

# Astronomical WFPDB (Wide-Field Plate Database): Application for long-term photometric study of different type variable stars

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## БДШФАН (База от данни за широкоъгълни фотографски астрономически наблюдения): приложение за дългопериодично фотометрично изследване на различни типове променливи звезди

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Photographic plates, although not widely in use in modern astronomy, are the main source of information for investigation of the long-term brightness variations of the bright stars. They have been in use in astronomy for over a hundred year period from the end of *XIX* century up to the 90ties years of the last century. Although their disadvantage, two of its characteristics - the large observational time-span and the large sky area they cover makes it unique and still precious data source for such kind of research.

The recent digitization efforts, together with the development of the dedicated software, enables for the first time effective data-mining and data analysis within these archival observations. Detailed information on the archival plates, as well as for the astronomical plate archives, is provided by the Wide-Field Plate Database (WFPDB). The main purpose of the presented thesis is addressed to the importance and value of these archival photographic plate observations in astrophysical research. Our work outlines the routines for cataloguing, digitization, and providing access for professional exploitation of the photographic plate collections on the basis of the experience gained through our work for the Wide-Field Plate Database project of the Institute of Astronomy of the Bulgarian Academy of Sciences.

The presented dissertation is referred into the field of long-term photometric study of the stars, particularly of the selected southern variables CF Oct, YZ Men, YY Men, BBW 76 and UX Men with different type of variability, on the basis of the photographic plate collection from the Bamberg Observatory Southern Sky Survey.

The studies of the long-term photometric behaviour at different type variable stars, exploit the main advantages of photographic plate collections - the long observational time span, and show that the stellar long-term brightness variations is a complex phenomenon at the different stages of stellar evolution, due to different physical processes. The aims of this work are two-fold: we aim firstly to collect and organize the information of the archival photographic observations in the Pleiades field and from the Bamberg Observatory Southern Sky Survey (BOSSS) and to demonstrate the applicability of stored

photographic plates for investigation current astrophysical problems; and secondly to study the long-term photometric behaviour of selected variable stars from BOSSS.

By the use of the archival photometric data gleaned from the BOSSS, long-term and rotational light curves are obtained for: two RS Cvn stars (CF Oct and YZ Men), one FU Ori-like star (BBW 76), one FK Coma star (YY Men) and one eclipsing binary star (UX Men).

Based on the light curves of the selected stars (long-term and the rotational) we confirmed previously observed rotational modulation for the stars CF Oct and YY Men, found out strong erratic changes in the long-term brightness behaviour for BBW 76 and a long-term brightness decrease for the star YZ Men.

Important scientific result of our work is analysis of the cyclic activity of the star CF Oct by the Bayesian statistical method. A strong evidence for differential rotation of the stellar photosphere is shown on the basis of smooth changes in the rotational period. We have found a strong probability for long-term cyclic activity of the star and have shown a significant probability for cycle with period of 2603.0 days ( $\sim 7.13$  years) with credible interval of 140 d. This cycle length is in good agreement with the previous suggestions. We have also detected a cycle with a period of 9.81 years, together with two overtones of the mentioned period with periods of 6.66 and 3.31 years. Similar cyclic behavior was detected for the RS Cvn star HK Lac by the use of the archival plates from Sonneberg Observatory, Germany.

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**Key words:** Stars:activity – Stars:individual: CF Oct, YZ Men, BBW 76, YY Men, UX Men – Techniques:photometry – Methods:Statistical – Astronomical Databases

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