LETTERS TO THE EDITOR

A SIMPLE MAGNETIC UNIVERSE

We shall call a distribution of magnetic field together with its associated geometry 'a magnetic universe'. One such universe is discussed by Melvin[1,2] and Melvin and Wallingford.[3] The object of the present note is to report on a simple magnetic universe which is different from that of Melvin.

The geometry of this universe is described by the line element

$$ds^2 = (dx^0)^2 - (dx^1)^2 - Y^2 (dx^2)^2 - (dx^3)^2, \quad (1)$$

where Y is function of x^1 alone. The metric (1) admits a 3-parameter group of motions, for it is unchanged by the transformation

$$\bar{x}^0 = x^0 + B_0,\ \bar{x}^2 = x^2 + B_2,\ \bar{x}^3 = x^3 + B_3 \quad (2)$$

where the B's are arbitrary constants.

The non-vanishing components of Ricci tensor R_k^i for the metric (1) are given by

$$R_1^1 = R_2^2 = -\frac{Y_{11}}{Y}. \quad (3)$$

The subscripts denote the differentiation with respect to x^1.

Now, for a magnetic field

$$R = 4\lambda \quad (4)$$

where R is the curvature scalar and λ is the cosmological constant. The equations (3) and (4) imply that

$$Y_{11} + 2\lambda Y = 0. \quad (5)$$

The solution of the above equation is given by

$$Y = B \cos(\sqrt{2\lambda}x^1 + C) \quad (6)$$

where B and C are constants of integration.

Applying a transformation similar to (2), one can make $B = 1$ and $C = 0$. Therefore, finally we have

$$Y = \cos(\sqrt{2\lambda}x^1). \quad (7)$$

The magnetic field in the universe can be described by a 4-potential ϕ_i of the form

$$\phi_i = \{0,\ 0,\ f(x^1),\ 0\} \quad (8)$$

so that only one component of the electromagnetic field tensor F_{ik}, *viz.*, F_{12} is non-vanishing.

$$F_{12} = -f_1. \quad (9)$$

The absence of charge and currents in the field implies that

$$F^{12} = \frac{A}{Y} \quad (10)$$

where A is a constant of integration. Results (9) and (10) lead to $f_1 = -AY$ so that

$$F_{12} = AY \quad (11)$$

where Y is given by (7).

The field equations of Einstein-Maxwell theory with a non-vanishing cosmological constant λ are

$$R_k^i - \lambda\delta_k^i = \tfrac{1}{2}(F^{in}F_{kn} - \tfrac{1}{4}\delta_k^i F_{mn}F^{mn}).$$

These equations are satisfied if we take λ to be positive and

$$\lambda = A^2. \quad (12)$$

Consider now a local observer using a Minkowskian frame of reference in his neighbourhood. The electromagnetic field as observed by him can be visualized by choosing the following tetrad at a point.

$$\gamma_{(a)}^i = \text{diag}\{1, 1, \cos(\sqrt{2\lambda}x^1), 1\} \quad (13)$$

Using (13) we find that the only non-vanishing tetrad component of F_{ik} is given by

$$F_{(12)} = H_3 = A = \sqrt{\lambda} \quad (14)$$

This shows that the local observer observes a magnetic field in the direction of $r^i_{(3)}$.

Here it should be noted that in Melvin's universe $\lambda = 0$, while in our solution λ plays a central role. If we set $\lambda = 0$, the electromagnetic field is also switched off and the geometry becomes Minkowskian. This is an interesting feature of our solution.

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ROTATORY DISPERSION OF SODIUM PERIODATE AND GUANIDINE CARBONATE

There has been a considerable revival of interest in the study of crystalline optical activity since the quadratic type of rotatory dispersion formula was first introduced by Chandrasekhar[1,2] and applied successfully to α-quartz, cinnabar, sodium chlorate and benzil crystals. On the theoretical side, Agranovich[3] developed a quantum mechanical theory of crystalline optical activity and showed that it

leads to the same formula derived by Chandrasekhar on the basis of an elementary model. On the experimental side the formula has been found to explain the rotatory dispersion, its temperature and pressure variation, of a number of crystals.[4-13] In this communication, the applicability of the formula to two more cases, *viz.*, sodium periodate ($NaIO_4.3\,H_2O$; belonging to the space group C_3^4) and guanidine carbonate [$(CN_3H_5)_2.H_2CO_3$; belonging to the space group D_4^4 (D_4^8)] is discussed. Previous data on these crystals are scanty[14,15] and no attempts have been made to express the data in terms of any formulae.

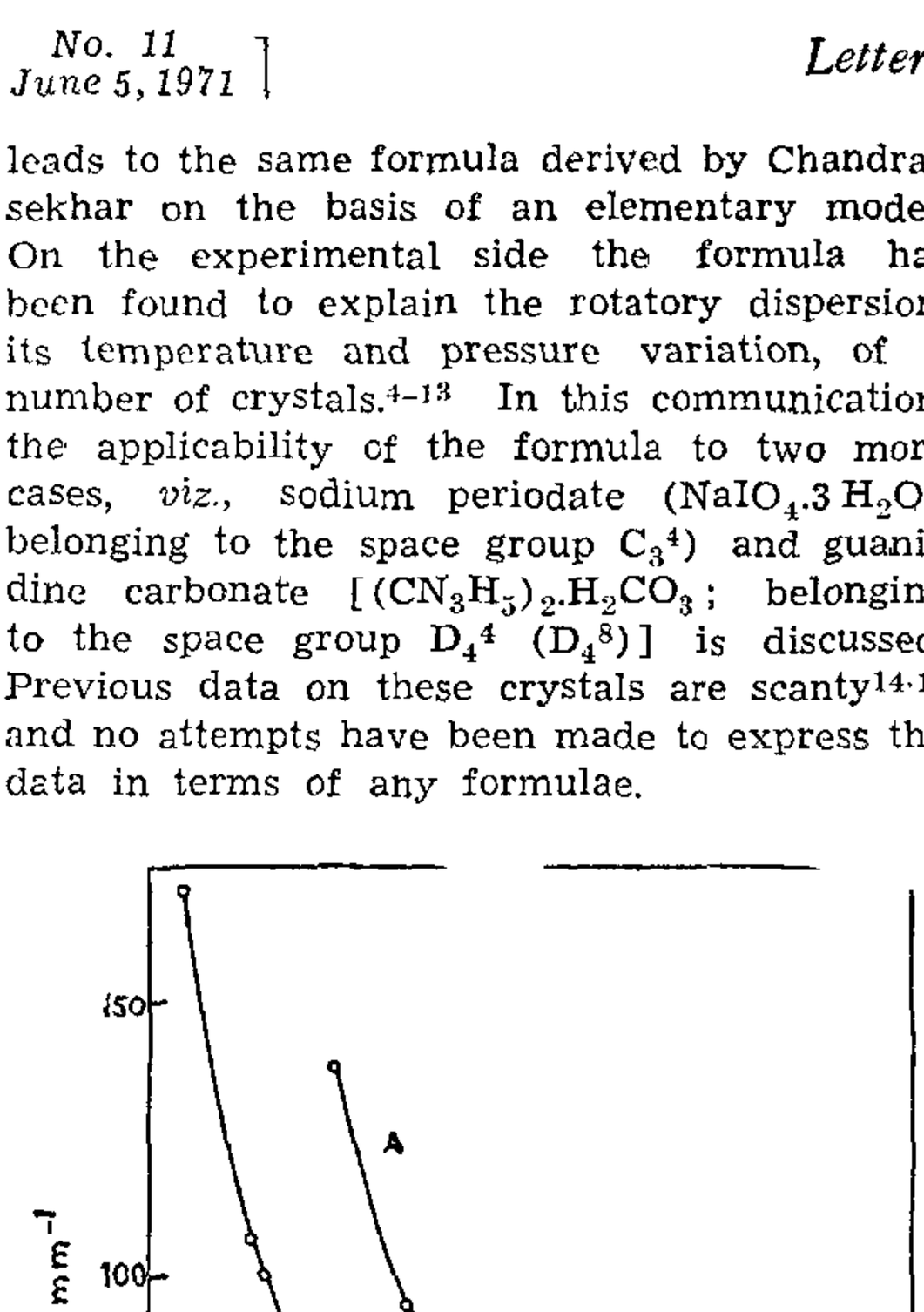

FIG. 1. Rotatory dispersion of (A) Sodium periodate; (B) Guanidine carbonate.

The crystals were grown from solution at room temperature by the slow evaporation technique and cut with faces perpendicular to the optic axis. The faces were ground and polished, and their parallelism was tested optically. The crystals were sandwiched between two fused silica discs with a drop of paraffin. The spectropolarimeter arrangement was the same as described in an earlier paper.[7]

Measurements on sodium periodate were made for 10 wavelengths from $\lambda\,0{\cdot}5790\,\mu$ to $\lambda\,0{\cdot}33415\,\mu$ and could not be extended to shorter wavelengths because of high absorption; measurements on guanidine carbonate were made for 16 wavelengths from $\lambda\,0{\cdot}5790\,\mu$ to $\lambda\,0{\cdot}2652\,\mu$. The rotatory power of both crystals are expressible by a single term Chandrasekhar formula

$$\rho = \frac{K\lambda^2}{(\lambda^2 - \lambda_0^2)^2}$$

with the following constants:

	K	λ_0
Sodium periodate	5·641	0·21
Guanidine carbonate	4·637	0·1625

The rotatory dispersion curves are presented in Fig. 1 and as can be seen the agreement is satisfactory. For $NaIO_4.3\,H_2O$ the r.m.s. deviation between calculated and experimental rotatory power is 0·41 deg/mm and the maximum deviation 1·7%; for guanidine carbonate the corresponding values are 0·51 deg/mm and 1·5%.

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EXPERIMENTAL MEASUREMENT OF THE K-CONVERSION COEFFICIENT OF 80 keV TRANSITION IN ^{144}Pr

THE K-conversion coefficient of the 80 keV transition has been determined using a 2·5 cc Ge (Li) detector for the gamma intensity measurements. Several groups have reported conflicting results for the K-conversion coefficient of this line. Hicock *et al.*[1] combining their X-ray and γ-ray intensity measurements with scintillation spectrometers and the internal conversion line measurements with magne-