More observations, analysis and modelling are to be done, but even these preliminary results suggest the value of dynamic spectral observations in the analysis of interplanetary scintillations. Just as spectral observations of scintillations from the ionosphere gave greater insight⁸ than single-frequency studies, so the spectral observations reported here extend single-frequency interplanetary studies. The fact that single-frequency observations of interplanetary scintillations might obey Rayleigh statistics is not always sufficient proof that a random scattering medium is actually involved. One possibility suggested here is of systematic diffraction from sharp density gradients.

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An alternative interpretation by A. Hewish*

Cole and Slee have suggested that their beautiful observations of interplanetary scintillation cannot be explained by conventional models of the solar plasma. I do not share their view and now outline my reasons for believing that the new data reinforce the standard theory.

On conventional models, derived from spacecraft and radioastronomical data, the solar plasma contains density irregularities having a three-dimensional wavenumber power spectrum $P(K)$ which approximates to a Kolmogorov spectrum $P(K) \propto K^{-11/3}$ for irregularities on a scale $10^6 \text{ km} > 2\pi K^{-1} > 10^3 \text{ km}$. Evidence for a flattening of the spectrum for $2\pi K^{-1} < 10^3 \text{ km}$ has been reviewed elsewhere^{1,2}. At a solar elongation of 13° , and at 400 MHz, Readhead *et al.*¹ predict intensity fluctuations on a time scale of about 0.7 s, with a scintillation index of about 0.75, and which correlate over a band of about 200 MHz. These features are in good agreement with Fig. 1.

It is well known that irregularities on a scale larger than about 10^3 km (at this elongation) give reduced intensity fluctuations at 400 MHz because the Earth is then within the near-field zone. The larger irregularities, therefore, introduce phase gradients across the incident wavefront. I have shown elsewhere³, in connection with the interstellar scintillation of pulsars, that scintillation due to small-scale irregularities combined with phase gradients due to large-scale irregularities produces characteristic frequency drifts similar to those observed by Cole and Slee. The drift rate is

$$\frac{d\nu}{dt} = \pm \frac{V\nu}{2Z\theta_r}$$

where V is the drift velocity of the diffraction pattern, Z the distance to the irregularities, and θ_r the angular refraction corresponding to the phase-gradient. This phenomenon was originally discussed by Shishov⁴.

The observations of Cole and Slee show frequency drifts which change sign in about 5 s, corresponding to a periodicity of roughly 10 s. This requires irregularities of scale $2\pi K^{-1} \sim 4 \times 10^3 \text{ km}$ assuming a solar wind speed of 400 km s^{-1} . The model of Readhead *et al.*¹ indicates a phase modulation $\phi \sim 0.53 \text{ rad}$ at 400 MHz for small-scale irregularities which produce scintillation on a time scale of about 0.7 s. Assuming $P(K) \propto K^{-11/3}$

we derive $\phi \sim 0.53(10/0.7)^{5/6} \approx 5 \text{ rad}$ for the integrated phase modulation on scales up to $4 \times 10^3 \text{ km}$. Putting $\theta_r \sim \phi K\lambda/2\pi \approx 0.2 \text{ arc s}$ we obtain $d\nu/dt \sim \pm 390 \text{ MHz s}^{-1}$ for $Z = 1 \text{ AU}$ and $\nu = 400 \text{ MHz}$. This drift rate is typical of many features seen in Fig. 1. The question of simultaneous drifts with opposite sign mentioned by Cole and Slee raises no problems. The magnitude of θ_r ensures that wave fronts refracted convergently at a distance of 1 AU must, on arrival at the Earth, be overlapping for $\sim 10\%$ of the total time, leading to the superposition of patterns having drifts in opposite directions. The convergence and divergence of wave fronts suggest that overlap regions should be flanked by bands of negative slope on the preceding side, and positive slope on the following side, which is certainly true for the feature at 45 s discussed by Cole and Slee. They should also be associated with a higher mean intensity which can again be seen.

Finally it should be mentioned that the 'spiky' nature of the intensity variations is typical of diffraction patterns at distances not too far from the 'focusing' distance of the random irregularities. This property has been reviewed by Uscinski⁵. I conclude that the standard theory, involving the integrated effect of many 'weak' irregularities along the line of sight, is in excellent agreement with the present observations. I believe that more extended data of this kind could add considerably to our knowledge of $P(K)$.

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Crystal structure of $\text{Ag} \cdot \text{TCNQ}$

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High resolution electron microscopy (HREM) has been used for the direct imaging of complex crystal structures. High resolution at an atomic level cannot be expected from most organic crystals due to their high sensitivity to electron radiation damage, although we¹ have previously considered the conspicuous images of chlorine and copper atoms in chlorinated copper phthalocyanine molecules as a special case dependent on the very radiation-resistant property of the compound. In practice, however, some organic crystals may be able to withstand the dosage necessary for the image recording itself but could not tolerate the extra dosage necessary for searching the proper image field and for successive careful focusing. In this respect, the principle of the minimum exposure proposed by Williams and Fisher² is attractive as it might reduce the unnecessary damage which takes place before the actual image recording. We describe here the structure images of a metal complex of 7,7',8,8'-tetracyanoquinodimethane (TCNQ) with the resolution of an atomic level obtained by developing an automated device which is basically similar to that by Unwin and Henderson³. The electron microscope equipped with the low dosage device was JEM-200CX, which gives the instrumental resolution of 0.24 nm.

The various metal salts of TCNQ behave as the charge transfer complexes which show interesting electronic and magnetic properties. A thin crystalline film of complex salt forms by solid state diffusion when a thin film is prepared in the form of a double layer by the successive vacuum condensation of TCNQ and metal on a suitable substrate⁴. If the metal film is deposited on TCNQ crystallites which have been epitaxially grown in advance on a KCl cleavage face, the reaction leads to a

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