**Table 2** Period of PSR 0611+22

| Date | Barycentric period (s) |
|---|---|
| August 28, 1972 | 0.33491817±8 |
| October 12, 1972 | 0.33491850±4 |

and period of the pulsar were therefore measured with greater precision than the other new pulsars, and the period measured on August 28 and October 12, 1972, is given in Table 2. The uncertainty in the period due to the barycentric correction is less than $10^{-8}$ s. The period has therefore increased by 0.33 μs ± 0.09 μs in 45 days, giving a value of $P/\dot{P}$ of 125,000 yr. This can be compared with the age of IC 443 estimated by Minkowski[2] of 65,000 yr. Milne[3] gives a distance of 1.4 kpc for IC 443, compared with 1.7 kpc for the Crab Nebula, which is 10° distant in the sky. The dispersion measure for PSR 0611+22 is 99 pc $cm^{-3}$, and for the Crab Nebula 57 pc $cm^{-3}$. In the neighbourhood of IC 443 there is a large HII region, which may contribute considerably to the dispersion measure of PSR 0611+22. Therefore the distance inferred from the dispersion measure is not discordant with that quoted for IC 443, and in view of the period measurements, the association of the pulsar with the supernova remnant seems clear. Assuming a distance of 1.4 kpc and a time of 125,000 yr, the pulsar's velocity normal to the line of sight is 110 km $s^{-1}$.

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# MWC 349, a New Radio Star

FURTHER examination of the Westerbork 1,415 MHz observations of the Cygnus X-3 region[1] revealed the presence of a radio source at the position of the peculiar emission-line star MWC 349.

The source, with a flux density of 0.060±0.007 flux units, is located at

$$\alpha(1950) = 20\text{ h }30\text{ m }56.8\text{ s} \pm 0.2\text{ s}$$
$$\delta(1950) = +40^\circ\ 29'\ 20.9'' \pm 2.5''$$

the rather large uncertainties being due to the distance of more than half a degree from the field centre. An upper limit of 20 arc s can be placed on the angular size of the source.

Comparison with the position of MWC 349,

$$\alpha(1950) = 20\text{ h }30\text{ m }56.82\text{ s} \pm 0.01\text{ s}$$
$$\delta(1950) = +40^\circ\ 29'\ 21.1'' \pm 0.1''$$

as measured from a Kodak 103a-O plate taken with the Leiden 33 cm refractor on September 30, 1972, strongly suggests that the radio emission is associated with this star. Certainly the probability of a chance coincidence between a 0.06 f.u. background source and a peculiar object like MWC 349 must be very low.

The star, which is identified on a photograph in the paper by Herbig and Mendoza[2], appears to be an object of exceptional interest. In the Mount Wilson Catalogue[3] it is listed as a Bep star of photographic magnitude 13.2. Swings and Struve[4] found it to be fainter than the 14th magnitude, and on the Leiden plate it appears as a slightly elongated image of magnitude ~15.5. The elongation is probably caused by the presence of a faint companion approximately 2 arc s north preceding[5]. Swings and Struve consider MWC 349 to be an early B-type object related to the symbiotic stars; they identified bright emission lines of H, He I, [O I], [N II], Fe II, and [Fe III] in its spectrum, and state that "the general intensity distribution in the continuous spectrum is similar to that of a late M star, but no late type absorption feature is apparent". Further, they find spectroscopic evidence for a tremendous absorption, probably of the order of 10 magnitudes. The star also occurs in Ackermann's catalogue of infrared objects in Cygnus[6] (star 78–0–94). On the basis of an objective-prism spectrum showing a near-infrared band of CN, he classifies MWC 349 as a carbon star, and from photographic photometry on the PSS prints he derives $B=14.5$, $B-R_K=5.5$; corresponding to $V\approx 11$, $B-V\approx 3.0$. These data are consistent with Swings and Struve's result, for, assuming a normal reddening law ($R=3$), the colour index is that of an early-type object with $A_V\approx 9$. The presence of the CN band supports the picture of a symbiotic star. Finally, MWC 349 has been reported to show an infrared excess by Geisel[7]. She links this excess radiation to circumstellar material ejected from the star.

An obvious interpretation of all the available data is that we are dealing with a binary system comprising a hot and a cool component embedded in a circumstellar cloud of gas and dust. Judging from its position in the colour-magnitude diagram it may belong to the heavily obscured Cyg OB2 association centred about half a degree to the north. Membership of Cyg OB2 would imply a distance of 2.1 kpc (ref. 8) and an absolute visual magnitude of about −10.0, placing MWC 349 among the intrinsically brightest stars known.

Clearly a detailed spectroscopic and photometric analysis is necessary to determine the exact nature of the object. If the observed radio emission is thermal bremsstrahlung then the predicted Hα flux is much smaller than that corresponding to the observed $V$ magnitude. In this case an accurate measurement of the Hα flux would yield a direct determination of the extinction at λ6,563 and therefore may be of prime interest.

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# The 8 to 13 μm Spectrum of Jupiter

THE spectrum of Jupiter in the wavelength range 8 to 13 μm is dominated by planetary thermal radiation and can give information on the thermal structure of the atmosphere. Spectra in this wavelength range have been published by Low[1] and by Gillet, Low and Stein[2]. The latter, with resolution $\Delta\lambda/\lambda \sim 0.02$, gives a hint of the absorption structure of the $\nu_2$ band of $NH_3$, and the high brightness temperature observed in the region 7.8 to 8.4 μm has been interpreted as due to $CH_4$ emission from a temperature inversion in the atmosphere of Jupiter. Encrenaz[3] has computed the expected Jovian infrared spectrum for a number of model atmospheres, with and without temperature inversion. Here we present