The relative photometric lightcurve of UM673 A&B *

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Abstract: From 1987 to 1993, we have carried out at ESO a photometric monitoring of the gravitationally lensed quasar UM673. The main result is that the two lensed images of UM673 did not show any significant relative variation during more than five years.

1 Introduction

A systematic search for gravitational lens systems in a selected sample of highly luminous quasars (M_V < -27, H_0 = 50 km s^{-1} Mpc^{-1}, q_0 = 0.5), led to the discovery of the double nature of UM673 = Q0142-100 [SUR87.1,SUR88.2].

This quasar (z_q = 2.179) consists in fact of two lensed images (A & B) separated by 2.2". Their magnitudes in the R filter are 16.9 (A) and 19.1 (B). The lensing galaxy has been detected: it has a redshift $z_g \sim 0.49$ and a magnitude $\sim$ 19.

In the framework of an ESO Key-Program [SUR92.2], we have carried out CCD photometry of UM673 A&B, with the hope of deriving the time delay between the variations of the two images, if any. In the present paper we report on the relative photometric lightcurve of this gravitational mirage.

2 Observations

45 CCD frames were obtained in the Bessel B filter at ESO (La Silla, Chile) from 1987 November 13 to 1993 January 29, using the Danish 1.54m, the ESO/MPI 2.2m and the NTT 3.5m telescopes equipped with various CCDs. The B filter was used in order to minimize as much as possible contamination by the underlying galaxy, more prominent in the red. Whenever possible, standard stars were also observed.

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Unfortunately, due to scheduling and weather conditions, the sampling of the data was quite irregular. Further, out of these 45 frames, 10 were corrupted due to technical problems (telescope jumps, bad guiding, ...), leaving us with a total of 35 useful frames.

All frames have been dark-subtracted and flat-fielded (including the subtraction of column offsets) using the ESO MIDAS application package.

3 Analysis of the data

Because of the small separation between the images (2.2") in comparison with the seeing (typically about 1.5"), we had to fit PSFs (Point Spread Functions) to both UM673A and UM673B, assumed to be point-like.

Unfortunately, there is no stellar-like object in the field of UM673 which may be adequately used to build a numerical PSF for the fitting procedure and/or to constitute a photometric reference. We have therefore considered analytical star profiles, essentially Moffat functions.

Using the same PSF for both images, we have obtained reasonably good results for 27 frames, corresponding to 18 nights of observation. For 8 frames, important residuals remain after the fitting procedure, essentially due to the bad quality of the images themselves (awful seeing, cosmic rays on the images, imperfectly subtracted column offsets, ...).

From these 27 frames, only 7 (corresponding to 3 nights), are of photometric quality and have at least one standard star available for calibration.

4 Results

The resulting relative lightcurve of UM673 is illustrated in Figure 1. The uncertainty on individual points is difficult to estimate but most probably ranges from 0.05 to 0.2 mag depending on the quality of the Moffat profile fitting. Apparently, from 1987 to 1993, there are no significant variations of one component of UM673 relative to the other one. The mean magnitude difference is equal to 2.16 ± 0.08. The observed scatter of the magnitudes is ~ 4 %.

For 3 nights (October 31, 1988, December 17, 1988, and October 27, 1991), it has been possible to evaluate the photometric zero point. We have derived, for UM673A+B, B = 16.8, 16.9, and 16.7, respectively. These values agree within the uncertainties. This suggests that the absence of significant variations in the relative light curve is actually due to the stability of the source.

Finally, we can evaluate the efficiency of our monitoring: if we note that ~ 25 % of the nights were lost due to bad weather (i.e. no observation at all), only ~ 50 % of the scheduled observations led to good quality measurements.

5 Conclusions

We do not detect any significant variation (≥ 0.1 mag) in the relative photometric light curve of UM673 A&B during more than five years. This is most probably due to the stability of the source luminosity.

Only 50 % of the scheduled observations led to useful data. This relatively poor efficiency clearly shows the need for a telescope dedicated to the monitoring of gravitational lenses.

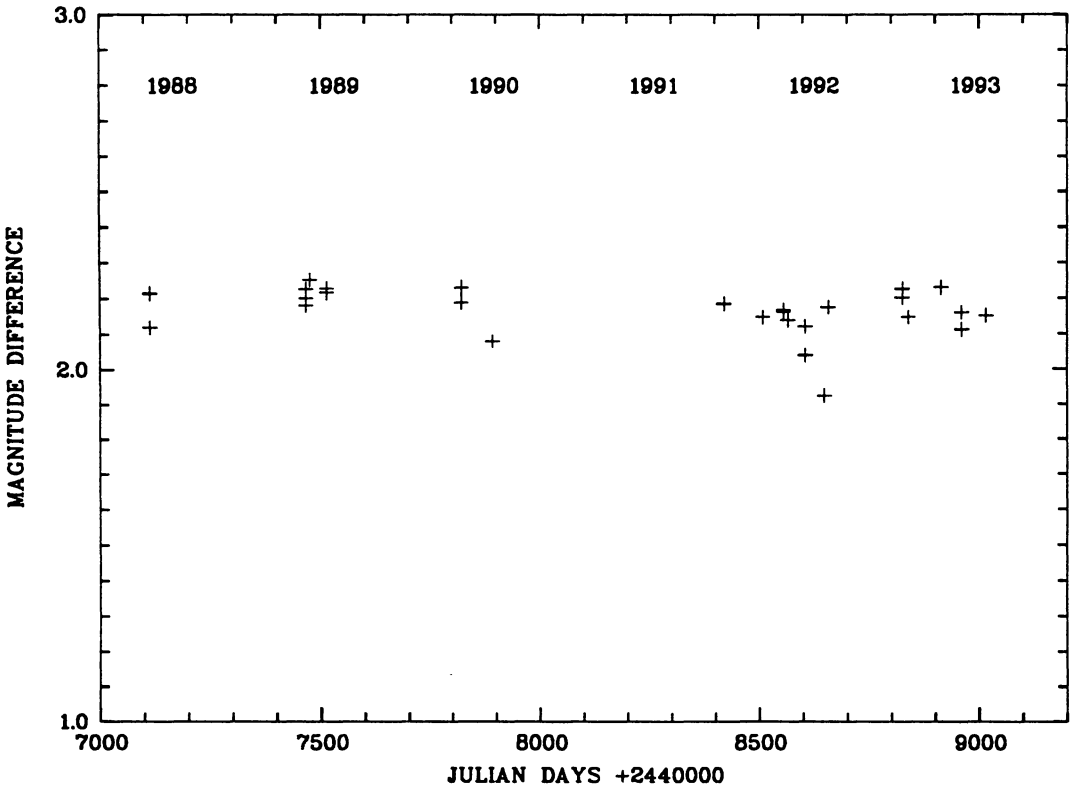

Figure 1: The relative photometric lightcurve of UM673 A&B from 1987 to 1993

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