Determination of absolute masses through apsidal motion studies

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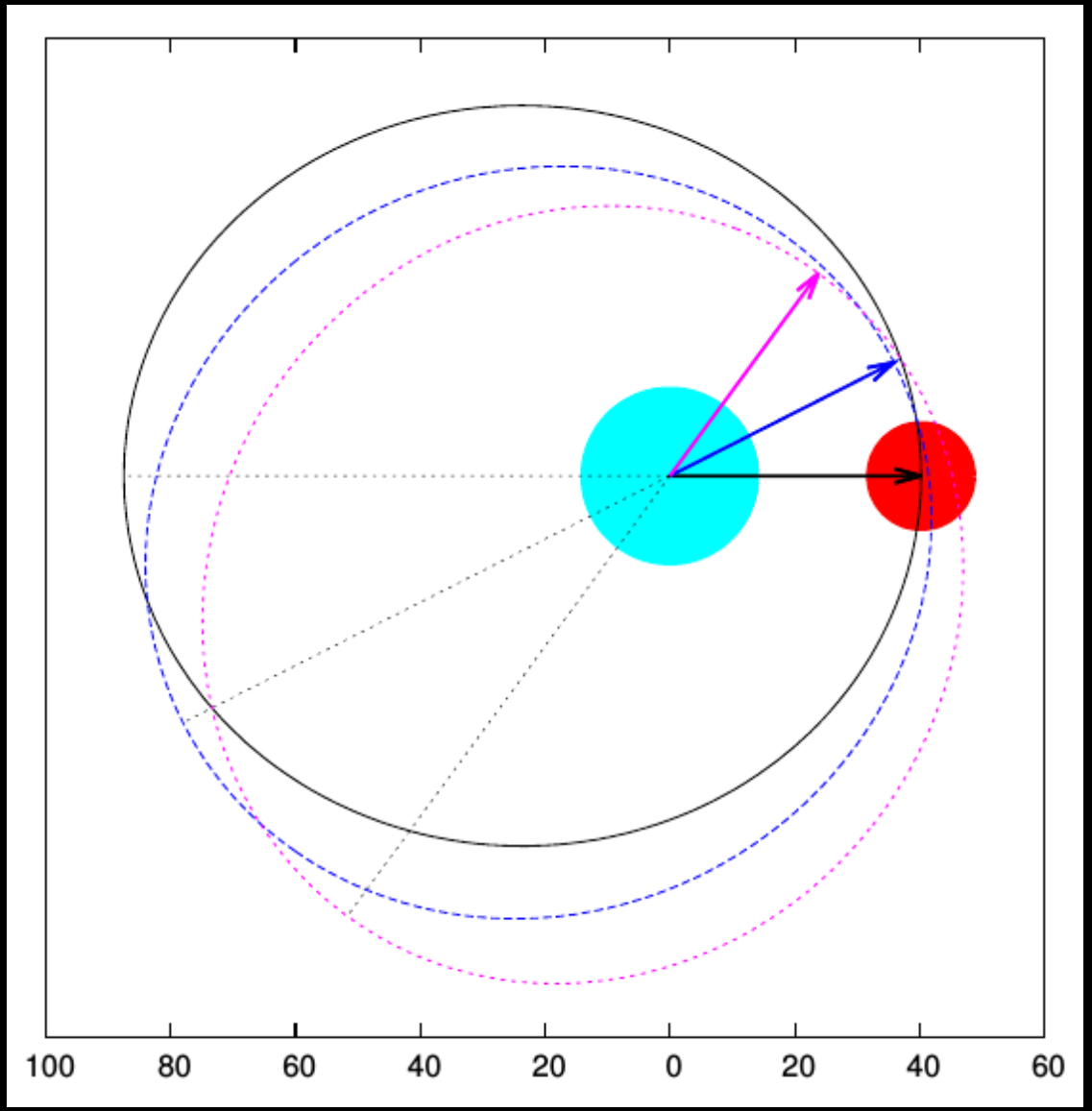
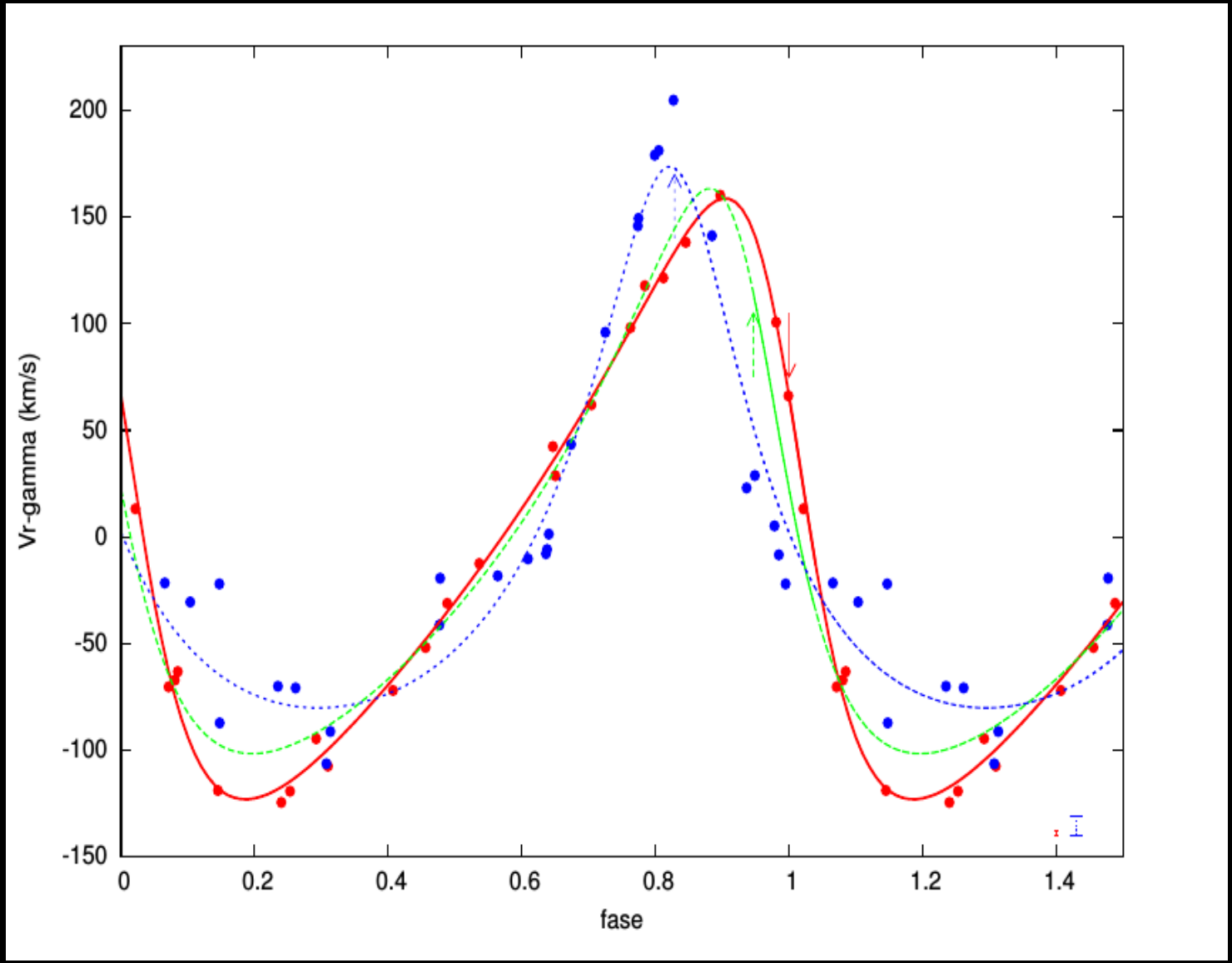
- Introduction: apsidal motion

HD 93205



- Introduction: apsidal motion

HD 93205



$$V_r = K[\cos(\theta + \omega) + e\cos\omega] + \gamma$$

- Introduction: apsidal motion

Potential = (point masses) + perturbations

Disturbing potential = rotational + tidal (Sterne 1939)

Relativistic precession (Levi-Civita 1937)

Benvenuto+2002

Apsidal motion $\dot{\omega}$

- primary mass
- mass ratio
- semi-major axis projection
- projected rotational velocity
- eccentricity
- radii
- structure constants
- age

(assuming no contribution from a third body)

- Methodology

  Sample selection

Criteria:

- Spectroscopic binary stars O + OB
- At least 1 orbital solution published
- Eccentric ($e > 0$)
- Visible from Southern hemisphere ($\delta < 29°$)

$\rightarrow$ 17 systems

- Methodology

Observations

Instrument	*R*	nights	spectra
CASLEO – J. Sahade – REOSC	13000	48	754
ESO-La Silla – 2.2m – FEROS	45000	OWN*	47
LCO – du Pont – Echelle	35000	OWN*	52

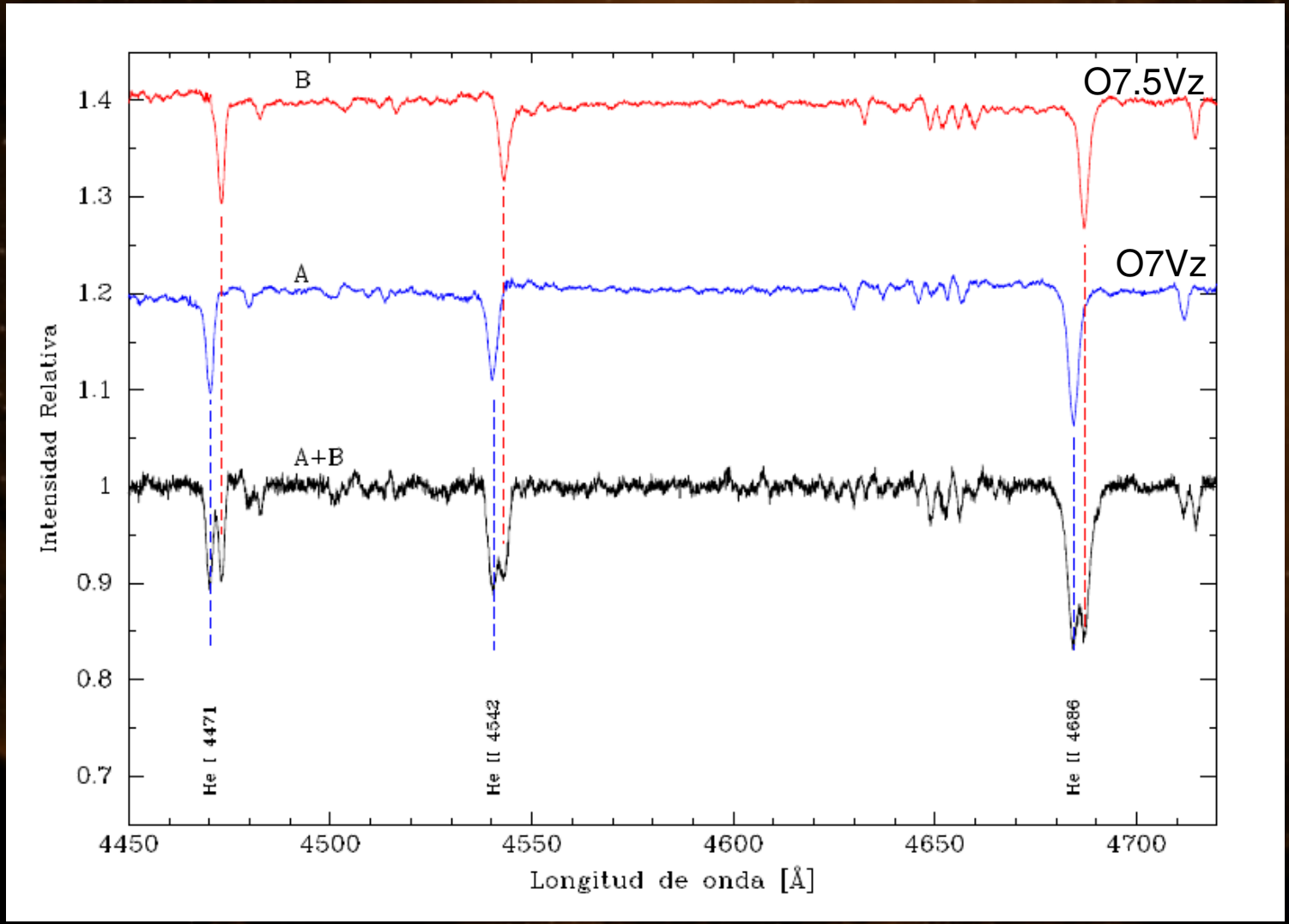
* *OWN Survey*, Barbá+2010, 2017

- Methodology: HD 165052

Disentangling + RV measurements

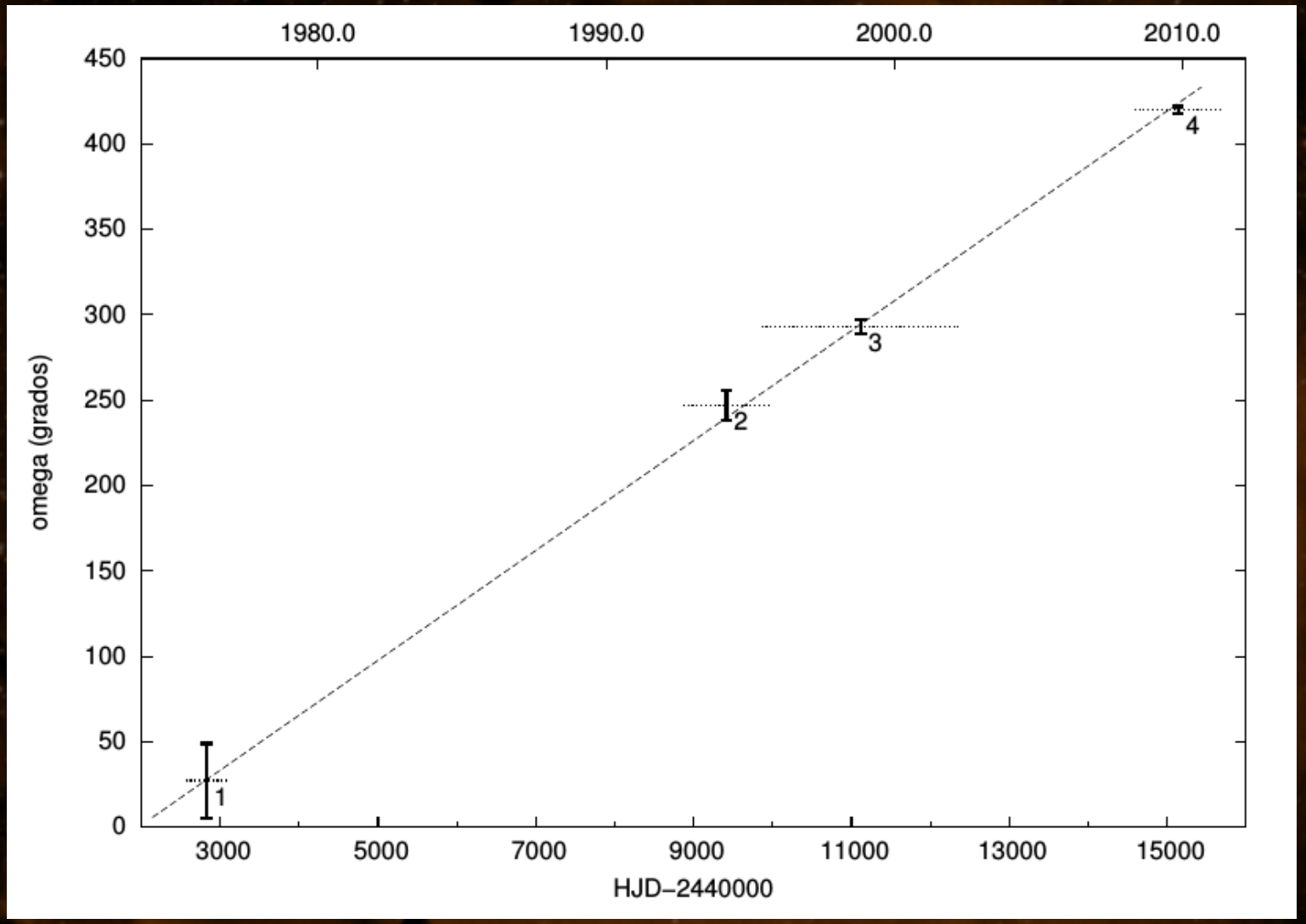
Using spectral lines of He I, He II, C IV, O III, Mg II y Si IV

(consistent with Arias+2002 and Linder+2007).



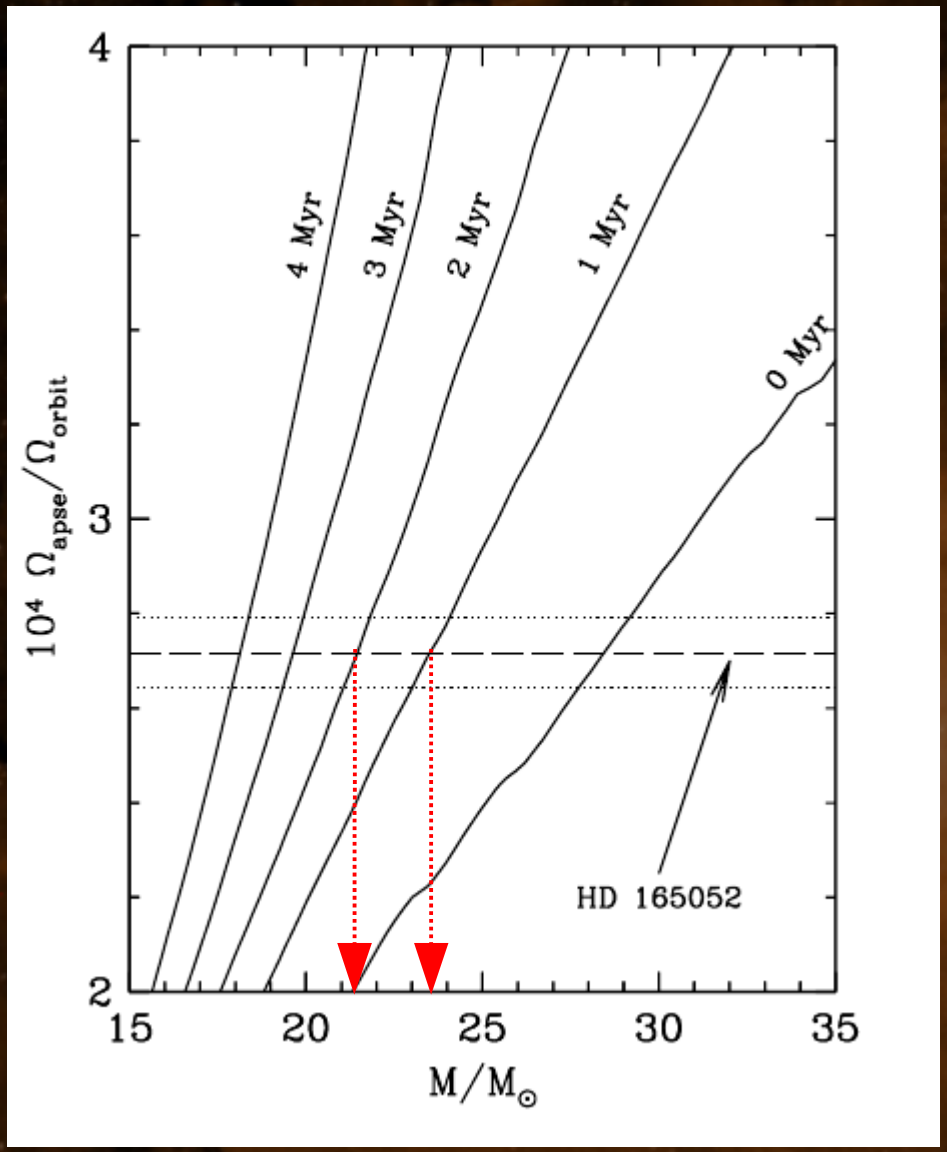
Ferrero+2013

- Methodology: HD 165052



$d\omega/dt$ = 0.0331 ± 0.0009 °/day = 12.1 ± 0.3 °/year (!)

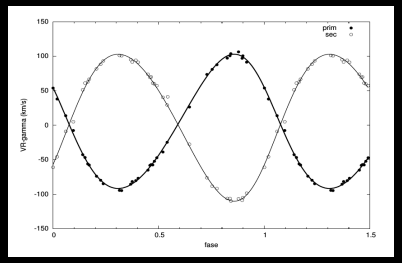
- Methodology: HD 165052

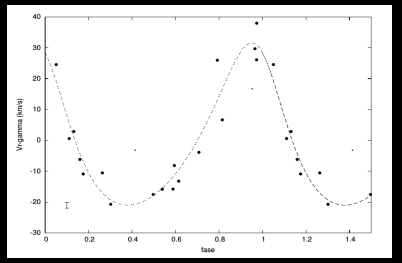


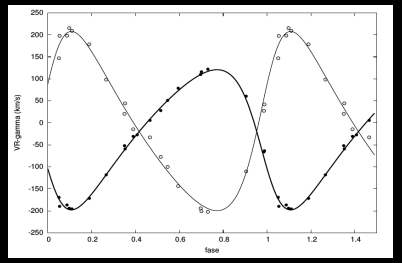
Mass from apsidal motion: M_1 = 22.5 +/- 1.0 $M_\odot$

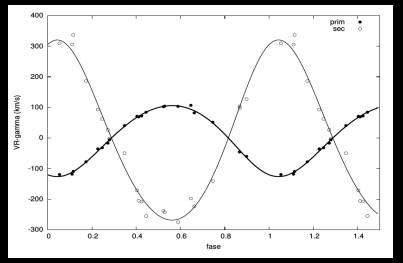
- Results

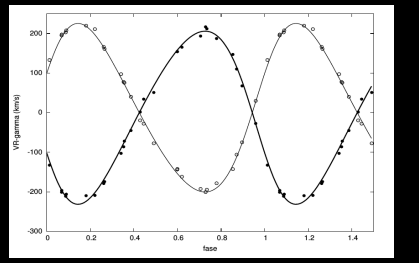
17 new spectroscopic orbital solutions of massive binary systems O+OB

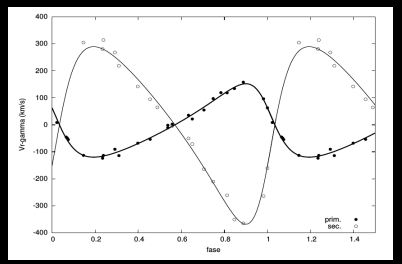

HD 165052

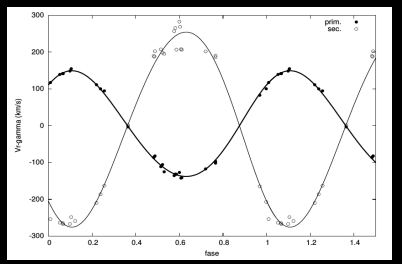

HD 153919

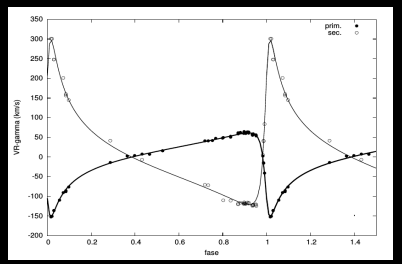

HD 152218

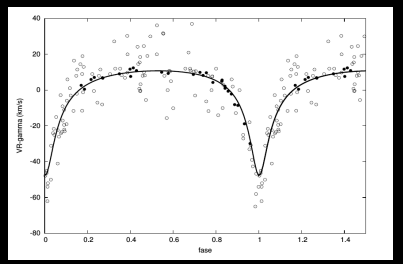

HD 152219

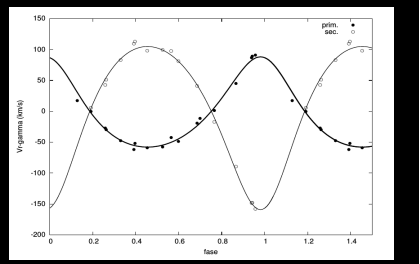

HD 152248

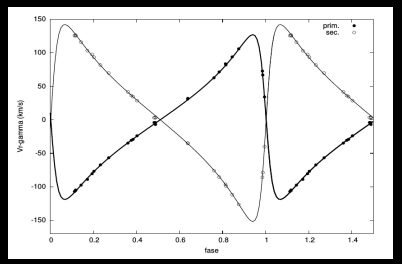

HD 93205

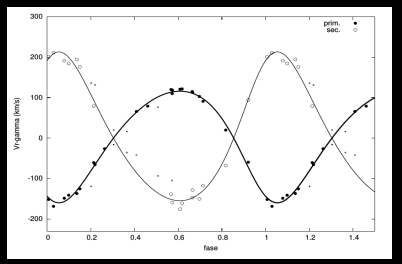

δ Cir

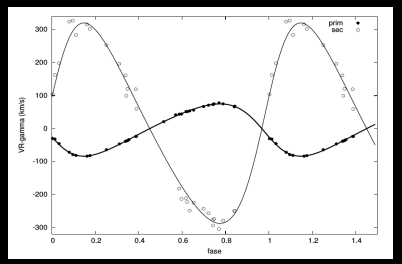

ι Ori A

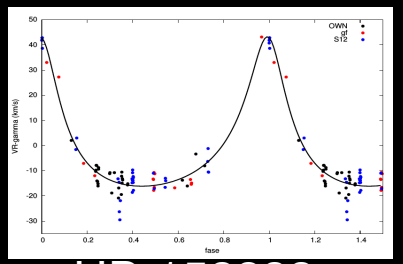

θ_1 Ori A


HD 93403

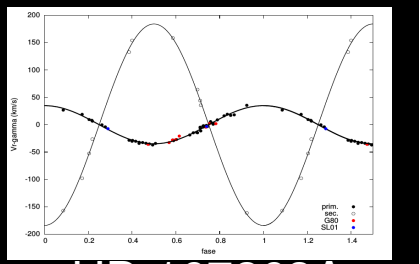

HD 75759


HD 101131

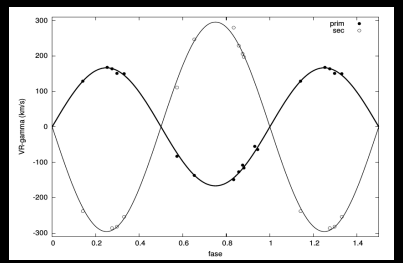

HD 152590

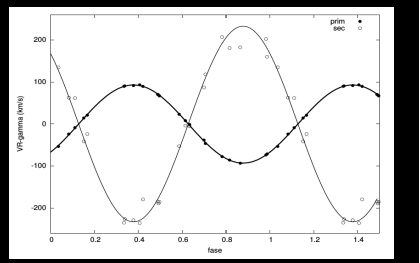


HD 152233



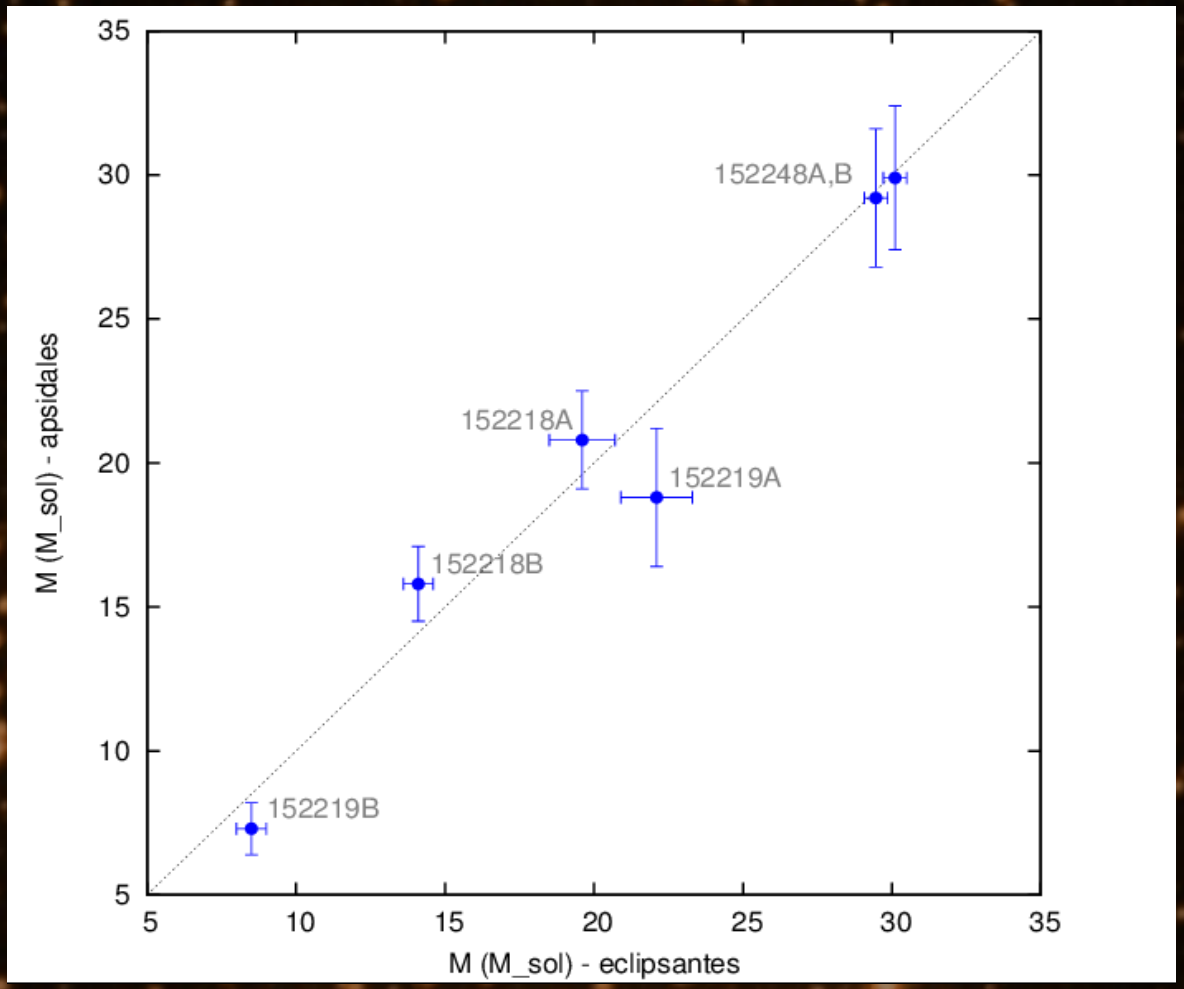
HD 167263A


CPD -41 7742


CPD -41 7733

- Results: eclipsing binaries in NGC 6231

HD152218, HD152219 and HD152248



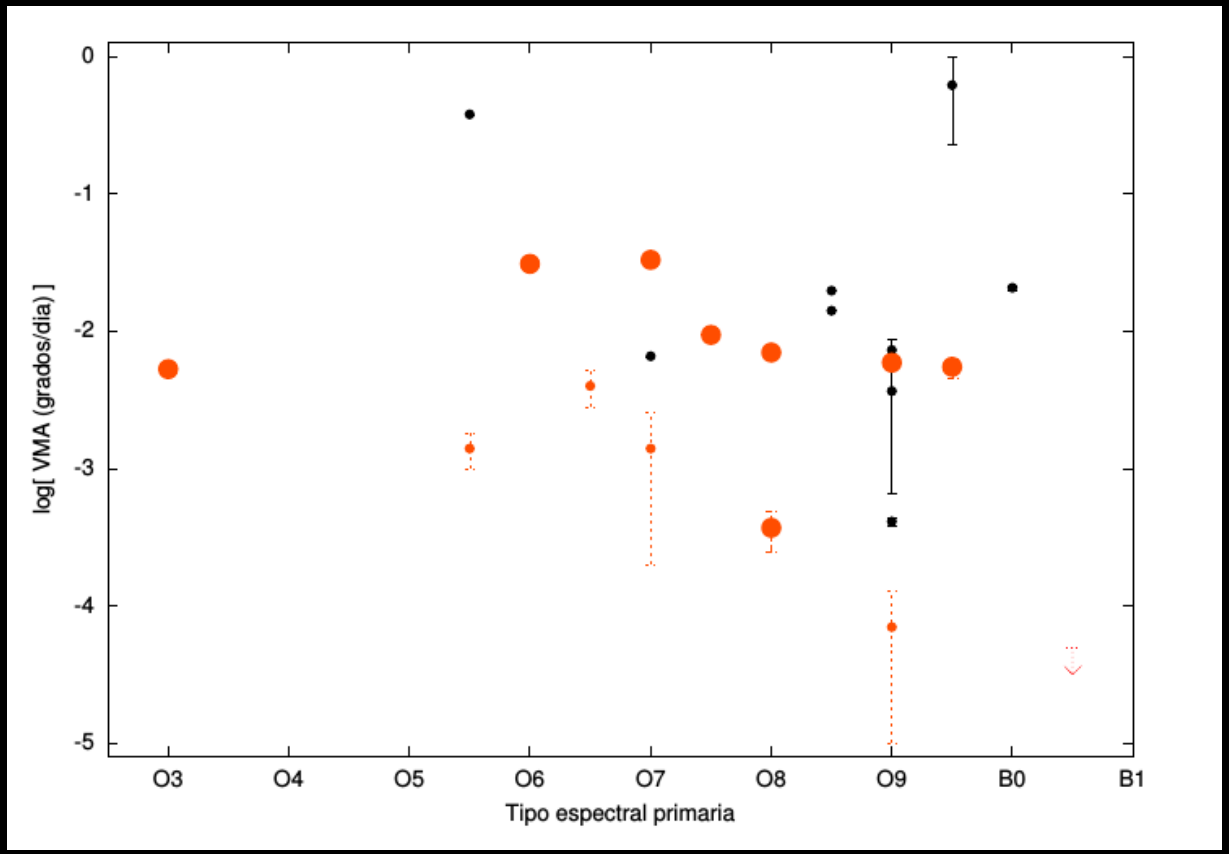
Apsidal masses vs. dynamical masses: differences below 15%

HD 152219

- Results

Apsidal motion detected and rate determined in 8 systems (in 5 previously unknown) and hints of apsidal motion in another 5 systems.

Nombre	$\dot{\omega}$ (grados/día)		
HD 165052	0.0331	±	0.0009
HD 153919	0.031	±	0.001
HD 152248	0.0094	±	0.0007
HD 152218	0.0059	±	0.0004
HD 152219	0.0055	±	0.0009
HD 93205	0.0049	±	0.0003
δ Cir	0.0024	±	0.0004
ι Ori A	0.0004	±	0.0001
θ_1 Ori A	< 0.0001		
HD 93403	0.0008	±	0.0005
HD 75759	0.00007	±	0.00006
HD 101131	0.004	±	0.001
HD 152590	0.001	±	0.001



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HD 101131	0.004	±	0.001
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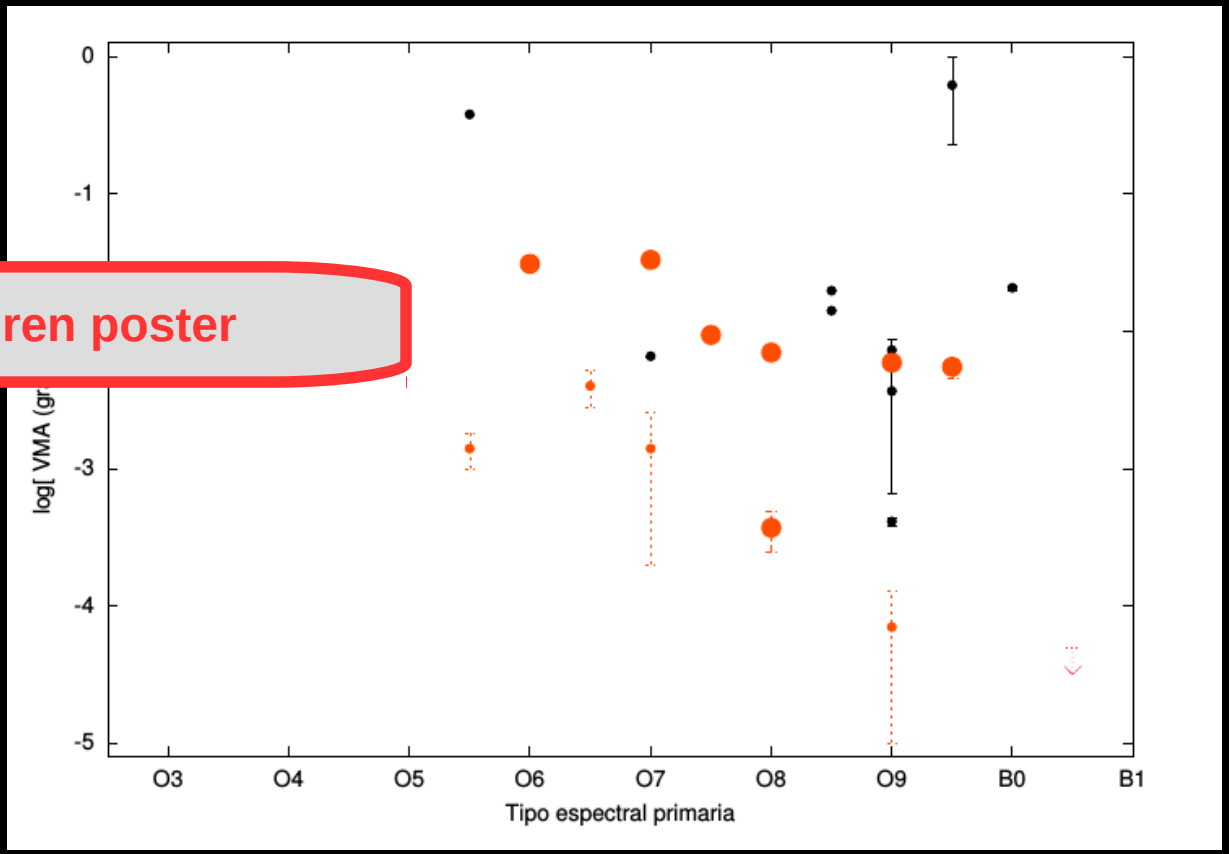
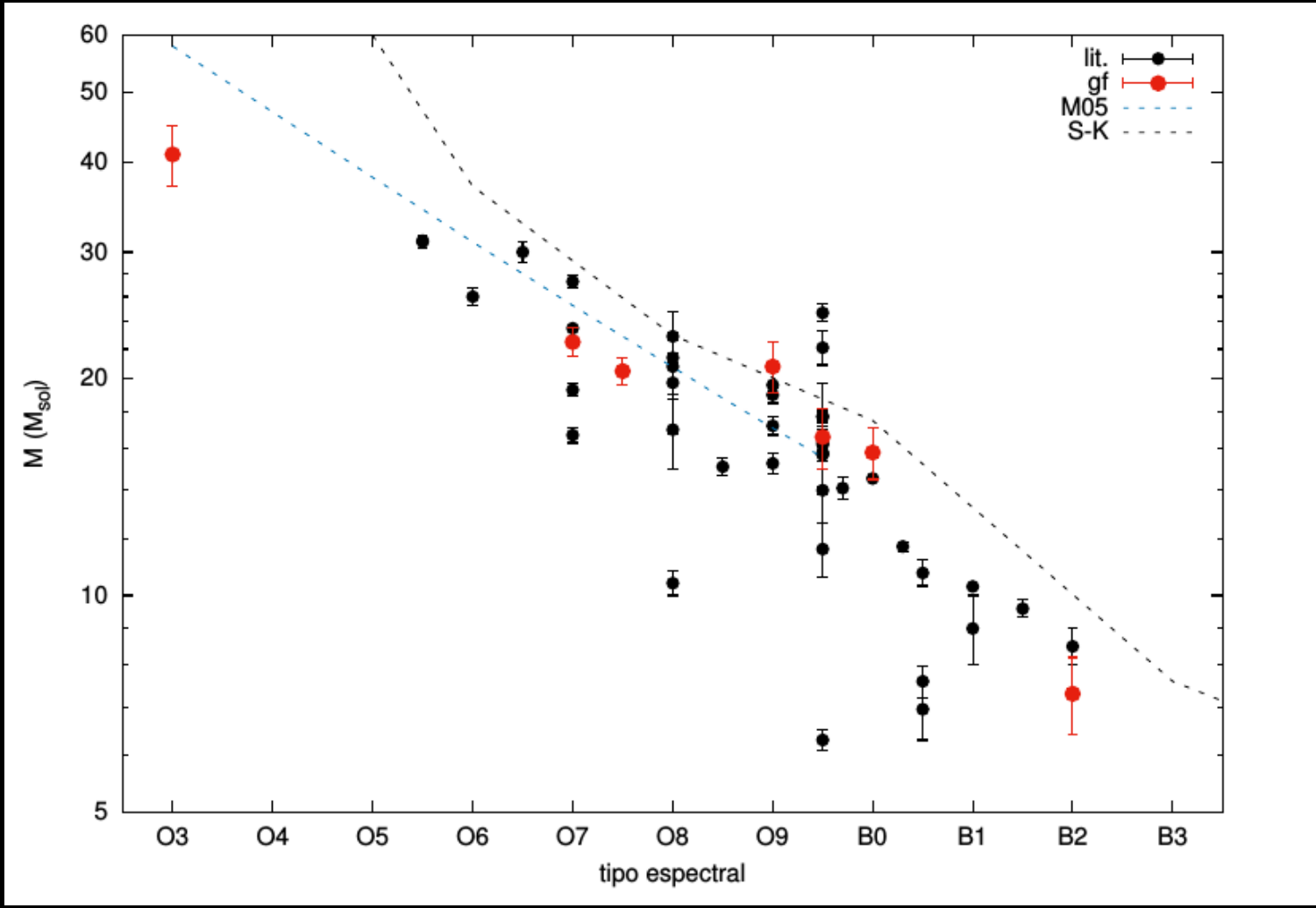
Jordi Eguren poster



- Main conclusion:

Apsidal motion method to calculate stellar masses seems to be trustable and can be used widely.



Thank you!