

CCD PHOTOMETRY OF IV GEMINORUM

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Abstract

We have used the 0.6-m Sawyer telescope of the Whitin Observatory at Wellesley College to obtain 167 CCD images of IV Geminorum during three different nights. Although IV Gem is listed as an RR Lyrae star in the GCVS, the light curve suggests that it may be an eclipsing binary.

1. Introduction

IV Geminorum is listed as an RR Lyrae star in the *General Catalogue of Variable Stars* (Kholopov *et al.* 1985) (GCVS), although no period is listed. The star has coordinates of RA $07^{\text{h}} 14^{\text{m}} 29^{\text{s}}$ and Dec. $31^{\circ} 00.1'$ (1950). Figure 1 shows one of our CCD images labeling IV Gem and the comparison and check stars which we used. The field of view is just over 9-arcminutes square. A search of the Simbad¹ Database indicates that no photometry on this star has been published.

2. CCD Observations

We used a Photometrics CCD camera attached to the 0.6-m Sawyer telescope of the Whitin Observatory at Wellesley College to observe IV Gem on three different nights during February 1993. On the first night, February 9, observations were made alternately with V and R filters with an integration of 120 seconds each until it became cloudy after a little over three hours. Observations cycling through the V, R, and I filters on February 19 lasted a little over 5.5 hours and, on February 20, for more than 4.5 hours. We obtained a total of 61 V images, 59 R images, and 47 I images of IV Gem during the three nights. On each night of observation we obtained 15 bias frames, six 120-second dark frames, and 5 flat field images of the twilight sky using each filter. The images were processed using IRAF (Image Reduction and Analysis Facility), a software package for image analysis written and supported by the National Optical Astronomy Observatory, and aperture photometry was done on IV Gem and five other stars in the field with the IRAF task "phot". The instrumental magnitudes were ported into a spreadsheet and differential magnitudes were found between every pair of stars in the field. We chose the pair of stars with the smallest standard deviation in instrumental differential magnitude as the comparison and check stars.

3. Results and Discussion

Figure 2 shows the R light curve of IV Gem for the two consecutive days along with the differential magnitudes of the comparison and check stars. The total amplitude of variation of IV Gem is about 0.3 magnitude in V, 0.25 magnitude in R,

¹This research has made use of the Simbad Database, operated at CDS, Strasbourg, France.

and 0.23 magnitude in I. This is much smaller than the 0.9-magnitude amplitude variation in the photographic given by the GCVS. The standard deviation of the differential magnitude between the comparison and check star are, respectively, 0.009 magnitude, 0.007 magnitude, and 0.13 magnitude in V, R, and I. From the light curve in Figure 2 and Fourier analysis, we estimated the period to be about 0.3 day. We tested different periods of that order by plotting several phase diagrams. The best fit is for a period of 0.293 day. The phase diagram for this period is shown in Figure 3. If this period is correct, there is considerable variability in amplitude between the different cycles.

The Fourier analysis indicated a secondary peak in the power spectrum at about 0.6 day. Consequently, we also tested periods close to 0.6 day. A period of 0.603 day gives a reasonable light curve with two peaks as shown in Figure 4. This light curve appears to show an eclipsing contact binary.

4. Conclusions

We suggest that IV Geminorum is misclassified in the GCVS, and should be listed as an eclipsing-type variable with a period of about 0.603 day.

5. Acknowledgements

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References

Kholopov, P. N. *et al.* 1985, *General Catalogue of Variable Stars*, Fourth Edition, Moscow.

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(IRAF)

457.0 512.0 374

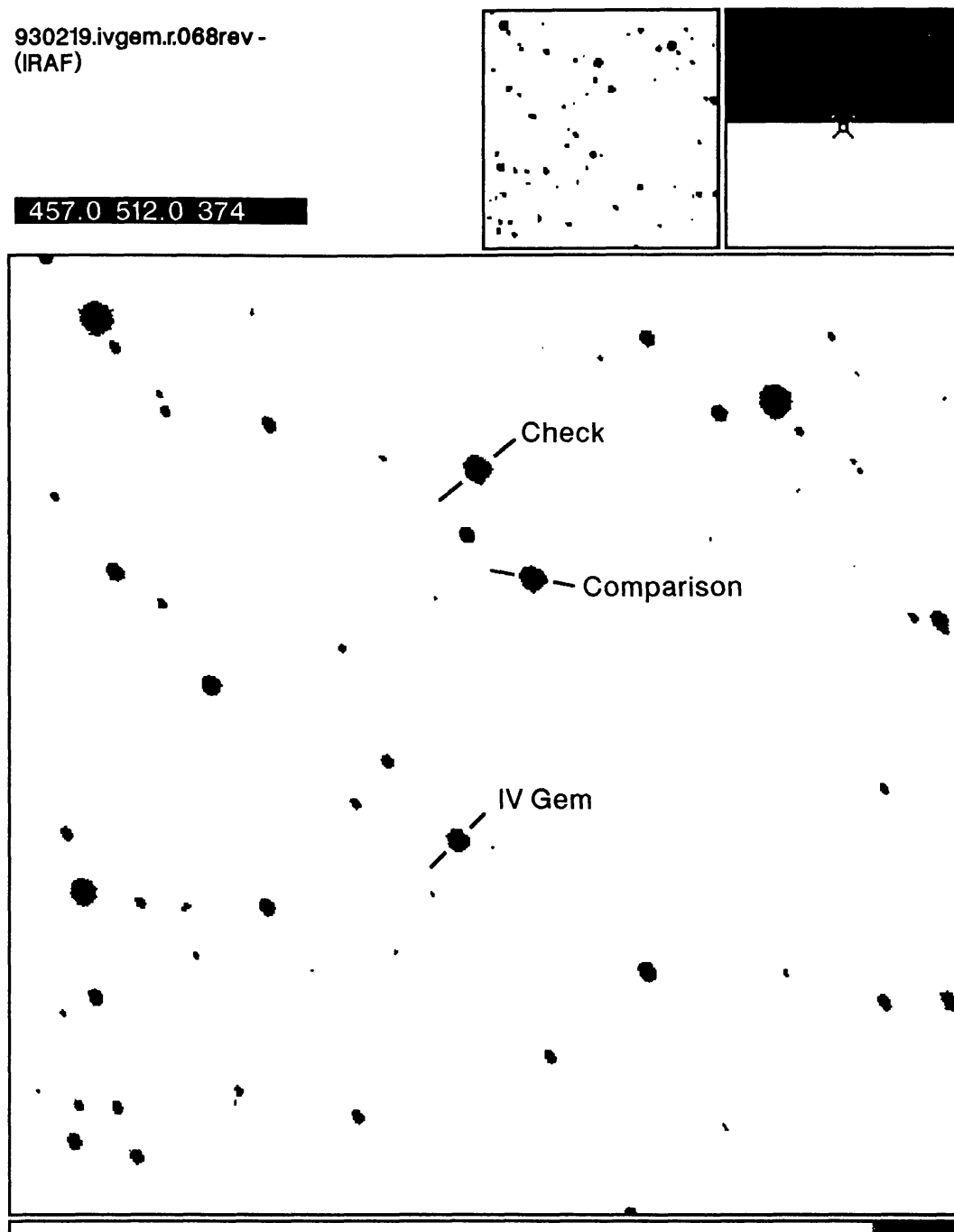


Figure 1. A CCD R image showing the field around IV Gem. North is up and east is left. Each side of the image is about 9 arcminutes.

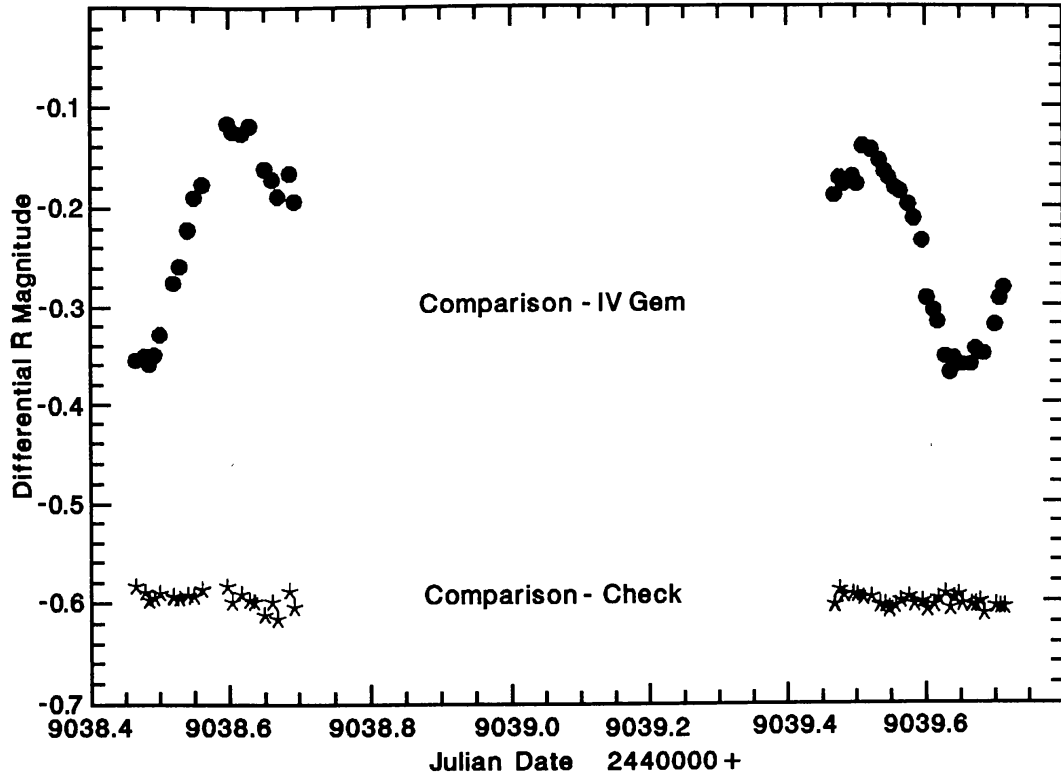


Figure 2. The R differential light curve for IV Gem for two consecutive nights. For an estimate of the errors, we show the differential light curve of the comparison and check star below the curve for IV Gem.

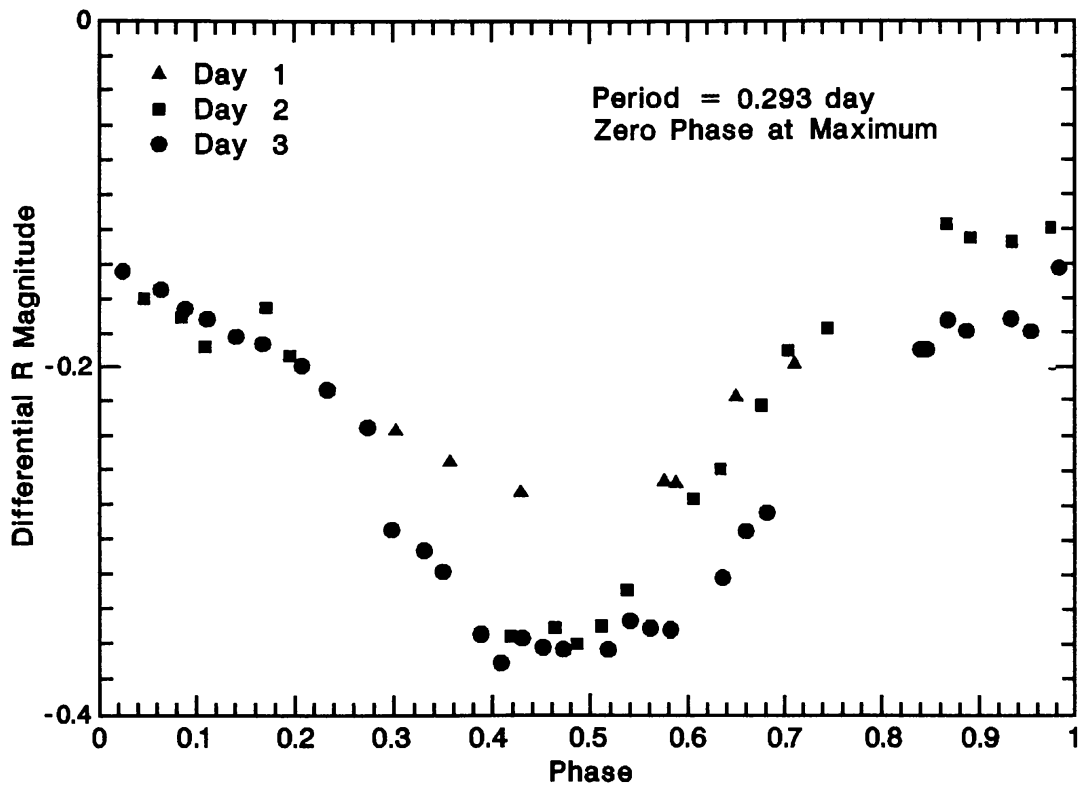


Figure 3. An overlapped phase diagram of IV Gem assuming a period of 0.293 day. We have set zero phase to be at maximum assuming the star is an RR Lyrae star.

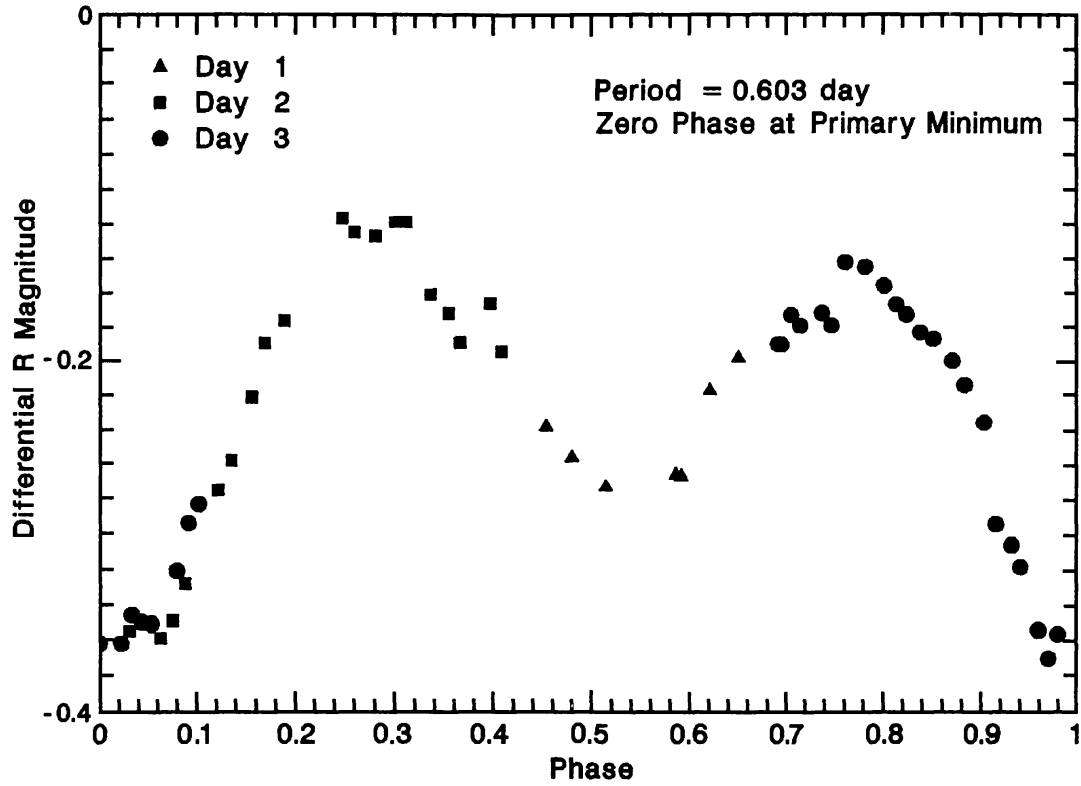


Figure 4. An overlapped phase diagram of IV Gem assuming a period of 0.603 day. We have set zero phase to be at primary minimum, assuming the star is an eclipsing binary.