Isotopes and the characterization of extrasolar planets

Zhang, Y.

List of Publications

1. **Zhang, Y.**, Snellen, I. A. G., Mollière, P., Alonso-Floriano, F. J., Webb, R. K., Brogi, M., & Wyttenbach, A. (2020) Search for He I airglow emission from the hot Jupiter τ Boo b. **A&A**, 641, A161.

2. **Zhang, Y.**, Snellen, I. A. G., Bohn, A. J., Mollière, P., Ginski, C., Hoeijmakers, H. J., Kenworthy, M. A., Mamajek, E. E., Meshkat, T., Reggiani, M., & Snik, F. (2021) The ^{13}CO-rich atmosphere of a young accreting super-Jupiter. **Nature**, 595, 370.

3. **Zhang, Y.**, Snellen, I. A. G., & Mollière, P. (2021) The ^{12}CO/^{13}CO isotopologue ratio of a young, isolated brown dwarf. Possibly distinct formation pathways of super-Jupiters and brown dwarfs. **A&A**, 656, A76.

4. **Zhang, Y.**, Snellen, I. A. G., Wyttenbach, A., Nielsen, L. D., Lendl, M., Casasayas-Barris, N., Chaverot, G., Kesseli, A. Y., Lovis, C., Pepe, F. A., Psaridi, A., Seidel, J. V., Udry, S., & Ulmer-Moll, S. (2022) Transmission spectroscopy of the ultra-hot Jupiter MASCARA-4b. Disentangling the hydrostatic and exospheric regimes of ultra-hot Jupiters. **A&A**, 666, A47.

5. **Zhang, Y.**, Snellen, I. A. G., Brogi, M., & Birkby, J. L. (2022) VLT/CRIRES science verification observations: A hint of C^{18}O in the young brown dwarf 2M0355. **Res. Notes AAS**, 6, 194.

6. **Zhang, Y.**, Ginski, C., Huang, J., Zurlo, A., Beust H., Bae, J., Benisty, M., Garufi, A., Hogerheijde, M.R., van Holstein, R.G., Kenworthy, M., Langlois, M., Manara, C.F., Pinilla, P., Rab, C., Ribas, A., Rosotti, G.P., & Williams, J. (2023) Disk Evolution Study Through Imaging of Nearby Young Stars (DESTINYS): Diverse outcomes of binary-disk interactions. **A&A**, 672, A145.

Curriculum Vitæ

I was born in Datong, a city located in the northern province of Shanxi, China, on May 10, 1995. Growing up, I developed a fascination with the mysteries of the universe, fueled by books and cartoons that explored the cosmos. This early interest culminates in my decision to major in astronomy in college. From 2013 to 2017, I studied astronomy at Nanjing University, located in eastern China. During my undergraduate studies, I became particularly interested in exoplanets and began exploring different aspects of this fast-moving field. Under the guidance of Prof. Jiwei Xie, I completed my Bachelor's research project, simulating terrestrial planet formation in highly inclined binary systems. In 2016, I had the opportunity to conduct a summer internship at the European Southern Observatory (ESO), where I worked on digging into Kepler lightcurves to search for unusual transiting events.

The short experience at ESO inspired me to pursue a PhD degree overseas. In 2017, I came to Leiden University for the Master's program in astronomy and data science. During my time there, I conducted research projects related to exoplanets and protoplanetary disks. Under the supervision of Prof. Ignas Snellen, I used novel techniques to search for molecular signatures in the atmospheres of directly imaged exoplanets. Additionally, my work on the dust evolution in protoplanetary disks, supervised by Prof. Michiel Hogerheijde, provided me with new perspectives on the birth environment of planets.

After obtaining my Master's degree (*cum laude*, 2019), I was thrilled to be offered a PhD position in the group of Ignas Snellen at Leiden University to continue my exploration of exoplanet atmospheres. My PhD studies were not without challenges, as the pandemic limited the possibility of travel and communication. Nonetheless, this allowed me to focus on the research per se, leading to the first detection of minor isotopologues in exoplanet atmospheres. This discovery marks a highlight of my PhD and is presented in this dissertation.

Now, as I move forward in my career, I am honored to be awarded the 51 Pegasi b postdoctoral fellowship to start a new journey in the United States. As of October 2023, I will be a post-doctoral researcher at California Institute of Technology and continue to delve deeper into the characterization of exoplanet atmospheres and their connections to planet formation. I am eager to see what the future holds as we continue to push the boundaries of discovery.

Acknowledgments

Although pursuing a PhD is a personal journey, I have never been alone during the process and could not have made it this far without the help of many people.

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I would like to express my deepest gratitude to my supervisor, Ignas, for the guidance and support for my career. Thank you for providing me with freedom in choosing any research project I wanted to work on (as one can easily tell from the broad range of topics in this dissertation). I appreciate your dedication to my academic and personal growth. Your insights during discussions have helped me develop the intuition for data as an observer, and your attitude towards science is an inspiring model. I am honored to have worked with you.

I am also thankful to other staff members at the Observatory, including Aline, Anthony, Ewine, Matt, Michiel, Nienke, and Yamila, with whom I had interactions, for your generous support and care for PhD students.

I would like to extend my appreciation to previous and current PhDs and postdocs in the Leiden exoplanet group, including Alex, Alex, Amy, Aurora, Aurélien, Christian, Christiaan, Darío, Dilovan, Javi, Jens, Mantas, Núria, Patrick, Paul, Paul, Rico, Sam, Sebastiaan, Sid, and Tomas, who have provided a friendly and stimulating environment in the group. I obtained plenty of inspiration, advice, and help from the discussions with you all.

I am grateful to my collaborators, Paul, Laura, and Christian, for their guidance and great science. I hope to continue our collaboration in the future.

I would also like to thank the Master students, Rosa and Merel, who chose to work on research projects with me. Your enthusiasm and dedication have been impressive, and I have gained valuable experiences through mentoring you.

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I further thank my close friends in Leiden, Na, Yao, and Yu, with whom I enjoyed numerous dinners and movie nights. These warm memories are invaluable to me.

Last but not least, I express my gratitude to my parents and friends in China for their unwavering support throughout my academic journey. Whenever I feel lost, they always uplift me with their encouragement and love, sustaining me through the ups and downs.

I am grateful for the six years in Leiden, long enough that it almost becomes my second hometown. Thanks to all the people I have met and the experiences I have had, my perspective has been reshaped and my horizons have expanded immensely. No regrets.