

Eccentric Planets : what's interesting?

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About "eccentric planets"

Possible properties

Help discovering second planet

If the system has a second planet, the gravitational interaction could be more complicated by the perturbation. Indirect methods such as transit timing variation(TTV) may be able to detect it.

Origin of Hot Jupiters

It's very difficult to explain how Hot Jupiters were formed. In recent studies, such "strange" Jupiters are said to be formed from eccentric planets. If there are more than 3 Jupiter-sized planets in a system, their orbit could be eccentric by the gravitational instability, and then their ellipse orbit become circle by the tidal effect.

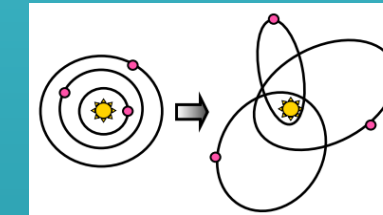


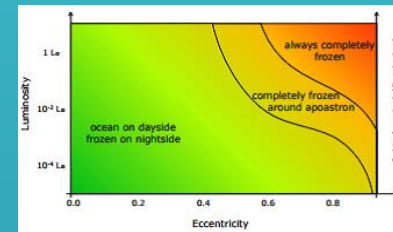
Image of the evolution from circular orbit to elliptic. This model is called "Jumping Jupiter".

Holding water

They have "four seasons" caused by their orbit. This big change of temperature makes the environment very hard. Especially, the most eccentric planet, HD20782b passes closer than the Mercury orbiting the Sun at the closest point. However, it is said that they could hold liquid water under an appropriate environment. In addition, they may be not tidally locked because of their orbit. This means they may be spinning, and this leads to atmospheric circulation. So, their temperature may be stable than tidally-locked model.



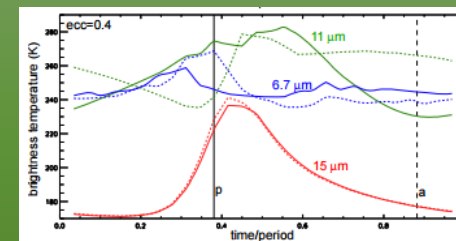
Image of HD20782b passing its host star at the closest point



Liquid water coverage map of tidally locked ocean-covered planets

Reference

Kane et al. 2016, ApJ, 821, 65K
E. Bolmont et al. 2016, A&A, 591A, 106A
Kipping, David M. 2008, MNRAS, 389, 1383K
http://optik2.mtk.nao.ac.jp/~takeda/ss_phys/presentation/sato.pdf
NASA's Exoplanet Archive
(<http://exoplanetarchive.ipac.caltech.edu/index.html>)
SF State News "Most eccentric planet known flashes astronomers with reflected light"
(<https://news.sfsu.edu/news-story/most-eccentric-planet-known-flashes-astronomers-reflected-light>)



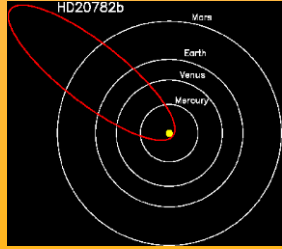
Thermal phase curve of eccentric planets

Future expectation

Detection of atmosphere

An elliptic orbit leads to a big change of the distance between the planet and the host star. This enables us to detect changing the brightness of planet caused by varying temperature. From this comet-like "flash", we may determine its atmosphere.

What are "eccentric planets"?

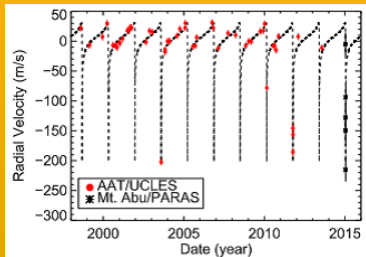


They are planets with an eccentric orbit. Differing from circular orbiting planets, they have various speed in their orbit. So they may have some interesting properties.

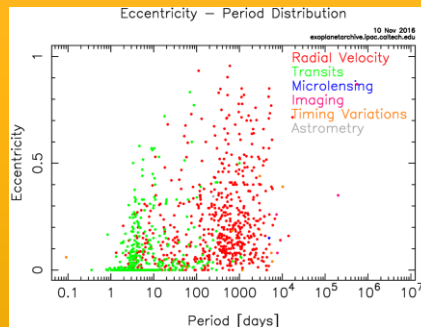
The orbit of HD20782b, whose orbit has the biggest eccentricity, 0.956!

How were they detected?

More than 80% of planets with eccentricity larger than 0.8 were detected by Radial Velocity method.



Radial velocity of HD20782b. The shape differs greatly from sine curve.



Effect on predict transit observations

Changing the speed of planet caused by its eccentric orbit may lead to the difference between Ingress and egress slope of transit. To distinguish this difference is very difficult, but JWST potentially can do that. We will get the information of eccentricity from not only fitting radial velocity but also transit light curve.