The time-integrated flux S is given by

$$S = K\tau(1 - e^{-t/\tau})$$

where t is the apparent duration of the burst. This will be determined by the detector noise level, which I assume to be constant and to imply a lowest sensitivity of L erg cm^{-2} s^{-1}. Now $t = \tau \ln(K/L)$, therefore $S = (K - L)\,\tau$.

If the sources are distributed uniformly,

$$N(>K) = CK^{-3/2}$$

and then, $N(>S) = \tau^{-2}C\,(S/\tau + L)^{-3/2}$

or

$$N(>S) \propto (S + L\tau)^{-3/2} \qquad (1)$$

So when $S \gg L\tau$, a three-halves dependence is expected, but when $S \ll L\tau$, $N(>S)$ is independent of S. This is because the events rapidly seem to weaken as K approaches L. The dependence given by equation (1) is of a reasonable form to fit the source counts and implies

$$L\tau \simeq 5 \times 10^{-5} \text{ erg cm}^{-2}$$

τ is not necessarily a constant from event to event and is only representative of the time scale of event decay.

I conclude that the arguments for a galactic origin for γ-ray bursts are by no means sound, and that the distance estimates are extremely uncertain. Number counts of γ-ray bursts, or any other transient phenomena, of time-integrated fluxes less than about $2L\tau$ may merely reflect the average time structure of the events rather than inhomogeneities in source distribution. Many more observations over a much wider range of sensitivity are required if source distances are to be inferred from the number counts. Sensitive γ-ray detectors carried whenever possible in satellite, spaceprobes or long-duration balloon flights would be invaluable in this respect.

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1 Strong, I. B., and Klebesadel, R. W., *Nature*, **251**, 396–397, (1974).
2 Trombka, J. I., *et al.*, *Astrophys. J. Lett.*, **194**, L27–L33 (1974).

STRONG AND KLEBESADEL REPLY—The arguments used in our letter[1] may be questioned on several grounds, but not those considered by Fabian[2], who makes two principal assumptions. These are the flux as a function of time may be represented adequately by a form having an abrupt rise to maximum followed by exponential decay, and the apparent duration of the bursts is limited by the detector noise level. Given that these were valid we would agree with his analysis. But both assumptions, although seemingly reasonable, are incorrect. The event of April 27, 1972 is an excellent counter-example[3,4]. Our paper did not include this case as it was written before the papers by Metzger *et al.*[3] and Trombka *et al.*[4] were published. Further examples may be found in ref. 5.

The actual time profiles of γ-ray bursts are very variable, ranging from single, very intense spikes to complex structures with one or more precursor pulses, a main burst comprising a number of sub-bursts lasting about a second each, and with pronounced substructure, and often a resurgence of weaker, but similar activity a few seconds to a minute later. If a decaying exponential were even an approximately correct model one would expect a strong correlation between S and the apparent duration, t. For values greater than $S = 3 \times 10^{-5}$ erg cm^{-2}, where we have noted that we expect trigger-threshold effects, this is not the case[6]. The Vela detectors can provide reliable values of S well below those of most of the measured events, if we assume the time profiles are similar to the stronger ones. We do not record these events because they fail to trigger the system. In other words, in dealing with low values of S we are trigger-limited rather than limited by the detector noise level.

Although Fabian's detailed argument is therefore not relevant this does not mean that we are still satisfied with our interpretation of the log N–log S plot. We had assumed, like Fabian, that the system would trigger only near the start of an event, and that trigger-threshold effects would appear as an increasing trigger-failure rate with weaker signals. Our threshold figure of 3×10^{-5} erg cm^{-2} meant that we would fail to detect a significant fraction of events with measured $S \lesssim 3 \times 10^{-5}$ erg cm^{-2}. What can happen is that even for $S > 3 \times 10^{-5}$ erg cm^{-2} the instantaneous flux may be low and a trigger, if it occurs at all, can take place after the start of the event. The event[3] of April 27, 1972 illustrates this. The Vela 6A system recorded only the last third of the event, giving 3×10^{-5} erg cm^{-2} instead of $\sim 10^{-4}$ erg cm^{-2}. Putting it simply, we had considered only failures to trigger which gives rise to errors in N. We did not consider errors in S caused by late triggering. The range over which the log N–log S relationship is reliable therefore lies at $S > 10^{-4}$ erg cm^{-2}. This contains too few events to be significant. (We note that the reported values of S from Vela data[6], and those used here, are low by a factor of about two compared with accurate simultaneous measurements made on some other spacecraft, and are probably all underestimated by this amount.)

Turning to the directional distributions, Fabian agrees with our assessment of their significance as being low. They are not therefore to be ignored. The point of our letter was to draw attention to the possibility that the data contained information relevant to the problem of determining the source distances, and not that there was conclusive evidence for a galactic distribution. We also intended to show how future data could be incorporated for this purpose. Work carried

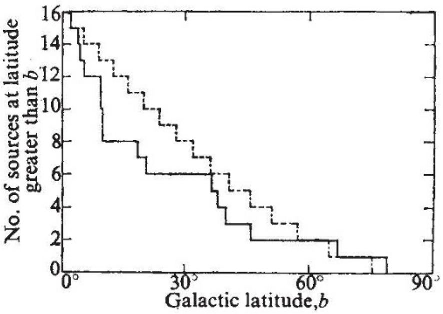

Fig. 1 Integral galactic latitude distribution for 16 gamma-ray burst sources. —, Observed distribution; - - -, isotropic distribution.

out by many people over the past year has provided additional source directions. This has had the effect of largely removing the original anisotropy in longitude, and of further emphasising the preference for low latitudes (Fig. 1). We note that two of the high-latitude sources have large errors (∼ ± 15°) and that one additional source on the Galactic Equator should probably be added.

This is again suggestive of a galactic association, but we accept the possibility that in a few cases we may be witnessing repeats from the same source. If this turns out to be true it is extremely important, but would mean that the distribution of sources as opposed to events would follow more closely the curve for an isotropic distribution.

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