# A UNIFIED MODEL OF DWARF NOVA OUTBURSTS BASED ON THE DISK INSTABILITY

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**Abstract.** A unified model for outbursts of dwarf novae is proposed based on the disk instability model in cataclysmic variable stars. In this model, two different intrinsic instabilities (i.e., the thermal instability and the tidal instability) within accretion disks are considered in non-magnetic cataclysmic variable stars. It is suggested that all of three sub-classes of dwarf novae (i.e., U Gem-type, Z Cam-type and SU UMa-type dwarf novae) may be explained in terms of two model parameters of the orbital period of the binary and of the mass transfer rate within the framework of the disk instability model.

## 1. Introduction

Dwarf novae are eruptive variables showing repetitive outbursts of amplitudes of 2-6 magnitude. There are three sub-classes in dwarf novae: the U Gem-type showing only the ordinary outbursts, the Z Cam-type showing occasional standstill, and the SU UMa-type showing superoutbursts. Various outbursting phenomena in these stars are now believed to be caused by variable accretion onto the white dwarf component in the cataclysmic binary system. Two different models have been competing to explain the outbursts of dwarf novae: one model is the mass transfer burst model advocated by Bath (1973) and by his group and the other is the disk instability model proposed first by Osaki (1974) and extensively pursued by many groups (for discussion of these models, see a recent review by Osaki 1989b). Here we present a unified model of dwarf nova outbursts from the standpoint of the disk instability model.

## 2. A Unified Model of Dwarf Nova Outbursts

In the disk instability model for outbursts of dwarf novae, the mass transfer rate from the secondary star is supposed to be constant at all time and all time-dependent and outbursting phenomena are thought to be caused by intrinsic instabilities in accretion disks. In our unified model, different outbursting behaviors among non-magnetic cataclysmic binary systems are classified by two-parameters characterizing accretion disks in these systems; that is, the orbital period of the system and the mass transfer rate to the accretion disk from the secondary star. There exist two different instabilities in accretion disks relevant in cataclysmic variables; one is the thermal instability due to the hydrogen ionization-recombination phase transition

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and the other is the tidally driven eccentric instability (Whitehurst 1988; Hirose and Osaki 1990) by which instability an accretion disk is deformed into an eccentric form and its apsidal line slowly rotates in the inertial frame of reference. It has already been well known in the disk instability theory that difference between non-outbursting system and outbursting system are due to difference in the mass transfer rate from the secondary. Among outbursting systems, the ordinary U Gem stars and the "superoutbursting" SU UMa stars are distinguished by the difference in the orbital period of the binary. This is in turn due to the difference in the mass ratio of the binary because the tidally driven eccentric instability occurs only in those systems with low mass secondary. The superoutburst and superhump phenomena of SU UMa stars can be explained by the combined mechanism of thermal and tidal instability of accretion disks (see, Osaki 1989a). The Z Cam sub-type dwarf novae, which are characterized by the "standstill" in the outburst and outbursting stars in the orbital period and the mass transfer rate diagram. The possible causes of the standstill phenomenon are discussed. A possible model is suggested to explain the standstill in Z Cam stars within the disk instability model, in that the disk radius may exhibit a long term variation, leading these stars sometime in a cyclic outbursting state and sometime in the standstill.

More details on this model will be presented elsewhere.

## References


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