The Hunt for Old Novae

Claus Tappert

Alessandro Ederoclite, Linda Schmidtobreick, Nikolaus Vogt

Departamento de Física y Astronomía
Universidad de Valparaíso
Valparaíso, Chile
claus.tappert@uv.cl

Stella Novae, 4–8 Feb 2013, Cape Town

Mind-boggling questions

- which CV makes the “best” nova?
- magnetic WDs: helpful, a hindrance, or unimportant?
- consequence of the eruption: long-term mass loss, hibernation?

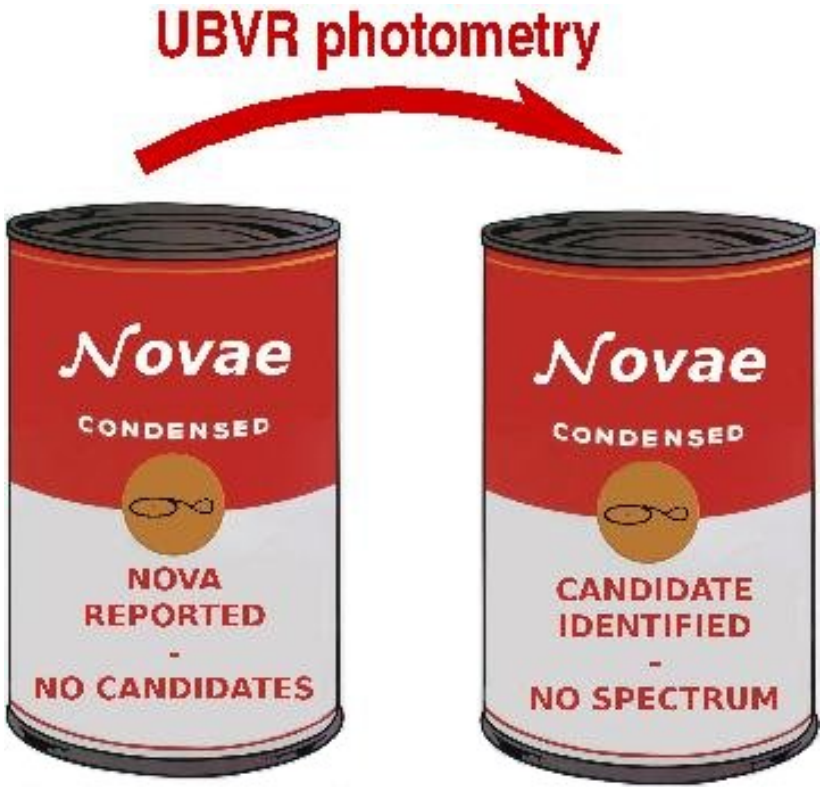
Answers: study post-novae as a group (needs large sample) and compare to the CV population

Mind-boggling numbers

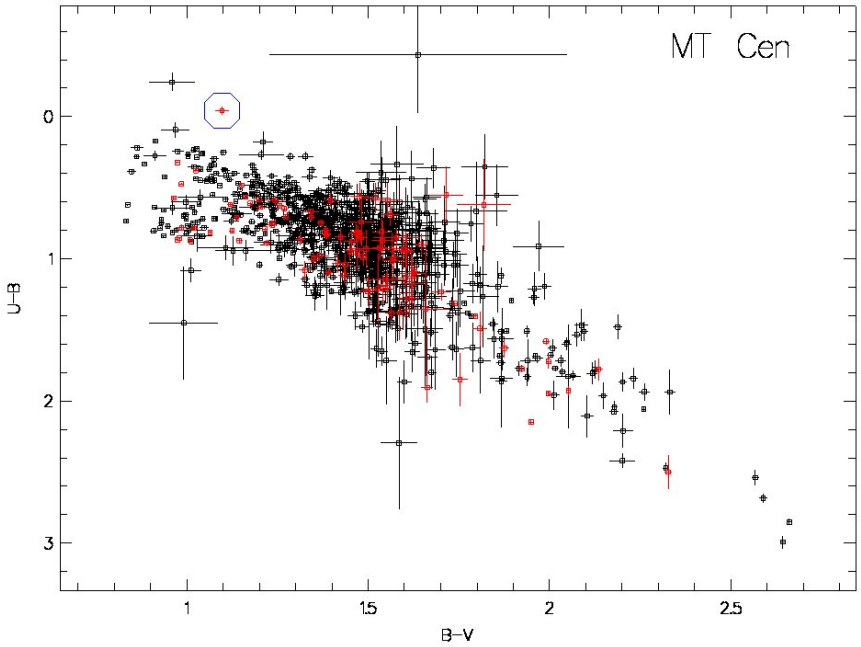
- 200 reported nova eruptions before 1980
- only 28 with good orbital periods
- 141 post-novae lack an identified candidate or spectroscopic confirmation

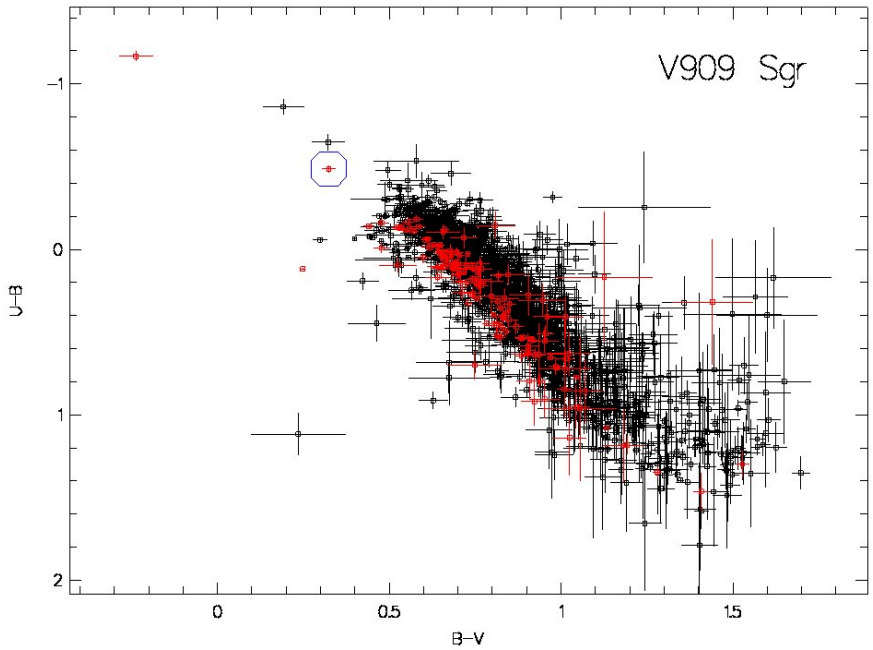
$\Rightarrow$ numbers are too low for good statistics

Binning and tinning I

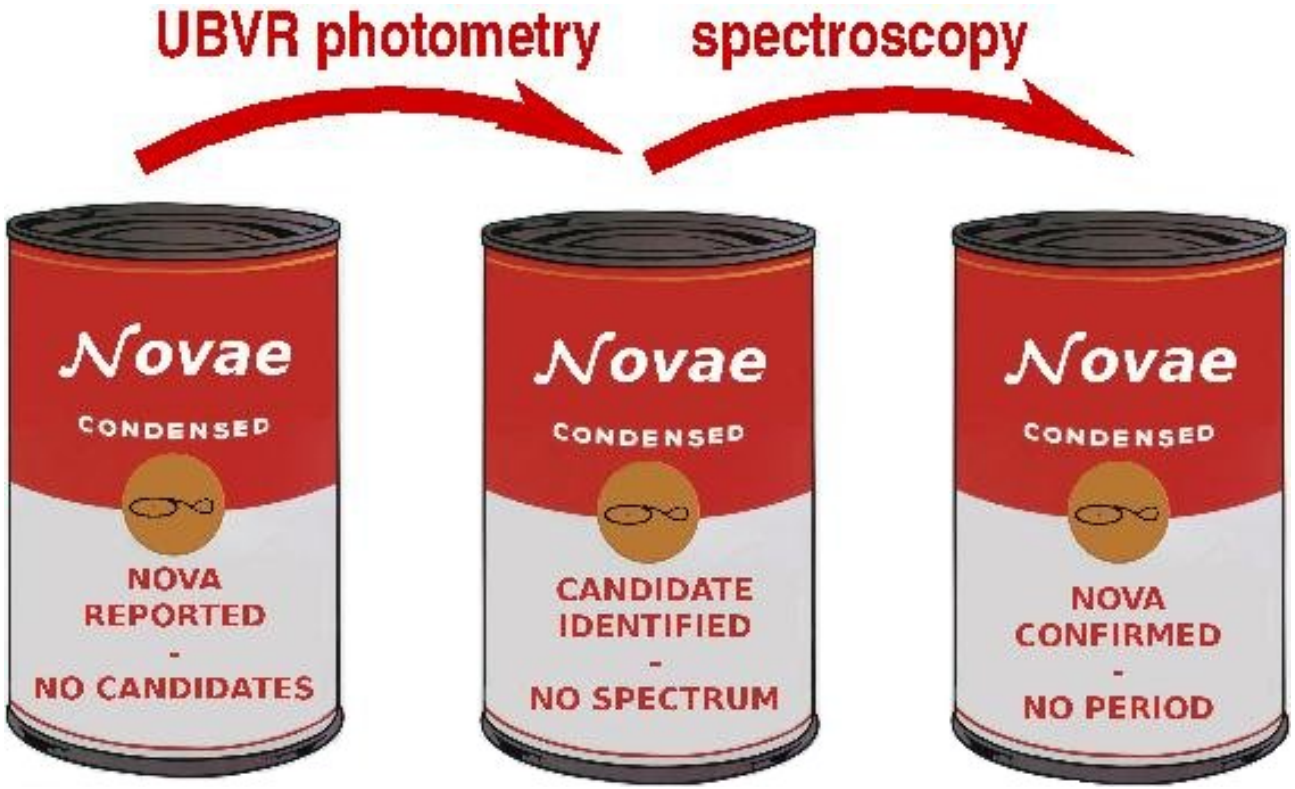


Colour-colour diagram

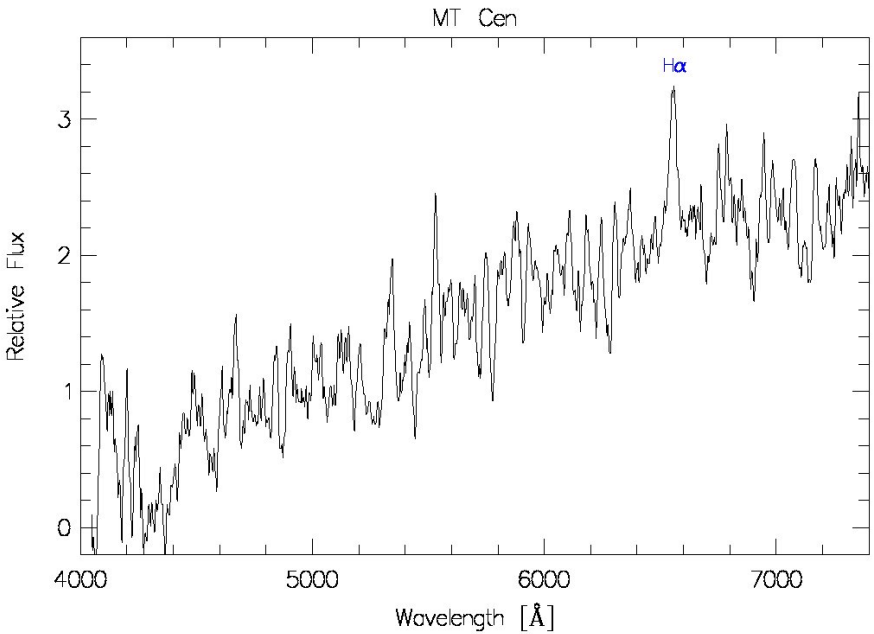


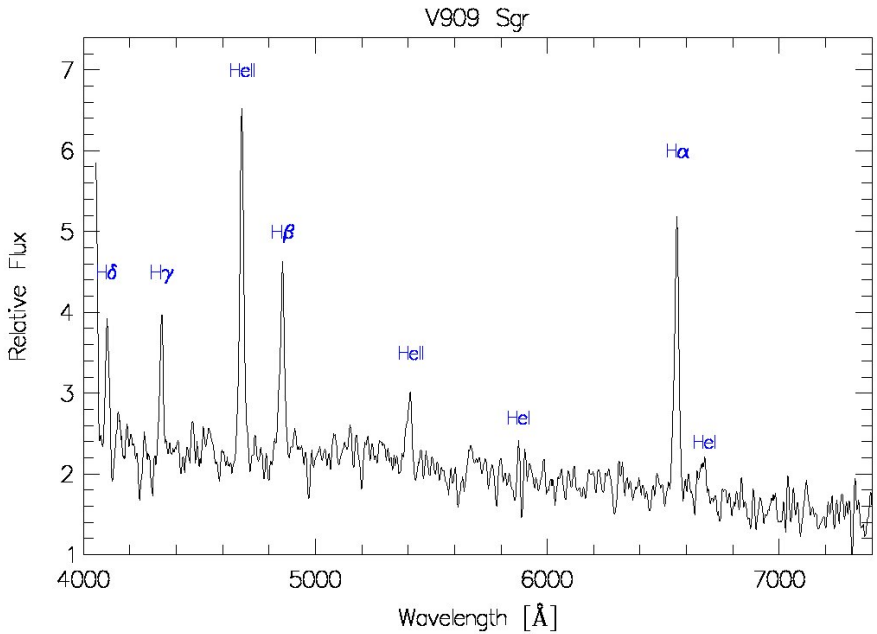


Binning and tinning II

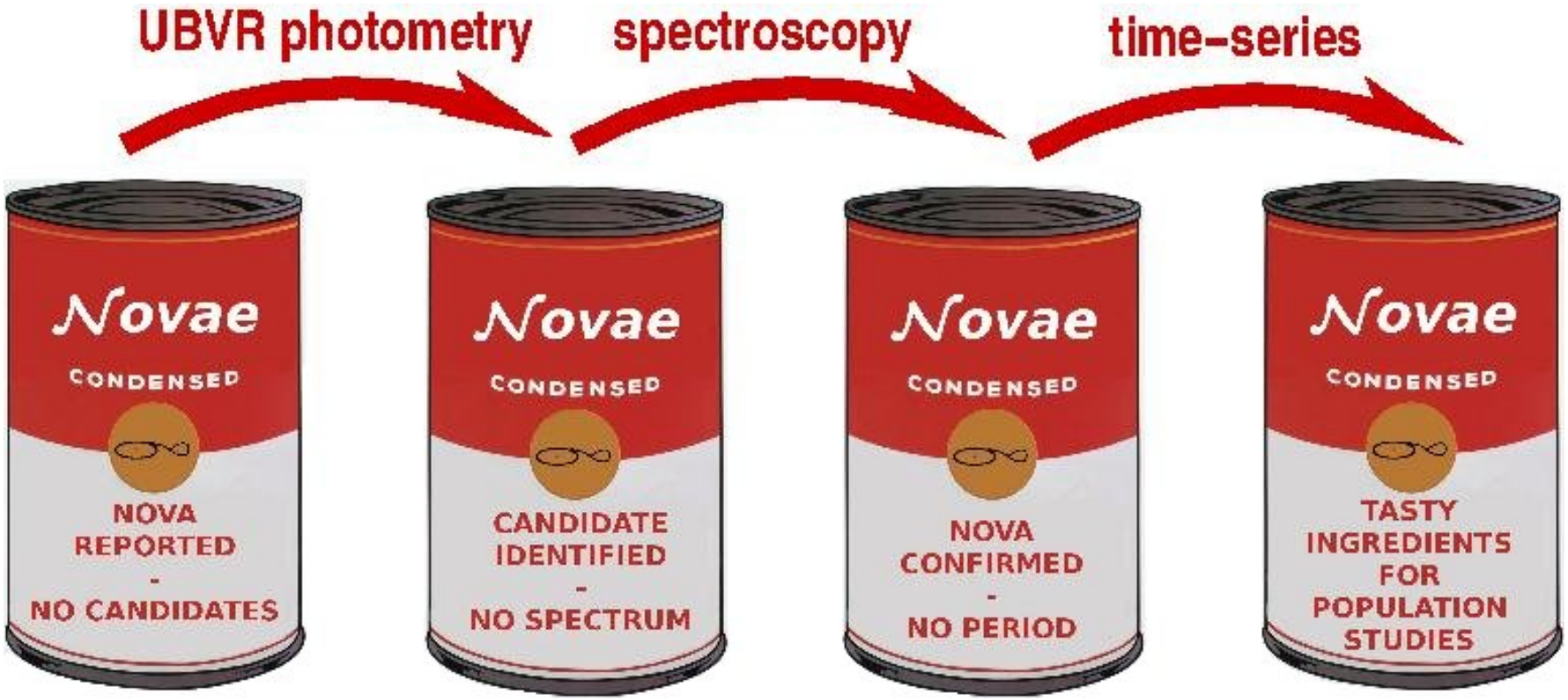


Low-resolution spectroscopy

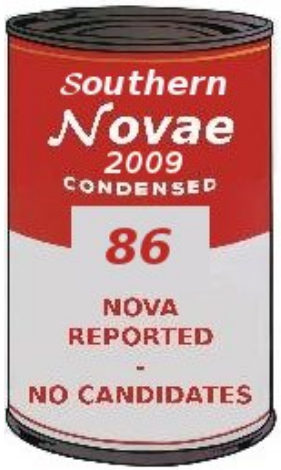


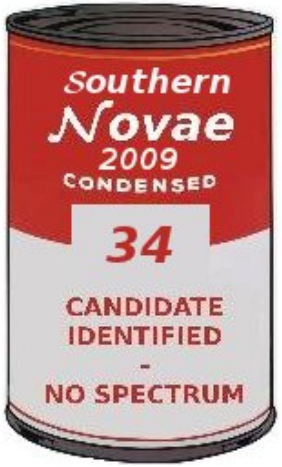


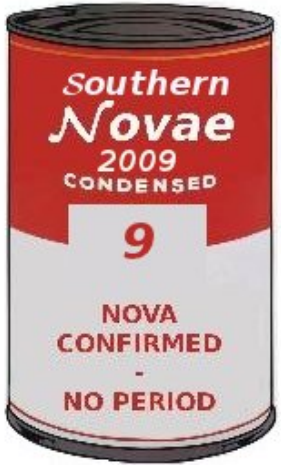
Binning and tinning III

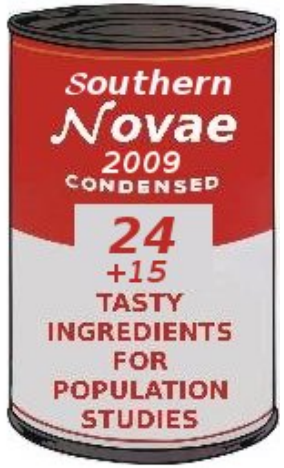


Then and now


Southern
Novae
2009
CONDENSED
86
NOVA
REPORTED
-
NO CANDIDATES


Southern
Novae
2009
CONDENSED
34
CANDIDATE
IDENTIFIED
-
NO SPECTRUM


Southern
Novae
2009
CONDENSED
9
NOVA
CONFIRMED
-
NO PERIOD


Southern
Novae
2009
CONDENSED
24
+15
TASTY
INGREDIENTS
FOR
POPULATION
STUDIES

Then and now

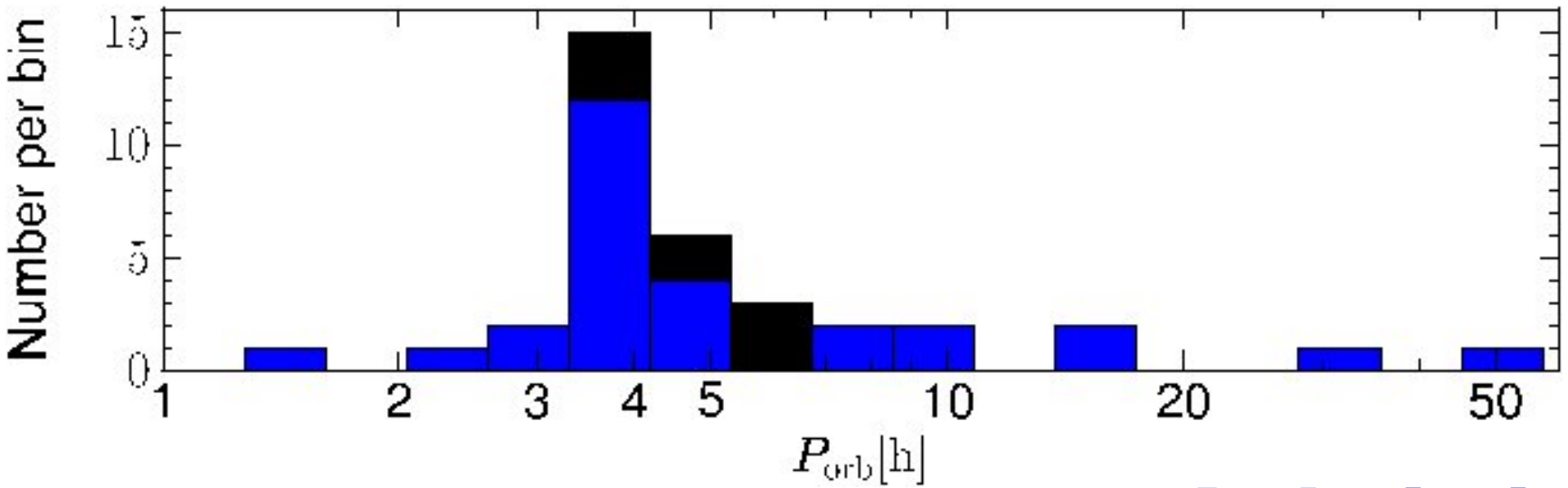

Southern Novae 2009 CONDENSED
86
NOVA REPORTED - NO CANDIDATES
Southern Novae 2009 CONDENSED
34
CANDIDATE IDENTIFIED - NO SPECTRUM
Southern Novae 2009 CONDENSED
9
NOVA CONFIRMED - NO PERIOD
Southern Novae 2009 CONDENSED
24 +15
TASTY INGREDIENTS FOR POPULATION STUDIES
Southern Novae 2013 CONDENSED
65
NOVA REPORTED - NO CANDIDATES
Southern Novae 2013 CONDENSED
36
CANDIDATE IDENTIFIED - NO SPECTRUM
Southern Novae 2013 CONDENSED
18
NOVA CONFIRMED - NO PERIOD
Southern Novae 2013 CONDENSED
32 +15
TASTY INGREDIENTS FOR POPULATION STUDIES

Then and now

+ 2 Mira/Symbiotics

Orbital periods

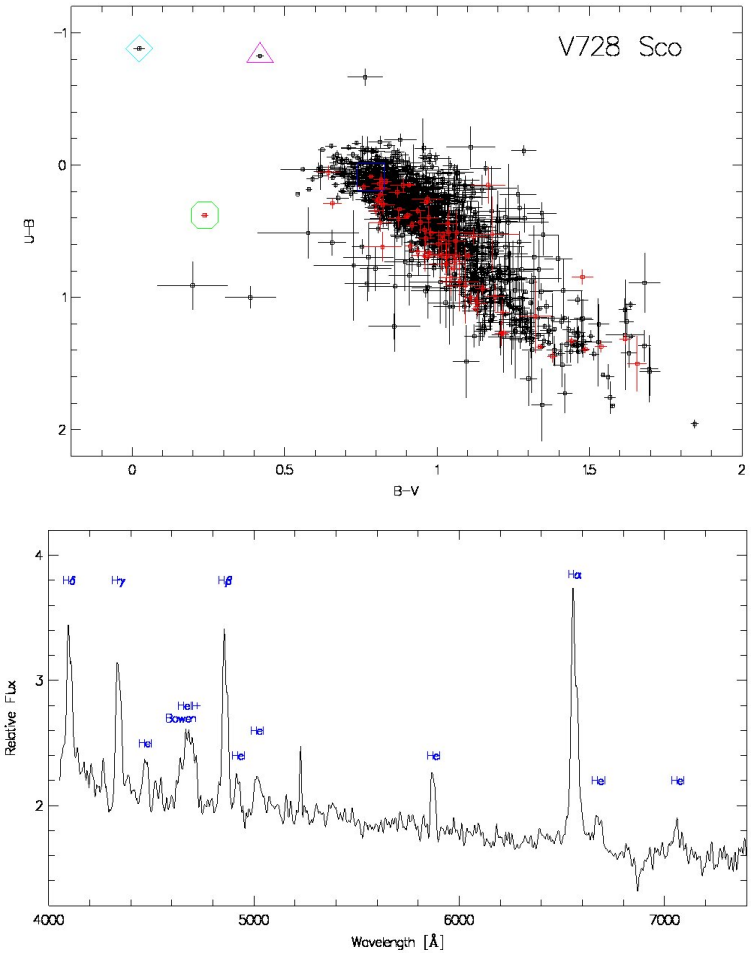
V728 Sco	V909 Sgr	V373 Sct	V365 Car
1862	1941	1975	1948
3.32 h	3.4 h	3.7 h	∼5 h
AR Cir	**CN Vel**	**HS Pup**	**V972 Oph**
1906	1905	1963	1957
5.18 h	5.3 h	6.4 h	6.7 h

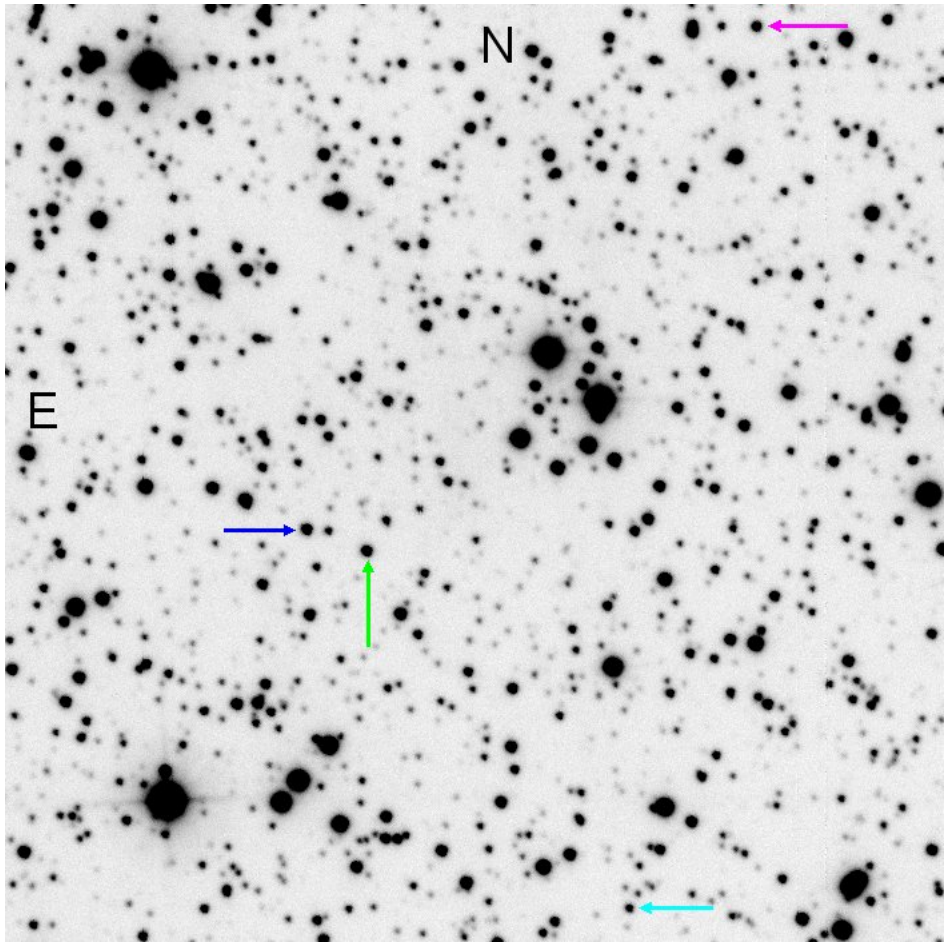


A 150 years ago...

- on October 5–9, 1862, a bright star of 5^{th} mag appears close to the border between constellations Scorpius and Ara (Tebutt 1878)
- only 4 days later it was found to have declined below 11^{th} mag
- Duerbeck (1987) identified two faint candidates ($j \sim 20 - 21$ mag) for the post-nova based on Tebbutt's coordinates
- Schmidtobreick et al. (2002) note that these candidates present colours that are more consistent with a main-sequence star than a CV and suggest two new candidates that are within $1'$ of the original coordinates

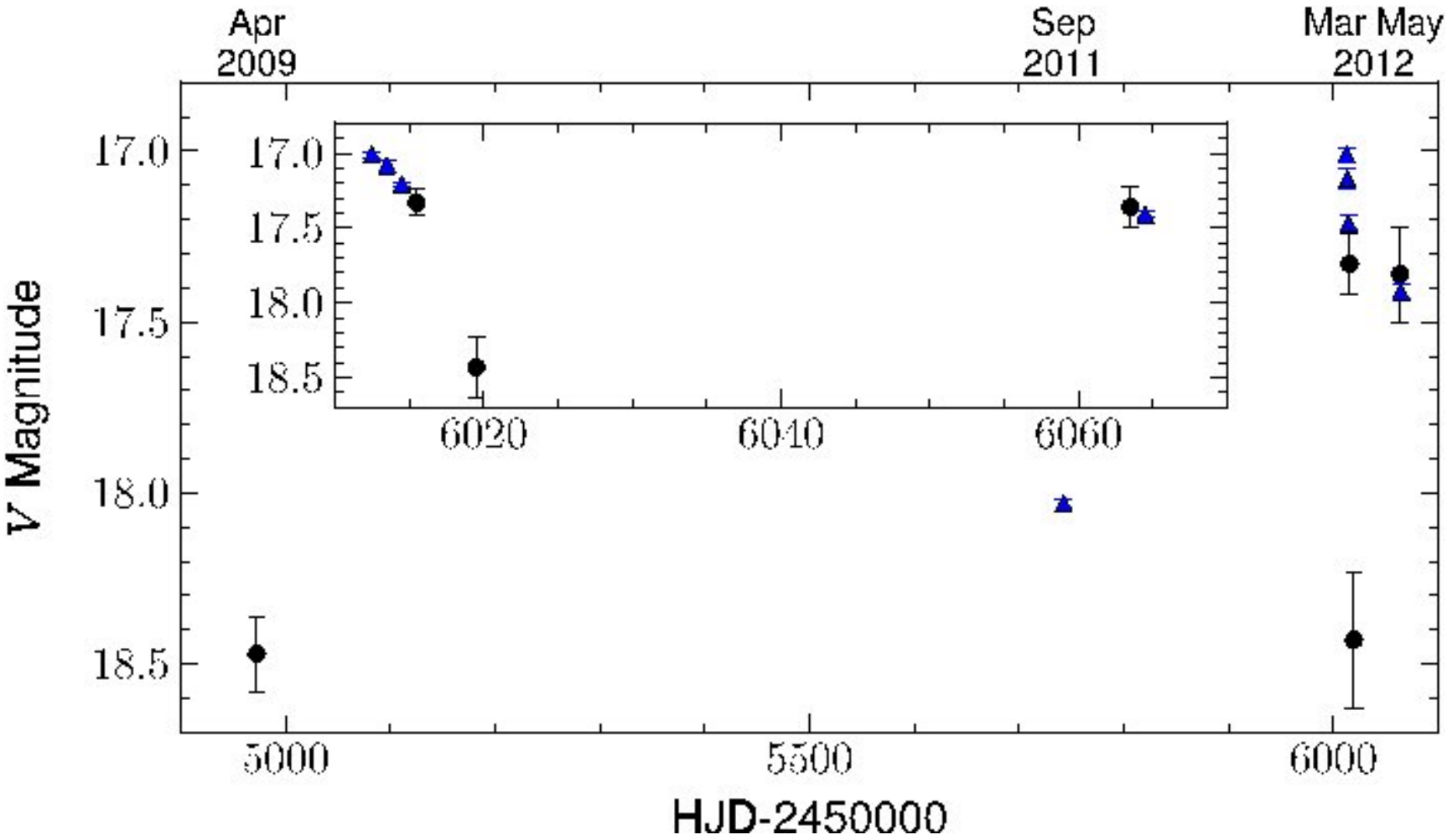
(Re)Discovery



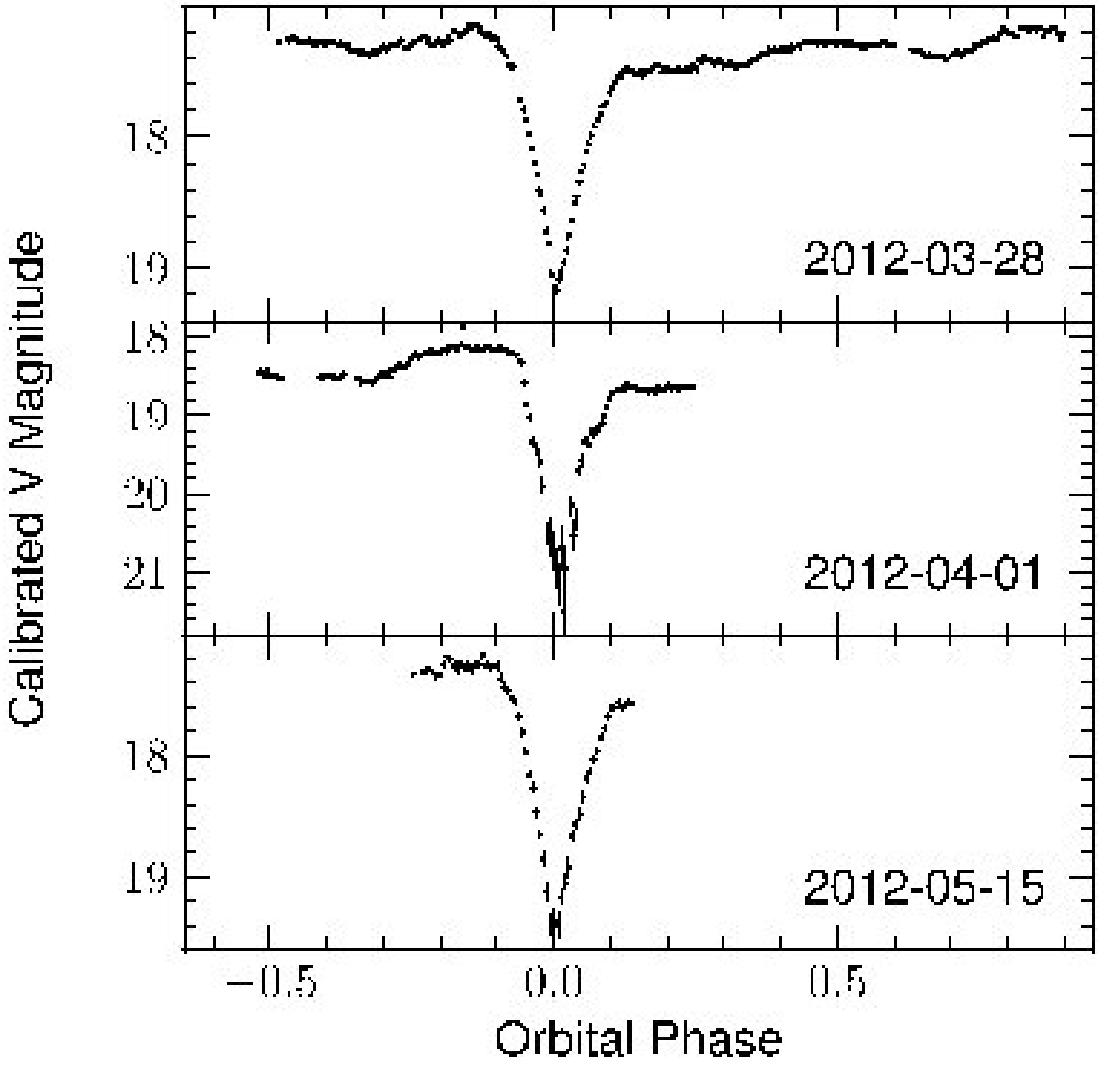


$\sim 2'$ NW of original coordinates

Long-term behaviour

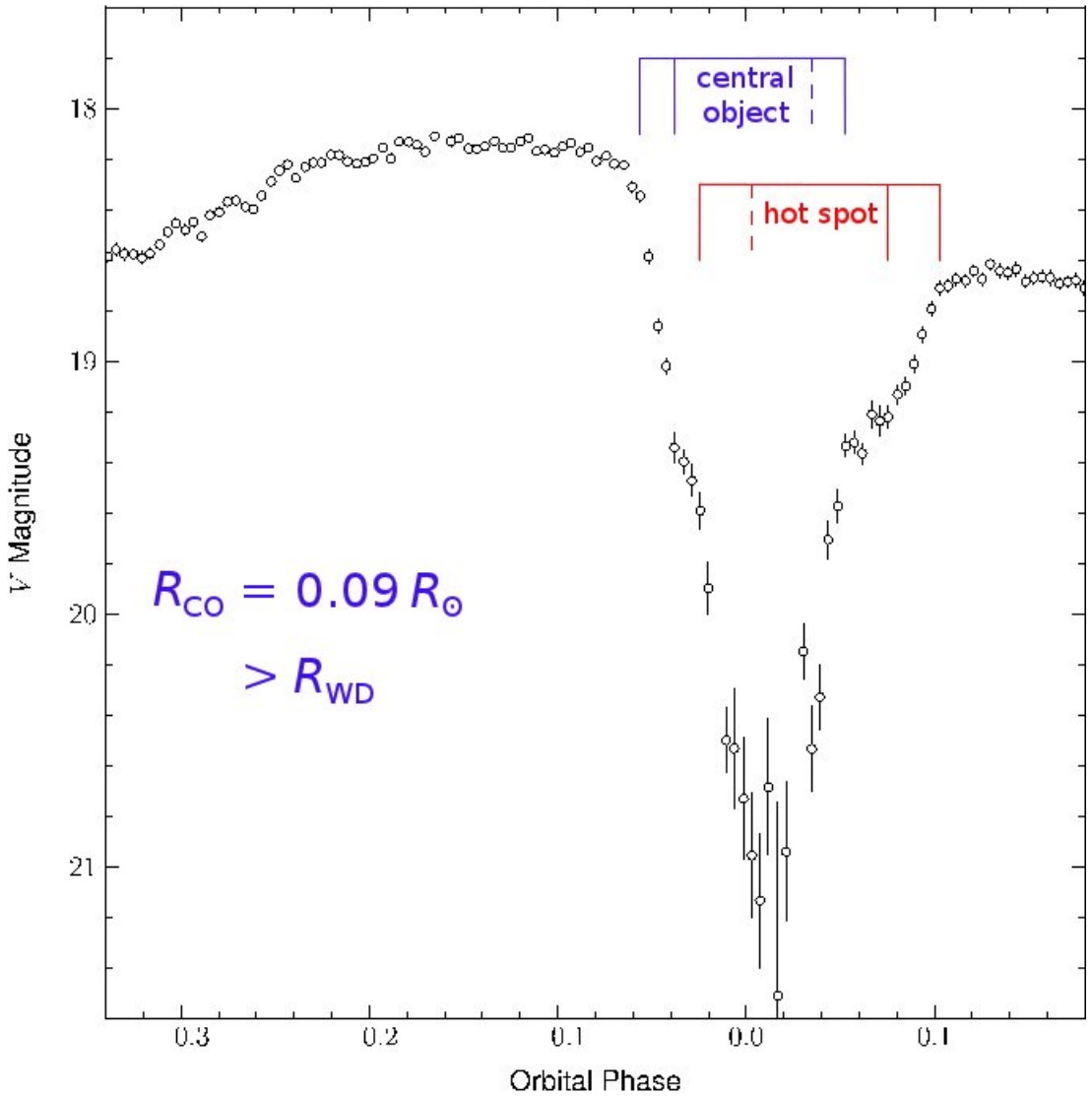


Eclipses

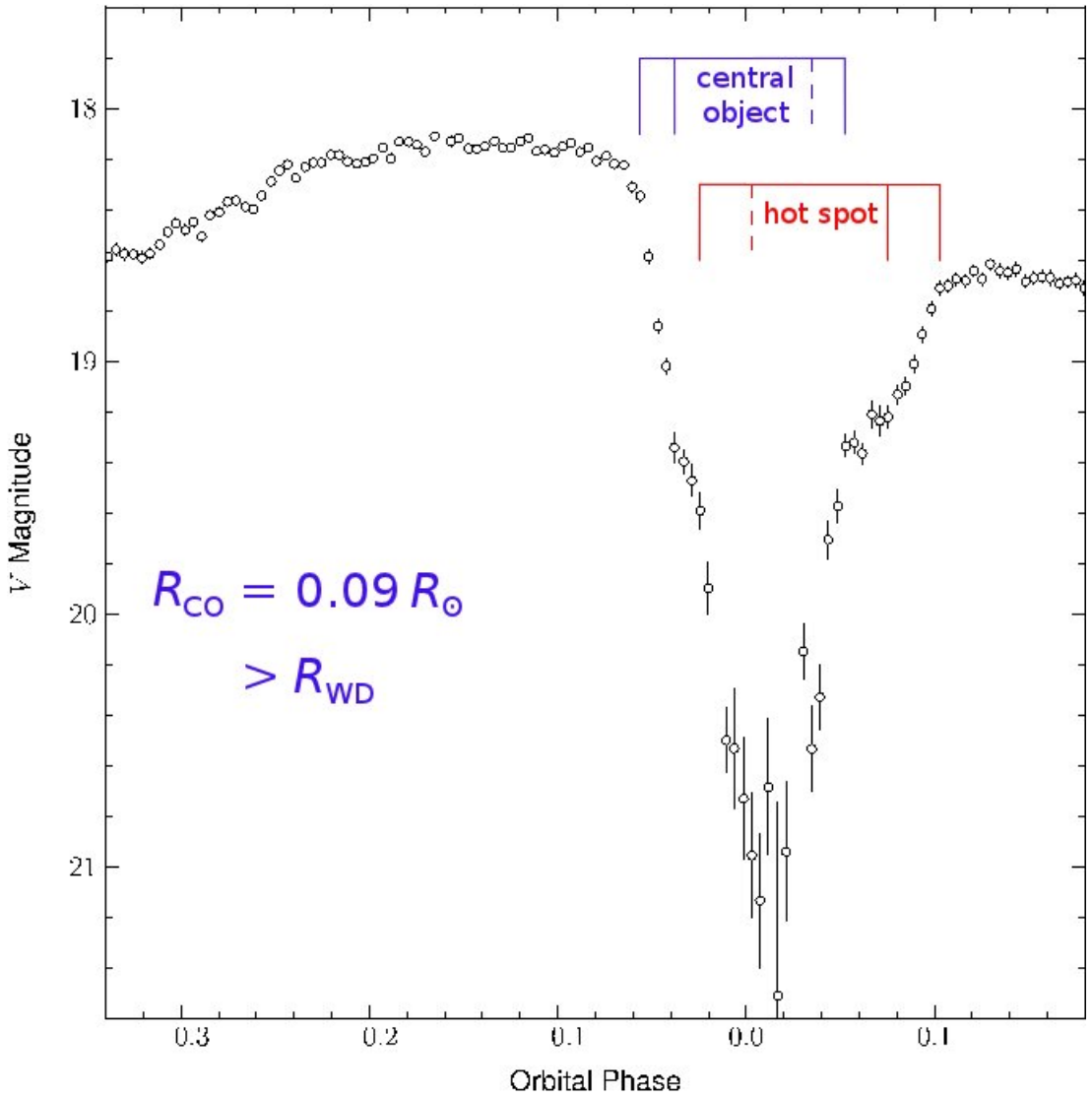


$$P_{\rm orb} = 3.32 \text{ h}$$

The low state eclipse



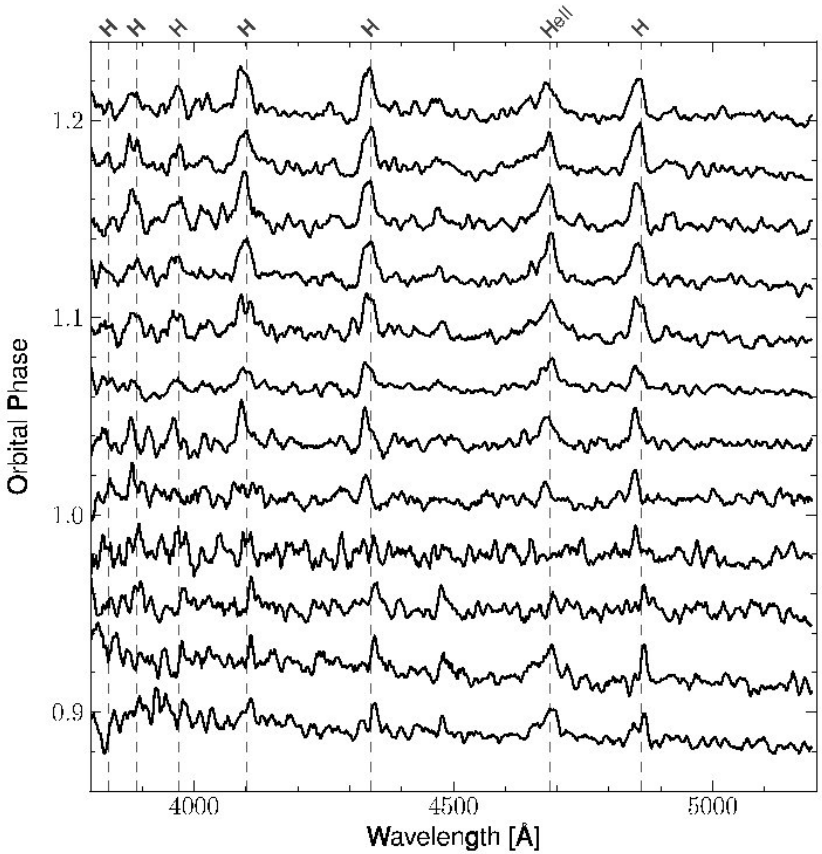
The low state eclipse



$\Rightarrow$ hot inner disc?

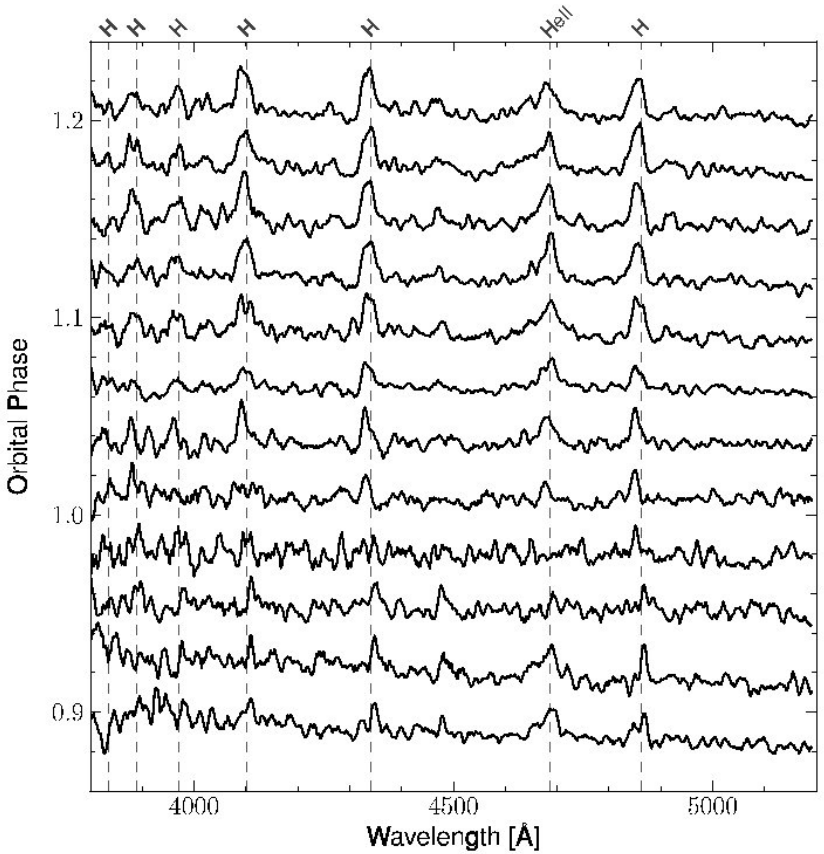
would also explain outburst behaviour (Schreiber et al. 2000)

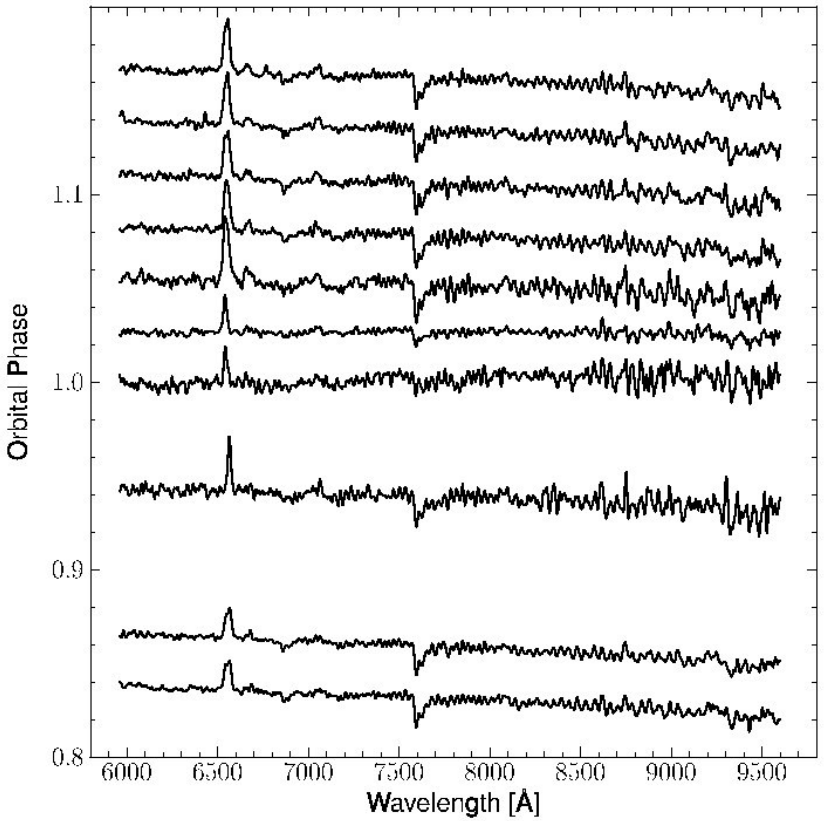
SED through eclipse



high-excitation lines vanish
$\Rightarrow$ eclipse of hot inner disc

SED through eclipse

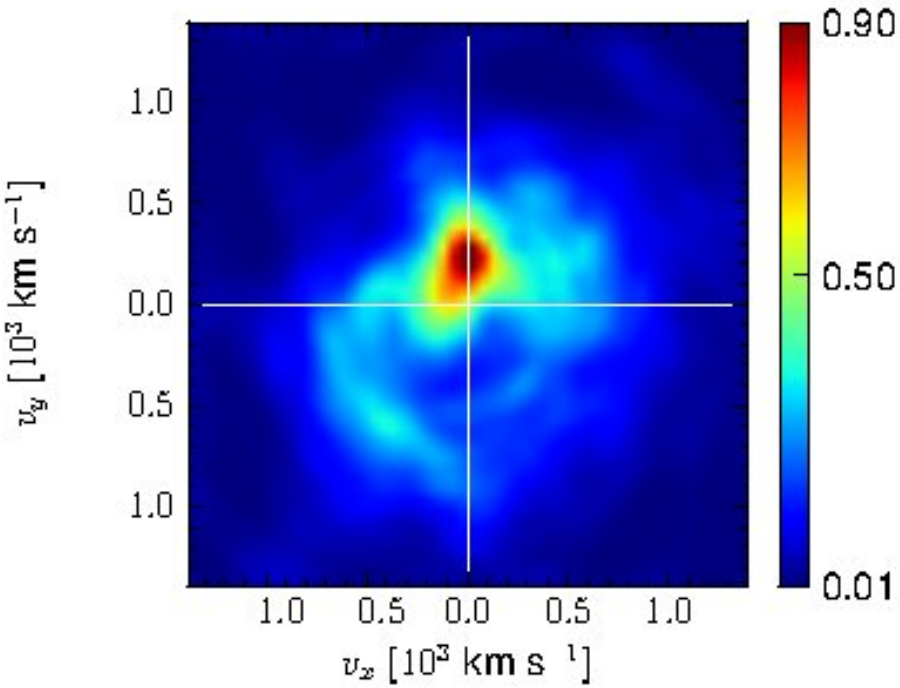


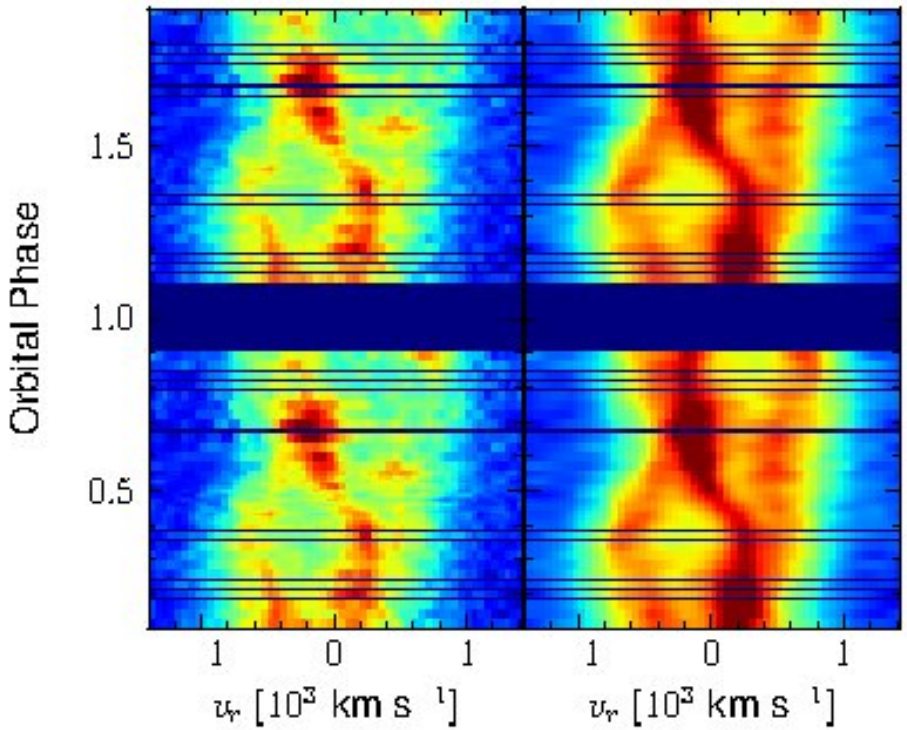


high-excitation lines vanish
$\Rightarrow$ eclipse of hot inner disc

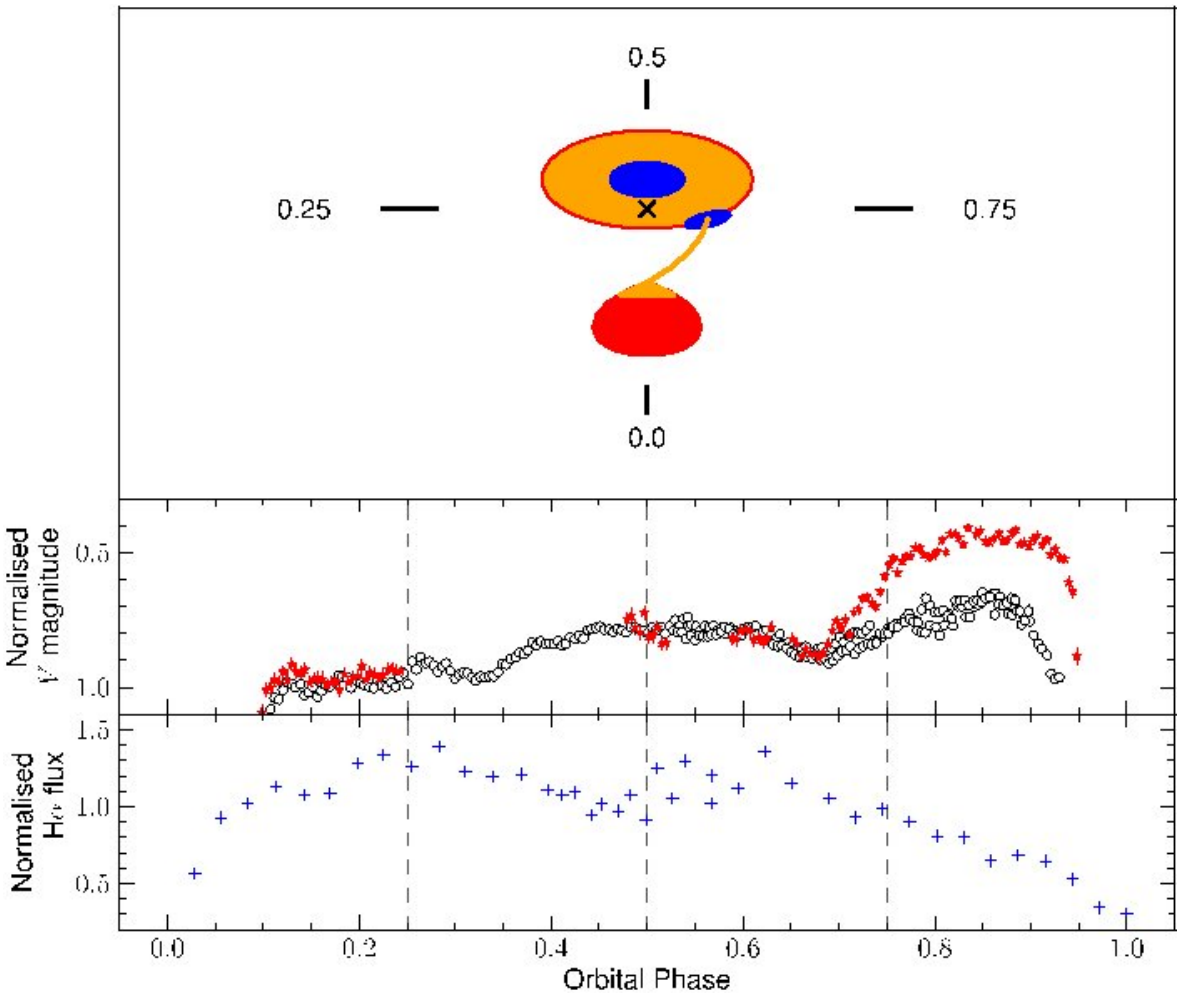
$\Rightarrow$ donor becomes visible in eclipse
(needs high S/N spectra)

Doppler Tomography



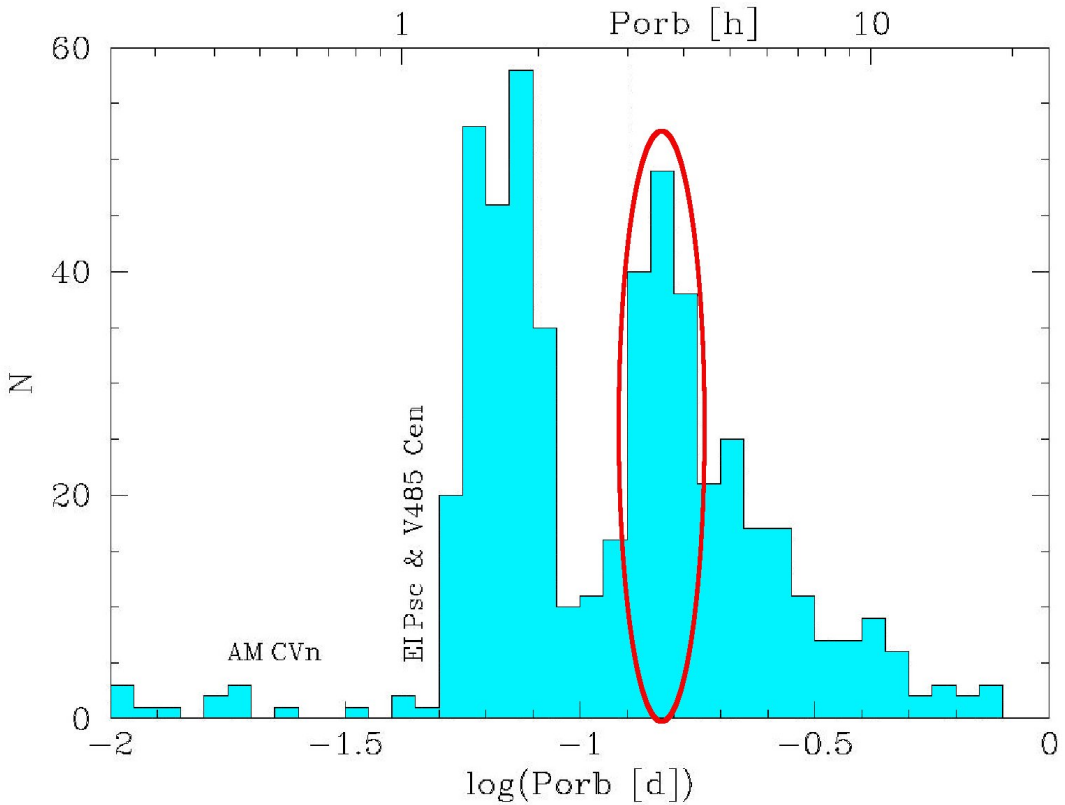


System Parameters



i	82°
q	0.36
$M_{\rm WD}$	0.81 $M_\odot$
$M_{\rm RD}$	0.29 $M_\odot$
$R_{\rm RD}$	0.38 $R_\odot$
a	1.31 $R_\odot$
R_d	0.41 $R_\odot$
$R_{\rm CO}$	0.09 $R_\odot$

The CV Context



Gänsicke (2004)

SW Sex: very high mass-transfer systems, dominant population at $P_{\rm orb} = 3 - 4$ h ($\sim$80%)

$\Rightarrow$ V728 Sco is one of the few exceptions

Summary

- project aims at providing spectroscopic confirmation of all pre-1980 novae in the southern hemisphere ($\delta < +20^\circ$)
- obtain orbital periods for the brightest systems
- steady, but slow, progress ($\sim$20% done)
- $\Rightarrow$ still needs a lot of observing time
- most interesting object so far: V728 Sco

Summary

- project aims at providing spectroscopic confirmation of all pre-1980 novae in the southern hemisphere ($\delta < +20^\circ$)
- obtain orbital periods for the brightest systems
- steady, but slow, progress ($\sim$20% done)
- $\Rightarrow$ still needs a lot of observing time
- most interesting object so far: V728 Sco
  - recovered 2′ from its supposed position, 150 years after eruption
  - eclipsing with $P_{\rm orb} = 3.32$ h
  - (probably) first direct observational evidence for irradiated inner disc
  - has 2 good reasons to be a high mass-transfer system (old nova, in the SW Sex regime), but it is not