matters arising

The 17-d periodicity of Cygnus X-3

ARIEL V observations have indicated[1] a possible 16.75-d periodicity in the flux of Cygnus X-3. I report here that the primary data (from ref. 1) have been digitised and power-spectrum analysed; the results are shown in Fig. 1. (Analysis details available from the author.) The power spectrum shows a broad continuum of fluctuations, with an r.m.s. variation ~ 40% of the average flux for periods $\gtrsim$ 3 d and a power law spectrum, $P(f) \propto f^{-1.5}$. This is not the spectrum expected from a shot-noise source[2].

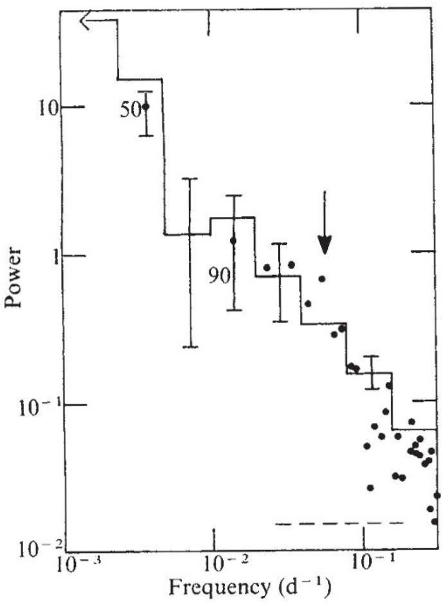

Fig. 1 Relative power spectrum of the flux of Cygnus X–3. Circular points are spectrum using FFT method (typical 50% and 90% confidence intervals are shown). The histogram gives spectrum using nested variance technique (90% confidence intervals shown). Dashed horizontal line represents noise level.

The arrow in Fig. 1 indicates a small peak in the power spectrum at the 16.75-d periodicity discussed in ref. 1. The significance of the peak is estimated from the excess power above the background fluctuation level (rather than above the Poisson noise level)[2]. There is about 50% likelihood that there exists a 16.75-d periodicity. This periodicity, if real, accounts for ~10% of the fluctuations and has an r.m.s. amplitude ~4% of the total flux.

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[1] Holt, S. S. *et al. Nature* **260**, 592–594 (1976).
[2] Terrell, N. J. *Astrophys. J.* **174**, L35–L41 (1972).

HOLT REPLIES—Owens implies that the ~17-d periodicity reported in ref. 1 may be artefactual, in view of the broad continuum of fluctuations evident in the raw data. We have no quarrel with such a qualification; indeed, ref. 1 explicitly pointed out that the high degree of source variability, variable gaps in coverage, and no explicit correction for the known 4.8-h source modulation could be expected to result in artefactual frequency components in the data analysis.

The ~17-d effect was not, therefore, reported solely on the basis of it being the most significant (statistically) period in the search we performed on the Ariel V All-Sky Monitor data. We felt that the apparent presence of the same effect in the Ariel V Sky Survey Experimental data, which were corrected for 4.8-h variations and which were obtained during extended gaps in the All-Sky Monitor exposure (so that the two sets of data were completely independent), was sufficient justification for alerting the scientific community to the possibility of its reality. We regret that the quality of our data cannot support a stronger statistical argument for the presence (or absence) of a persistent ~17-d modulation of the variable Cyg X-3 intensity.

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[1] Holt, S. S. *et al. Nature* **260**, 592–594 (1976).

No new limit on size distribution of γ-ray bursts

Carter *et al.*[1] derived an upper limit to the (balloon) intensity of small γ-ray bursts at ≈ 100 below the extrapolated known size spectrum, and concluded that γ-ray bursts are of galactic origin. But we claim, for the following reasons, that their results are entirely consistent with the −1.5 index power-law extrapolation. There is, therefore, no conclusion regarding the nature or the origin of γ-ray bursts to be drawn from their measurements.

(1) Their selection criterion for candidate events was that of three successive 0.6-s increases in the γ-ray count rate. A study of all known bursts (data kindly supplied by R. W. Klebesadel) shows that this requirement ignores 75% of events due to their widely varying temporal nature.

(2) The total energy sought in 1.8-s does not represent the entire energy that would be found, for the same reason. The missing energy due to fluctuations is incorporated by reassigning the event size by a factor of ≈ 2.

(3) Observed γ-ray burst size spectra have been published[2,3] with the measured flux of each known event multiplied by 1.4 to 2, to include the emission below the satellite energy threshold, knowing the typical spectra[4–6]. Comparison data must normalise equivalently.

(4) The authors knowingly employed a 1-s.d. upper limit[1]. Small-number statistics demand the usual confidence limit of 95%, raising their upper limit by three.

(5) The observed fraction of the sky was apparently taken to be 0.5, ignoring atmospheric absorption at large zenith angles which would give an unobscured sky fraction of 0.25–0.3. This point is incorporated within the following considerations.

(6) The response of a horizontal, flat detector must distort the measurement of the burst size spectrum, even from an isotropic source distribution. For a totally absorbing detector it can be shown[7] that the average burst size $\overline{S}$ that contributes to the smallest events of apparent size $Z = S \cos\theta$, given an intrinsic spectrum $N(S)\,\mathrm{d}S = kS^{-\gamma}$, is

$$\overline{S} = Z\,[(\gamma-1)/(\gamma-2)]$$

$$\times\,[(1-\cos^{(\gamma-2)}\theta_0)/(1-\cos^{(\gamma-1)}\theta_0)], \quad (2)$$

with θ_0 the maximum equivalent unobscured zenith angle θ. Using their published detector characteristics[1], we find a required vertical shift of 2.2 and a horizontal shift of 1.3 on the size spectrum, including point 5.

The total combined effect is that the upper limit rederived from the data of Carter *et al.*[1] is raised up by two orders of magnitude, entirely consistent with the −1.5 index power-law extrapolation