remarkably well with the simple curve shown by the dashed line.

B. H. ANDREW
C. R. PURTON

Radio and Electrical Engineering Division,
National Research Council, Ottawa.

Received April 23, 1968.

[1] Sandage, A. R., Osmer, P., Giacconi, R., Gorenstein, P., Gursky, H., Waters, J., Bradt, H., Garmire, G., Sreekantan, B. V., Oda, M., Osawa, K., and Jugaku, J., *Astrophys. J.*, **146**, 316 (1966).
[2] Giacconi, R., Gorenstein, P., Gursky, H., Usher, P. D., Waters, J. R., Sandage, A., Osmer, P., and Peach, P. V., *Astrophys. J. Lett.*, **148**, L129 (1967).
[3] Johnson, H. M., *Astrophys. J.*, **144**, 635 (1966).
[4] Hobbs, R. W., and Hollinger, J. P., *Science*, **155**, 448 (1967).
[5] Yokoi, H., Sato, T., and Morimota, M., *Pub. Astro. Soc. Japan*, **18**, 185 (1966).
[6] Heeschen, D. S., *Astron. J.*, **72**, 1118 (1967).
[7] Peterson, L. E., and Jacobson, A. S., *Astrophys. J.*, **145**, 962 (1966).
[8] Matthews, T. A., and Sandage, A. R., *Astrophys. J.*, **138**, 30 (1963).
[9] Willstrop, R. V., *Mon. Not. Roy. Astro. Soc.*, **121**, 17 (1960).
[10] Johnson, H. M., *Astrophys. J.*, **146**, 960 (1966).
[11] Tucker, W., *Astrophys. J. Lett.*, **149**, L105 (1967).
[12] Greene, J., *Astrophys. J.*, **130**, 693 (1959).
[13] Manley, O. P., *Astrophys. J.*, **144**, 1253 (1966).

Upper Limit to Radio Emission from Nova Delphini 1967

A NOVA (Alcock's Nova) appeared in 1967 in the constellation Delphinus[1] and had a maximum brightness of 4·6 magnitudes in mid-September[2]. An attempt to detect radio emission from the nova at a wavelength of 4·6 cm was made on September 4, 1967, when its visual magnitude was $\sim 5{\cdot}0$. The observations were made with the 46 m radio telescope of the Algonquin Radio Observatory, and consisted of 100 scans across the position of the source (1950·0; $\alpha = 20^h\ 40^m\ 04^s{\cdot}2$, $\delta = 18°\ 58'\ 51''$), resulting in a total integration time on the source of approximately 25 min. The measured flux density was $0{\cdot}006 \pm 0{\cdot}012$ flux units (1 flux unit $= 10^{-26}$ W m^{-2} Hz^{-1}), so the upper limit may be taken as 0·02 flux units. The confusion level, less than 0·011 flux units for this measurement (see preceding communication), was not large enough to affect seriously this upper limit.

B. H. ANDREW
C. R. PURTON

Radio and Electrical Engineering Division,
National Research Council, Ottawa.

Received April 23, 1968.

[1] Mumford, G. S., *Sky and Telescope*, **34**, 82 (1967).
[2] *Sky and Telescope*, **34**, 300 (1967).

Upper Limit on X-rays from a New Supernova

KNOWLEDGE of the intensity of X-radiation from the early stages of a supernova is important to our understanding of the processes which take place during the outburst. With this in mind, two of us (H. O. and E. B.) have compared the celestial positions and times of occurrence of recently reported supernova outbursts with some recent surveys of the sky at X-ray wavelengths. It was noted that a high-sensitivity scan of the Virgo cluster of galaxies from an Aerobee rocket on July 7, 1967, by Bradt *et al.*[1] occurred 6 days after the discovery of a supernova *SN*1967*h* in *NGC*4254 by Zwicky[2].

*NGC*4254 (*Messier* 99) is a spiral galaxy of type *Sc* with co-ordinates (1950) $\alpha = 12^h\ 16{\cdot}3^m$, $\delta = 14°\ 42'$, angular diameter $\sim 5'$ and a recessional velocity of about 2,400 km s^{-1} after correction for solar motion with respect to the local group[3]. The supernova was first noted on a plate taken on June 30, 1967, with the 48 in. Schmidt telescope at Mt Palomar. Its offset from the galactic core was 80″ E. and 19″ S. The supernova did not appear on a plate taken on June 3, 1967. On July 1, the day it was discovered, its photographic magnitude m_{pg} was 15·0 (private communication from E. Herzog). Further observations at Mt Palomar on July 2 and August 7 clearly indicate that its luminosity was decreasing from June 30. To obtain the photographic magnitude of the supernova on July 7, the date of the X-ray observations, we have made use of plates taken at Mt Palomar on July 1 ($m_{pg} = 15{\cdot}0$) and on August 7 when the photographic magnitude was 16·3 (private communication from E. Herzog). We estimate that on July 7, m_{pg} was about 15·3, which corresponds to an energy flux of $\sim 8 \times 10^{-12}$ erg cm^{-2} s^{-1} in the 3500–5000 Å region.

In December 1967 the supernova had faded to $m_{pg} \geq 19{\cdot}0$. This fast decrease in luminosity is characteristic of type II supernovae. Spectra taken at the McDonald Observatory during July indicate that it is not a type I supernova but is either type II or type V (private communication from F. Fairall).

The X-ray survey of the Virgo region at 1·5–6 keV is described in detail in the earlier work[1]. The Aerobee rocket was launched from White Sands Missile Range, New Mexico, at $16^h\ 06^m$ sidereal time on July 7, 1967, and scanned *NGC*4254 about 4 min later ($04^h\ 14^m$ UT, July 8). During a slow (0·3° s^{-1}) scan, the fields of view of two independent $2° \times 20°$ (FWHM) collimators transited *NGC*4254 shortly after they transited *M*·87. The rocket aspect was obtained from star photography with a precision of about 5′.

The counting rate data given in the previous work are presented in Fig. 1. As reported in that work, both collimators detected an X-ray signal from the region of *M*·87. The triangles in the figure show the shape and width of the expected response of the collimators to a point source. The times at which the centres of the fields of view of the collimators transited *SN*1967*h* are also indicated. There is no detectable X-ray signal from the region of *SN*1967*h* in either set of data. The upper limit to the X-radiation between 1·5 and 6 keV from the supernova is, with 95 per cent confidence,

$$R < 0{\cdot}02 \text{ counts cm}^{-2}\text{ s}^{-1}$$
$$I < 2 \times 10^{-10} \text{ erg cm}^{-2}\text{ s}^{-1}$$
$$\mathcal{L} < 2 \times 10^{42} \text{ erg s}^{-1}$$

where the intensity I and luminosity $\mathcal{L}$ are quite insensitive to the assumed spectrum and where we have taken the distance to *NGC*4254 as 3×10^7 light years.

The upper limit, I, is about twenty-five times the power received at optical wavelengths (3500–5000 Å) on

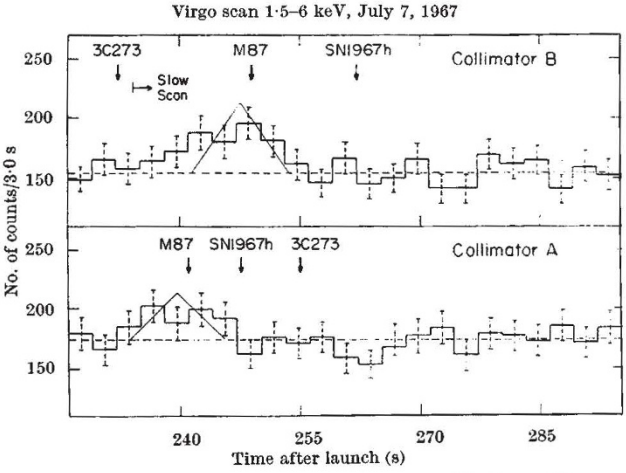

Fig. 1. Counting-rate versus time for the two collimators. The expected response for a point source is triangular in shape with a 12 s base width, as shown fitted to the data peaks attributed to *M*·87 (ref. 1).