A space scene with a large red star on the left, two smaller planets in the upper center and right, and a large planet in the foreground on the right. The background is a dark blue space filled with stars.

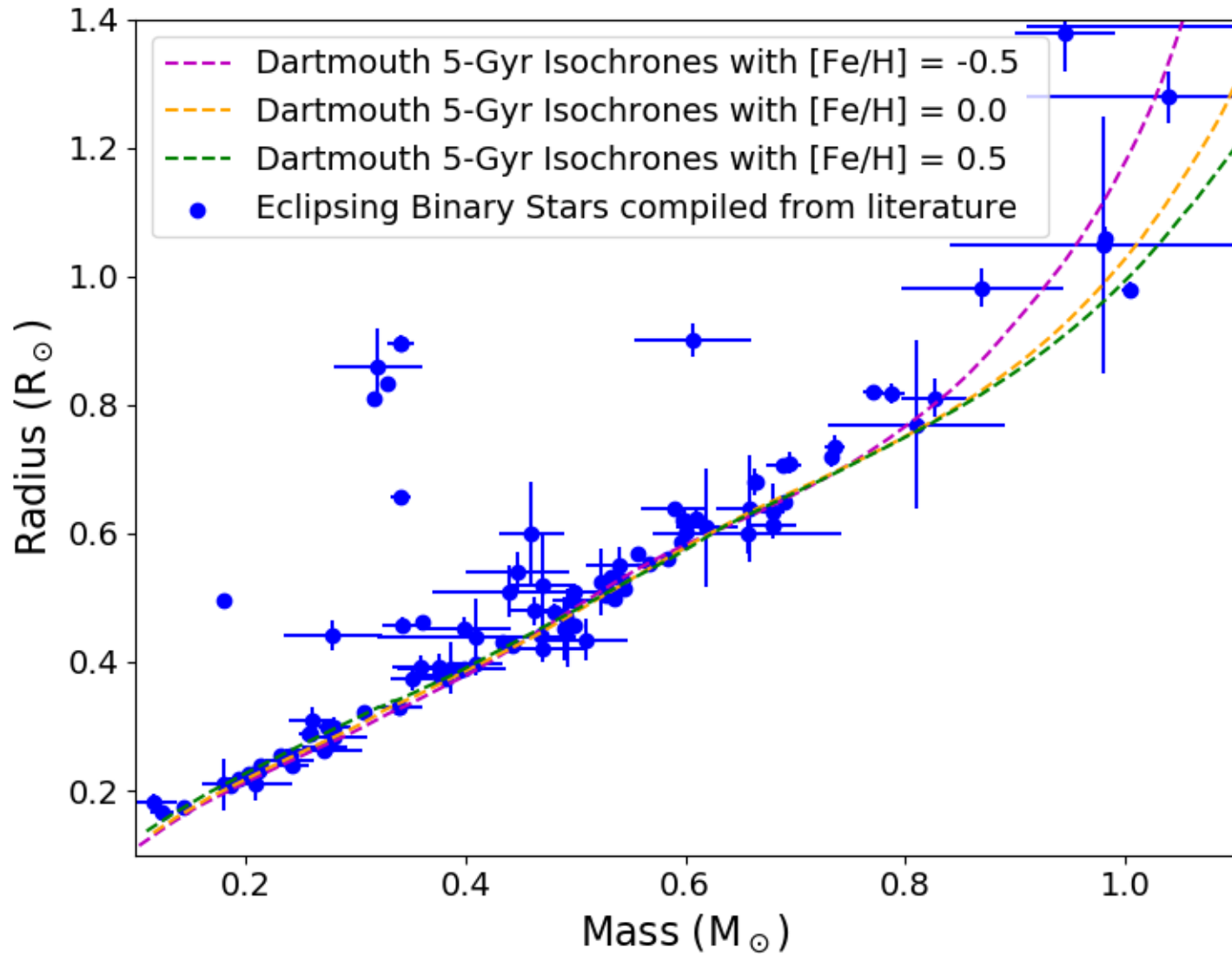
Magnetic Inflation and Stellar Mass of M dwarf stars

Eunkyu Han
Boston University

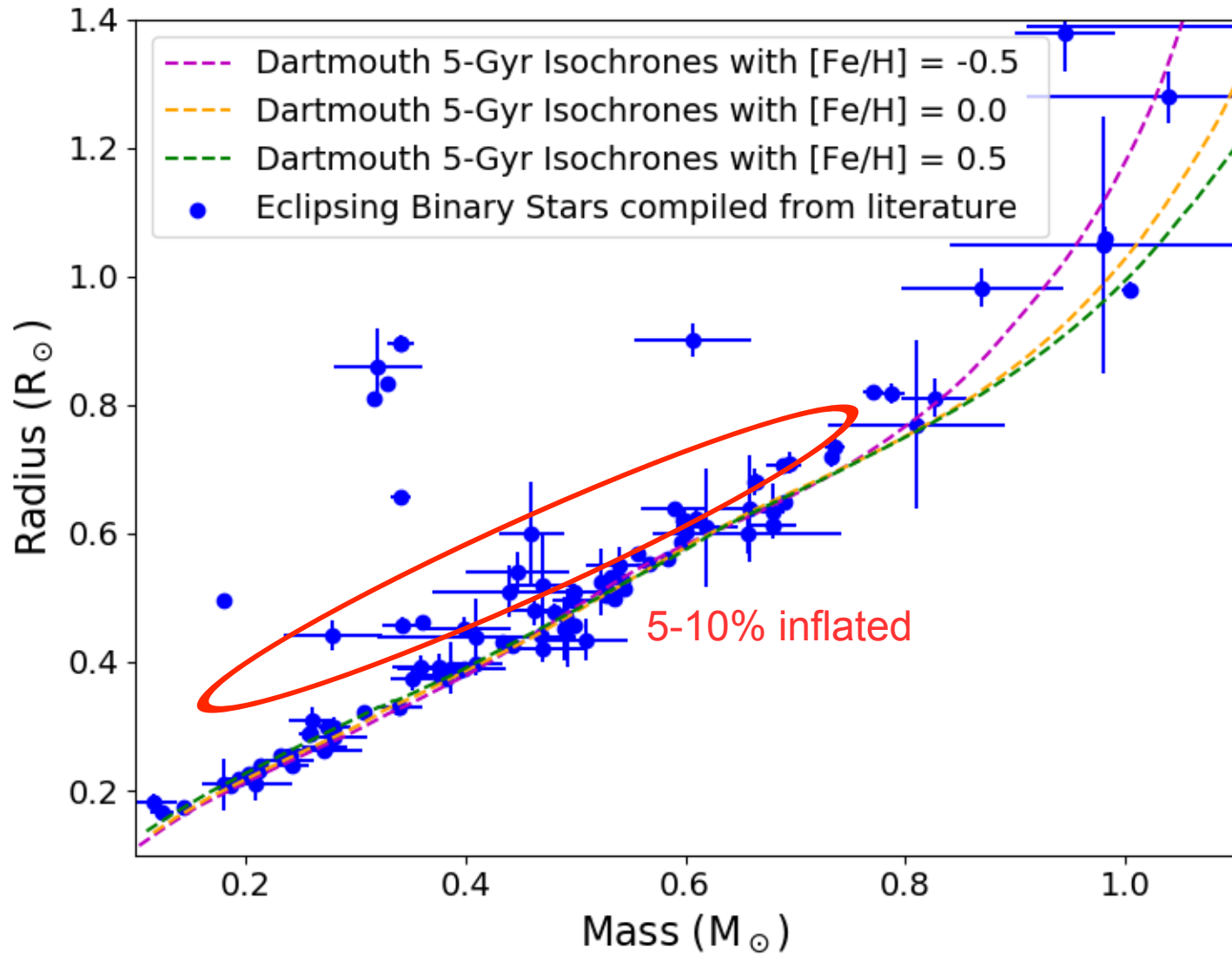
Collaborators:

Philip S. Muirhead, Jonathan J. Swift, Christoph Baranec, Nicholas M. Law, Reed Riddle, Dani Atkinson, Gregory N. Mace, Daniel DeFelippis

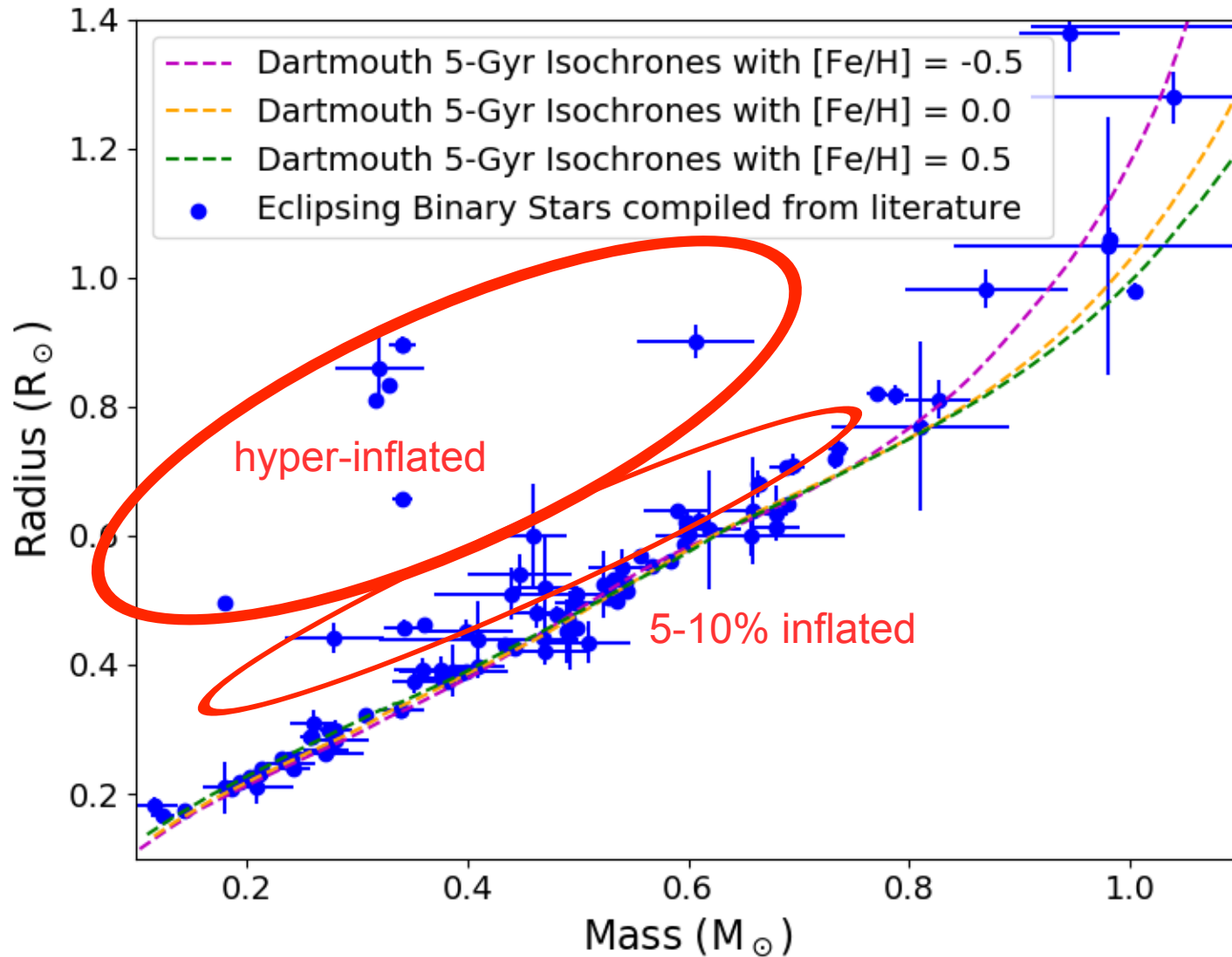
Empirical measurements of EBs have large scatter



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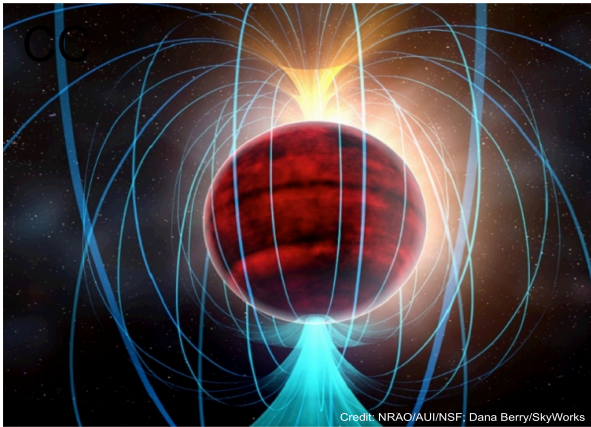


Empirical measurements of EBs have large scatter



Strong magnetic fields can lead to an increase in the radius of a low-mass star

1. Through the inhibition of the convective heat transfer



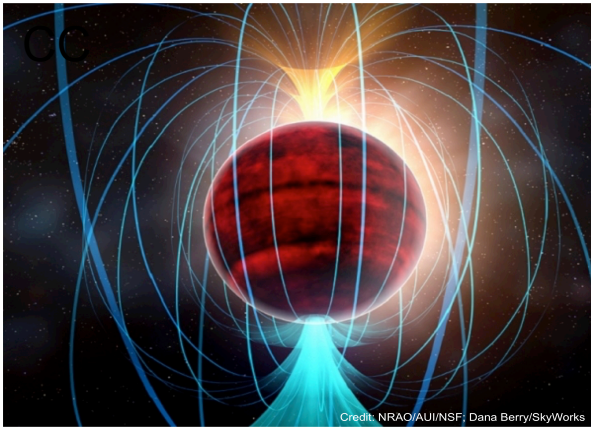
$$\nabla > \nabla_{ad}$$

where $\nabla = \frac{\partial \log T}{\partial \log P}$

Gough & Tayler 1965

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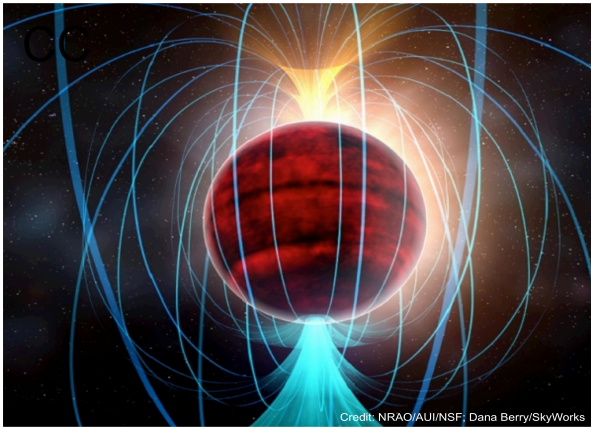
$$\nabla > \nabla_{ad} + \delta \quad \text{where} \quad \nabla = \frac{\partial \log T}{\partial \log P}$$

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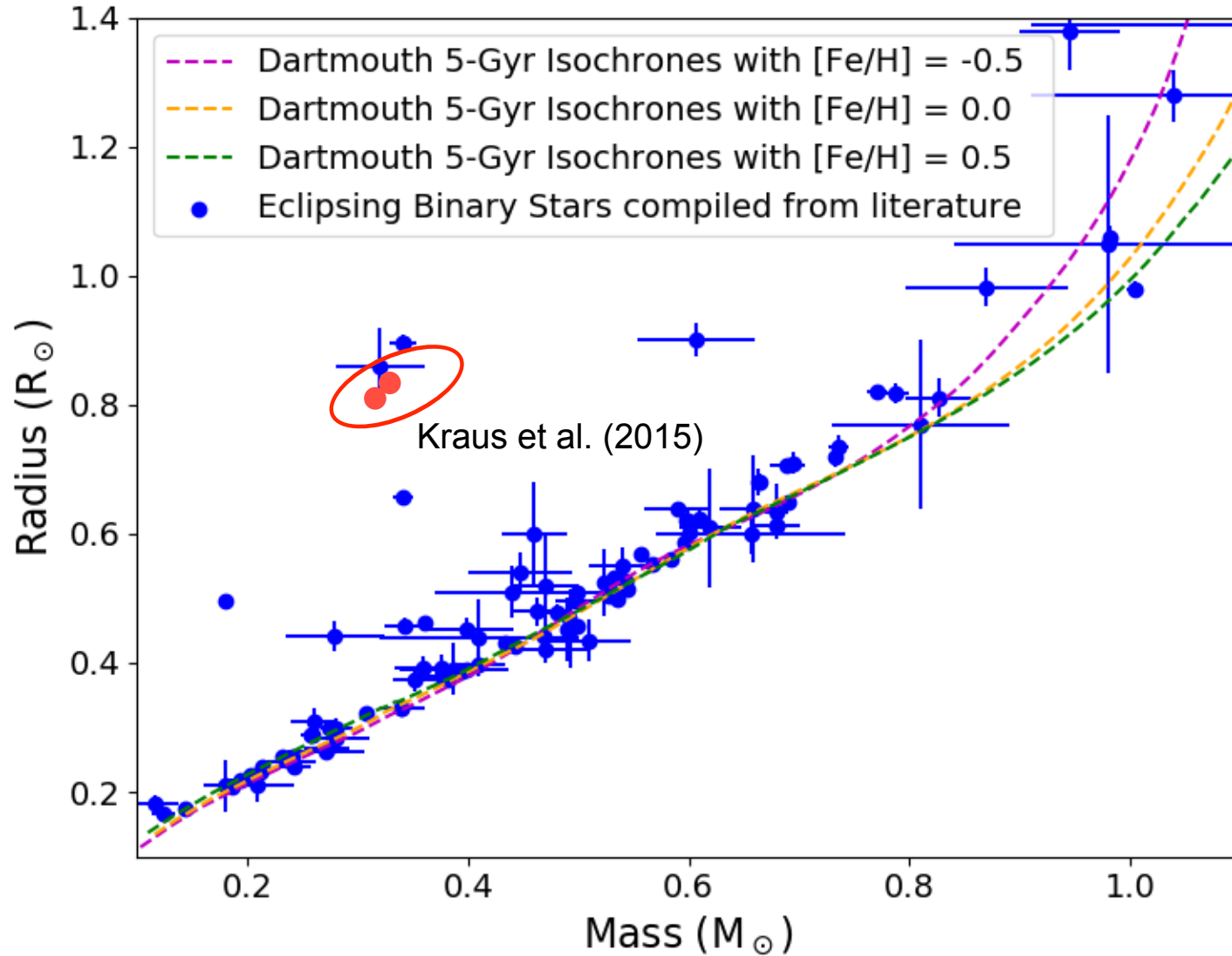
2. Through the the generation of dark spots on the stellar surface



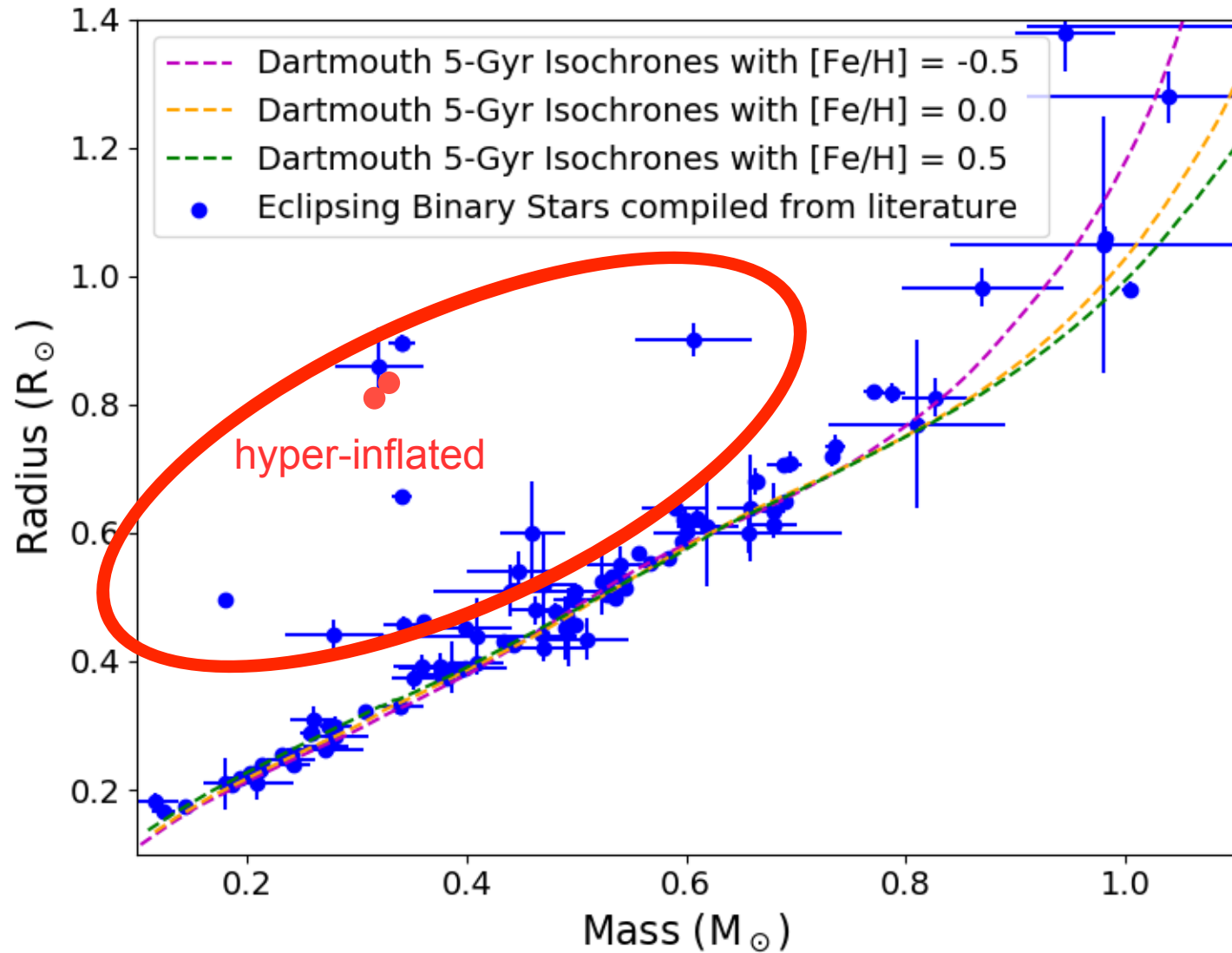
$$L = 4\pi R^2 \sigma [(1 - f_s) T_{star}^4 + f_s T_{spot}^4]$$

$f_s = \text{fractional spot coverage}$

Young EBs and their inflated radii

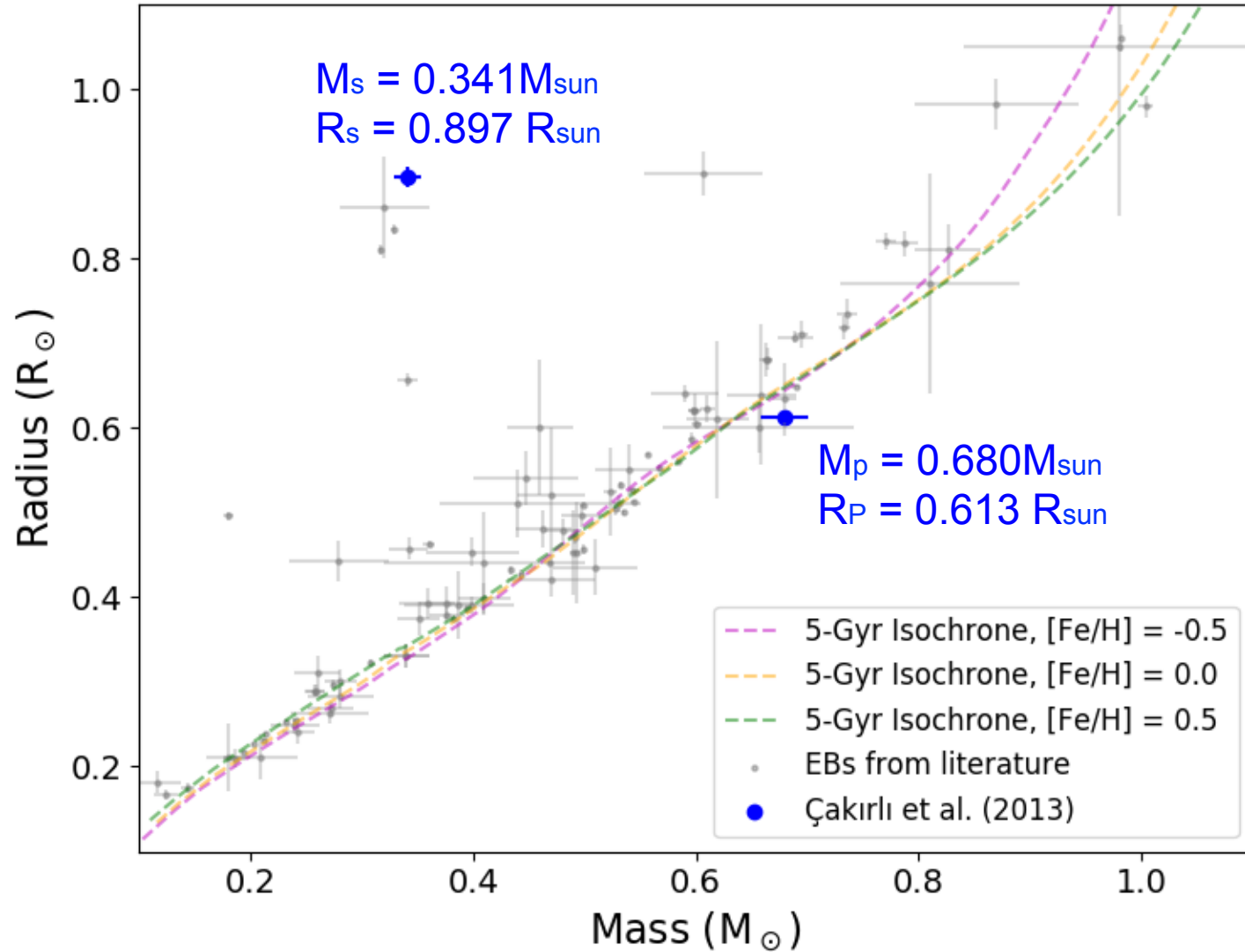


Are the hyper inflated M dwarfs real?



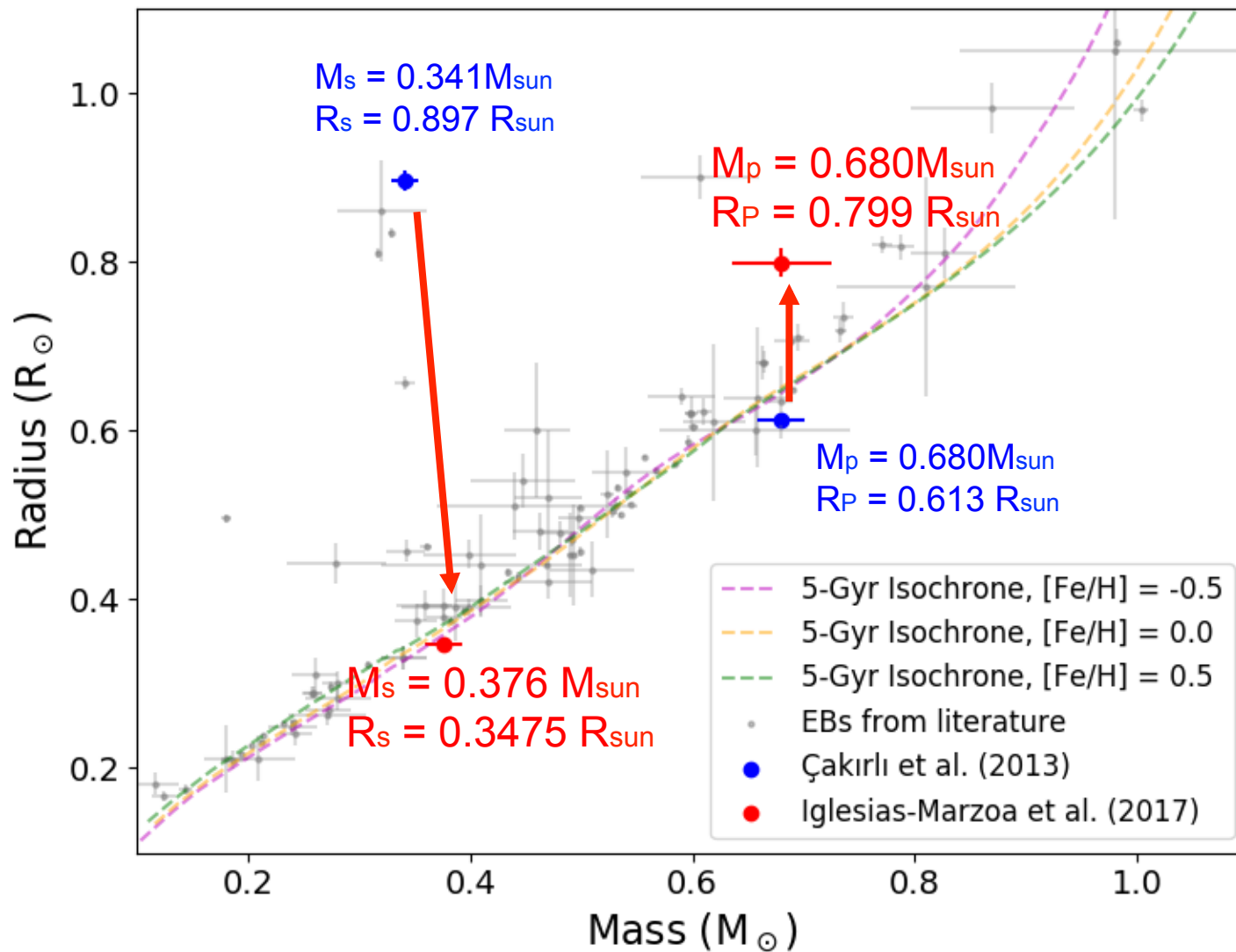
Case study I: KIC 10935310

From Cakirli et al. (2013)



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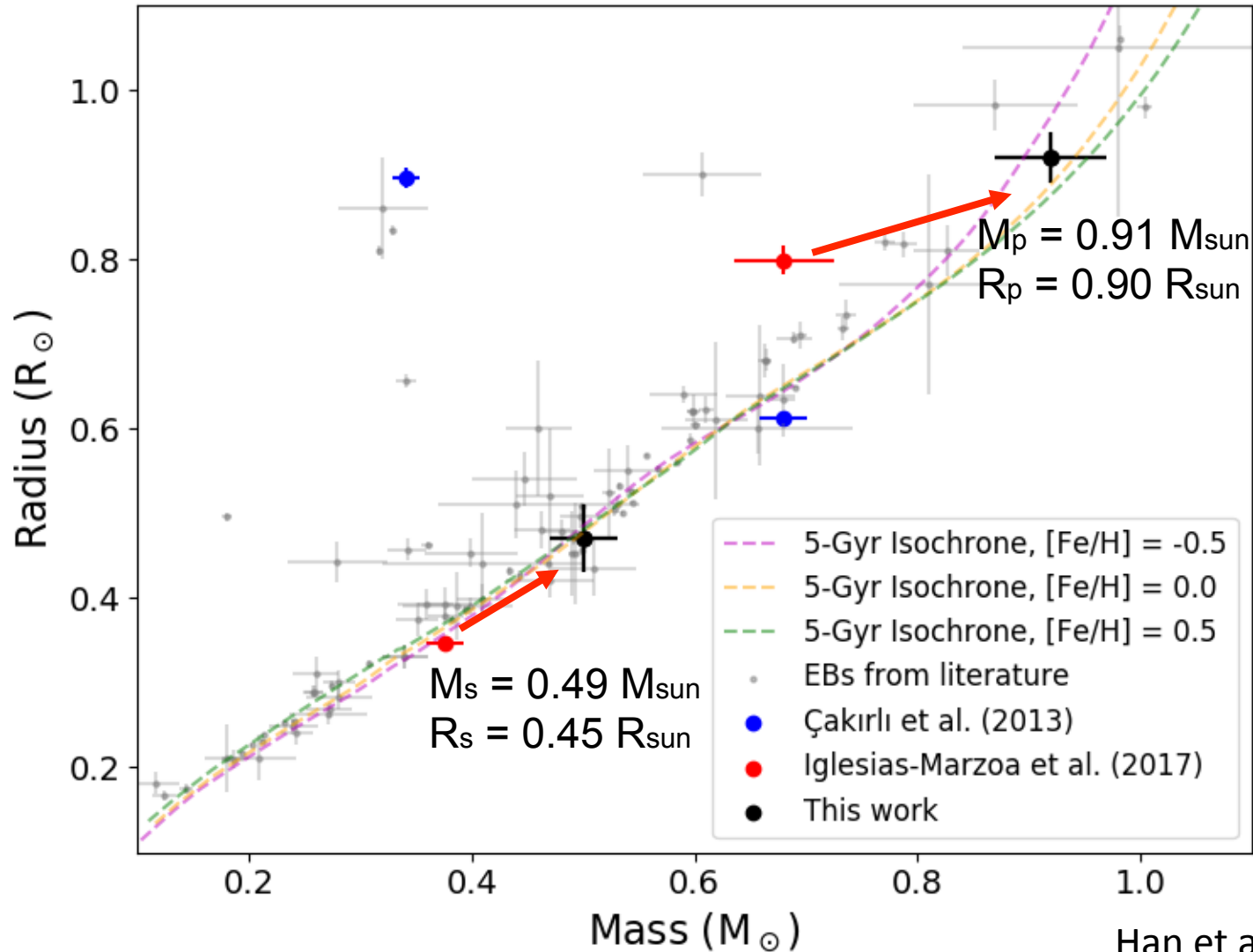
From Iglesias et al. (2017)



Case study I: KIC 10935310

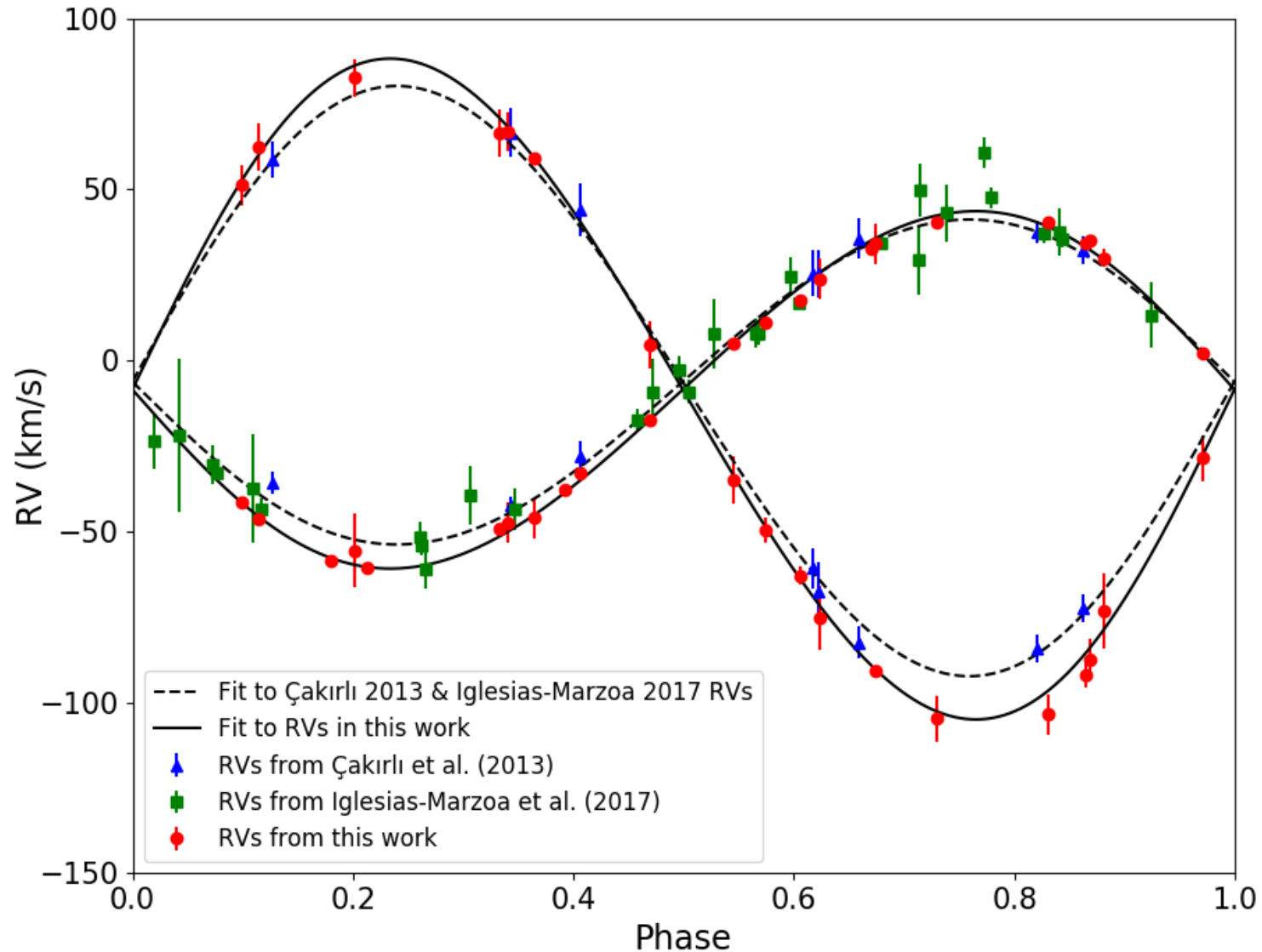
From Han et al. (2017)

Neither of the components are inflated

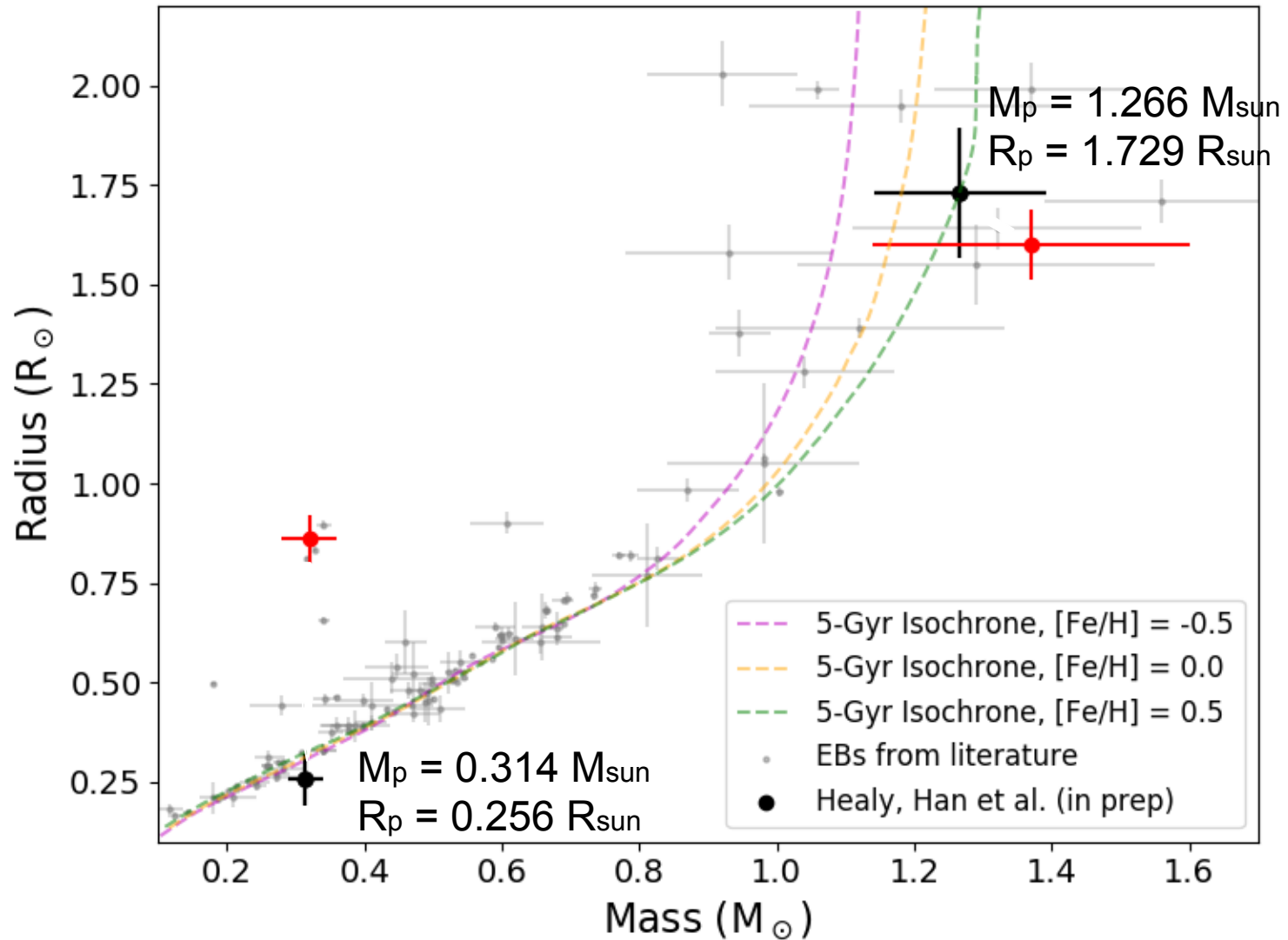


Han et al. (2017)

High-resolution near-infrared SB2 spectroscopy is the key



Case study II: T-Lyr0-08070



Conclusion

1. Magnetic hyper inflation of M dwarfs may not be real
 - Neither of KIC 10935310's components are inflated (Han et al. 2017)
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3. Care must be taken when analyzing EB data

A space scene featuring a large, bright red star in the upper left. Two smaller, dark planets are visible in the upper right. The foreground is dominated by the curved, cratered surface of a large planet, likely Mars, which is reddish-brown in color. The background is a dark blue space filled with numerous small, distant stars.

Questions?