nuclear continuum component, as with the OH absorption. The maximum optical depth is about 0.02, considerably less than the corresponding value (0.07) for the OH absorption. There is no distinct feature that corresponds to the narrow-band OH emission near 250 km s^{-1}.

For NGC4945 spectra obtained at positions displaced from the nucleus by about ±3 arc min along the major axis were consistent with the absorption of an unresolved source coincident with the nucleus. If it is assumed that about 80% of the continuum flux at 6 cm originates in the nucleus, the antenna temperature of the peak absorption (0.066 K) corresponds to an optical depth of about 0.08. For the OH absorption the maximum optical depth is 0.3 (ref. 1). Compared with the molecular absorption in the Galaxy the optical depth of the H_2CO is unusually low—our (unpublished) observations of galactic sources suggest that the opacity of H_2CO generally exceeds that of OH when the optical depth of OH is greater than about 0.15.

It is worth noting that the relative enhancement of the H_2CO absorption at the more positive velocities, mentioned earlier, occurs also in the nuclear region of the Galaxy, where the ratio {optical depth (H_2CO):optical depth (OH)} is greater for the +40 km s^{-1} absorption than for the −130 km s^{-1}. The presence of absorption at radial velocities more positive than the systemic velocity in NGC253, in NGC4945, and in the Galaxy is most readily explained in terms of material moving towards the nucleus. It may be a common feature of the nuclear regions of spiral galaxies.

F. F. GARDNER
J. B. WHITEOAK

Division of Radiophysics, CSIRO, Sydney, Australia

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Radio structure of the 'double quasar' 4C11.50

WAMPLER *et al.*[1] have recently announced the discovery of a close pair of optical quasars associated with the radio source 4C11.50. The brighter quasar (a) has a redshift of 0.436, whereas its companion (b), 4.8 arc s away in position angle 95°, has a much larger redshift of 1.901. The statistical probability of a chance coincidence is small and this has led to speculation that, despite the discordant redshifts and the lack of any visible connection, the objects may be physically associated. Hazard *et al.*[2] report unpublished observations from Cambridge and Westerbork which suggest that the radio structure is double, with one component coincident with quasar a. Here, we investigate further the alignment of the radio structure, seeking in particular any evidence of a radio connection between the two optical quasars.

The observations were obtained with radio link interferometers at Jodrell Bank during the period 1973 November–December. Details of the observing frequencies and baselines are given in Table 1.

TABLE 1 Parameters of Jodrell Bank interferometers used in the observations of 4C11.50

Home station	Out station	Observing frequency (MHz)	Baseline length (wavelengths)	Minimum lobe spacing (arc s)
Mark Ia	Defford	408	172,700	1.2
Mark II	Mark III	962	76,400	2.7
Mark Ia	Mark III	1666	132,300	1.6

The variation of fringe amplitude with hour angle for each of the three baselines is shown in Fig. 1. Parameters which describe the radio structure have been assigned using a model fitting technique which assumes components with elliptical gaussian distributions of surface brightness. Details of the best fitting models are given in Table 2 and the corresponding visibility curves are shown by the solid lines in Fig. 1. Although the separation and position angle of the double structure at 408 and 962 MHz are well defined,

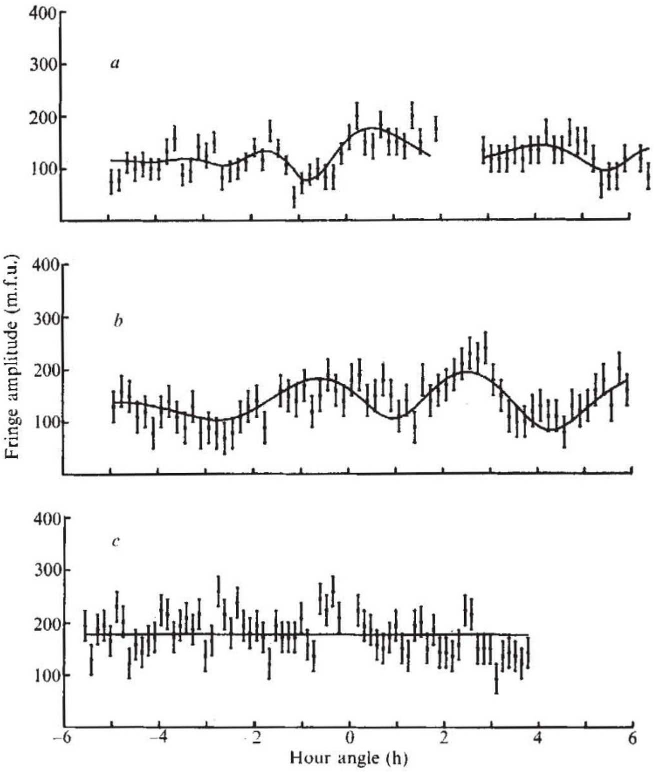

FIG. 1 Variation of fringe amplitude with hour angle at *a*, 408 MHz; *b*, 962 MHz; *c*, 1,666 MHz.

TABLE 2 Parameters of the best fitting models

Frequency (MHz)	Separation (arc s)	Position angle (degrees)	Component one: Flux density (m.f.u.)	Component one: Size (arc s)	Component two: Flux Density (m.f.u.)	Component two: Size (arc s)	Component two: Position angle of elongation (degrees)
408	14.0 ± 1.0	170 ± 2	115 ± 12	<0.3	65 ± 25	1.3 ± 0.4 x < 0.3	65 ± 25
962	12.8 ± 1.0	168 ± 2	146 ± 15	<0.6	77 ± 35	1.5 ± 0.7 x < 0.6	30 ± 40
1,666	—	—	179 ± 18	<0.4	—	—	—

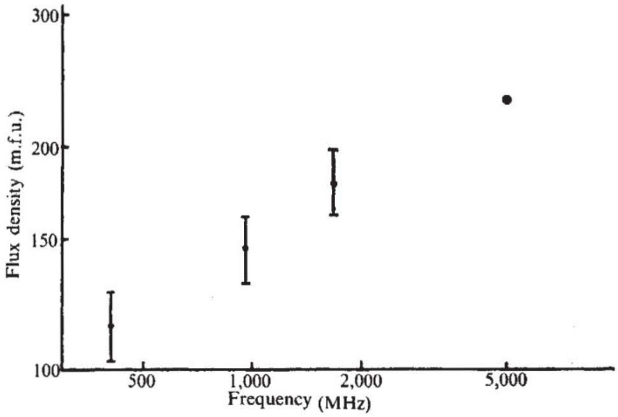

FIG. 2 Radio spectrum of the compact component coincident with 4C11.50a.

the parameters of the weaker component are more uncertain. At 1,666 MHz any variation of fringe amplitude is weak. Simple double models failed to provide a satisfactory fit to the data, which do not justify the fitting of any model more complicated than a single unresolved component.

The observations at 962 and 1,666 MHz were obtained using an improved local oscillator system developed by R. E. Spencer and R. S. Warwick (unpublished). At both frequencies the resulting phase stability over a period of several hours is sufficient to derive a position in right ascension for the more intense component. This position coincides, within our error of ± 2 arc s, with the optical position of quasar a given by Wills *et al.*[3] The short term phase stability is not good enough to say whether the weaker component lies to the east or west of this position, and hence there is an ambiguity of 180° in the position angle of the double structure given in Table 2.

The stronger component is unresolved at all three frequencies with an angular diameter $\lesssim 0.5$ arc s. The derived flux densities may therefore be used to construct a spectrum. This is shown in Fig. 2, where we have also included a measurement made with the Westerbork synthesis telescope at 5 GHz (R. D. Ekers, private communication). The radio spectrum is inverted, with a spectral index α (defined in the sense that $S \propto f^{\alpha}$) of $+0.29$. This combination of a compact structure and an inverted spectrum suggests that the component may well be variable at centimetre wavelengths.

At 408 MHz the flux density accounted for by our model is only 0.18 f.u., considerably less than the zero spacing flux density of 1.8 f.u. given by Hazard *et al.*[2] This discrepancy indicates that extended structure of low surface brightness is present, to which our high resolution interferometers are insensitive. Synthesis observations at lower spatial frequencies are needed to define such structure. The observations at 408 and 962 MHz show, however, that the compact component associated with quasar a has a resolved companion situated about 13 arc s away in position angle 170°. At 1,666 MHz, where the resolution is comparable with that at 408 MHz, any contribution from this component is less than 30 m.f.u., which implies that it has a normal radio spectrum. The angular structure and component spectra of 4C11.50 therefore show some similarity to those of the quasar 3C273. In the case of 4C11.50 however, the secondary component is elongated in a position angle somewhat different from that of the main double structure.

At all three frequencies the observations enable us to place an upper limit of 30 m.f.u. on any radio emission from compact structure associated with quasar b. Neither the axis of the double radio source, nor the elongation of the extended component is directed at quasar b. Thus the evidence on the radio structure of 4C11.50 presented in this paper suggests that there is no radio association between the two optical quasars.

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D. STANNARD
P. N. WILKINSON
R. S. WARWICK
R. J. DAVIS

University of Manchester,
Nuffield Radio Astronomy Laboratories,
Jodrell Bank,
Macclesfield, Cheshire

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Airborne measurement of the temperature of the cosmic microwave background at 3.3 mm

THE 'primaeval fireball[1] model of the Universe' predicts a cosmic microwave background radiation field which has the spectral character of a blackbody source. The radiation arises from an initially very dense, very hot Universe, and has been cooled to around 2.7 K through the cosmological expansion. Previous ground-based radiometric measurements[2–6] at wavelengths as short as 3.3 mm are consistent with a 2.7 K blackbody, but most of these points are in the Rayleigh-Jeans tail of such a blackbody spectrum.

The short wavelength direct radiometric points are shown in Fig. 1. The expected curvature of the spectrum shown in Fig. 1 should be observable even at 3.3 mm, however, and both existing measurements[7,8] in this atmospheric window are inconsistent with a gray body or power law spectrum. They are consistent with one another and the blackbody model. Even though both experiments were performed at high altitude sites in an attempt to minimize atmospheric emission from H_2O and O_2, in no case was the atmospheric signal less than nine times the signal attributed to the background radiation. By carrying a radiometer above the tropopause, the H_2O and O_2 contribution is reduced to the point that the atmospheric emission is roughly equal to the cosmic signal.

Because the blackbody nature of this observed radiation is crucial to the validity of the big bang hypothesis and the departure of the spectrum from a power law can be checked at a wavelength of 3.3 mm, we attempted to obtain direct radiometric data free from large atmospheric effects by constructing a 3.3 mm Dicke radiometer designed specifically for mounting in a Lear Jet aircraft made available by the NASA Ames Research Center at Moffett Field, California. The instrument was carried above the tropopause on five flights in May and July of 1971; but only one flight was successful. During the course of that flight, we made 21 measurements of the background intensity at various zenith angles and report here a minimum variance weighted average of those points indicating a thermodynamic temperature of (2.48 ± 0.54) K.