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Further investigation of the pair of quasars Q 0107-025 A and B*

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Summary. Low and intermediate dispersion spectroscopy of Q 0107-025 A ($z = 0.956$, $g \simeq 17.9$ mag) and Q 0107-025 B ($z = 0.952$, $g \simeq 17.3$ mag) obtained at ESO, the AAT and the MMT enables one to definitely reject the possibility that this pair of objects are gravitational lens images of a single quasar: a redshift difference $\Delta z \simeq 0.004$ is clearly seen between the two objects and some forbidden emission lines ([O II] λ3727, etc.) are only present in the spectrum of Q 0107-025 A. Not a single narrow absorption line could be detected in the $\lambda\lambda$3252-5616 Å spectral range of the intermediate resolution data of Q 0107-025 A and B. CCD photometry reveals the possible presence of a highly redshifted ($z \gtrsim 0.5$) cluster of galaxies in the field of Q 0107-025 A and B. Spectroscopy of the brightest galaxies is required in order to investigate the possible association between the galaxy and quasar clusters.

Key words: quasars: general – quasars: Q 0107-025 A and B – quasars: redshift of – spectroscopy

1. Introduction

The quasars Q 0107-025 A and B were first identified as a close pair of ultraviolet-excess objects on a Palomar Schmidt plate (~25 deg^2) centered around NGC 450 (Arp, 1983; Swings et al., 1983). Preliminary low resolution spectroscopy of this pair of quasars obtained with the 200-inch Palomar telescope as well as broad band CCD photometry with the Danish 1.5 m telescope (ESO, La Silla) were reported at the Liège International Astrophysical Colloquium in June 1983 by Surdej et al., 1983. They showed that Q 0107-025 A and B are two quasars located fairly near one another (separation ~77 arcsec) and that their spectra and redshifts ($z = 0.96$ and $z = 0.95 \pm 0.01$) are very similar. Furthermore, the magnitude difference between the quasars A and B was found to be nearly constant ($\Delta m \simeq 0.65$) in the four g, r, i and z Gunn filters.

These observations naturally led to the suggestion that Q 0107-025 A and B might constitute a new case of twin quasi stellar objects *or* of two images caused by a gravitational lens. In order to test this alternative, further spectroscopic and photometric observations of these two objects have been collected at various observatories (cf. Sect. 2).

Low resolution spectroscopic observations with higher signal to noise ratio have been obtained at the European Southern Observatory in order to confirm and improve the redshifts of the two quasars as well as to search for the presence of new emission lines (see Sect. 3). Because pairs of quasars lying close together on the plane of the sky offer a unique way of investigating the size, location and physical conditions of the clouds responsible for the narrow absorption lines in QSO spectra (cf. Shaver and Robertson, 1983), intermediate dispersion spectroscopy of Q 0107-025 A and B has been carried out at the Anglo-Australian and Multiple Mirror Telescope Observatories (see Sect. 4). Finally, CCD photometry collected at ESO allows us to classify, as well as to derive magnitudes of, the faint objects seen near the two quasars (Sect. 5). Discussion and conclusions form the last section of the present paper.

2. Observations

New low resolution spectra of the quasars Q 0107-025 A and B were first obtained in September 1982 at the European Southern Observatory, using the Image Dissector Scanner (IDS) attached to a Boller and Chivens spectrograph at the $f/8$ Cassegrain focus of the ESO 3.6 m telescope. Intermediate dispersion spectra were subsequently taken in October 1983 using the Image Photon Counting System (IPCS; Boksenberg and Burgess, 1973) attached to the Royal Greenwich Observatory spectrograph at the $f/8$ focus of the 3.9 m Anglo-Australian Telescope. Further intermediate dispersion observations of this pair of quasars were obtained at the MMTO in October 1983 with the Multiple Mirror Telescope spectrograph utilizing a photon counting dual Reticon. Finally, additional low resolution spectra of Q 0107-025 A and B were made at the European Southern Observatory in November 1984, using the Reticon Photon Counting System (RPCS;

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* Based on observations collected at the European Southern Observatory (La Silla, Chile), at the Anglo-Australian Telescope (Siding Springs, Australia) and at the MMT Observatory (Mount Hopkins, Arizona). The MMTO is a joint facility of the University of Arizona and the Smithsonian Institute.

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Table 1. Journal of spectroscopic observations of the quasars Q 0107-025 A and B

	ESO Sept. 1982	AAT Oct. 1983	MMT Oct. 1983	ESO Nov. 1984
Observation date	18/19 Sept. 1982	1 Oct. 1983	5 Oct. 1983	30 Nov. 1984
Telescope	ESO 3.6 m	AAT 3.9 m	MMT [4.4 m]	2.2 m at ESO
Instrument	B&C + IDS	RGO + IPCS	MMT + Ret.	B&C + RPCS
Camera focal length (cm)	14.4	25		14.4
Grating (ℓ/mm)	300	1200	600	300
Dispersion (Å/mm)	224	33	27	224
Detector format	2048	2044 × 60	2048 × 2	3744 × 2
Pixel sizes	4.5 Å × 13″.5	0.50 Å × 2″.35	0.41Å	6.7 Å × 4″.4
Slit (arcsec)	4 × 4	1.4	1.0	2.0
Seeing (arcsec)	≃5	1.5	1.3	≃2
Transparency	cirrus	photometric	clouds	foggy + moon
Wavelength range (Å)	3700 – 7558	3253 – 4100	4800 – 5620	3600 – 8920
Total exposure time (min)	20/20/40	28	120 for A 90 for B	60 for A 30 for B
Resolution (Å FWHM)	12	1.5 – 2.0	1.4	14
Wavelength range (Å)		4077 – 4923		
Total exposure time (min)		28		
Resolution (Å FWHM)		1.2 – 1.6		

Christensen et al., 1984) and a Boller and Chivens spectrograph at the $f/8$ Cassegrain focus of the 2.2 m telescope. More details on the equipment, configuration, etc. used to collect these spectroscopic data are summarized in Table 1.

For the AAT data, the reduction procedure consisted of flat-fielding to remove pixel-to-pixel gain variations in the detector, a weighted sum to combine the object signal in several adjacent spatial increments, linearization of the wavelength scale using comparison spectra, sky subtraction, extinction correction, a weighted sum of separate exposures, and normalization using observations of a standard star to remove variations in instrumental sensitivity with wavelength. This results in spectra whose ordinate is on a relative scale of $\lambda \cdot F(\lambda)$. The spectra were subsequently reduced to relative fluxes $F(\lambda)$ versus λ. Finally, all wavelengths were converted to air wavelengths and corrected for the earth's heliocentric motion and a galactic rotation of $250\,\mathrm{km\,s^{-1}}$ at the sun. The use of weights in the addition of signals from individual spatial increments and for the combination of separate exposures optimizes the signal/noise of the resulting spectrum (Robertson, 1983). The reduction of the ESO and MMT data was similar, except that the ordinate was kept on a relative scale of $F(\lambda)$. Furthermore, the IDS and the Reticon detector collect only two simultaneous spectra (object and sky), so the addition of spectra from adjacent spatial increments does not arise.

Table 2. Journal of the CCD photometric observations of the quasars Q 0107-025 A and B

	Gunn Filters			
	g	r	i	z
Exposure time (min)				
Date				
1 Dec. 1981		15		
2 Dec. 1981	45	45		
3 Dec. 1981			45	45
7 Jan. 1982		4 × 15	4 × 15	

CCD frames of the small field around Q 0107-025 A and B were acquired with the ESO CCD camera at the Danish 1.5 m telescope in December, 1981 and in January, 1982. The exposure times, filters, etc. used for each individual frame are listed in Table 2. These data were reduced with the MIDAS application programs available at ESO (Garching bei München); a standard procedure consisting of cleaning, flat fielding, dark subtraction, etc. was followed. With the help of an automatic searching program, all objects detected in at least two spectral regions within the 6.5 square arcminutes field around Q 0107-025 A and B have been catalogued. Standard aperture magnitudes have been measured for all of these in an equivalent g, r, i, z Gunn system (cf. Pedersen, 1985).

3. The low resolution spectra of Q 0107-025 A and B

Because of the proximity of the moon, of the smaller size of the telescope, etc. the low resolution spectra of Q 0107-025 A and B obtained in November 1984 with the 2.2 m telescope at the European Southern Observatory turned out to be of much lower quality than those collected before. Therefore, we have only illustrated in Fig. 1 the average low resolution spectra of Q 0107-025 A and B, as observed with the ESO 3.6 m telescope in September 1982.

Nevertheless, these two sets of data confirm the spectral similarities (redshift, wave-like continuum, line profile of Mg II[1]) existing between the two quasars which were first reported on the basis of moderate exposure Palomar spectroscopic observations (see Surdej et al., 1983).

[1] The narrow emission peak present in the red wing of Mg II $\lambda 2799$ at $\lambda \sim 5577$ Å results from a poor sky subtraction.

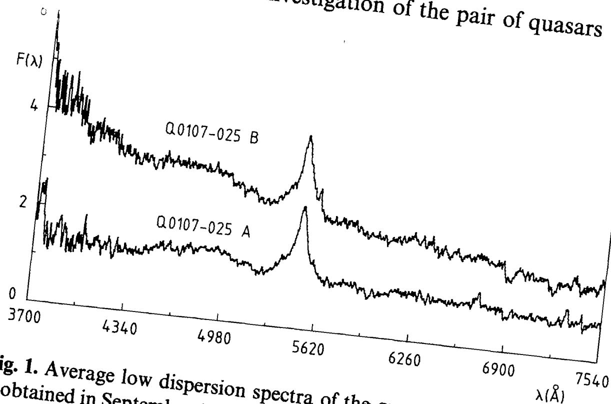


Fig. 1. Average low dispersion spectra of the quasars Q 0107-025 A and B obtained in September 1982 with a Boller and Chivens spectrograph + IDS at the $f/8$ Cassegrain focus of the ESO 3.6 m telescope (see Table 1). The ordinates refer to a relative flux scale

Several methods were tried to fit synthetic line profiles to the observed emission of Mg II: it was found that a two-gaussian profile (see Fig. 2) gave the best results for both quasars. Whereas this model fitting has no real physical meaning, it nevertheless gives further support for the similarity existing between the emission line profiles of Mg II in the spectra of Q 0107-025 A and B. The observed wavelengths – corrected for the earth's heliocentric motion and galactic rotation –, the FWHM and the height of the two gaussian components are listed in Table 3. Within the observational and measurement uncertainties, we conclude that the FWHM and height of each component are the same for the two objects. Furthermore, when referred to the central position of the narrow component, the position of the wide component is found to be blueshifted by a comparable amount (~ 924 and $\sim 734\,\mathrm{km\,s^{-1}}$) in the two QSO spectra. However, the redshift derived from the central position of the narrow gaussian component is found to be:

$z = 0.9595 \pm 0.0010$ for Q 0107-025 A, and

$z = 0.9557 \pm 0.0003$ for Q 0107-025 B.

Figure 3 illustrates this redshift difference $\Delta z \sim 0.004$ between

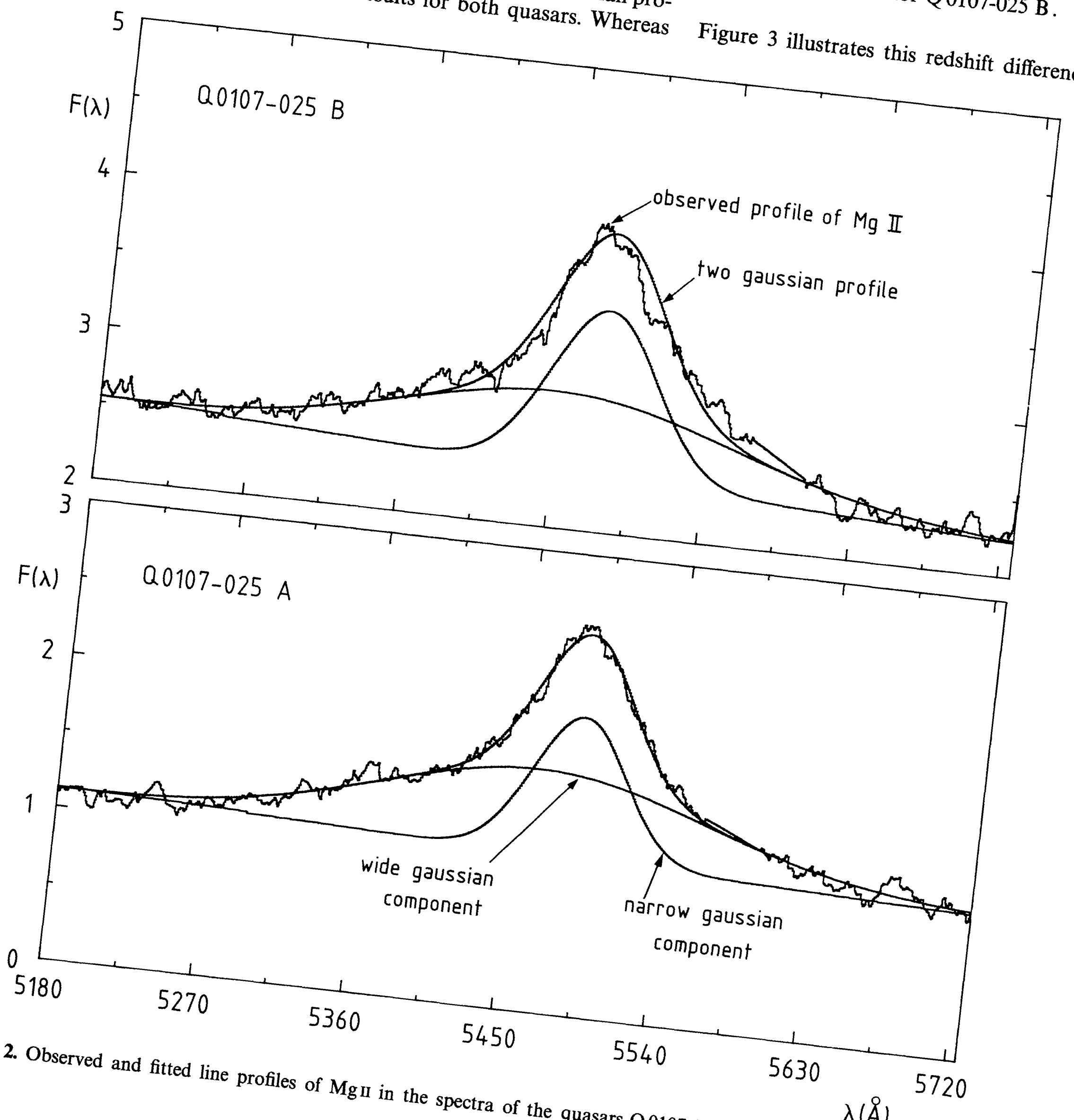


Fig. 2. Observed and fitted line profiles of Mg II in the spectra of the quasars Q 0107-025 A and B (see Text)

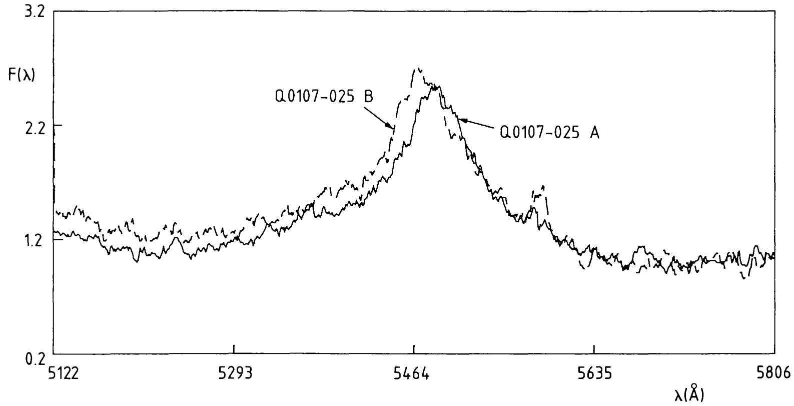


Fig. 3. Superposition of the observed Mg II emission lines of Q 0107-025 A and B. Note the similarity between the flux and profile characterizing these lines (see Text)

the two quasars. In terms of Doppler shifts, this corresponds to a velocity difference $\Delta v \sim 600 \pm 200\,\mathrm{km\,s^{-1}}$.

When referring to previous studies on Fe II line identification (cf. Wills et al., 1980, 1985; Wills, 1983), it is straightforward to establish that the asymmetry seen in the blue wing of the broad Mg II line is due to emission in spectral lines belonging to the Fe II multiplets UV 62 and 63 ($\lambda_{\rm lab} \sim 2748$ Å) and that the absorption-like trough appearing on the very blue side of the Mg II line arises from the absence of Fe II emission near $\lambda_{\rm lab} \sim 2700$ Å. Furthermore, following Wills et al. (1980, 1985) we easily identify in Fig. 1 the broad emission features between 2300 and 2600 Å (see the wave-like shape of the continua) and near 2950 Å to emissions from transitions of the Fe II multiplets UV 1–3, 33–36, 64 and UV 60–61, respectively. It is very likely that additional Fe II emission features could be identified in the blue spectral range ($\lambda \lesssim 4300$ Å) on the basis of better signal to noise data. Adopting a similar pseudo continuum in the two quasar spectra, we find that the equivalent width of the Mg II emission amounts to 89.1 ± 6.2 and 45.4 ± 2.5 Å in the rest frame of Q 0107-025 A and B, respectively. While it is difficult to make similar measurements for the broad Fe II emission blends, it appears that the equivalent width of these features is also about two times larger in the spectrum of Q 0107-025 A than in that of Q 0107-025 B. We further estimate that at $\lambda \sim 5200$ Å the ratio of the continuum levels between Q 0107-025 B and A is approximately 2.2 ± 0.3, corresponding to 0.9 ± 0.1 mag. A comparable ratio $\sim 1.9 \pm 0.3$, corresponding to $\sim 0.7 \pm 0.1$ mag, can be derived from the published Palomar spectroscopic observations (see Surdej et al., 1983).

Further inspection of our low resolution spectra indicates the presence of [O II] λ 3727 at $\lambda \sim 7300$ Å and the possible detection of [Ne V] λ 3426 at $\lambda \sim 6688$ Å in the spectrum of Q 0107-025 A (see Fig. 1). Additional data are desirable to confirm the presence of these emission lines. The absorption-like feature seen around $\lambda \sim 6886$ Å in the spectra of Q 0107-025 A and B is due to an O_2 atmospheric band.

4. The intermediate dispersion spectra of Q 0107-025 A and B

Figures 4–6 illustrate the intermediate dispersion spectra of Q 0107-025 A and B obtained in October 1983 with the MMT and AAT telescopes.

From the observed positions of the Mg II λ 2799.1 emission line (see Fig. 4), we derive the redshifts $z_{\rm A} \simeq 0.957$ and $z_{\rm B} \simeq 0.952$, in good agreement with those calculated from the ESO low resolution data. Using the rather noisy line profiles of C III] λ 1907.6 (see Fig. 6), we find that $z_{\rm A} \simeq 0.954$ and $z_{\rm B} \simeq 0.949$. The small difference $\Delta z \sim 0.003$ noticed between the redshifts of the Mg II and C III] emission lines is not unusual among quasar spectra.

It is interesting to see that a weak emission line is present at $\lambda \sim 3553.5$ Å in the spectrum of Q 0107-025 A. We identify this feature with the [Ne III] λ 1815 line transition. It is possible that a similar – but definitely fainter – emission is present in the spectrum of Q 0107-025 B at $\lambda \sim 3543.5$ Å; higher quality data are badly needed in order to confirm this.

No significant absorption lines are present in these spectra. This is unfortunate, but not too surprising, given the low number density of Mg II lines which dominate in this redshift range (cf. Young et al., 1982).

5. CCD photometry of the field around Q 0107-025 A and B

We have illustrated in Fig. 7 a composite CCD frame of the 8.6 arcmin² field around Q 0107-025 A and B resulting from the addition of all data frames obtained with the ESO CCD camera

Table 3. Wavelength, FWHM and height of the two gaussian components leading to the best fit of the observed Mg II emission in the spectra of Q 0107-025 A and B

Quasar	Gaussian component	Wavelength (Å)	FWHM (Å)	Height (arbitrary flux units)
A	Wide	5460.7 ± 6.7	218.5 ± 18.5	0.54 ± 0.16
	Narrow	5474.1 0.7	72.7 6.4	0.97 0.13
B	Wide	5468.1 10.9	237.7 14.3	0.54 0.14
	Narrow	5485.0 2.8	65.7 8.3	0.94 0.10

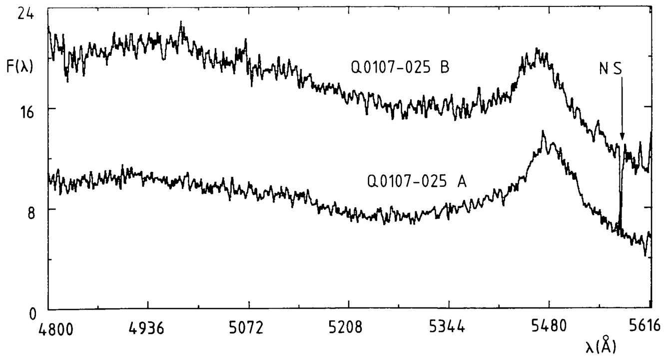
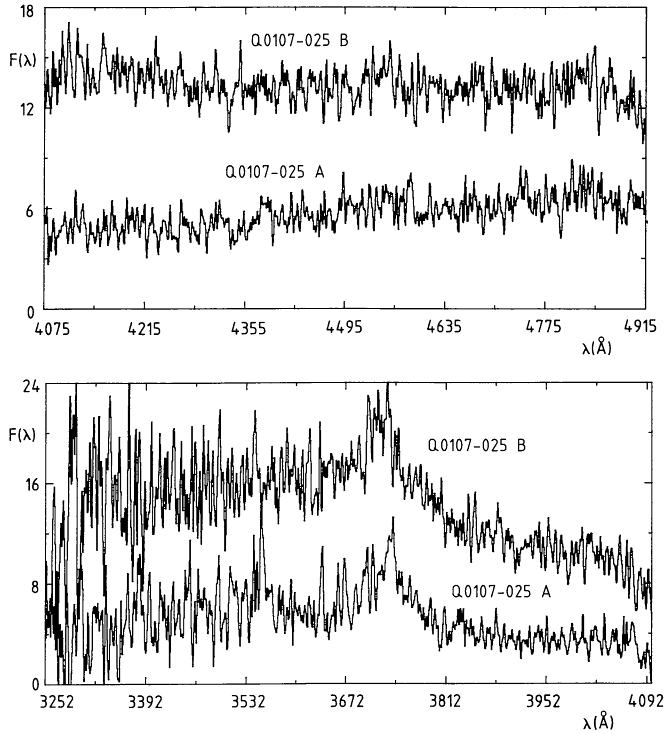


Fig. 4. Intermediate dispersion spectra of the quasars Q 0107-025 A and B obtained in October 1983 using the MMT spectrograph + Reticon with the Multiple Mirror Telescope (4.4 m equivl. aperture, see Table 1)



Figs. 5 and 6. Intermediate dispersion spectra of the quasars Q 0107-025 A and B obtained in October 1983 with the RGO spectrograph + IPCS at the $f/8$ Cassegrain focus of the 3.9 m Anglo-Australian telescope (see Table 1)

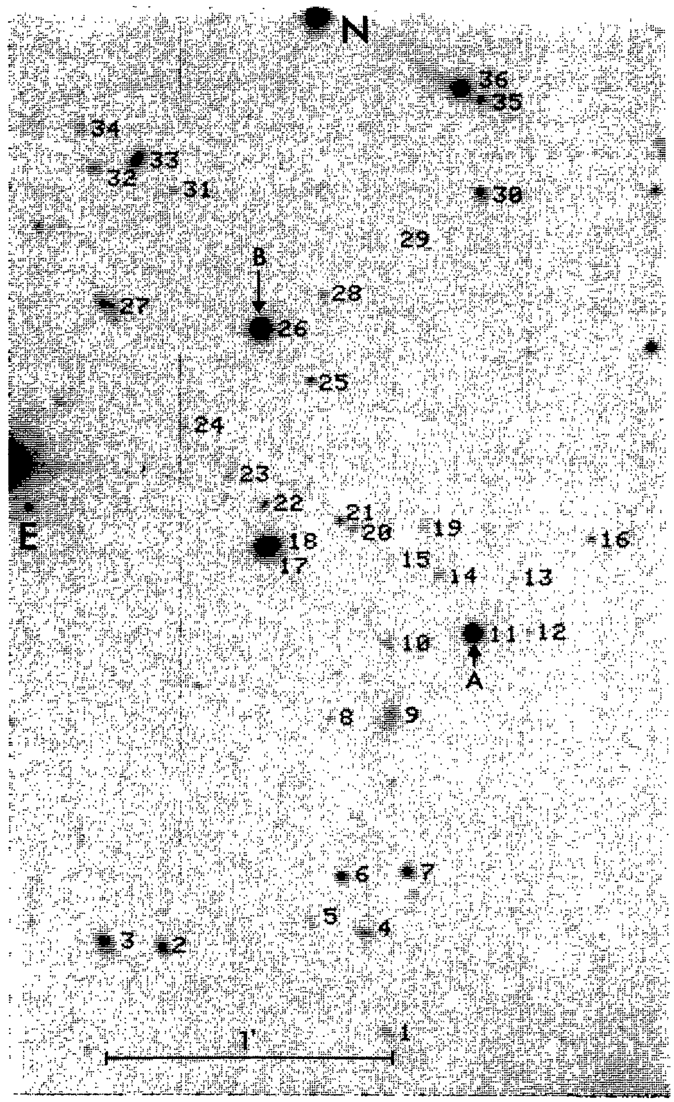


Fig. 7. Composite CCD frame (exp.: 195 min.) resulting from the superposition of the g, r, i, and z frames obtained with the ESO CCD camera at the Danish 1.5 m telescope in December 1981 (see Table 2). The quasars Q 0107-025 A and B correspond to the objects No. 11 and 26, respectively. The type (star or galaxy) and standard aperture magnitudes of all objects detected within the inner 6.5 square arcminutes of this field are listed in Table 4. Table 5 contains the equatorial coordinates – accurate to within 1''.5 – of all these objects

at the Danish 1.5 m telescope in December, 1981 (see Table 2). Let us mention that an even deeper composite CCD frame of the innermost 4 arcmin^2 field centered around Q 0107-025 A and B is shown in Fig. 6 of Surdej et al. (1983). All the objects which are numbered in Fig. 7 were found by an automatic searching program (INVENTORY in the MIDAS data reduction system) in at least two frames obtained with different filters. The type (star or galaxy) as well as the g, r, i, and z standard aperture magnitudes – using an aperture diameter of 5 arcsec – are listed for most of the objects in Table 4. Let us point out that the quasars Q 0107-025 A and B are referred to as objects No. 11 and 26. The magnitudes given in Table 4 were kept in the instrumental system of the ESO CCD camera used with the g, r, i, and z Gunn filters (see Pedersen, 1985). The zero points of these magnitudes were set up by observing the nearby standard star BD + 21° 607 (Hoessel, 1981) and the mean errors affecting the magnitude measurements are mostly based on photon statistics. The zero points should be accurate to within a few hundredths of a magnitude.

On the basis of these photometric measurements, we may directly state that the magnitude difference observed between the quasars Q 0107-025 A and B is roughly the same ($\Delta m = 0.66 \pm 0.05$) in the four Gunn filters.

The number of galaxies detected within the 6.5 arcmin^2 field is not found to be particularly large. Limiting ourselves to the 15 galaxies brighter than $r = 22.0$ mag, we derive for this well defined sample a surface density somewhat higher than 2 galaxies/arcmin^2. When compared with counts of galaxies performed on the basis of red sensitive plates (Kron, 1980; Kruszewski, 1985),

Table 4. Identification number, type (star or galaxy), and standard aperture magnitudes of all objects detected in the field near Q 0107-025 A (No. 11) and Q 0107-025 B (No. 26)

ID	*g*		*r*		*i*		*z*		Type	Remarks
1	22.36	± 0.16	22.42	± 0.21	22.2	± 0.5	21.11	± 0.28	G	
2	21.35	0.06	21.05	0.06	20.21	0.08	19.90	0.10	G	
3	20.49	0.03	20.66	0.04	19.98	0.07	20.00	0.11	G	
4	21.96	0.11	21.71	0.11	21.09	0.18	20.93	0.26	G	
5	23.9	0.7	22.85	0.31	> 23.0		> 22.0		G	
6	20.83	0.04	20.78	0.05	20.73	0.13	20.42	0.15	S	
7	20.70	0.04	20.50	0.04	20.30	0.08	20.20	0.13	S	
8	23.7	0.5	23.20	0.31	22.7	0.5	21.5	0.4	?	
9	21.10	0.05	21.00	0.04	20.90	0.10	20.72	0.21	G	
10	23.8	0.6	22.00	0.10	21.86	0.24	21.6	0.5	G	
<u>11</u>			18.08	0.02					S	1
	17.91	0.02	18.08	0.02						2
					18.18	0.02	18.01	0.03		3
			18.15	0.02	18.25	0.02				4
12	> 24.0		23.7	0.5	22.3	0.4	21.8	0.6	?	
13	> 24.0		23.6	0.5	22.3	0.4	21.7	0.5	?	
14	22.75	0.23	22.44	0.15	22.08	0.29	21.9	0.6	?	
15	> 24.0		23.7	0.5	22.9	0.6	21.9	0.6	?	
16	> 24.0		23.6	0.4	22.14	0.31	21.22	0.34	S	
17	19.41	0.10	19.04	0.12	18.64	0.15	19.12	0.20	G	
18	20.43	0.20	19.52	0.17	18.69	0.15	18.25	0.10	S	
19	> 24.0		> 24.0		22.4	0.4	20.56	0.18	G	
20	22.99	0.29	21.80	0.09	21.59	0.19	21.60	0.5	G	
21	22.08	0.13	21.55	0.07	21.25	0.14	21.13	0.12	G	
22	23.12	0.32	21.71	0.08	21.00	0.11	21.14	0.32	S	
23	23.5	0.5	23.6	0.4	22.3	0.4	20.78	0.34	G	
24	22.65	0.20	22.72	0.20	22.7	0.5	21.9	0.6	?	
25	21.85	0.10	21.60	0.07	21.46	0.17	21.13	0.31	S	
<u>26</u>			17.42	0.02					S	1
	17.31	0.02	17.41	0.02						2
					17.51	0.02	17.41	0.02		3
			17.44	0.03	17.52	0.02				4
27	21.70	0.08	20.48	0.03	20.06	0.05	19.78	0.10	G	
28	22.53	0.19	21.94	0.10	22.09	0.30	21.9	0.6	G	
29	> 24.0		23.8	0.5	22.9	0.7	22.4	1.0	?	
30	21.66	0.09	20.83	0.05	20.45	0.10	19.93	0.10	G	
31	22.88	0.26	22.73	0.28	22.3	0.5	> 22.0		?	
32	22.52	0.19	21.56	0.11	20.82	0.14	20.91	0.25	G	
33	20.61	0.03	19.95	0.03	19.54	0.04	19.18	0.05	G	
34	22.79	0.24	22.09	0.16	> 23.0		> 22.0		S	
35	21.36	0.07	20.83	0.05	20.52	0.10	20.35	0.15	G	
36	19.92	0.02	19.26	0.02	18.78	0.02	18.34	0.03	G	

Remarks: (1) 1 December 1981, (2) 2 December 1981, (3) 3 December 1981, (4) 7 January 1982

we find that such a density is not in excess with respect to the average background value measured at the same magnitude limit.

We can readily see in Fig. 7 a clump of labelled objects around quasar A. 14 objects are detected within a circular field having an area of 1.1 arcmin^2. Out of these 14 objects, two are stellar ones (including the quasar), five are galaxies brighter than $r = 22.0$ mag, two are faint galaxies and five are faint unclassified objects. Among these 7 faint objects, 6 appear to be very red with $r - z$ colour indices greater than 1.5 mag. Only one such red object (No. 16, S) may be found outside the area defined above.

This group of very red objects near quasar A is the main argument supporting the possible presence of a distant cluster in that area. The r magnitudes of these faint red objects range from 23.2 down to fainter than 24.0 mag. These can be considered to be the brightest elliptical galaxies of a distant cluster. Let us remark that there is not a single object resembling a giant elliptical or a cD galaxy which usually dominate the cluster brightness.

We may naturally wonder whether the magnitudes and colours of these galaxies are consistent with a redshift value of $z = 0.96$. For this purpose, we shall make use of the magnitudes of the brightest cluster galaxies that have been published by

Table 5. Coordinates of all objects detected in the field near Q 0107-025 A (No. 11) and Q 0107-025 B (No. 26)

ID	R.A.	(1950.0)	Decl.
1	$1^h07^m39\overset{s}{.}7$		$-2°37'17''$
2	1 07 43.1		−2 37 02
3	1 07 43.9		−2 37 01
4	1 07 40.4		−2 36 57
5	1 07 41.1		−2 36 55
6	1 07 40.9		−2 36 44
7	1 07 40.0		−2 36 43
8	1 07 41.6		−2 36 11
9	1 07 40.8		−2 36 10
10	1 07 41.2		−2 35 54
11	1 07 40.0		−2 35 51
12	1 07 39.3		−2 35 50
13	1 07 39.7		−2 35 39
14	1 07 40.7		−2 35 39
15	1 07 41.4		−2 35 37
16	1 07 38.7		−2 35 30
17	1 07 43.2		−2 35 36
18	1 07 43.1		−2 35 35
19	1 07 41.0		−2 35 30
20	1 07 42.0		−2 35 30
21	1 07 42.2		−2 35 29
22	1 07 43.3		−2 35 26
23	1 07 43.9		−2 35 21
24	1 07 44.7		−2 35 11
25	1 07 43.1		−2 34 59
26	1 07 44.0		−2 34 49
27	1 07 46.2		−2 34 46
28	1 07 43.3		−2 34 41
29	1 07 42.5		−2 34 29
30	1 07 41.5		−2 34 17
31	1 07 45.7		−2 34 21
32	1 07 46.9		−2 34 17
33	1 07 46.3		−2 34 15
34	1 07 47.2		−2 34 08
35	1 07 41.8		−2 33 58
36	1 07 42.2		−2 33 56

Djorgovski and Spinrad (1981). These authors use apertures which vary with redshift, but for redshifts near $z = 1$ their aperture size is close to 10″, i.e. twice as large as that used in our photometric determinations: their magnitudes are thus found to be systematically brighter than ours by a few tenths of a magnitude. They report F magnitudes which are very close to Johnson's R. Gunn's r magnitudes are about 0.5 mag. fainter than R ones, and from their results we conclude that our data should give values of r between 21 and 22 mag for the brightest cluster galaxies. Because the uncertainty affecting the determination of the magnitude zero-point published by Djorgovski and Spinrad could be as high as 0.5 mag (Djorgovski, 1985) and as systematic shifts could possibly arise between magnitudes derived by using different apertures, we conclude that our data are consistent with the presence of a (not very rich?) cluster of galaxies at $z \sim 0.96$.

The $r - i$ and $i - z$ colours of the 6 faint red objects around quasar A appear redder by about 1 magnitude in each colour index than the colours derived for the members of the moderately distant ($z = 0.35$) cluster 0630-566 which has been observed with the same equipment (Kruszewski and West, 1983). This supports the idea that the redshifts of these red objects are much larger than $z = 0.35$. The lack of multi-colour photometry of other very distant clusters as well as the possible relevance of evolutionary effects prevent us from assigning a more precise estimate of the redshift from the observed colour indices.

We conclude that the observed magnitudes and colours of the red objects seen in projection near quasar A are not in conflict with the hypothesis that some of them belong to a cluster at the quasars' redshift, though a still larger redshift is also plausible.

6. Discussion and conclusions

Low and intermediate dispersion spectra obtained for Q 0107-025 A ($z = 0.956, g \simeq 17.9$ mag) and Q 0107-025 B ($z = 0.952, g \simeq 17.3$ mag) at ESO, the AAT and the MMT provide evidence for spectral differences between these two quasars:

(i) the redshift difference $\Delta z \simeq 0.004$ observed between the two quasars is well established;
(ii) forbidden emission lines due to [O II] λ 3727, [Ne III] λ 1815 and possibly [Ne V] λ 3426 are present in the spectrum of Q 0107-025 A, while only [Ne III] λ 1815 is possibly detected in the spectrum of Q 0107-025 B;
(iii) the spectrum of quasar B is definitely steeper in the blue than that of quasar A.

Furthermore, observations carried out with the radio telescopes of Nançay (September 1982, $\lambda = 18$ cm, beam $\simeq 20' \times 4'$), Effelsberg (December 1982, $\lambda = 6$ cm, beam $\simeq 140''$) and Westerbork (February 1983, $\lambda = 21$ cm, beam $\simeq 1.2''$) have provided the following flux densities: $S_{18} = 200 \pm 25$ mJy, $S_6 = 120 \pm 10$ mJy and $S_{21} = 160 \pm 10$ mJy. In the two latter cases, the radio position of the source coincides with the optical position of Q 0107-025 A (Hill, 1983).

Results (i) and (ii) definitely preclude Q 0107-025 A and B from being the gravitational lens images of a single quasar. Despite Q 0107-025 B being about $\Delta m \simeq 0.66$ mag brighter in the visual than Q 0107-025 A – but much fainter at radio wavelengths –, it is remarkable that these twin quasars show such similar fluxes and line profiles for the Mg II and Fe II emissions, but not for the forbidden emission lines.

Given the radial velocity difference $\Delta v \simeq 597$ km s^{-1} and projected linear separation $d \simeq 828$ kpc ($H_0 = 50$ km s^{-1} Mpc^{-1}, $q_0 = 0.0$) observed between Q 0107-025 A and B, it seems very likely that these two objects lie within a same cluster. The detection of a possible high redshift ($z \gtrsim 0.5$) cluster of galaxies on the same CCD frame urges us to obtain spectra of the brightest galaxies in order to check whether or not this cluster and Q 0107-025 A and B are associated.

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