To be a standard, or not to be? — Variable polarization in 9 Gem

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Abstract. The linear polarimetry has been made in 1991-1996 for the supergiant star 9 Gem, which has been recently found to be periodic variable (period = 13.70 day) by the Hipparcos observation. We find that the polarimetric variability marginally depends on the phase of the flux. This finding suggests that a portion of the observed polarization in 9 Gem is circumstellar origin. This star will be still useful as a polarimetric standard of the position angle with the accuracy of ∼1 degree if the effect of periodic variability is calibrated.

1. Introduction

A supergiant star 9 Gem (=HD43384, B3Ia) was one of the polarized standard stars listed by Serkowski (1974), and had been used to calibrate the position angles in linear polarimetry. However, this star was claimed unsuitable for a standard, because the temporal variability of polarization was reported (Hsu and Breger 1982, Dolan and Tapia 1986). A serious problem by the discard of this star is that we have no alternative bright polarized standards in the right ascension ∼6h.

Recently, the catalogue by Hipparcos satellite has been released (ESA 1997). In this catalogue, 9 Gem (=HIP29840) is shown to be periodically variable in flux (the period is 13.70 day, and the epoch is J.D.=2448509.85). In this paper, we investigate the dependence of polarimetric quantities on the phase of the flux variation, to find a clue to the mechanism of the polarimetric variabilities, and also to know whether 9 Gem is useful as a standard or not at a certain accuracy.

2. Observations

We have made linear polarimetry of 9 Gem since 1991 with a multi-channel polarimeter at Dodaira Observatory (Kikuchi 1988). The stellar light into the polarimeter passes the polarizer, then it is divided by dichroic mirrors, and finally it is guided to 8 photomultipliers. We thus obtain the polarimetric data in 8 bands simultaneously. The instrumental polarization was calibrated by observing the unpolarized standard stars (Serkowski 1974). The de-polarization factor was obtained with the measurements of the stellar light through a Glan-Taylor

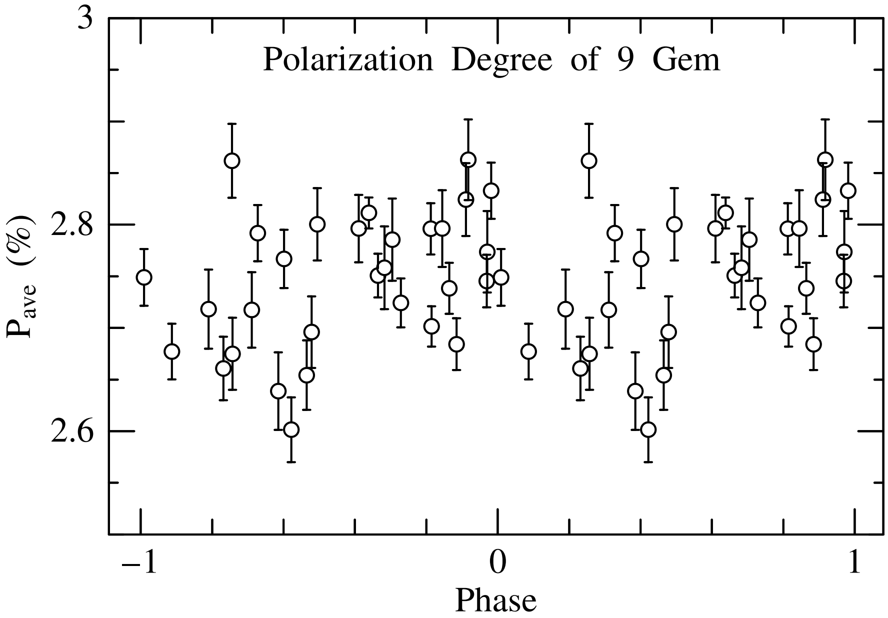

Figure 1. The dependence of P_{ave} on phase.

prism. The observations of 9 Gem were made with the monitoring observation of R Mon (Matsumura, Seki and Kawabata in preparation).

3. Results and Discussion

Fig.1 shows the polarization degree P_{ave} of 9 Gem as a function of phase, where P_{ave} is the average over the data of 7 channels (0.36-0.76 μm). We have not included the data of the 8th channel whose sensitivity is low. The polarization degree P_{ave} reaches its maximum at phase$\simeq$0.6, and decreases till phase$\simeq$0.4. The amplitude is $\sim$0.2%.

The difference of position angle between 9 Gem and that of HD21291 is presented in Fig.2. The star HD21291 is another polarized 'standard' listed by Serkowski (1974), though it is noted that the position angle of HD21291 is slightly variable (Dolan and Tapia 1986). In this paper, we *assume* that the position angle of HD21291 is constant or nearly non-variable. Then, Fig.2 shows that the position angle of 9 Gem depends on phase. The curve in Fig.2 is the result of non-linear fitting on the assumption of a sin function. The amplitude of the curve is 0.5 degrees.

Those results suggest that at least a portion of the observed polarization is stellar or circumstellar origin. If the star pulsates non-radially, dust might form anisotropically in the circumstellar space. This might cause anisotropic light scattering, and might explain the observed variable polarization.

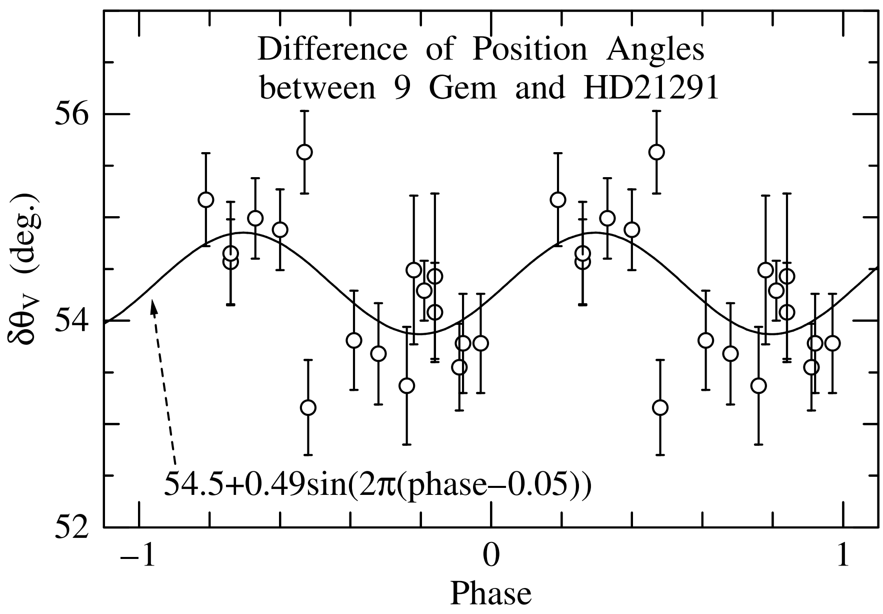

Figure 2. The difference of position angles between 9 Gem and HD21291 as a function of phase.

4. Conclusions

Our answer of the question in the title is as follows:

- Let 9 Gem be a standard, if the accuracy of the position angle may be as large as 3 degrees.
- If the accuracy of 1 degree is required, one should calibrate the periodicity of the position angle, to let 9 Gem be a standard.

References

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