LETTERS TO THE EDITOR

PHYSICAL SCIENCES

Optical Variations in 3C 345

Hunter and Lü[1] claim that on June 11, 1969 (UT), the quasi-stellar source 3C 345 showed a variation of ≈0·4 blue magnitudes within the span of a few hours. The first ten of their observations on this night (shown in Fig. 3 of their article) have a range of only 0·19 mag, while the inclusion of their eleventh and last observation increases the range to 0·38 mag. If ten observations have a range of 0·19 mag, then the expected r.m.s. deviation of a single observation (σ) is ±0·062 mag and the expected probable error of a single observation is ±0·042 mag (ref. 2, Table 6). Because Hunter and Lü give probable errors in the range ±0·02 to ±0·055 for their ten observations, it would seem that these ten observations give little or no evidence for any real variation in the object. The reality of the alleged variation therefore depends entirely on the reliability of their last observation on that night.

In the period June 6, 1969 (UT), to June 15 (UT) inclusive, six photographs in the blue were made on 5 nights with the Crossley reflector and the 20-inch astrograph, and six photographs in the visual were made on 6 nights with the 12-inch refractor at Lick Observatory. Blue (B) and visual (Y) magnitudes of 3C 345 were obtained from these plates by measurements with an iris astrophotometer using a photoelectric sequence obtained with the 120-inch reflector. The blue magnitudes are close to the Johnson B system while the Y magnitudes differ from the Johnson V system by a constant colour term which for 3C 345 is of the order of 0·1 mag. The total range of the six blue observations is only 0·14 mag corresponding to a σ of ±0·055 mag, while for the six visual observations the range is 0·22 mag corresponding to a σ of ±0·087 mag, so that these observations give no evidence for a variability of more than a few hundredths of a magnitude during this period. The mean values are B = 15·99 ± 0·02, Y = 15·57 ± 0·04 and B–Y = +0·42 ± 0·05. Fig. 1 shows a plot of the Yale observations for the nights of June 11, 12 and 13 (UT) as a function of the hour angle of 3C 345 at the time of the observation. It will be noticed that the eight observations made with the object high in the sky (hour angle less than 40 min) have a total range of only 0·14 mag while the eight observations made with the object lower in the sky (00 h 40 m < hour angle < 03 h 30 m) have a range of 0·38 mag and there is possibly a systematic relation between the Yale magnitude and the hour angle. At any site, and particularly at those at low altitude and near urban areas, a significant deterioration in the quality of a photometric observation may be expected with increasing hour angle because of the increase in sky brightness and extinction. Systematic effects are less predictable but are possible so that the effect shown in Fig. 1 is not unusual.

The evidence for a large variation in 3C 345 on the night of June 11 UT depends on the reliability of the last observation made by Hunter and Lü on that night. This observation (Yale blue magnitude 15·51) is the one with the greatest hour angle in Fig. 1 and was made at 02 h 45 m EST. An exposure with the Lick 12-inch refractor between 03 h 00 m and 04 h 10 m EST on the same night gave Y = 15·59 which (taking B–Y = +0·42) gives B = 16·01, in good agreement with the other Lick observations referred to. The mean blue magnitude given by the first ten Yale observations on the night of June 11 UT is 15·77, while the mean blue magnitude is 15·74 for the eight Yale observations with hour angle less than 40 min on June 11, 12 and 13 UT. From this latter value we suggest that a correction of 0·25 mag be added to the Yale magnitudes to bring them to the Lick system. If this is done, the mean B magnitude of the first ten observations of Hunter and Lü on June 11 UT is 16·02, which is in very good agreement with the single Lick observation of this night.

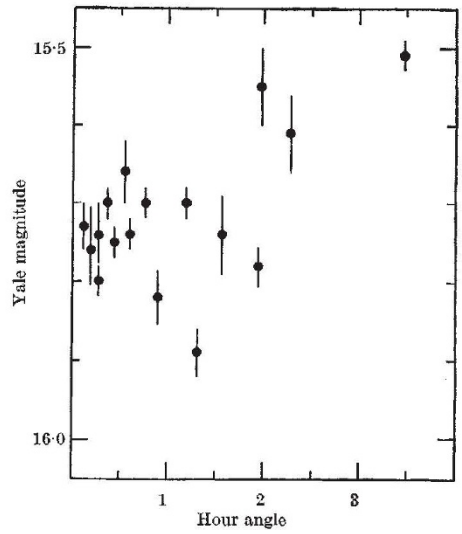

Fig. 1. Yale photographic magnitudes of 3C 345 for the nights of June 11, 12 and 13, 1969 (UT), as a function of the hour angle of the object at the time of observation.

Hunter and Lü give a probable error of only 0·02 mag for the magnitude derived from their eleventh plate. Presumably this error is derived from the scatter in the magnitudes of their comparison stars about their calibration curve. It is my experience that fluctuations in the background can occasionally cause a large error in the measured magnitude of a star without necessarily producing a significant increase in the errors of the comparison stars: such effects are more common when the plate background is dark as may be expected at large hour angles. For this reason it was stated in an earlier paper[3] that "no single photographic observation by itself can be taken as sufficient evidence for a change in brightness of the object". I conclude that the rapid variation of 3C 345 on June 11 UT should therefore be treated with considerable reserve.

This work is supported by a grant from the US National Science Foundation.

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Received September 29, 1969.

[1] Hunter, J. H., and Lü, P. K., *Nature*, 223, 1045 (1969).
[2] Lindley, D. V., and Miller, J. C. P., *Cambridge Elementary Statistical Tables*, 7 (Cambridge, 1953).
[3] Kinman, T. D., Lamla, E., Ciurla, T., Harlan, E., and Wirtanen, C. A., *Astrophys. J.*, 152, 357 (1968).