Testing eccentricity pumping processes in wide sdB binaries with MESA

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Seventh meeting on hot subdwarfs and related objects

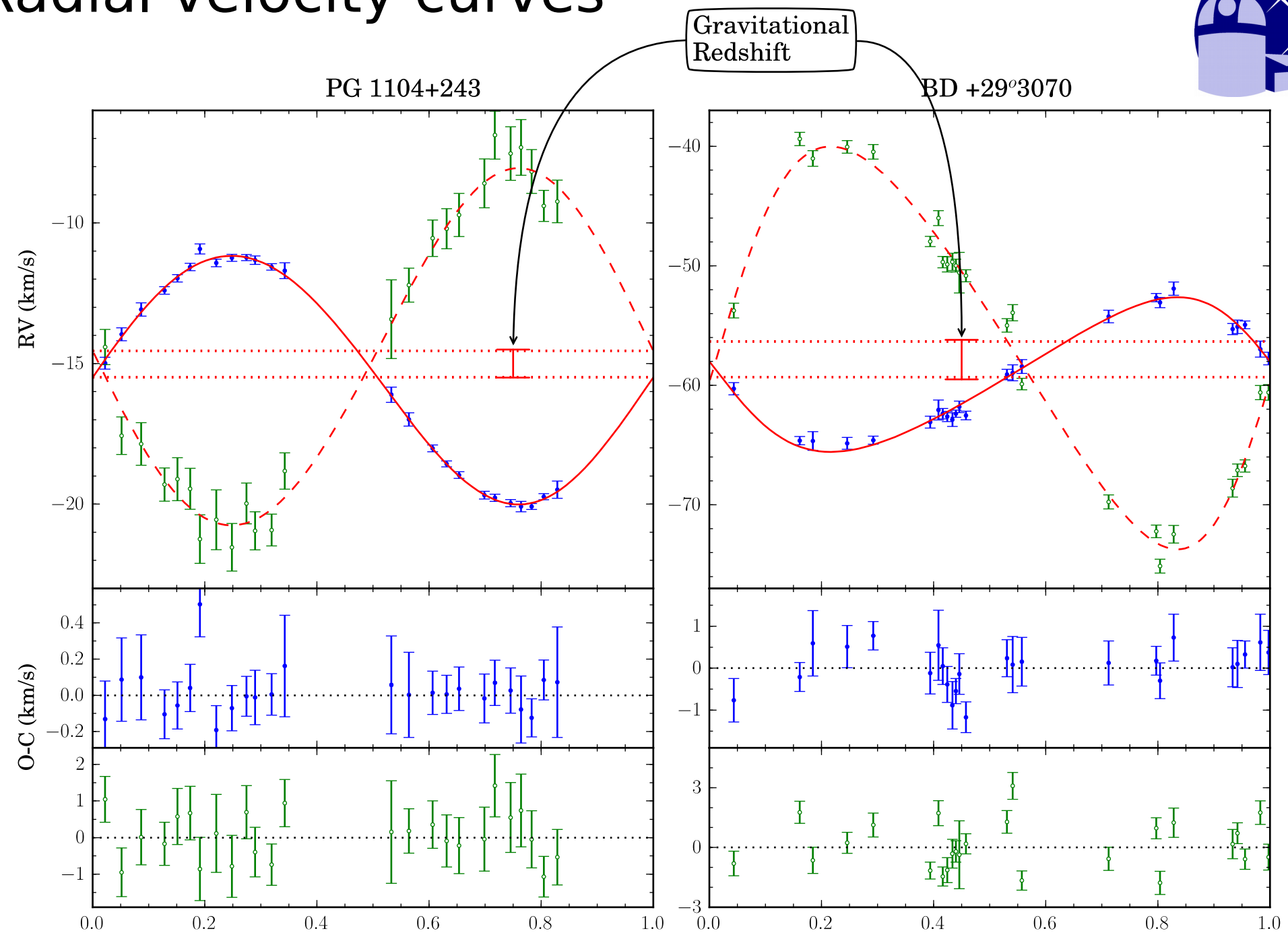
KU LEUVEN

sdB observing campain

HERMES @ Mercator

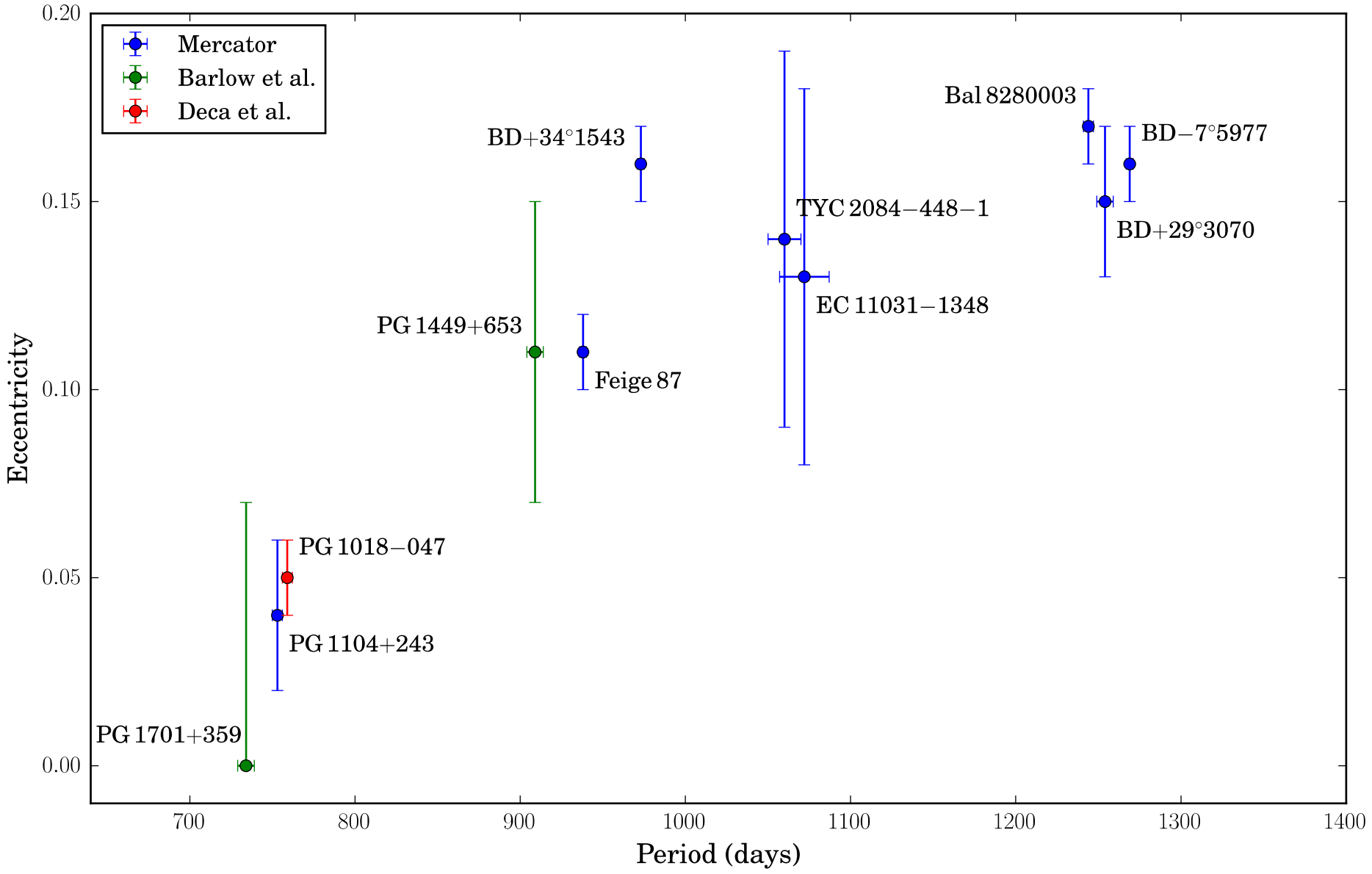
- 8 targets
- 6 years of monitoring
- ~50 spectra/target

Radial velocity curves

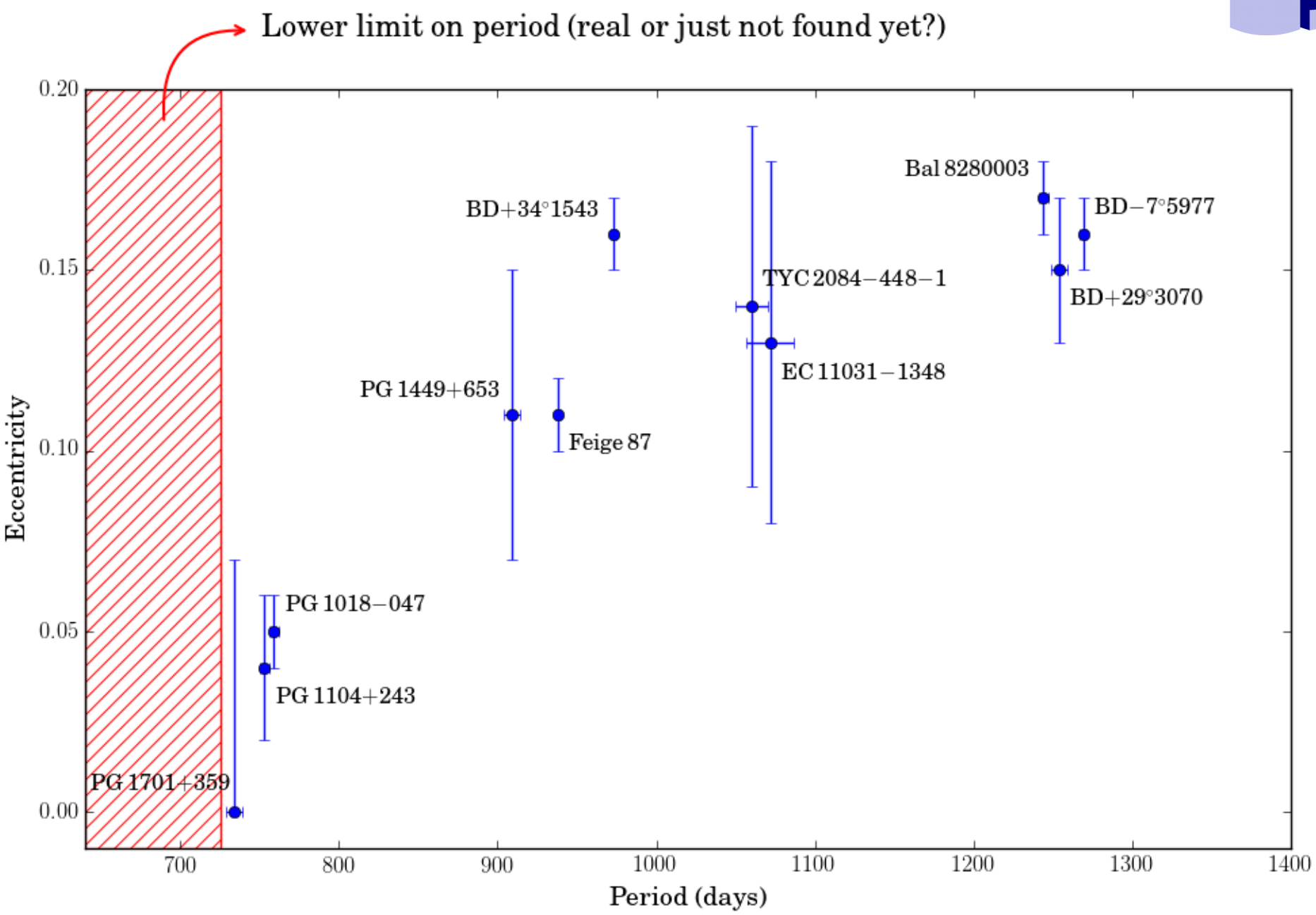


Vos et al 2012, 2013, 2014

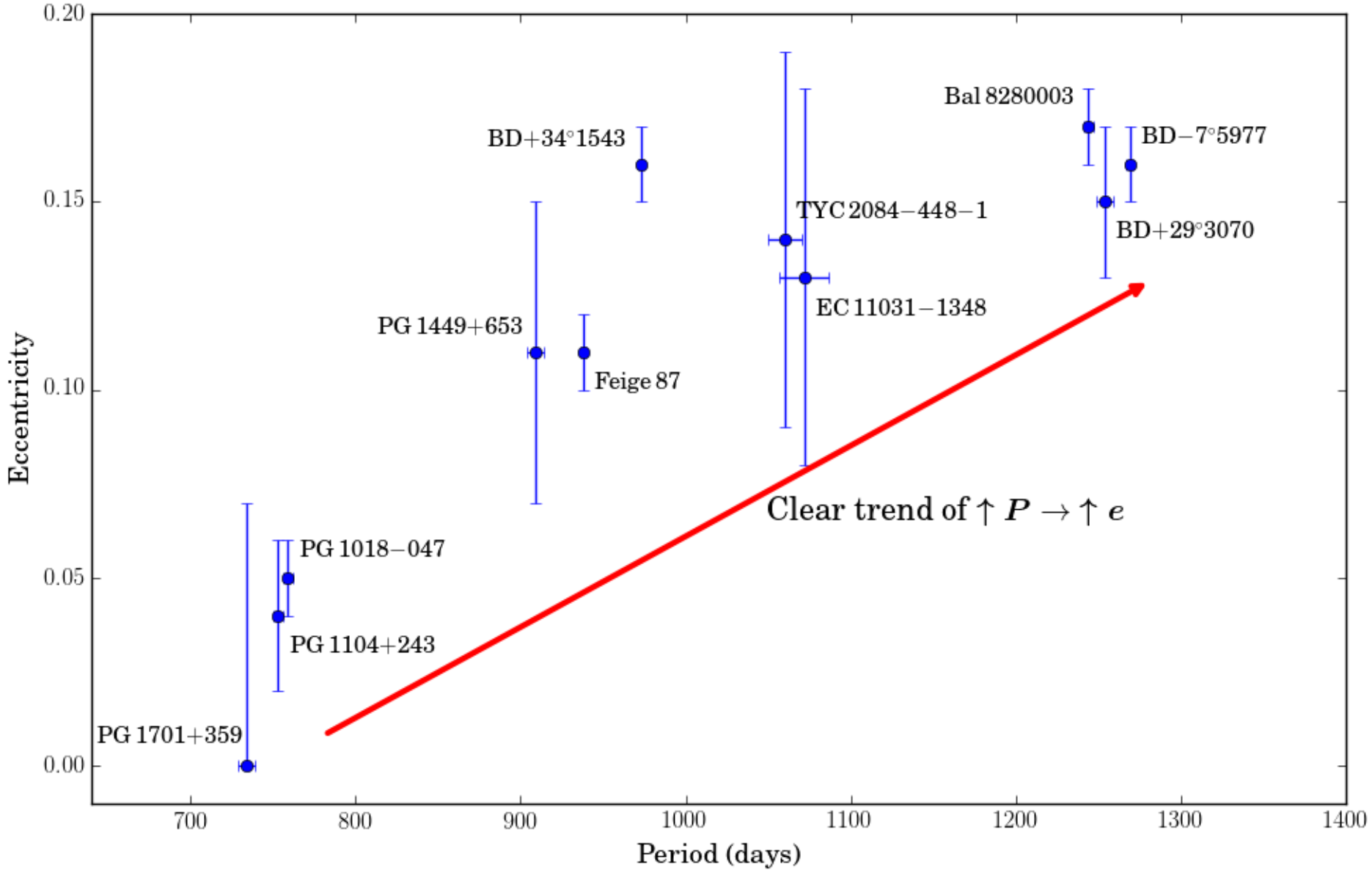
Observed period - eccentricity



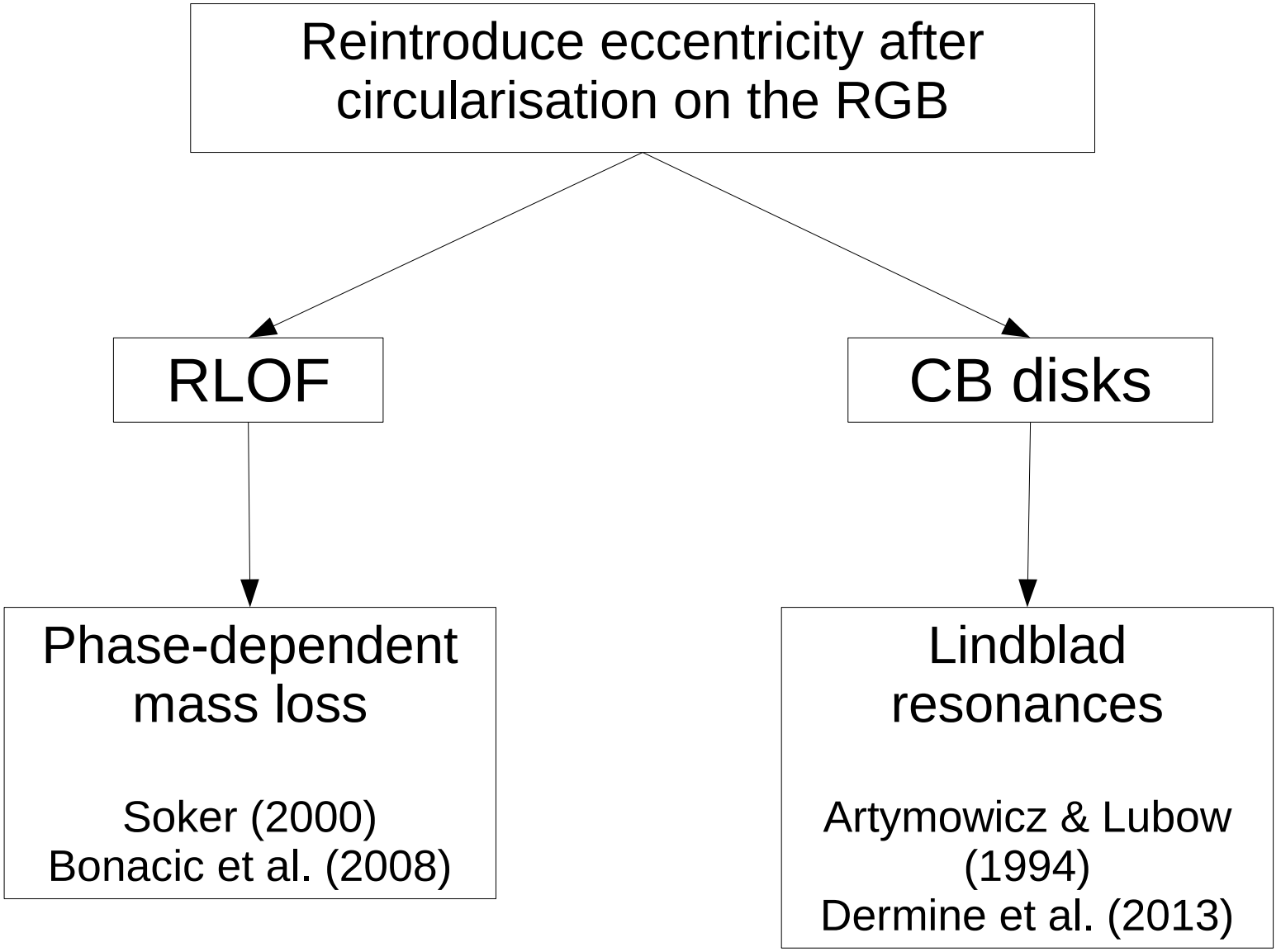
Observed period - eccentricity



Unexpected eccentricity



Eccentricity Pumping

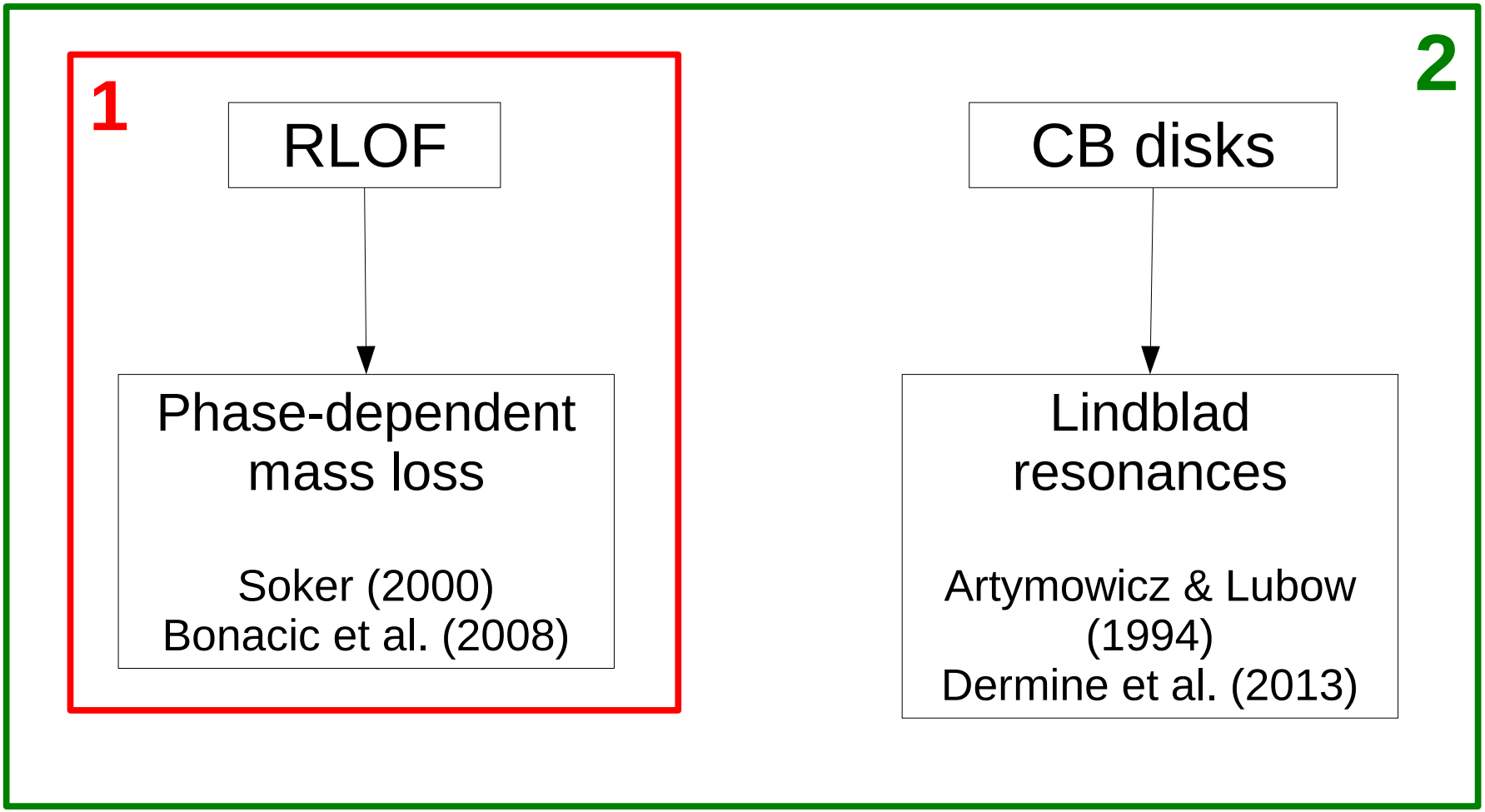


Needs minimum eccentricity emin = 0.001

Model setup

1) Only models with phase dependent RLOF

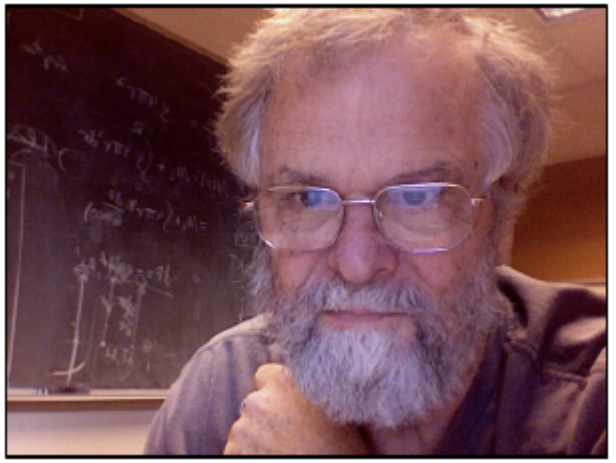
2) Models with phase dependent RLOF and a CB disk



MESA

Modules for Experiments in Stellar Astrophysics

MESA is a state-of-the-art, modular, open source suite for stellar evolution



Bill Paxton, father of MESA

- MESA stellar evolution code: mesa.sourceforge.net
- MESA instrument papers (Paxton et al. 2011, 2013, 2015)

MESA

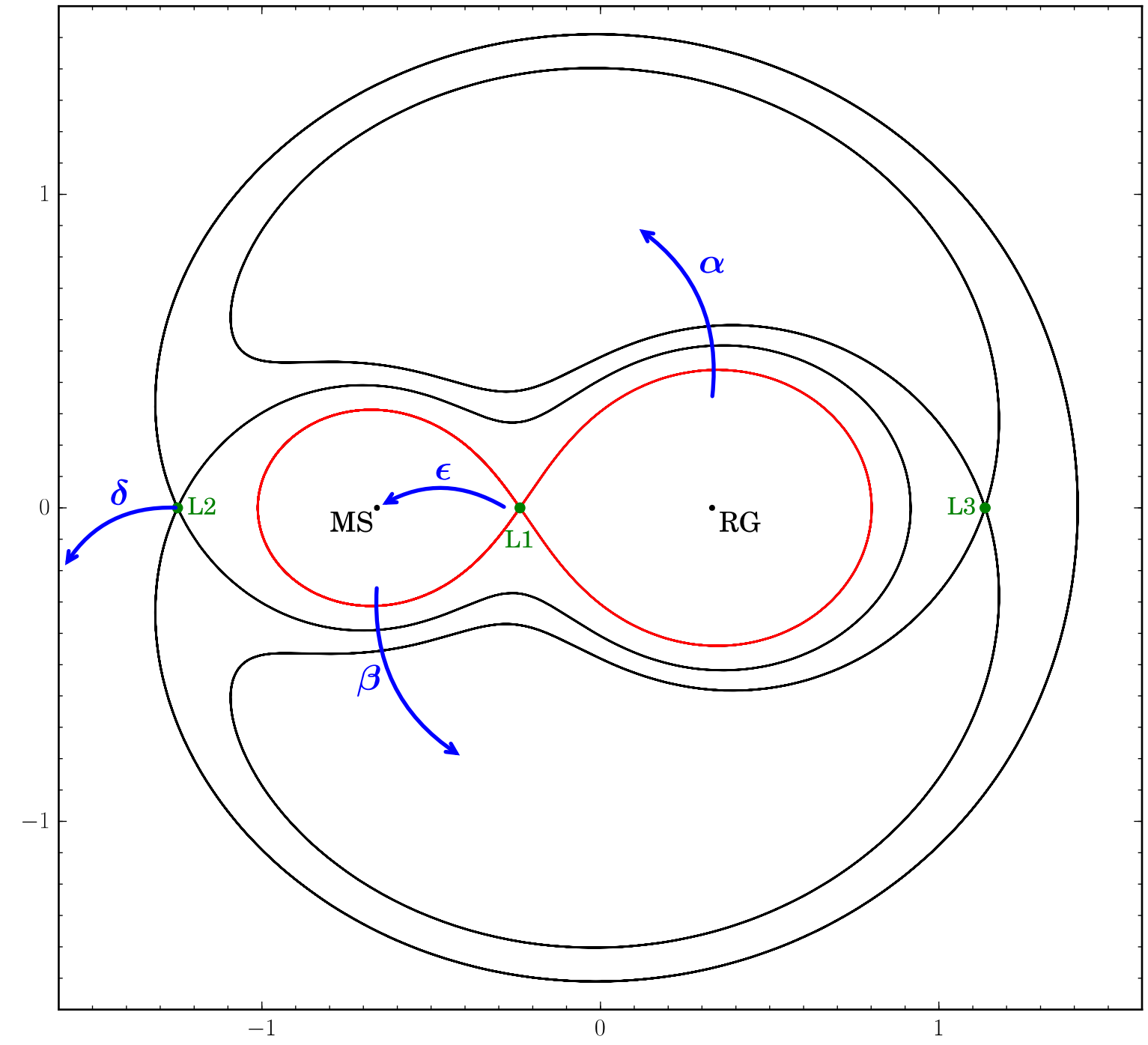
Modules for Experiments in Stellar Astrophysics

Binary Module

- 2 stars evolved at the same time
- Implicit mass transfer (Ritter & Kolb)
- Tides (Zahn 1977)
- Circularisation (Hut 1981, Zahn 1988)
- Magnetic braking
- Gravitational waves
- Angular momentum accretion

Interaction mechanisms presented here will be added in the future versions of MESA

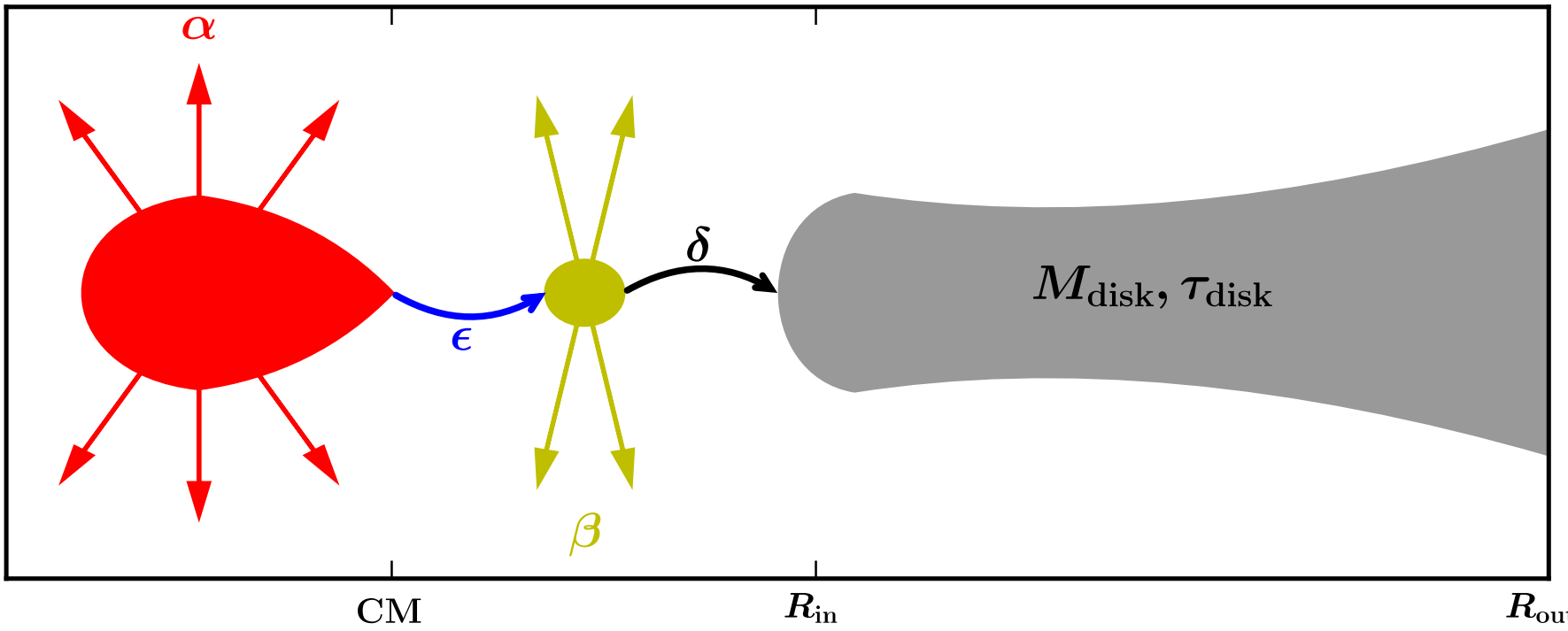
RLOF mass-loss fractions



Mass loss fraction from Tauris et al. 2006

α : jeans mode
β : isotropic re-emission
δ : circumbinary coplanar toroid
ε : accretion

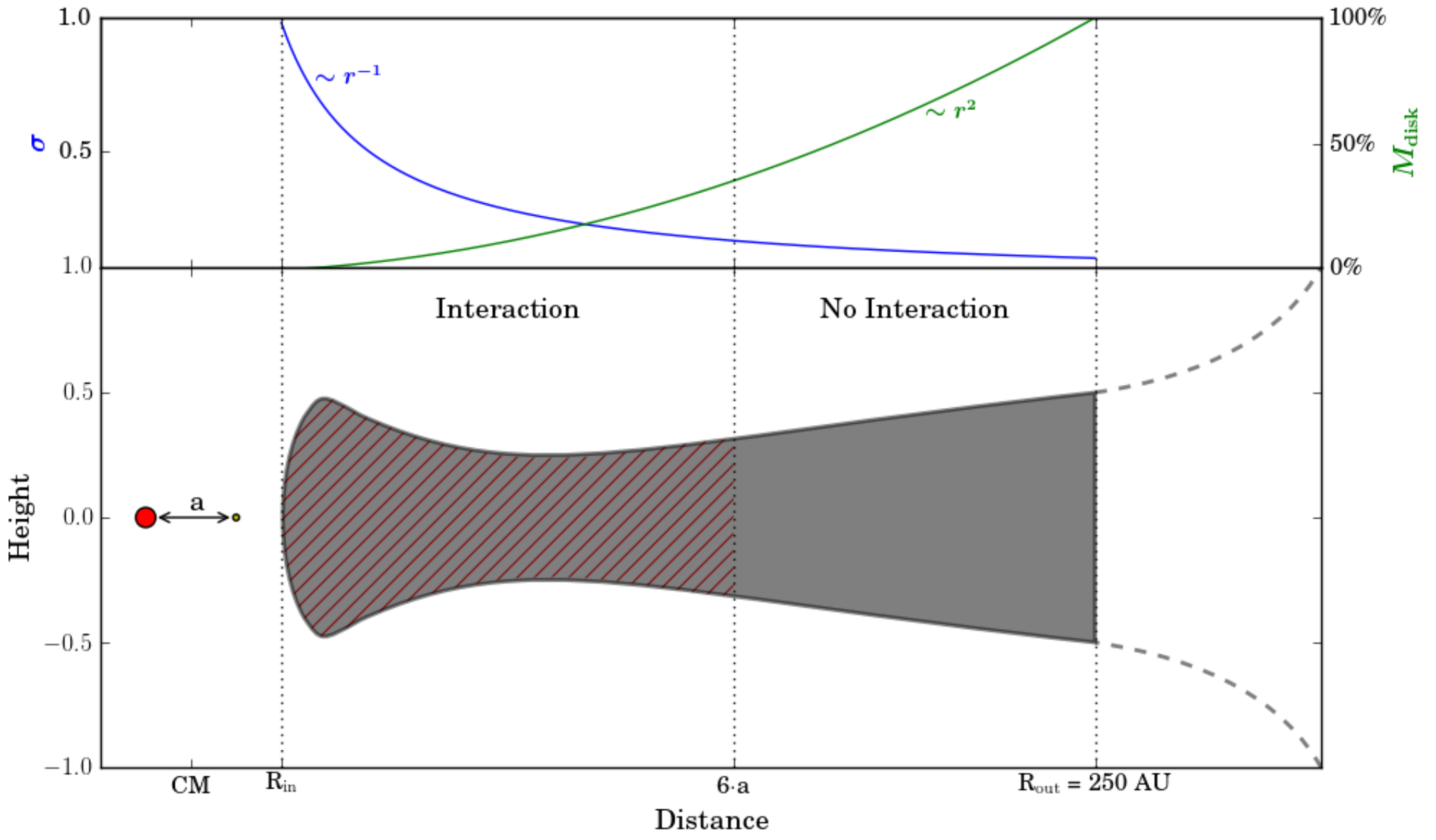
RLOF mass-loss fractions



Mass takes away the angular momentum from where it is lost: donor, companion or L2

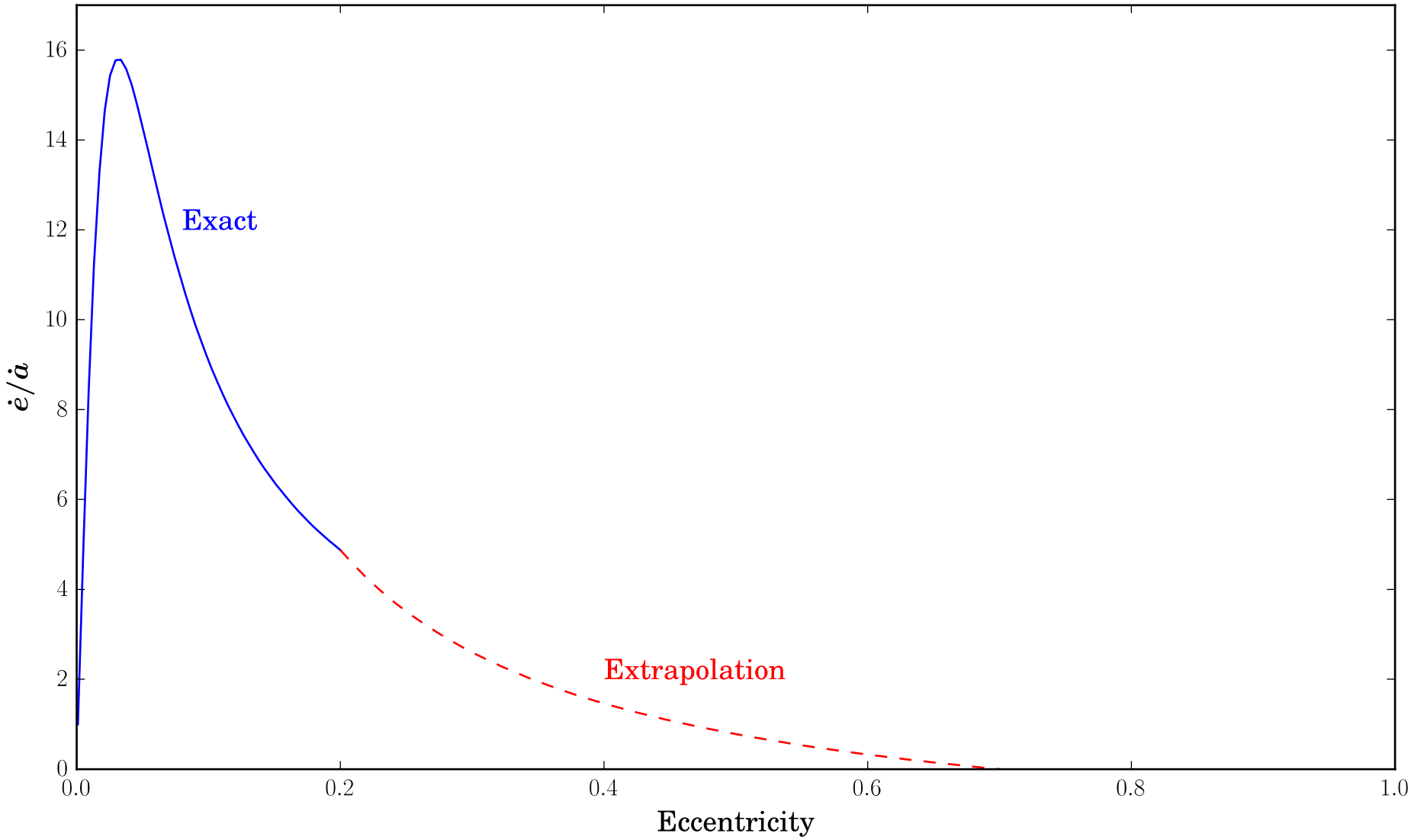
δ fraction feeds the CB disk

Circumbinary Disk parameters

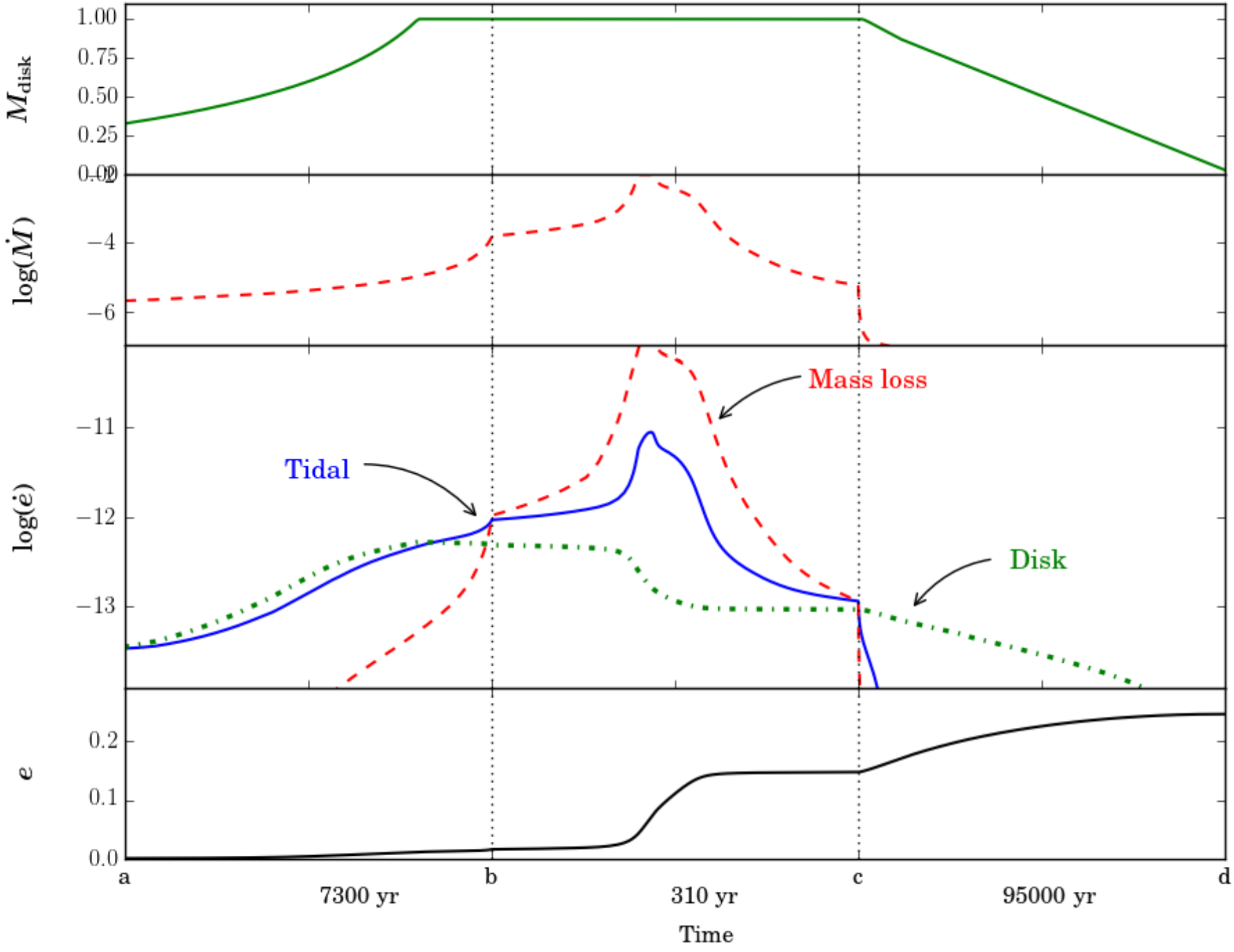


Circumbinary Disk edot

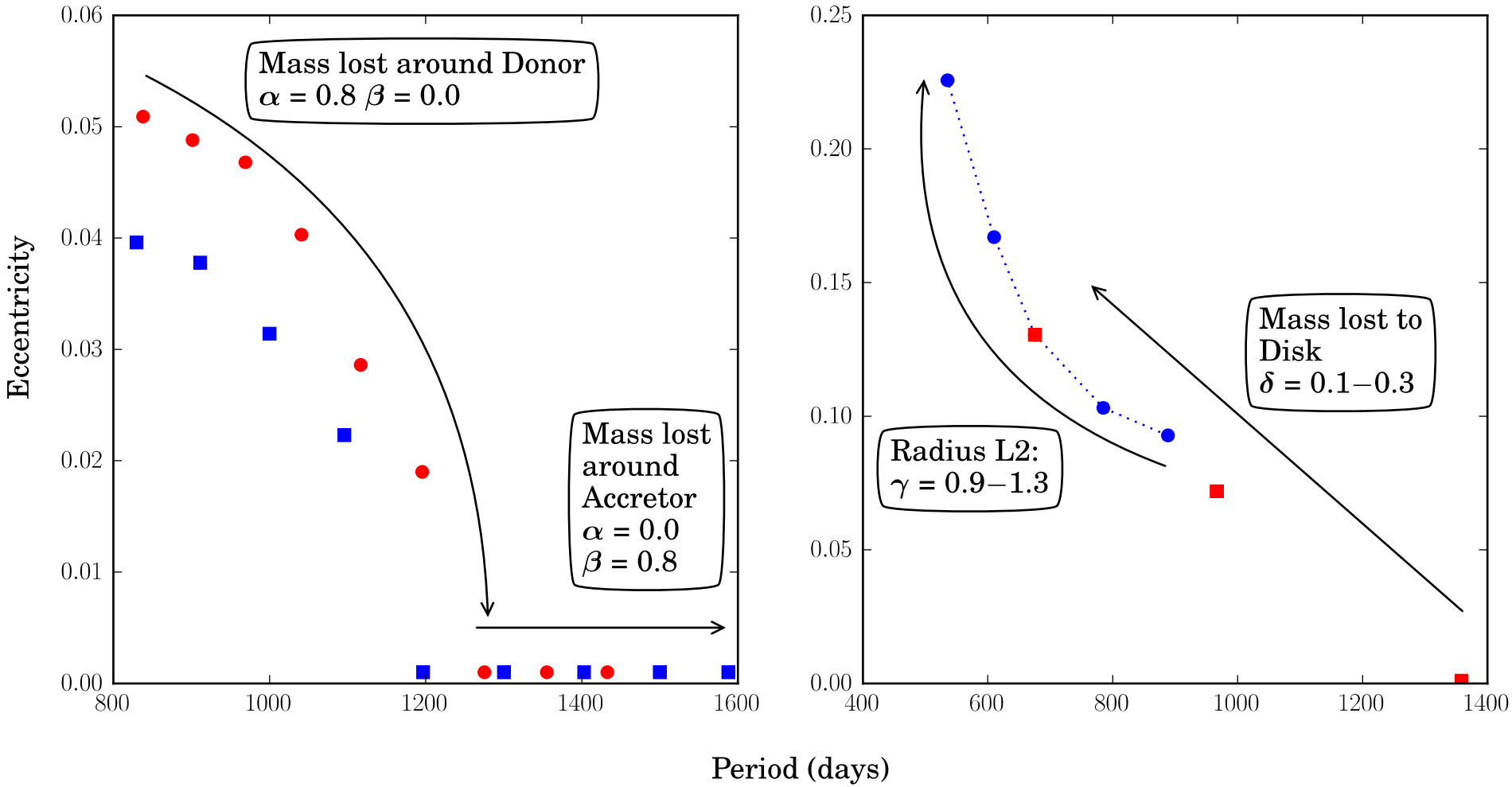
Eccentricity pumping depends on the orbital eccentricity



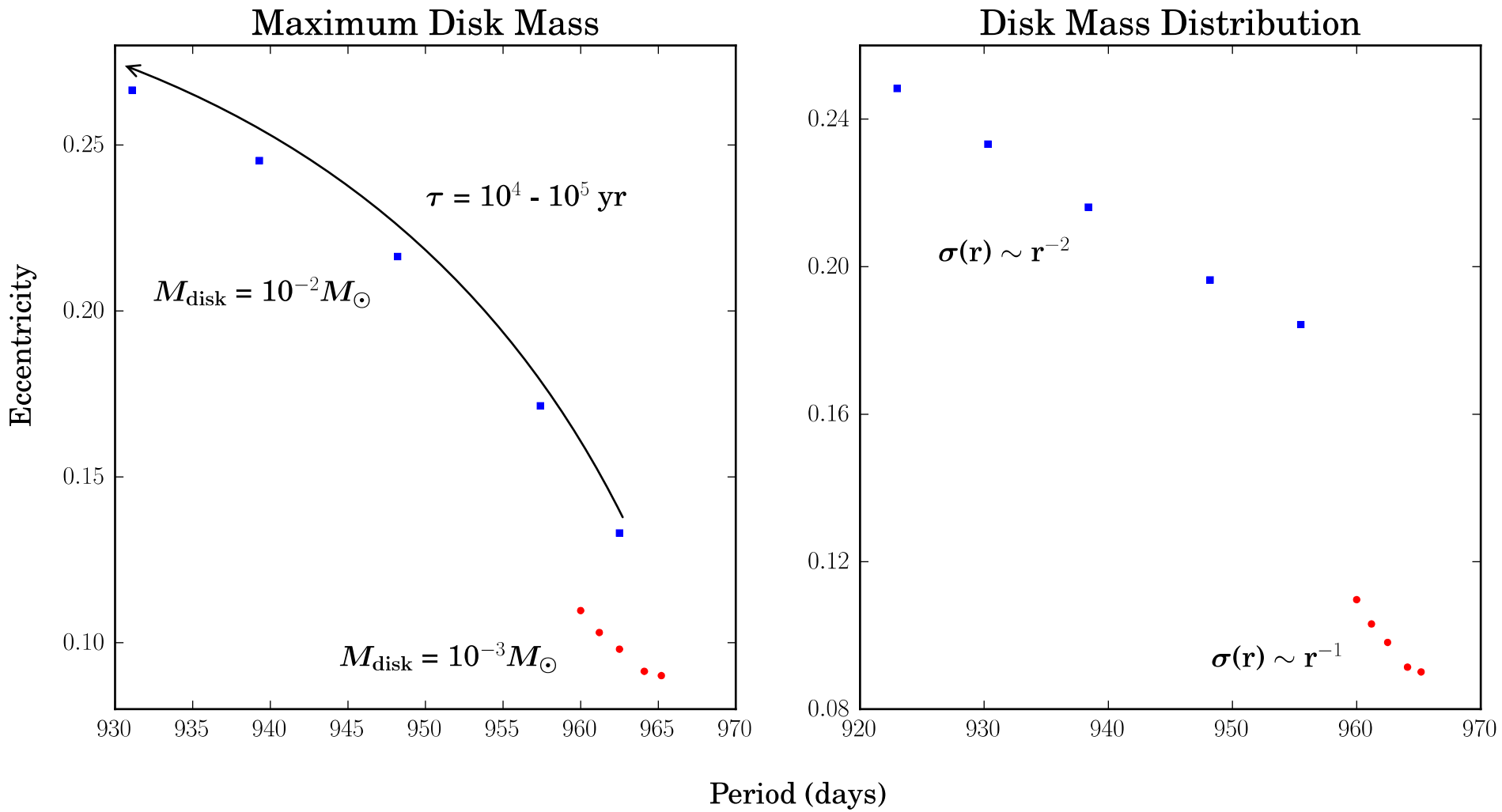
Eccentricity evolution in CB disk model



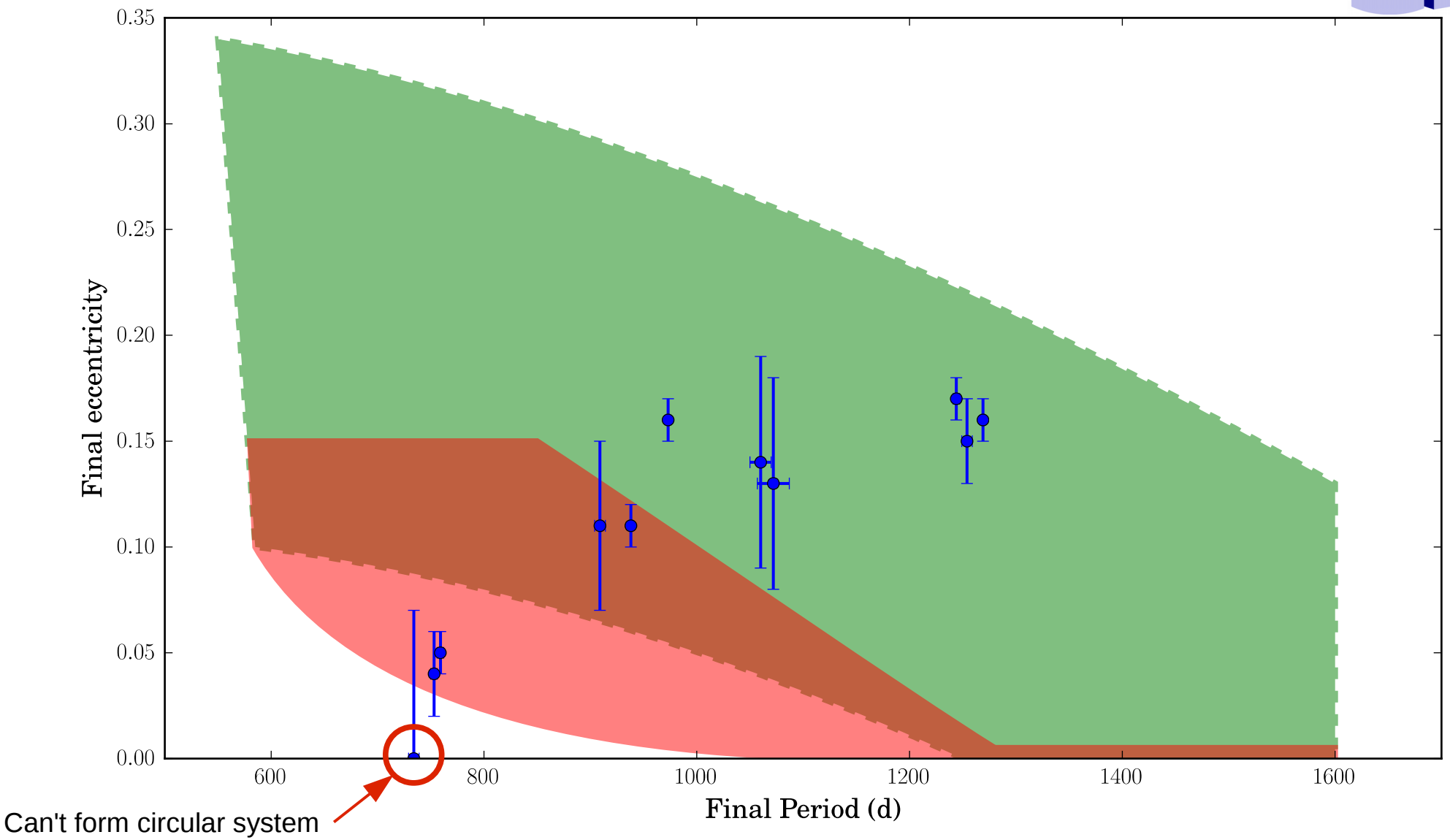
Parameter Effect - RLOF



Parameter Effect – CB disk



Period – Eccentricity Disk & RLOF



1) Only models with phase dependent RLOF
2) Models with phase dependent RLOF and a CB disk

Results & Conclusions

Created a small test sample for binary interaction mechanisms

MESA

Models allow for observed systems, but don't predict them.

Future prospects:

- Connection to He-WD and dust post-RGB binaries
- Population synthesis studies
- Search for evidence for CB disks
- Continue observing wide sdB binaries

This work was published as: Vos et al. 2015, A&A,579A, 49V
http://arxiv.org/abs/1505.03293