Exploring New Worlds in the Search for Life

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Is there life elsewhere in the universe?

That question has driven scientists from antiquity till today – and led to the detailed study of the planets in our Solar System. In the last two decades, with the explosion in finding exoplanets, the answer to that question seems nearer than ever. The *New Worlds, New Horizons* 2010 Decadal Survey, the 2006 NASA Astrophysics Roadmap, and many community studies have emphasized the long-term vision to find, study, and characterize habitable exoplanets. For a flexible, 30-year vision, the science and technology challenges in exoplanet science allow for a multitude of implementation paths, all of which are essential stepping stones for the long-term challenge of understanding the diversity of new worlds in the search for the signatures of life on exoplanets.

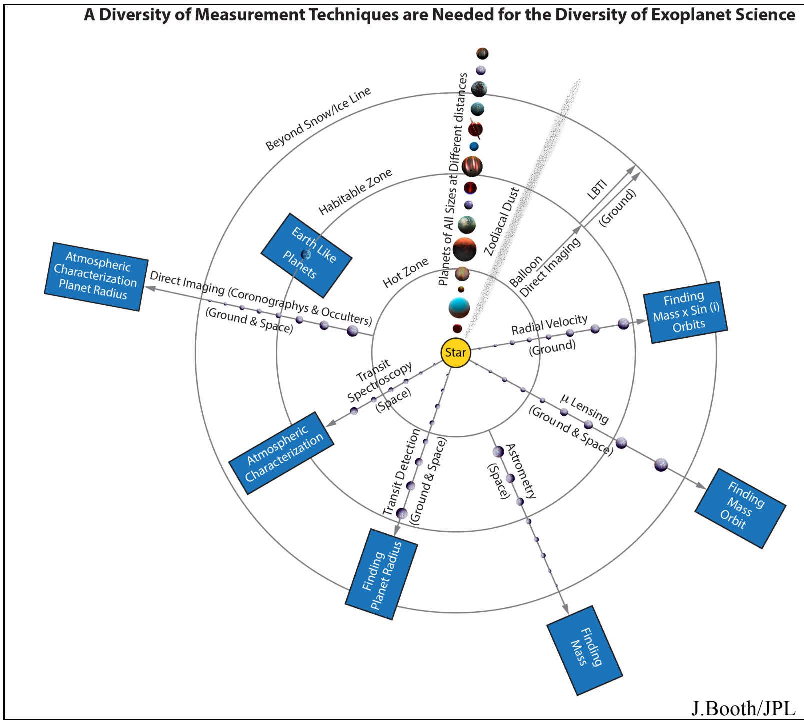

Figure 1: The diversity of exoplanets studied with a multitude of techniques highlights the opportunity for a flexible portfolio-approach for the next decades. The illustration shows how different measurement techniques provide specific information (ie, “Finding”, or “Mass”) for ranges of planetary orbits, and sensitivities to planet size. Future projects over the next 3 decades like JWST, WFIRST, Explorers, sub-orbital balloons and cubesats, and others combine to probe the full range of exoplanet types and properties, leading to searching for the signs of life on “Earth-like” planets in the HZ.

10 years: Science Challenge – Characterize the Diversity of Exoplanets

With the next Explorer missions, JWST, and ground-based programs, we can accelerate more detailed characterization of exoplanets, particularly their atmospheres via combined light spectroscopy. What is the chemistry and composition of the full diversity of the exoplanet family? We must understand that for 100s of planets so we can interpret non-equilibrium chemistry signatures in the following decades.

20 years: Science Challenge – Directly Image Exoplanets in the Habitable Zone

Using precise RV surveys and/or an IR transit survey, along with more knowledge of the chemistry of exoplanets, the habitable zone (HZ) may be redefined and more populated (ie. around cooler stars). Using a dedicated 2.4m telescope probe (SALSO) or a coronograph on WFIRST we could make direct images of gas/ice giants in the HZ with low-resolution spectroscopy.

30 years: Science Challenge – High Resolution Spectra of Rocky Planets in the HZ

Search for biosignatures in non-equilibrium chemistry with high-resolution spectra of small (~few R_E) HZ planets using a large telescope with an external occulter or internal coronograph. Technology investments in next-generation deployable optics and optimization of coronographs and occulters are critical enabling steps.