SEARCH FOR PHOTOMETRIC ECLIPSES
OF THE RUNAWAY STAR 9 Sge

BARANNIKOV, A. A.[1,2]

[1] Sternberg Astronomical Institute, University Avenue 13, 119899 Moscow, Russia,
e-mail: albardon@mail.ru

[2] South-Russia State University of Economics and Service, Shevchenko str. 147, Shakhty 346500, Rostov region, Russia,
e-mail: albar@sssu.ru

Name of the object:
QZ Sge = 9 Sge = SAO 105360 = HD 188001 = BD+18°4276

Equatorial coordinates:	Equinox:
R.A.= $19^h52^m21^s\!.76$ **DEC.**= $+18°40'18''\!.7$	2000

Observatory and telescope:
Crimean Laboratory, Sternberg Astronomical Institute, 60 cm Cassegrain telescope

Detector:	photometer: one channel

Filter(s):	BVR

Date(s) of the observation(s):
1989.07/2002.08

Comparison star(s):	HD 188062

Check star(s):	none

Transformed to a standard system:	No

Availability of the data:
upon request

Remarks:

The star 9 Sge (HD 188001) is one of the best-known runaway stars, it has a high peculiar space velocity, $V_p = 127.6$ km/s, and lies at a large distance below the Galactic plane, $z = -205$ pc (Stone 1979). The spectroscopic and photometric studies of 9 Sge have a more than 80-year history. However, despite the attention to this comparatively bright (V = 6^m243) object, several very important questions are still open. This is especially true for period determination and for revealing the character of spectroscopic and photometric variations.

Hill et al. (1976) were the first to put forward the idea that 9 Sge was an eclipsing binary. Aslanov et al. (1984) found a dominant spectroscopic period of 78.3 d. Aslanov & Barannikov (1992) found a new spectroscopic period of 32.514 d and cautiously 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. Underhill & Matthews (1995) specified a more precise spectroscopic period of 78.74 d, with the set of orbital elements indicating that the companion could be a small star whose mass was probably in the $1.2 - 1.9$ $M_\odot$ range.

In this paper, we present the B, V and R light curves of 9 Sge obtained in 1989–2002. This is a new attempt to find photometric eclipses of the star on the base of long-term observations. We analyzed the light curves by three methods: Lafler & Kinman (1965), Deeming (1975), and Scargle (1982), in the modification by Horne & Baliunas (1986). Unfortunately, none of the methods revealed a dominant peak in the 0–1 c/d frequency range. Moreover, we could not detect any appreciable eclipses (exceeding 3σ, i.e. $\sim 0^m05$) in the phase diagrams for the earlier-found period values, 32.514 d (Fig. 1, the three upper panels) and 78.74 d (Fig. 2, the three upper panels), though the presence (especially in B light) of the non-dominant brightness minimum at the phases 0.9 - 1.0 for the period of 32.514 d should be mentioned (Fig. 1, top panel). Near this phase, the theoretical radial-velocity curve passes through the gamma velocity (Aslanov & Barannikov 1992, Fig. 2). It is possible that these light variations result from eclipses and the radial-velocity curve results from orbital motion. Unfortunately, absolutely no secondary minimum is visible. The analysis of the Hipparcos data (ESA 1997) reveals no signatures of eclipses with these periods (the bottom panels of Fig. 1 and Fig. 2). It appears from Figs. 1 and 2 that there is no correlation in brightness variability between our observations and Hipparcos observations.

These results cast doubt on the eclipsing status of 9 Sge (but no final decision is possible yet). The question of the star's binarity and hence of the mechanism (binary supernova or dynamical ejection) of its acceleration to the runaway velocity remains unsettled. Observations of 9 Sge should be continued.
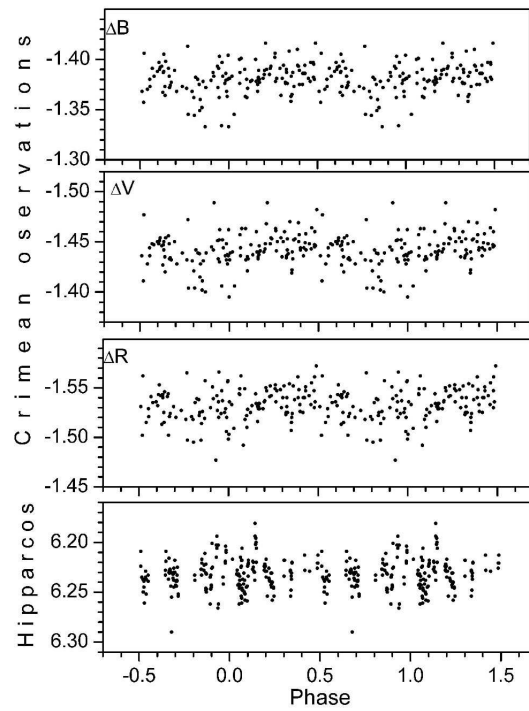
Figure 1. Light curves of 9 Sge with the 32.514-day period. The three top panels show our Crimean B, V, and R observations. The bottom panel shows Hipparcos observations
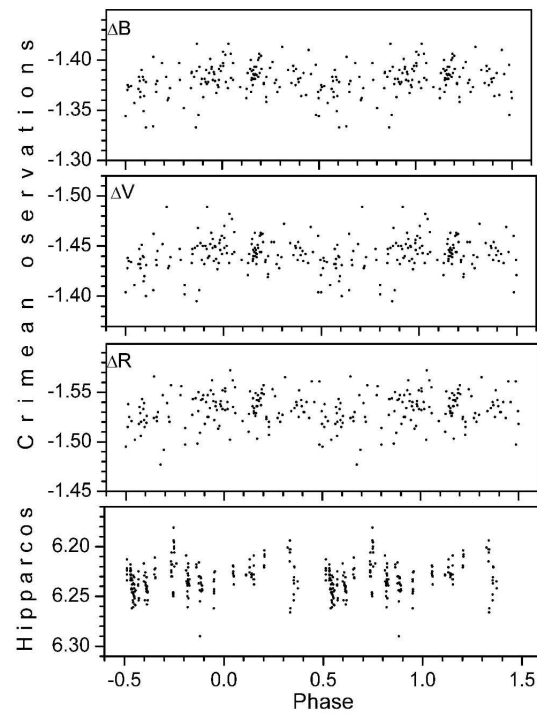

Figure 2. Light curves of 9 Sge with the 78.74-day period. The three top panels show our Crimean B, V, and R observations. The bottom panel shows Hipparcos observations

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