



Stellar Astrophysics in China: SONG & 50BiN

Contact binary as distance indicator in SONG era

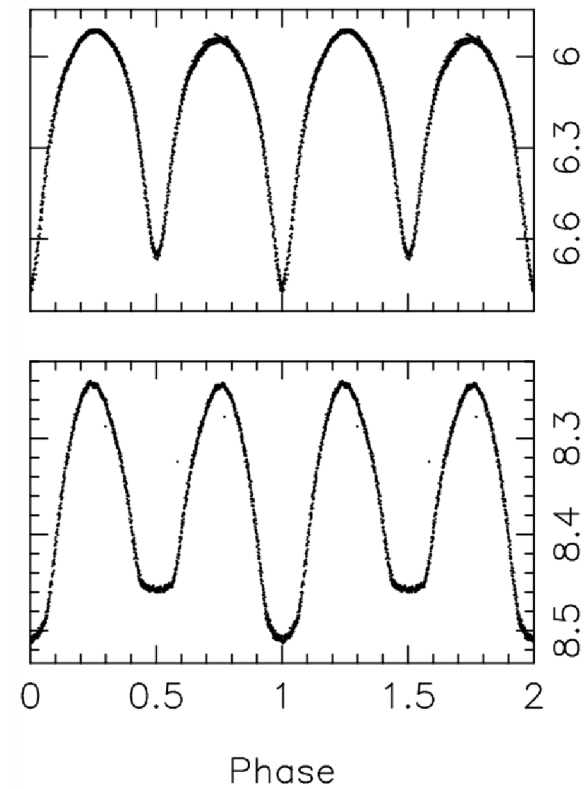
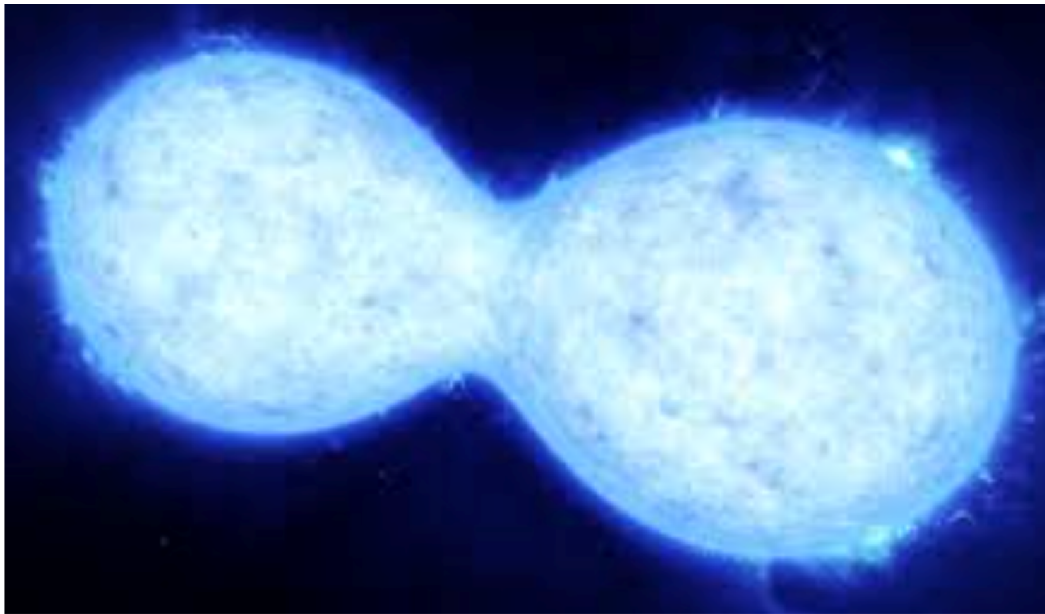
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Contact eclipsing binary (CB)

- Different to Semi-detached and Detached eclipsing binary



Period-Luminosity (color) Relations in theory

- Roche-lobe limit
- Eggleton's approximation (Eggleton 1983)

$$r_L = \frac{0.49q^{2/3}}{0.6q^{2/3} + \ln(1 + q^{1/3})}, \quad 0 < q < \infty .$$

- $P(\rho)^{1/2} = C (\sigma < 2\%)$

Period-Luminosity (PL) relation (W UMa-type)

- PL relation based on 21 CBs (Rucinski 2006)

$$V = -(12 \pm 2.0) \log P + (-1.5 \pm 0.8), \quad \sigma \sim 25\%$$

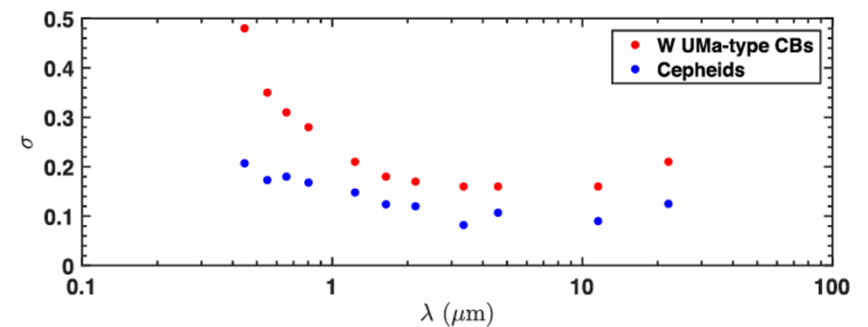
- NIR PL relations based on 66 CBs with open cluster and Hipparcos distances
 $\sigma \sim 9\%$ (Chen et al. 2016)

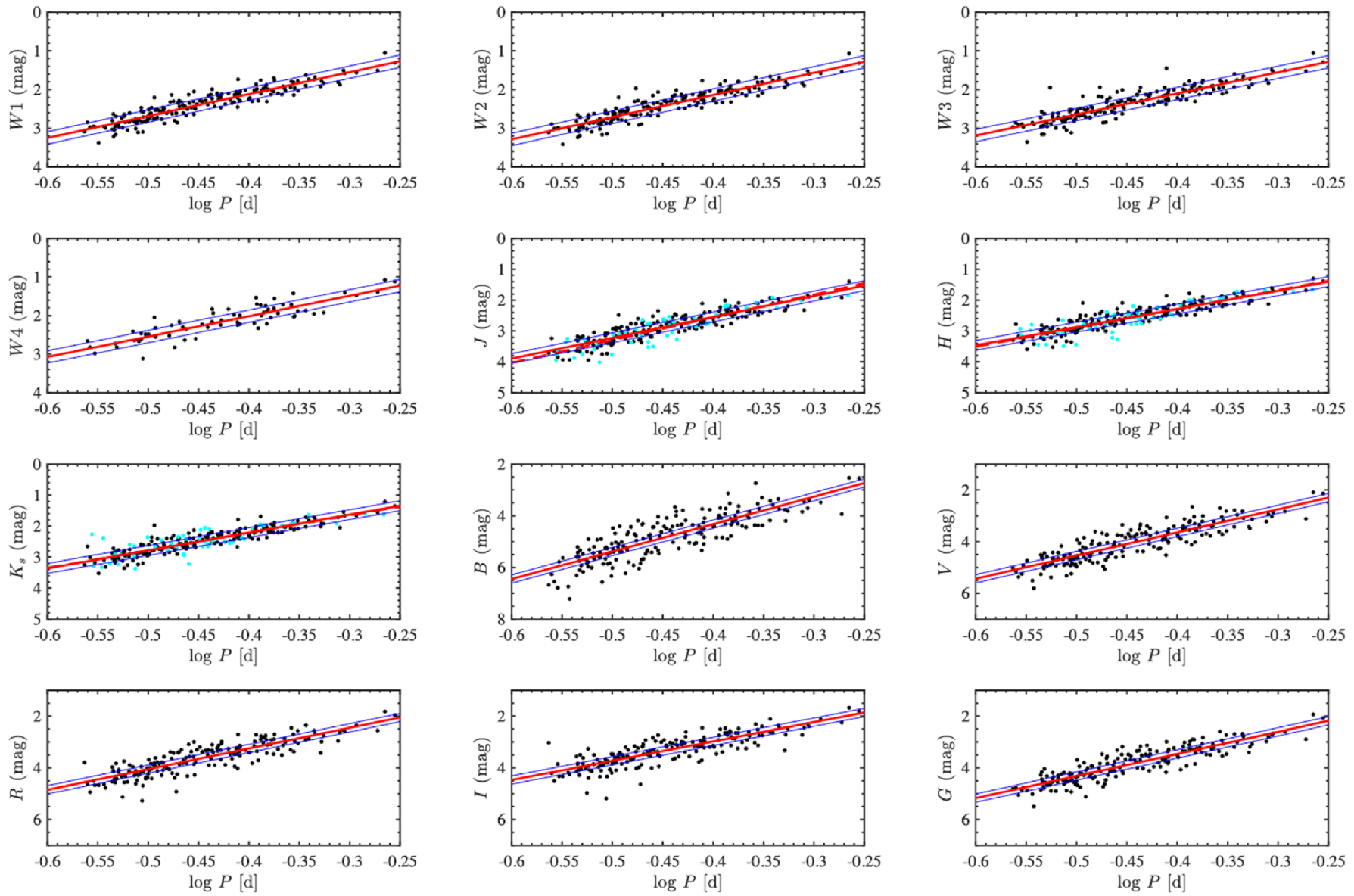
- 12 bands PL relations based on Gaia DR 1 (143, near-by < 300 pc)

WISE W1 $\sigma = 7\%$ (Chen et al. 2018a)

- Updated by Gaia DR 2

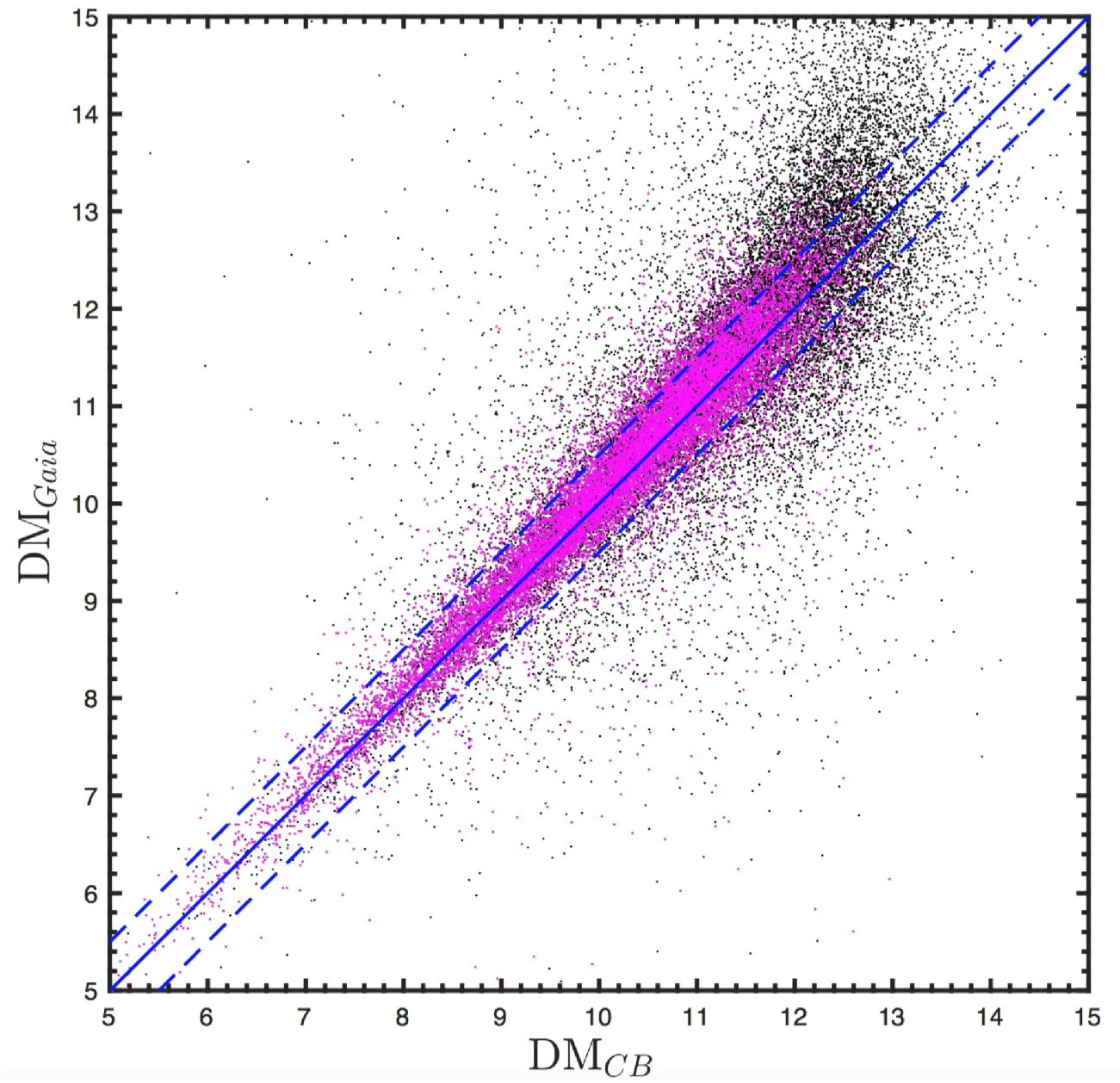
$\sigma = 6\%$





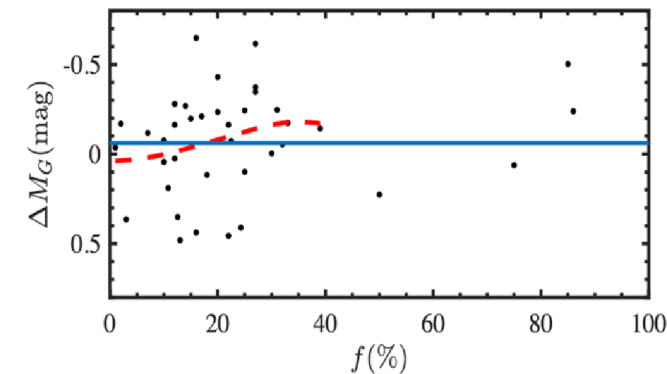
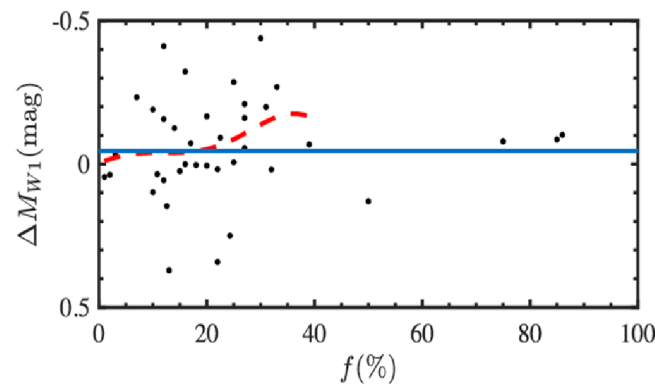
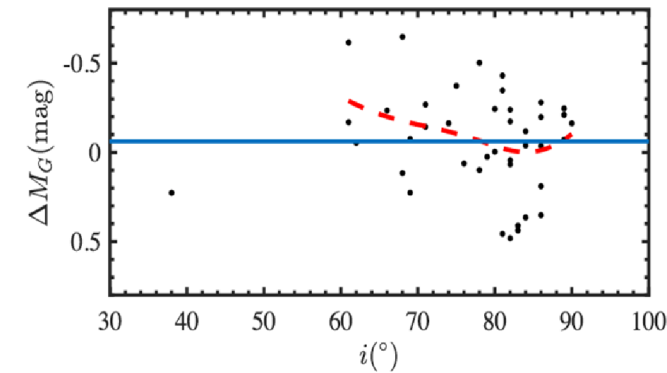
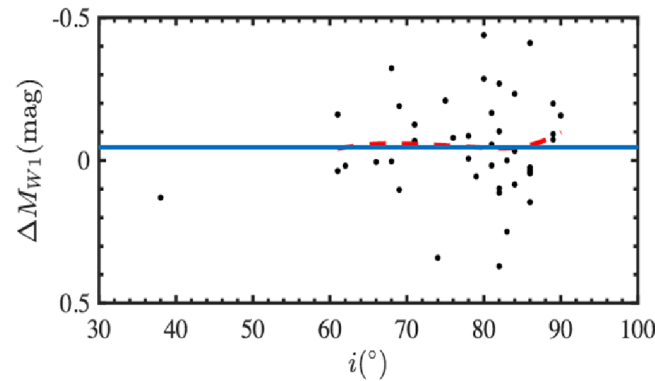
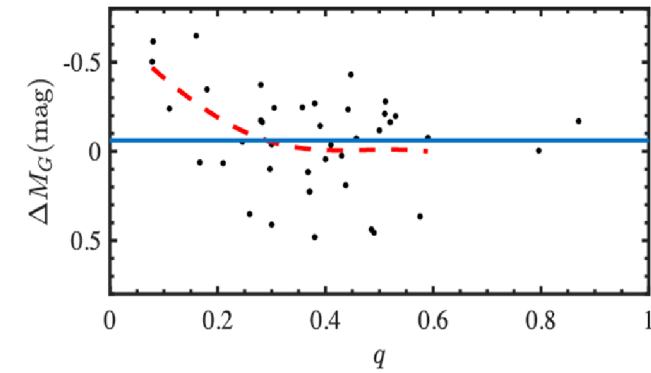
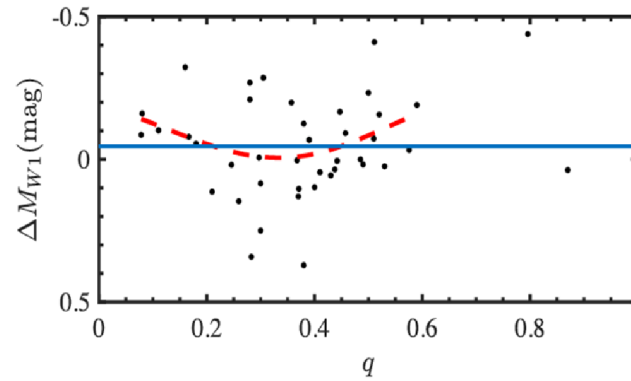
(Chen et al. 2018a)

- Distance moduli comparison to Gaia DR 2

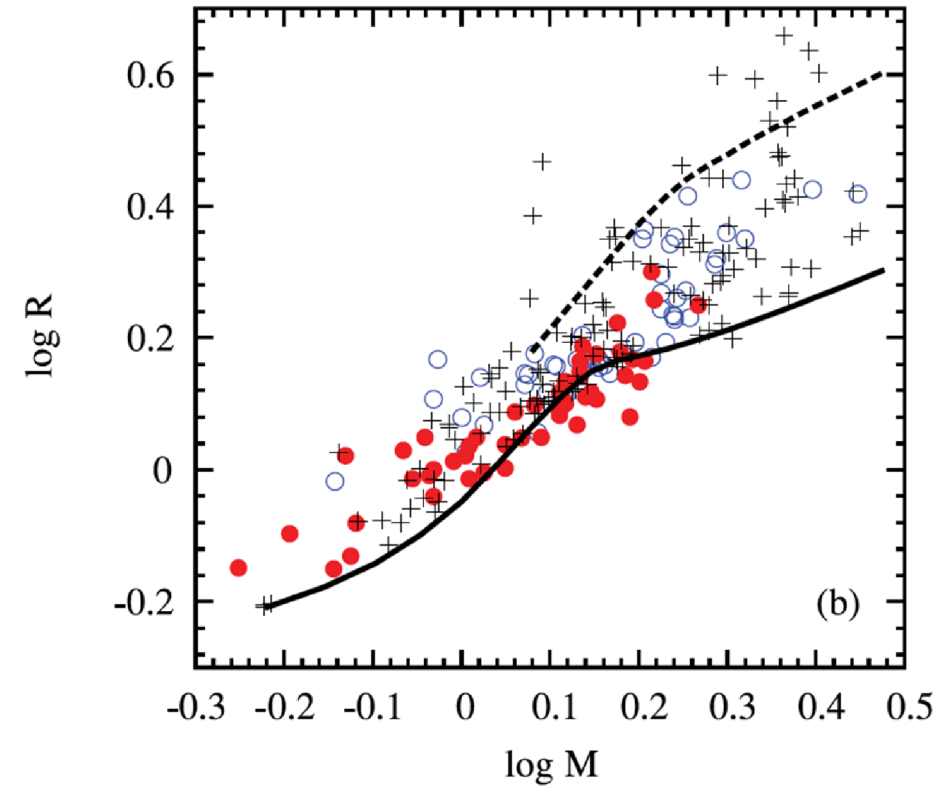
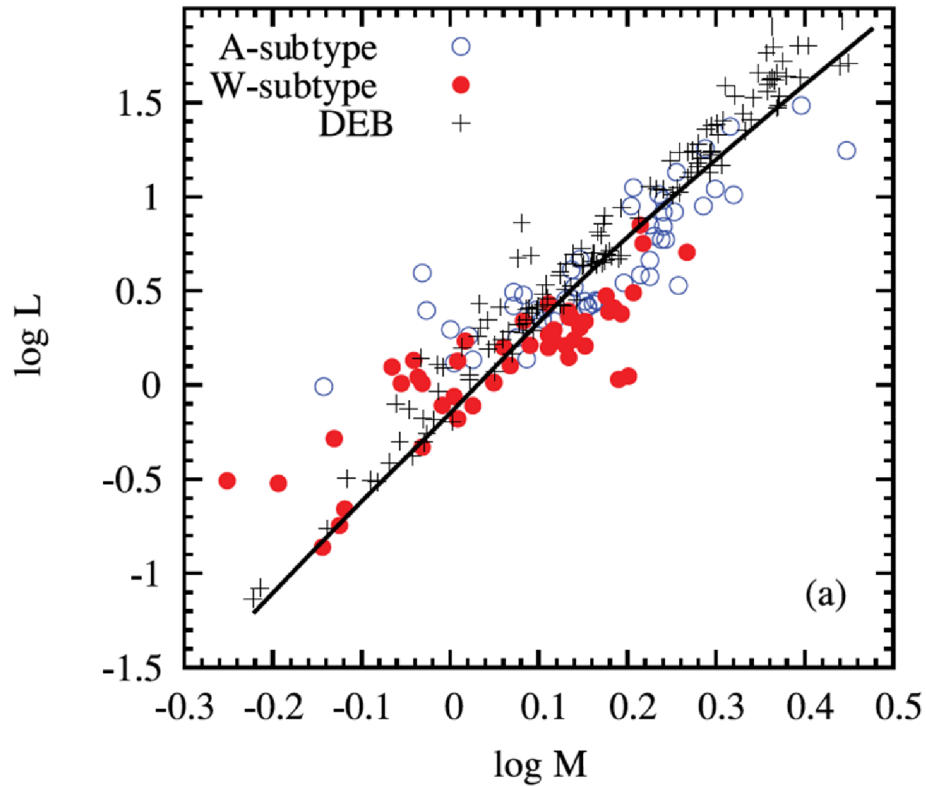


SONG on CB

- **Homogenous** RV curve from SONG and light curves from literature.
- Better constraint of mass ratio q , inclination i , fill-out factor f .
- **>100 CBs**



- Mass-luminosity relation



- Parameters constraint
- Gaia DR 3-4
- Accuracy < 5%

Yıldız & Dogan 2013

Distance indicators

- Number, huge increase!
- ASAS-SN (Jayasinghe et al. 2018), ATLAS (Tonry et al. 2018), WISE variable catalog (Chen et al. 2018b) ... Gaia DR 3

	Cepheid	RR Lyrae	Contact binary
Distance accuracy	3%	4-5%	6% (< 5% soon!)
Age	<100 Myr	>10 Gyr	100 Myr ~ 10 Gyr (4 Gyr)
Number in Galaxy (known)	2, 000-3, 000	>100, 000	>200, 000
Number in Galaxy (will be in Gaia)	6, 000-9, 000	~200, 000	~1 million (fraction 0.2%)