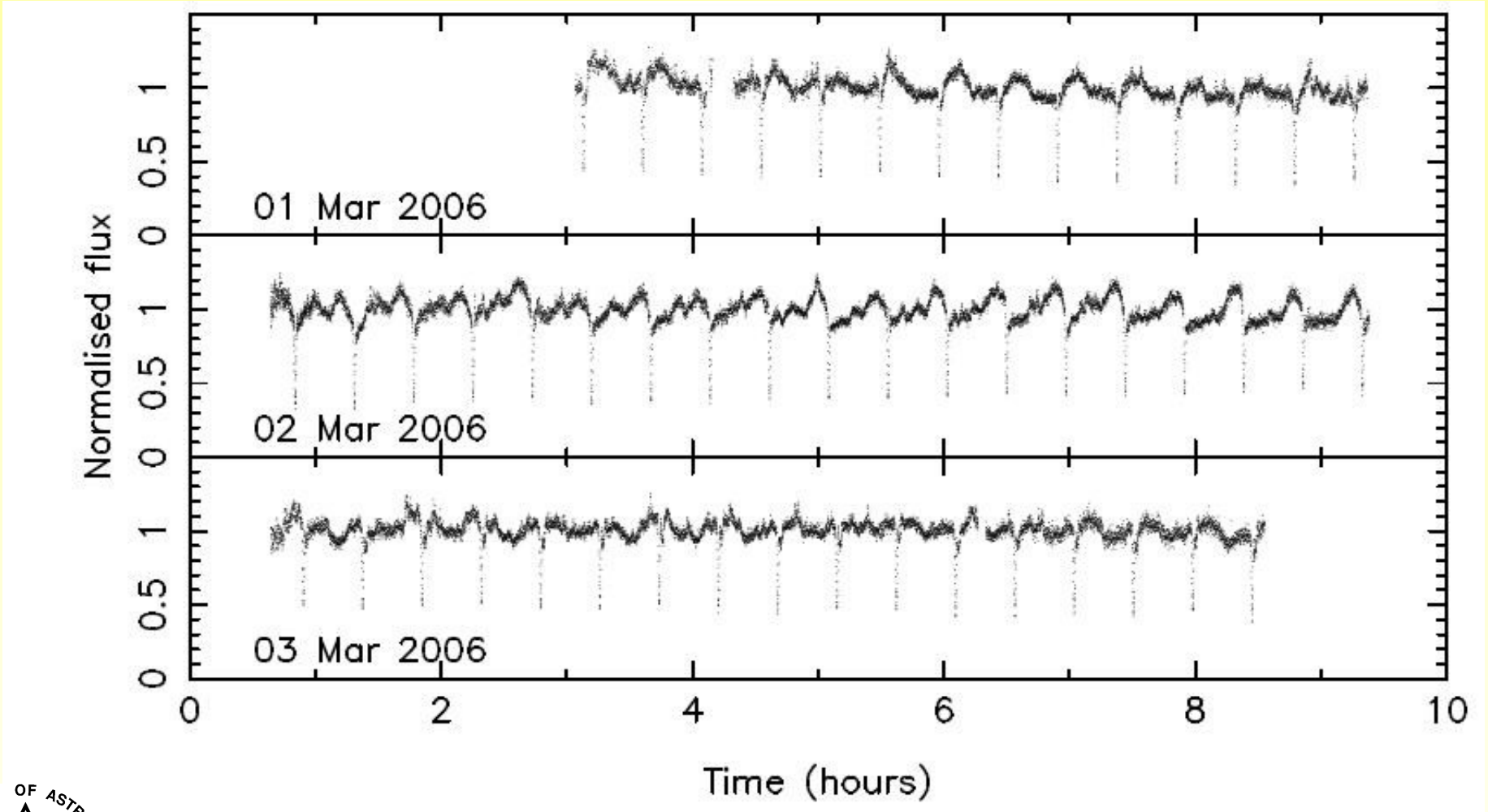
The OmegaWhite Survey



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DEPARTMENT OF ASTROPHYSICS • RADBOUD UNIVERSITY NIJMEGEN •

Omega White

Goal of OmegaWhite

Galactic population of ultracompact binaries

Paul Groot, Gijs Nelemans, Gijs Roelofs, Danny Steeghs
Tom Marsh, Thomas Augusteijn, Vik Dhillon
Luisa Morales Rueda, *Kars Verbeek*

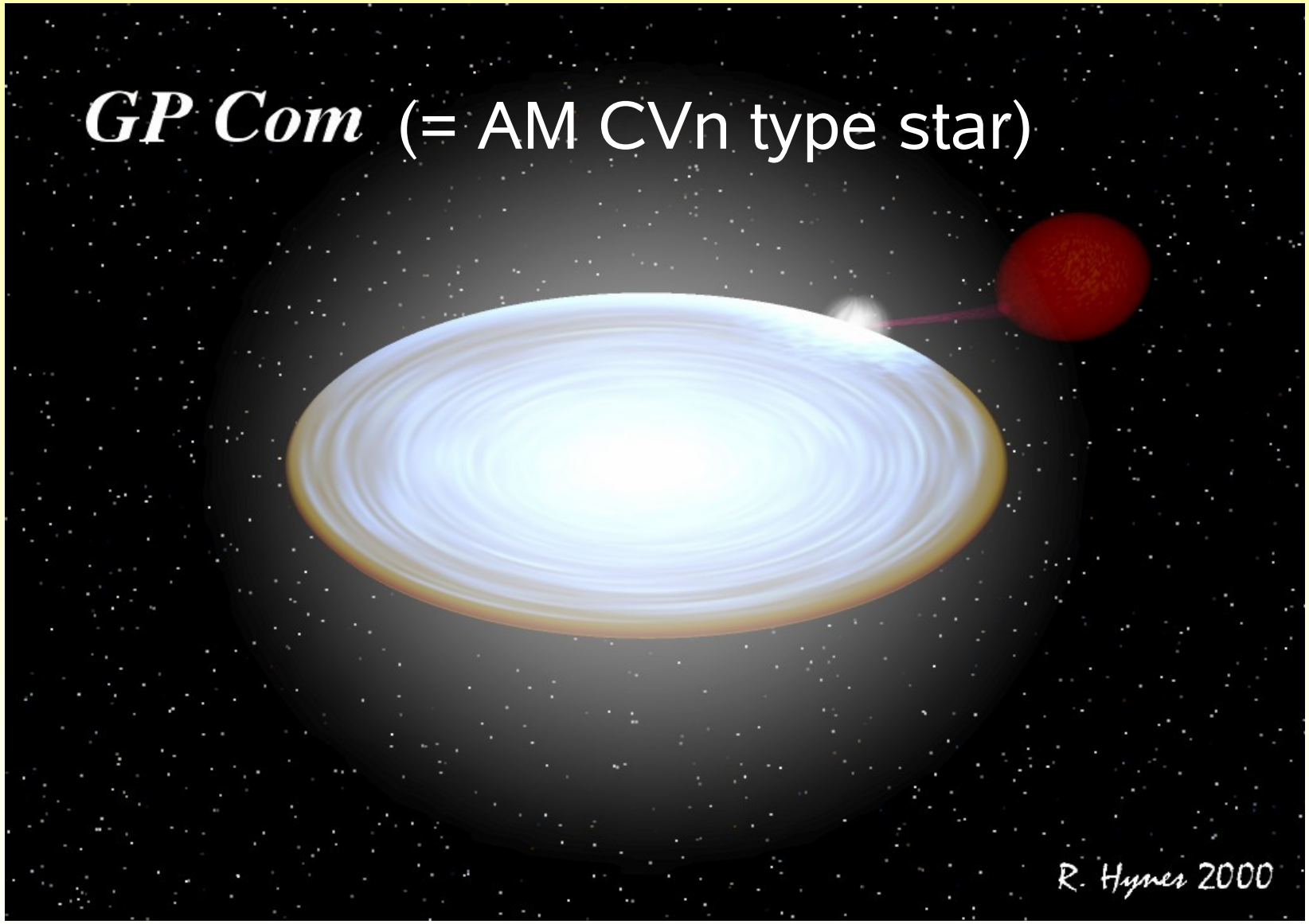
Why?

- *Late stages of binary evolution*
- *Galactic Gravitational wave emitters*
- *Physics of accretion disks + direct impact*

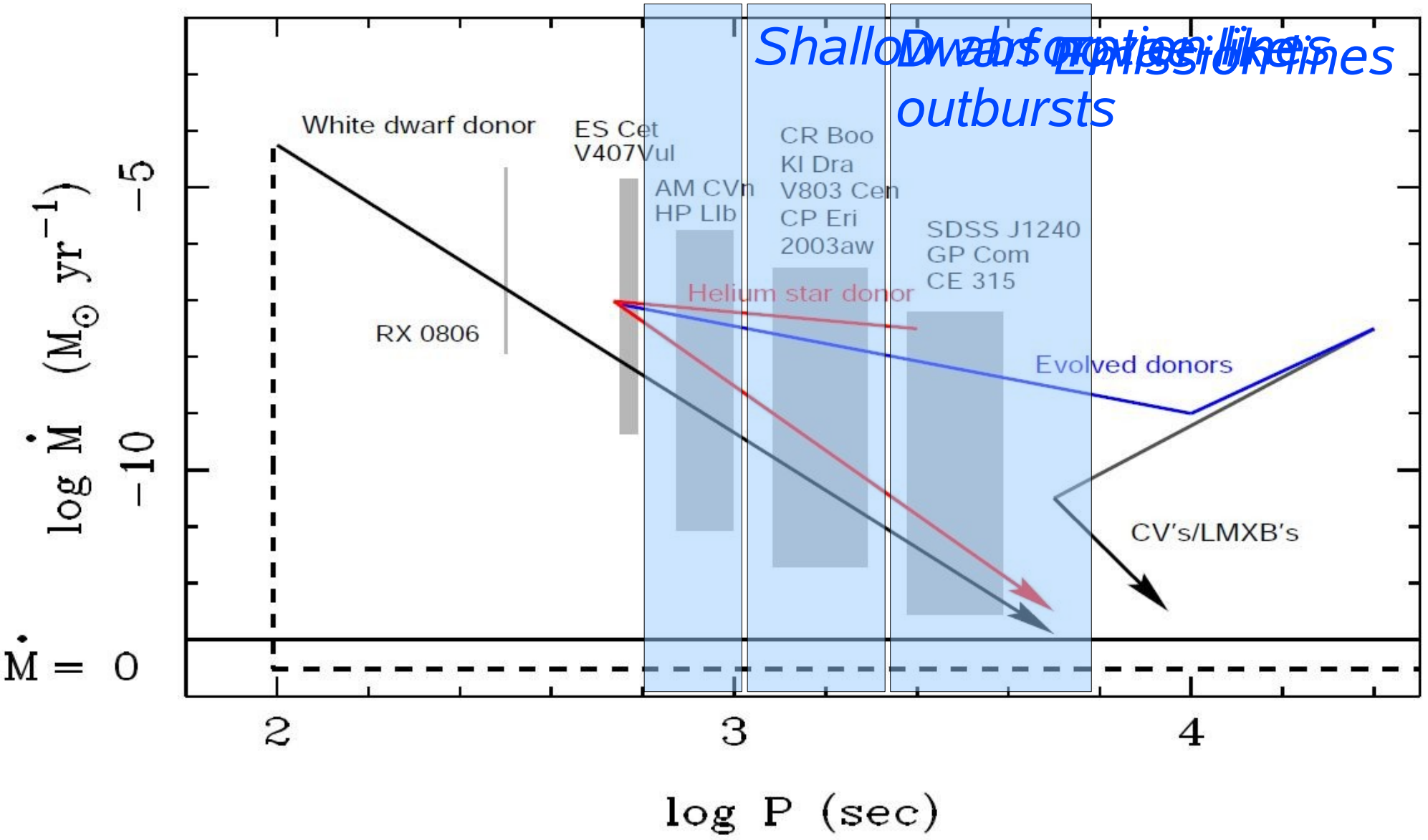
At $P_{orb} < 80$ min: donor must be hydrogen-depleted. Evolved systems.

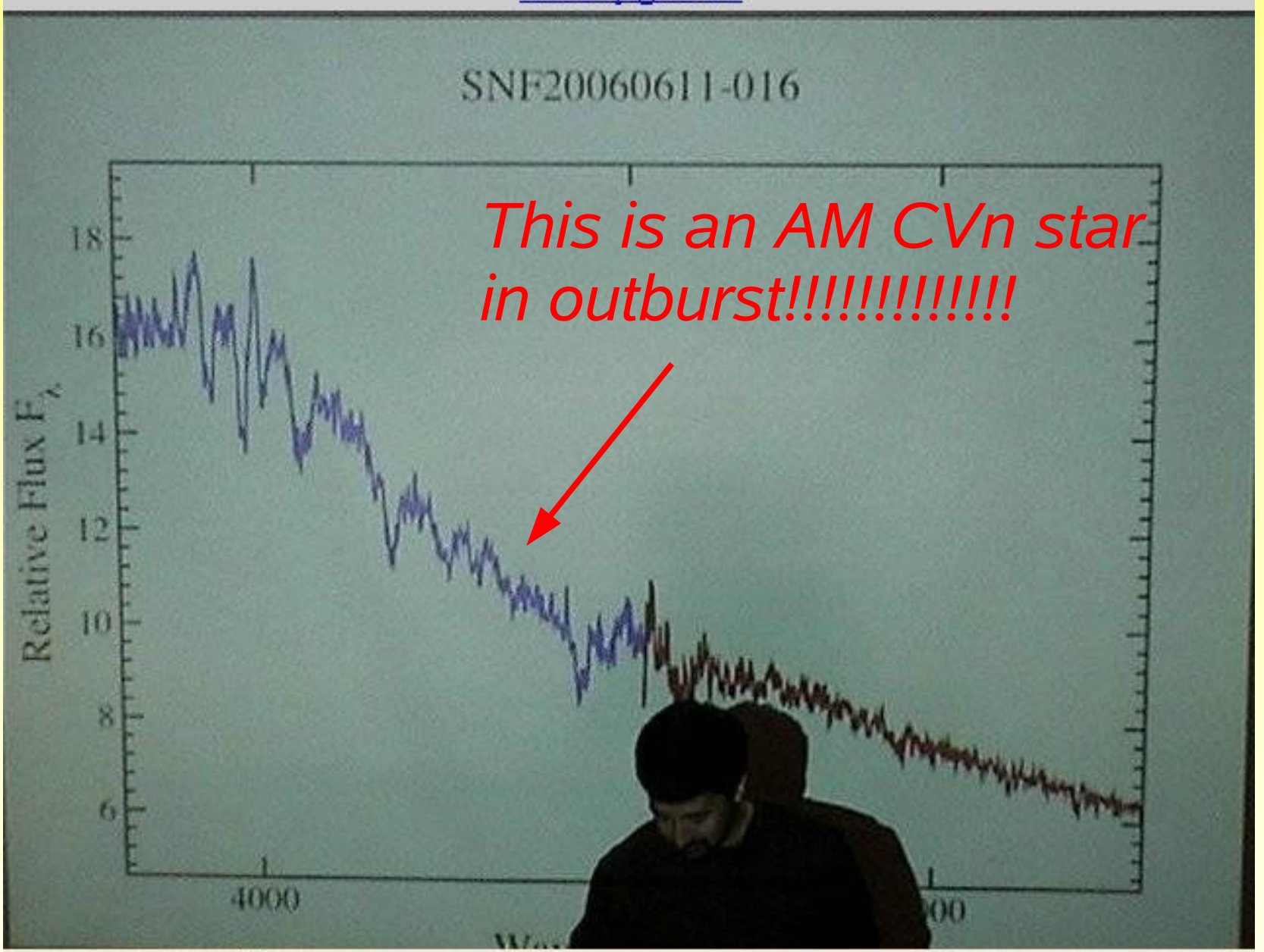
Omega White

What kind of binary?



Appearance

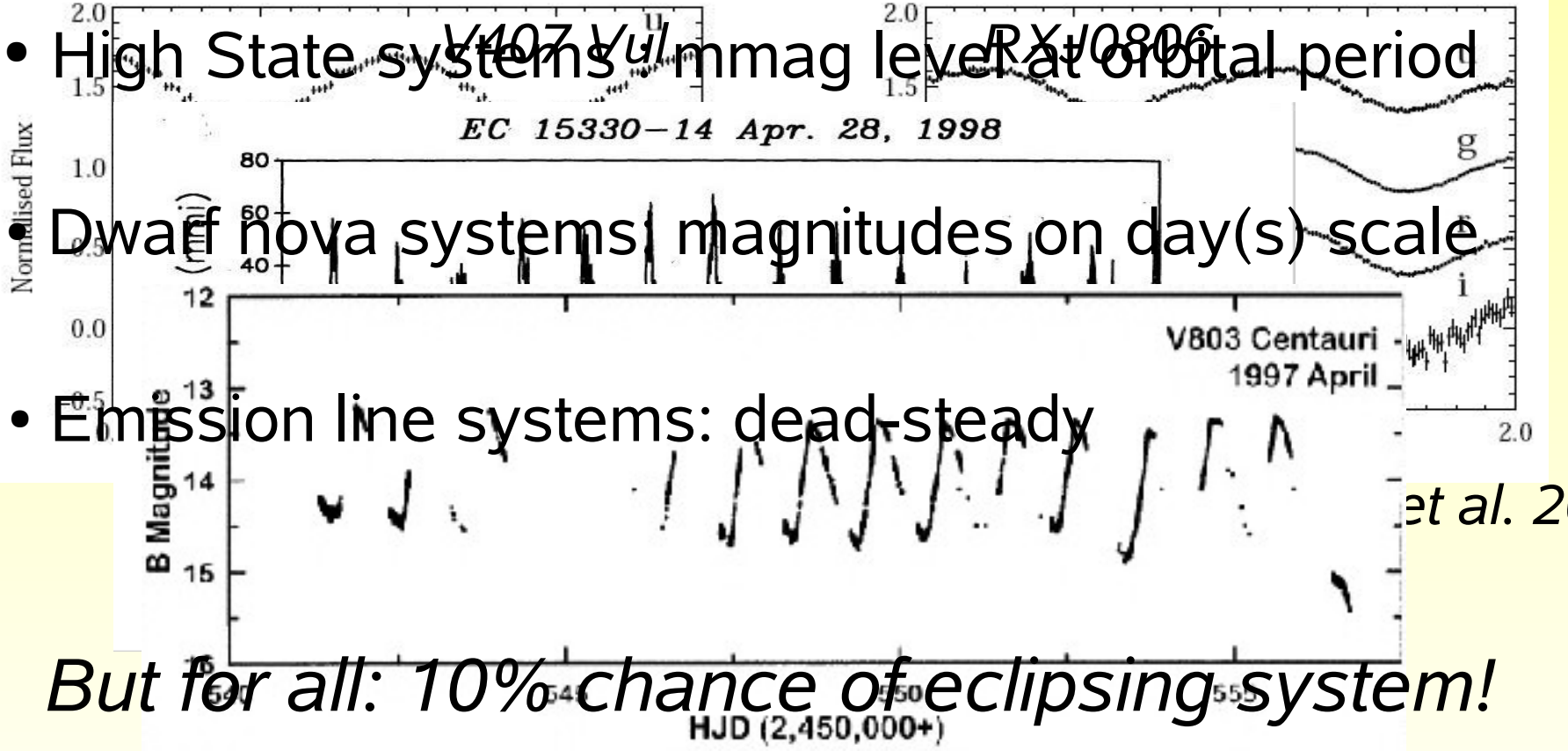

Shallow absorption lines
Deep absorption lines
Emission lines
outbursts
White dwarf donor
ES Cet
V407Vul
AM CVn
HP Lib
CR Boo
KI Dra
V803 Cen
CP Eri
2003aw
SDSS J1240
GP Com
CE 315
Helium star donor
RX 0806
Evolved donors
CV's/LMXB's
log Ṁ (M⊙ yr⁻¹)
−5
−10
Ṁ = 0
2
3
4
log P (sec)



Paused 0:12:06 / 1:03:27

Variability

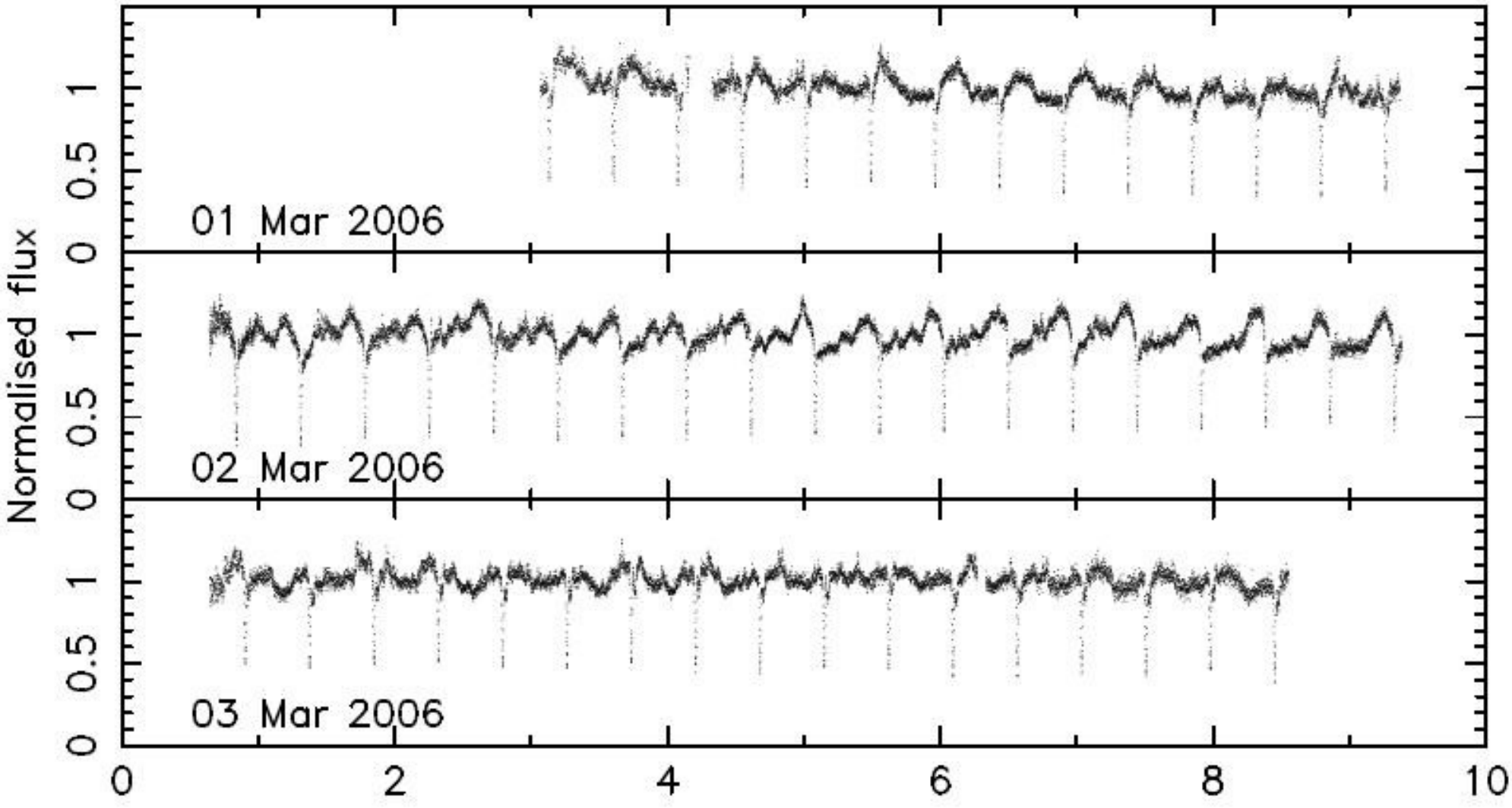
- Ultrashort: sinusoidal (50%) on orbital period
- High State systems: mmag level at orbital period
- Dwarf nova systems: magnitudes on day(s) scale
- Emission line systems: dead-steady



et al. 2007

But for all: 10% chance of eclipsing system!

SDSSJ0926+3624



Marsh et al., 2006

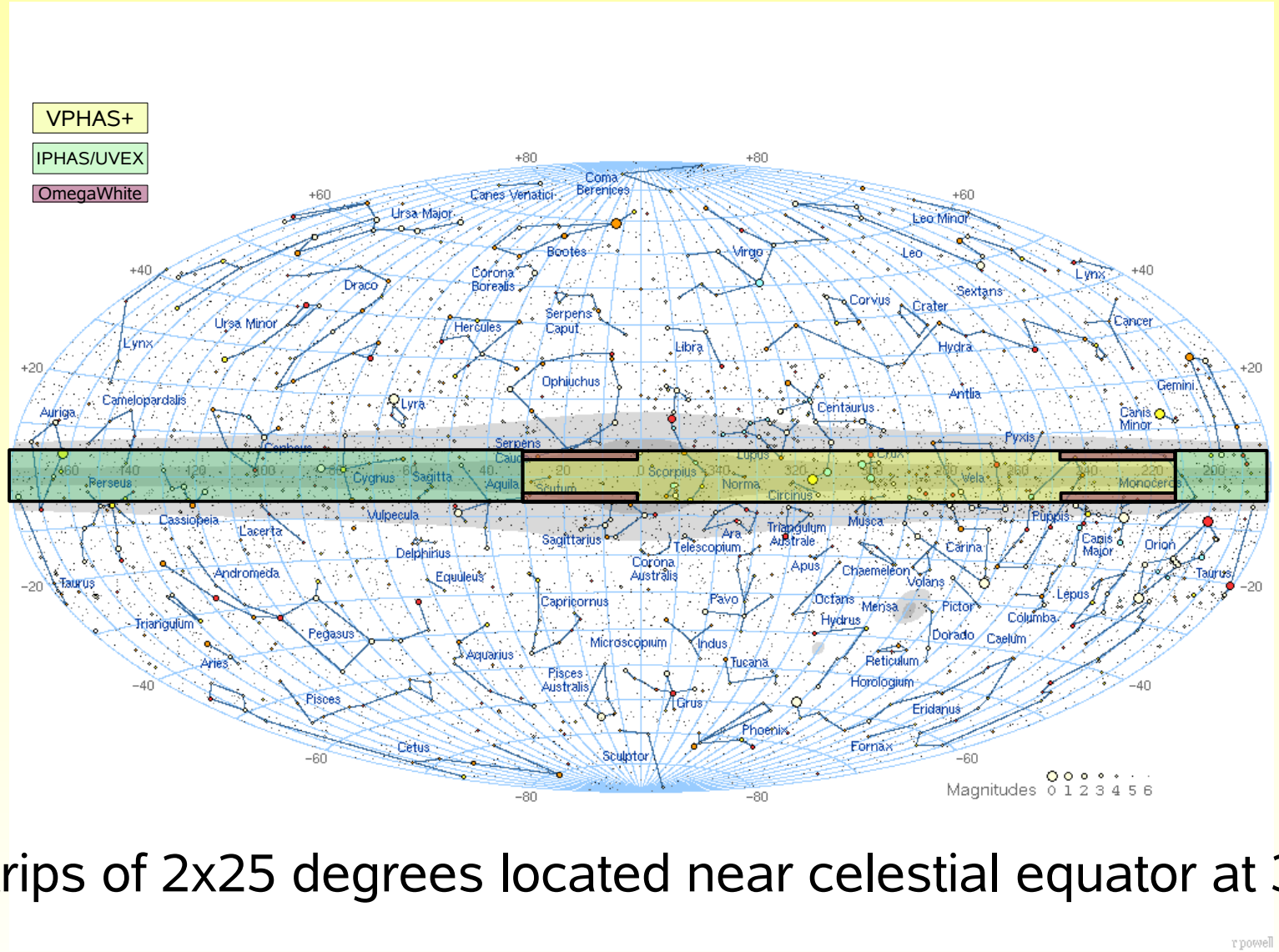
OmegaWhite

On the VST: initially 100 sq. degrees, eventually 400 sq. degrees

- Broad band (u,g,r,i,Hα) from EGAPS
- Narrow band in He I lines (5015, 4471 & 3888)
- Depth g~22 (S/N=10) : 40 s. integration
- 25 observations in *g* over 2 hours stretch.

OmegaCam in ESO lab

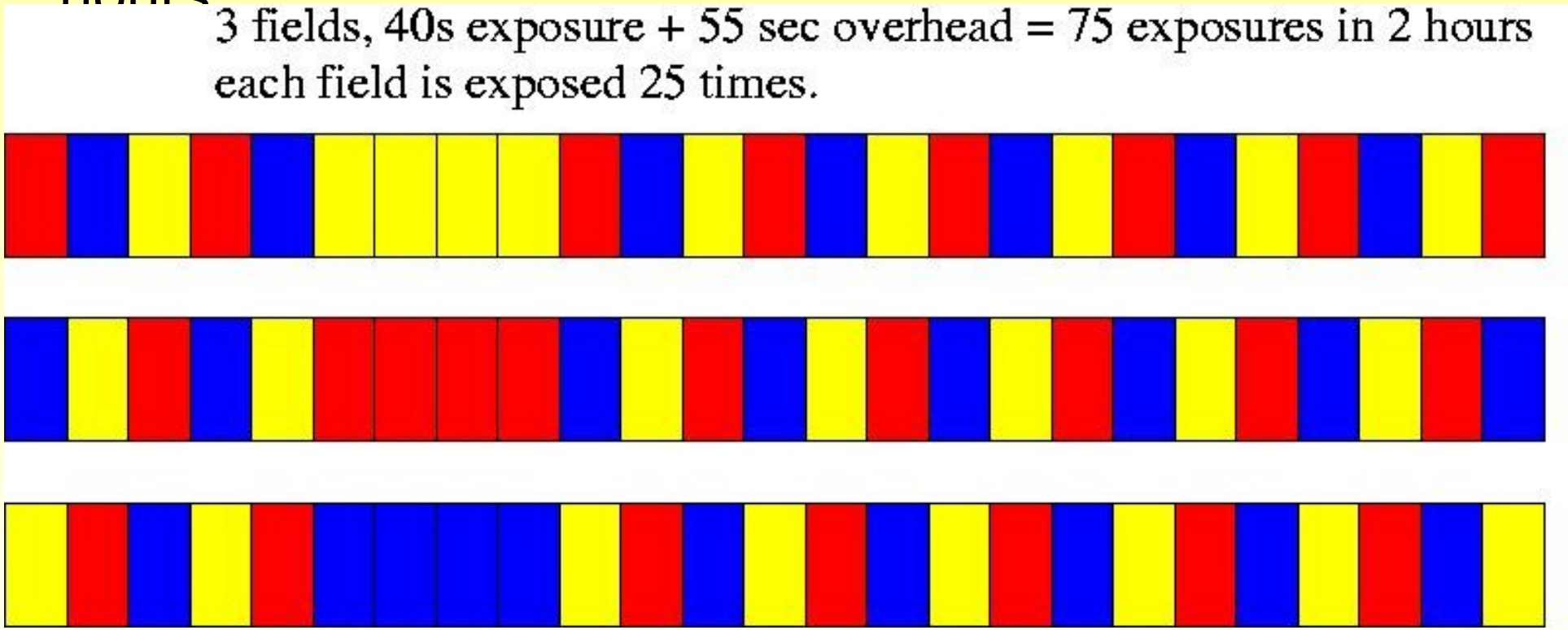
OmegaWhite on the sky



4 strips of 2x25 degrees located near celestial equator at 3<|b|<5

Cadence

Three one-square degree fields will be cycled. Effectively gives us 3 square degrees per 2 hours



Alias optimization still needed

Yield

We expect ~200 AM CVn systems in total (23 known now)

- Long period systems: from emission lines
- Shorter period systems: from photometric variability

We expect to pick up ~50 eclipsing systems with P<30 min, based on space density by Gijs Roelofs and characteristics of the survey.

Also: eclipsing CVs, sdB stars, detached white dwarfs, pulsating white dwarfs, small number UCXB

Follow-up using X-Shooter (on the VLT in Fall 2008)

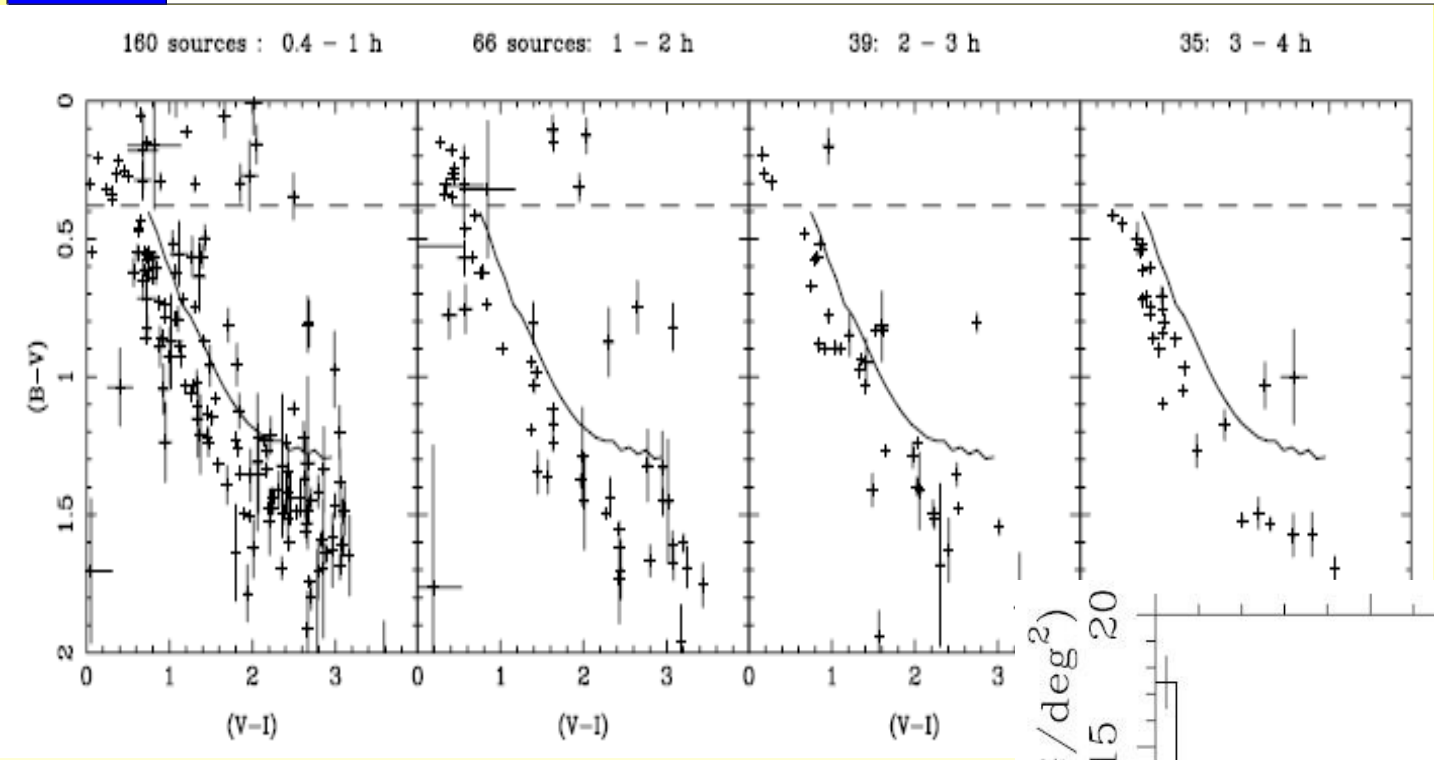
Results from the FSVS

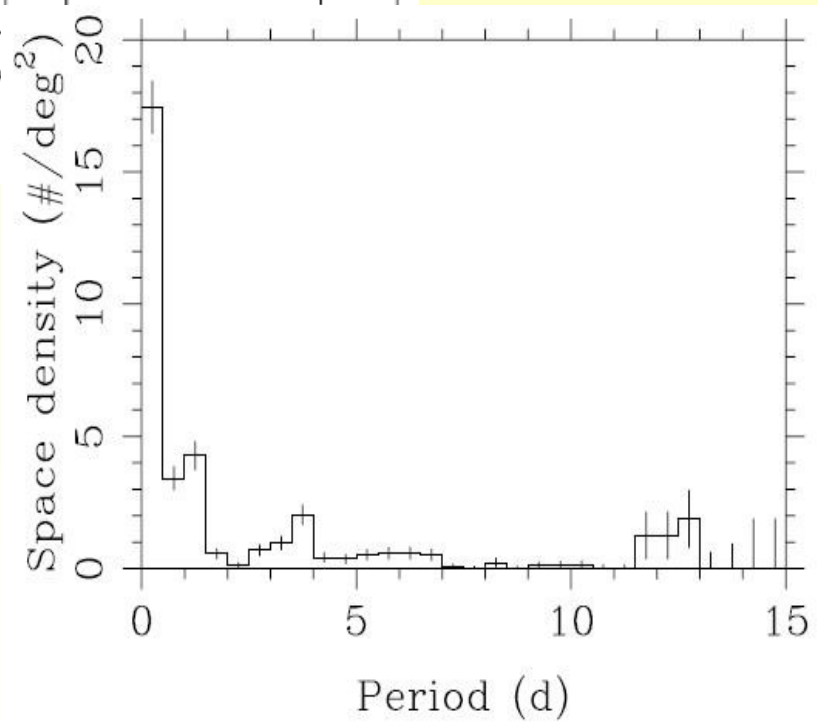
- Total area: 21 square degrees down to V=23
- Variability in V, colours in B, I
- Cadence: ~15 observations over a 1 week timeslot
  : yearly re-observations

Conclusions:

- At least 25 observations per object to get (sinusoidal) periods accurately
- ~ 2-3% of all point sources are variable (all colours)
- 46% of variables is 'above' the main-sequence
- 50% of variables have periods < 6 hrs.
- Be consistent in observing sequence...

Results from the FSVS





Morales-Rueda et al., 2006
2007

OmegaWhite precursor: RATS

RATS: RApid Temporal Survey

(Ramsay & Hakala, 2005& 2007)

* Similar set-up as OmegaWhite: 2hr observations, rapid sequence
* INT Wide Field Camera observations, V_{lim} = 22.5, white light
* Initially: 3 square degrees (= 2hr in OmegaWhite)
* Independent datareduction pipeline and analysis

Plan:

* To download and rereduce the complete RATS survey with Astro-wise.
* Compare with original data reduction by Pasi Hakala.
* First task, first year PhD project Kars Verbeek.

OmegaWhite precursor: RATS

Results from RATS

- In 3 sq. degr: 4 variable with P< 1 hr.
- Mostly non-radially pulsating stars.
- 46 variables with P>1 hr or significant variations

Extrapolated to OmegaWhite: (400 sq.degr @ b=4-5)

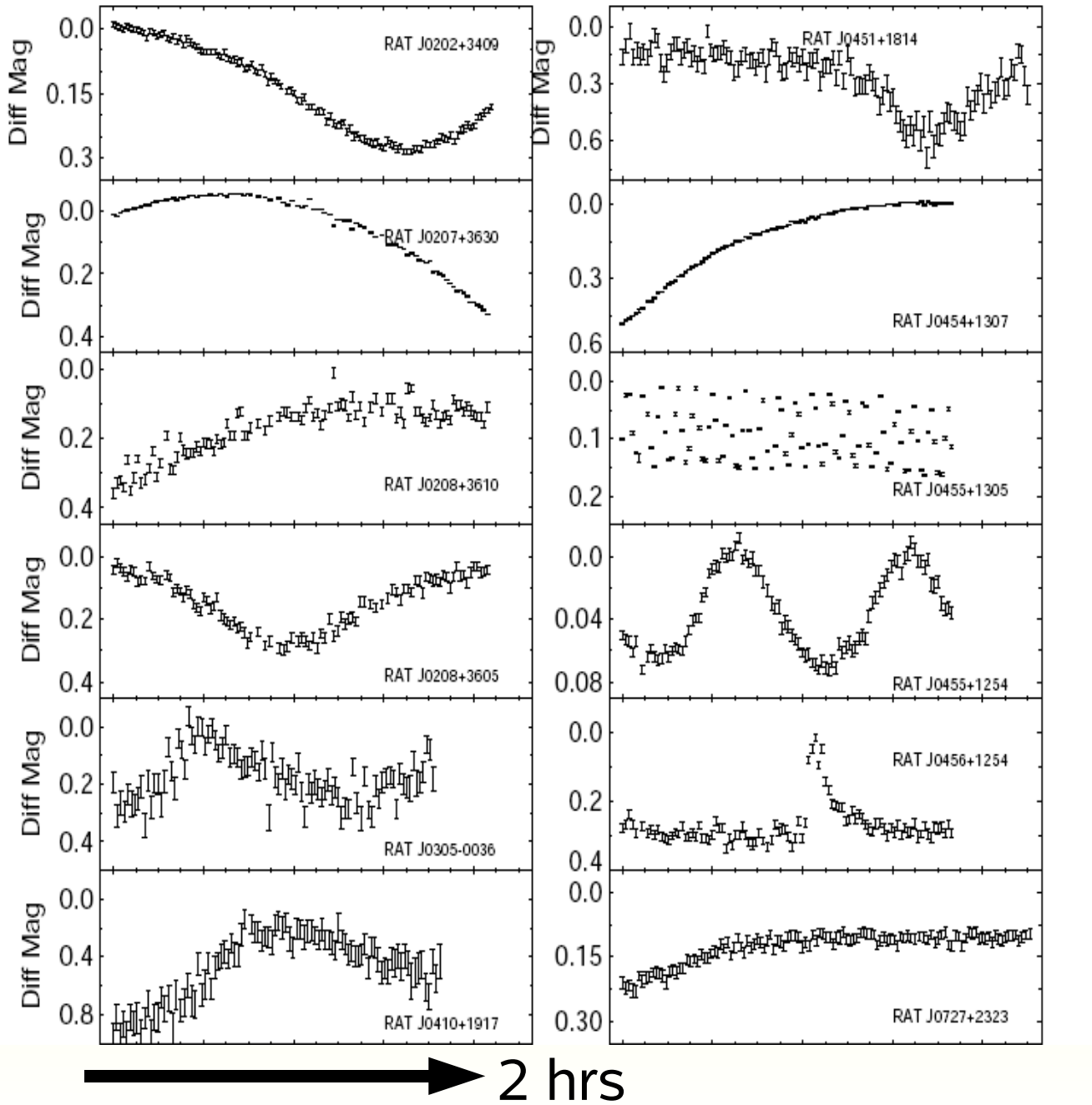
(~200 000 stars/sq.degr)

- 2400 variables with P<1hr
- 36000 variables with significant variations.

Finally some statistics!

OmegaWhite precursor: RATS

Some Examples



Open questions, tbi

- Optimal sampling over 2 hours
- Can telescope software handle 'offsets' of ~ 1 degree
- OBs with 2hrs maximum?
- Accuracy of tracking mode of VST or overhead for setting up guide stars?
- Technique used for lightcurves: will be checked with RATS survey

Nijmegen Hardware contribution

Computer cluster: 60 nodes Linux cluster
Astro-Wise (being) installed

Hardware: 10 Tbyte storage currently available,
will be increased to 30 Tb at least.