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ASTROPHYSICS

HARVARD & SMITHSONIAN

Microlensing: State of the Field

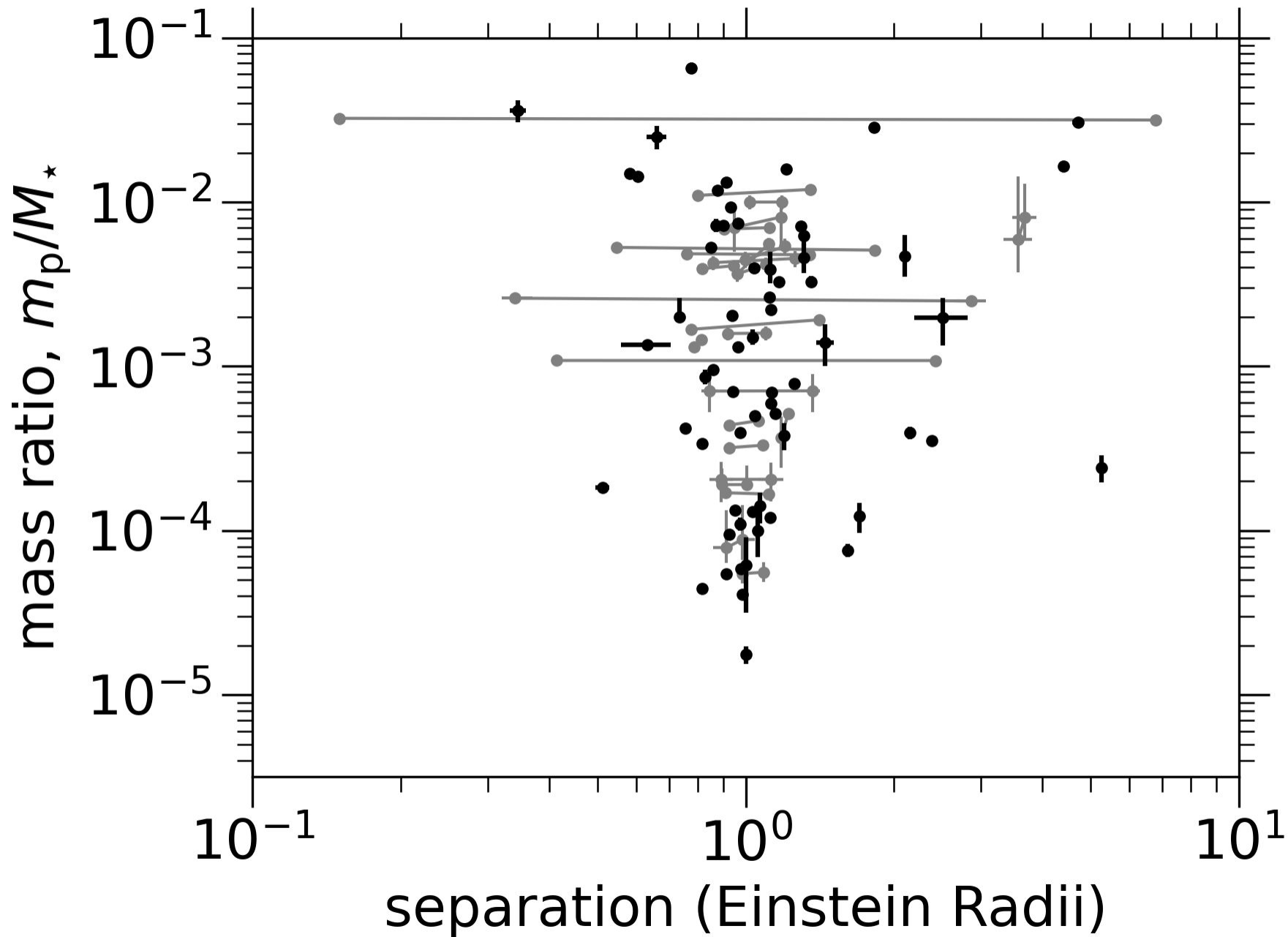
Dr. Jennifer Yee

EXOPAG

January 5, 2021

Microensing Has Found Approximately...

- a) 30 planets
- b) 65 planets
- c) 100 planets

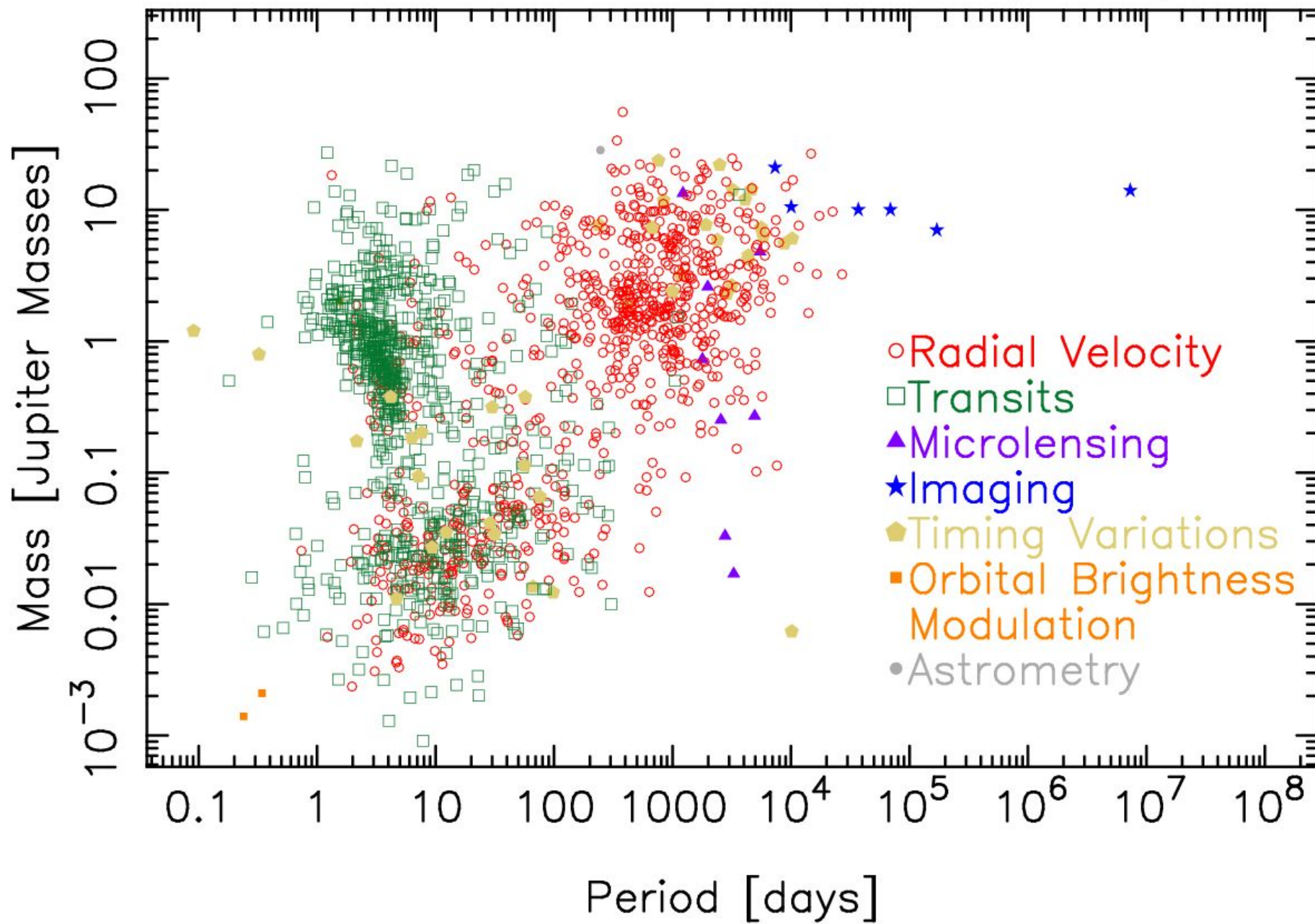


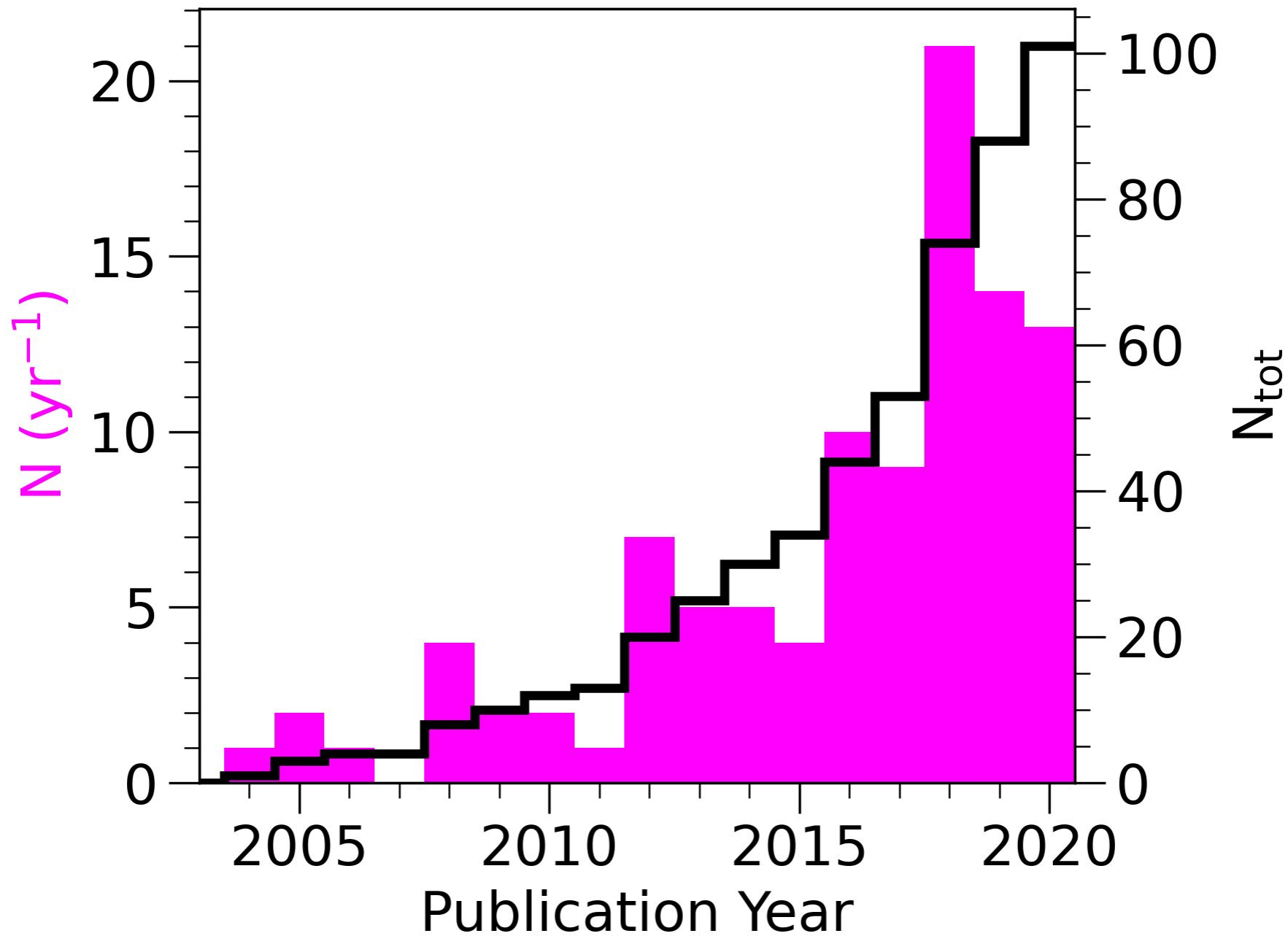
Data (mostly) from the Exoplanet Archive as of 10/27/20

Mass – Period Distribution

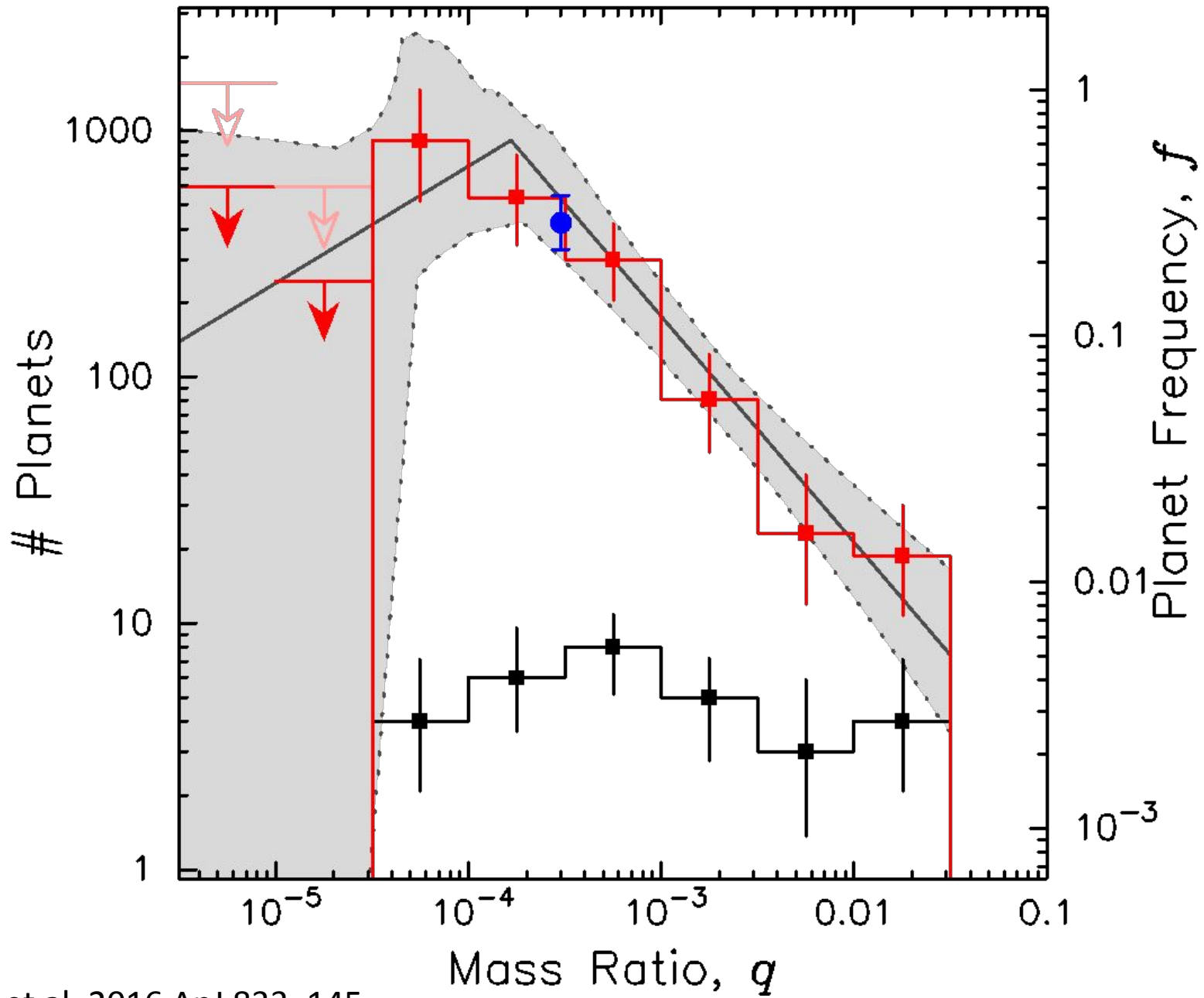
08 Dec 2020

exoplanetarchive.ipac.caltech.edu

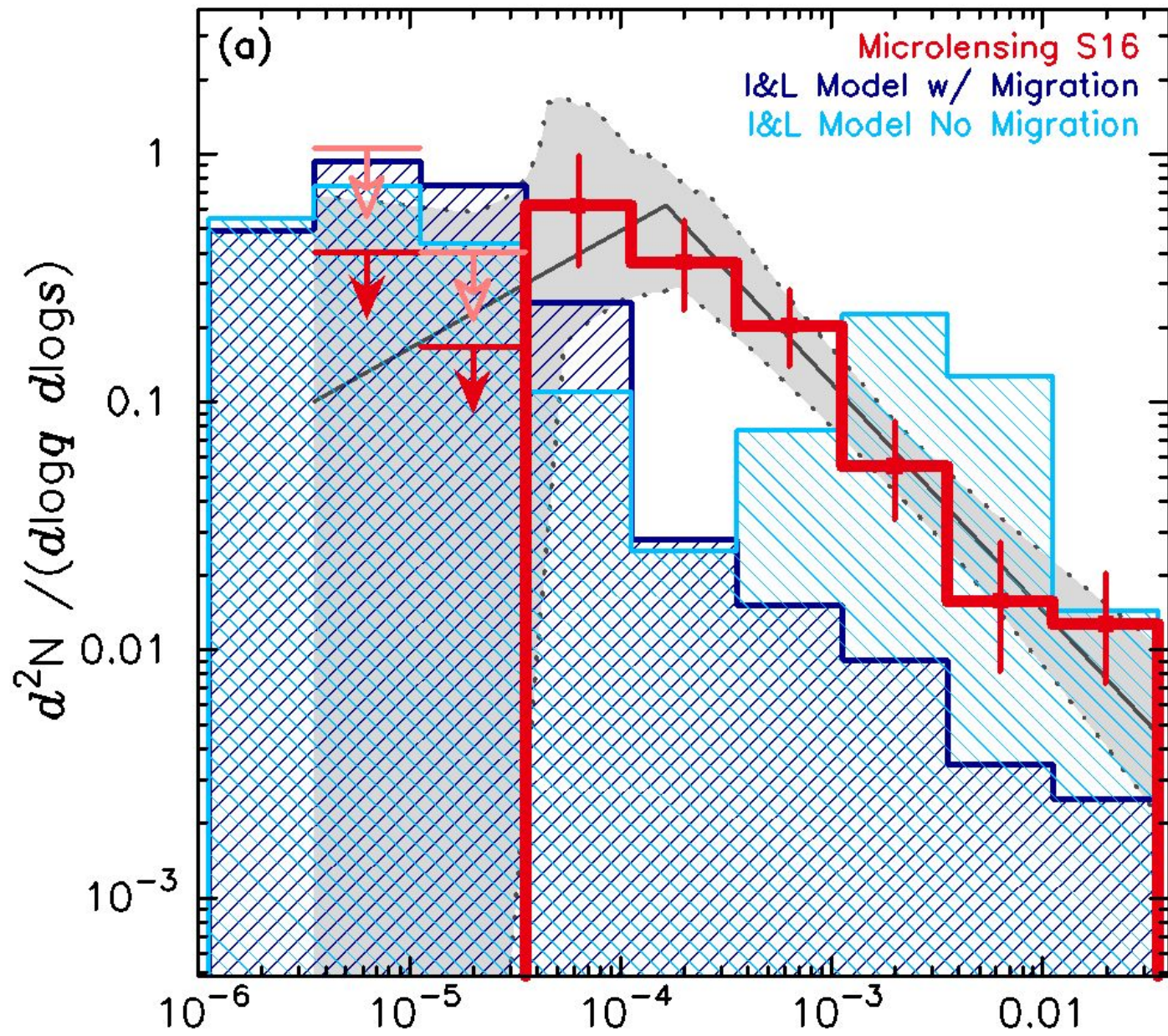


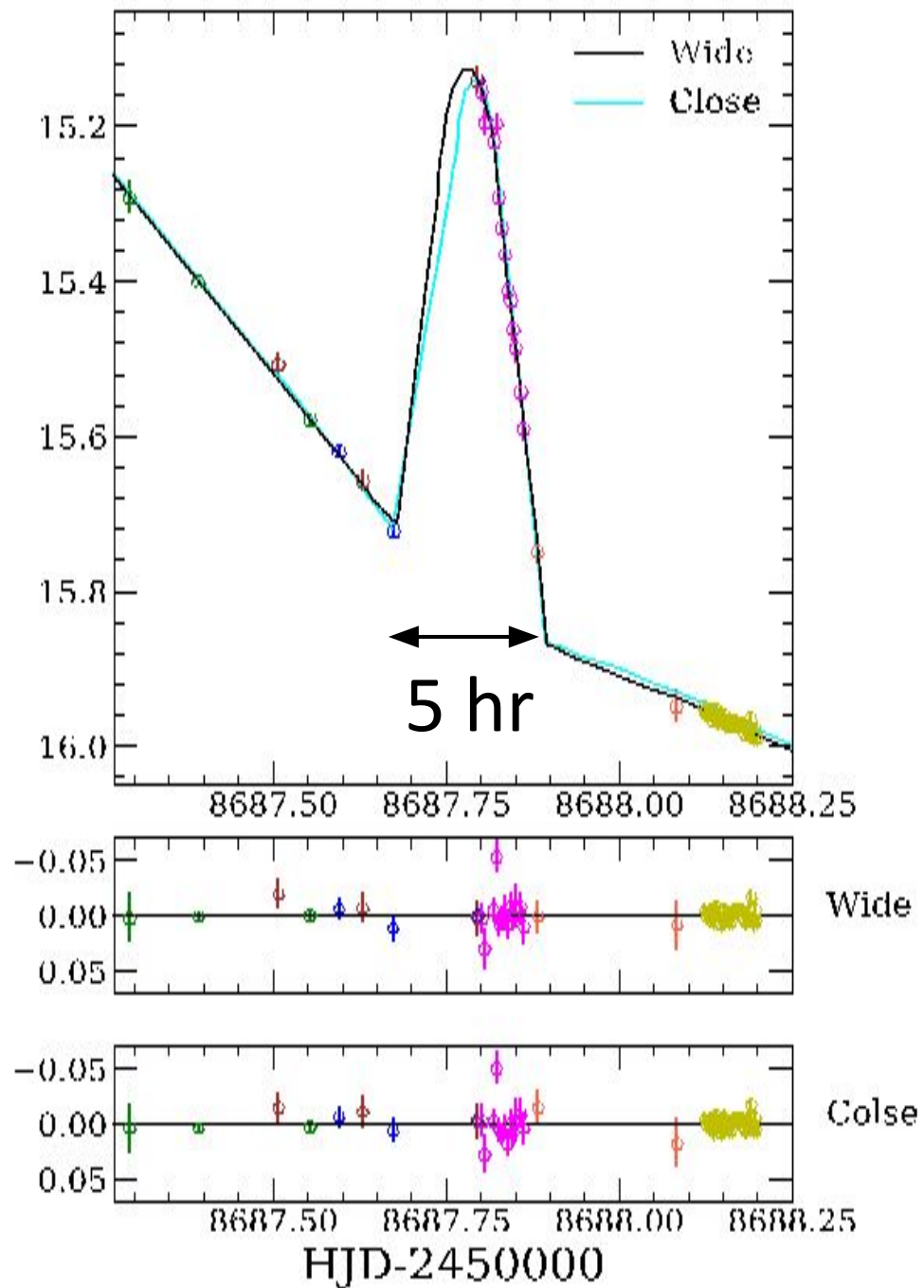
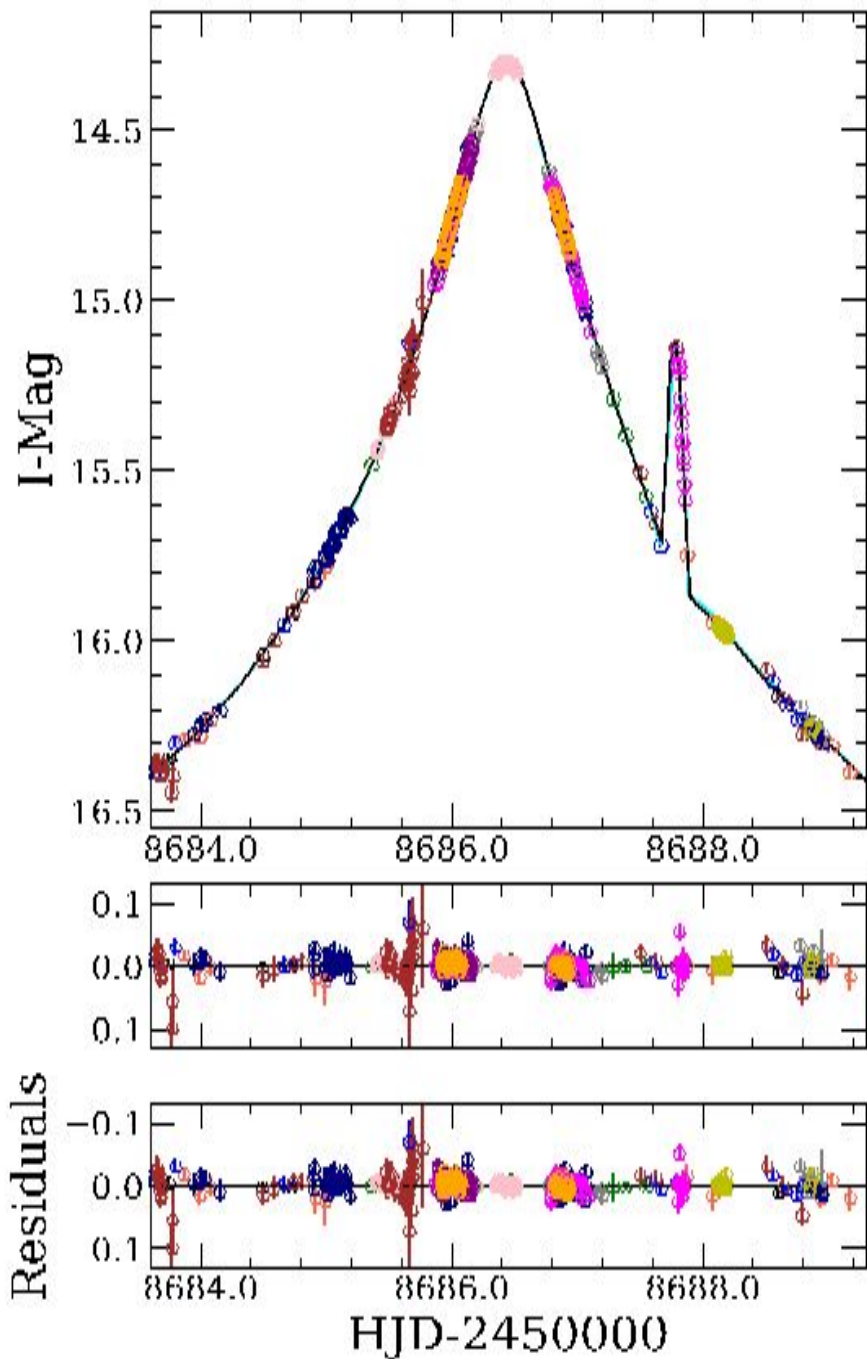


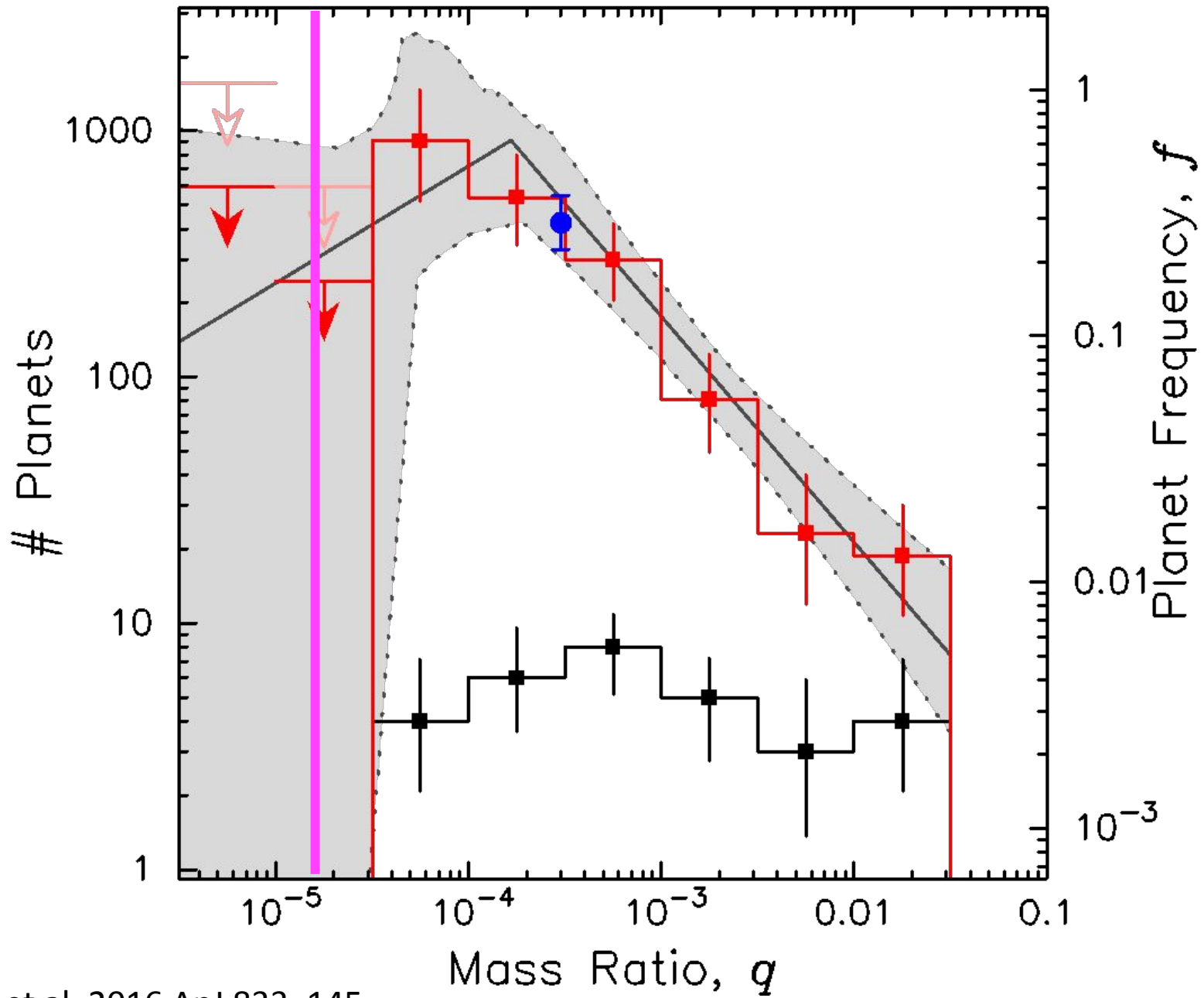
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Cold Planet Distribution

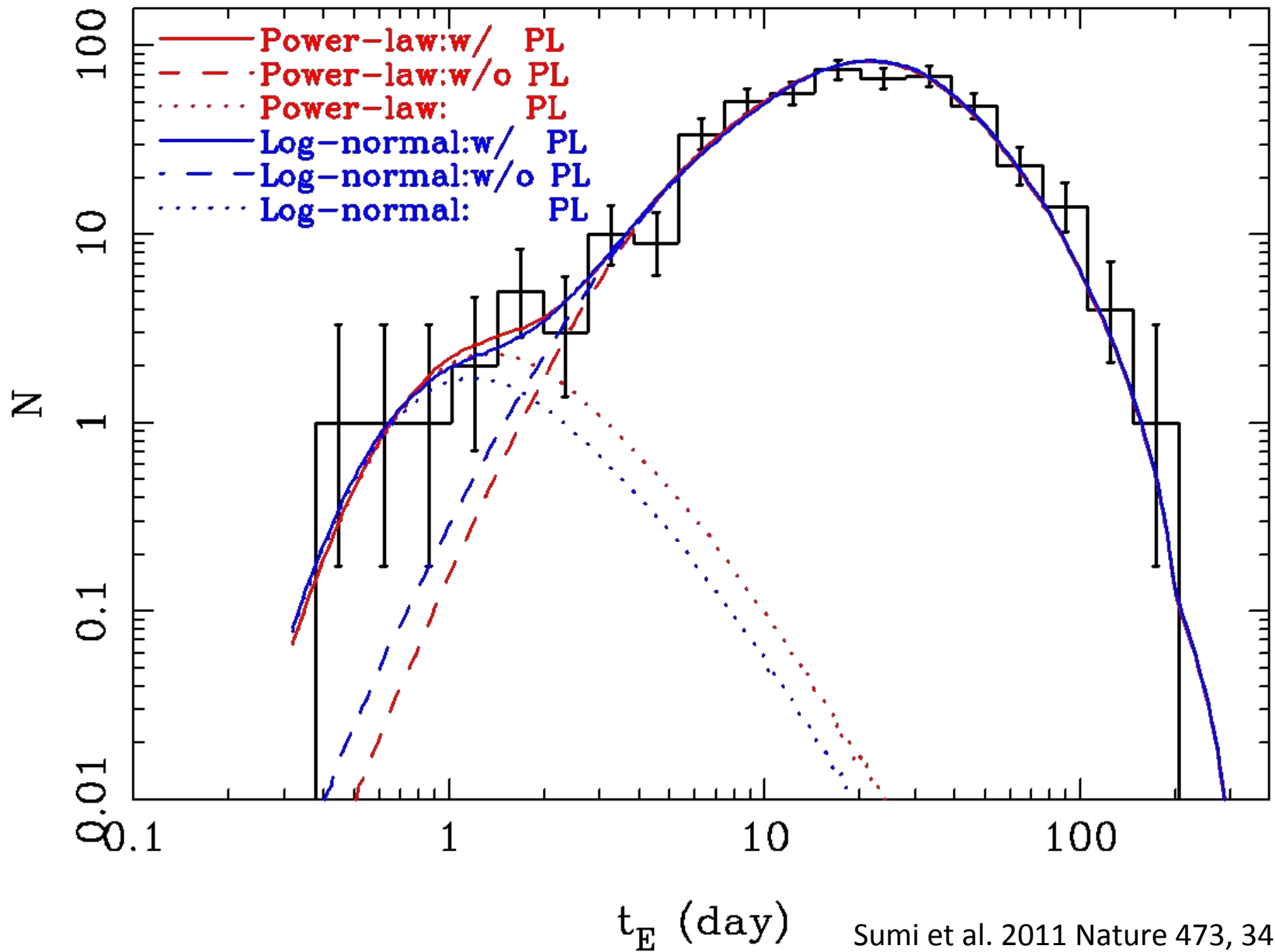




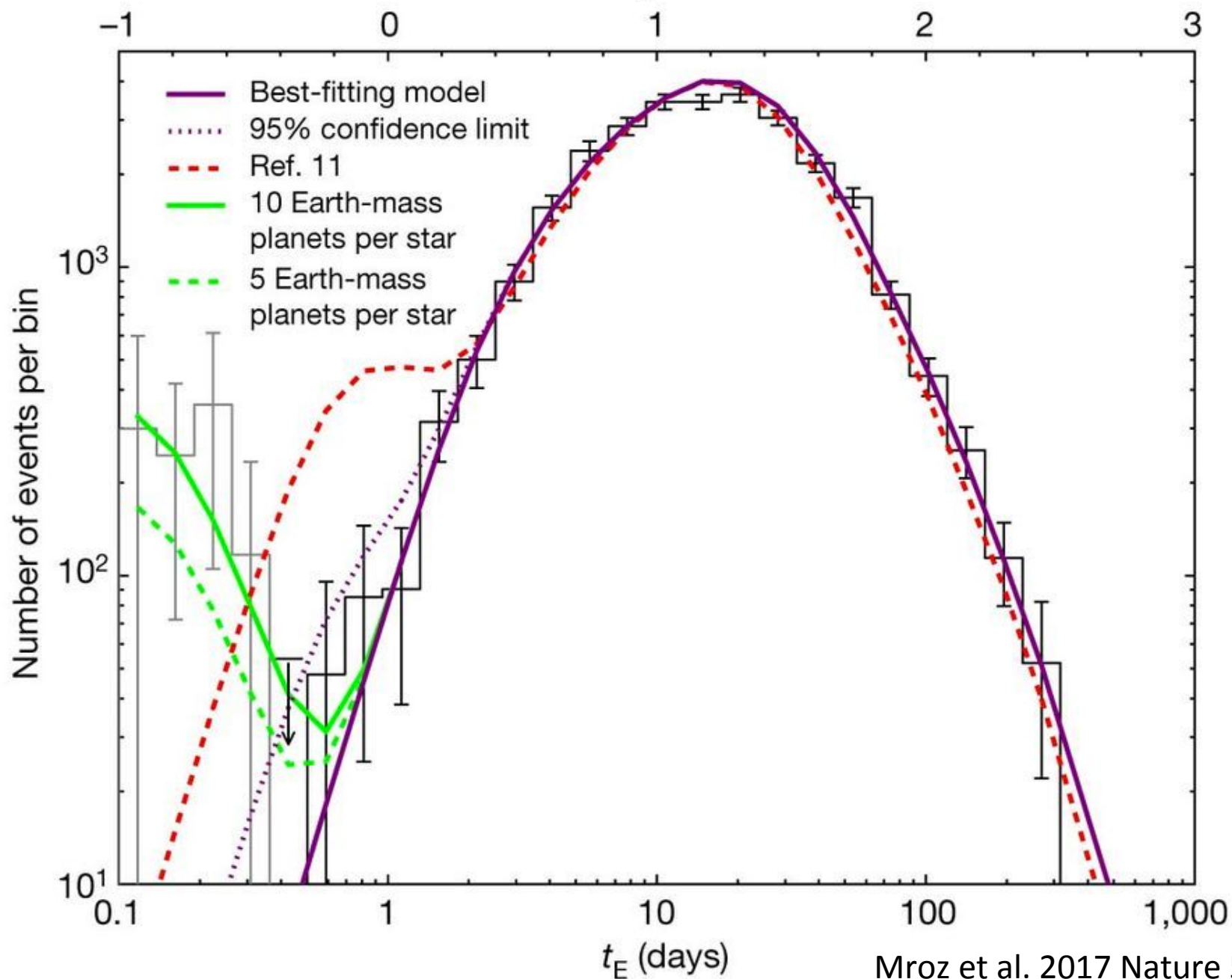


FFPs: shorter timescale \square smaller mass

$$M_L = \frac{\theta_E^2}{\kappa\pi_{\text{rel}}} = \frac{(t_E / \mu_{\text{rel}})^2}{\kappa\pi_{\text{rel}}}$$

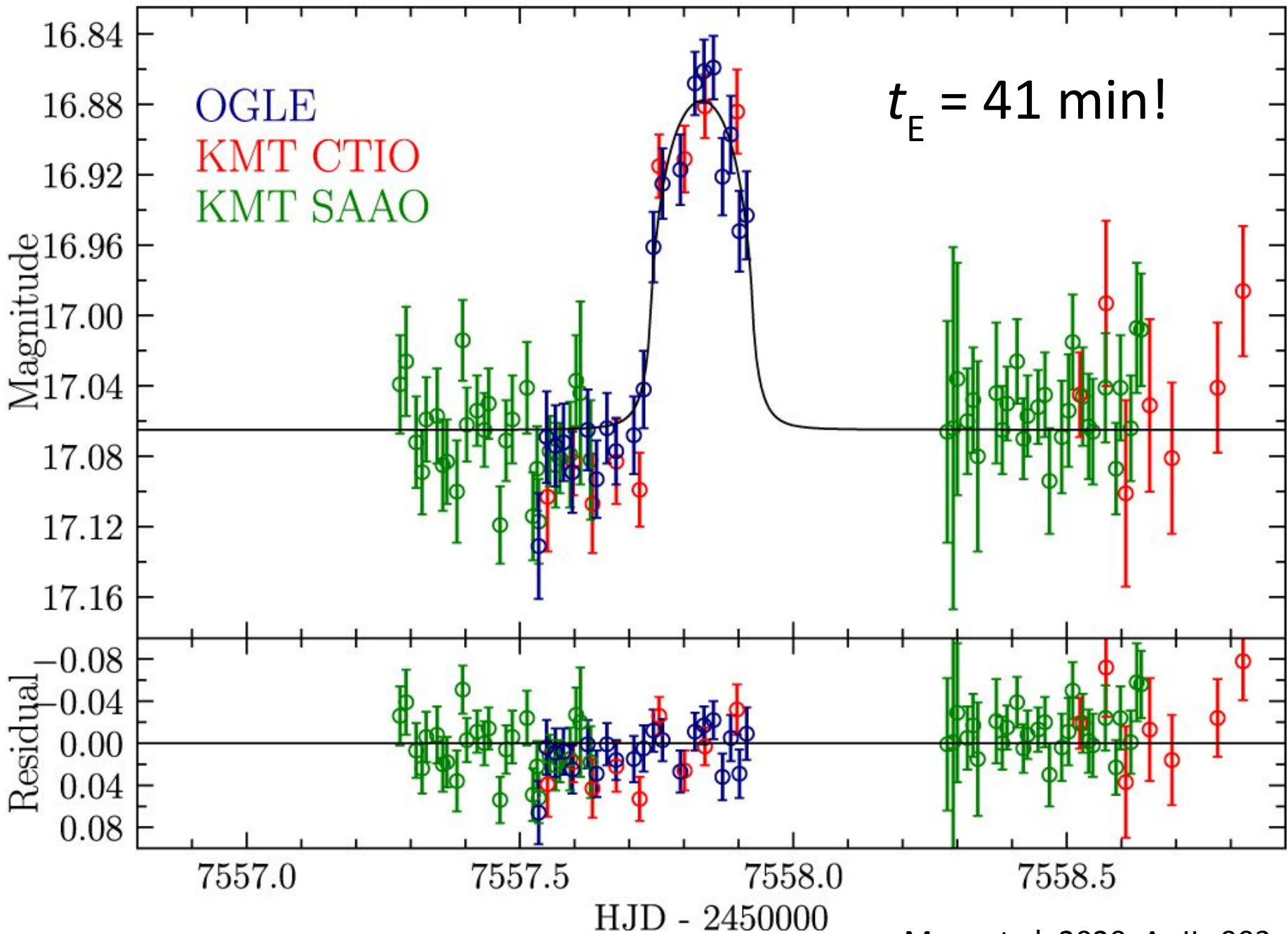


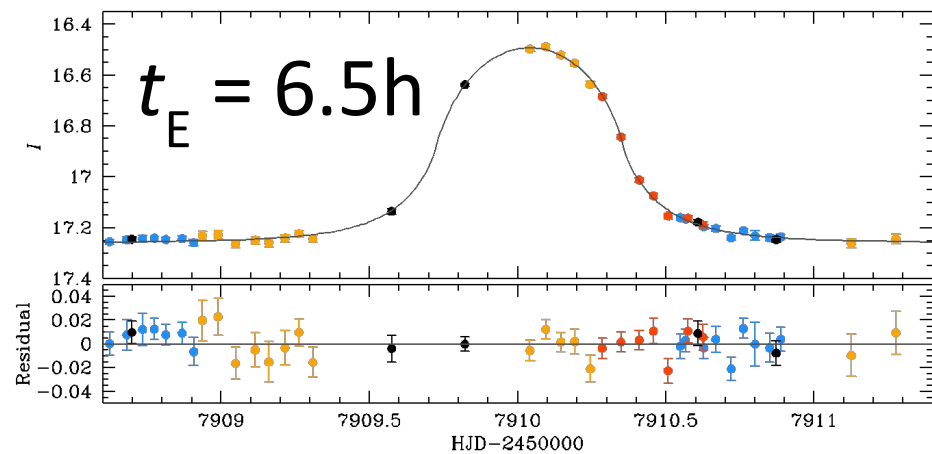
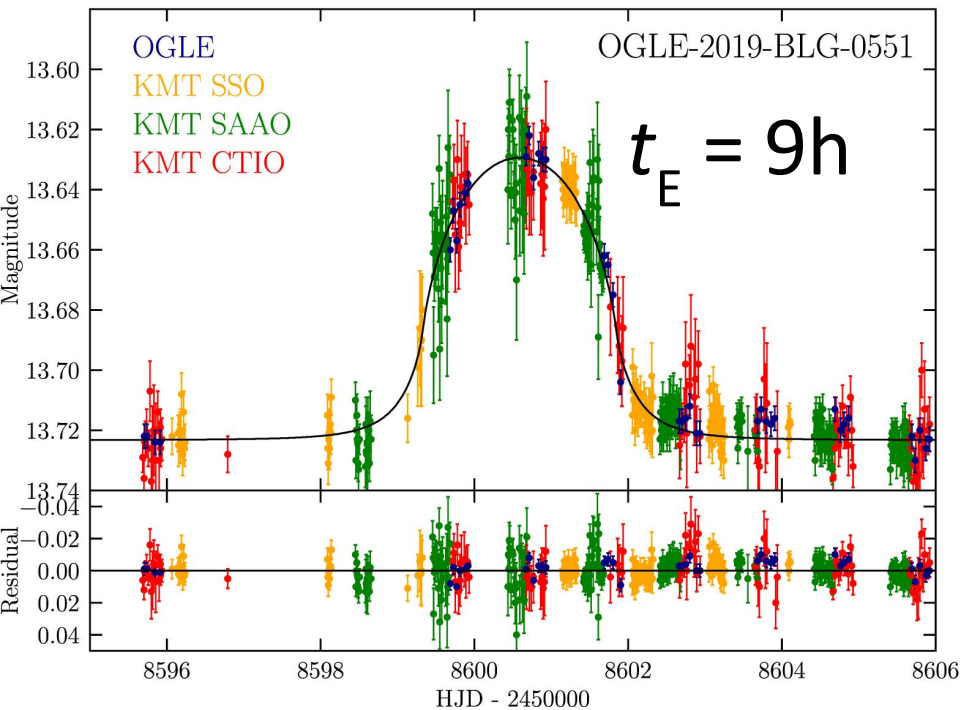
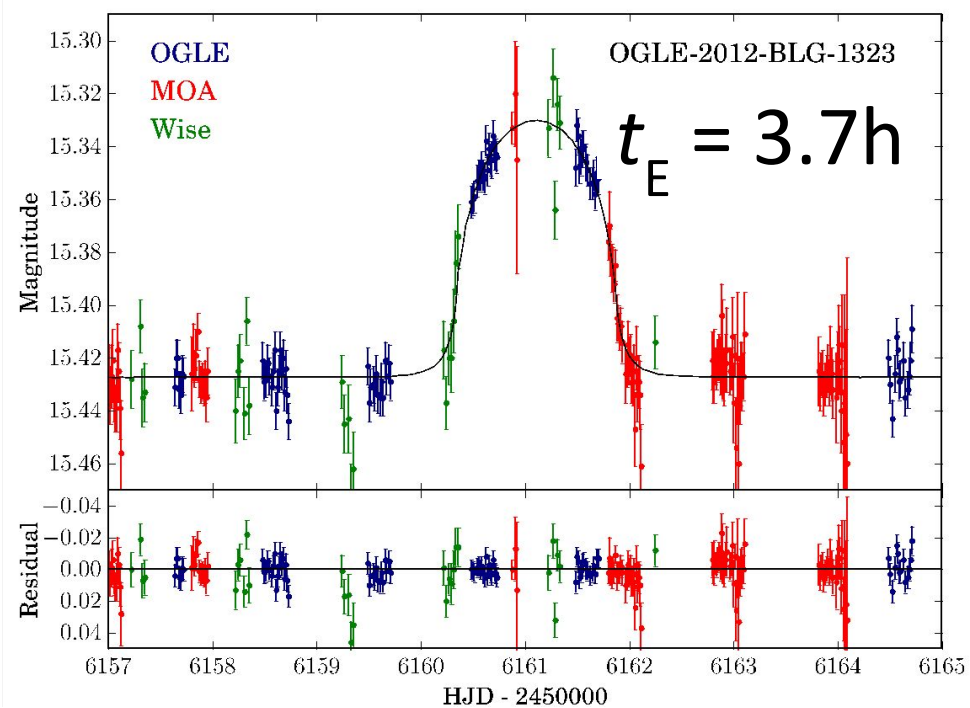
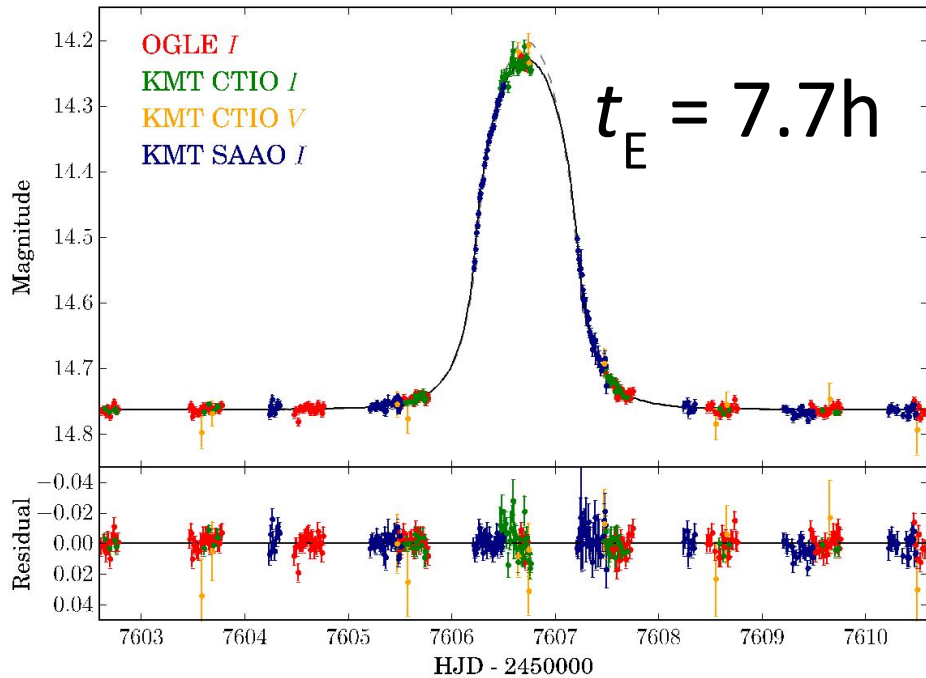
$\log[t_E \text{ (days)}]$



FFPs: θ_E is better than t_E

$$M_L = \frac{\theta_E^2}{\kappa\pi_{\text{rel}}} = \frac{(t_E / \mu_{\text{rel}})^2}{\kappa\pi_{\text{rel}}}$$



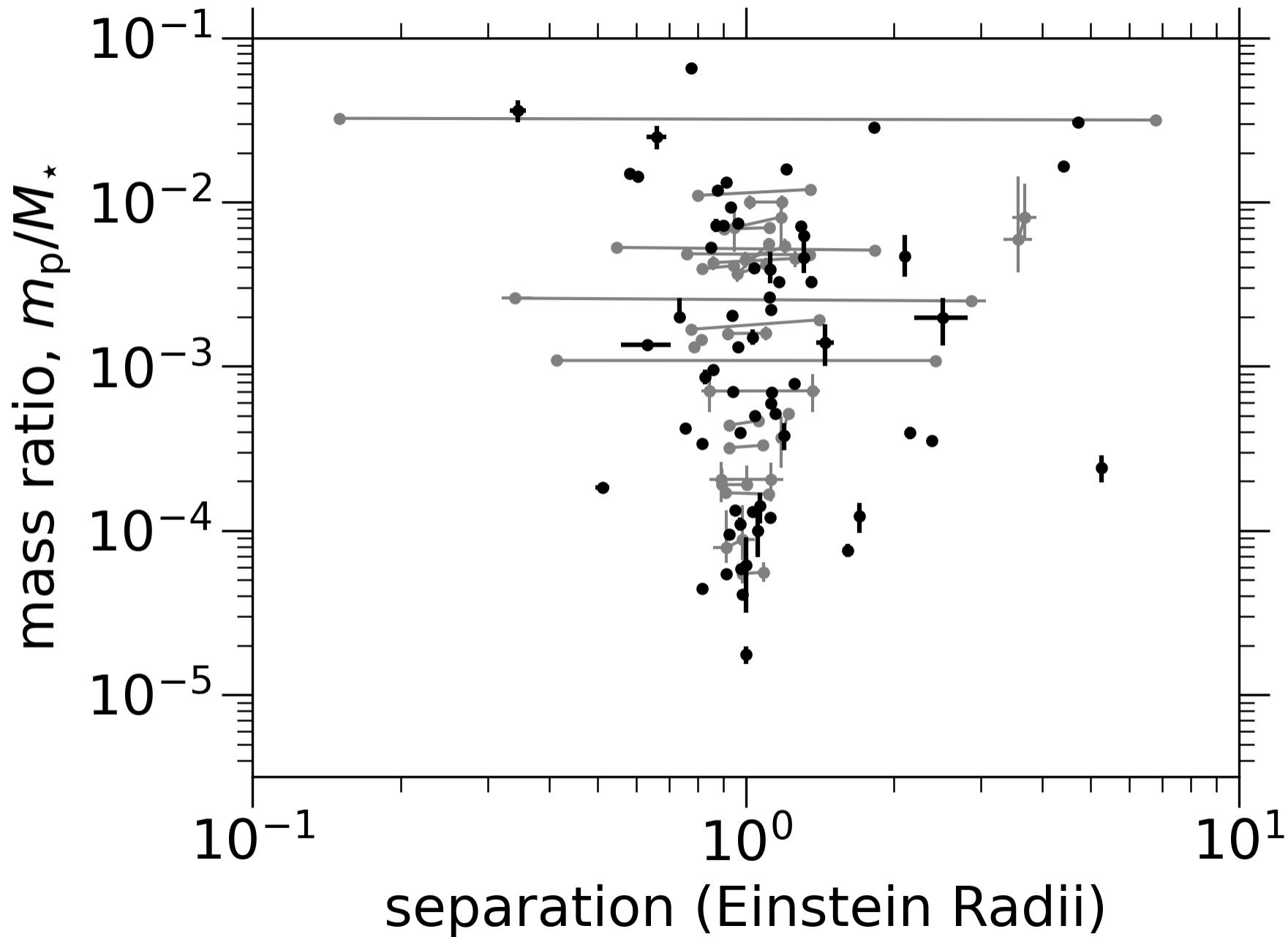


Mroz et al. 2018, AJ, 155, 121

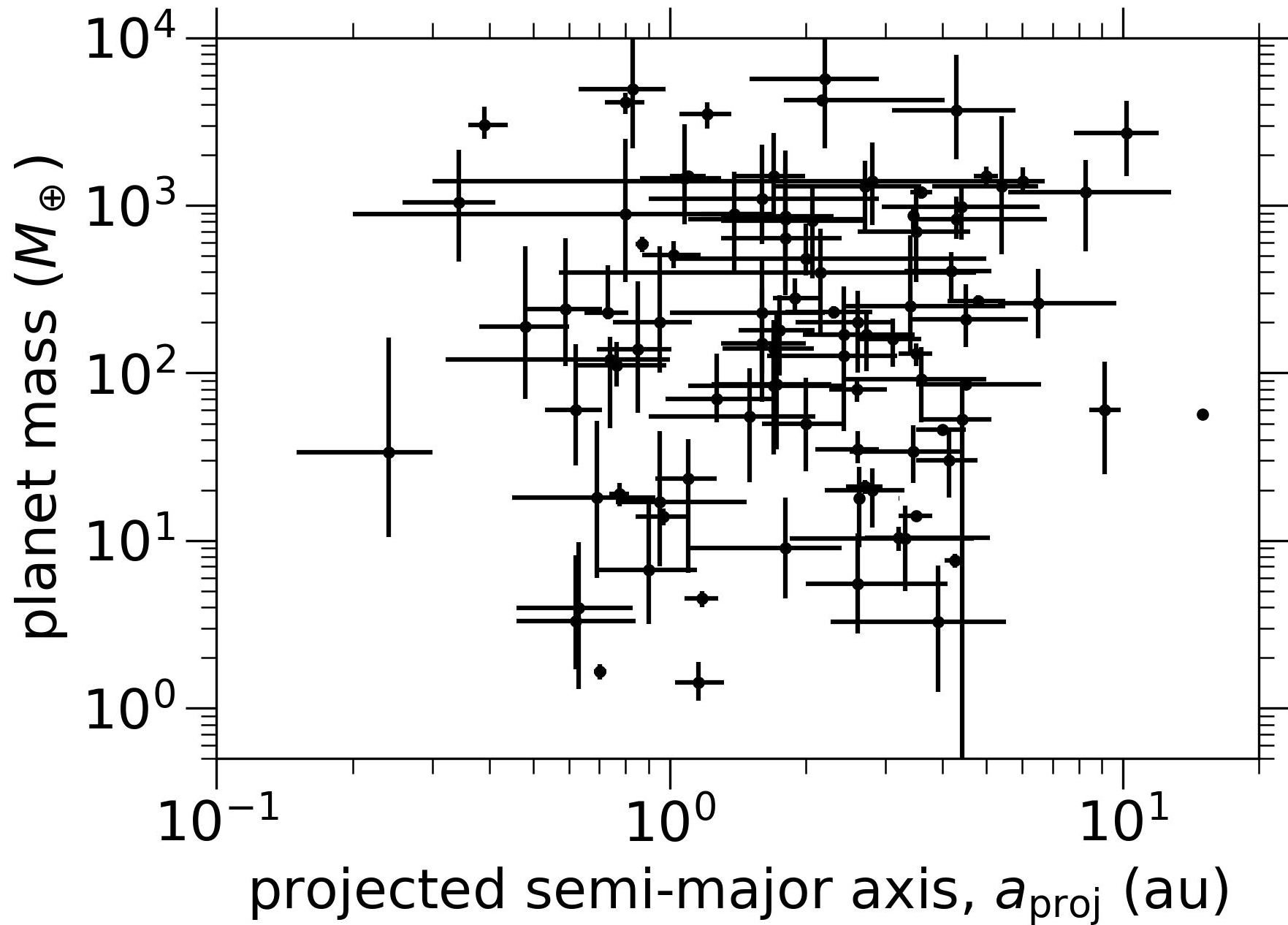
Mroz et al. 2019, A&A 622, 201

Mroz et al. 2020 AJ, 159, 282

Ryu et al. 2020, arXiv:2010.07527



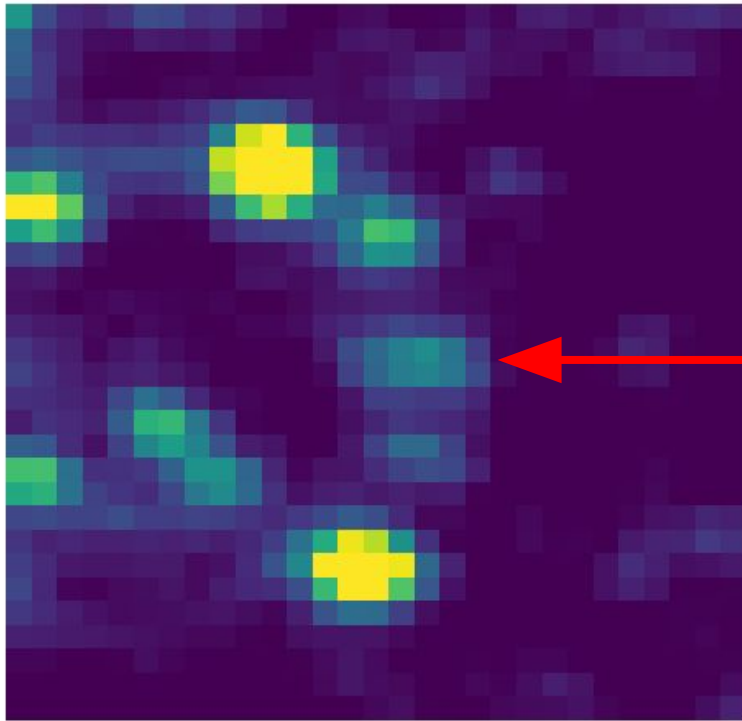
Data (mostly) from the Exoplanet Archive as of 10/27/20



Data (mostly) from the Exoplanet Archive as of 10/27/20

No Clear Detection of Host (=Lens) in Seeing-Limited Images

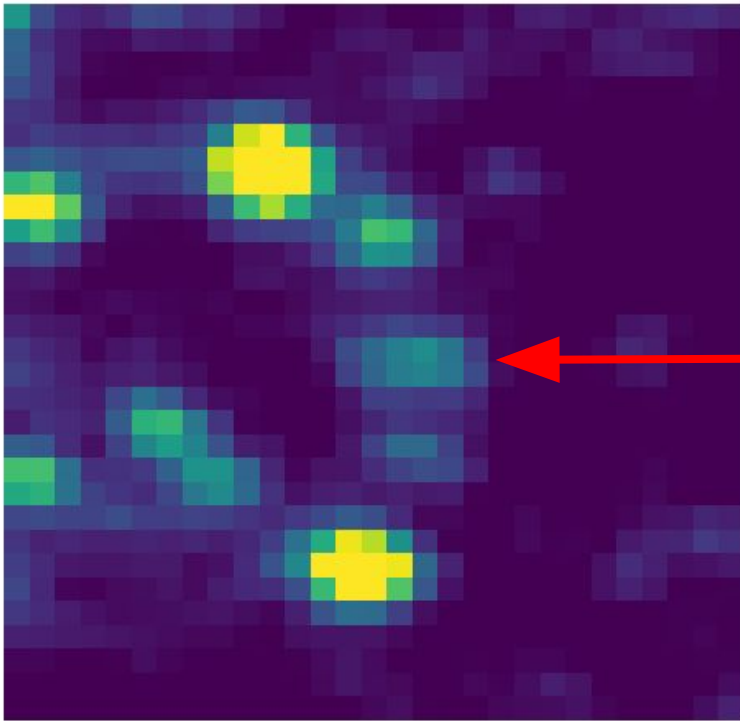
VVV



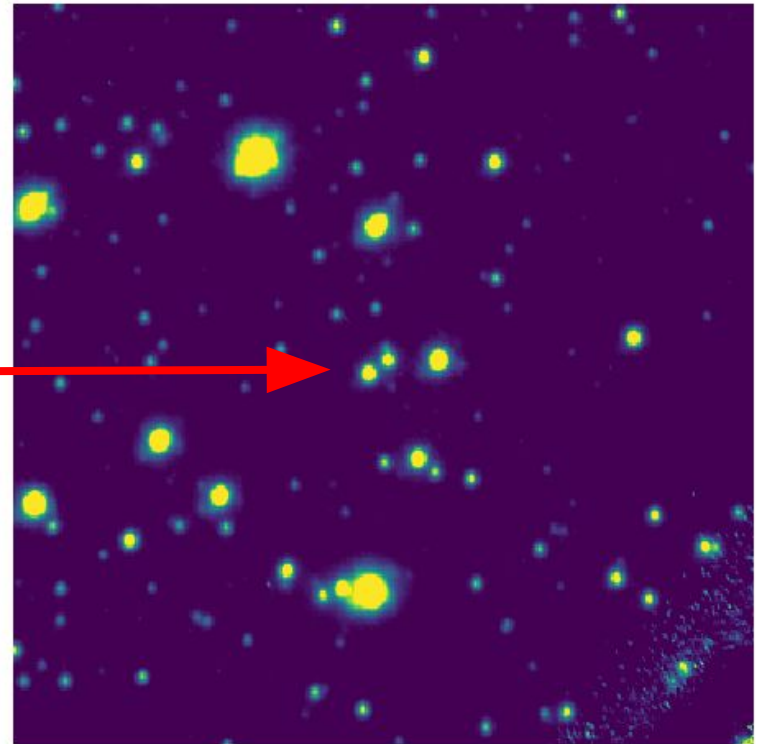
= Source + Lens
+ Companion to
Source?
+ Companion to
Lens?
+ Unrelated Star(s)?

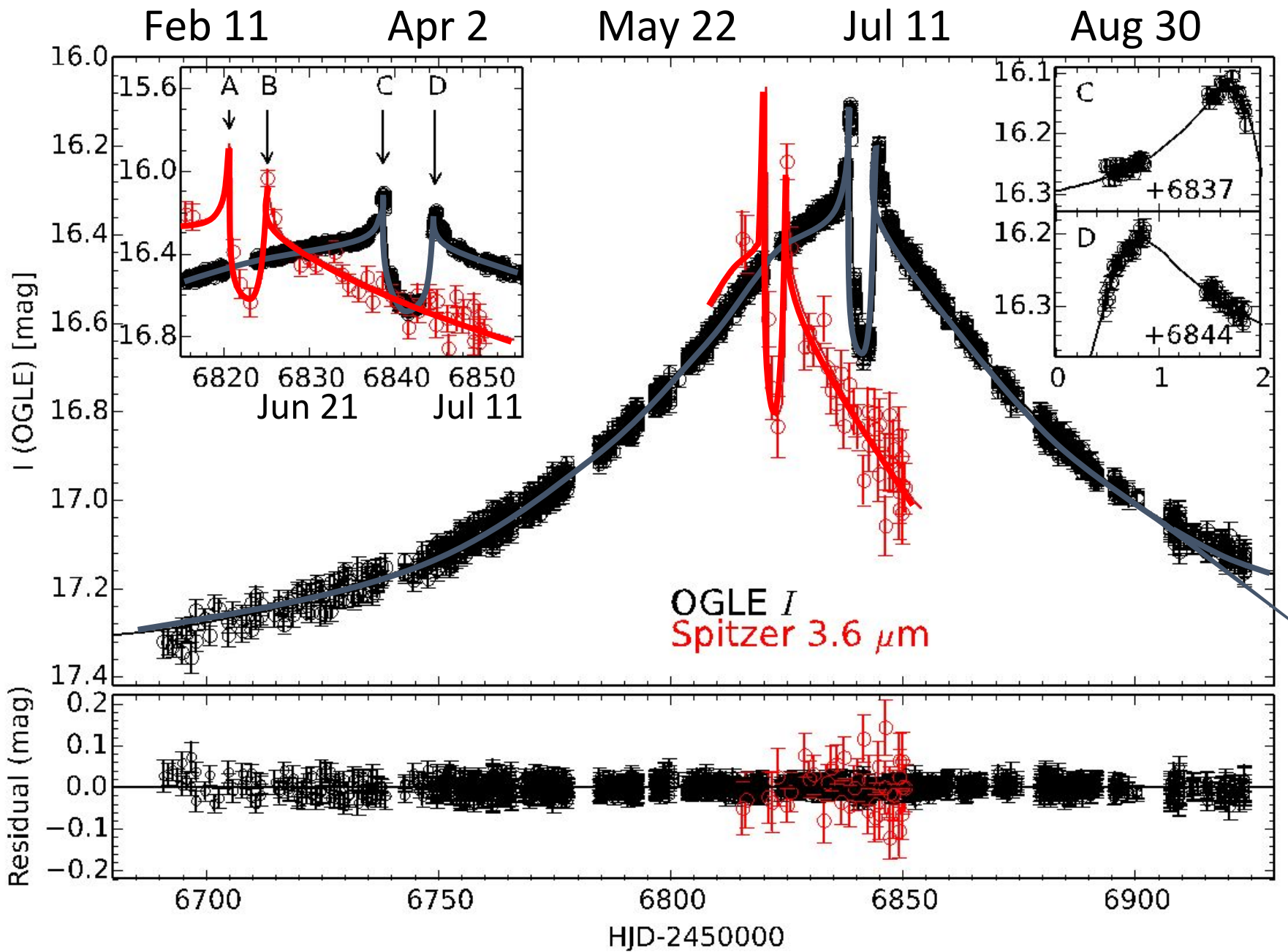
No Clear Detection of Host (=Lens) in Seeing-Limited Images

VVV



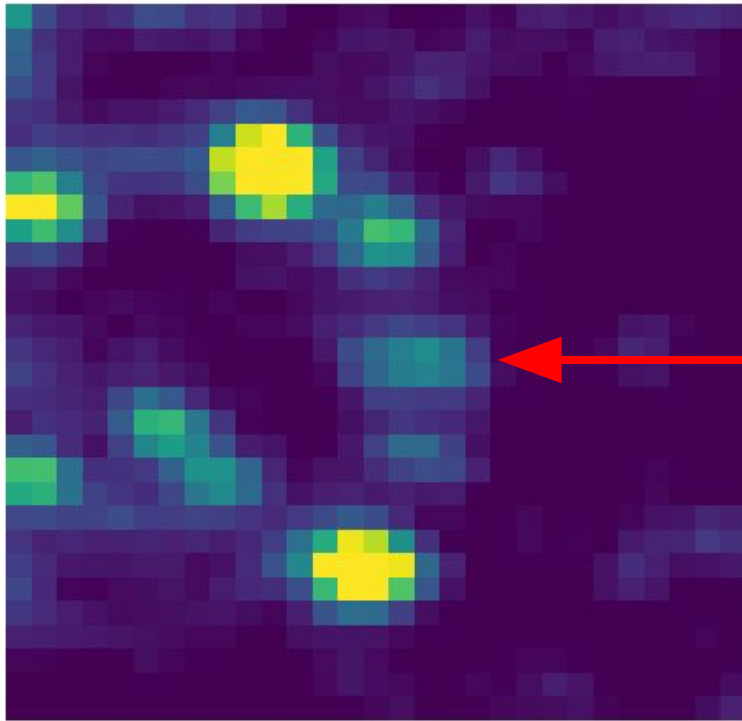
MagAO





No Clear Detection of Host (=Lens) in Seeing-Limited Images

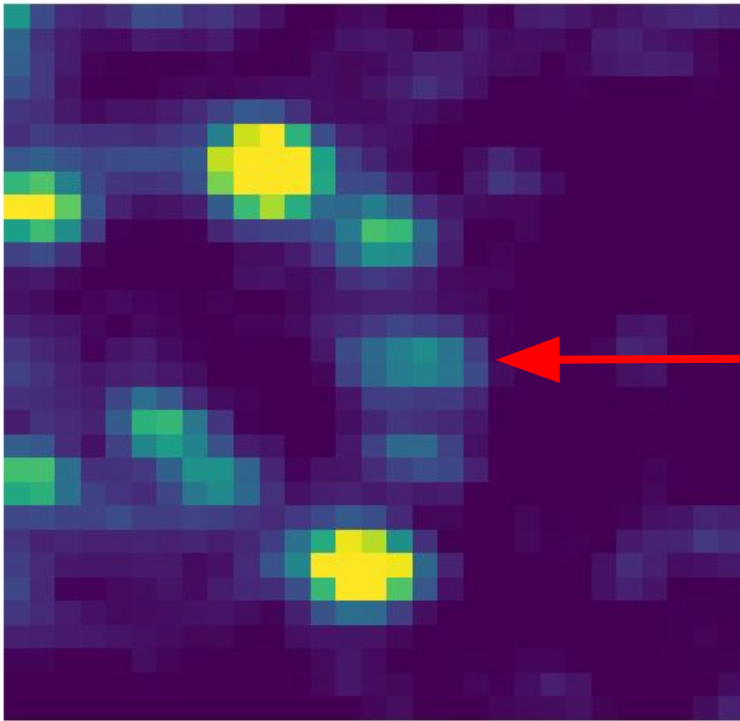
VVV



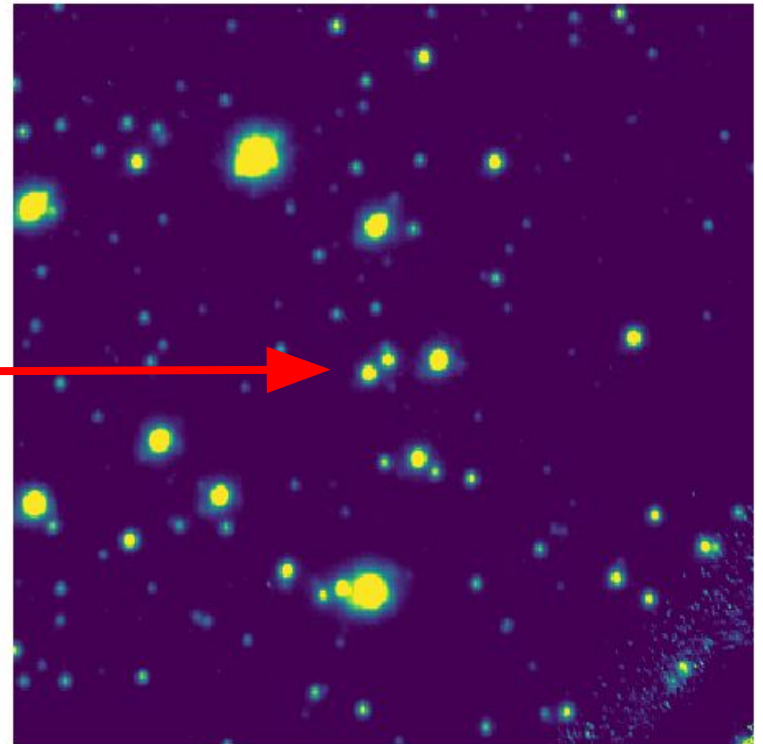
= Source + Lens
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Lens?
+ Unrelated Star(s)?

No Clear Detection of Host (=Lens) in Seeing-Limited Images

VVV



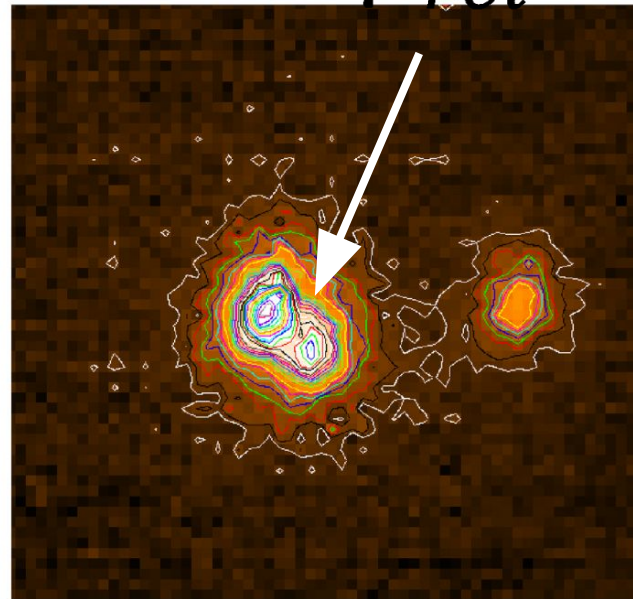
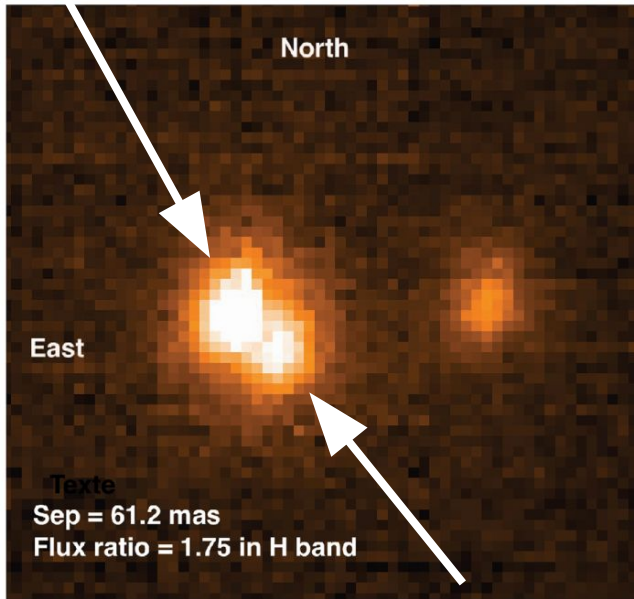
MagAO



AO of OB05169: Separation is Better

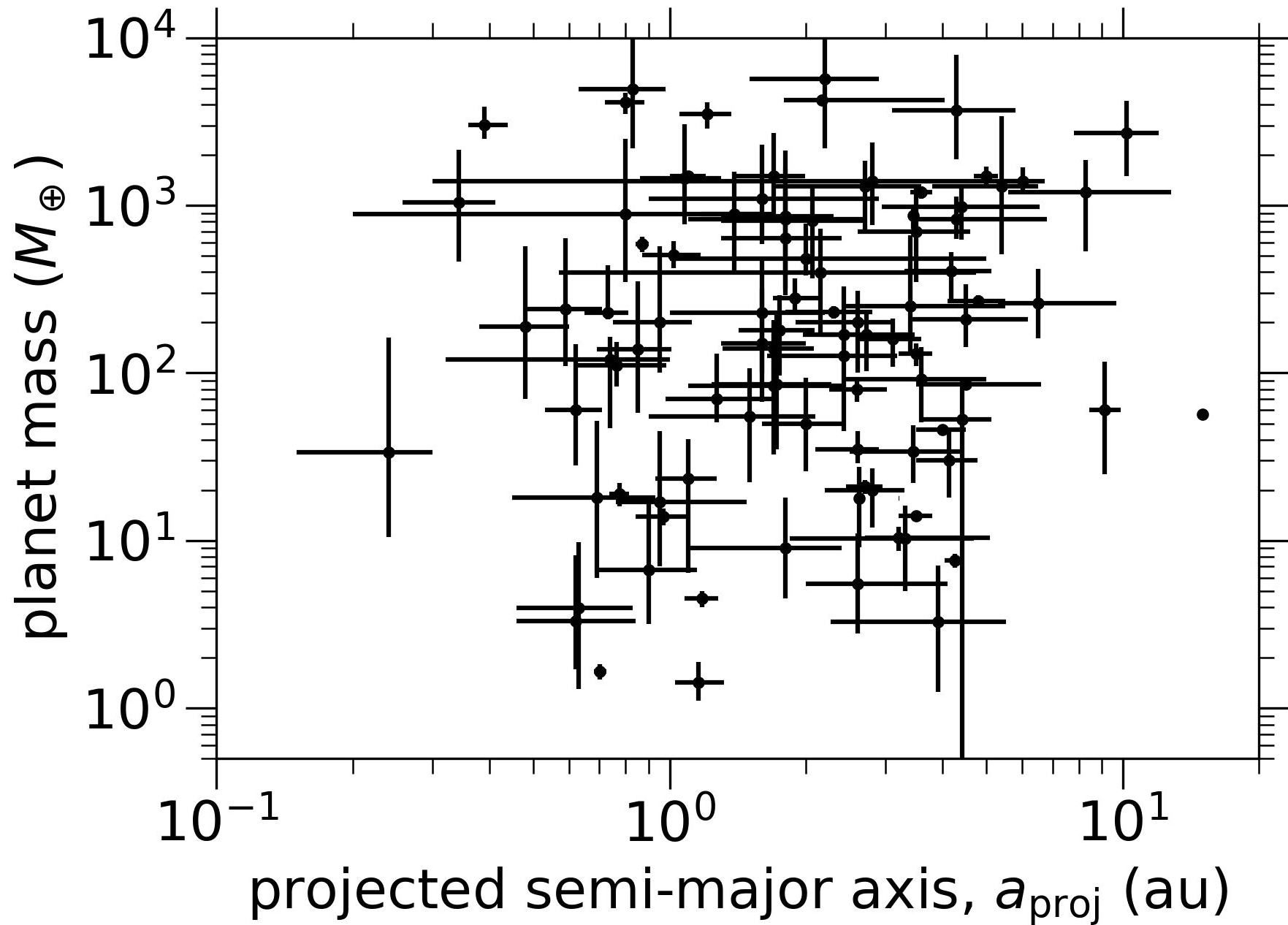
Lens (+ Comp?)

$$\mu_{rel} = \frac{\theta_E}{t_E}$$

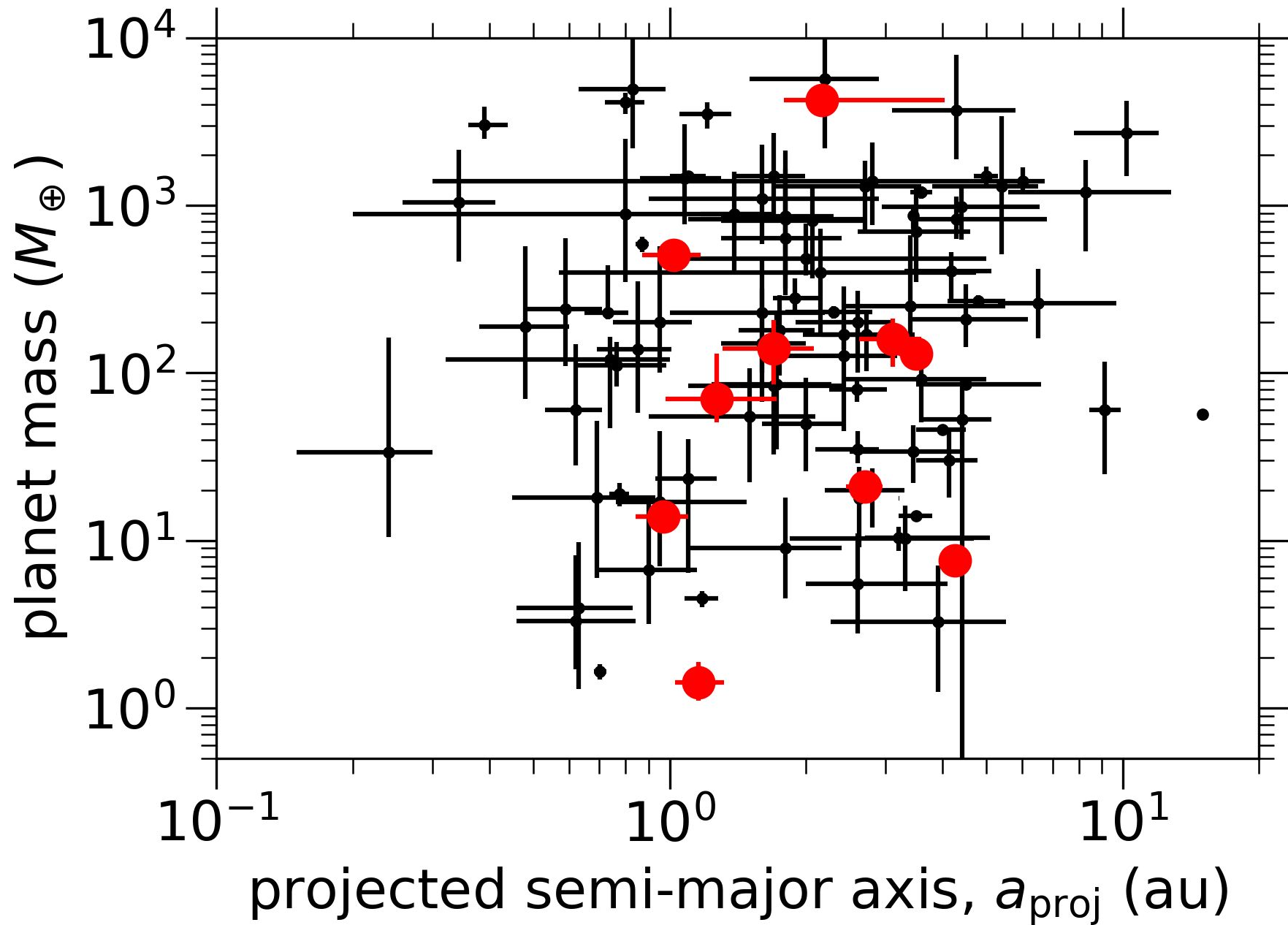


Source

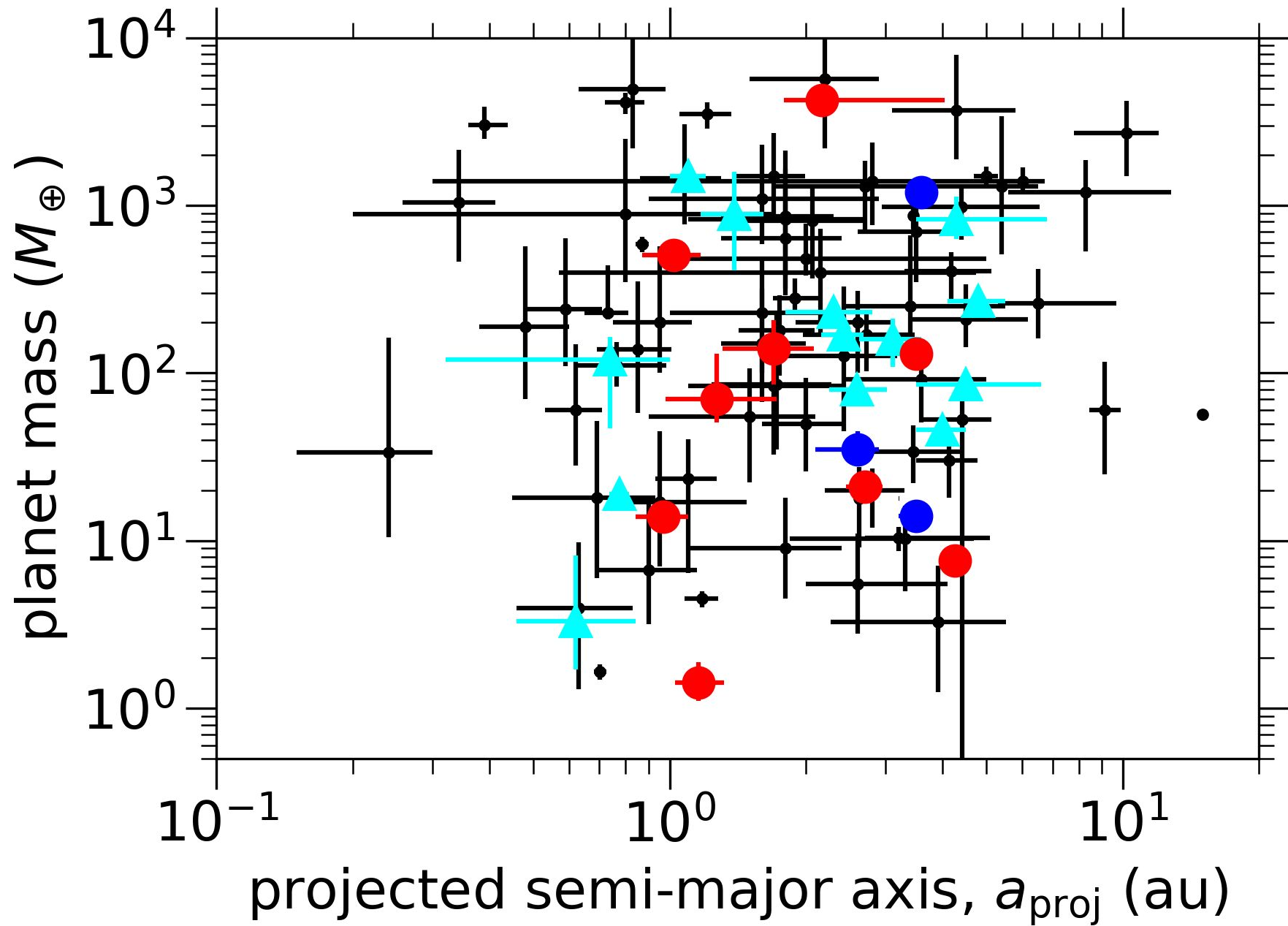
Batista et al. 2015 ApJ 808, 170



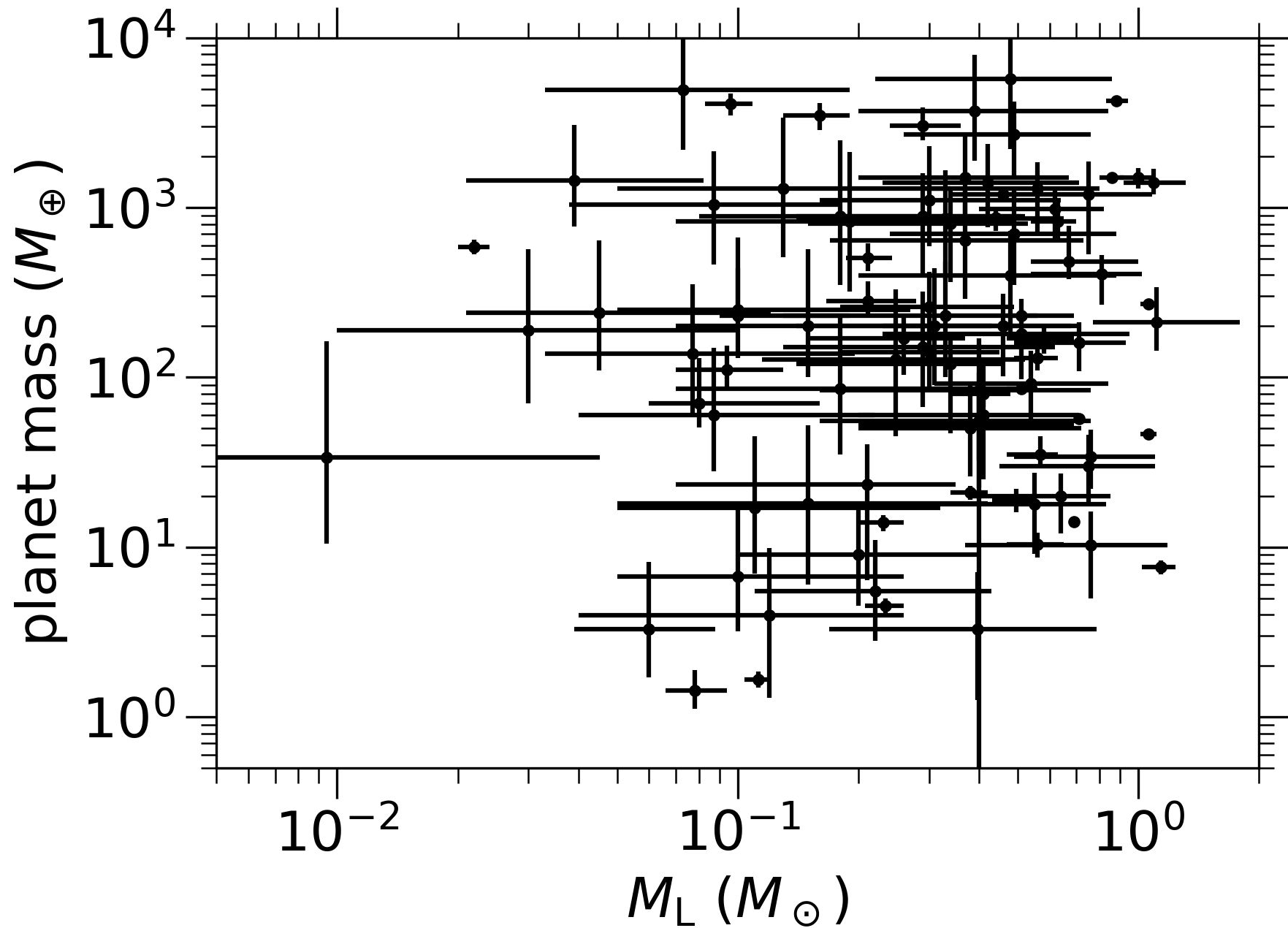
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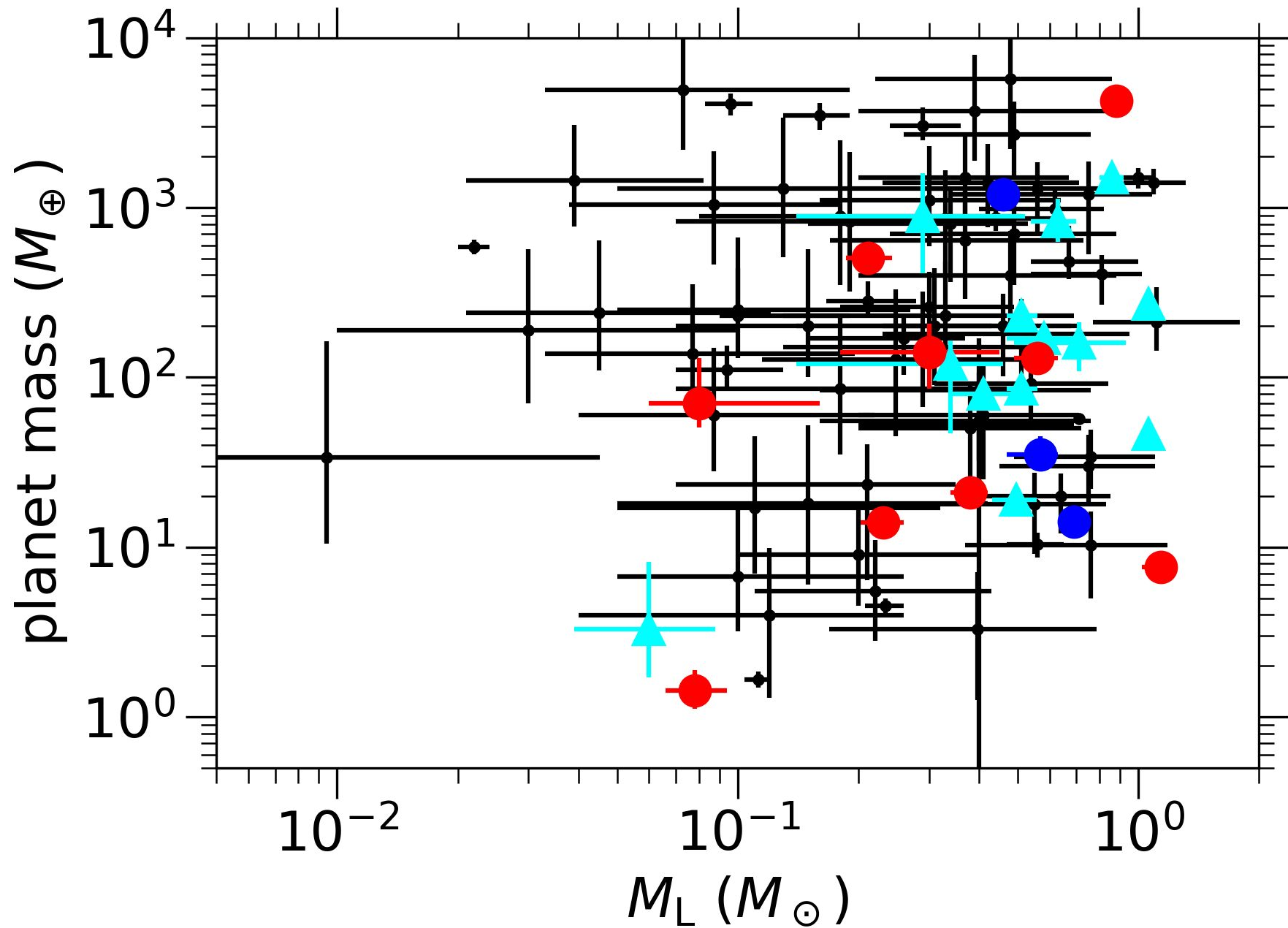
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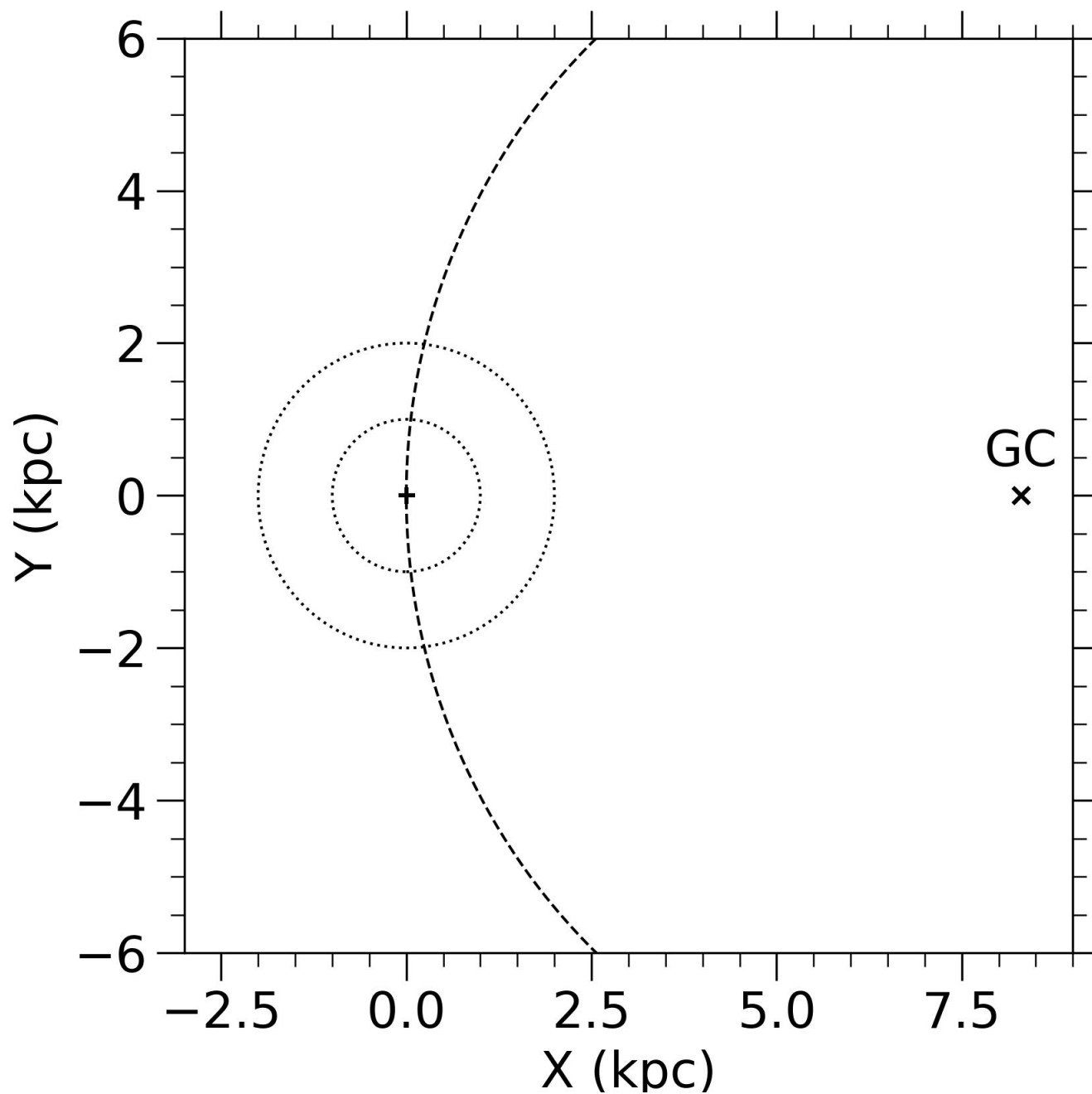
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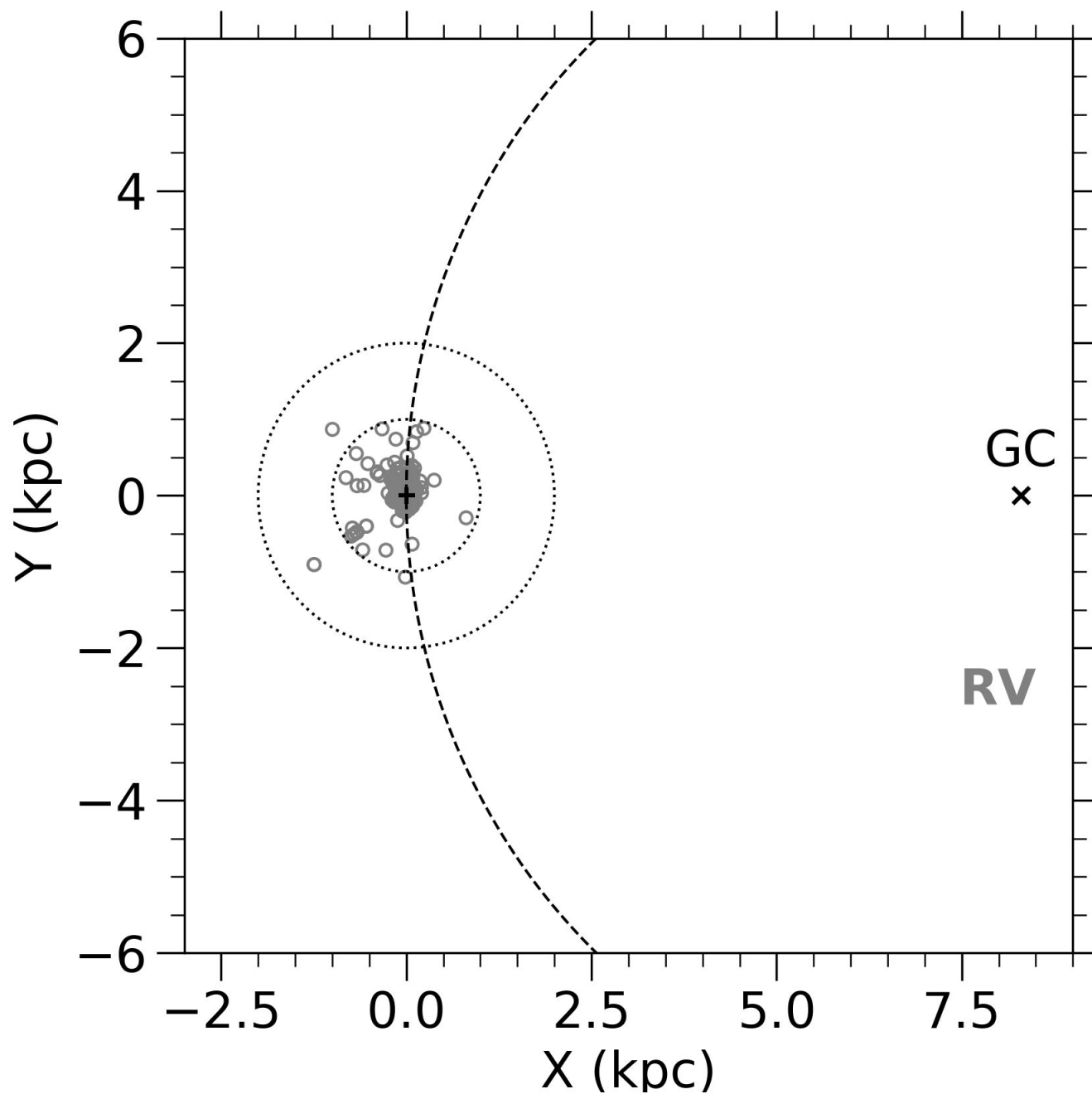
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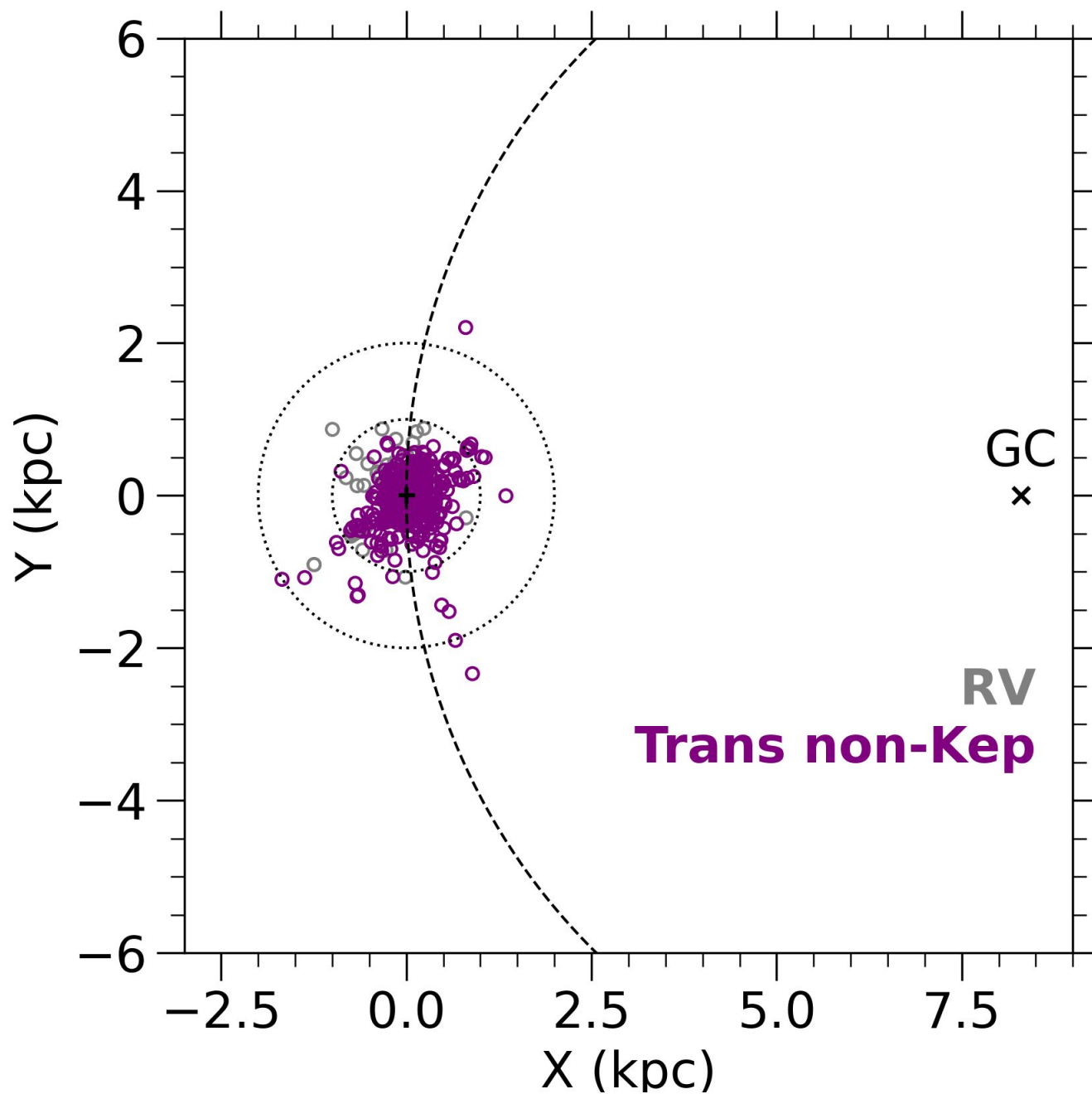
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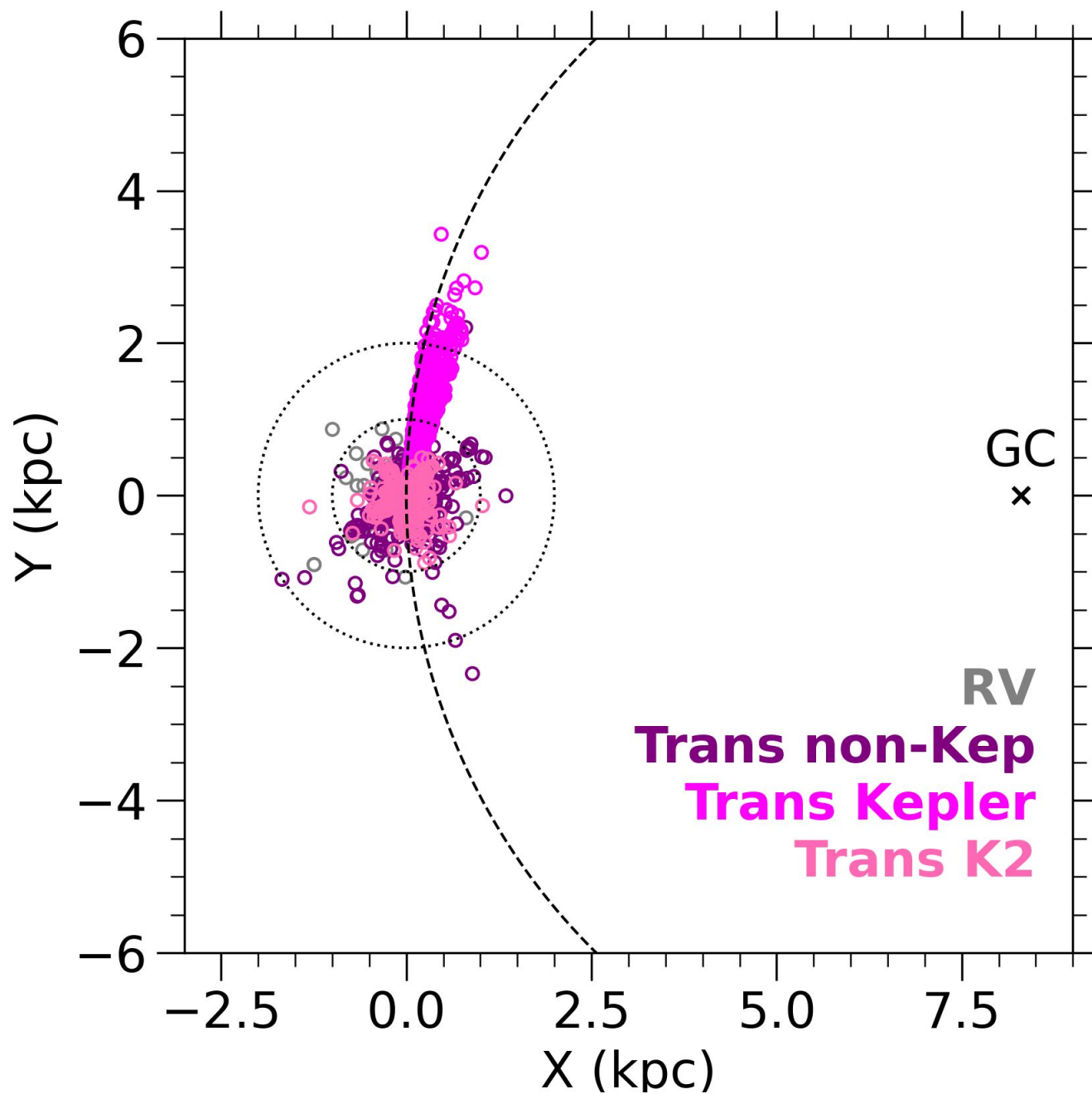
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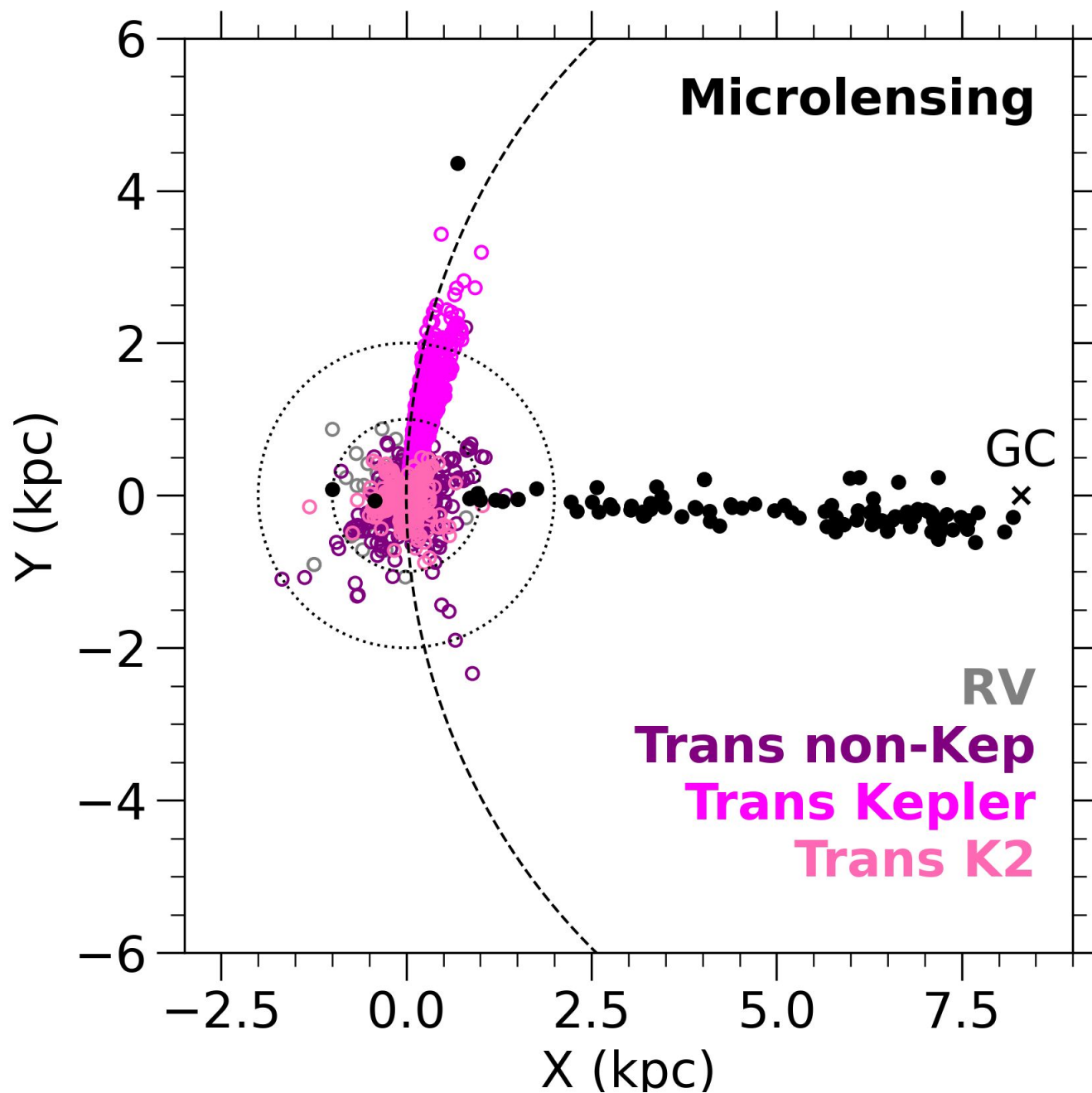
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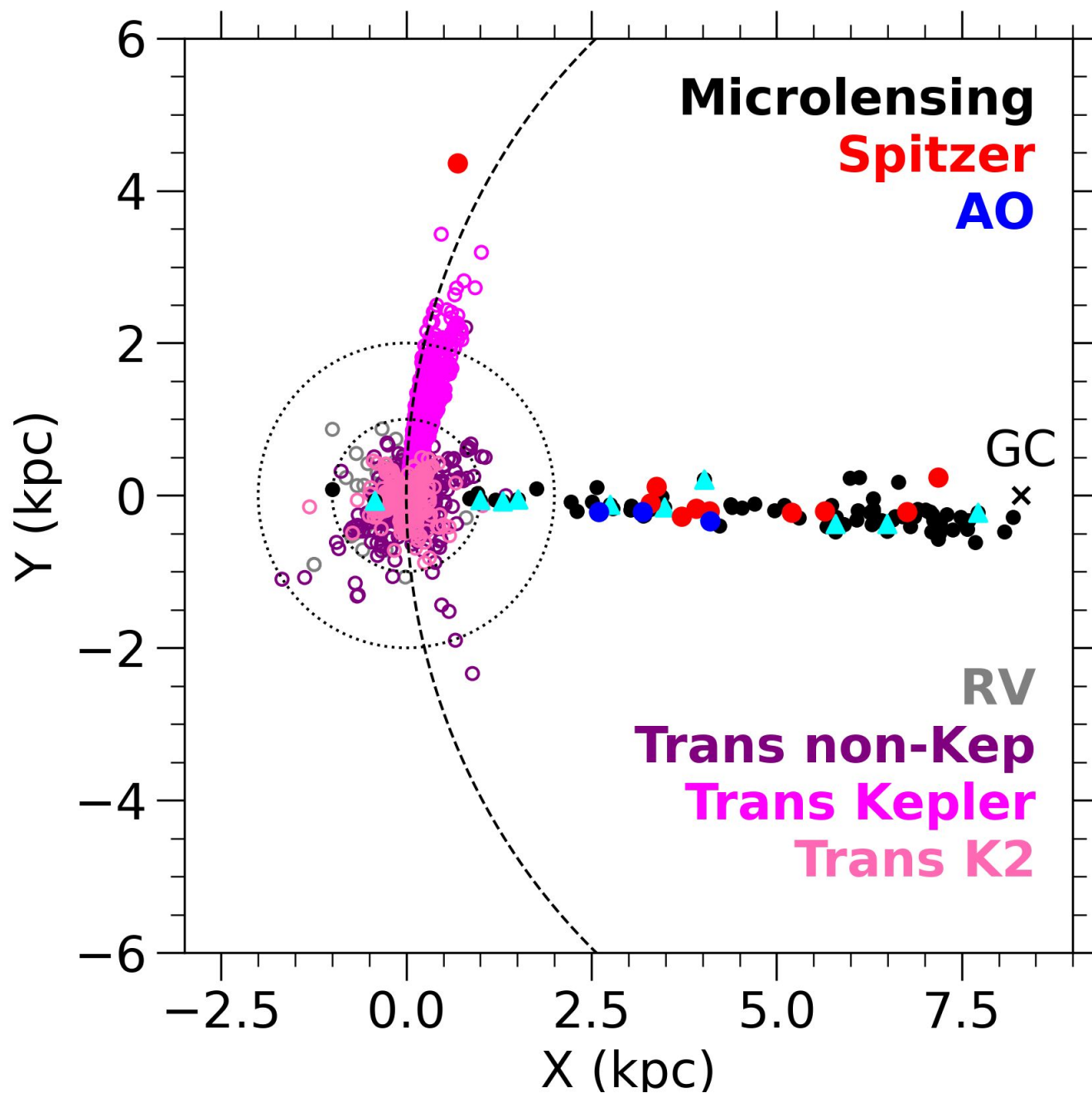
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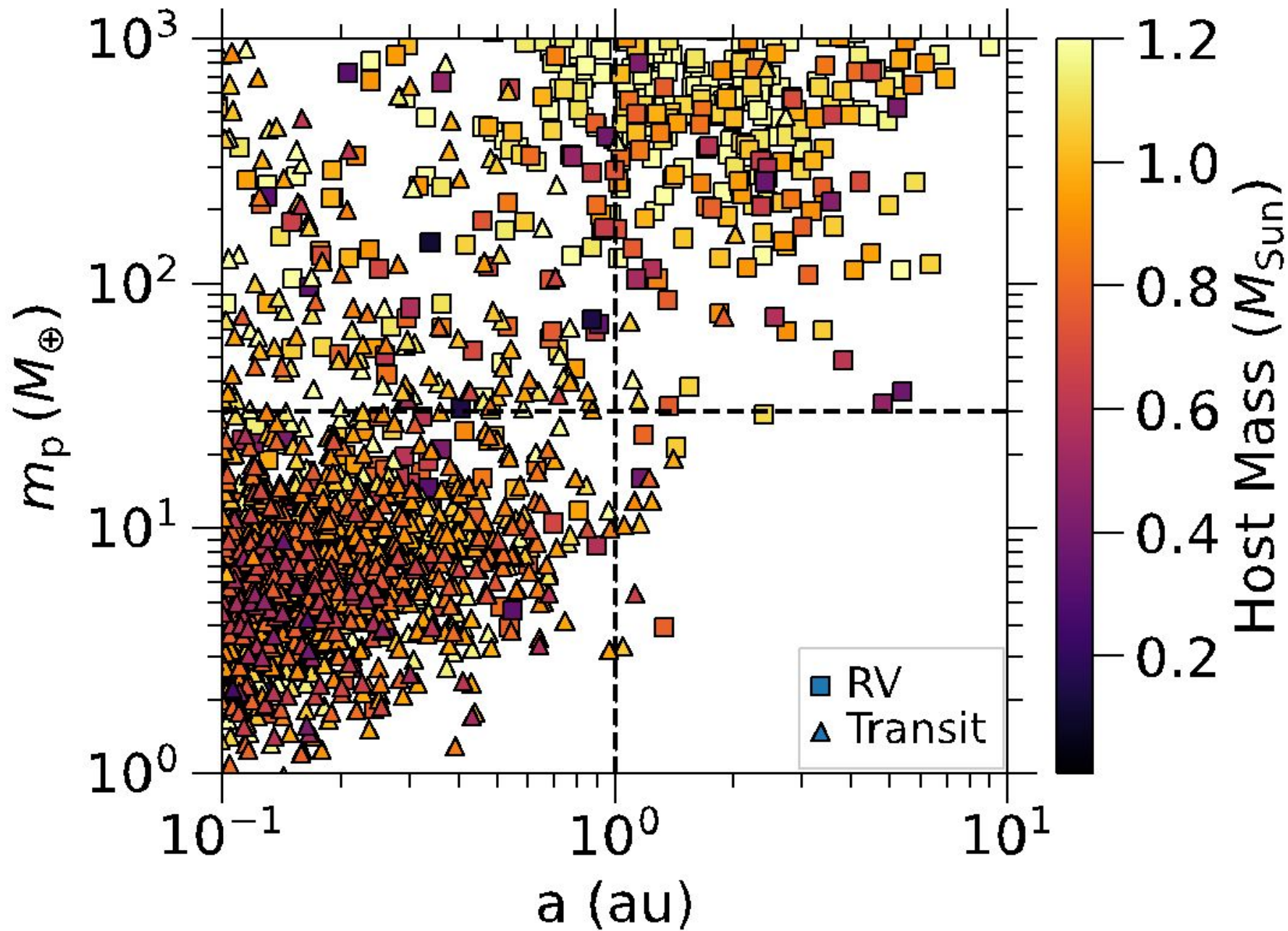
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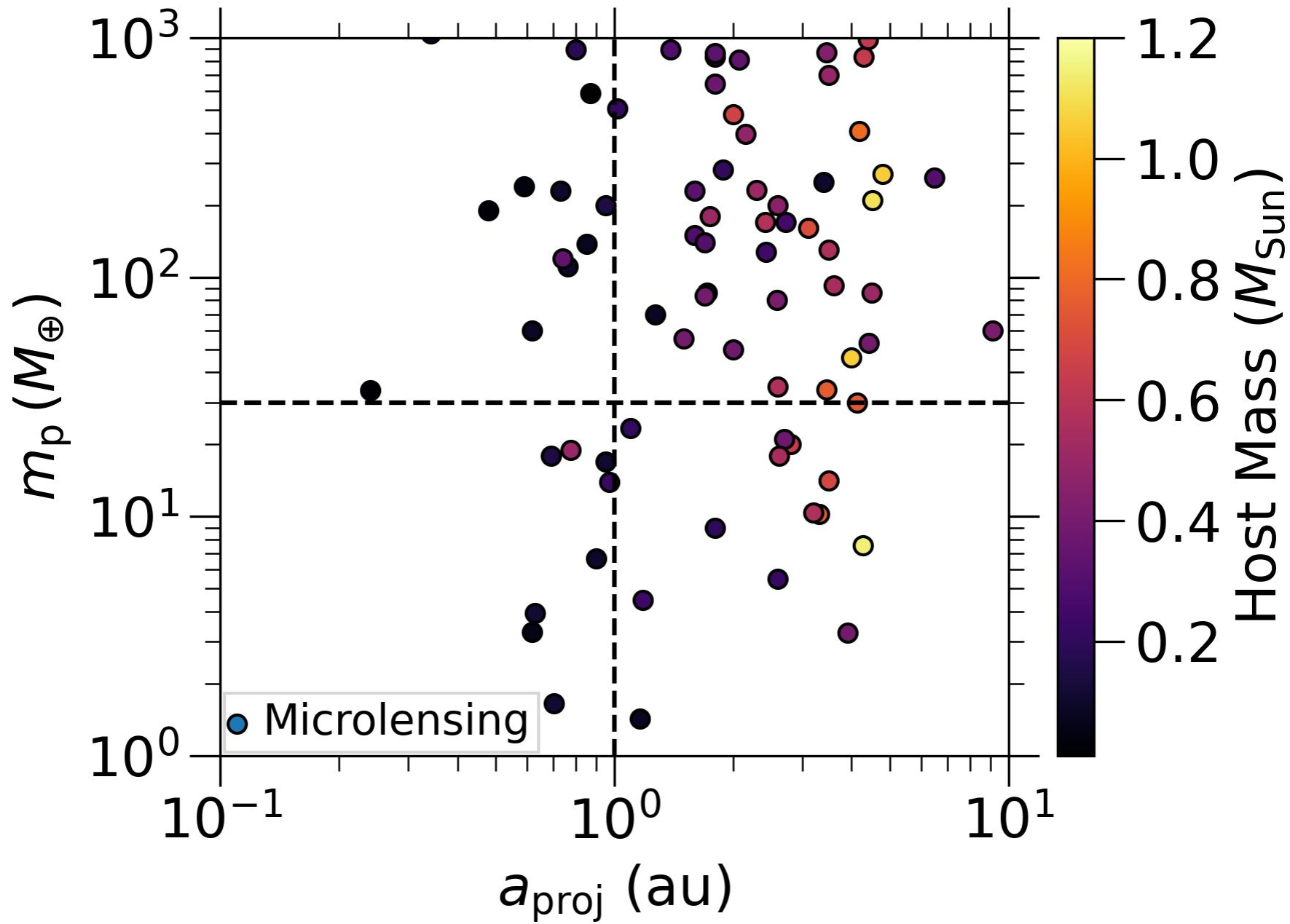
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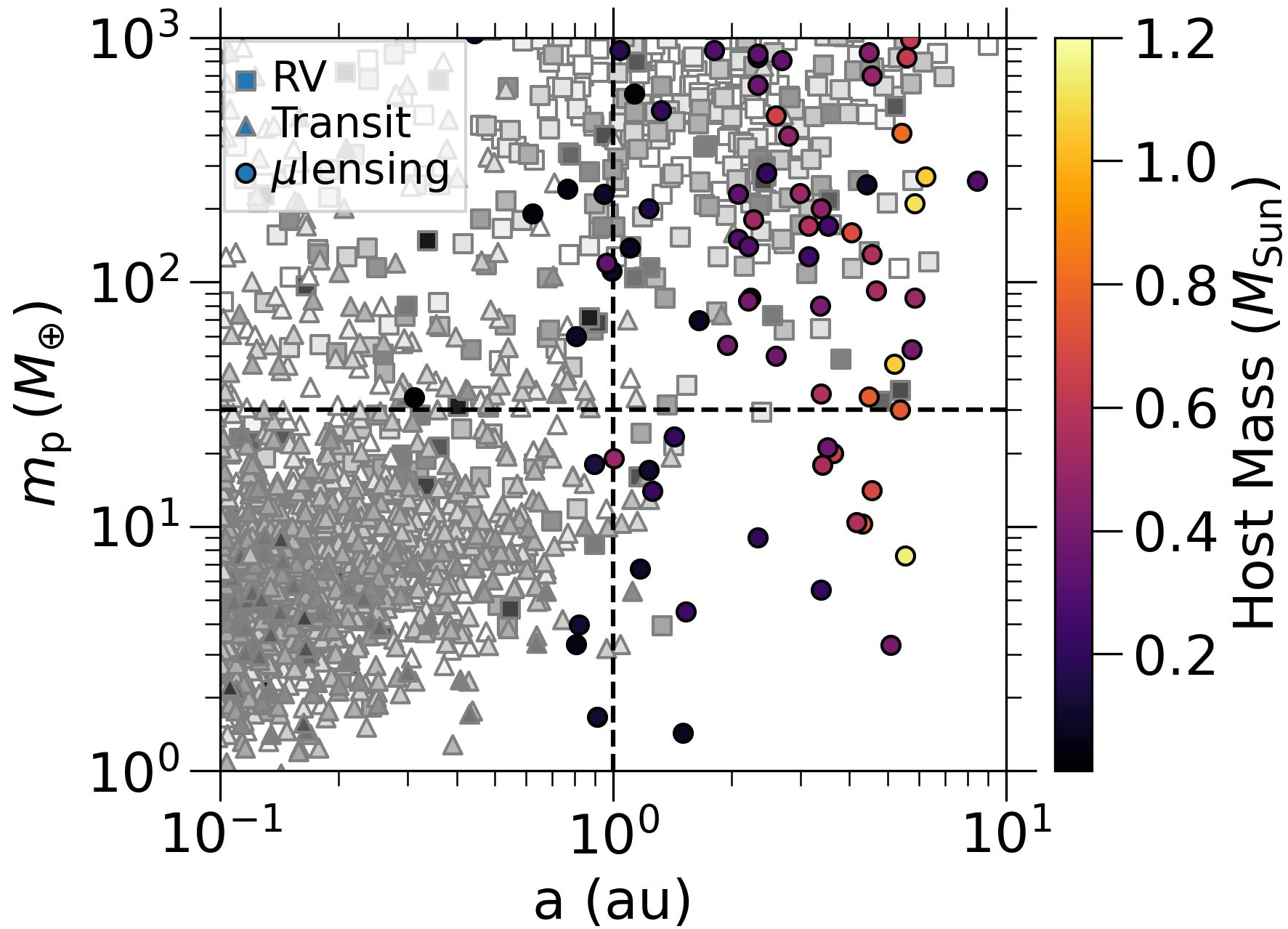
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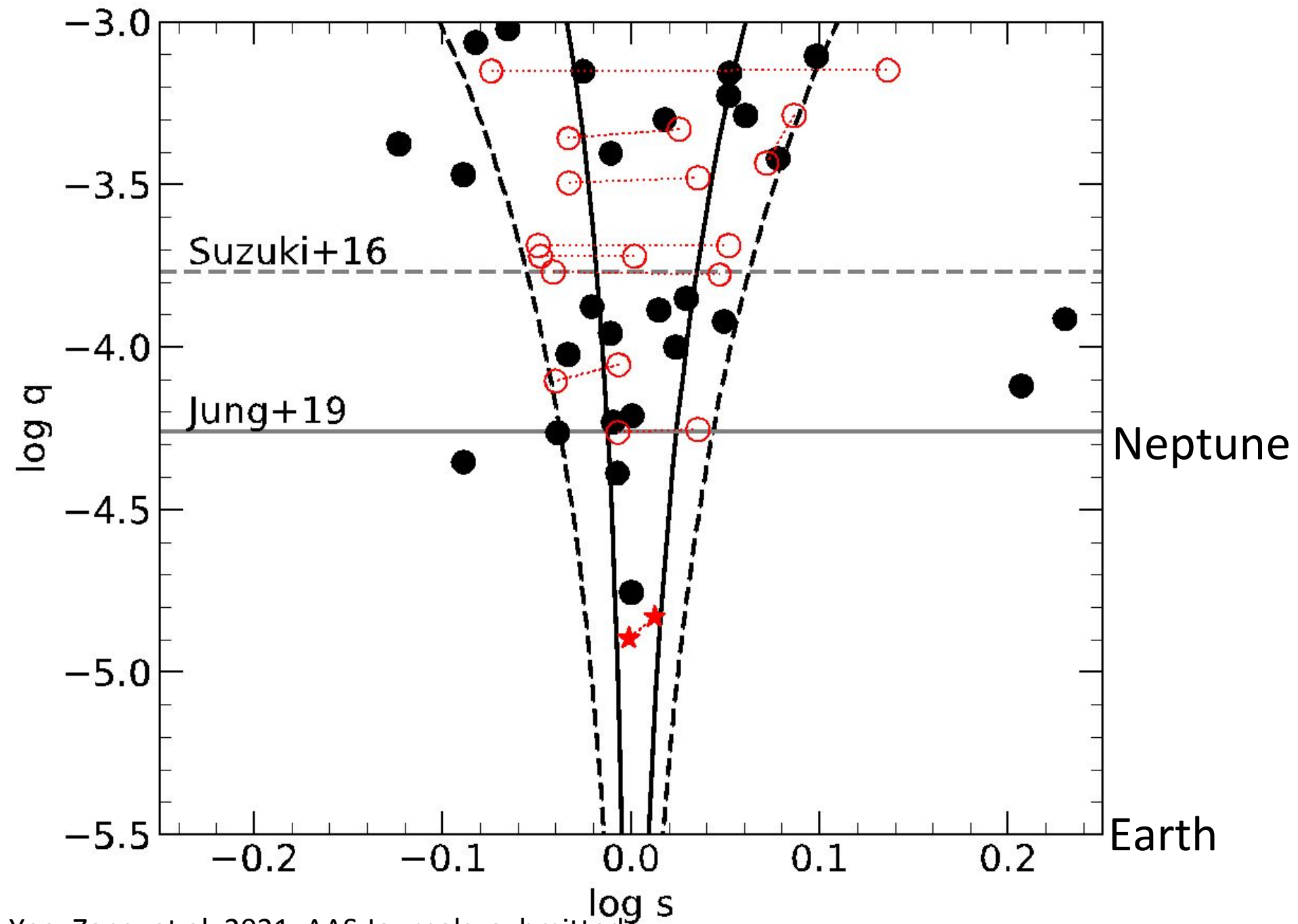
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Microlens Parallax (π_E) Constrains Mass and Distance

$$M_L = \frac{\theta_E}{\kappa \pi_E}$$

$$D_L = \left(\theta_E \pi_E + \frac{1}{D_S} \right)^{-1}$$