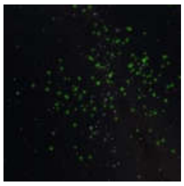
BROWN DWARFS REVEAL EXOPLANETS’ SECRETS

Monday, August 15, 2016



Washington, DC— Brown dwarfs are smaller than stars, but more massive than giant planets. As such, they provide a natural link between astronomy and planetary science. However, they also show incredible variation when it comes to size, temperature, chemistry, and more, which makes them difficult to understand, too.

New work led by Carnegie’s Jacqueline Faherty surveyed various properties of 152 suspected young brown dwarfs in order to categorize their diversity and found that atmospheric properties may be behind much of their differences, a discovery that may apply to planets outside the solar system as well. The work is published by *The Astrophysical Journal Supplement Series*.

Scientists are very interested in brown dwarfs, which hold promise for explaining not just planetary evolution, but also stellar formation. These objects are tougher to spot than more-massive and brighter stars, but they vastly outnumber stars like our Sun. They represent the smallest and lightest objects that can form like stars do in the Galaxy so they are an important "book end" in Astronomy.

For the moment, data on brown dwarfs can be used as a stand-in for contemplating extrasolar worlds we hope to study with future instruments like the James Webb Space Telescope.

"Brown dwarfs are far easier to study than planets, because they aren't overwhelmed by the brightness of a host star," Faherty explained.

But the tremendous diversity we see in the properties of the brown dwarf population means that there is still so much about them that remains unknown or poorly understood.

Brown dwarfs are too small to sustain the hydrogen fusion process that fuels stars, so after formation they slowly cool and contract over time and their surface gravity increases. This means that their temperatures can range from nearly as hot as a star to as cool as a planet, which is thought to influence their atmospheric conditions, too. What's more, their masses also range between star-like and giant planet-like and they demonstrate great diversity in age and chemical composition.

By quantifying the observable properties of so many young brown dwarf candidates, Faherty and her team—including Carnegie's Jonathan Gagné and Alycia Weinberger—were able to show that these objects have vast diversity of color, spectral features, and more. Identifying the cause of this range was at the heart of Faherty's work. By locating the birth homes of many of the brown dwarfs, Faherty was able to eliminate age and chemical composition differences as the underlying reason for this great variation. This left atmospheric conditions—meaning weather phenomena or differences in cloud composition and structure—as the primary suspect for what drives the extreme differences between objects of similar origin.

All of the brown dwarf birthplaces identified in this work are regions also host exoplanets, so these same findings hold for giant planets orbiting nearby stars.

"I consider these young brown dwarfs to be siblings of giant exoplanets. As close family members, we can use them to investigate how the planetary aging process works," Faherty said.

Other co-authors on the paper are: Adric R. Riedel, Kelle L. Cruz, Joseph C. Filippazzo, Erini Lambrides, Haley Fica, Vivienne Baldassare, Emily Lemonier, and Emily L. Rice from the American Museum of Natural History; John R. Thorstensen of Dartmouth College, and C. G. Tinney of University of New South Wales.

This work was supported by the National Collaborative Research Infrastructure and Collaborative Research Infrastructure Strategies of the Australian Federal, the

Australian Research Council, and the National Science Foundation.

This publication has made use of the Carnegie Astrometric Program parallax reduction software as well as the data products from the Two Micron All-Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation. This research has also made use of the NASA/ IPAC Infrared Science Archive, which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration. Furthermore, this publication makes use of data products from the Wide Field Infrared Survey Explorer (WISE), which is a joint project of the University of California, Los Angeles, and the Jet Propulsion Laboratory/California Institute of Technology, and NEOWISE, which is a project of the Jet Propulsion Laboratory/California Institute of Technology. WISE and NEOWISE are funded by the US National Aeronautics and Space Administration.

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