# LETTERS TO THE EDITOR

## PHYSICAL SCIENCES

### The Unusually Large Redshift of 4C 05·34

THE quasi-stellar object identified[1] with the radio source 4C 05·34 has been recently observed spectroscopically by us at Kitt Peak National Observatory and has been found to have a redshift of $z=2{\cdot}877$, a value considerably higher than that of any quasi-stellar object reported so far. The largest previous values were $z=2{\cdot}358$ for 4C 25·05 (ref. 2) and, possibly, $z=2{\cdot}38$ for 5C 02·56 (ref. 3).

The 2,700 MHz position of the radio source as measured[1] at Parkes differs from the 178 MHz position given in the 4C catalogue[4] by about 1·5 minutes of arc in right ascension and 19 minutes of arc in declination. The source is affected by confusion in both position determinations, however, and there is little doubt that the observations refer to the same source. The associated stellar object is located about 20 s of arc south—preceding the Parkes radio position; it is approximately eighteenth magnitude and appears to be definitely blue on the *National Geographic Society–Palomar Observatory Sky Survey*. The radio and optical positions for the source are given in Table 1.

Table 1. POSITIONS OF THE RADIO SOURCE AND OPTICAL OBJECT

| Frequency | α (1950) | δ (1950) | Flux density ($10^{-26}$ MKS) |
|---|---|---|---|
| 178 MHz | 08 h 05 m 15·1 s ± 1·6 s | +05° 00·7′ ± 8′ | 2·6±0·6 |
| 2,700 MHz | 08 h 05 m 20·9 s ± 0·5 s | +04° 41′ 36″ ± 8″ | 0·46±0·02 |
| Optical | 08 h 05 m 20·1 s ± 0·6 s | +04° 41′ 24″ ± 9″ | ($m_V \approx 18$) |

During the course of a programme of redshift determination for 4 C quasi-stellar source identifications, five spectrograms of 4C 05·34 were obtained—one with a grating blazed at approximately 4000 Å, and the remainder with a grating blazed at approximately 6750 Å. The most prominent emission lines visible are Lyman α of hydrogen at 4714 Å, and C IV λ1,549 at 6004 Å, with Lyman α being the stronger by a factor of about three. There seems to be emission at the expected positions of N V λ1,240, Si IV λλ1,394, 1,403, and C III] λ1,909. The C III] line is badly confused with the OH (8–3) emission band in the airglow spectrum, however.

The question of the possible presence of expected emission lines shorter than Lyman α is complicated by the presence in the spectrum of numerous narrow (less than 2 Å wide in the rest frame of the source) absorption lines that seem to be strongest and most abundant in the spectral region short of the Lyman α emission line. The analysis of our material on the absorption-line spectrum is incomplete at present, and the detailed description will be published later. It seems certain, however, that one absorption-line system is present with a redshift of 2·475—represented by Lyman α, Si IV λλ1,394, 1,403, and C IV λ1,549—and that several systems are present with redshifts nearer to the emission-line value. Lyman α absorption in these several systems seems to have destroyed any evidence for emission from the higher members of the Lyman series or emission from other expected transitions such as C III λ977.

Because of the large redshift, the intrinsic luminosity of 4C 05·34 is very dependent on the particular cosmology that is adopted. With this reservation, the radio and optical luminosities appear to be roughly comparable with the most luminous quasi-stellar objects already known. In particular, calculating the luminosities at 2500 Å and 500 MHz in the rest frame of the source according to the procedure outlined by Schmidt[5] leads to $F(2{,}500)=1\times10^{24}$ W Hz$^{-1}$ and $F(500)=8\times10^{27}$ W Hz$^{-1}$, where we have adopted a radio spectral index of 0·65 and a deceleration parameter $q_0=1$ for the relativistic cosmology. These luminosities may be compared with the tabulation of values for 3CR quasi-stellar sources given by Schmidt.

It has been suggested by Rees[6] that the previous failure to discover objects with redshifts larger than 2·4 could result from the heavy absorption of light by intergalactic atomic hydrogen at early epochs, making such objects faint and, in particular, reddening them to such an extent that they would no longer be found by using conventional optical identification procedures. But 4C 05·34, at eighteenth magnitude, is not near the optical brightness limit for identifications and is definitely blue on the *Palomar Sky Survey*. Furthermore, the appearance of relatively narrow absorption lines shorter than Lyman α is in contrast to Rees's prediction that objects of such large redshift might exhibit broad absorption bands shorter than the Lyman emission lines. In this connexion it should be mentioned that, with the exception of the narrow absorption lines, the intensity of the spectrum short of Lyman α is not depressed to an unusual degree. This does not mean that Rees's suggestion is incorrect but only that, as Rees points out, the expected effect may be anisotropic in the sky because of inhomogeneities in the reheating of the neutral hydrogen. We emphasize that any observational selection effects that work against the discovery of quasi-stellar sources having redshifts greater than 2·4 are not effective in the case of 4C 05·34, a source which is well within the optical and radio limits appropriate to the optical identification of 4C radio sources from inspection of the *Palomar Sky Survey*. This leads us to suggest that the low rate of discovery of objects with redshifts in the range 2·4 to 3·0 is largely a consequence of their intrinsic rarity.

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### Upper Limits for CP 1919 X-ray Emission

WE report here a search in the direction of the radio pulsar CP 1919 (ref. 1) which has resulted in upper limits on possible X-ray emission from this object at $3{\cdot}9\times10^{-33}$ J m$^{-1}$ Hz$^{-1}$ per pulse over the 30–100 keV range.