pulse is displayed on the '*y*' plates. Using a new form of high-speed time base and low-level trigger circuit[1], the group of pulses due to the 14·1-MeV. neutrons from the reaction $^3H(d, n)^4He$ has been analysed. A full account of the technique will be published later ; but it is felt that a preliminary indication of the feasibility of the method and indeed of the accuracy of the analysis even with such high-energy neutrons will be of interest. The graph shows the number of pulses falling in each division of the time base which is triggered from the recoil ^4He detected in a stilbene crystal. The neutrons travel about five metres and into six cubic inches of toluene/terphenyl solution. By moving the toluene bottle towards the target, the shift observed in the peak is in agreement with that calculated from the neutron energy. The optimum resolution is less than 10 mμsec.[2] and is obtained by adjusting the biases on the two low-level discriminators. At this setting most of the neutron pulses overcome the bias.

Although the high-speed time-base is invaluable in setting up the apparatus, it is tedious to estimate a