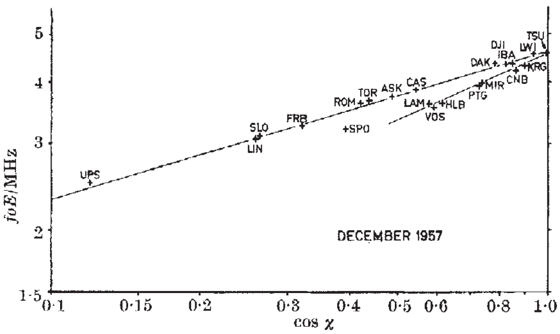

Fig. 2. Dependence of the monthly median critical frequency of the E-layer at noon on the zenith angle χ, December 1957. Upper line, northern hemisphere; lower line, southern hemisphere

longitude range. One finds two straight lines instead of only one as would be expected. It is always the winter hemisphere which gives the higher values, and hence the lines are inverted on changing from December to July. The 'scissors' effect disappears at the equinoxes.

It follows that a few stations, such as Lwiro, Chiclayo and Chimbote, are in a much better position for E-layer observations because the perturbing effects that cause seasonal variations, etc., seem to be unimportant at those places.

R. EYFRIG

Fernmeldetechnisches Zentralamt
der Deutschen Bundespost,
Ionosphären-Institut, Breisach/Rheim.

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RADIOPHYSICS

Faraday Rotation Effects associated with the Radio Source Centaurus *A*

THE remarkable observations of Cooper and Price[1] indicate that the radiation from the radio source Centaurus A is linearly polarized and is subject to Faraday rotation of an amount such that:

$$\int n\, H \cos\alpha\, dr \sim 2{\cdot}5\times 10^{14} \text{ gauss cm}^{-2} \qquad (1)$$

where n is the number of free electrons per cm^3, H is the magnetic field in gauss and α is the angle between the magnetic field and the line of sight. Cooper and Price assert that "the majority of the rotation must be occurring either within our own Galaxy or in the outer regions of Centaurus A". Nevertheless they find that both of these possibilities are quantitatively somewhat implausible.

For the Galaxy, Cooper and Price take values representative of the halo. I differ from them by assuming $n \sim 10^{-3}$ cm^{-3}, $H \sim 10^{-6}$ gauss (their value of 10^{-5} gauss seems much too large[2]), and $\int \cos\alpha\, dr \sim$ one-fifth of the dimensions of the region (a somewhat arbitrary choice which I make for all the regions mentioned in this communication). Taking the dimensions of the halo as 10 kiloparsecs we have:

$$\int n\, H \cos\alpha\, dr \sim 6\times 10^{12} \text{ gauss cm}^{-2}$$

which is rather less than expression (1).

As regards the possibility that the rotation occurs in the outer envelope of Centaurus A, Cooper and Price point out that it is remarkable that the effect varies so little from one line of sight to another. This point is somewhat strengthened by the following consideration. If we assume that the dependence of the percentage polarization on frequency is due to Faraday rotation in the emitting regions themselves, one can calculate: (1) the amount of this rotation (which turns out to be about one-tenth of the total rotation observed); (2) the percentage polarization in the absence of this rotation (which is a measure of the uniformity of the magnetic field in the emitting regions). The calculation shows that both these quantities vary from one line of sight to another by more than a factor 2, in contrast to the 15 per cent or so for the total Faraday rotation.

The difficulty is less severe in an alternative explanation which I wish to propose, namely, that most of the rotation takes place in the local cluster of galaxies (or possibly in the cluster containing Centaurus A). According to a model recently developed by me[3], the local cluster contains a magnetic field of about 5×10^{-7} gauss. In this model $n \sim 1/3 \times 10^{-3}$ cm^{-3}, and the dimensions of the region are about one megaparsec[4]. This increase in dimensions as compared with the galactic halo more than compensates for the decrease in n and H. In fact for the local cluster:

$$\int n\, H \cos\alpha\, dr \sim 10^{14} \text{ gauss cm}^{-2}$$

In view of the uncertainties in the parameters of the cluster, this agrees reasonably well with expression (1). The small variation in the rotation from one line of sight to another is now more understandable, since the regions involved lie closer together in space, and their separation is a smaller fraction of the dimensions of the magnetically active medium.

One should also examine the possibility that the Faraday rotation occurs mainly in the intergalactic space between the source and the local cluster. Most cosmologists believe[5] that the average particle density in the universe as a whole is about 10^{-5} cm^{-3}, and it is probable[6-8] that most of this is in the form of ionized hydrogen. Accordingly, $n \sim 10^{-5}$ cm^{-3}. Taking $H \sim 10^{-7}$ gauss[9] and the distance of Centaurus A as 4 megaparsecs[1], we have:

$$\int n\, H \cos\alpha\, dr \sim 2\times 10^{12} \text{ gauss cm}^{-2}$$

which is again too small.

I conclude that the observations of Cooper and Price may be explained in terms of a magnetic field in the local cluster of galaxies. If other polarized sources can be detected, it might be possible to check this conclusion by studying the dependence of the amount of Faraday rotation on the direction of the source.

D. W. SCIAMA

Department of Applied Mathematics
and Theoretical Physics,
University of Cambridge.

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