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PHOTOMETRY OF STARS IN THE FIELD OF R AURIGAE

R Aurigae (= HR 1707 = HD 34019) is a bright, well-studied Mira variable with a 15-month period. The mean spectral type is about M7IIIe; maxima rise as bright as $6^m.6$ (visual), minima are as faint as $13^m.8$ (Isles & Saw 1987). The star was under visual observation by members of the BAA from 1904 until 1974; it has been on the program of the AAVSO since 1921. The period is somewhat variable, a phenomenon most thoroughly analyzed by Lloyd (1989). I observed a number of stars in the field as a check on the existing AAVSO comparison sequence, which has remained unchanged since 1928.

I observed the comparison stars using the Lowell 53cm telescope on 30 January, 25 February, and 1 March 1994 UT. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about $9^m.0$. Bright Moonlight especially on 25 February necessitated additional 'sky' readings to maintain proper signal-to-noise.

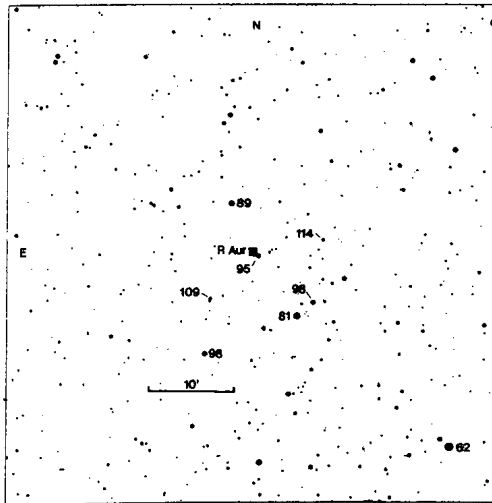


Figure 1. The field of R Aurigae showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

| Name | V (std) | $b - y$ (std) | V (obs) | $b - y$ (obs) | n | source |
|-----------|------------|------------------|------------|------------------|---|------------|
| HD 11577 | 7.707 | 0.112 | 7.710 | 0.109 | 1 | O83 |
| HD 16082 | 7.236 | 0.701 | 7.235 | (0.717) | 1 | O83 |
| HD 23324★ | 5.665 | -0.022 | 5.665 | -0.016 | 1 | O83/CB70 |
| HD 24357★ | 5.970 | 0.221 | 5.973 | 0.225 | 1 | Nic/CB70 |
| HD 24482 | 8.184 | 1.256 | (8.208) | 1.261 | 3 | Lowell |
| HD 26546 | 6.085 | 0.658 | 6.089 | 0.657 | 1 | Lowell |
| HD 27749★ | 5.632 | 0.180 | 5.638 | 0.181 | 1 | POC/CB70 |
| HD 33021★ | 6.165 | 0.397 | 6.172 | 0.397 | 3 | POC/O83 |
| HD 35299 | 5.701 | -0.092 | 5.715 | -0.098 | 1 | GO76 |
| HD 41143 | 7.757 | 0.720 | 7.763 | 0.732 | 1 | GO91 |
| HD 42131 | 7.059 | 0.614 | 7.061 | 0.620 | 1 | GO91 |
| HD 42049 | 5.929 | 1.044 | (5.951) | 1.057 | 1 | Lowell |
| HD 42398 | 5.821 | 0.683 | 5.815 | 0.683 | 1 | Lowell |
| HD 42824 | 6.627 | 0.019 | 6.621 | 0.030 | 2 | GO76/C72 |
| HD 43358★ | 6.363 | 0.296 | 6.368 | 0.298 | 1 | POC/O83 |
| HD 44974 | 6.524 | 0.571 | 6.524 | 0.570 | 1 | O93 |
| HD 45433 | 5.540 | 0.858 | 5.541 | 0.850 | 1 | AT91 |
| HD 47420 | 6.118 | 0.910 | 6.120 | 0.922 | 1 | AT91/O83 |
| HD 48805 | 6.497 | 0.543 | 6.499 | (0.526) | 2 | O93 |
| HD 50188 | 9.539 | 0.010 | 9.544 | (-0.012) | 1 | L92/Lowell |
| HD 52533 | 7.702 | 0.006 | 7.693 | 0.000 | 1 | L83/HM |
| HD 57006★ | 5.915 | 0.339 | 5.914 | 0.336 | 2 | GOS/O83 |
| HD 58580 | 6.781 | -0.003 | 6.782 | -0.004 | 2 | O83 |
| HD 60803★ | 5.902 | 0.376 | 5.902 | 0.376 | 3 | O83 |
| HD 73665 | 6.391 | 0.603 | 6.387 | 0.597 | 4 | O93/CB69 |
| HD 73666 | 6.618 | 0.005 | 6.610 | 0.004 | 3 | CB69 |
| HD 74721 | 8.715 | 0.029 | 8.713 | 0.027 | 2 | AT91/S91 |
| HD 79248 | 6.480 | 0.017 | 6.490 | 0.017 | 1 | Nic/C72 |
| HD 85217★ | 6.236 | 0.305 | 6.234 | 0.307 | 1 | GOS/O83 |
| HD 86238 | 7.272 | 0.815 | 7.268 | (0.803) | 1 | Lowell |
| HD 88923 | 7.699 | 0.266 | 7.698 | 0.261 | 1 | O83 |
| HD 98280 | 6.660 | 0.024 | 6.663 | 0.034 | 1 | Nic/C72 |
| HD100600★ | 5.948 | -0.070 | 5.952 | -0.076 | 1 | POC/CB70 |
| HD101606★ | 5.744 | 0.312 | 5.745 | 0.310 | 1 | O83 |
| HD103095★ | 6.429 | 0.484 | 6.425 | 0.487 | 1 | O83/CB70 |
| HD107655 | 6.200 | -0.002 | 6.192 | -0.001 | 1 | Nic/C72 |
| HD109995 | 7.600 | 0.048 | 7.602 | 0.045 | 1 | Nic/CB70 |
| HD113865 | 6.520 | 0.033 | 6.519 | 0.039 | 1 | CP89 |

Table 2. Photometry of Stars in the Field of R Aurigae

| Name | RA (2000) | Dec (2000) | V | $b - y$ | n | spec | Remarks |
|---------------|---|--------------|--------|---------|---|--------|---------|
| HD 34019 | 5 ^h 17 ^m 17 ^s .7 | +53° 35' 10" | 10.568 | 2.289 | | M7IIIe | (1) |
| | | | 10.228 | 2.170 | | | (2) |
| HD 33654 | 5 14 44.3 | +53 12 50 | 6.153 | 0.109 | 2 | A0V | (3) |
| | | | .007 | .000 | | | |
| HD 33941 | 5 16 42.9 | +53 27 53 | 8.054 | 0.735 | 2 | K0 | |
| | | | .000 | .007 | | | |
| HD 233098 | 5 17 34.6 | +53 40 45 | 8.923 | 0.624 | 2 | K0 | |
| | | | .006 | .001 | | | |
| HD 233095 | 5 17 13.6 | +53 34 43 | 9.492 | 0.324 | 2 | F4IV | (4) |
| | | | .001 | .001 | | | |
| BD+53°0885 | 5 17 54.7 | +53 23 32 | 9.802 | 0.864 | 2 | | (5) |
| | | | .036 | .004 | | | |
| GSC 3735-0918 | 5 16 30.4 | +53 29 27 | 9.847 | 0.801 | 2 | | |
| | | | .013 | .001 | | | |
| GSC 3735-1121 | 5 17 50.5 | +53 29 49 | 10.865 | 0.391 | 2 | | |
| | | | .012 | .018 | | | |
| GSC 3735-1310 | 5 16 23.0 | +53 36 36 | 11.411 | 0.197 | 2 | | |
| | | | .023 | .062 | | | |

Remarks:

- (1) - = R Aurigae = HR 1707; observation on 1994 Jan 30.24 UT.
(2) - observation on 1994 Feb 25.22 UT.
(3) - = HR 1692. $V = 6.20$ (Oja 1983), 6.16 (Oja 1991), $b - y = 0.094$ (Crawford et al. 1972).
(4) - $V = 9.50$ and spectral type (Lutz & Lutz 1977).
(5) - = GSC 3735-1156. possibly slightly variable.

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources listed in Table 1. Dr. Olsen has supplied me with revised values for the primary four-color standards (marked with * by the star name) derived from the original standard-star list of Crawford & Barnes (1970). The “Lowell” secondary standards were observed on about thirty nights each over several seasons with the 53cm telescope directly against primary standards. Table 1 shows the adopted and observed mean V and $b - y$, the number of observations ‘n’, and the source for the standard values. The stars are sorted in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are: $V = +0.001 \pm 0.005$; $b - y = +0.001 \pm 0.006$.

Results for the stars near R Aurigae are shown in Table 2, sorted in order of decreasing brightness. Two measures of R Aurigae itself are given in the first entry. The stars are identified by HD, BD, or GSC number; positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. The standard deviation of the mean values are given in the second line of each entry.

The color of R Aurigae is of course far outside the range of the standards, and so the results are subject to ‘reduction errors’ from extrapolating the calibrations defined by the standards (cf. Manfroid & Sterken 1992). Previous experience suggests the uncertainties arising from this source are ± 0.03 to 0.05 mag. in $b - y$, with smaller errors in V .

For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable- star charts.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France. It was also helpful to have at hand a copy of "The Bright Star Catalogue", 5th revised edition (March 1994), by D. Hoffleit and W. H. Warren, Jr., kindly supplied by Wayne Warren.

Brian A. SKIFF
Lowell Observatory
1400 West Mars Hill Road
Flagstaff AZ 86001-4499
Internet: bas@lowell.edu

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