IS HR 1469 = NSV 1671 A CONSTANT STAR?

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Abstract

A revised interpretation of the possible fade in brightness of star HR 1469 observed by the Hubble Space Telescope Fixed Head Star Trackers is given. Most likely HR 1469 was at a normal brightness on the reported epoch of observation.

1. Introduction

The bright star HR 1469 = 49 Eri = NSV 1671 = SAO 111928, now in Taurus, (RA = $4^h 37^m 13.66^s$, DEC = + 0° 59' 53.9" (equinox J2000); V = 5.31, B-V = -0.12, B7V) has been suspected of light variability by Cousins (1963). He reported a V-magnitude change of 0.08 magnitude. No conclusive observations have been published since, confirming or refuting Cousins' conclusion. Therefore, a surprise came when one of us (A.B.) on November 4, 1992, noticed an oddity in operational signals from the Hubble Space Telescope (HST) Fixed Head Star Trackers (FHST) which indicated a substantially fainter magnitude for HR 1469 (Bradley *et al.* 1992). At that time a real fade in brightness, down to magnitude 6.9, seemed to be the most reasonable explanation, although later, Hoffleit (1993) raised the question of a possible HST on-board malfunction. A subsequent examination of old plate archives worldwide showed no signs of variability of that order in the past. Meanwhile, we again checked the telemetered data from the FHST. After reviewing these data, we propose an alternative explanation for the apparent fading of HR 1469, not related to any intrinsic variability of the star.

2. How the FHST works

The Fixed Head Star Trackers are used to determine the approximate pointing of the telescope. The FHST star detector provides roughly V-bandpass integral fluxes as faint as V~8 magnitude using an effective aperture of 9'. The observed fluxes and positions in different FHSTs are compared with predicted positions and magnitudes from a ground-based catalogue complete down to V = 8.5 magnitude. In case of a false detection, the FHST is given a command to step to a new 1.5 by 1.5 degree subfield and continue the search. An important feature of the search pattern is that it is not contiguous: there is a dead zone of ~50' around each mis-identified star. Alternatively, it is possible to map an area of 8 by 8 degrees if the search fails totally, in order to determine the HST pointing.

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A legitimate question is why does the search fail from time to time? There might be two explanations for a star with a well-established magnitude and position in the ground-based catalogue: (1) the FHST gets a "hit" on a nearby star then accidently skips over the target star, or (2) the target star is detected but its magnitude has changed by an amount that places it outside the magnitude tolerance range.

In the first case one may ask how is it possible to miss a 5th magnitude star? As mentioned before, the FHST search pattern contains "dead zones" around every detected star, within which even such a bright star may go undetected. Assuming that the FHST might have captured another star, close to HR 1469, we searched for such a 6.9 magnitude star within one degree around HR 1469. There is no such star. The closest star to HR 1469 is SAO 111902 (V = 7.27) located at the distance 55.3'. The latter circumstance led us to the conclusion that the detected 6.9 magnitude star was in fact HR 1469 and that its magnitude must have changed, as we reported in the IAU Circular (1992).

3. A nearby double star

Upon reconsideration we realized that another scenario exists in which HR 1469 may have gone undetected by the FHST. The effective aperture of the FHST is large enough that the combined light from two or more stars may have produced a false "hit" near HR 1469, thus providing an opportunity for it to fall within a "dead zone." Subsequent inspection of the field surrounding HR 1469 revealed such a pair of stars whose combined magnitude reasonably approximated the observed 6.9 magnitude. These stars are SAO 111934 (V = 8.4, G5) and SAO 111935 (V = 8.3, G5), having a separation of 79" and located 25.6' away from HR 1469. Their combined magnitude would be V = 7.6, which is still 0.7 magnitude fainter than that observed. However, the magnitudes from the SAO catalogue could be incorrect by such an amount. Indeed, combined results of photoelectric and CCD photometry provide the following B and V magnitudes: for SAO 111934 V = 7.66, B-V = 0.42, and for SAO 111935 V = 7.65, B-V = 0.46. An internal accuracy of the magnitude and color is about $\pm$0.03 magnitude. From these measurements the combined magnitude 6.90 is identical to the value measured by the FHST on November 4, 1992.

4. Conclusions

Taking into account the FHST operational features, we conclude that on November 4, 1992, the FHST did not detect HR 1469 but instead detected the combined light from two nearby stars, SAO 111934 and SAO 111935. Thus, the FHST did not actually make a measure of the brightness of HR 1469 on that date. Furthermore, Wenzel (1992) and Chinarova and Andronov (1993) examined the brightness of HR 1469 using the Sonneberg and Odessa plate collections, respectively. No variations have been found over the years 1928-1992. At Harvard, Hoffleit examined 300 AC plates (1.5-inch lens) taken between 1898 and 1930 and found no significant variation. These results strongly suggest that HR 1469 most likely is a nonvariable star within the limitations of photographic estimates. In addition, Baldwin (1993) and co-observers of the AAVSO Eclipsing Binary Committee found no variations out of ~50 visual observations after November 4, 1992. Photoelectric observers, however, are encouraged to verify the amplitude of 0.08 magnitude found by Cousins.

5. Acknowledgments

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