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Autocorrelation analysis of the Crimean and Hipparcos photometry of the runaway star HD 188001

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Crimean photoelectric photometry and Hipparcos epoch photometry of runaway star HD 188001 are presented. Data processing of this observation by a form of autocorrelation analysis confirms the periodic ($P = 32.514$ d) variability of this star.

Keywords: Runaway stars; Photometry; Data analysis

The star HD 188001 = QZ Sge = 9 Sge is a well-known runaway star with the peculiar space velocity $V_p = 127.6$ km/s and with the significant height z = -205 pc above the Galactic plane [1]. This star is included in the Catalogue "Highly evolved massive close binary systems" [2] as a close binary system among a class of objects "X-ray quiet $OB'_2 + c$ binaries". This deduction has been made on the basis of the spectroscopic period $P = 78.3$ d found in [3]. Aslanov and Barannikov [4] found the new spectroscopic period of 32.514 d and proposed that 9 Sge was an eclipsing binary system with a low-mass (1.5 $M_\odot$) companion moving in an eccentric ($e \sim 0.6$) orbit. The one more spectroscopic period of 78.74 d, with the set of orbital elements indicating that the companion could be a low-mass star whose mass was probably in the $1.2 - 1.9$ $M_\odot$ range specified by Underhill and Matthews [5].

The photometric observations of HD 188001 which have been carried out from July 1989 through August 2002 with the Zeiss-600 telescope at the Crimean Laboratory of the SAI using a photon-counting BVR-photoelectric photometer. The comparison star was HD 188062 ($B8V5$, $V = 7^m.63$). Each observational night no less than 3 individual estimates of the star brightness were made. A total of 133 brightness measurements in each band B, V and R were made in 118 observational nights.

In the present paper on the basis of the Crimean author's observations in V band and on a basis of the data Hipparcos (194 brightness measurements) [6] the autocorrelation analysis has been carried out. The author used a form of autocorrelation analysis [7] to once again investigate the periodic variability of light of HD 188001.

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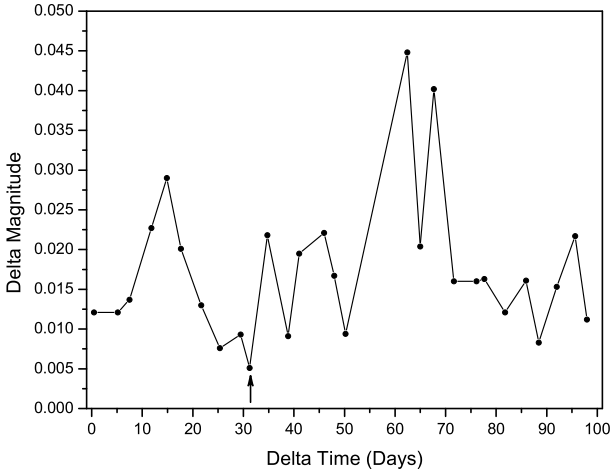


Figure 1 A self-correlation diagram of the Hipparcos data. Minimum at lag of $P \approx 32$ *d* is indicated by an arrow.

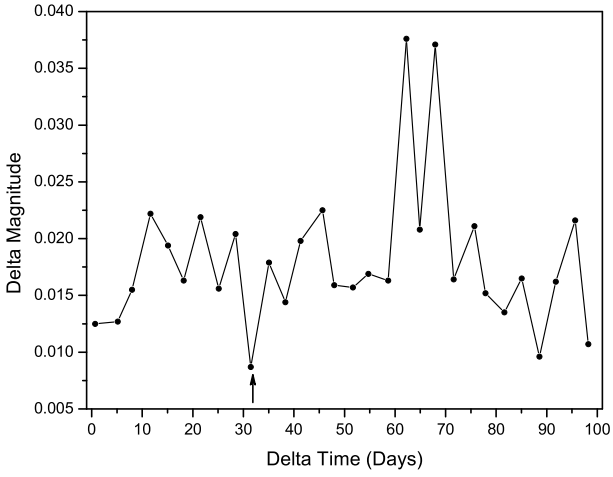


Figure 2 A self-correlation diagram of the Crimean and Hipparcos combined data. Minimum at lag of $P \approx 32$ d is indicated by an arrow.

The given method differs in essence from Fourier methods, on the basis of which the above mentioned spectroscopic periods have been found [4]. The new photometric data also were reanalyzed earlier by Fourier and nonparametric methods (see [8] for more details). Autocorrelation method has confirmed the period $P = 32.514$ *d* which

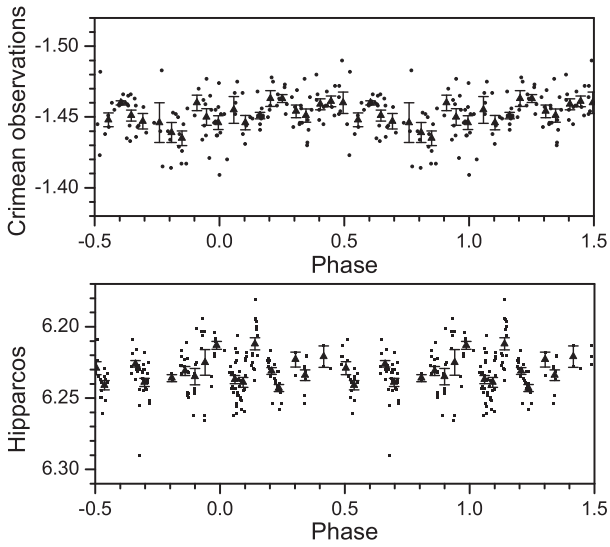


Figure 3 Light curves of 9 Sge with the 32.514-day period. The top panel shows our Crimean V-band observations. The bottom panel shows Hipparcos observations. The filled triangles with error-bars are the data averaging in bins of 0.05 cycles.

has been found in [4]. The minimum on the all diagrams at values Delta Time ≈ 32 *d* which misses near to values Delta Time ≈ 78 *d* is well seen. It can be the additional proof of correctness of the period 32.514 *d* in comparison with other periods. Figure 1 shows a self-correlation diagram for Hipparcos data. Figure 2 shows a self-correlation diagram for Crimean and Hipparcos combined data (totally 327 brightness measurements). It should be noted that Hipparcos observations have been transformed to V. Figure 3 shows light curves of 9 Sge with a 32.514-day period.

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