Exoplanets: Past, Present, and Future

Review by Chien-Hsiu Lee (2018)

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Assignment 4: Exoplanet Review Paper

Paper: *Exoplanets: Past, Present, and Future* by Chien-Hsiu Lee (2018)

Link: https://arxiv.org/abs/1804.08907

Instructions:

- Read the paper and write down a list of questions you may have.
- Read it again a few days later, and revisit your list of questions.

Initial Questions After First Read

1. Microlensing sounds really interesting, but I don't quite get how a planet so far from its star can still affect the light enough for us to detect it. What exactly does the light curve look like in such a case?

2. The paper says radial velocity only gives us $M \sin i$. But how do we figure out the actual mass then? Do we always need transits for that?

3. Direct imaging seems super cool but also very hard. Are we currently only able to take images of really big and young planets that glow in infrared?

4. The part about exoplanet atmospheres got me curious — how do we even figure out what gases are there from a transit? Isn't the light too faint?

5. I noticed that most discovered exoplanets are very close to their stars. Is that because those are the easiest to detect, or are Earth-like orbits just rare?

6. JWST is mentioned a few times — what exactly will it add to exoplanet research? Is it more about imaging, or atmosphere stuff, or both?

Reflections After Second Read

1. I watched a quick video on microlensing after reading the paper again. It helped a bit — the planet causes a small bump in the light curve when it briefly aligns just right. Still feels kind of magical that we can detect something that precise.

2. I now understand that the $\sin i$ issue means we cannot get the exact mass unless we know the angle of the orbit. I guess with enough systems, people can make reasonable estimates overall?

3. Yes, direct imaging is mainly for hot and far-out planets right now. I saw that ELTs in the future might let us image smaller and cooler ones too, which is exciting.

4. The atmospheric bit makes more sense now — during a transit, some starlight passes through the planet's atmosphere and we can detect tiny absorption features. It still feels amazing that we can get any signal at all from such a tiny change.

5. Pretty sure now that close-in planets dominate because they are just easier to spot with our current tools. Earth-like planets probably exist, but we just are not sensitive enough yet.

6. JWST looks like it will be really helpful for characterizing atmospheres and maybe spotting more super-Earths. I wonder how long each observation takes and how much data we can actually get.