On Detecting Exoplanets and Planetary Distributions Moving Forward

R.W. Pfeifle$^{1,2,*}$, A. Hornstra$^1$

1. Department of Physics and Astronomy, George Mason University
2. NASA Goddard Space Flight Center
*Contact author: rpfeifle@gmu.edu

**Keywords:** Exoplanet, Transit, Microlensing, Radial Velocity

Exoplanet science has witnessed an alarming rate of growth in detection and characterization of extrasolar planets in recent years. To date, nearly 2000 extrasolar planets have been detected through four different methods, namely: the transit technique, radial-velocity technique, direct-imaging, and gravitational microlensing. Transit and radial-velocity detections account for the vast majority of exoplanet discoveries, identifying planets in orbits characterized typically by small semi-major axes, particularly in recent years through networks and missions such as KELT and the Kepler spacecraft. With future missions, such as the James Webb Space Telescope, these two methods are predicted to continue finding a vast number of planets with small semi-major axes. Gravitational microlensing is particularly sensitive to exoplanets inhabiting orbits of large semi-major axes and thus has the potential to inform planetary distributions beyond the snow-line in planetary systems and provide further statistical estimations for gas and ice giants. While only a handful of extrasolar planet discoveries have occurred through the use of gravitational microlensing, future dedicated missions are expected to rapidly inflate the rate of planetary events found within microlensing event light curves. Through these methods a potential planetary distribution for the Milky Way galaxy has been constructed, although at the current moment continued and more expansive sampling is required for a more definitive view of extrasolar planet distributions across the galaxy. We present relevant statistics for current exoplanet detections and distributions, focusing primarily on the transit, radial-velocity, and microlensing detection methods. Further, we will examine the mechanics and theory of each detection method, reduction processes necessary to complete when constraining data, as well as an outlook for each field through predicted detection rates for the coming decade. As dedicated missions will make impactful contributions in the near future, we shall too examine upcoming telescope missions such as the Wide Field Infrared Survey Telescope (WFIRST) and preparatory work necessary to complete in order to ready current observatory arrays as well as the scientific community in general for the expected influx of data and detections. Due to the expected expansion of exoplanetary science through the use of these three methods, collaboration between the exoplanet community and the big data and computer science communities will be paramount to handling the plethora of data from these extrasolar planet events.