Astrobiology News August 2020: The Birth and Habitability of Planets

How do planets form? The birth of planets is intimately connected to the birth of stars. As cold, rotating clouds in space are pulled together by gravity, they flatten out. Stars form through the gravitational collapse of material at the centers of these huge (billions of miles across) *protoplanetary disks*, while planets form further out through slower processes that aggregate small particles into larger bodies over millions of years. Although protoplanetary disks were first observed in silhouette against bright nebulae by the Hubble Space Telescope in the 1990s,[1] only recently have astronomers been able to study details of their structure.

The Disk Substructures at High Angular Resolution Project (DSHARP) at the Atacama Large Millimeter/submillimeter Array (ALMA) has observed a wide variety of protoplanetary disks at microwave wavelengths that probe these dusty regions.[2] This project has uncovered many structures in these disks that are beginning to help reveal how, where, and when different types of planets form in these systems. Understanding the important physical processes that occur in the birth of planetary systems is important for understanding the diversity of the thousands of mature planetary systems that have been discovered during the past 25 years.

Of particular interest are planets that occupy their star's habitable zones - these planets might contain liquid water, which is essential to life on Earth. A recent paper produced by a team from the University of California, Riverside, explores the question, how many habitable zone planets can orbit a host star?[3] This study considered the sizes of habitable zones around stars of different temperatures and how the orbits of planets are affected by the presence of other planets. One interesting conclusion of this study is that a Jupiter-sized planet would have a destabilizing effect on the maximum number of planets in a star's habitable zone. Since Jupiter functions as something of an "asteroid magnet" in our Solar System, protecting planets like Earth from some major impacts, a planet's actual habitability depends upon many factors.

Due to the pandemic, ALMA isn't currently conducting science operations, but there is an exciting way you can help discover new protoplanetary disks! If you go to the research projects[4] link on the Zooniverse platform that I supplied last month and search for "Disk Detective", you can inspect infrared images obtained from NASA's Wide-field Infrared Survey Explorer (WISE). These images don't resolve protoplanetary disks, but the large areas surveyed by WISE enable searching for "infrared excesses" around many young stars that might indicate the presence of a protoplanetary disk. You might discover some great new targets for future ALMA studies!

If you participate in *Disk Detective* or any other Zooniverse projects, either individually or in any of your programs, we humbly ask you take a few minutes to fill out a pre-participation[5] or

---

[1] https://hubblesite.org/contents/news-releases/1994/news-1994-24.html
[2] https://public.nrao.edu/news/2018-alma-survey-disks/
[3] https://astrobiology.nasa.gov/news/how-many-habitable-zone-planets-can-orbit-a-host-star/
[4] https://www.zooniverse.org/projects?utm_source=newsletter@utm_campaign=projects-CLP
[5] Pre-survey: https://forms.gle/x5TezWJEqAZnLb39A

post-participation[6] survey that will help us improve the Zooniverse experience. Also, please don't hesitate to contact me with any questions! Finally, I have a new professional "home" as a Senior Scientist & Senior Education and Communication Specialist with the Planetary Science Institute[7] - expect to hear more from me about this in the future!

Until next month,

Grace Wolf-Chase (gwolfchase@gmail.com)
Senior Scientist and Senior Education & Communication Specialist, Planetary Science Institute (psi.edu)
Vice President, Center for Advanced Study in Religion and Science (CASIRAS: casiras.org)

[6] Post- survey: https://forms.gle/opYzTKSxK3PFJtv9A
[7] https://www.psi.edu/