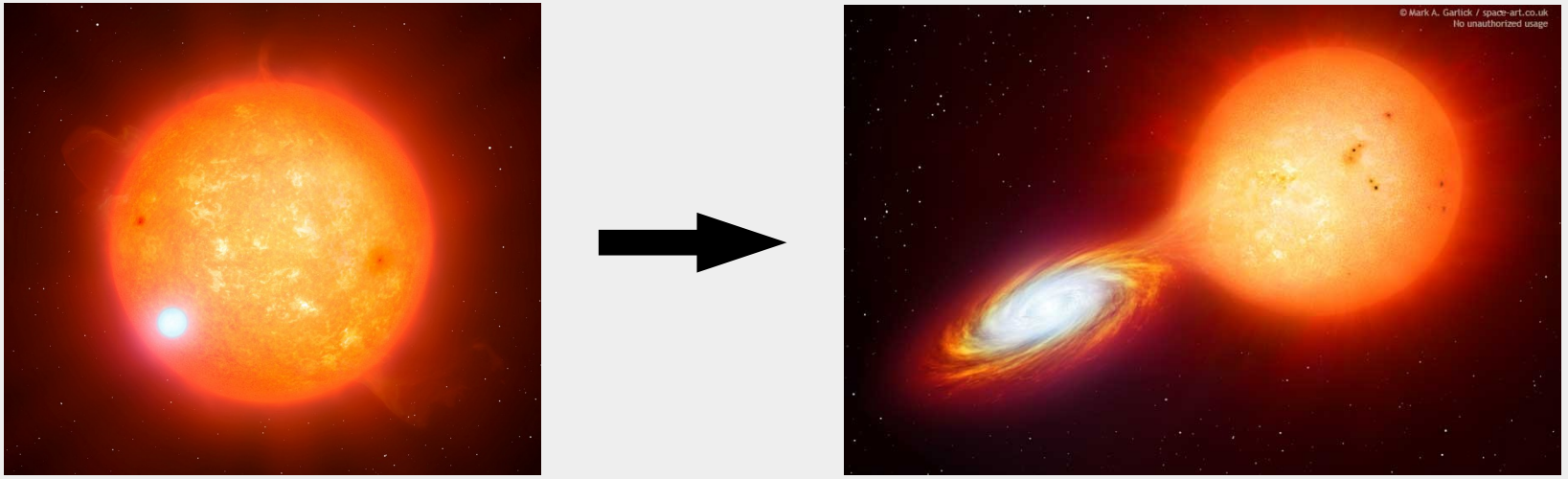
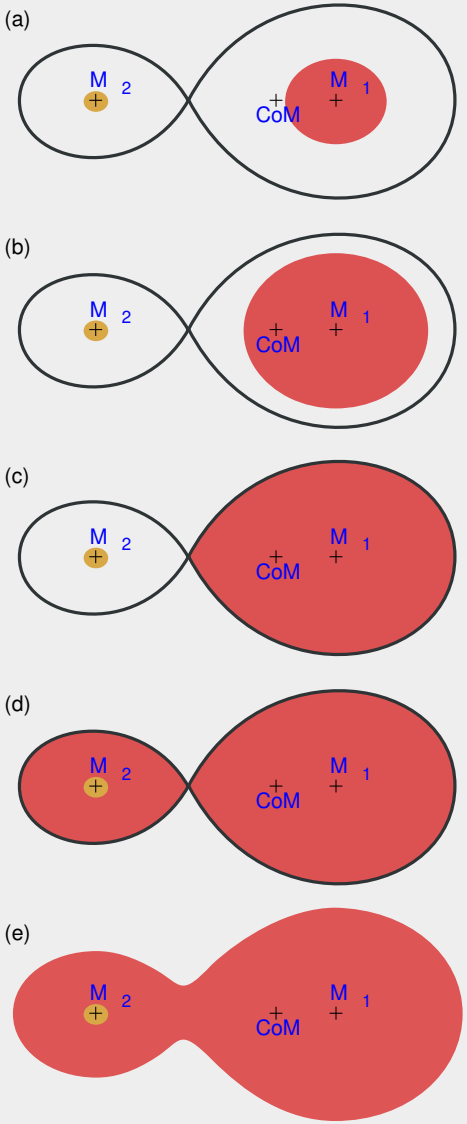
From common envelope to cataclysmic variable:

an overview of white dwarfs in close binaries



Part 1: Detached systems (Dr. Steven Parsons, University of Sheffield)
Part 2: Cataclysmic variables (Dr. Anna Pala, ESO)



Common Envelope Evolution

Original binary has large mass ratio ($M_1/M_2 \gtrsim 3.2$)

Original separation less than a few AU

Evolution of the primary effectively terminated at onset of CE

Orbital energy used to expel the envelope, leading to short period binaries

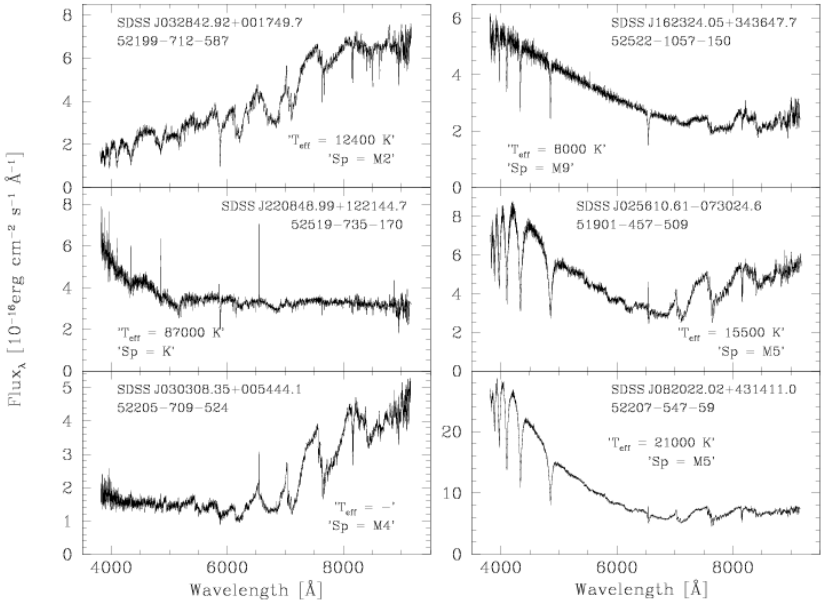
Most common outcome: WD+dM binary

Detached WD+dM binaries

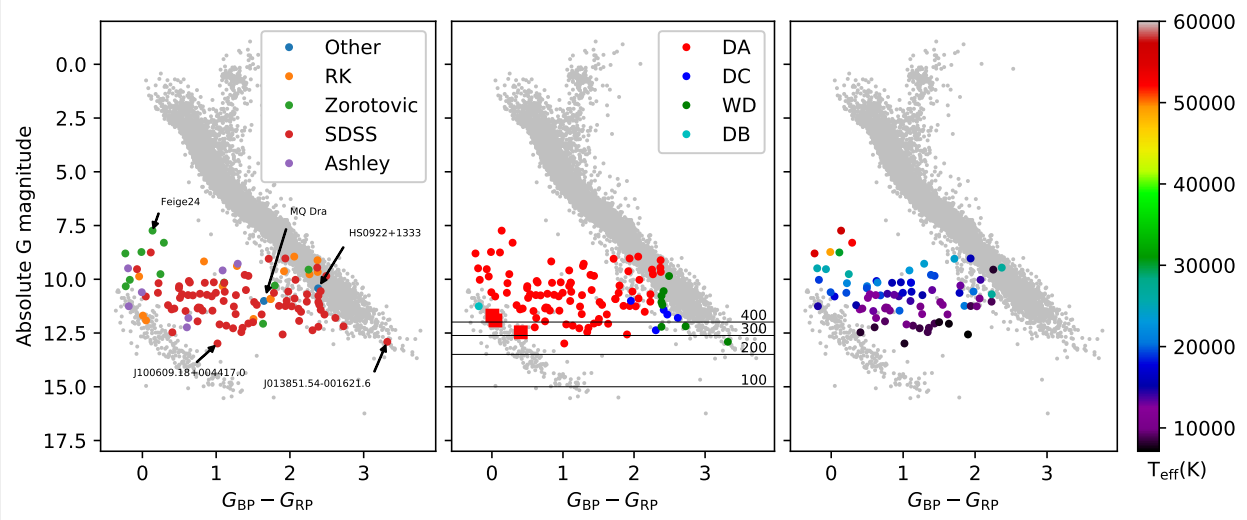
Large number of known systems (>3000, Rebassa-Mansergas et al. 2016)

Easy to analyse (no contamination from accretion, both stars visible at optical wavelengths, often eclipsing)

Excellent population for testing binary evolution models



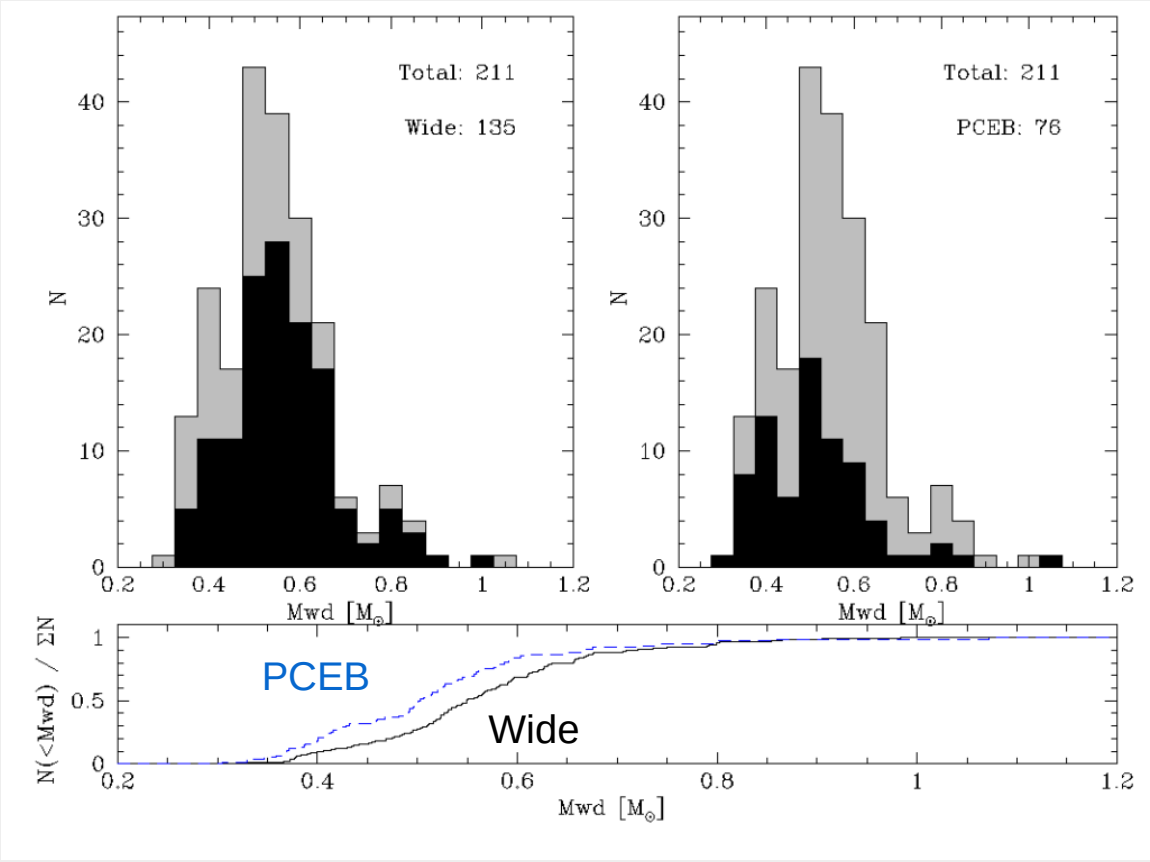
Rebassa-Mansergas et al. 2010



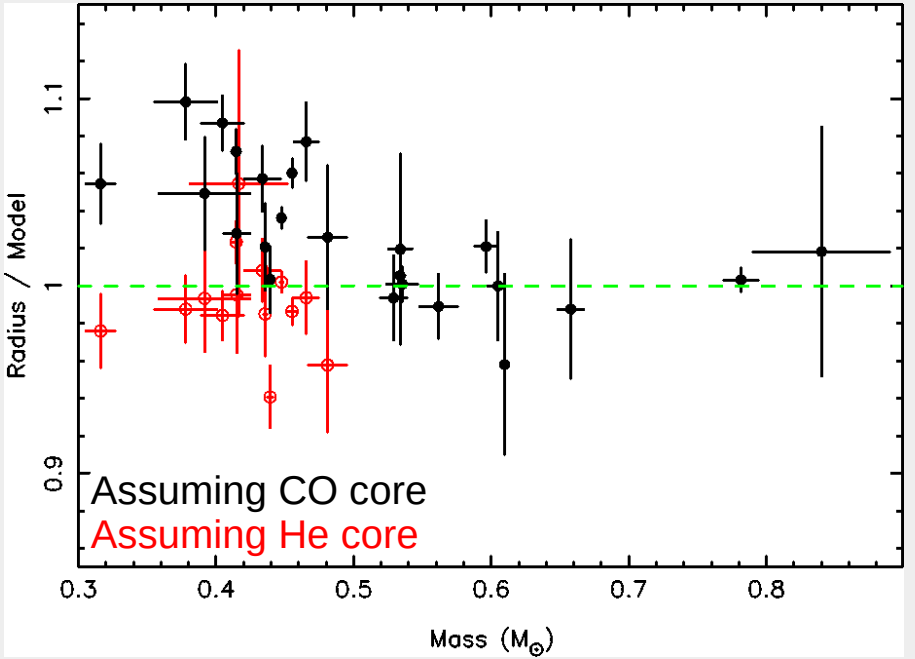
Inight et al. 2021

The results of CE evolution

He-core white dwarfs



Rebassa-Mansergas et al. 2011



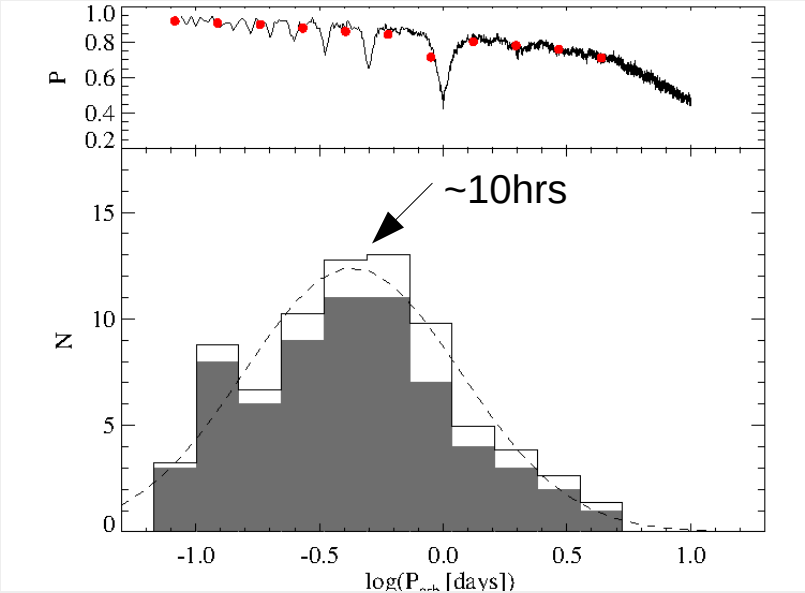
Parsons et al. 2017

The results of CE evolution

An inefficient loss of the envelope

How efficiently orbital energy is converted into kinetic energy of the CE is parametrized as α

Low α > CE inefficiently removed > substantial AM loss > very short periods

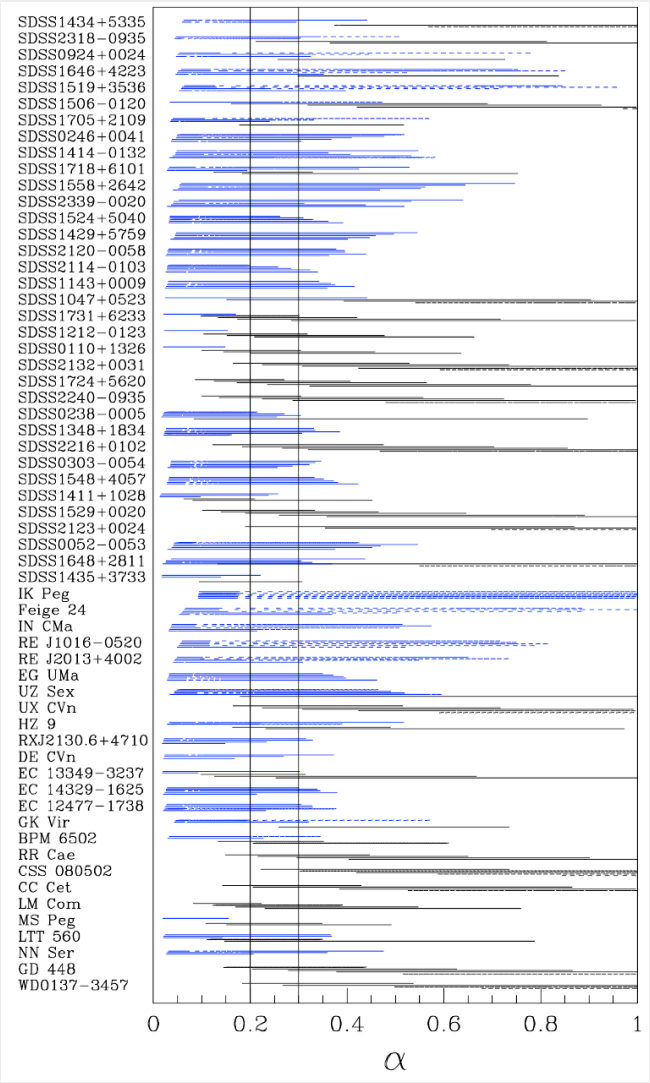


Nebot Gómez-Morán et al. 2011

See also:

Toonen & Nelemans, 2013
Camacho et al. 2014
Zorotovic et al. 2014

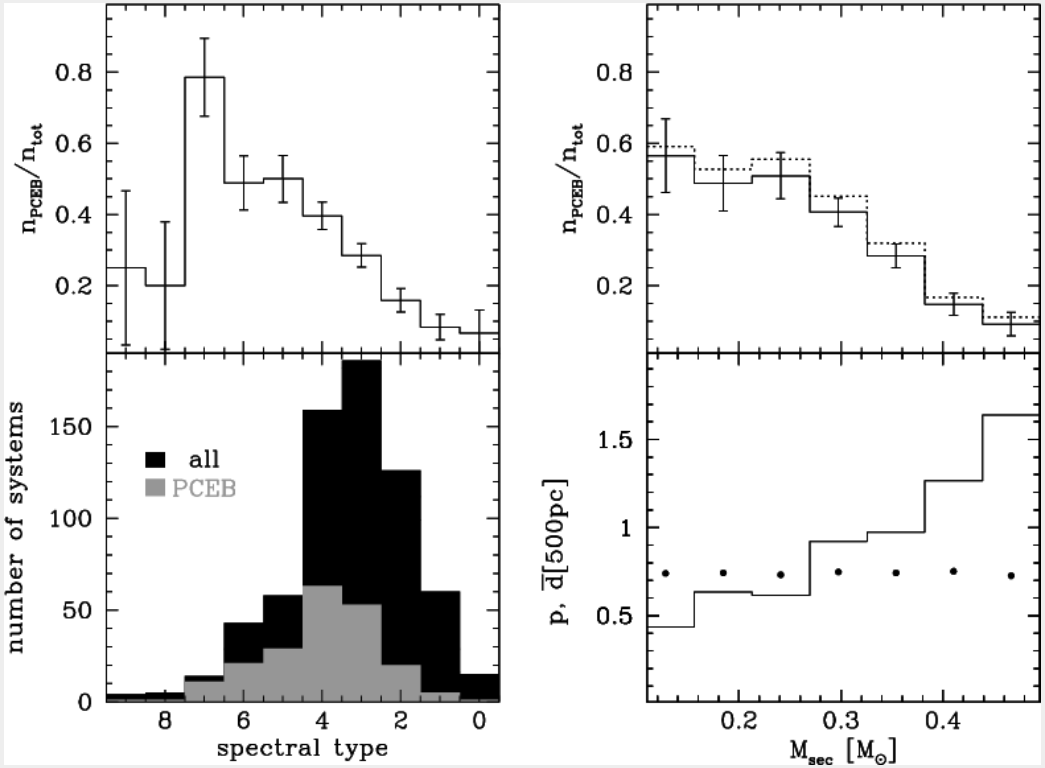
α~0.2-0.3



Zorotovic et al. 2010

The evolution of WD+dM binaries

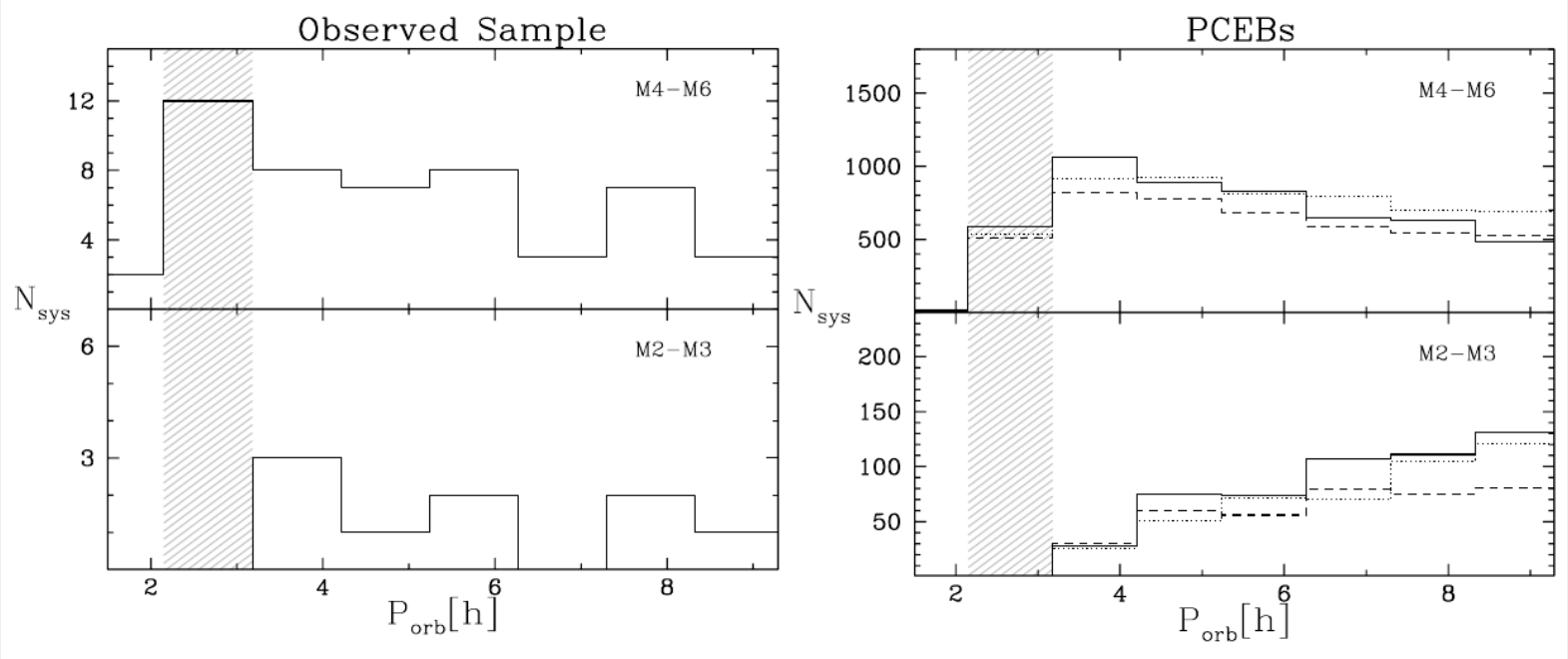
Evidence of disrupted magnetic braking



Schreiber et al. 2010

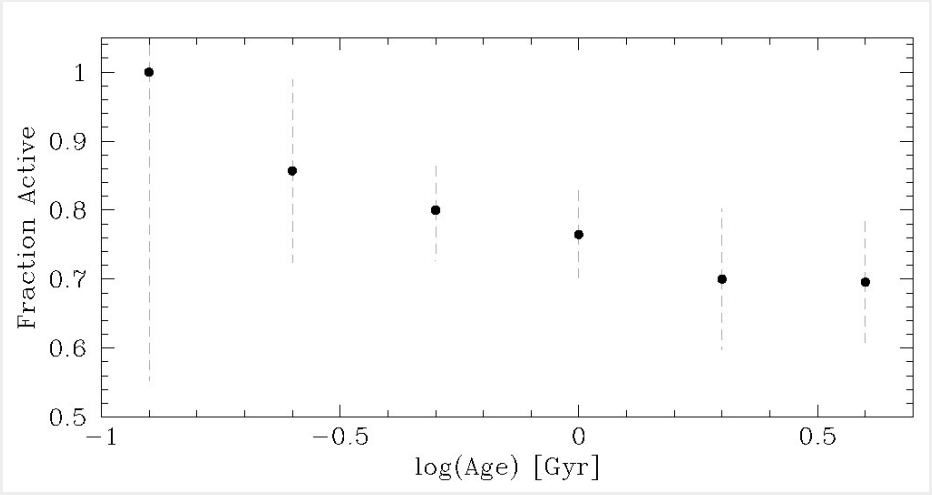
The evolution of WD+dM binaries

Evidence of detached CVs crossing the period gap

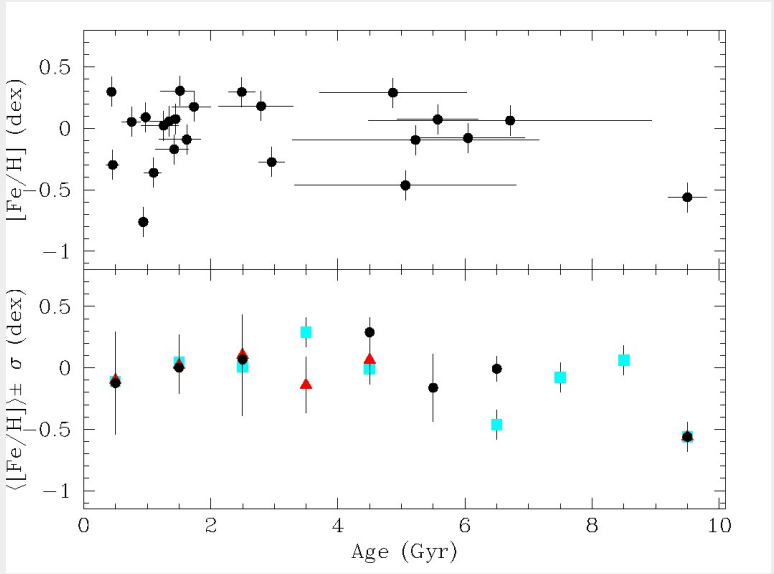


Zorotovic et al. 2016

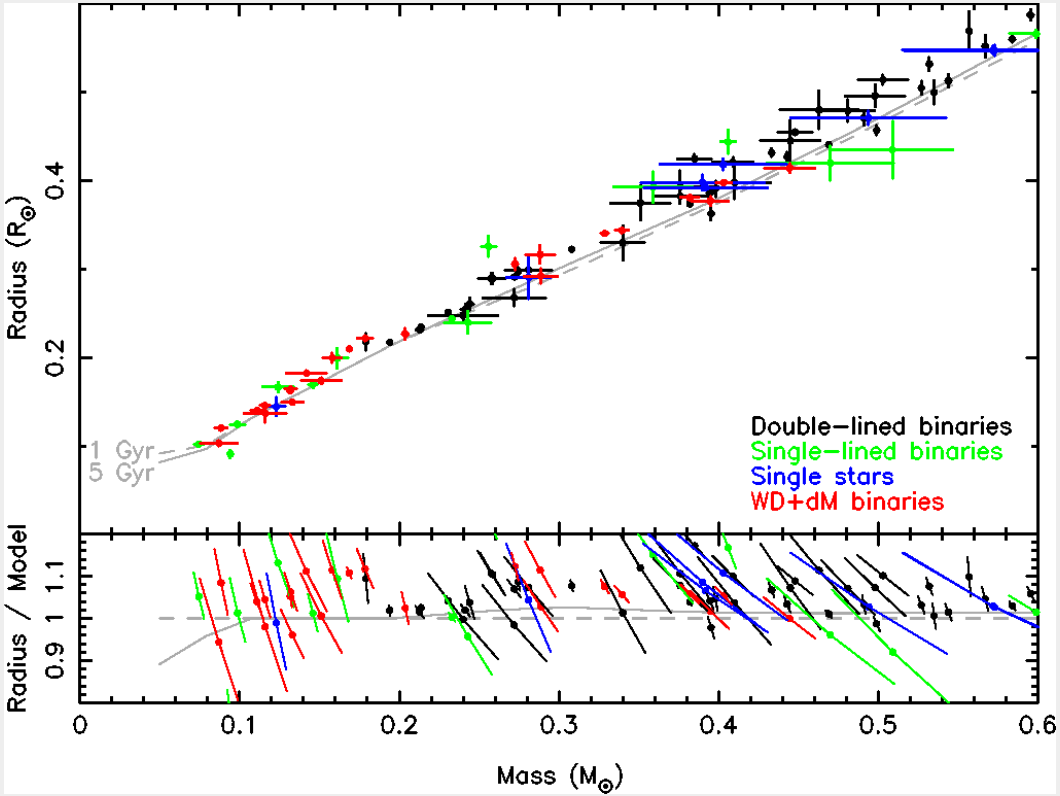
The dM stars



Age-activity relation – Rebassa-Mansergas et al. 2013

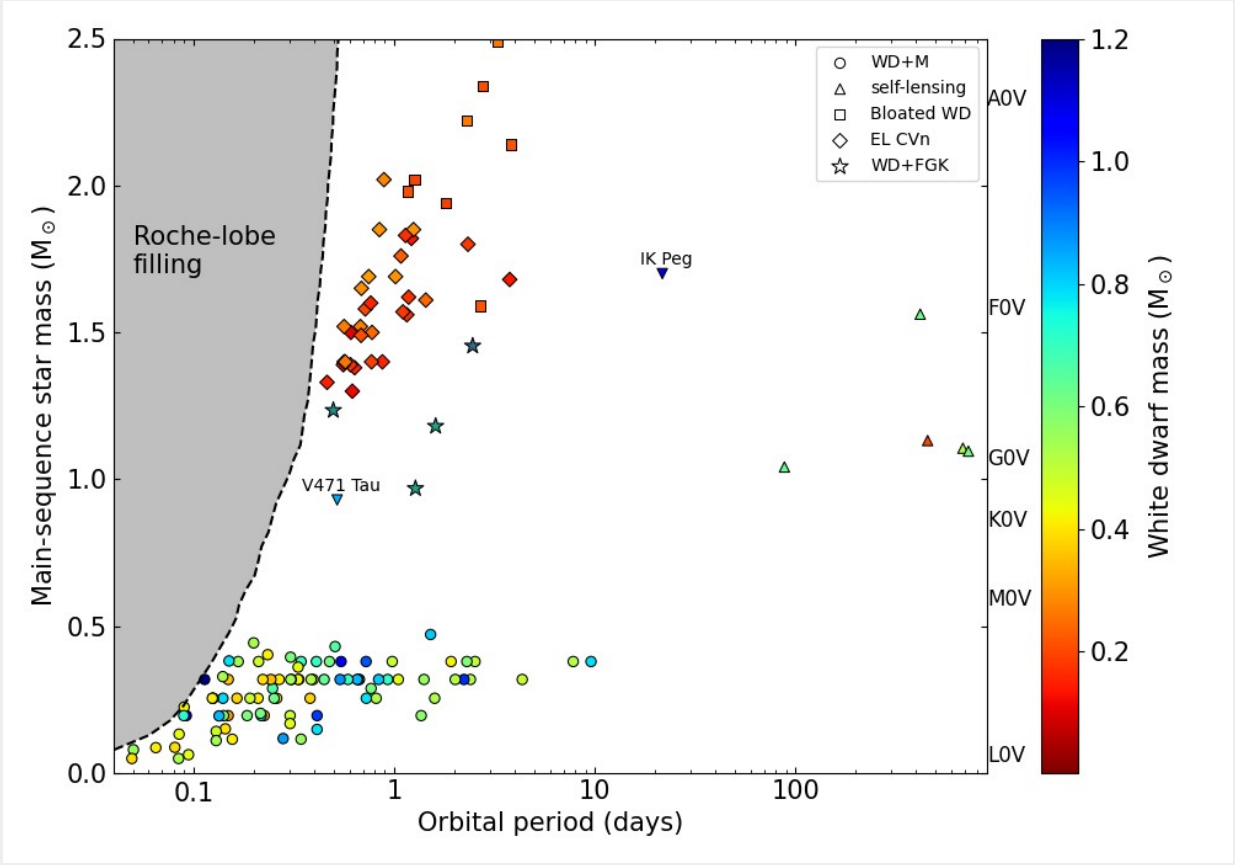


Age-metallicity relation – Rebassa-Mansergas et al. 2016

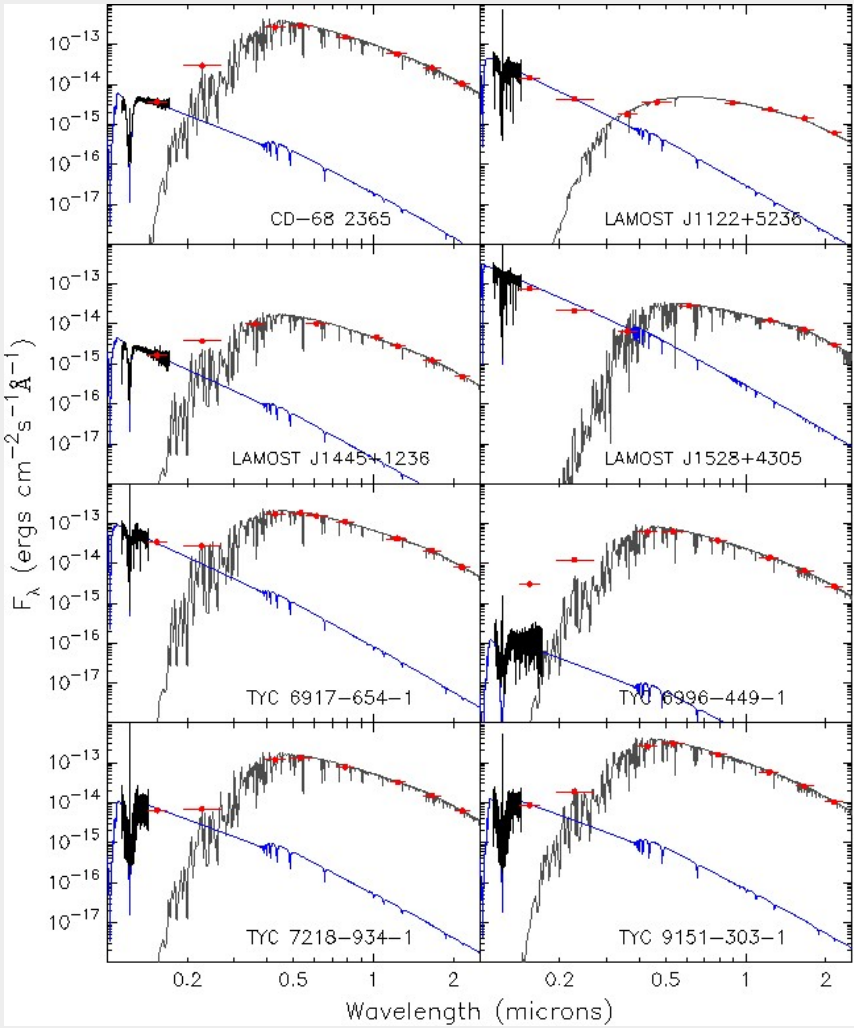


Mass-radius relation – Parsons et al. 2018

Extending to higher masses



Adapted from Hernandez et al. 2021



Parsons et al. 2016

Detached WD+MS binaries are great laboratories

WD+dM catalogues:

Ren et al. 2018, MNRAS, 477, 4641 - *White dwarf-main sequence binaries from LAMOST: the DR5 catalogue*

Rebassa-Mansergas et al. 2016, MNRAS, 458, 3808 - *The SDSS spectroscopic catalogue of white dwarf-main-sequence binaries: new identifications from DR 9-12*

WD+AFGK catalogues:

Ren et al. 2020, ApJ, 905, 38 - *The White Dwarf Binary Pathways Survey. V. The Gaia White Dwarf Plus AFGK Binary Sample and the Identification of 23 Close Binaries*

Rebassa-Mansergas et al. 2017, MNRAS, 472, 4193 - *The white dwarf binary pathways survey - II. Radial velocities of 1453 FGK stars with white dwarf companions from LAMOST DR 4*

Parsons et al. 2016, MNRAS, 463, 2125 - *The white dwarf binary pathways survey - I. A sample of FGK stars with white dwarf companions*