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THE PHOTOMETRIC RANGE OF EX LUPI: a correction to IBVS 3755

In IBVS 3755, Herbig, Suntzeff and Blanco reported Johnson BV photometry carried out at CTIO of the comparison star sequence for EX Lupi, the V magnitudes being intended to replace the visual estimates that had been in use by the observers of the Royal Astronomical Society of New Zealand, Variable Star Section. Shortly after the appearance of IBVS 3755, one of the authors of the present note (A. C. Gilmore) called to the attention of Herbig *et al.* that a serious discrepancy existed between their data in IBVS 3755 and photometry of the same stars that had been carried out, quite independently, by Gilmore. It was then discovered that in the final stage of the reduction of the CTIO measures, there had been a shuffling of the data with the result that the 'B' magnitudes of IBVS 3755 were actually V magnitudes, and that while the B-V values were correct, those 'V' magnitudes were spurious, being simply 'B' minus B-V. The present *Information Bulletin* is intended to set the record straight.

The observations by Gilmore were made in 1992 September and October at Mount John University Observatory, with photometer no. 1 on the 0.6-m Boller and Chivens Cassegrain reflector. Standard Johnson-Cousins filters were used with a cooled EMI 9558B (S-20) photomultiplier and pulse-counting electronics. The measures were made differentially with respect to HR 5952, 27' WSW of EX Lupi, and checked against HR 5945, 42' SW of the variable. *Bright Star Catalogue* (4th ed.) magnitudes were adopted for both stars, and a V-R = -0.03 assumed for HR 5952. The details of the CTIO photometry are given in IBVS 3755.

Table 1
Magnitudes of Comparison Stars for EX Lupi

| star | CTIO | | Gilmore | | | | Ptg. mag. | Vis. mag. |
|------|-------|-------|-----------|-----------|-----------|-----------|--------------|--------------|
| | V | B-V | V | B-V | U-B | V-R | | |
| W | 8.21 | +0.16 | 8.19 (2) | +0.13 (3) | -0.09 (4) | +0.09 (1) | — | 8.4 |
| X | 8.56 | 0.62 | 8.54 (1) | 0.60 (1) | +0.24 (1) | 0.43 (2) | — | 8.9 |
| Y | 9.56 | 0.55 | 9.56 (1) | 0.54 (1) | -0.03 (1) | 0.33 (1) | — | 9.8 |
| a | 10.31 | 0.29 | 10.29 (1) | 0.29 (0) | — | 0.15 (2) | 10.9 | 10.6 |
| c | 10.95 | 0.65 | 10.94 (1) | 0.62 (3) | — | 0.40 (2) | 11.4 | 11.3 |
| d | 10.70 | 0.56 | 10.67 (0) | 0.51 (1) | — | 0.31 (1) | 11.4 | 11.5 |
| b | 10.66 | 0.71 | 10.63 (1) | 0.66 (4) | — | 0.41 (1) | 11.4 | 11.7 |
| f | 11.14 | 1.33 | 11.15 (1) | 1.28 (0) | — | 0.73 (2) | 12.3 | 12.2 |
| h | — | — | 11.45 (0) | 1.39 (1) | — | 0.81 (2) | 12.6 | — |
| e | 11.80 | 0.54 | 11.82 (0) | 0.51 (1) | — | 0.32 (1) | 12.2 | 12.4 |
| g | 12.06 | 0.71 | 12.06 (1) | 0.73 (2) | — | 0.43 (2) | 12.4 | 12.6 |
| i | 12.26 | 0.78 | 12.22 (0) | 0.72 (2) | — | 0.40 (0) | 12.8 | 13.0 |
| k | 12.67 | 0.98 | 12.62 (1) | 0.98 (1) | — | 0.58 (1) | 13.1 | 13.3 |
| u | 12.35 | 1.91 | — | — | — | — | — | 13.5 |
| l | 13.23 | 0.80 | 13.16 (1) | 0.83 (2) | — | 0.42 (6) | 13.3 | 13.8 |
| m | — | — | 14.09 (0) | 1.1 (30) | — | 0.4 (20) | 14.1 | — |
| n | — | — | — | — | — | — | 14.2 | — |
| EX | 12.60 | 0.71 | 13.03 (6) | 1.18 (3) | — | 0.88 (6) | — | — |

Table 1 contains both the CTIO data (B magnitudes are not tabulated), now properly labelled, as well as the photometry by Gilmore. The figures in parentheses following the Mt. John data are standard deviations in hundredths of a magnitude.

The "ptg. mag." of the next-to-last column is from McLaughlin (1946), while the "vis. mag." of the last column is from Bateson and Jones (1957). The mean B from the CTIO and Mt. John observations, but disregarding star *m*, can be related to McLaughlin's magnitudes by

$$B = 1.334 (\text{ptg. mag.}) - 3.88 , \quad (1)$$

so that McLaughlin's range of 11.4–13.9 converts to 11.3–14.7 on the B scale, although it must be noted that this minimum magnitude represents an extrapolation of 0.7 mag. beyond the limit of the data to which (1) was fitted. Similarly, the means of the two series of V's relate linearly to the visual estimates, if the very red star *u* is omitted, by

$$V = 0.895 (\text{vis.mag.}) + 0.63 . \quad (2)$$

This expression converts the original Bateson-Jones visual range of 8.7–14.0 for EX Lupi to 8.4–13.2 on the V scale.

The observations of EX Lupi itself in the last line of Table 1 were obtained on 1989 Sept. 15.1 at CTIO and on 1992 Oct. 17.4 at Mt. John, the latter at an air mass of 2.2. As noted in IBVS 3755, observations by Bastien and Mundt in 1977 and 1979 gave a mean B–V of +1.11 when EX Lupi had a mean V of 13.2. The Mt. John observation is quite near those values; the CTIO observation was apparently obtained at a time when the star was somewhat brighter and bluer. The B and V minima of EX Lupi inferred from eqs. (1) and (2) are of course less reliable; they correspond to a B–V at minimum light ($V = 13.2$) of about +1.5.

However, the B–V color of EX Lupi at maximum light inferred in the same way is +2.9. It was suggested in IBVS 3755 that this quite unreasonable value is the result of incomplete photographic coverage of the light curve, with the consequence that bright maxima such as the one observed visually in 1955–56 were simply missed on the Harvard plate series.

For this reason, the V range of 8.4–13.2 is to be preferred to the B value. This V range of 4.8 mag. is not very different from the original Bateson-Jones value of 5.3 mag. Thus EX Lupi and PV Cephei continue to have the largest ranges among the known EXors, although the photometric information on PV Cephei is less extensive.

G. H. HERBIG ¹,
ALAN C. GILMORE ²,
and
N. SUNTZEFF ³

¹ Institute for Astronomy, University of Hawaii,
Honolulu, Hawaii, USA

² Mt. John Observatory and Dept. of Physics and
Astronomy, University of Canterbury, Christchurch,
New Zealand

³ Cerro Tololo Inter-American Observatory,
La Serena, Chile

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