Old novae and the SW Sex phenomenon

Linda Schmidtobreick
European Southern Observatory, Chile

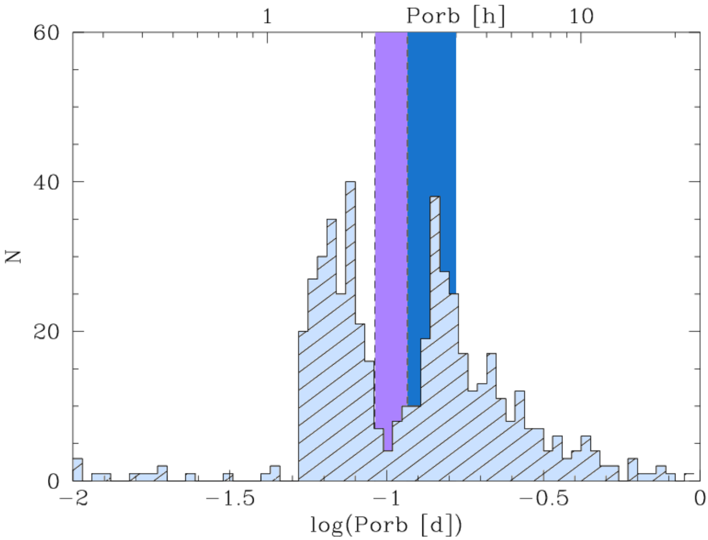
Stella Novae: Past and Future Decades, Capetown, 2013-02-04

Two projects without apparent connection?

SW Sextantis stars

Old Novae

SW Sextantis stars



The golden age of surveys, Gänsicke 2005, Strassbourg

Original definition (Thorstensen et al. 1991, AJ 102, 272):

- novalike stars
- eclipsing but single-peak emission lines
- velocity of Balmer emission lines lags behind the expected velocity of the WD (about 0.2 phases)
- transient absorption in the emission lines at phase $\Phi \approx 0.5$
- strong He II emission but no polarisation

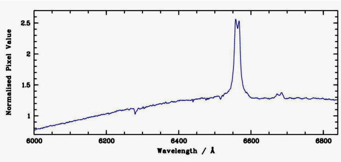
Other features that were found later:

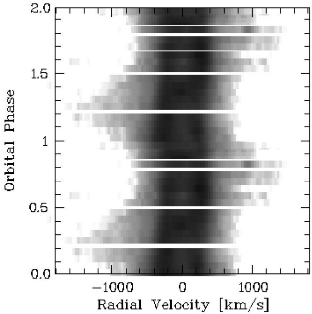
- most objects have periods between 3 and 4 h
- high velocity wings extend to up to 4000 km/s

$\longrightarrow$ extremely high mass transfer rates

SW Sextantis stars

- old nova with $P_{orb} = 3.5\,h$
- inclination of $\sim 65\,deg$, not eclipsing, or only marginally
- line wings with velocities of 1200 km
- Hα line profile in RR Pic changes from single-peaked to centrally-absorbed over the orbital cycle
- offset of about 0.2 cycles between the velocities of the line wings and those of the line core





Schmidtobreick, Tappert, Saviane 2003, MNRAS 342, 149

SW Sextantis stars

- Surveys have found many new SW Sex stars between 3 and 4 hours
- All eclipsing novalike stars between 3 and 4 hours are of SW Sex type!

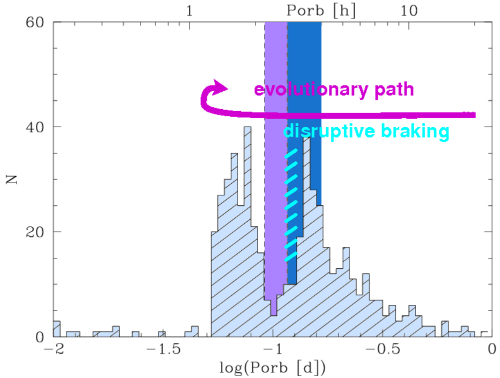
The golden age of surveys, Gänsicke 2005, Strassbourg

The hypothesis:
As the physical properties of SW Sex stars have nothing to do with their inclination, all non- or weakly-magnetic CVs in the 2.8–4 h period range are physically SW Sex stars.

The method:
Obtain time-resolved spectroscopy of CVs in the 2.8–4 h period range to test for the presence of the defining SW Sex characteristics

The result:
SW Sex type stars are the dominant CV population in the 2.8–4 h period range.

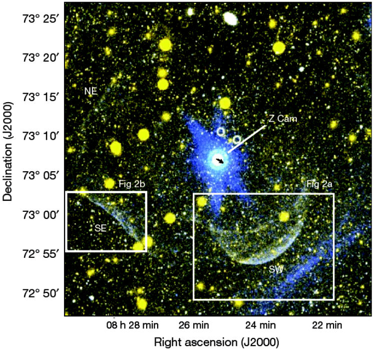
Rodríguez-Gil, Schmidtobreick, Gänsicke, 2007, MNRAS 374, 1359
Schmidtobreick et al. 2013, MNRAS, in preparation



If the disruptive braking model holds, all CVs that are formed above the gap must evolve through the SW Sex type regime before entering the gap.

- The hibernation model predicts changes of the mass transfer rate in the evolution of the pre- and post-nova, i.e. a long state of low mass transfer once the white dwarf has cooled down and irradiation ceases to push the secondary out of thermal equilibrium (Shara et al. 1986; Prialnik & Shara 1986).
- It was originally invoked to explain the missing CV population at minimum orbital period. However, after SDSS, it is established that this is an observational bias - in principle, hibernation is no longer needed.
- Still, the theoretical thoughts that went into it are still valid, and it is likely that some kind of hibernation occurs.

Old Novae

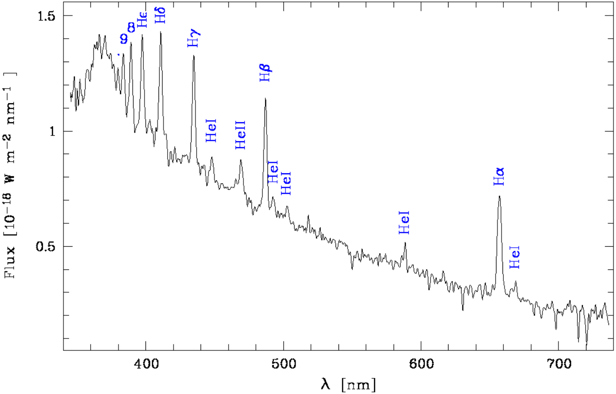


- nova shell discovered around the dwarf nova Z Cam
- this could be interpreted as evidence for hibernation
- however, it could also just show that all type of CVs (including low mass transfer dwarf novae) can experience the one or other nova explosion during their lifetime

Shara et al. 2007, Nature 446, 159

- old project to find low mass transfer systems by looking for novae with large outburst amplitudes
- the hope was to find enough low mass transfer systems to build up a period distribution for old novae with low mass transfer rates and compare that with the general period distribution of CVs.
- it became pretty soon obvious that the success rate of finding low mass transfer novae was much lower than expected and we would always deal with low numbers
- Claus Tappert continued this project in a broader sense to find the general population of old novae
(→ stay tuned in the afternoon session)

XX Tauri

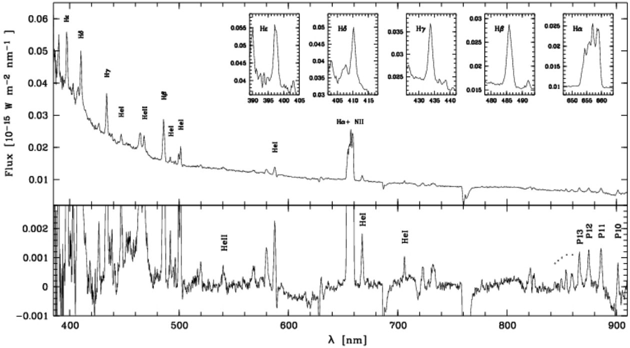


Schmidtobreick et al. 2005, A&A 432, 199

From time-resolved photometry: $P = 3.4\,\mathrm{h}$

Rodríguez-Gil & Torres 2005, A&A 431, 289

V842 Cen



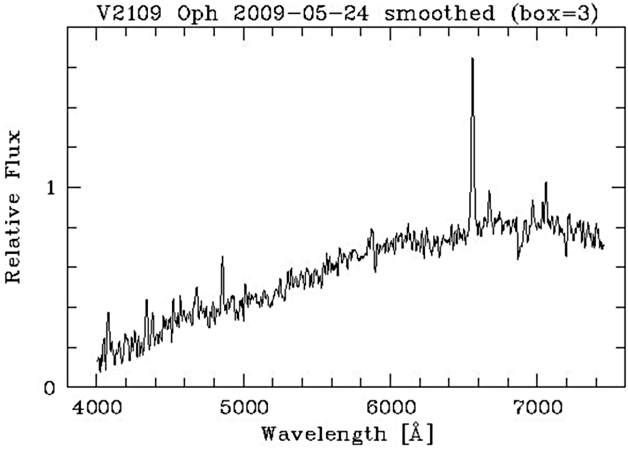
Schmidtobreick et al. 2005, A&A 432, 199

Possible orbital periods:

$P = 3.94\,\mathrm{h}$, $P = 3.79\,\mathrm{h}$ Woudt et al. 2009, MNRAS 394, 2177

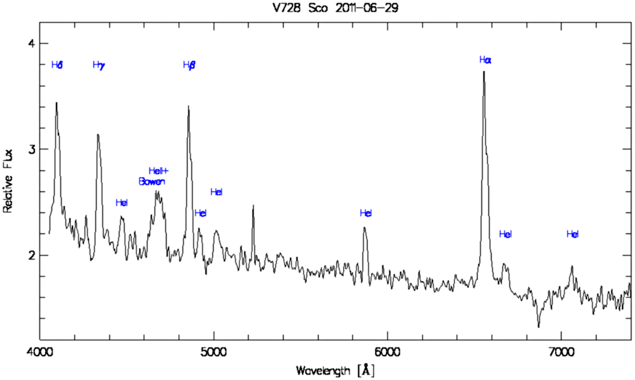
$P = 3.5\,\mathrm{h}$ Luna et al. 2012, MNRAS 423, L75

V2109 Oph



Tappert et al. 2012, MNRAS 423, 2476

V728 Sco



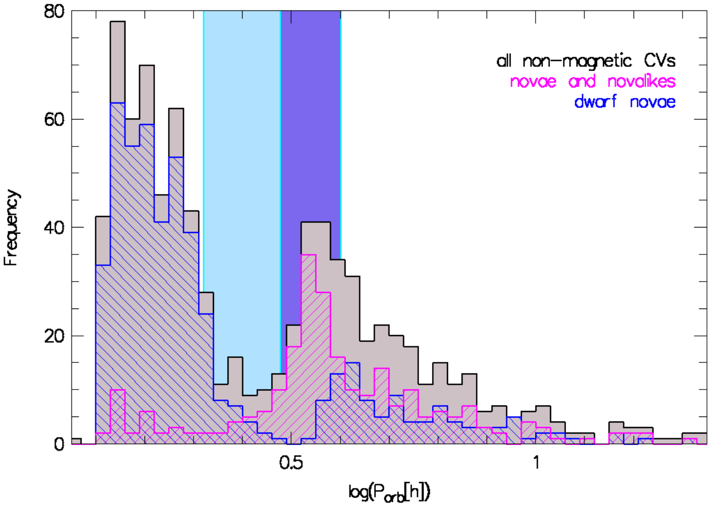
Tappert et al. 2012, MNRAS 423, 2476

From time-resolved photometry of the eclipse: $P = 3.32\,\mathrm{h}$

Tappert et al. 2013, MNRAS in press

- we found at least four probable low mass transfer systems
- three of these have an orbital period between 3 and 4 hours
- $\longrightarrow$ SW Sex systems? (They certainly don't look like any)

The orbital period distribution



data from Ritter & Kolb 2003, A&A, 404, 301 (update RKcat7.18, 2012)

Two projects without apparent connection?

SW Sextantis stars

Old Novae

SW Sextantis stars – Old Novae

- CVs with orbital periods between 3 and 4 hours are in general SW Sex stars
- Some old novae that should be SW Sex stars are not. They have instead a very low mass transfer rate and are similar to dwarf novae $\longrightarrow$ hibernation candidates!
- We need dynamical masses and the temperatures of the components to determine the binary solution but also the recent mass transfer history. $\longrightarrow$ V728 Sco (eclipsing)
- Check the few dwarf novae between 3 and 4 hours, they are good candidates for old novae and might have a remnant shell