MUNI

Doubly eclipsing systems

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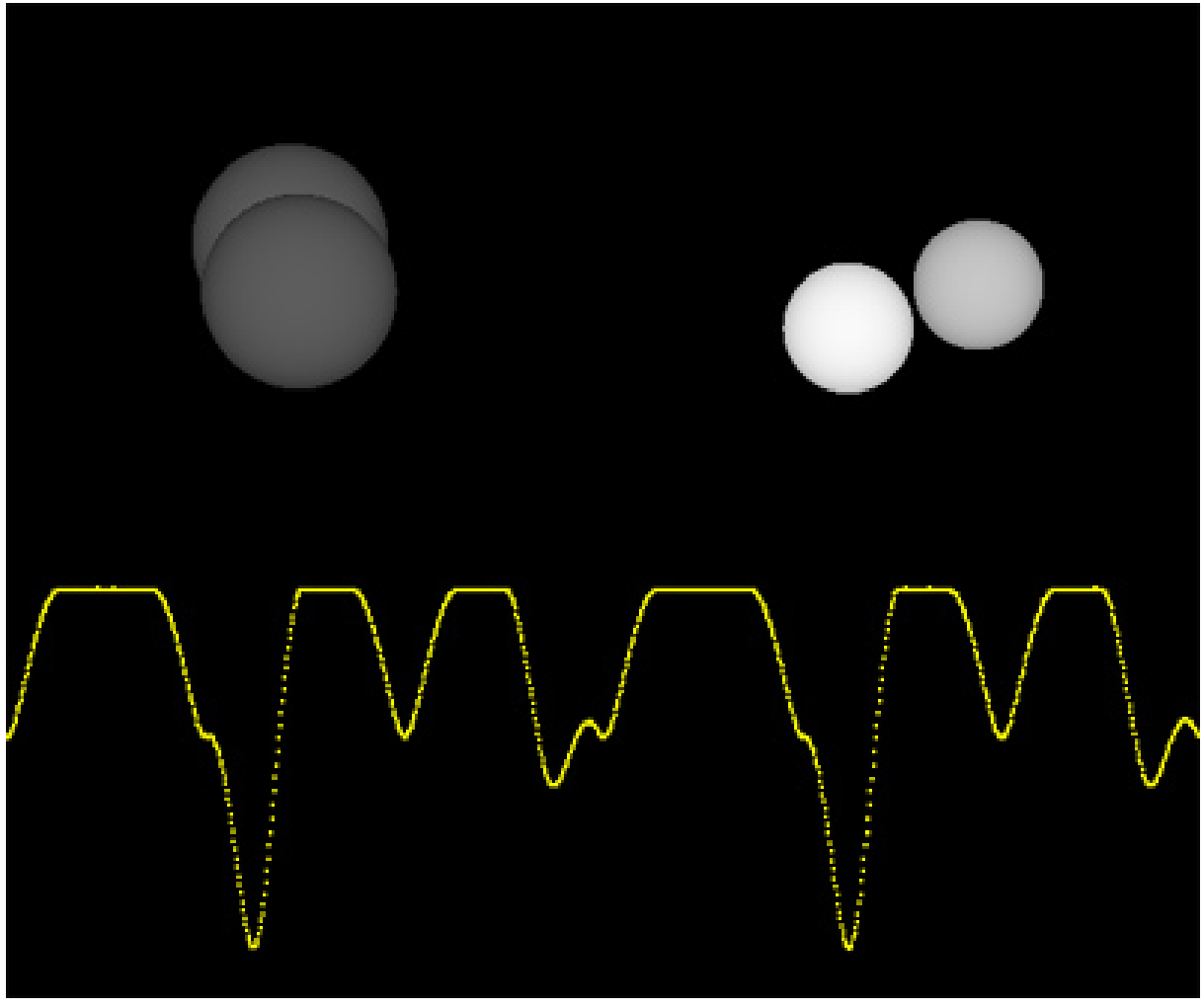
December 2, 2021

Doubly eclipsing stars

- Four stars, $2 + 2$ configuration
- Two eclipsing binary subsystems
- Mutual motion, interaction

Structure

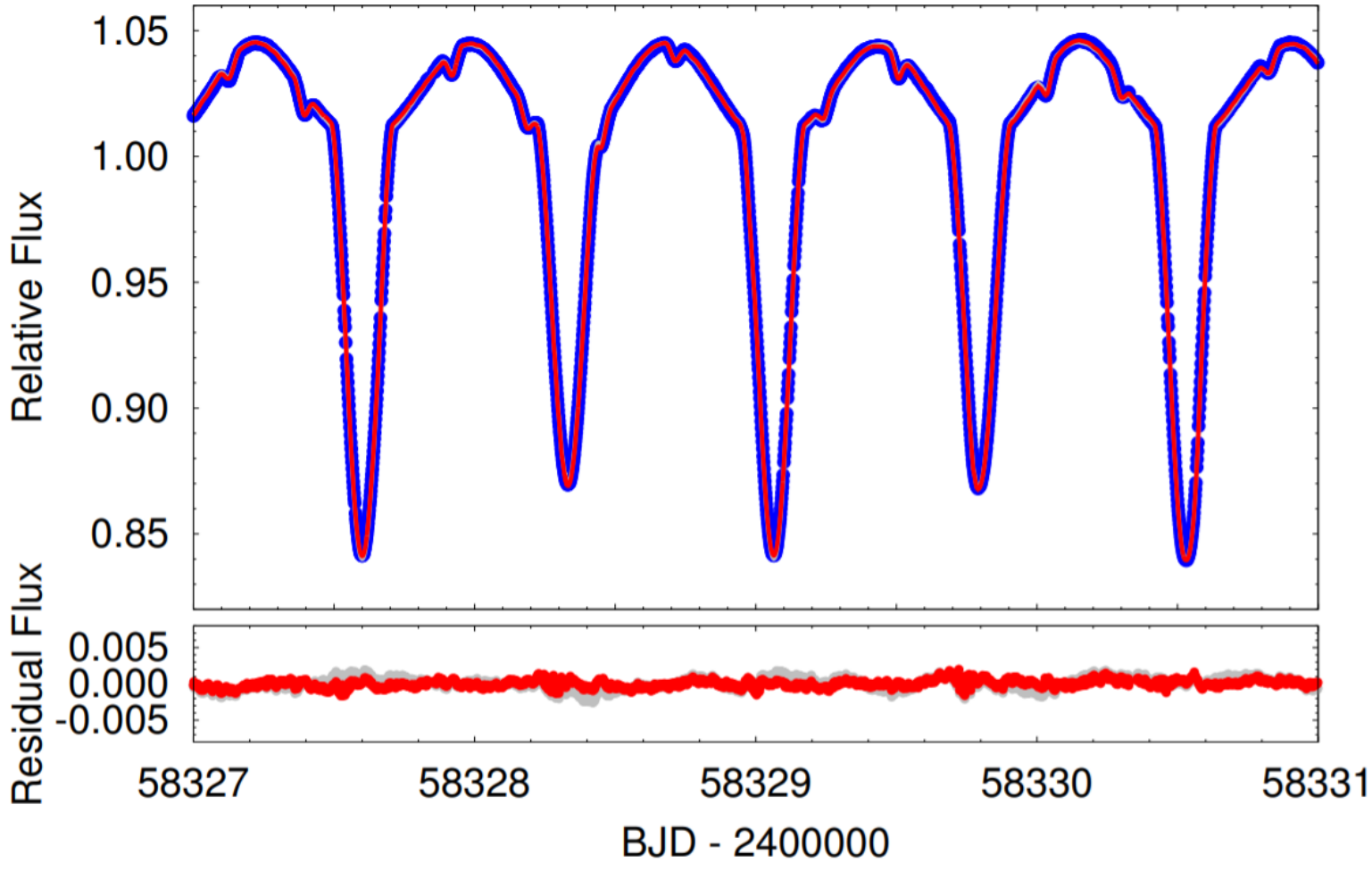


www.gxccd.com/art?id=404&lang=409

Doubly eclipsing stars

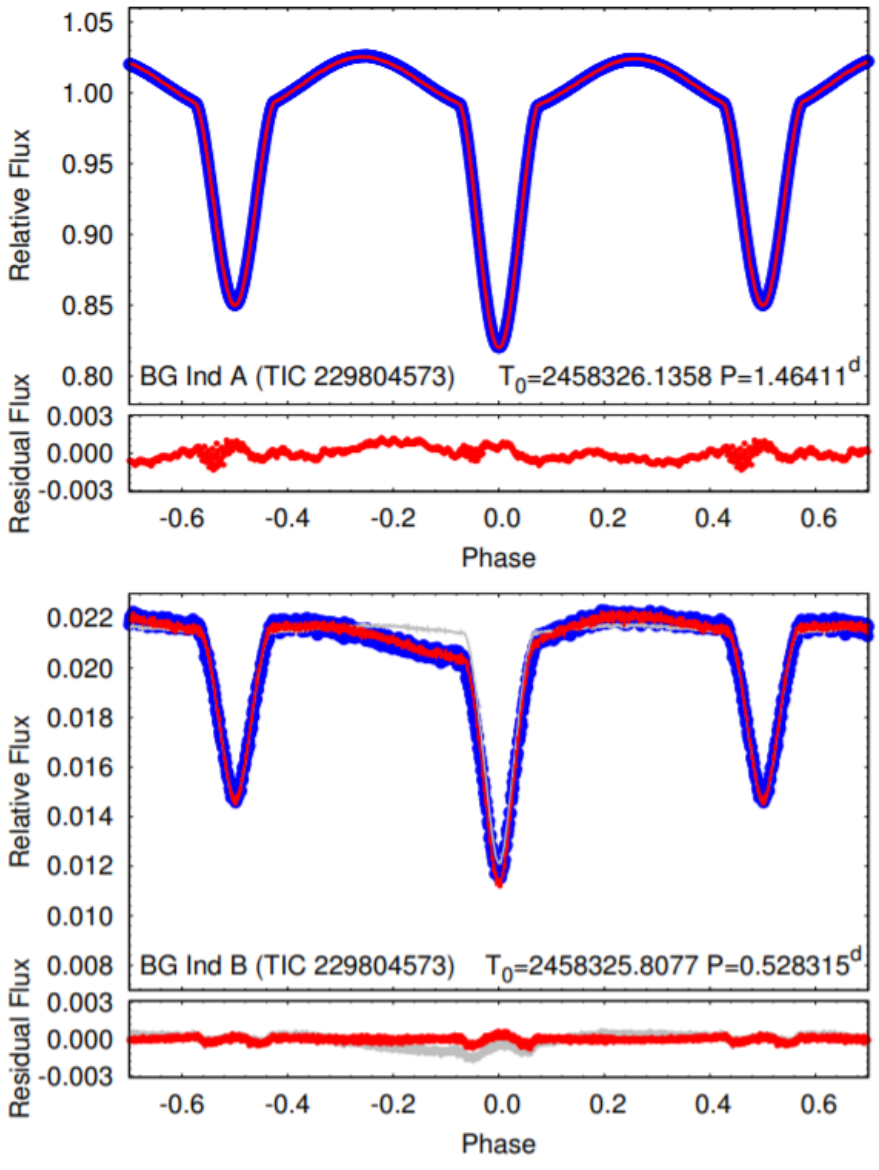
- New class of objects
- Nowadays: 160+
- There should be much more doubly eclipsing systems

BG Ind



Borkovits et al., 2021

BG Ind

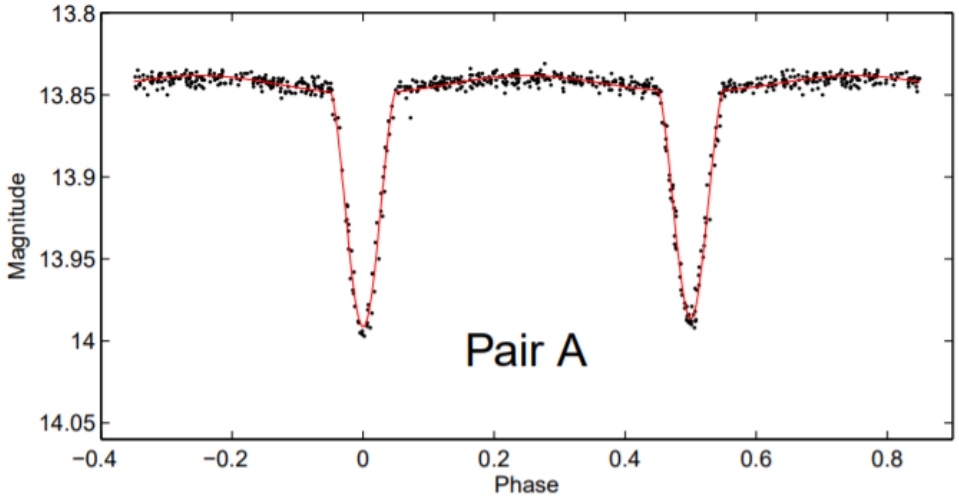


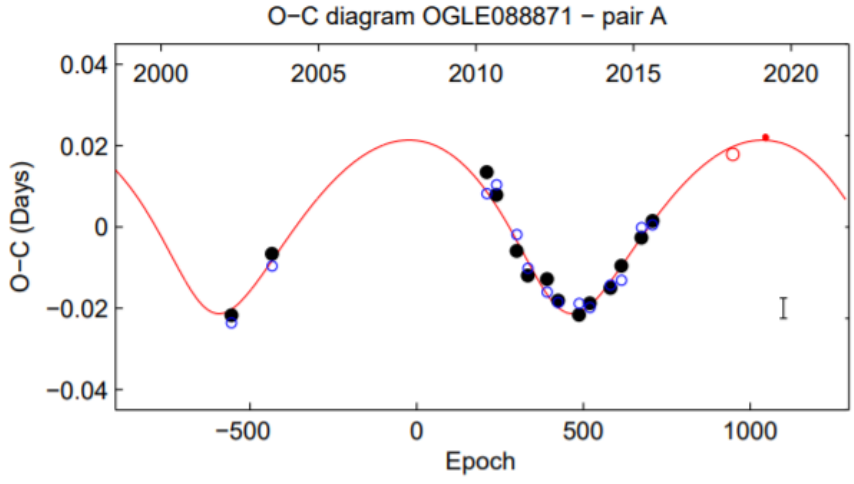
Borkovits et al., 2021

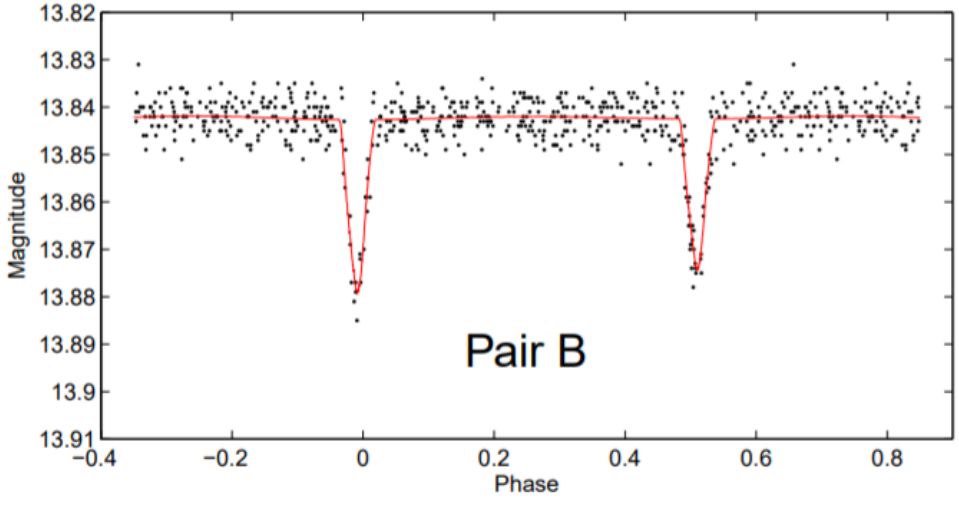
Study

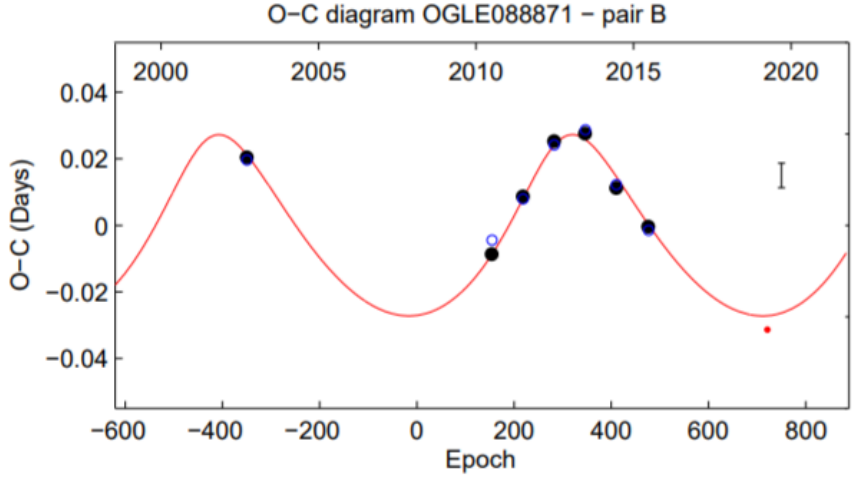
- Detection of another light changes (TESS data)
- Second period determination
- Spectra
- Long-term monitoring
- Main goal: confirm mutual motion of the pairs, period P_{AB}
- $P_{AB} \sim$ several years - thousands of years

OGLE BLG-ECL-088871







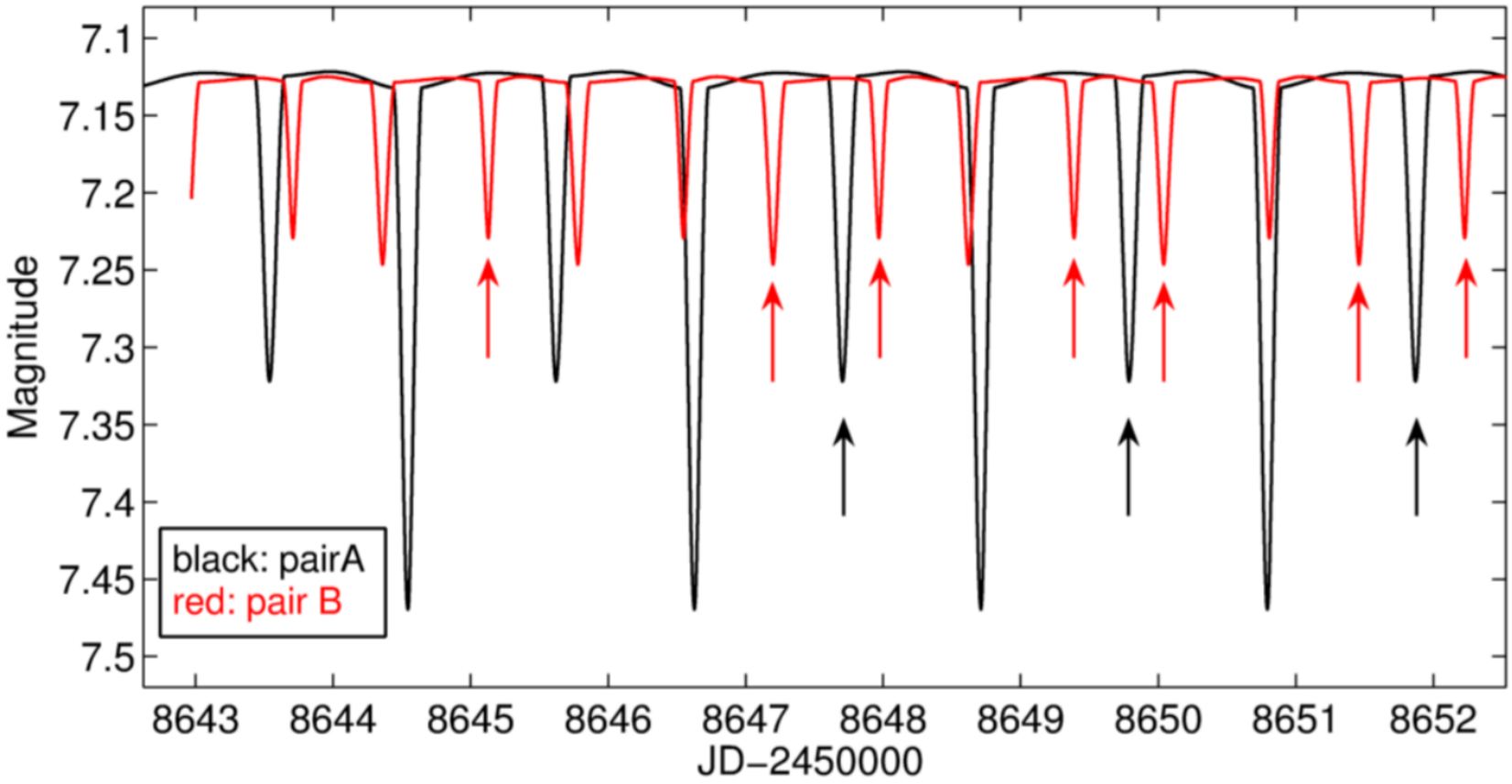


Zasche et al., 2019

Modelling

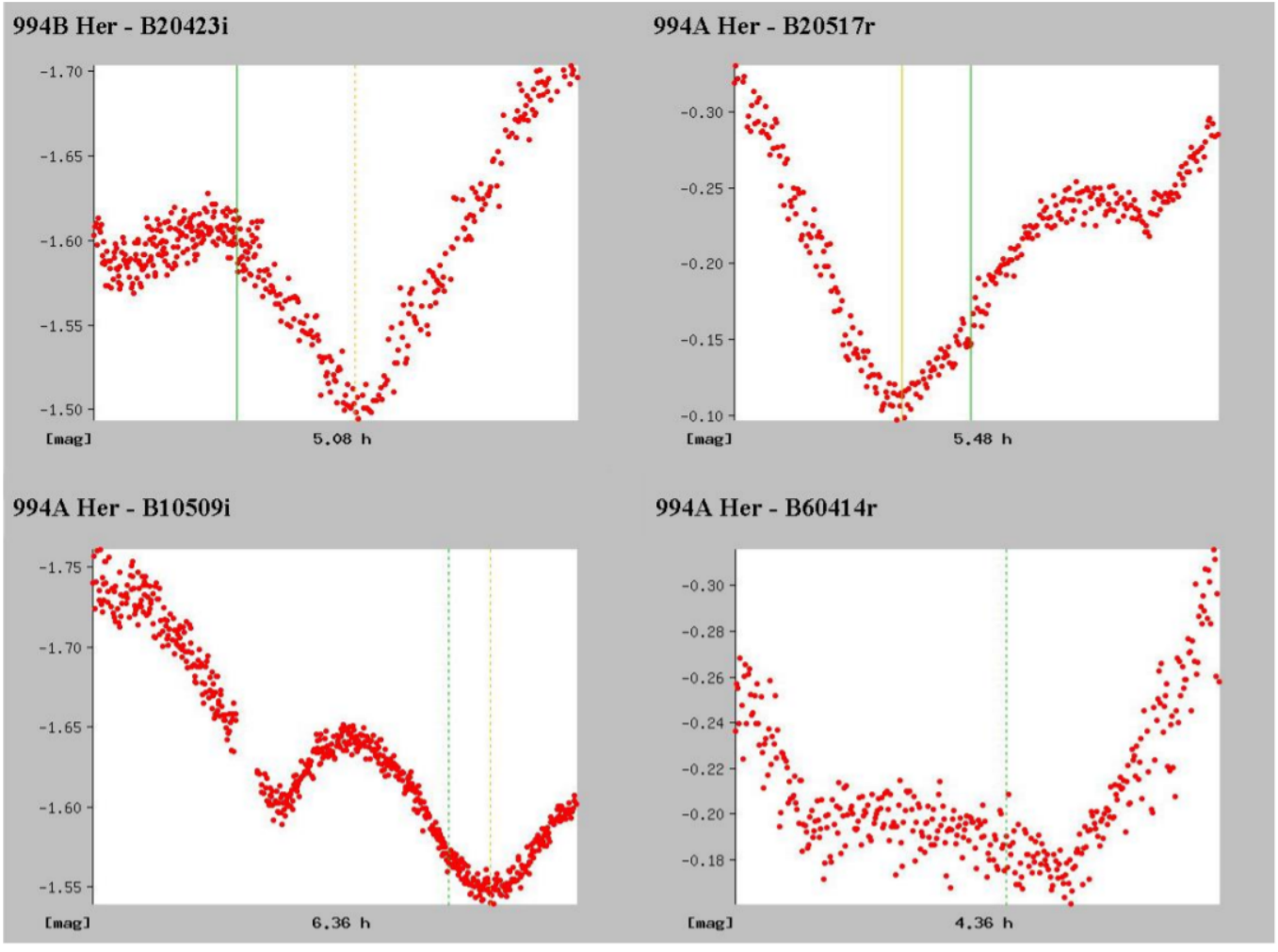
- Disentangling light curves
- Data contains both pairs
- Modelling pair A - remove pair B
- Modelling pair B - remove pair A
- Iterative process

V994 Her models



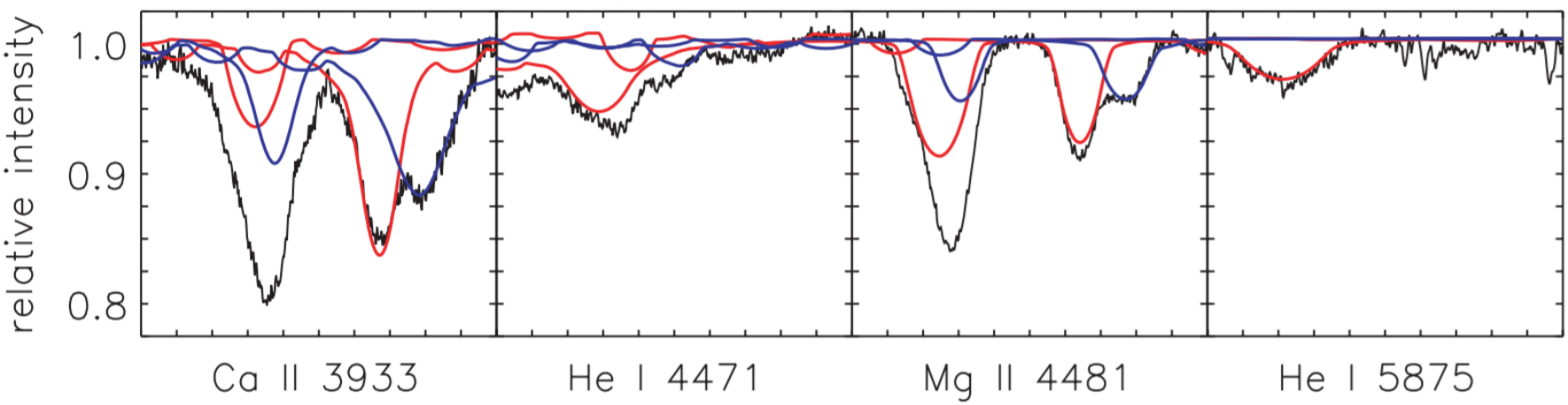
Zasche, 2019

Minima distortions



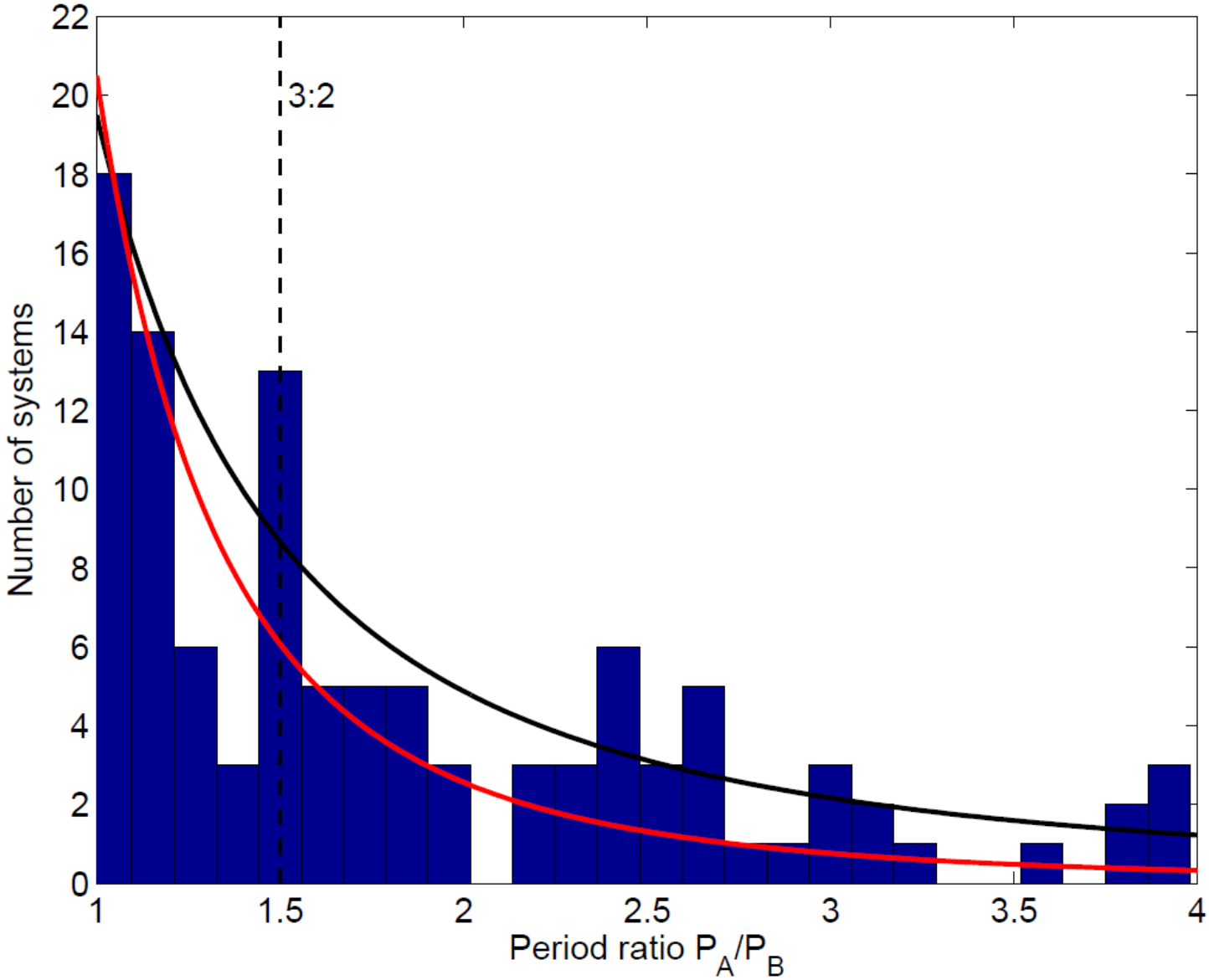
Zasche, 2019

Spectra



Lee et al., 2008

Period ratio distribution



Zasche et al., 2019

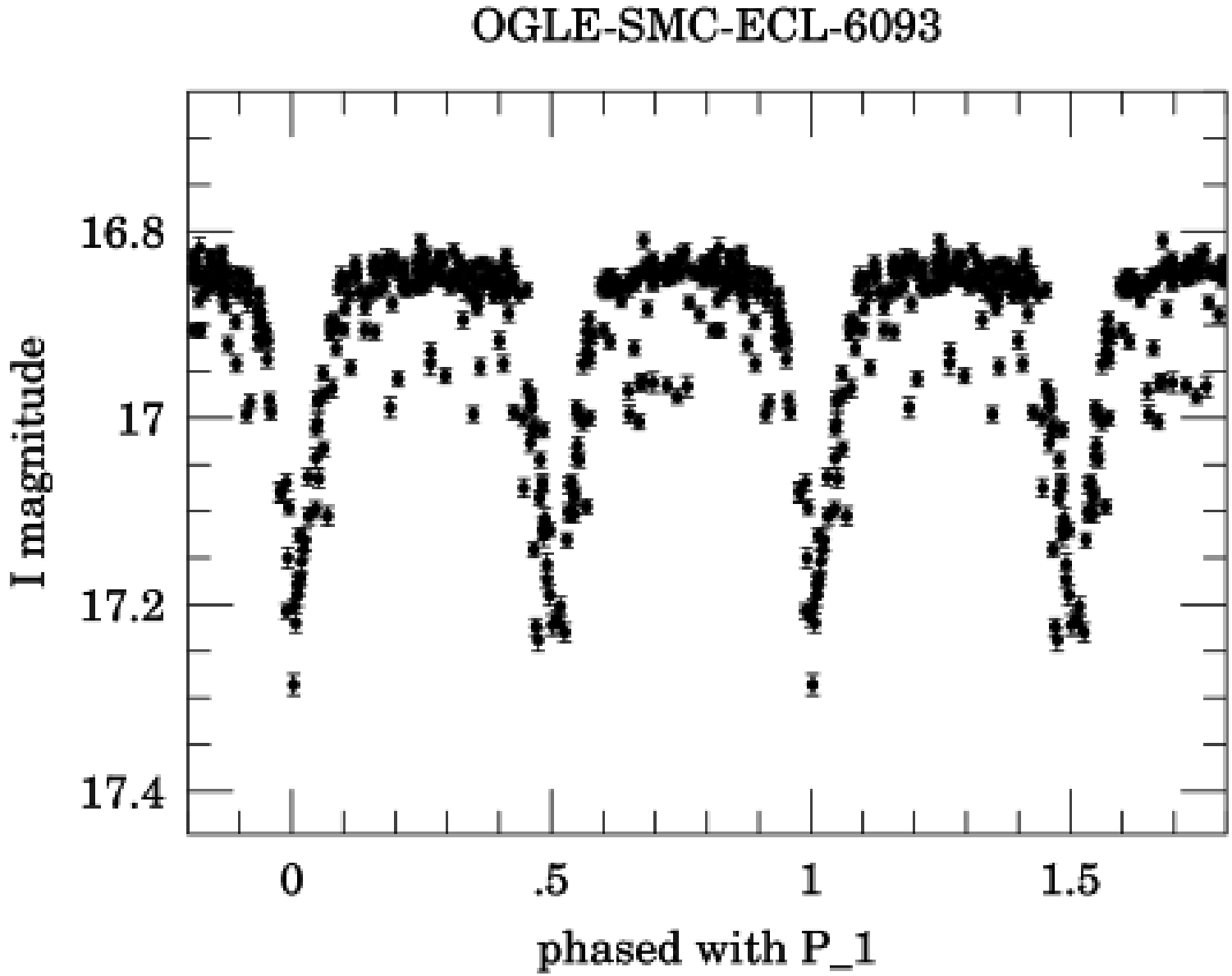
Resonances

- Models for 1 : 1 ratio, the largest number of stars
- No theory has yet been able to explain 3 : 2 configuration
- Period ratio is a dynamical quantity
- Possibly different configurations for different evolutionary states
- Period ratio distribution for the same evolutionary status - no sufficient amount of data
- More systems with determined dynamics are necessary

New candidates

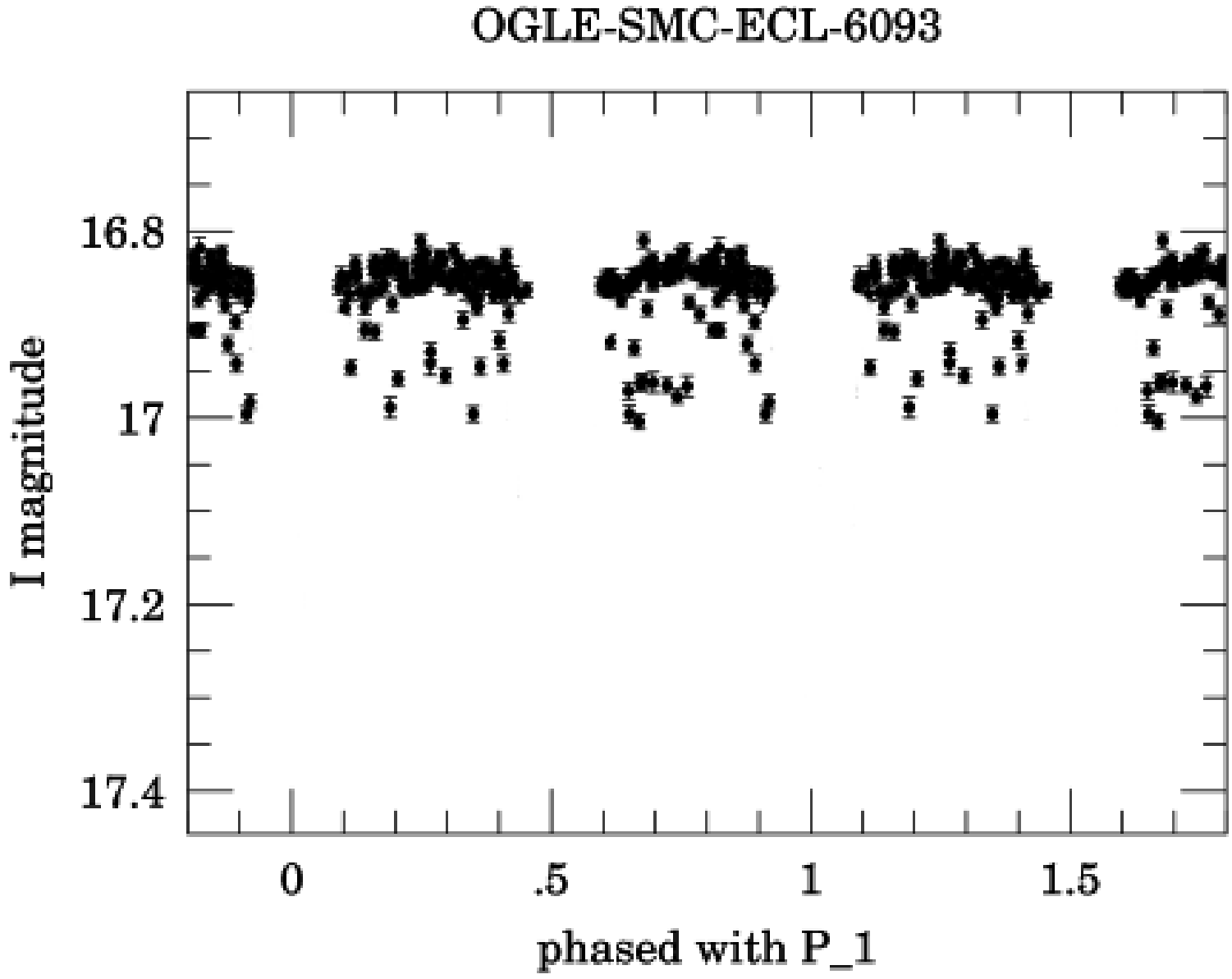
- Searching using light curves
- Comprehensive analysis to confirm the interaction
- TESS, OGLE
- SMC: 43 binary stars for period analysis, 10 candidates

Candidates in SMC



OGLE database

Candidates in SMC

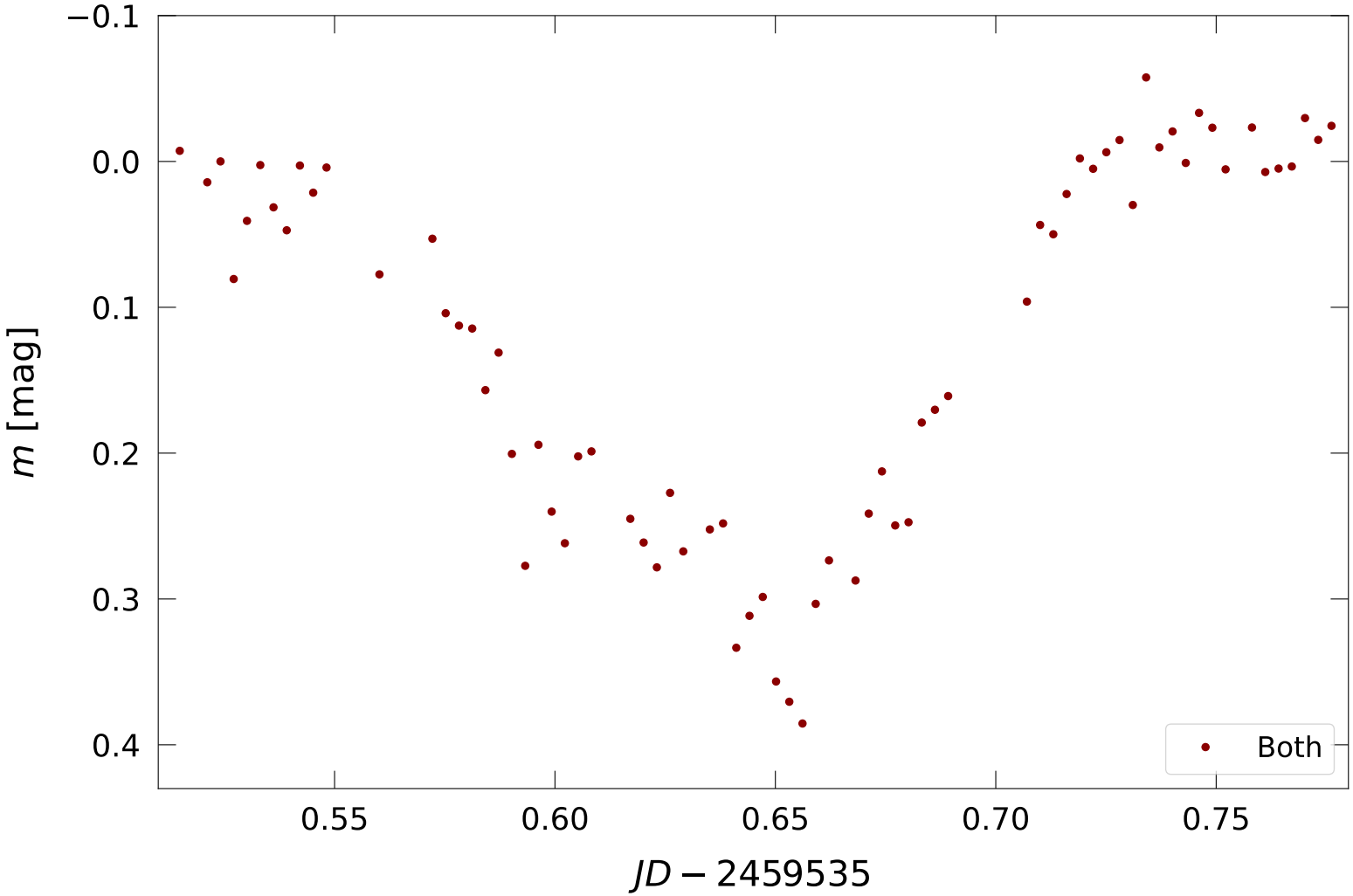


OGLE database

Candidates in SMC

System name	P_A [d]	P_B [d]	Period ratio
OGLE SMC-ECL-2339	0.728835	1.697881	2.33
OGLE SMC-ECL-2417	7.53885	7.07905	1.06
OGLE SMC-ECL-4569	1.971148	1.985094	1.01
OGLE SMC-ECL-5925	2.90892	8.8216	3.03
OGLE SMC-ECL-6093	0.90193	2.03034	2.25
OGLE SMC-ECL-8061	1.26659	1.778332	1.40
OGLE SMC-ECL-8098	1.233846	1.060909	1.16
OGLE SMC-ECL-1086	2.180685	3.320906	1.52
OGLE SMC-ECL-2541	0.893638	0.872412	1.02
OGLE SMC-ECL-4595	1.582897	7.9655	5.03

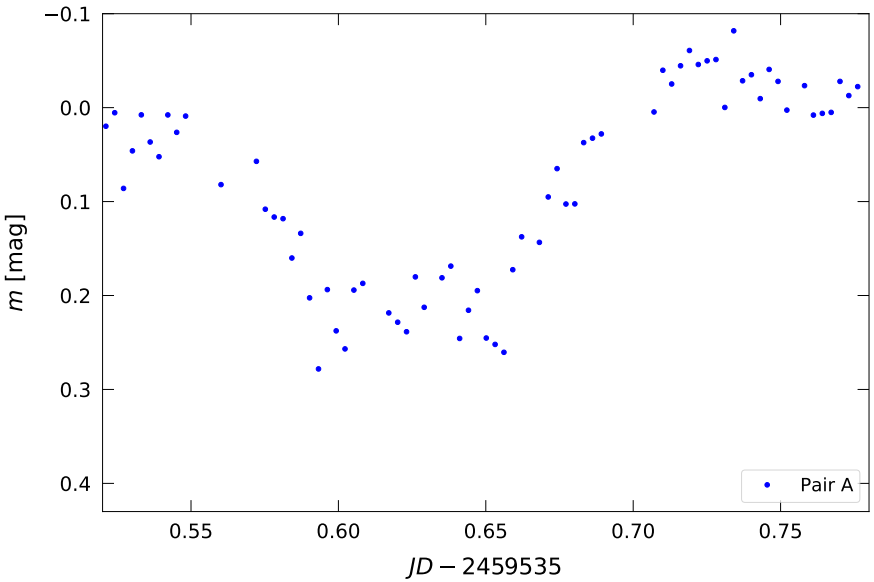
OGLE SMC-ECL-8098



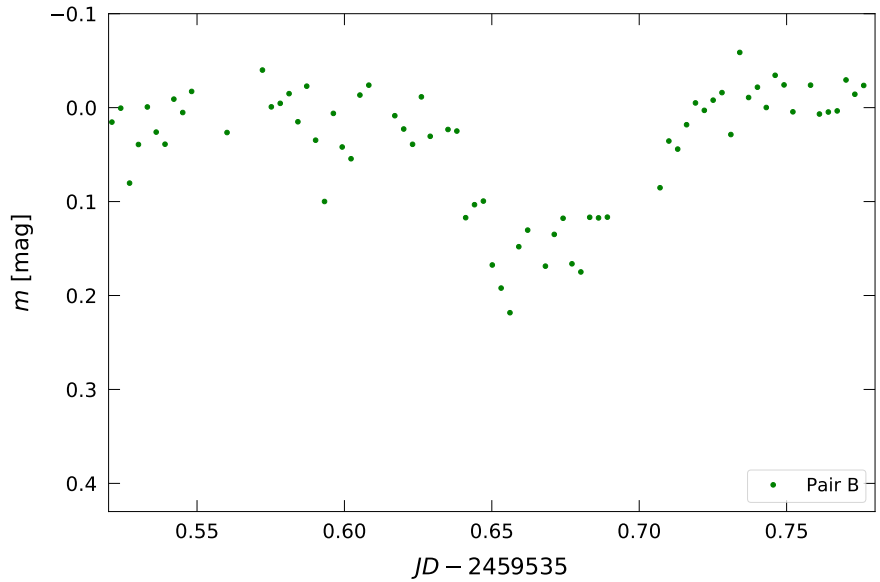
M. Zejda observation

OGLE SMC-ECL-8098

Pair A



Pair B



Summary

- New type of stellar systems
- Only several of them is known
- Many unresolved questions (periods, evolution)
- New candidates for further analysis
- 7 candidates + 3 possible blends in SMC, other stars from TESS

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