ABSTRACT

We present analysis of the long-term photometric data of the active giant OP And. Our research is based on previously published photometric data, Hipparcos photometric series and observations obtained at Belogradchik observatory, Bulgaria. We provide Bayesian estimate photometric period of the star in the time interval 1983-1999 and compare it with the previous published ones. We have looked for rotational period changes and we are going to search for a possible long-term cycle. Questions: Is the period change indication for differential rotation of OP And? Statistics: Is there robust statistical tool for complex light curves analysis? Archival data: Is it useful to collect and analyse all of them?

INTRODUCTION

OP And: a single, K1 III, giant star with active chromosphere.

very active: variable and complex brightness modulation due to photospheric cool spots H&K emissions partially emission filled Hα line

Periodic modulations of its light curve

Several periods are reported. Larger periods near 60 to 70 days are supposed to be caused by one large spot, rotating with the stellar photosphere, while the shorter period found about 38 days are due to two or more groups of smaller spots. Spot configuration changes?

METHODS

Bayesian statistical methods

Gregory – Loredo (for simple periodical modulation) Bayesian statistical method for study of the stellar variability.

Uses Gaussian error distribution and Jeffrey’s priors for estimating the probability for constant, periodic and variable brightness variation. Problem – light curve appears complex, need to get Used in our previous study of the active giant star CF Oct. Need for a tool of complex light curves analysis. Why Bayes? Hypothesis testing, error analysis, sparse data set, relatively fast, priors and prior information

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RESULTS

PHOTOMETRIC DATA

1983 – 1996:

Sources:

Barksdale et al. 1984, Strasmeier and Hall, 1988

periodical modulation with period

Published data Gregory-Loredo method gives:

36.8 d in 1983 p=41.8 +/- 1.1 d

64.6 d in 1984 p=63.8 d

76.0 d in 1985 p=63.87, 69.17, 77.67 90.97

All the data give indication for a very complex model of the light curve

1990 – 1993:

Hipparcos photometry + Gregory-Loredo

P=32.25d and P=64.94d +/-0.7

Belogradchik Observatory data

Konstantinova-Antova and Antov, 2000

1995 – 1996 p=76 d

Gregory-Loredo method

1994 p=40.65 +/-1.2d

1995 p=57.5 +/- 1d , 76.8 +/-2.0d

1996 p=96.2 +/-1.1d

1997-1999 p=73.2 d +/-1.0d

SPECTRAL DATA

1979 – 1996:

star is extremely active at 90'ties with strong asymmetric single peak CaII H&K emission, filed-in Hα core and blue-shifted emission

2008 and 2010:

the star is in a low activity stage, clearly distinguished double peaked CaII H&K emission

LONG-behaviour of the spectral activity indicators: Ca II H line emission (left) and Hα absorption core intensity

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CONCLUSIONS

Photometric variability of OP And is very complex and we need to develop and apply advanced statistic.

Photometric periods between 60 and 80 days clearly correspond to rotational period of the star and are due to the rotation of one large polar spot.

Short periods, near 30 – 40 day corresponds to configuration of two spot groups, distributed symmetrically on the star surface.

Longer periods are probably harmonics of the shortest period.

Photometric data we have are in the period of a high activity state (according to the spectral observations) of the star. Is there relation between activity level and complexity of the light curve?

For questions, discussions and collaborations, please mail me: aborisova@astro.bas.bg

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