

## Astrobiology News for June 2013: The Diversity of Worlds – and Scientists

When I began graduate school in the early 1980s, scientists who studied the planets in our Solar System (planetary scientists) and those who studied “the rest of the Universe” (astronomers) didn’t interact very much. In fact, these groups rarely attended the same conferences, even though an initiative to cross-fertilize these populations had begun in the late 1970s, when planetary scientist Tom Gehrels proposed a “Protostars and Planets” project to bring the communities together to study star and planet formation. Naysayers wagered the initiative wouldn’t be successful because astronomers and planetary scientists were too far apart to even speak the same language!

“Speaking the same language” is hardly a problem restricted to the sciences, but the lesson here is that the situation I’ve described only began to change when stellar astronomers and planetary scientists began to see the relevance of interdisciplinary discourse. How did this happen? The discovery of solar-system-sized flattened nebulae around young stars (circumstellar disks) and the discovery of exoplanets orbiting other stars provided strong incentives for both groups to learn to collaborate with each other. After all, how else could progress be made in understanding how large interstellar clouds could eventually collapse gravitationally to become stars with orbiting worlds, some of which might have active geology, and perhaps even harbor life? I recall an American Astronomical Society meeting in the mid-1990s when Dan Goldin, NASA Administrator at the time, called for a show of hands regarding how many conference attendees had any academic training in biology. Very few hands went up. Most of us astronomers (myself included) were trained in physics and had little or no post-secondary education in biology. Goldin’s point was well made – we needed to get biologists on board in the search for life beyond Earth. Thus, the field of Astrobiology was born.

Mirroring the explosion of discoveries and advances in many other fields of science and technology over the past few decades, the number of known exoplanets has increased almost exponentially since these objects were first discovered in the 1990s. As of the time I am writing this, there are nearly 900 confirmed exoplanets and thousands of exoplanet candidates awaiting confirmation through rigorous vetting processes and follow-up observations. The diversity of exoplanetary systems is far beyond what scientists imagined just a couple of decades ago, based on the architecture of our Solar System and what we thought we understood about how planets form. We expected other planetary systems would look much like our own, with small rocky planets and gas giant planets orbiting their stars at distances reflecting where theory predicted these different types of planets should form, but what we’ve actually found has, I’m sure, left science fiction writers smiling: planets of virtually all sizes orbiting many different types of stars. There are huge, hot planets that orbit their stars with periods of just a few days; systems with multiple planets that orbit their stars closer than Venus orbits our Sun; planets orbiting dim M-dwarf stars that are ten times as ubiquitous as our Sun; many systems that contain “super-Earths” that bridge the size gap between Earth and the gas giant

planets in our Solar System; and planets orbiting binary stars (two stars that orbit each other). One planet that was discovered last year by citizen scientists participating in the *Planethunters* project actually orbits two stars that in turn are part of a quadruple star system! I could go on, but you get the picture. In tandem with these discoveries has come much more sophisticated computer modeling of planet formation, which indicates that the positions of planets in our own Solar System were probably not established by the orderly, in-situ formation process envisioned decades ago, but rather reflect significant interactions between the forming planets and the Sun's circumstellar disk.

At the present time, Earth is the only planet on which we know life exists, but consider this. Two decades ago, we knew of only one planetary system – our Solar System. The history of scientific progress (not to mention the laws of statistics) reminds us that extrapolating from a sample size of one is fraught with uncertainty, to say the least. The incredible diversity of exoplanetary systems suggests that, if anything, we have been far too conservative in thinking about what life might be like elsewhere. Next month, we'll explore the concept of "Habitable Zones". Note that "habitable" does not necessarily mean "inhabited", but rather that the conditions for life as we know it to exist are met. Traditionally, the Habitable Zone around a particular star has been defined by the requirement that a planet have liquid surface water. By this definition, a relatively small fraction of *currently* known exoplanets lie in the Habitable Zones of their stars; however, as we'll see next month, the growing diversity of exoplanet discoveries is motivating re-thinking and broadening of our ideas about habitability.

I'd like to close this month with a quote from Kian Jek, a citizen scientist in the *Planethunters* project, who won the prestigious Chambliss Amateur Achievement Award at the January 2013 American Astronomical Society meeting: "As someone who grew up with the Apollo moon landings, whose childhood imagination was fired by Kubrick's 2001 and the original Star Trek, I never had any doubt that planets around other stars existed and that one day we would discover them. But I never dreamed that we would find them in my lifetime, let alone being involved in their discovery. Although there are over 700 discovered since 1996, each new planet opens another door to a strange alien world, some of them we could not even imagine could exist. *Planethunters* is an exciting project that allows citizens and scientists [to] participate in pushing the final frontier ever slightly further."

Remember, all of you are invited to join *Planethunters* ([www.planethunters.org](http://www.planethunters.org)) in the search for new worlds! For a preview of next month's topic, check out The Habitable Exoplanets Catalog: <http://phl.upr.edu/projects/habitable-exoplanets-catalog>

Until next month,

Grace Wolf-Chase, Ph.D.