Outburst properties of AM CVn stars

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AM CVn stars

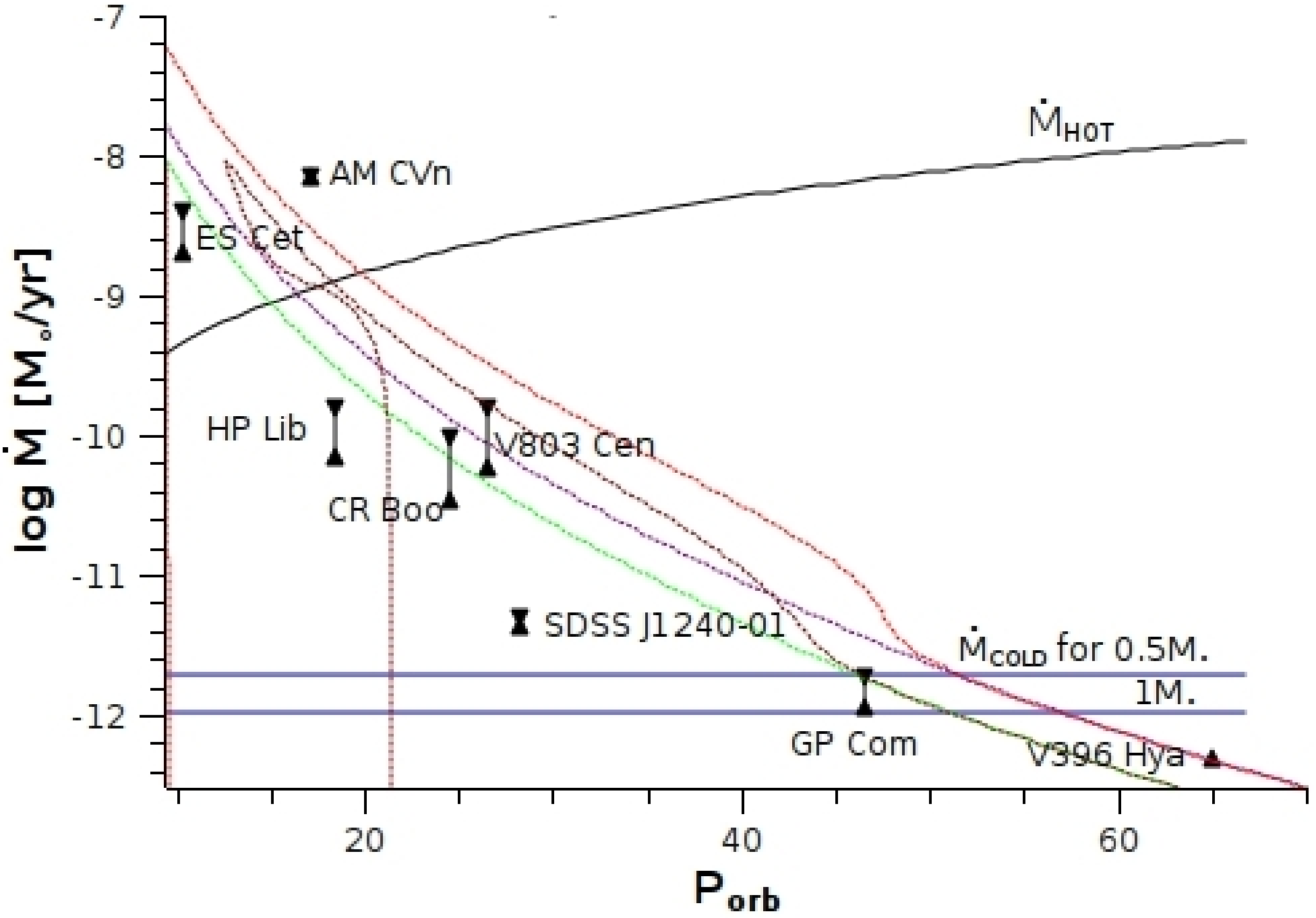
- Close binary systems consisting of two white dwarfs
- As mass transfer from helium donor takes place a He accretion disc is formed
- Characteristic observational features :
  - very short orbital periods : in the range from 10 to 65 minutes
  - spectra deprived of hydrogen lines
  - observed in 3 distinct states : high (bright) , low (faint) and outbursting
- By now there have been observed about 18 binaries classified as AM CVn

Why AM CVn stars are interesting

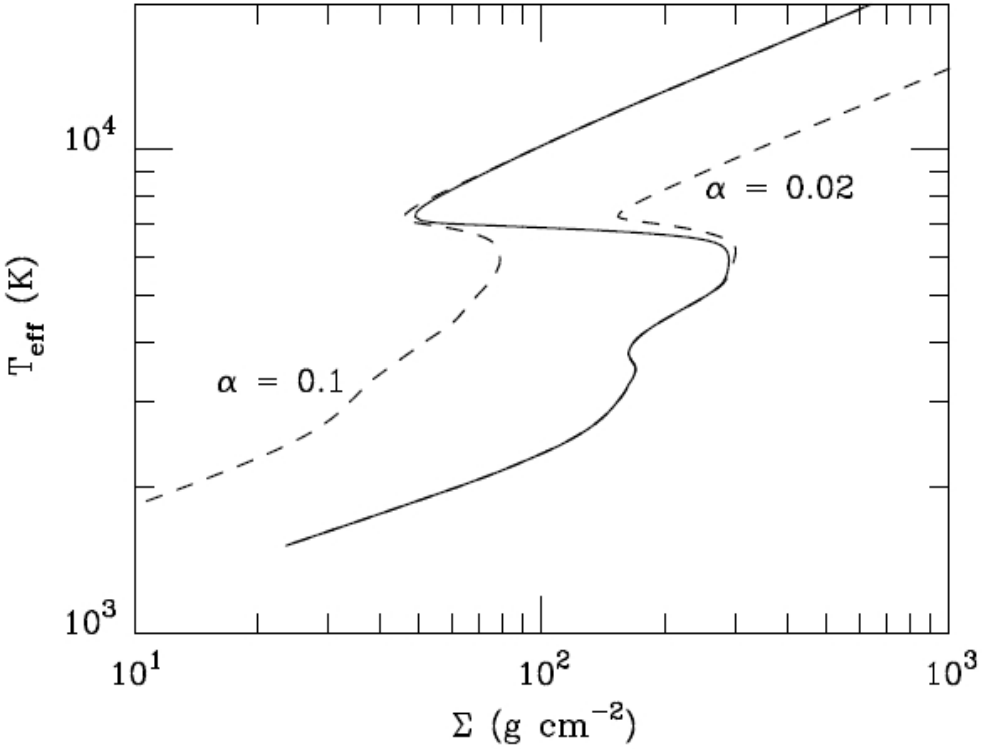
- By comparing the properties of hydrogen and helium discs they may provide better understanding of accretion disc physics
- Another step in understanding binary evolution
- Interesting as a sources of gravitational waves background signal – estimating their population may help in the detection of gravitational waves in future
- Determining white dwarf composition
- Possible progenitors of some SN Ia

Problems

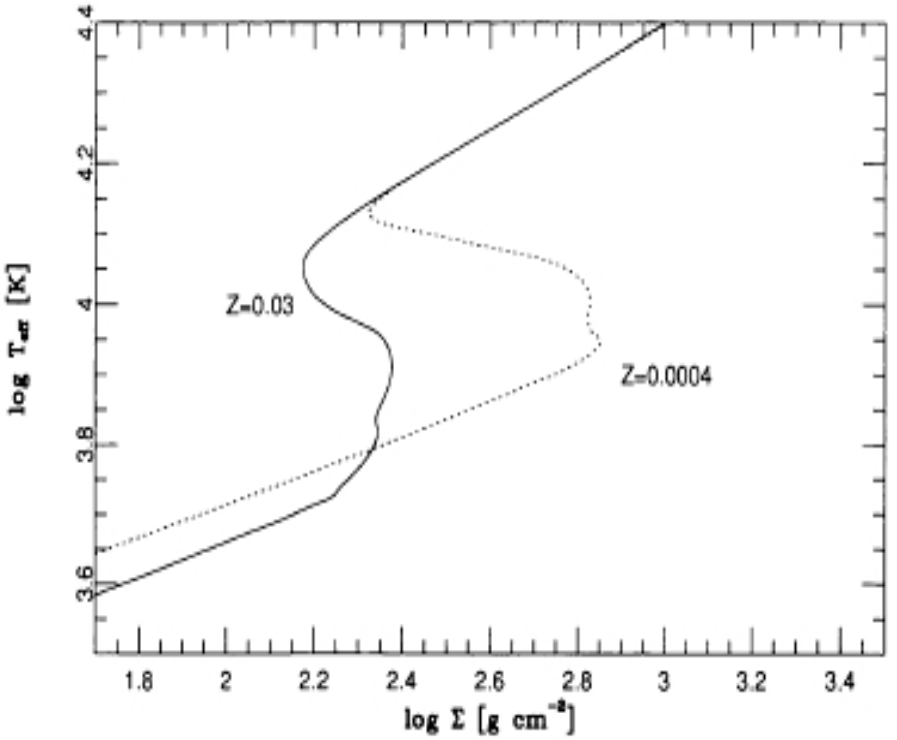
- Test and application of the dwarf nova instability model in a helium disc
- More information about mass transfer rate :
  - how it varies
  - its connection with the orbital period
- The α parameter
  - the contrains on its value
  - is a change of α between cold and hot branches always necessary to produce outbursts?


-7
-8
-9
-10
-11
-12
log Ṁ [M⊙/yr]
20
40
60
P orb
Ṁ HOT
AM CVn
ES Cet
HP Lib
CR Boo
V803 Cen
SDSS J1240-01
Ṁ COLD for 0.5M.
1M.
GP Com
V396 Hya

S-curves for H and He accretion discs

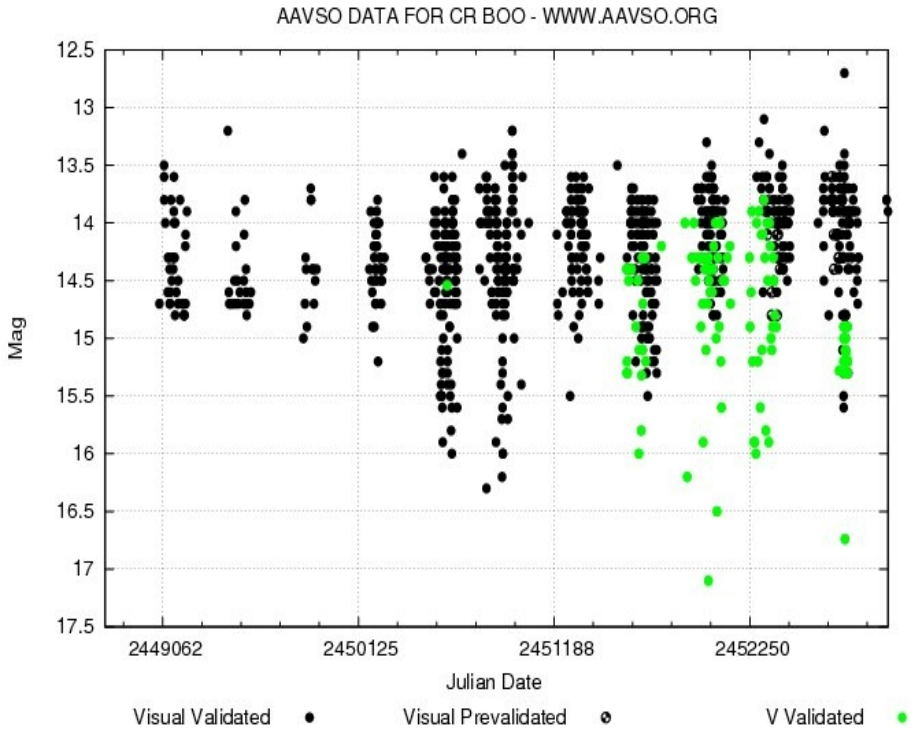


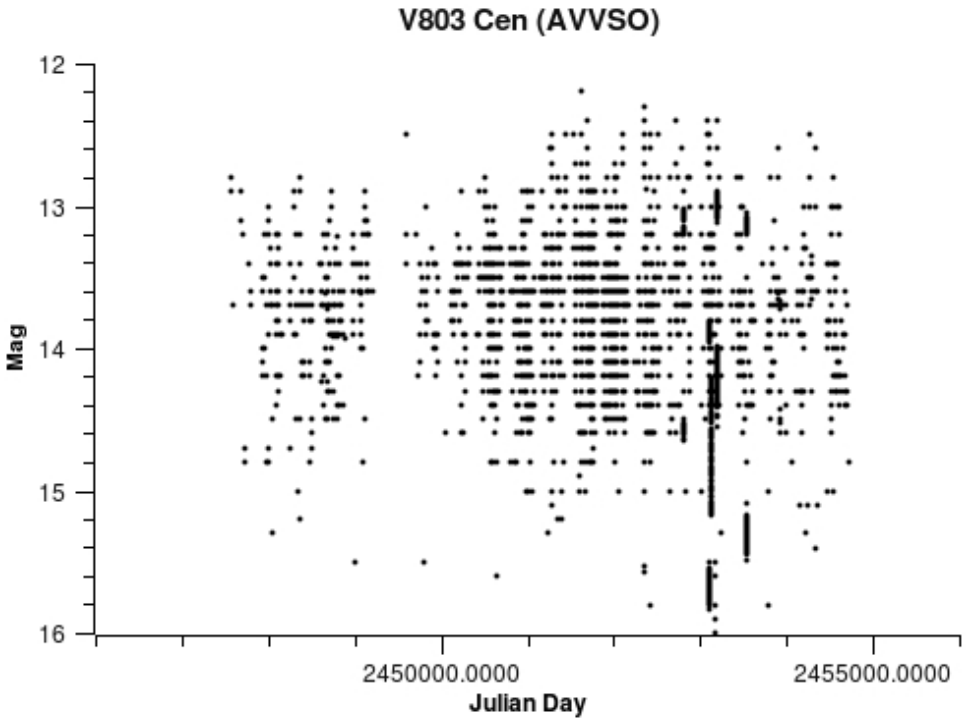
Hameury et al. (1998)

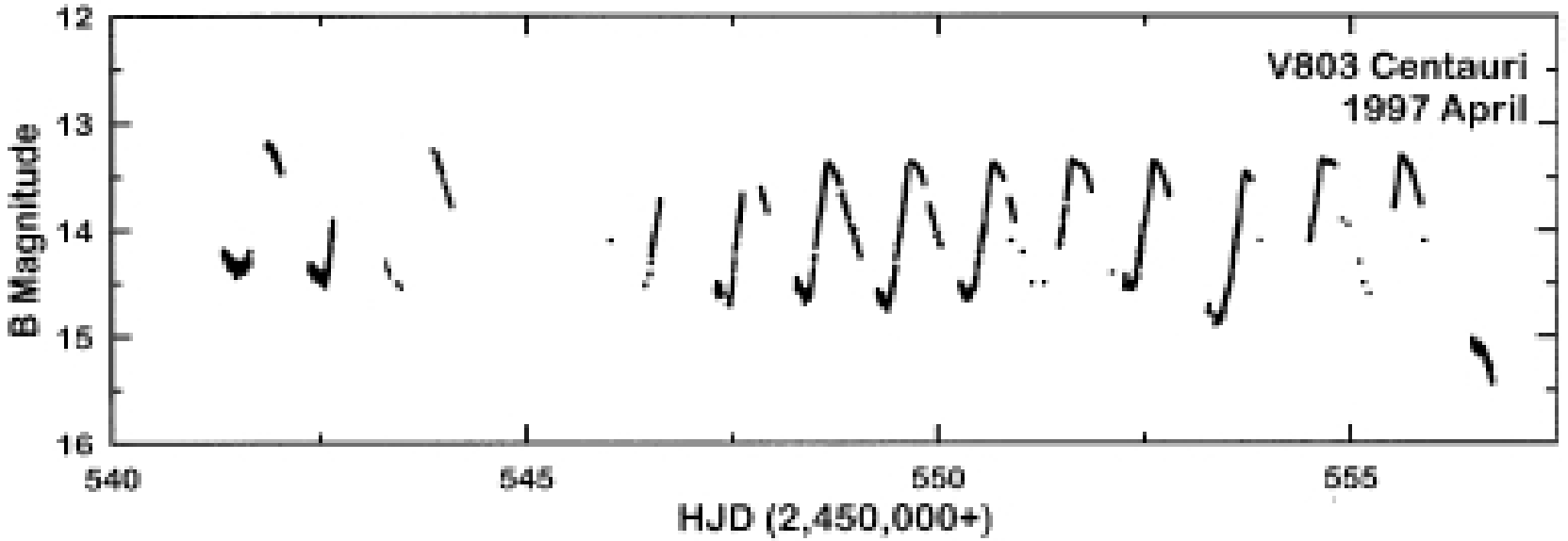


Tsugawa, Osaki (1997)

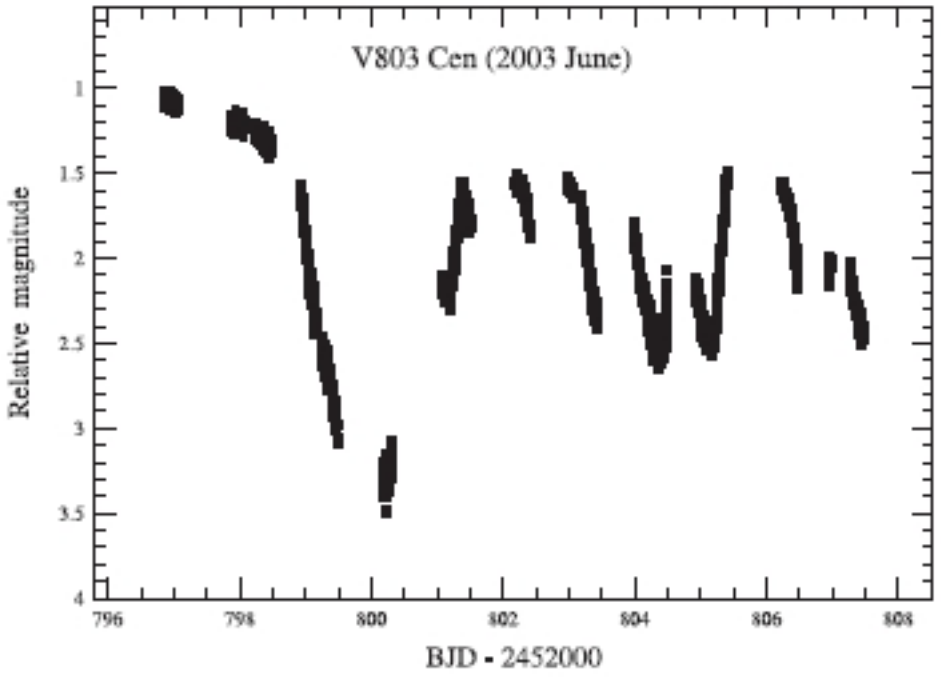
Observational light curves of AM CVns

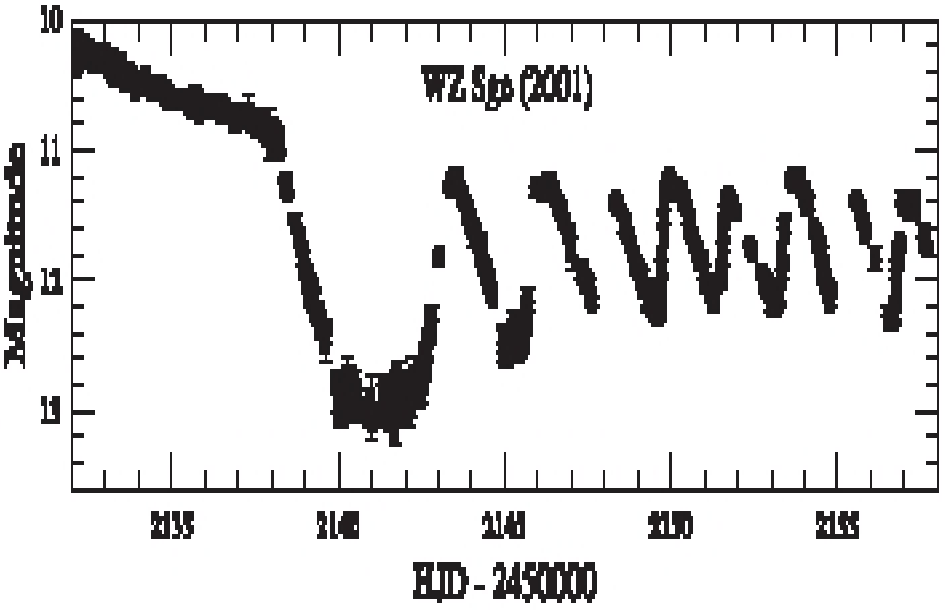




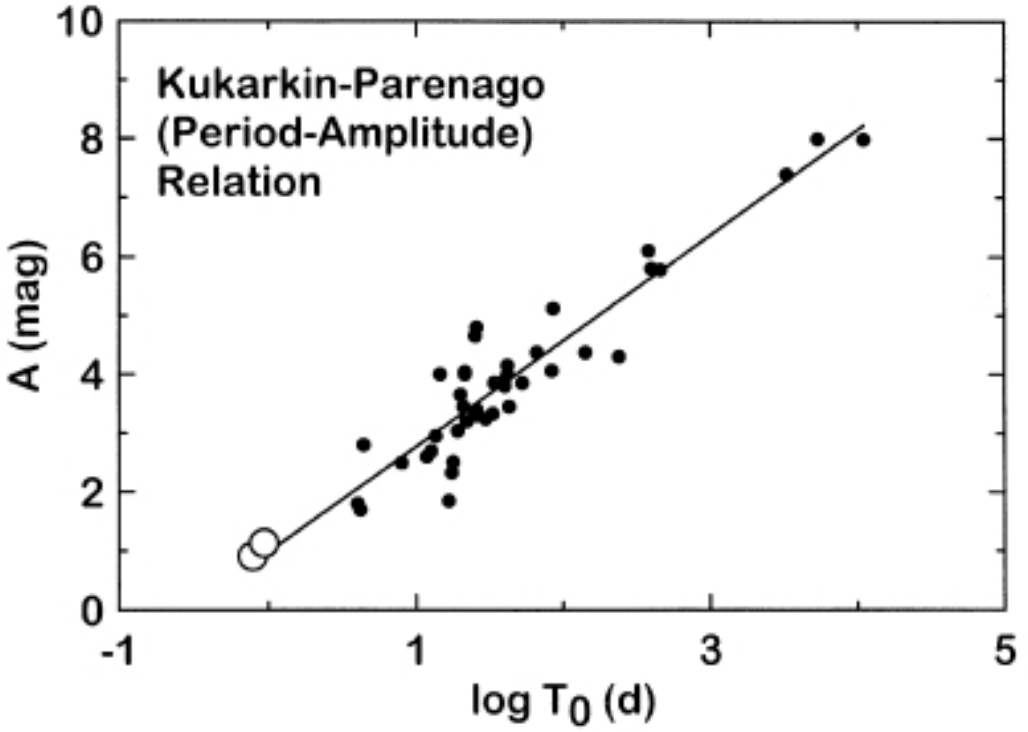


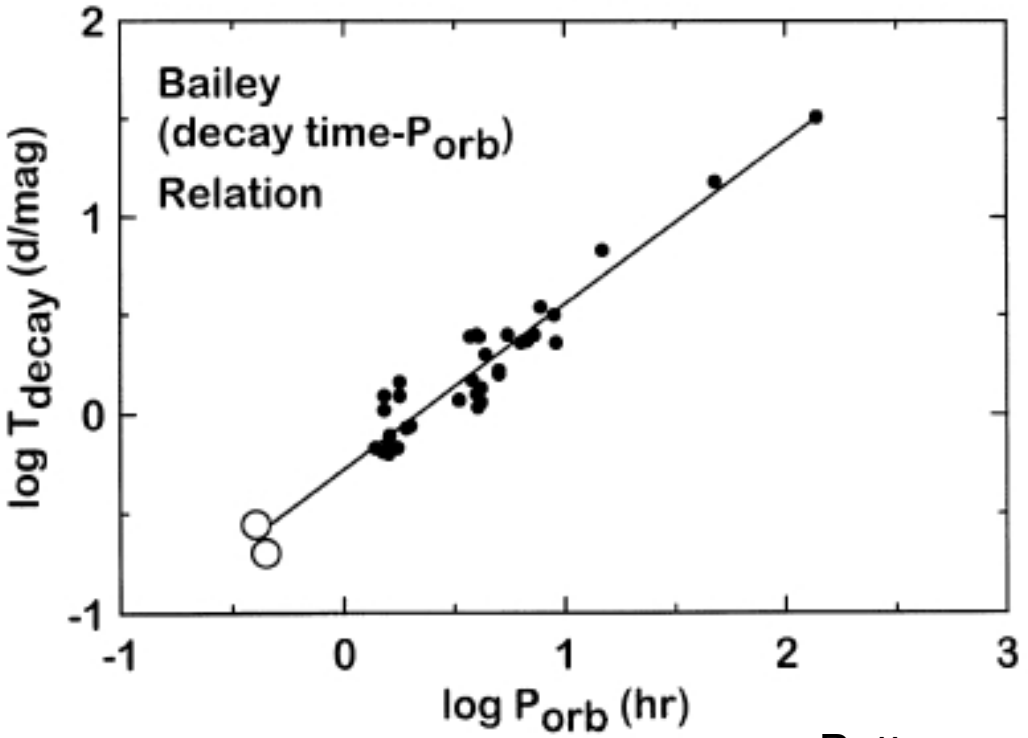
Patterson et al. (2000)





Kato et al. (2004)

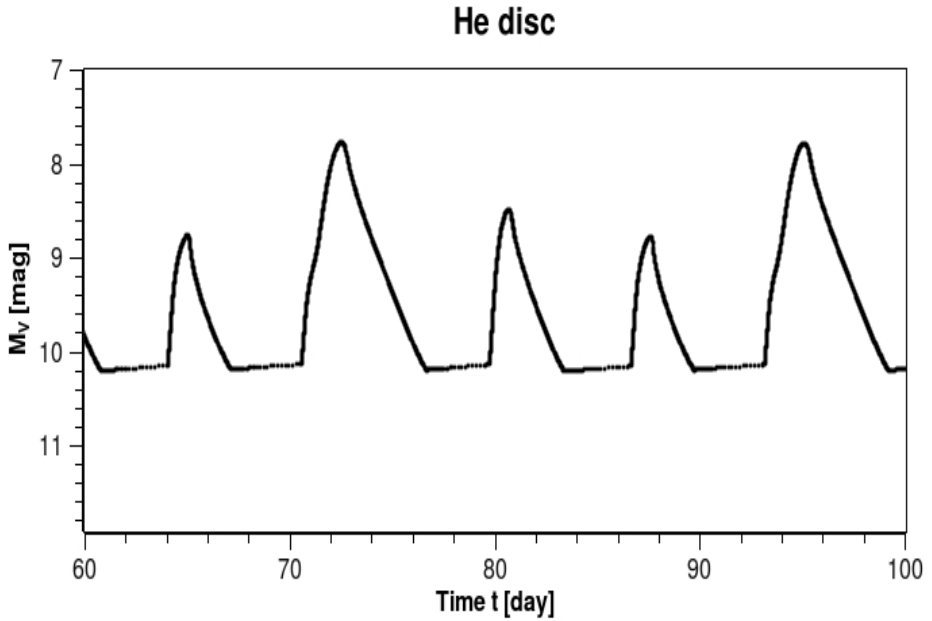


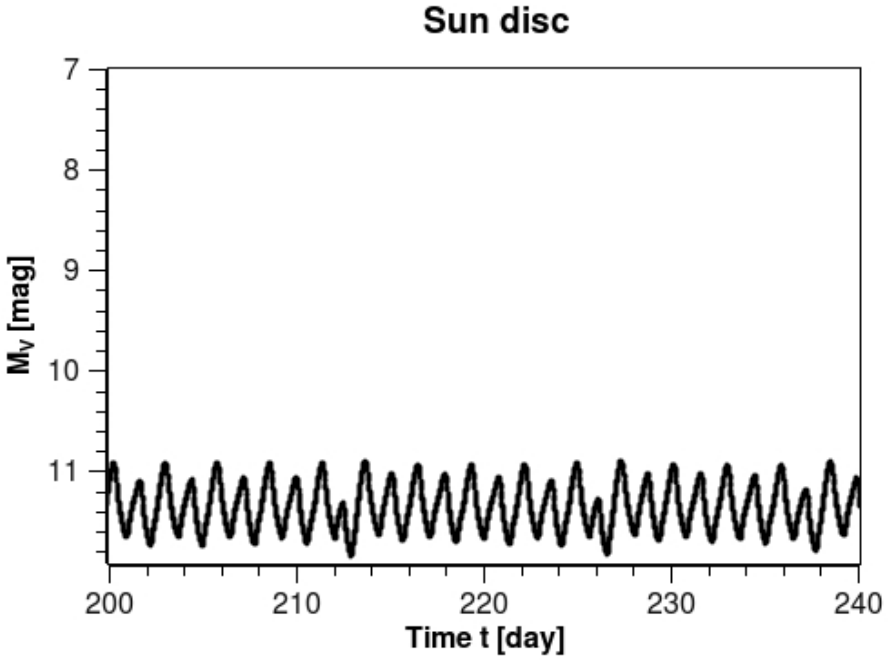


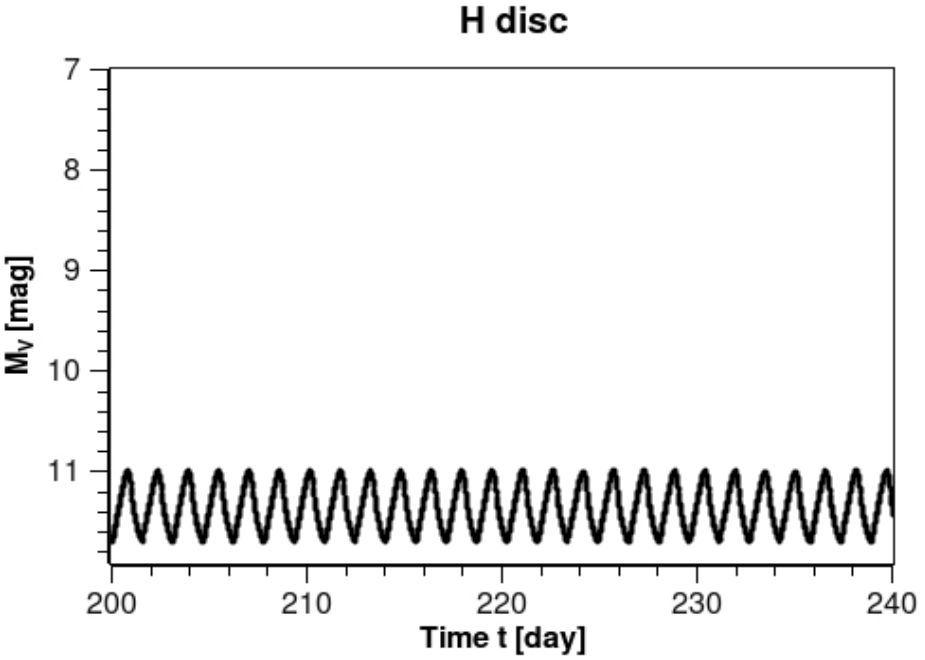
Patterson et al. (2000)

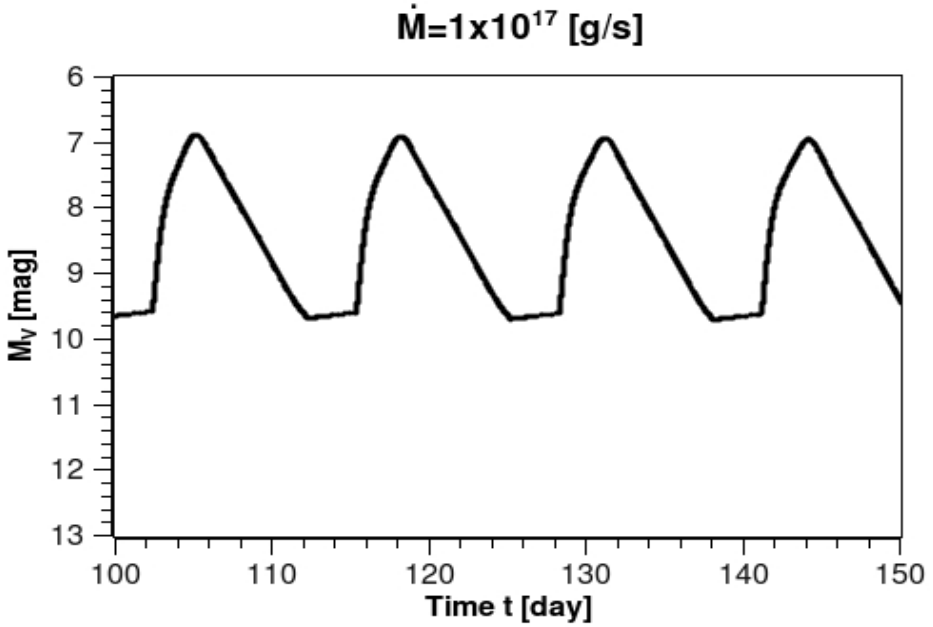
Results for Sun, H and He disc

$\alpha_H=\alpha_C=0.1$, CRBoo parameters





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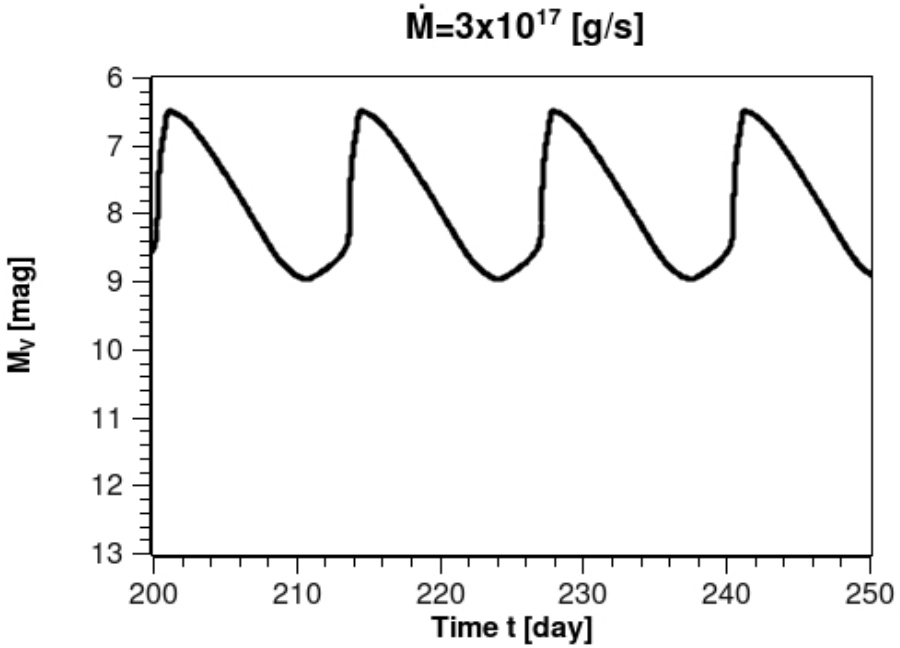
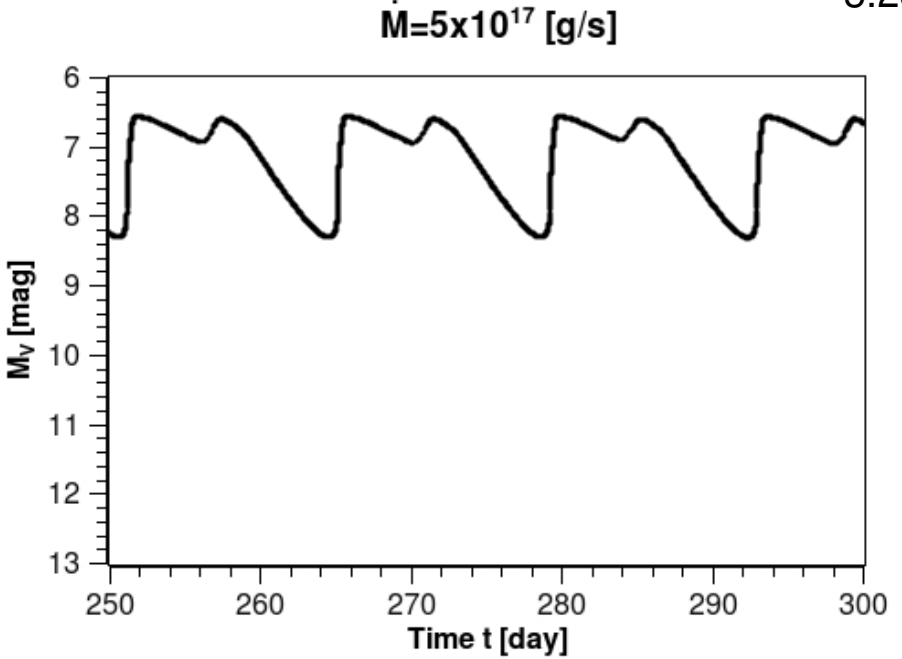
M_V [mag]
Time t [day]


$\dot{M}$=3x10^{17} [g/s]
M_V [mag]
Time t [day]

5.23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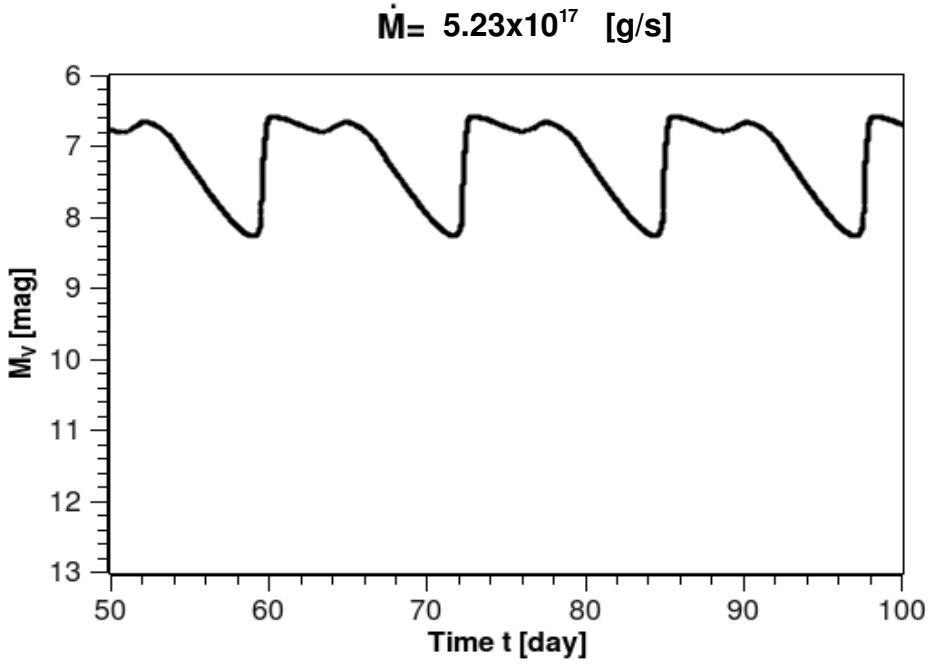
M_V [mag]
Time t [day]


$\dot{M}$= 5.23x10^{17} [g/s]
M_V [mag]
Time t [day]

Conclusions

- Lightcurves from simulations with $\alpha_H=\alpha_C=0.1$ resemble cycling states of CRBoo and V803
- The „cycling” phase could correspond to dwarf nova normal outburst if $\alpha_H \approx \alpha_C$
- If true one needs to explain why and when α is unchanged
- From outbursts shapes it might be possible to estimate the mass transfer rates
- Work in progress : superoutbursts, standstills ecc.