Determination of the physical parameters of the sources of fast variability in selected cataclysmic and symbiotic stars

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In this thesis the results of our study of the fast variability of selected cataclysmic and symbiotic stars are presented. The thesis is divided into eight chapters with two appendices and bibliography. In Chapter 1 the motivation, the main aims, and a short review of observed fast variability in Cataclysmic variables (CVs) and Symbiotic stars (SS) are discussed. The basic methods for analysis and extraction of the physical parameters of the sources of fast variability (flickering, flaring, QPOs etc.) are described in Chapter 2. In the next 5 chapters (3-7) we give the physical properties of individual systems - V794 Aquilae, AE Aquarii, MWC 560, RS Ophiuchi and CH Cygni and we add the obtained parameters of their sources of fast variability. The main results, conclusions, and final remarks are summarised in the last chapter. The Appendices contain information about the characteristic distances, sizes, time scales, and amplitudes of variability observed in CVs and SS.

The rapid variability (photometric and/or spectral) is an observational feature in wide class of astrophysical objects and systems. It can be found in cataclysmic variables (in almost all of their classes and subclasses), symbiotic stars, quasars, active galactic nuclei, and protostars.

One of the most characteristic manifestations of rapid variability (for almost all cataclysmic and in some symbiotic stars) is the *flickering* phenomenon. The study of the physical characteristics of the flickering source in a wide range of photometric states (high, intermediate, and low) offers an opportunity to explain a number of observational and empirical relationships, ($log\Delta F - logF_{\rm av}$, *rms-flux* etc.) observed in both classes of objects. Another appearance of variability are outbursts called *flaring*, which manifest themselves as short (in minute timescale), with larger amplitude (up to and over 1 mag) increase in the luminosity. Analysis of these outbursts and determination of the physical characteristics of the source gives extensive information on the accretion process and evolution of the accreted matter in close binary systems.

The main aims of this study are:

(1) Determination of the physical characteristics of the sources of flickering and flaring in different photometric states in the cataclysmic variables V794 Aquilae and AE Aquarii and symbiotics MWC 560, RS Opiuchi and CH Cygni.

(2) Search for a statistically significant correlation between the amplitudes of variability (full and effective) and average energetic state of the object.

(3) Analysis of the light curves in search of quasi-periodic oscillations (QPOs).

Using slight modification of Bruch method (1992) and an adaptation of Pearson, Horne and Skidmore theoretical model (2003, 2005) for expanding fireballs we apply them to the photometric data in order to obtain physical parameters of the sources of the flickering and flaring, respectively. We analysed "amplitude-flux" relationship (King 2004) in order to obtain the viscosity parameter α.

The main results of this study are published in Latev et al. (2011), Zamanov et al. (2012), Latev et al. (2015), Zamanov et al. (2015) and the conclusions are summarised below:

(1) The resulting physical parameters of the sources of variability in V794 Aquilae are compatible with those obtained for star V425 Cas (Tsvetkova et al. 2010). Given the fact that this class of objects (VY Scl nova-like) display a wide range of photometric states, we still can not unambiguously say if the sensed parameters are stable.

(2) The range of the physical parameters of the source of flickering in MWC 560 is compatible with that of RS Oph, obtained by Zamanov et al. (2010). The presented range of photometric states is not large and it is not possible to draw final conclusions about sustainability of these parameters and whether the various conditions manifest the same source.

(3) In general, the range of estimated temperature of cataclysmic variables is compatible with that of symbiotics, but the size and luminosity of the flickering source in symbiotic stars are an order of magnitude higher than those of cataclysmic stars.

(4) An analysis of outbursts in AE Aquarii, through the model of "evolving plasma condensate", is successful and can be actually applied over photometric data.

(5) The detected quasi-periodic oscillations in AE Aquarii show evidence for possible retention of matter close to the magnetosphere.

(6) The "rms-flux" relationship is confirmed in a new class of object - reccurent novae (RS Oph).

(7) Additional multicolor observations are required to determine the parameters of the source of flickering of the star CH Cygni.

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