LETTERS TO THE EDITOR

ASTRONOMY

Character of the Optical Luminosity Fluctuations of 3C 273

In formulating the purpose of their note on the optical luminosity fluctuations of 3C 273, Manwell and Simon¹ confuse the conventional terms "random", "random process" and the concept of statistical independence. We emphasize that our statement in ref. 3 (see also refs. 4 and 5) is based on the fact that the light curve of the quasi-stellar source 3C 273 shows that a quasar nucleus is a system with a high self-interaction, and the rapid (in comparison with the quasi-period of the 3C 273 light curve) variations of optical radiation are conditioned by internal random causes.

To reject the conflicting view that the quasar brightness record (without the secular trend)

$$x(t) = R(t) \cos [\omega t + \theta(t)]$$

can be generated by a superposition of independent occasional events of the same type, we have applied the statistical criterion which is based on the properties of the envelope $R(t)$. Clearly, direct substitution of two functions, the envelope $R(t)$ and the phase $\theta(t)$, for one record, $x(t)$, allows them to be chosen rather arbitrarily. If the envelope $R(t)$ and the phase $\theta(t)$ are chosen so that they are statistically independent, $R(t)$ would have a Rayleigh, and $x(t)$ a Gaussian, distribution.

Direct control has supported not only the absence of correlation between the functions $R(t)$ and $\theta(t)$ used by us³ but has also pointed to their independence⁵. This fact made it possible to reject with 99 per cent confidence the hypothesis that the stationary process $x(t)$ is Gaussian and independent (when the lag Δ is at least 2 years). The "slow amplitudes" $x(t)^*$ and $y(t)$ introduced by Manwell and Simon can be chosen rather arbitrarily; because of this the issue of checking for their independence and their distribution is not in any way directly concerned with a search for sensitive statistical criteria.

Earlier³ we pointed out that the sampling of spectral density at low frequencies, which was used in ref. 2, is not representative. Now Manwell and Simon¹ direct their attention to the χ^2_p test[†] and apparently they believe that fulfilment of this criterion means that the Gaussian hypothesis for 3C 273 may be accepted. It is common knowledge, however, that a particular case can only reject but not prove some general mathematical statement.

The closeness to a Gaussian of the distribution of fluctuations of quasar radiation in various physical models is worth studying⁵. In terms of the conception of the superposition of independent occasional flashes it is necessary for the frequency of flashes to be 10^2 – 10^3 events year⁻¹. Obviously, for an 80 year period of observation the one-dimensional distribution of records of $x(t)$ should be found to be practically Gaussian. We note that, because of the small magnitude of the variable part of

* The function $x(t)$ which appeared in ref. 1 is not the same as the function we introduced in ref. 3.

† From their note it is not clear how the χ^2_p test was applied, but some indirect details cause alarm. For example, because the dispersion of process $x(t)$ is not *a priori* known and we need to know the sampling standard deviation, it is more natural to use the F test than the χ^2 test.

the recorded $x(t)$, the change-over from astronomical magnitude to luminosity is of no importance.

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¹ Manwell, T., and Simon, M., *Nature*, **212**, 1224 (1966).

² Manwell, T., and Simon, M., *Nature*, **217**, 931 (1968).

³ Gudzenko, L. I., Ozerney, L. M., and Chertoprud, V. E., *Nature*, **215**, 605 (1967).

⁴ Ozerney, L. M., and Chertoprud, V. E., *Soviet Astro. A. J.*, **10**, 15 (1966).

⁵ Gudzenko, L. I., Ozerney, L. M., and Chertoprud, V. E., *Astr. Zh.*, **45** (in the press, 1968).

CHEMISTRY

Metal-Nitrogen Infrared Stretching Frequencies in Dialkylamido-transition Metal Compounds

THE infrared and Raman spectral analysis of $\text{Ti}(\text{NMe}_2)_4$ reported by Bürger *et al.*¹ prompts us to disclose some of our infrared data on a number of dialkylamido derivatives of transition metals². Of particular interest are the stretching frequencies of the metal-nitrogen bonds. All the compounds examined had a characteristic strong band in the 590–700 cm^{-1} region (Table I) which was absent in the parent amine and which we believe is predominantly metal-nitrogen stretching in character. For the tetrakis-dialkylamido-metal (IV) compounds, assuming local T_d symmetry of the MN_4 system, an infrared active band (ν_3) should occur involving the asymmetric metal-nitrogen stretching vibration and it is suggested that this corresponds to the "characteristic band" shown in Table I although it is recognized that coupling with other modes of vibration may be involved. The work of Bürger *et al.*¹ confirms our assignment in the case of $\text{Ti}(\text{NMe}_2)_4$. Considering the titanium, zirconium, hafnium compounds $\text{M}(\text{NR}_2)_4$, it is interesting to note the definite increase in frequency with increase in chain length of the alkyl group R . This is interpreted as indicative of a significant degree of ligand $\rightarrow$ metal π -electron donation $\text{M}=\text{N}^+\text{R}_2$ involving the lone-pair of electrons on nitrogen and the vacant d-orbitals on the metal. Other factors such as the mass-effect of the ligand or its steric effect would lead to a decrease in frequency with increase in size of the alkyl groups contrary to the observed results.

Table 1. METAL-NITROGEN STRETCHING FREQUENCIES IN $\text{M}(\text{NR}_2)_4$

	NMe_2	NEt_2	NP^nr_2	NBu^n_2
Ti	592	610	667	667
Zr	537	577	637	637
Hf	533	577	637	—
V(IV)	595	613	—	—

The data for $\text{Ti}(\text{NR}_2)_4$ and $\text{V}(\text{NR}_2)_4$ are, as expected, very similar and so also are the values of the data of the corresponding zirconium and hafnium compounds. These results suggest that force constants are greater for the titanium and vanadium(IV) compounds than for the corresponding zirconium and hafnium compounds, but it is not possible to state whether this is due to a difference in π -bonding contributions.

Some data on niobium and tantalum compounds show interesting behaviour. For example, the pentakis-dimethylamido-derivatives $\text{M}(\text{NMe}_2)_5$ (where $\text{M} = \text{Nb, Ta}$) each give a single band (Nb , 540 cm^{-1} ; Ta , 528 cm^{-1}) although local D_{3h} symmetry for the expected trigonal bipyramidal structure requires two infrared bands (A'_2 ,