NON CIRCULAR DISKS IN AM CVN SYSTEMS?

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1. Introduction

The AM CVn stars are mass transferring, interacting binary, white dwarf systems with orbital periods of 15...45 minutes. Hydrogen is completely lost from these systems, and we observe small helium disks which may show thermal and tidal instabilities if the mass transfer rate is large enough (Osaki 1995). A tidal instability brings the disk into a superoutburst state, and in the light curve we may observe superhumps. Based on the observed periods and mass transfer rates we can divide the AM CVn stars into three groups:

A: In permanent superoutburst: AM CVn and EC 15330−1403

B: Regular superoutbursts: CR Boo, V803 Cen and CP Eri

C: Not yet observed superoutburst: GP Com

Group A consists of systems with disks which are too hot to decline into a low state. These disks are in a constant superoutburst state, analogous to nova-like CVs which show no outbursts, but still exhibit permanent superhumps (Skillman & Patterson 1993). Group B shows normal outbursts which can trigger superoutbursts, analogous to the VY Scl dwarf novae. The group C object may also be a superhumper, but with very infrequent outbursts analogous to the SU UMa stars (Warner 1995). In the following we will discuss evidence for superoutbursts in these systems, and the likelihood for these systems to develop elliptical disks.

2. Observations

AM CVn shows variable absorption line profiles, which have been analysed by Patterson, Halpern & Shambrook (1993). They found a line profile skewness modulation with a period of 13.4 h, which was interpreted as due to the variable aspect of a precessing elliptical disk. This modulation is also observed as high frequency sidebands of 20.8 μHz to a set of harmonic fre-

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quencies of the superhump modulation frequency in the Fourier transform of the light curve (Solheim et al. 1991, Warner 1995). From these observations we can determine an orbital period of 1028 s and a superhump period of 1051.2 s.

For EC 15330 a photometric period of 1119 s is observed. Its spectrum and general properties are almost like those of AM CVn (O'Donoghue et al. 1994). A search for periodic line profile variations is so far inconclusive.

For CR Boo a stable period of 1471 s and an unstable period of 1493 s have been determined (Provencal et al. 1991). The unstable period was only observed during high state observations, and is interpreted as the superhump period, while the 1471 s period is interpreted as the orbital period (Warner 1995).

For V803 Cen and CP Eri no superhump periods have been detected, but the mass ratios are comfortably lower than the ratio $q = 0.22$, which is the limit for development of elliptical disks.

For GP Com the situation is not settled. No outbursts have been detected so far, and the disk may be in a permanent cold state without outbursts. However, even with a low mass transfer rate, the disk may become hot enough for a normal outburst; this may trigger a superoutburst which may last considerably longer than a normal superoutburst because much more mass has been accumulated in the disk during the long dormant phase. This is analogous to the model for WZ Sge proposed by Osaki (1995).

3. Conclusions

All the AM CVn systems have low mass ratios and their disks can, with suitable mass transfer rates, expand beyond the tidal radius and become elliptical. AM CVn and EC 15330 are in a constant superoutburst state and show superhump periods. For the 3 objects which cycle between low and high states, a superhump period is observed only in one case (CR Boo). The object in a (quasi) stable low state (GP Com) will probably show a superoutburst during the next few years.

References

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