

Exoplanets: Past, present, and future¹

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This study includes notes extracted from the article written by Lee (2018). This article examines recent developments related to the discovery and characterization of extrasolar planets (exoplanets). It discusses how new tools and observation programs have advanced exoplanet research and improved our understanding of planet formation and evolution.

New Tools and Observation Programs:

- **High-Precision Spectrometers:** The new generation of high-precision spectrometers allows for more accurate measurements of planetary masses using the radial velocity method. This makes it possible to discover planets with masses close to that of Earth.
- **Space Telescopes:** Space telescopes such as Kepler, TESS, and PLATO have discovered numerous new planets using the transit method. These telescopes also offer the possibility of finding smaller, Earth-like planets.
- **Ground-Based Observations:** Ground-based wide-area surveys continue to discover new planets using the transit method. Additionally, high-resolution imaging techniques are used to solve the issue of stellar blending.
- **Microlensing:** The WFIRST space telescope makes it possible to discover thousands of new planets using the microlensing method and to detect planets as small as Earth's mass.
- **Direct Imaging:** The new generation of AO systems and wide-area surveys will allow for the discovery and study of more planets using the direct imaging method. The Starshade spacecraft will make it possible to directly image Earth-like planets in habitable zones.

Formation and Evolution of Exoplanets:

- **Orbital and Mass Distributions:** The graph shows that planetary masses increase with their orbital distances. Planets located in close orbits to their stars tend to be gas giants, while planets in distant orbits tend to be terrestrial planets.
- **Super-Earths and Sub-Neptunes:** There are two gaps in the graph referred to as the "Super-Earth" and "Sub-Neptune" regions. It is rare to discover planets in these mass ranges, providing important information about planetary formation processes.
- **Migration Capability:** The article emphasizes that planets may migrate and may not have formed in their current positions. This offers additional insights into the orbits and mass distributions of planets.

Conclusion: Thanks to new tools and observation programs, we will gain more information about the formation and evolution of exoplanets and have the chance to discover Earth-like planets. These findings will provide new insights into the origins of life in our Solar System and the possibility of life existing elsewhere in the universe.

¹ Lee, C. H. (2018). Exoplanets: Past, present, and future. In *Galaxies* (Vol. 6, Issue 2). <https://doi.org/10.3390/galaxies6020051>