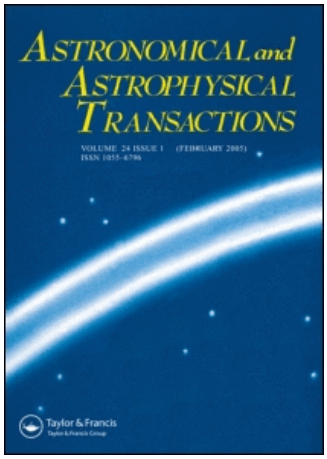

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A search for evolutionary changes in the period of classical Cepheid GY Sge

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Evolutionary changes in the period of classical Cepheid GY Sge are found to be $203 \pm 27\,\mathrm{s\,year^{-1}}$, which is in good agreement with theoretical predictions for a star in the third crossing of the instability strip.

Keywords: Cepheids; Pulsational period

1. Observational data and method of analysis

We estimated the magnitudes for GY Sge on plates of the field contained in the photographic plate collections of the Sternberg Astronomical Institute and Harvard College Observatory. Also we observed this star photoelectrically in 1980–1996 as well as spectroscopically in 1990–2005. In total, 706 photographic and 484 photoelectric observations were obtained, and 95 radial velocity measurements were made. Moreover, published observations including data from the ASAS3 and HIPPARCOS projects were used. The oldest plates used were taken at Harvard in the 1890s, while the last charge-coupled device measurements were conducted in 2006. Hence, our data span a time interval of about 110 years.

To study period changes in GY Sge, we applied the generally used technique of the analysis of the $O - C$ diagram. We calculated the $O - C$ residuals by the Hertzsprung method, for which a computer version was previously developed and described by one of us [1].

2. Results

The $O - C$ data obtained were used to improve the Cepheid's light elements:

$$\text{maximum Julian date} = 2\,433\,000.64(\pm 1.85) + 51^{\mathrm{d}}.5359(\pm 0.0122)E + 0.165\,715 \times 10^{-3} \times (\pm 0.223\,27 \times 10^{-4})E^2 + 0.291\,802 \times 10^{-6}(\pm 0.112\,475 \times 10^{-6})E^3.$$

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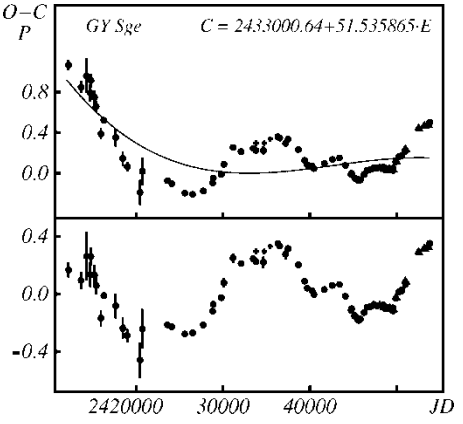

Figure 1. $O - C$ data for GY Sge plotted as a function of the observed heliocentric Julian data of the light maximum (upper plot), and corrected for the gradual increase in the pulsation period (lower plot).

The estimated rate of evolutionary period change in GY Sge is 203 ± 27 s year^{-1}, which is in good agreement with theoretical predictions for a star in the third crossing of the instability strip [2]. The above elements were used to construct figure 1 where the $O - C$ data are plotted as open circles (photometric data) and open triangles (radial velocity data) with vertical bars showing the uncertainty limits. For convenience, we express the $O - C$ residuals in fractions of the period.

The most prominent detail in figure 1 is the wave with a cycle length of about 23 000 days. Such waves are typical features in the $O - C$ diagrams of many Cepheids [3–6].

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