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STATISTICS OF CATACLYSMIC VARIABLES

from "Highly Evolved Close Binary Systems: Catalog"

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1. Introduction

"Catalog of Highly Evolved Close Binary Systems" [1] is containing information on approximately 650 Highly Evolved CBSs.

Chapter 2 contains the parameters of massive CBSs: *W Ser* type stars; *WR+OB* systems consisting of a *WR* star and a massive star of an early spectral type; CBSs including an *OB* star and presumably a compact object — neutron star or black hole; massive CBSs at *X-ray* stage; transient *X-ray* sources; candidates for hard *X-ray* transient systems and persistent *X-ray* sources. Chapter 3 is dedicated to low-mass CBSs containing a relativistic object coupled with a "normal" star. These are low-mass transient *X-ray* sources, so-called *X-ray* novae, stationary *X-ray* sources in the Galactic bulge and *Sco X-1* type stars and *X-ray* bursters. The wide class of cataclysmic variables (*CVs*) and related objects is given in Chapter 4 by sub-classes according to their physical parameters (specifically by their magnetic fields). There are *precataclysmic variables*; *symbiotic stars* with determined or assumed orbital periods; *double-degenerate* close binary systems (*AM CVn* systems and seven binary white dwarfs); *novae*, *recurrent novae*, *dwarf novae* and *nova-like* systems; *DQ Her* stars (*intermediate polars*) and *AM Her* stars (*polars*). The parameters of *radiopulsars* — members of binary systems are given in Chapter 5.

2. A statistical view

Statistics of the different types of *Cataclysmic Variables* were considered by many authors (*see* [2–4]). We analyzed the masses of *CVs* from "Catalog..." and the period distribution for the different sub-types.

D. Maoz et al. (eds.), Astronomical Time Series, 211–214.

Cataclysmic variables are binary stars of very short orbital period, in which a low-mass red K–M dwarf star ("the secondary") overfills its gravitational equipotential, or Roche, lobe and transfers matter to its companion star ("the primary"), which is a white dwarf. Because the transferred material carries substantial angular momentum and forms an encircling ring, which viscosity broadens into a disk. *CVs* have many components, including the accretion disk, the white dwarf, the red star, the gas stream, the bright spot where the gas stream hits the disk, and the disk/white dwarf boundary layer.

Accumulation of observational data for *CVs* shows that their separation into types is rather conventional. Often, with increasing information, a system assigned to one type is reclassified into another, or it is found that the system possesses, together with signatures of one type, also features that are characteristic of another type.

At last time a number of *CVs* (including subtypes) with confidence determined periods and masses increased. So it is appeared a possibility to examine indicated correlation empirically.

There are 72 ordinary *dwarf novae*, or *U Gem,* stars in "Catalog". These stars have 2^m–6^m outbursts, which last several days and recur over weeks to months, often unpredictably instability.

There are 41 the *SU UMa* stars in "Catalog". The *SU UMa* have (in addition to normal outbursts) superoutbursts and superhumps.

The fifty nine *nova-like variables* are included in "Catalog". *Nova-like CVs* do not constitute a homogeneous class.

Intermediate polars (IPs), or *DQ Her* stars, are cataclysmic variables (*CVs*) consisting of a weakly magnetic white dwarf (B$\simeq 10^5$–10^6 G). The magnetic field does not prevent the formation of the disk. *Intermediate polars* have two fundamental periods: a rotation (spin) period of the white dwarf and an orbital period. The degree of asynchronism, $\Omega = P_{sp}/P_{orb}$ is changing from about 0.001 to about 0.95.

AM Herculis variables or *polars* are a subtype of *CVs* with a strongly magnetic WD as a primary star. The magnetic field of the primary star (WD) in polars is sufficiently strong to synchronize the white dwarf's rotation. Only two nontypical systems, *V1500 Cyg* (a very fast nova) and *BY Cam*, have spin period shorter than the orbital ones by a few percent.

There are 43 *polars* and probably *polars* in "Catalog...". We excluded from our analysis a new possible polar *RX J0515+01* with an orbital period of 479 min. There are five of them in the "gap", *UZ For*, *RE 1938-4612*, *RE 2107-0518*, *RE 0531-462*, and *V 2009-65.5.* One of the interesting characteristics of the polar periods is the peak at 114 min, the lower edge of the period "gap". Nine *polars* have a period at about a "spike" period 114^m.

TABLE 1. The mean characteristics for subtypes

Subtypes	$M_1/M_\odot$	$M_2/M_\odot$	$q = M_2/M_1$	period ranges, d	
U Gem	0.86 ± 0.41	0.64 ± 0.44	0.83 ± 0.60	$0.041 - 0.61$	*1*
SU UMa	0.52 ± 0.14	0.14 ± 0.08	0.35 ± 0.28	$0.051 - 0.2$	
Nova-likes	0.90 ± 0.31	0.49 ± 0.29	0.58 ± 0.29	$0.056 - 1.23$	*2*
IPs	0.87 ± 0.22	0.43 ± 0.15	0.53 ± 0.24	$0.057 - 0.42$	*3*
polars	0.79 ± 0.21	0.21 ± 0.09	0.28 ± 0.15	$0.055 - 0.19$	
All CVs	0.79 ± 0.34	0.39 ± 0.25	0.61 ± 0.55		

1. A star *SV CMi* with $P_{orb} = 1.^d14$ is not included.
2. A star *V1017 Sgr* with $P_{orb} = 5.^d714$ is not included.
3. *GK Per* has a period $1.^d97$.

The average masses of white dwarfs and red dwarfs are given in the Table 1. It should be noted that there is no correlation between the periods and the primary (wd) masses for all subtypes.

The period–number relations (histograms) are given on fig.1.

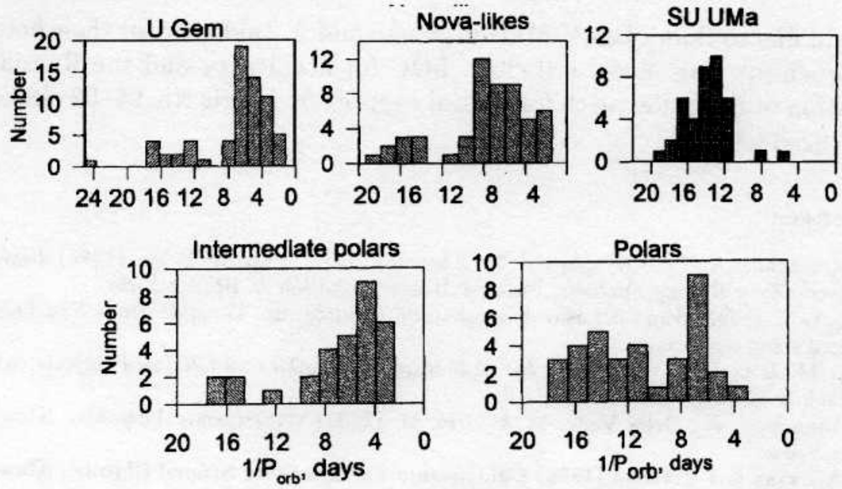

Figure 1. Period distribution for different *CVs* subtypes. A period "gap" about of $0.08 - 0.12^d$ is seen evidently

3. Conclusion

It should be noted that there is no correlation between the periods and the primary (WD) masses for all subtypes.

The data analysis shows that "period gap" exists for all *CVs* subtypes except magnetic stars, among them there are some systems with $2 - 3^h$ periods.

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