Biases From Missing a Small Planet in High Multiplicity Systems

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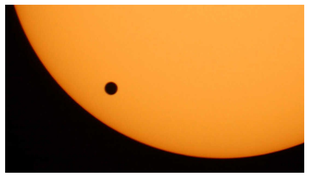
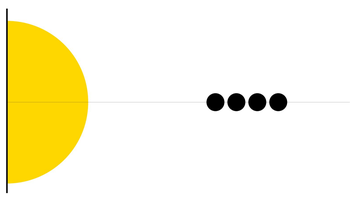
Kepler and Exoplanets

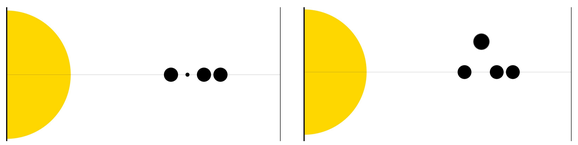
By looking for small dips in the light of stars we can find planets as they pass in front of it. This is how the Kepler Space Telescope (2009-2014)discovered over 4000 small planets.[1]



A key result of the Kepler Mission is that planets tend to form with similar sizes and regular spacing.... [2]



...but Kepler can miss a planet if the planet is too small or if the planet's orbit is tilted.



References

[1] Lissauer et. al., 2024
[2] Weiss et. al. 2018
[3] Gilbert & Fabrycky, 2020
[4] Gautier et al. 2012
[5] Fressin et al. 2012
[6] Buchhave et. al.., 2016
[7] He et. al., 2019

How does missing a planet affect our understanding of a system?

Gap Complexity (C)[3]
0 = Evenly Spaced
1 = Maximally uneven spacing

An example: Kepler-20

Mass Partitioning (Q)[3]
0 = Evenly Sized
1 = All Mass in single planet

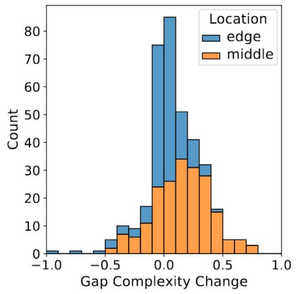
C = 0.24

Kepler Mission (~2012)[4,5]

Q = 0.16

Missing a planet causes more irregular spacing

Missing a planet doesn't affect the mass similarity

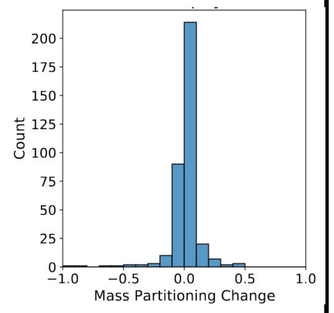


C = 0.02

Buchhave et al (2016)[6]

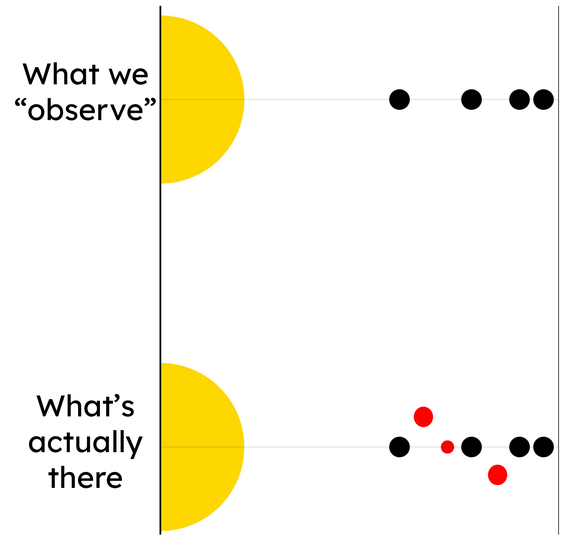
Q = 0.15

New planet!



Experimental Design

Starting from a large, homogeneous catalog,[1,7] we remove planets and monitor how the gap complexity and mass partitioning of the system architecture change.



Where do we go from here?

How many planets have we missed? Can we predict and observe these currently missing planets?

To help answer this question, we won NASA time on the Keck Telescope to perform observations this summer to attempt to find a missing planet in the gap of Kepler-48!