Free Floating Planet ~How to detect?~

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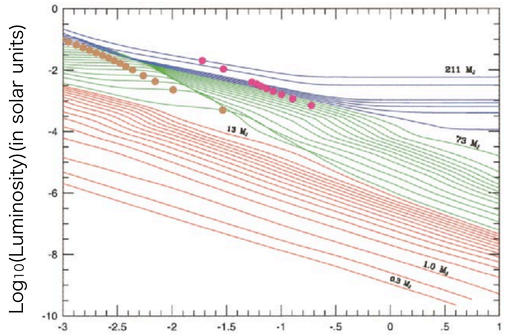
Introduction

What is the Free floating planets?

Free floating planets are planets that are not bounded by any host stars. It is difficult for us to detect them, however we sometimes can detect by spectroscopy or microlensing. It is said that free floating planets are made in stars' systems, and gravitationally scattered to the outer region of the systems. So it is important to know about free floating planet in order to understand planet formation.

Planets or Brown dwarfs?

"Brown dwarfs" have intermediate mass between stars and planets. The mass is about 13Mjup ~ 73Mjup. In the brown dwarfs, hydrogen does not burn stably, and deuterium burns temporarily. So brown dwarfs, as planets, are difficult to detect because they are typically very faint (see right figure). Some people distinct planets and brown dwarfs by the formation process, but in my poster, I will distinct them by the mass.

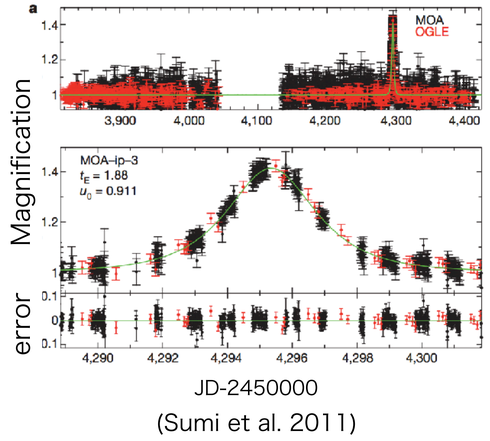


Free floating planets and brown dwarfs are darker and darker.
(Burrows et al. 2011)

How to detect?

So, how can we detect these free floating planets?
The answer is, spectroscopy or microlensing.

Microlensing



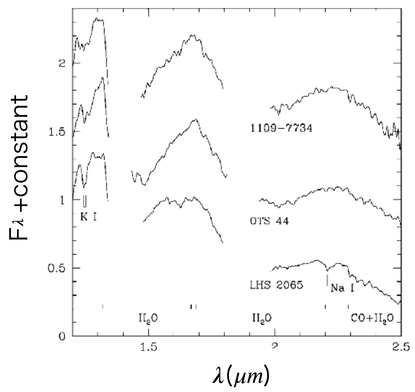
(Sumi et al. 2011)

Free floating planets are seen as a single-star event, but the timescale is very short(~2days).

Free floating planets are seen as single lens events(see the left figure), so we cannot know the lens-masses. And microlensing is good at detecting the distant planets from the earth, but is not good at detecting the further information such as orbital period or atmosphere. We can only statistical analysis via microlensing.

Sumi et al. 2011 examined how many short-single lens events are free floating. They calculated the mass distribution of such short events, and they concluded that the number of the free floating planets is twice as many as M-dwarfs.

Spectroscopy



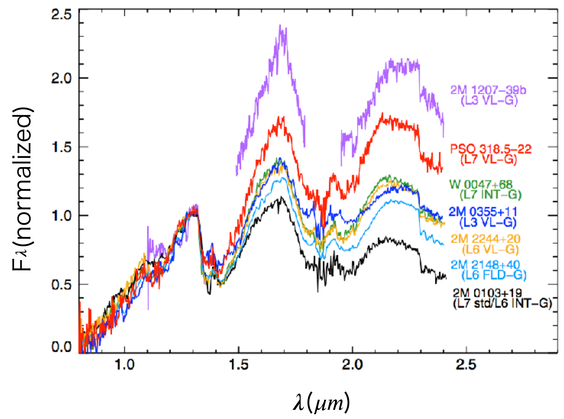
(Luhman et al. 2005)

Planetary mass brown dwarf

The left picture is from Luhman et al. 2005. They detected the planetary mass object, Cha 1109-7734. First, they found it using HST photometric observation. Next, they confirmed using Gemini Near-Infrared Spectrograph (GNIRS), because they have to except the false positive probability. According to the triangular shape of spectra in H-band, this object has low surface-gravity, because the absorption of water is expanded by the fast rotating. This object is interesting because this have the ring around itself. The mass of this object is estimated about 5-15Mjup, so Luhman said that this is the "planetary mass brown dwarf".

PSO318.5-22

Liu et al. 2013 said that they detected the planetary mass free floating object, PSO318.5-22. They saids the spectrograph shows that the low surface gravity, and the mass is estimated 5.5-7.8Mjup. The color is similar to the known planets, for example, HR8799's planets.



(Liu et al. 2013)

Summary

- Free floating planets are defined as unbound planets by their hosts.
- The formation process is not known well, so it is important to detect free floating planets.
- We can detect free floating planets via spectroscopy and microlensing.

References

[1] Adam Burrows et al. 2001, Reviews of modern physics, Vol 73
[2] Luhman et al. 2005, ApJL, 635:L93–L96
[3] Liu et al. 2013, ApJL, 777:L20
[4] Sumi et al. 2011, Nature, vol 473, p349