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Novel approaches for direct exoplanet imaging: Theory, simulations and experiments

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Cover Page



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Curriculum Vitae

I was born on the 19th of November 1992 in Zoetermeer, the Netherlands. With both my mom and dad having studied physics, both specializing in computational physics, I came into contact with the natural sciences and programming early on. Throughout my youth, my interest in those primarily focused on computer graphics with ray and path tracing. From 2004 to 2010 I attended secondary gymnasium education at the Stedelijk College Zoetermeer, later renamed to the Picasso Lyceum, with a specialization in the natural sciences.

I started a double Bachelor in Physics and Astronomy at Leiden University in 2010. My interest in astronomy grew over the years, and only solidified after starting my Bachelor thesis project on sparse aperture masking under supervision of Matthew Kenworthy. This project turned out to be the perfect combination of simulation, observing and data reduction. I graduated cum laude in 2013.

In September 2013, I continued with a Master in Astronomy, specializing in Astronomical Instrumentation. My first research project was on post-Newtonian N-body dynamics supervised by Simon Portegies Zwart and Adrian Hamers. I graduated cum laude in 2016 with a research project on holographic electric field sensing for high-contrast imaging supervised by Christoph Keller, and I got the opportunity to present this work at a conference in Edinburgh, UK.

Afterwards, I continued at Leiden University with my PhD, supervised by Matthew Kenworthy and Christoph Keller. While the original goal was to improve post-coronagraphic wavefront sensing techniques, my interest was drawn towards coronagraphy. I developed an algorithm for finding the global optimum solution for apodizing phase plate coronagraphs, for the first time providing fundamental limits of this coronagraph. This algorithm turned out to be the basis for the development of the SCAR and PAPLC coronagraphs later on, and many side projects that did not make it to published articles.

My love for programming led me to develop HCIPy, a software package for simulating high-contrast imaging systems. While initially this package was intended to simplify code sharing and unify definitions within our research group, we decided to release HCIPy as open-source software and

keep maintaining and developing over the next few years. In these years, the number of users of HCIPy grew steadily and at the time of writing at least 12 researchers across the world use HCIPy for, at least part of, their daily research. Furthermore, HCIPy has been used in education at the Master and PhD level.

I presented my work at many conferences across the world, from the USA to Europe and Japan. I also visited the Space Telescope Science Institute in Baltimore, USA, for a period of six weeks, where I worked on exploiting symmetries and progressive refinement for the optimization of apodized-pupil Lyot coronagraphs and implementing wavefront control algorithms on HiCAT, their high-contrast imaging testbed.

In January 2021, I will be starting as an NHFP Sagan fellow at the Russell B. Makidon Optics Laboratory at the Space Telescope Science Institute in Baltimore, USA.

Acknowledgments

During my ten years at Leiden University – from the start of my Bachelor to the end of my PhD – I have met a large number of amazing people. This single section is too short to thank them all to the degree that they deserve, but I am grateful to have met you all.

First of all, let me thank my direct supervisors during my PhD, Matthew and Christoph. You let me roam free and explore whatever piqued my interest at the time, which I highly enjoyed. At times, you definitely had to keep me grounded and on track; I hope that this job became easier as time progressed. Frans, your crazy ideas and neverending enthusiasm made my time at Leiden much more dynamic.

Many thanks to the current and former members of the instrumentation and high-contrast imaging group: Sebastiaan, David, Steven, Maaïke, Kelsey, Vikram, Alex, Mike, Mireille, Patrick, Olivier, Christian, Jos and Schuyler. I've had the privilege to travel with you to many new countries for conferences and holidays, commissioning new instrumentation and coronagraphs, observing a solar eclipse, celebrating New Years Eve on a mountain top, visiting ancient temples and many other amazing experiences. Your company made these so much more memorable. Thanks for coping with my incessant questions. Also, many thanks to Kirsty, Stijn, Leon and Leindert for providing happy distractions from instrumentation, and most of the time research altogether, during the frequent coffee, tea and lunch breaks.

Teaching has been something I never thought I would enjoy but actually did. Besides teaching at the Astronomical Observing Techniques tutorial sessions, I had the pleasure of supervising several excellent Bachelor and Master students. Thijs, Christian and John: I learned a lot from supervising you; I wish you all a great future career.

My visit to the Space Telescope Science Institute in Baltimore, USA, was one of the highlights of my PhD. Thank you, Rémi, Marshall, Laurent, Iva, Jamie, Kathryn, Jules, Keira, Scott, Pete, Greg, Anand and Chris, for providing a welcoming atmosphere during the six weeks of my visit and afterwards during the many remote group meetings. Thank you Katie, for letting me stay in your spare room on such short notice.

I would be amiss to not mention NYRIA, the Network of Young Re-

searchers in Instrumentation for Astronomy, for connecting me to many new people, in particular to Faustine, who showed me how quickly an idea can be turned into a scientific paper, chapter six in this thesis.

And last, but definitely not least, I would like to thank my family. To Mom, thanks for showing me that curiosity never stops. To my late dad, our time together was too short. You still inspire me to this day. To my sister, Anne, thanks for helping me get through a difficult time in my life. I could not have done it without you.