THE HUNT FOR ECLIPSING POST COMMON ENVELOPE BINARIES

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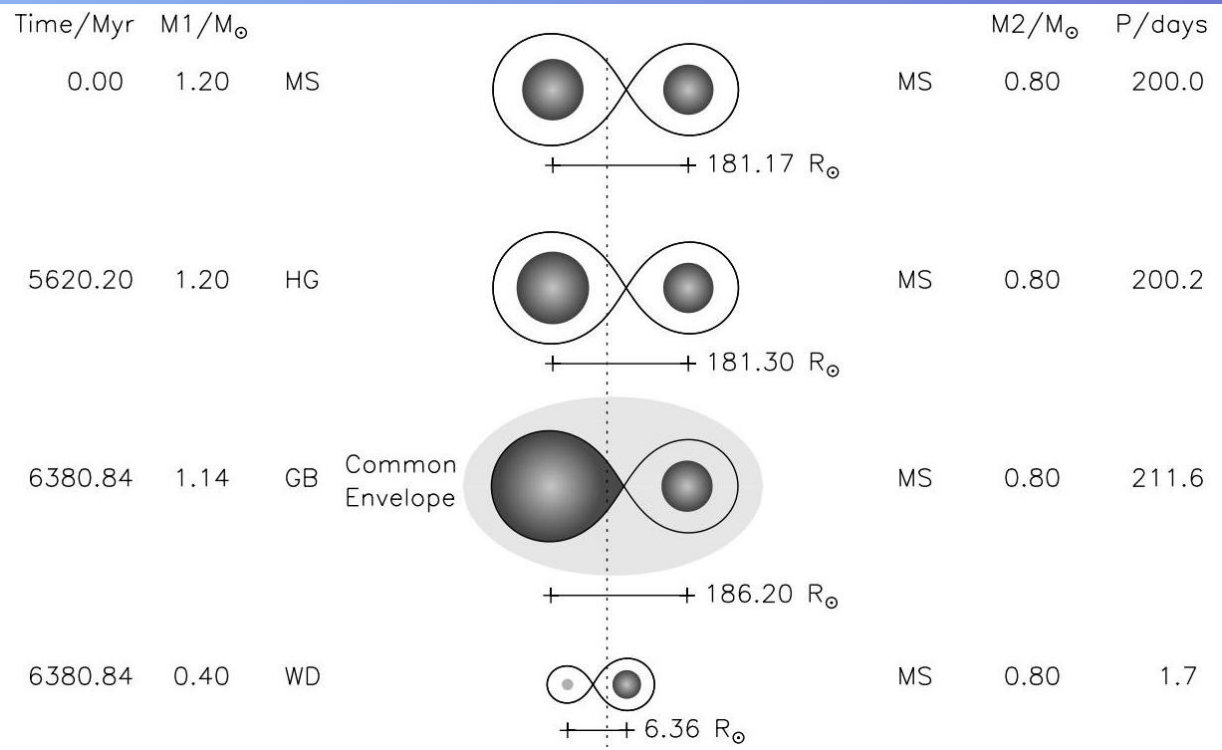
Fellow hunters:

B.Gänsicke, T.Marsh, S.Parsons, P.Rodríguez-Gil, M.Schreiber, A.Rebassa-Mansergas, M.Zorotovich, A.Schwope, A.Nebot Gomez-Moran, D.Koester

Post Common Envelope Binaries



Willems & Kolb, 2004, A&A, 419, 1057

- CE-phase: low-mass WD & short P_{orb}
- CE-phase poorly understood
- e-PCEBs → precise, model independent Masses and Radii
- Testing of CE predictions & M-R relations of WDs and MS stars

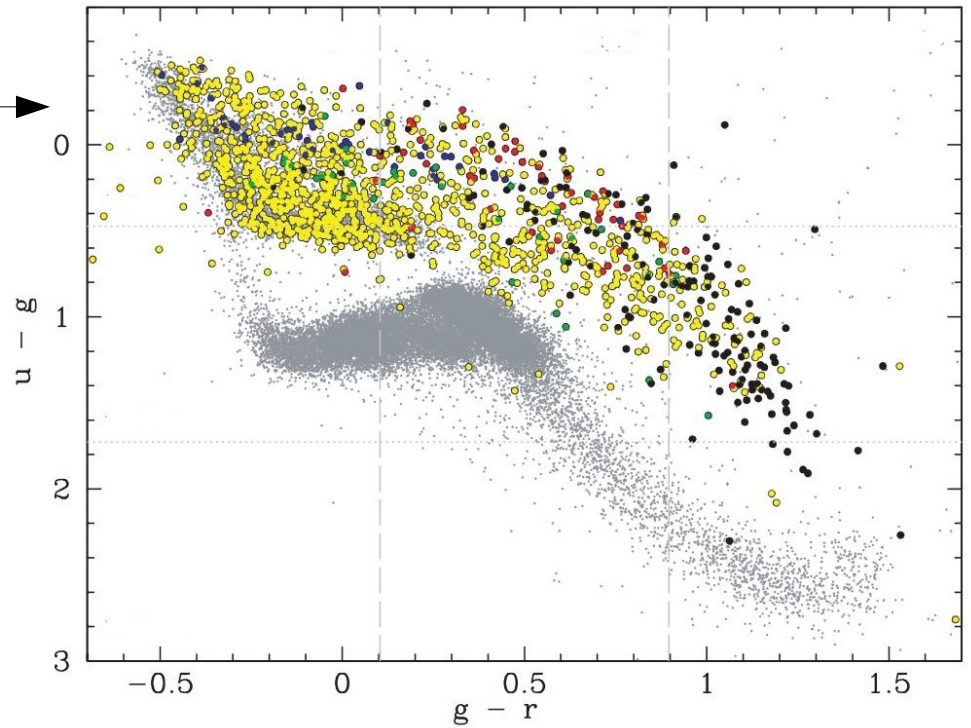
Post Common Envelope Binaries from the SDSS

- Until recently: PCEBs ~30, 7 e-PCEBs - biased sample (Schreiber & Gänsicke, 2003, A&A, 406, 305)

- SDSS = Numbers + wide range
- WD+MS: DR6 ~1600

  DR7 >2000
- New PCEBs >100

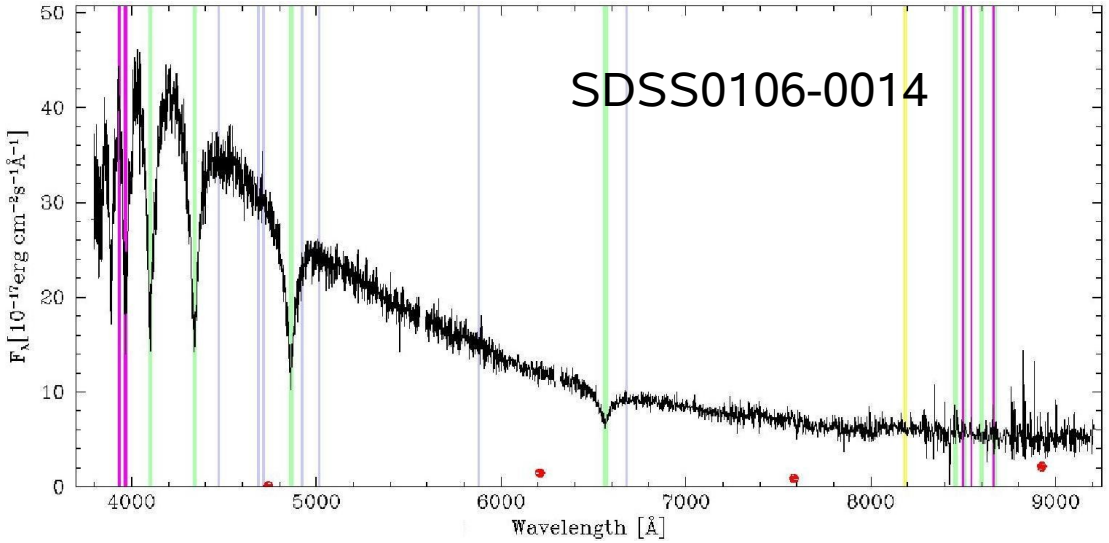
- Follow-up spectroscopy: P_{orb} & RVs
- Hunt for e-PCEBs



Coloured points: WD+MS binaries
Various colours: various component flavours

For the details: Rebassa-Mansergas et al., 2007, MNRAS, 382, 1377
Rebassa-Mansergas et al., 2010, MNRAS, 402, 620

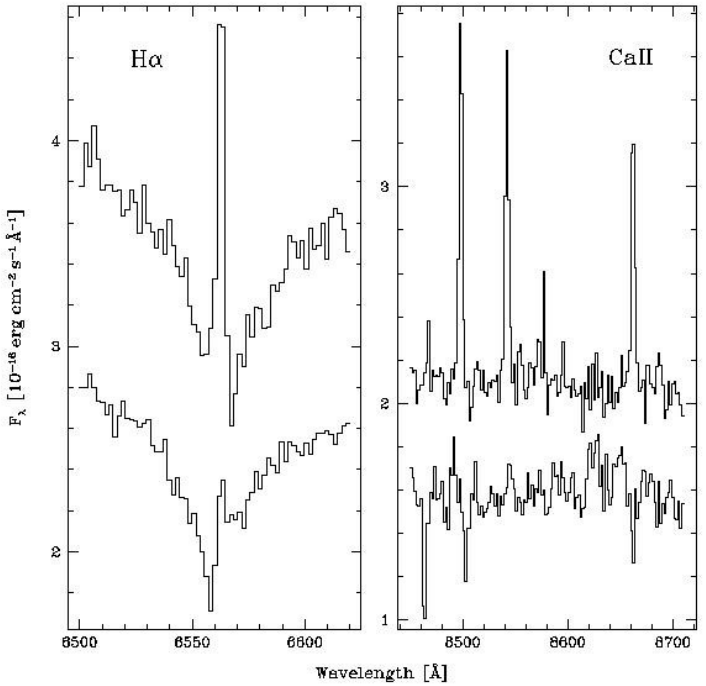
Finding e-PCEBs – Part I: SDSS-based



- Differences in SDSS phot. & spect. fluxes
- Differences in multiple SDSS photometry

Kleinmann et al., 2004, ApJ, 607, 426
Pyrzas et al., in prep.

SDSS0110+1326



- Varying EW of emission lines in multiple SDSS spectroscopy

Pyrzas et al., 2009, MNRAS, 394, 978

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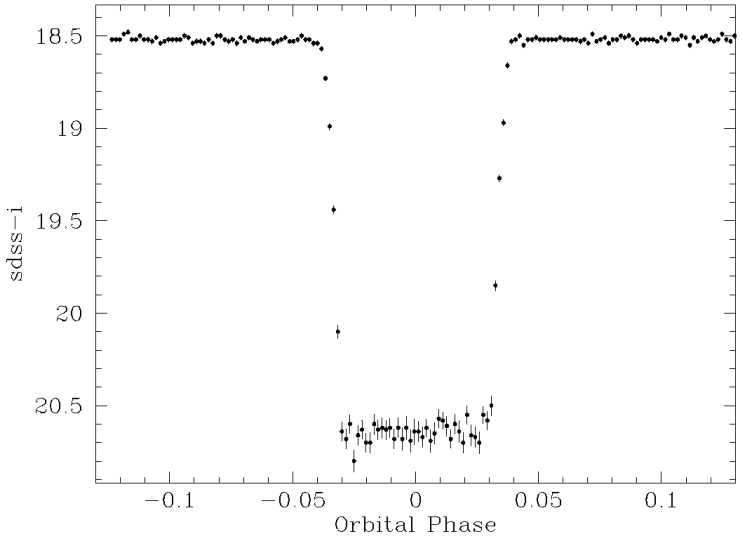

SDSS0106-0014

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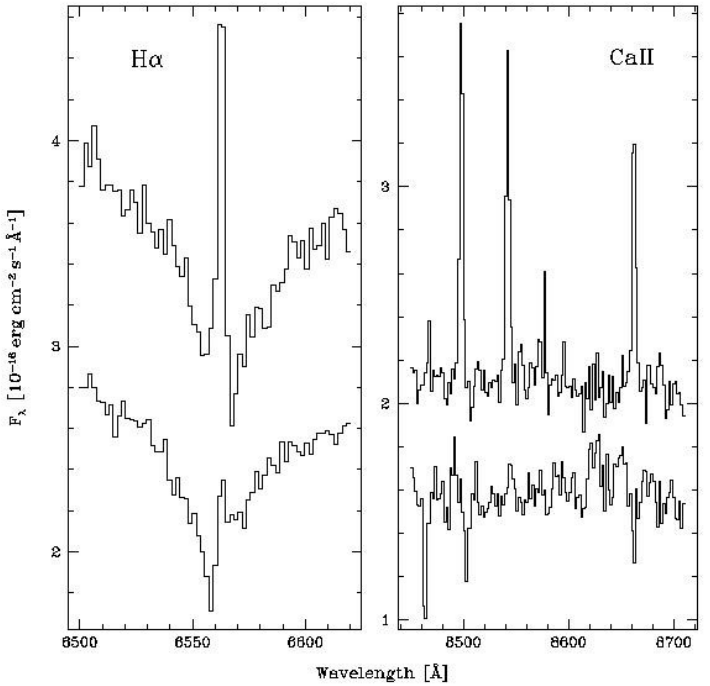

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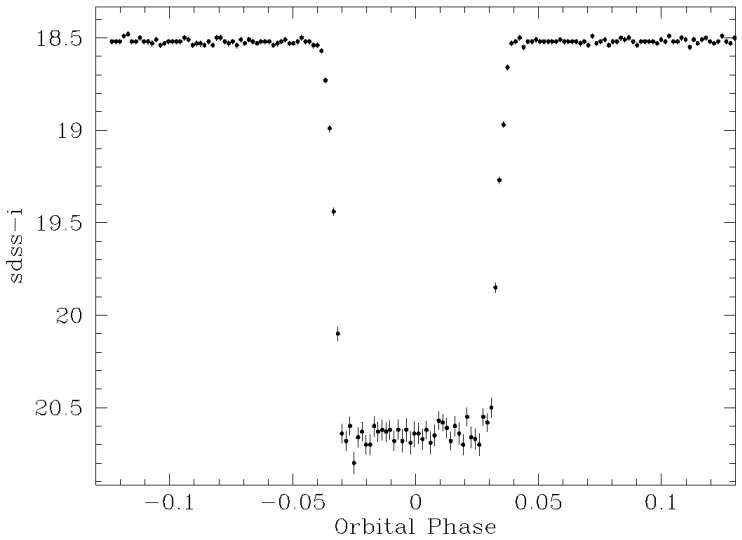

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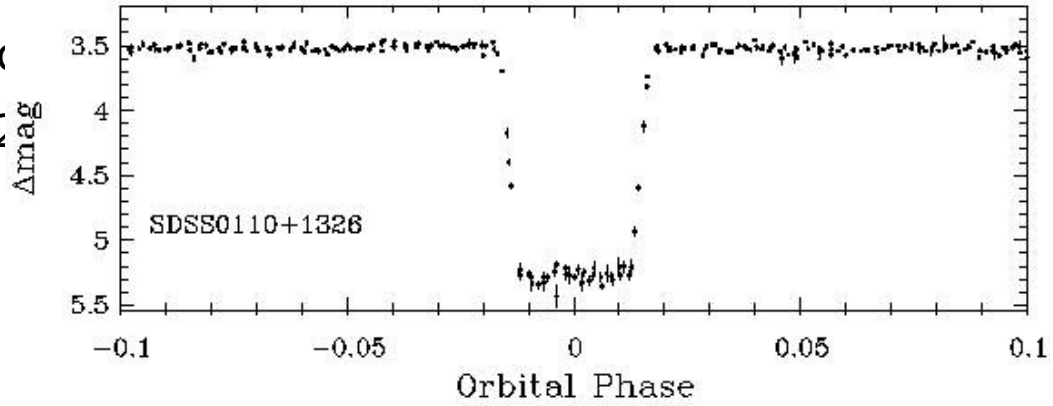

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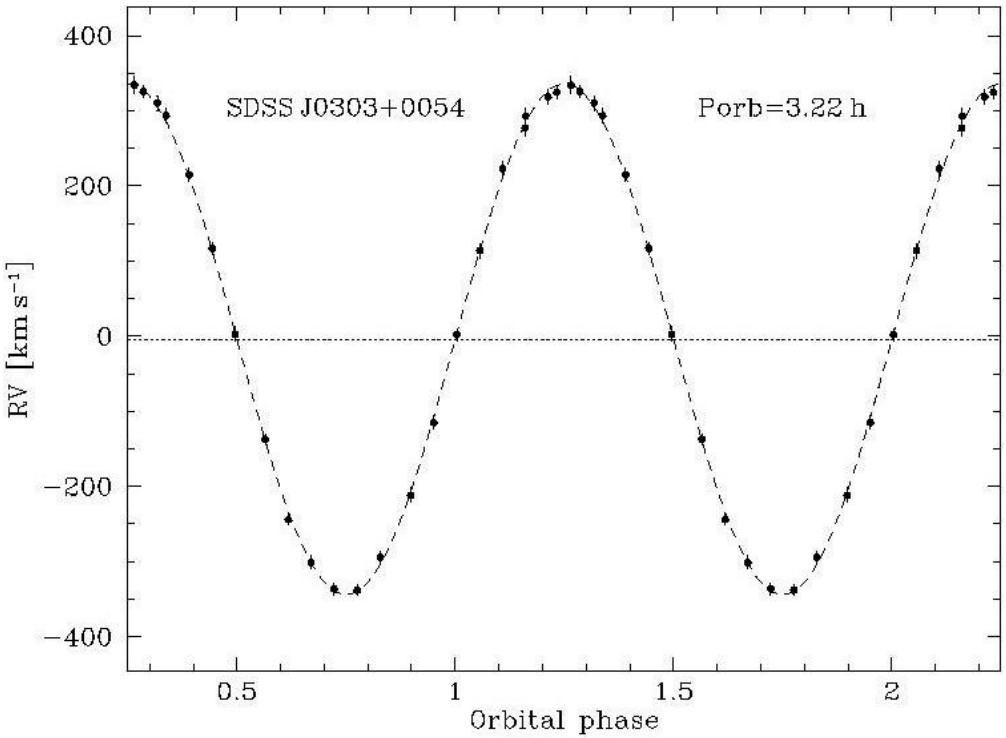
Finding e-PCEBs – Part II: follow-up



Large radial velocity variation/amplitude
Pyrzas et al.,2009,MNRAS,394,978

The mass function re-written:

$$\sin i = \left[\frac{P_{\rm orb} K_{\rm sec}^3}{2\pi G} \frac{(M_{\rm WD} + M_{\rm sec})^2}{M_{\rm WD}^3} \right]^{1/3}$$

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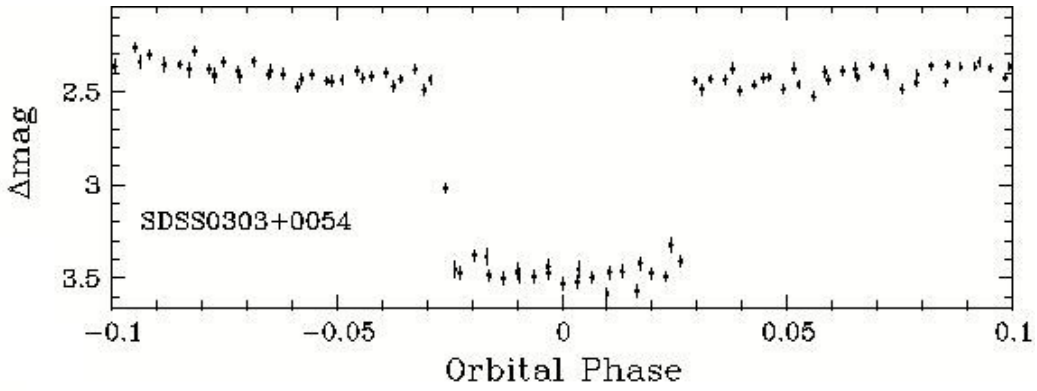

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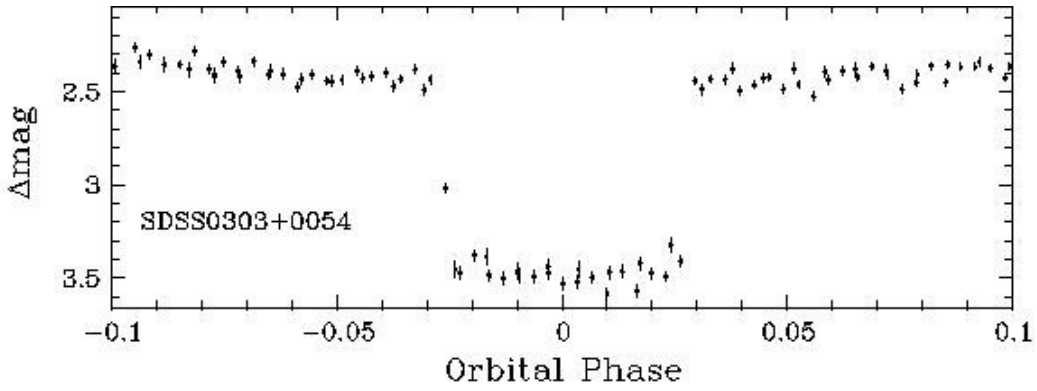

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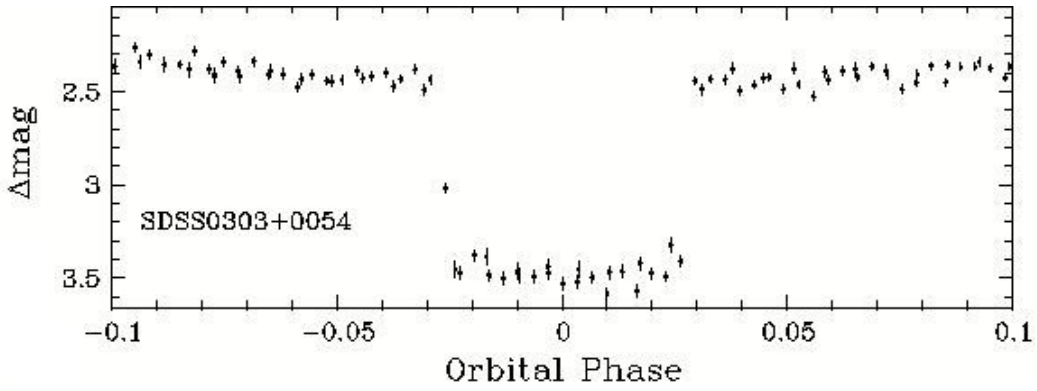

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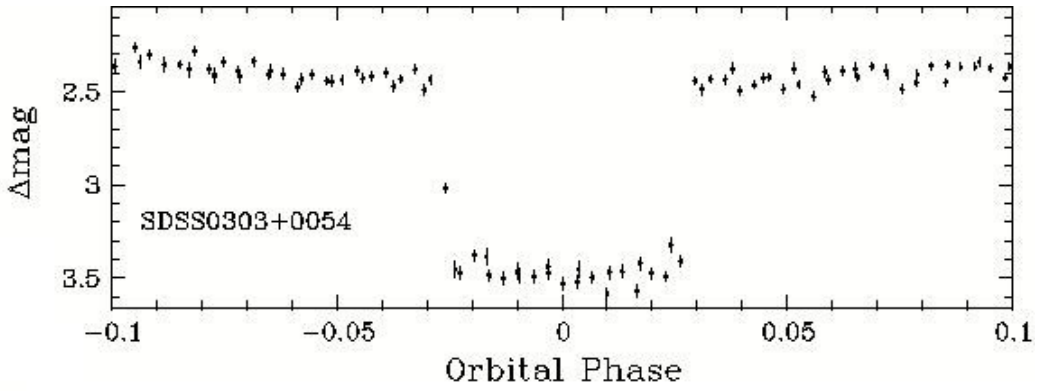

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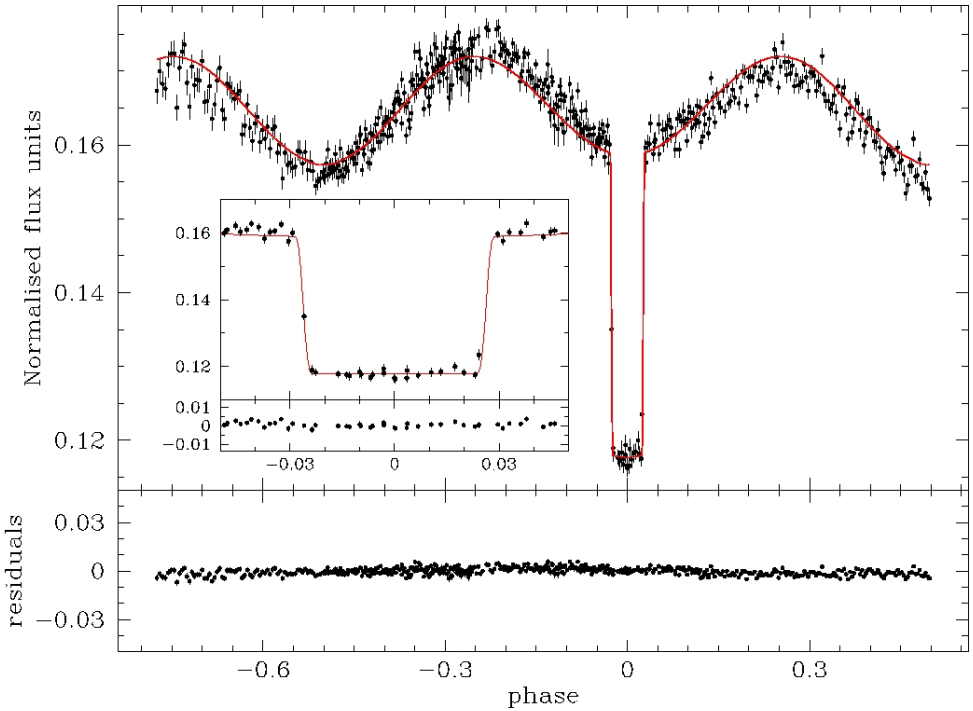
from SDSS spectra

from follow-up

The only unknown

Large radial velocity variation/amplitude
Pyrzas et al.,2009,MNRAS,394,978

Measuring M and R – A first approach



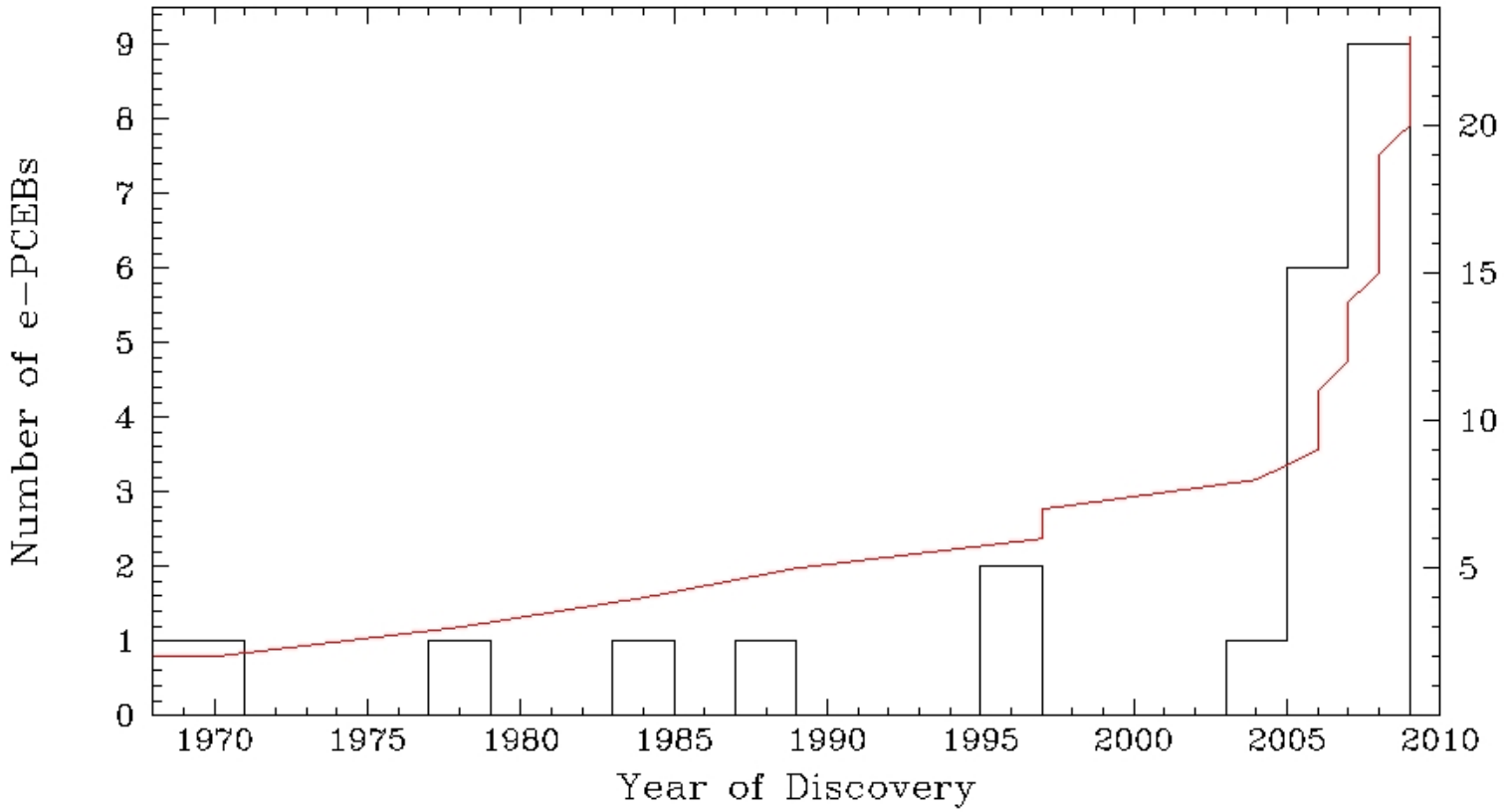
Example: SDSS0303-0054
Pyrzas et al., 2009, MNRAS, 394, 978

Basic dataset
- WD eclipse
- Secondary's RV

Light curve fitting: q, i, R_{WD}/α, R_{sec}/α

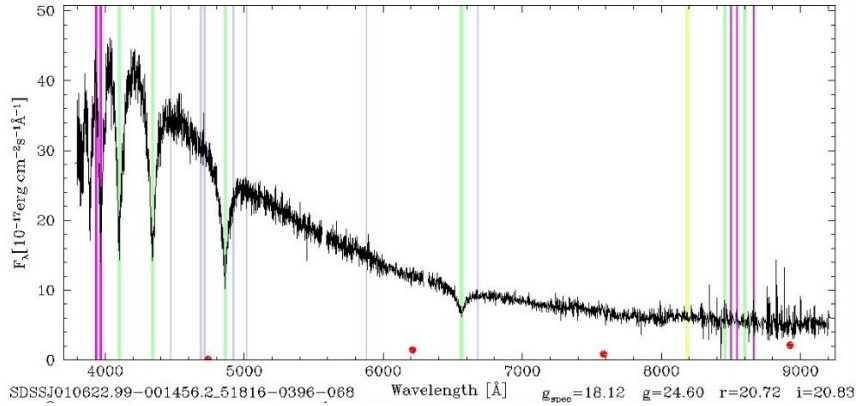
- Degeneracy between parameters
- Not enough constraints!
- Still need M-R relations
- Accuracy: 10%-20%
- Talk from Steven Parsons...

Results – Part I: Increasing the numbers



- New e-PCEBs: 16
- Candidate e-PCEBs: 12
- Stripe 82: 4 in 250 deg^2 ⟶ ~ 100 in SDSS legacy footprint

Results – Part II: All flavours



SDSS0106-0014

DA / M8 & M ~ 0.35 / 0.1 M_{Sun}

Kleinmann et al., 2004, ApJ, 607, 426
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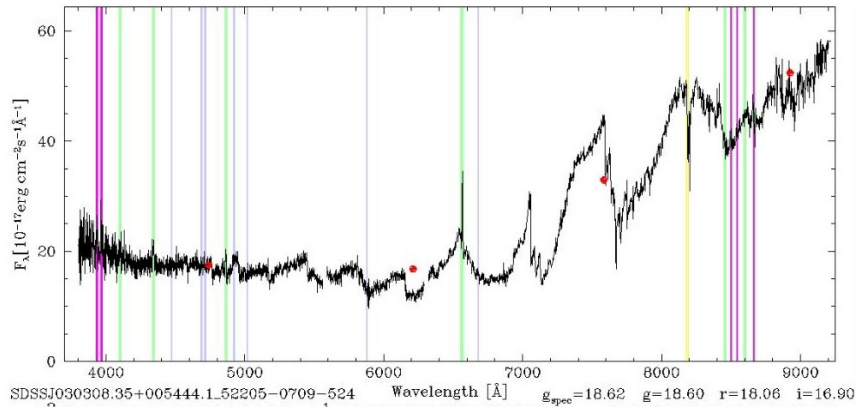

SDSS0303+0054

DC / M4 & M ~ 0.9 / 0.25 M_{sun}

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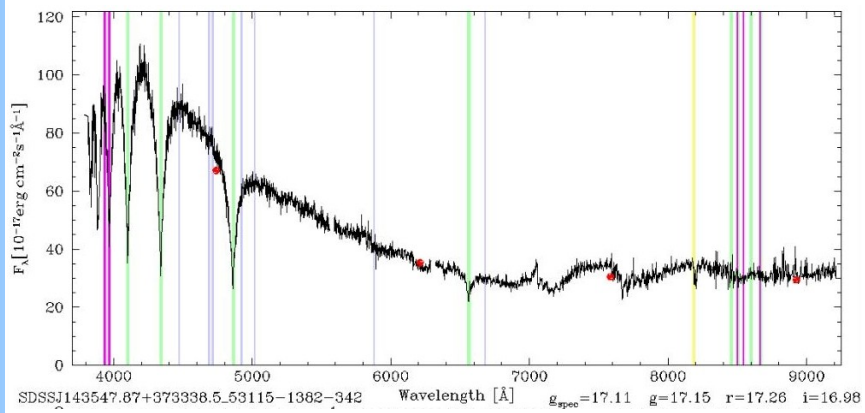
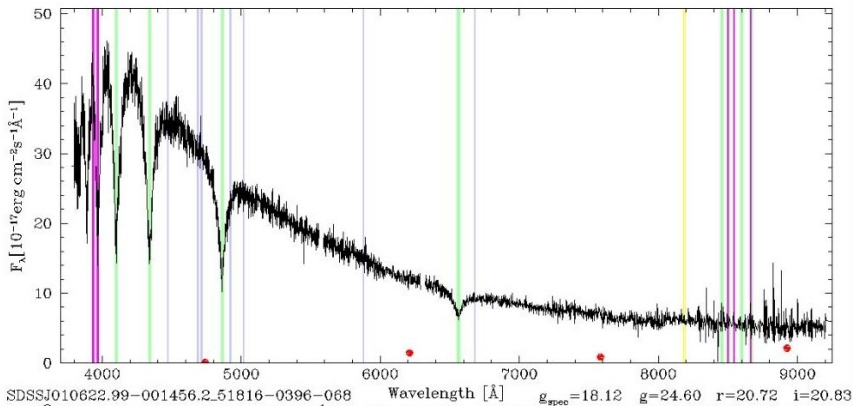


SDSS1435+3733

DA / M5 & M ~ 0.5 / 0.22 M_{Sun}

Steinfadt et al., 2008, ApJ, 677, 113
Pyrzas et al., 2009, MNRAS, 394, 978

Results – Part II: All flavours



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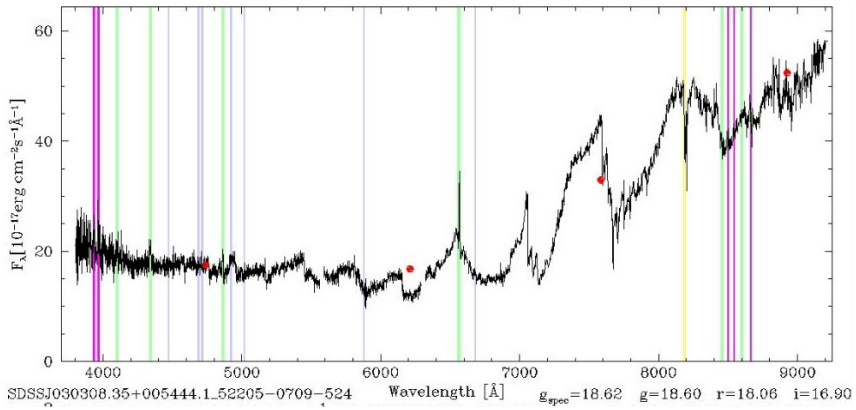

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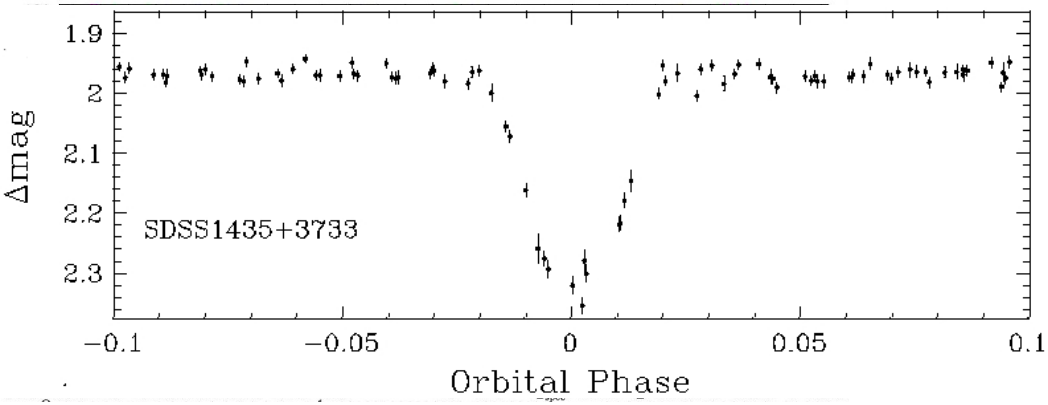
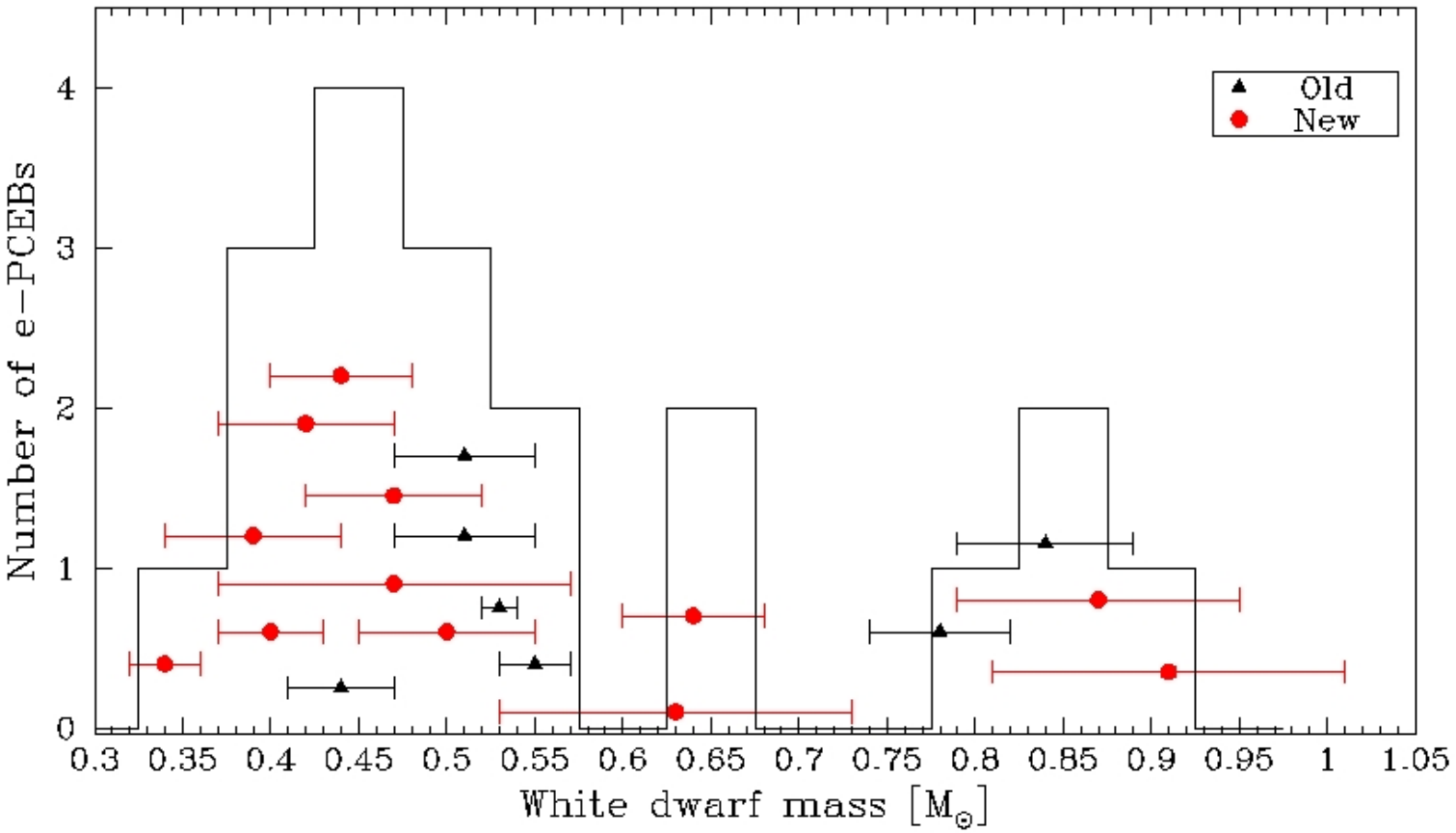


435+3733

& M ~ 0.5 / 0.22 M_{Sun}

lt et al., 2008, ApJ, 677, 113
s et al., 2009, MNRAS, 394, 978

Results – Part III: WD mass distribution



- Most SDSS-discovered e-PCEBS have $M_{WD} \leq 0.5\ M_{SUN}$
- SDSS samples a wide range of WD masses

Conclusions

- Eclipsing Post Common Envelope Binaries deserve more attention!
- Masses and Radii of WDs over a wide range of masses – low-mass as well!
- (Very) low-mass MS stars (untested region in M-R relations)
- Large scale surveys can dramatically improve this field
- From 7 to 23 (and counting...) in 4 years
- Still small number statistics and large error-bars

References

- e-PCEBs-related publications: Kleinmann et al., 2004, ApJ, 607, 426

  Steinfadt et al., 2008, ApJ, 677, 113

  Drake et al., 2009, ApJ, 696, 870

  Nebot Gomez-Moran et al, 2009, A&A, 495, 561

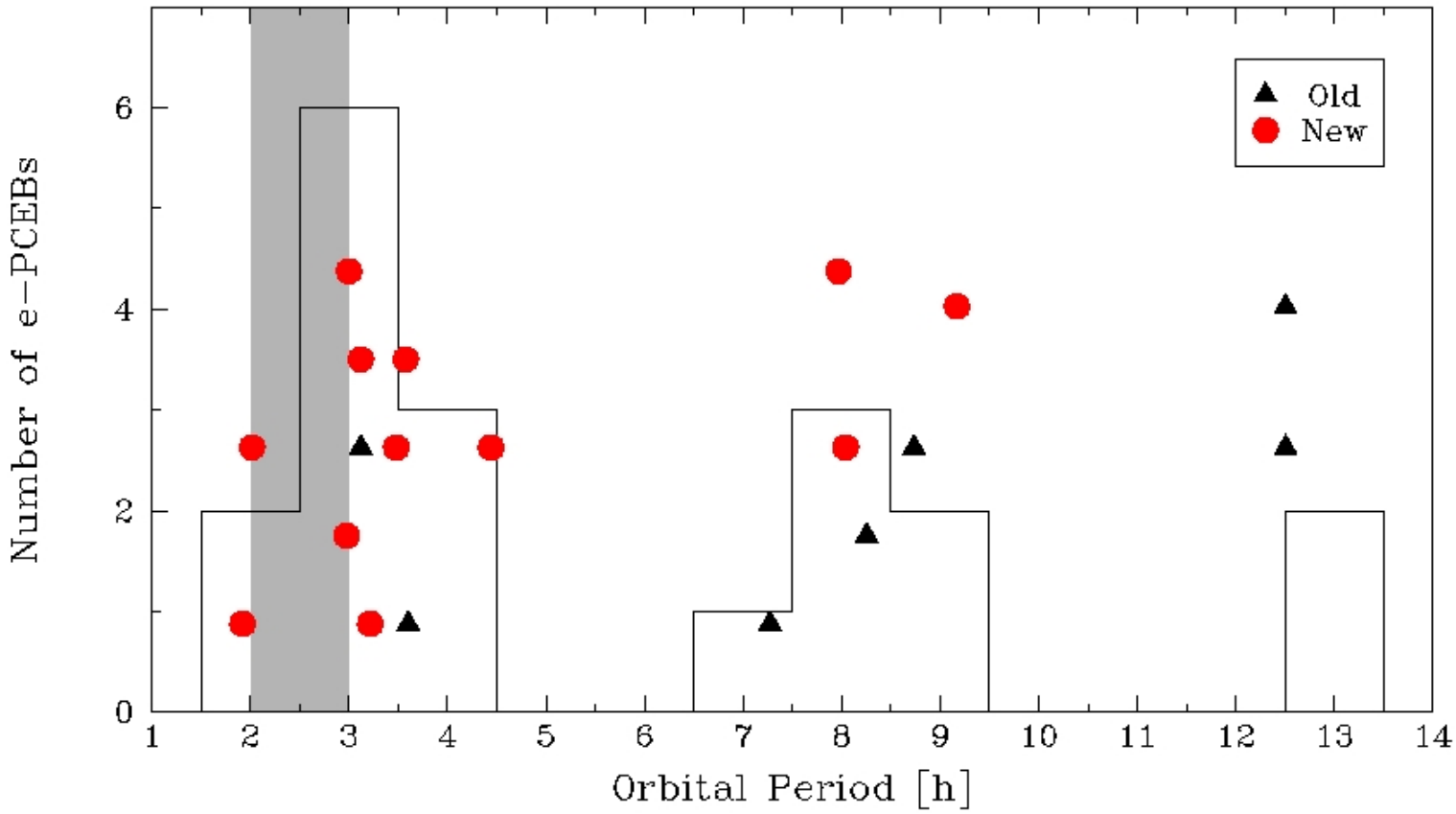
  Pyrzas et al., 2009, MNRAS, 394, 978

- Other Publications from our work with SDSS:

Papers called: "Post-Common-Envelope Binaries from SDSS - "

followed by a Roman number – currently I to X

Results – Orbital period distribution



- Most SDSS-discovered e-PCEBS are around the (CV) Gap