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High-contrast spectroscopy of exoplanet atmospheres

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List of publications

First-author, refereed

1. *Making the unmodulated Pyramid wavefront sensor smart. Closed-loop demonstration of Neural Network wavefront reconstruction with MagAO-X*
   R. Landman, S. Y. Haffert, J. R. Males, L. M. Close, W. B. Foster, K. Van Gorkom, O. Guyon, A. Hedglen, M. Kautz, J. K. Kueny, J. D. Long, J. Lumbres, E. A. McEwen, A. McLeod, and L. Schatz
   Astronomy & Astrophysics, 684, A114 (2024)

2. *β Pictoris b through the eyes of the upgraded CRIRES+. Atmospheric composition, spin rotation, and radial velocity*
   R. Landman, T. Stolker, I.A.G. Snellen, J. Costes, S. de Regt, Y. Zhang, S. Gandhi, P. Mollière, A. Kesseli, A. Vigan, and A. Sánchez-López
   Astronomy & Astrophysics, 682, A48 (2024)

3. *Trade-offs in high-contrast integral field spectroscopy for exoplanet detection and characterisation. Young gas giants in emission*
   R. Landman, , I. A. G. Snellen, C.U. Keller, M. N'Diaye, F. Faggінger-Auer, and C. Desgrange
   Astronomy & Astrophysics, 675, A157 (2023)

4. *Detection of OH in the ultra-hot Jupiter WASP-76b*
   R. Landman, A. Sánchez-López, P. Mollière, A.Y. Kesseli, A.J. Louca, and I.A.G. Snellen
   Astronomy & Astrophysics, 656, A119 (2021)

5. *Self-optimizing adaptive optics control with reinforcement learning for high-contrast imaging*
   R. Landman, S.Y. Haffert, V. M. Radhakrishnan and C.U. Keller
   Journal of Astronomical Telescopes, Instruments, and Systems, 7, 039002 (2021)

6. *Nonlinear wavefront reconstruction with convolutional neural networks for Fourier-based wavefront sensors*
   R. Landman and S.Y. Haffert
   Optics Express, 28, 11, 16644 (2020)

Proceedings

7. *Joint optimization of wavefront sensing and reconstruction with automatic differentiation*
   R. Landman, C. Keller, E. H. Por, S. Haffert, D. Doelman, and T. Stockmans
   SPIE, 12185, 1218589 (2022)

8. *Self-optimizing adaptive optics control with reinforcement learning*
   R. Landman, S. Y. Haffert, V. M. Radhakrishnan, and C. U. Keller
   SPIE, 11448, 114484 (2020)

Selected co-authored publications

1. *Into the red: an M-band study of the chemistry and rotation of Pictoris b at high spectral resolution*
   L. Parker, J. Birkby, **R. Landman**, J. Wardenier, M. Young, S. Vaughan, L. van Sluijs, M. Brogi, V. Parmentier, M. Line
   Monthly Notices of the Royal Astronomical Society, in press (2024)

2. *Revealing H_2O dissociation in WASP-76 b through combined high- and low-resolution transmission spectroscopy*
   S. Gandhi, **R. Landman**, I. Snellen, L. Welbanks, N. Madhusudhan, and M. Brogi
   Monthly Notices of the Royal Astronomical Society, in press (2024)

3. *Searching for the origin of the Ehrenreich effect in ultra-hot Jupiters. Evidence for strong C/O gradients in the atmosphere of WASP-76 b?*
   A. Sánchez-López, **R. Landman**, P. Mollière, N. Casasayas-Barris, A. Y. Kesseli, and I. A. G. Snellen
   Astronomy and Astrophysics, 661, A78 (2022)

Curriculum vitae

I was born on the 16th of April in 1997 in Haarlem, the Netherlands. I grew up in Nieuw-Vennep and attended the local high school, the Herbert Vissers College. As a child, I had a strong curiosity for everything and, of course, had a room decorated in a space theme. Outside of school, I spent a lot of time at the local korfball club KIOS, where I can still often be found. I was initially not sure about my future career after high school. After watching the movie *Interstellar*, I realized I wanted to learn the answer to the big questions about the universe. I chose to study Physics and Astronomy at Leiden University, graduating cum laude with a Bachelor of Science in 2018, but learned that unfortunately you do not get concrete answers to these big questions. My bachelor research project on "Nonlinear wavefront reconstruction with Convolutional Neural Networks" under the supervision of Sebastiaan Haffert and Christoph Keller was my first exposure to conducting scientific research, and it was a very enjoyable experience.

I continued my education in Leiden with a Master degree in Astronomy & Data Science, and I continued to work with Sebastiaan Haffert and Christoph Keller in applying machine learning to adaptive optics for my first master research project. This time, we used Reinforcement Learning to develop a self-learning algorithm for predictive control. With a good feeling of what a scientific research career would hold for me, I decided I wanted to see what it would be like to work outside the university. To this end, I conducted my master thesis at ESA/ESTEC on "Bayesian inference of meteor spectra" under the supervision of Joe Zender and worked as a Data Specialist at ABN AMRO during my master.

I decided I was not yet done with science and, after obtaining my Master of Science degree cum laude in 2020, started a PhD with Ignas Snellen and Christoph Keller on developing novel instrumentation for exoplanet characterization. Over the course of my PhD, I conducted research projects on a variety of topics, all with the goal of detecting and characterizing exoplanets. These projects included the analysis of observations of exoplanets at high-spectral resolution, and the development and testing of new algorithms for adaptive optics. During my PhD, I got the chance to present my work at many conferences, observe with the VLT in Chile, and visit Christoph and the MagAO-X team in Arizona.

Acknowledgments

During my almost 9 years of walking around the halls of the Oort and Huygens building, and now the new building, all the way from the Bachelor to the PhD, I have met many amazing people. Before thanking individual people, I would first like to thank everyone at the Observatory for contributing to the great atmosphere that I felt every time I came into work. I also want to thank all the support staff at the Observatory for making sure everything runs smoothly.

First of all, I want to express my deepest thanks to my supervisors Ignas and Christoph. Ignas, thank you for allowing me the freedom to explore my own interests, while always guiding me towards the right path. You are an inspiration both as a scientist and manager. Christoph, even though you moved to the US during my 2nd year to start a new, busy job, you always took your time in the early mornings to have chat with me, which I deeply appreciate. Over the many years I have learned a tremendous amount from you. Visiting you and your family in Flagstaff was one of the highlights of my PhD.

I want to thank all the current en previous members of the instrumentation and exoplanet groups for all the exciting science, stimulating discussions, and fun conferences, including Amy, Alex, Aurora, Bernhard, Christiaan, Christian, Dario, Dilovan, Emiel, Emily, Fedde, Frans, Kira, Maaike, Mantas, Matt, Naor, Natalie, Remko, Richelle, Sam, Sid, Steven, Tomas, Vikram, Yamila, Yapeng, and many more. Specifically, Willeke, Thijs, Elina, and Floor, it was an honor to start the PhD together on the 11th floor. Even though we were initially limited to online coffees and socially distanced borrels, I immediately felt part of a group. Sebastiaan, thanks for being a great mentor, patiently answering all my questions on optics and high-contrast imaging, and showing me how great Tucson is. David, thanks so much for all your advice and keeping the group together when it was needed the most. Michiel, thank you for bringing some extra humor in the group and teaching me a few Flemish words. Next to the great people in Leiden, I also want to thank all my other collaborators for their contributions towards this thesis.

Ook wil ik mijn vrienden uit Nieuw-Vennep en van KIOS bedanken voor alles. De trainingen, wedstrijden, feestjes en 3e helften zorgden er altijd voor dat ik de dag erna weer met nieuwe energie aan het werk kon. Mike, heel erg bedankt voor het prachtige ontwerp van de cover.

Daarnaast wil ik mijn familie bedanken. Pap en mam, bedankt voor alles, zonder jullie was dit nooit gelukt. Ik voel me ontzettend dankbaar voor alle aandacht, advies, steun en aanmoediging die ik heb ontvangen bij het volgen van mijn eigen pad. Lisa, onze ritjes samen naar Leiden waren een ontzettend fijne en gezellige start en einde van de werkdag. Ook wil ik mijn lieve kat Leia bedanken voor alle

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