THE HUNT FOR ECLIPSING
POST COMMON ENVELOPE BINARIES

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Post Common Envelope Binaries

- CE-phase: low-mass WD & short $P_{\text{orb}}$
- CE-phase poorly understood
- e-PCEBs $\rightarrow$ 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


- SDSS = Numbers + wide range
- WD+MS: DR6 ~1600
  DR7 >2000
- New PCEBs >100

- Follow-up spectroscopy: \( P_{\text{orb}} \) & RVs
- Hunt for e-PCEBs

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

Finding e-PCEBs – Part I: SDSS-based

- Differences in SDSS phot. & spect. fluxes
- Differences in multiple SDSS photometry
  Pyrzas et al., in prep.

- Varying EW of emission lines in multiple SDSS spectroscopy
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Finding e-PCEBs – Part II: follow-up

The mass function re-written:

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

Large radial velocity variation/amplitude
Finding e-PCEBs – Part II: follow-up

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from follow-up
Finding e-PCEBs – Part II: follow-up

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\[
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\]

from SDSS spectra
from follow-up

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

from SDSS spectra

from follow-up

The only unknown

Large radial velocity variation/amplitude

Measuring M and R – A first approach

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

Example: SDSS0303-0054

Light curve fitting: q, i, $R_{WD}/\alpha$, $R_{sec}/\alpha$

WD eclipse
Basic dataset
Secondary's RV

Hunting for e-PCEBs – S. Pyrzas, EUROWD10, Tübingen, August 2010
Results – Part I: Increasing the numbers

- New e-PCEBs: 16
- Candidate e-PCEBs: 12
- Stripe 82: 4 in 250 deg\(^2\) \(\rightarrow\) \(\sim\) 100 in SDSS legacy footprint
Results – Part II: All flavours

SDSS0106-0014
DA / M8 & M ~ 0.35 / 0.1 $M_{\odot}$
Pyrzas et al., in prep.

SDSS0303+0054
DC / M4 & M ~ 0.9 / 0.25 $M_{\odot}$

SDSS1435+3733
DA / M5 & M ~ 0.5 / 0.22 $M_{\odot}$
Results – Part II: All flavours

SDSS0106-0014
DA / M8 & M ~ 0.35 / 0.1 M$_{\text{Sun}}$
Pyrzas et al., in prep.

SDSS0303+0054
DC / M4 & M ~ 0.9 / 0.25 M$_{\text{Sun}}$

SDSS1435+3733
DA / M5 & M ~ 0.5 / 0.22 M$_{\text{Sun}}$

435+3733
DA & M ~ 0.5 / 0.22 M$_{\text{Sun}}$
Most SDSS-discovered e-PCEBS have $M_{\text{WD}} \leq 0.5 \, M_{\odot}$

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


• 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