Turtles all the way down: multiscale simulations connecting star and planet formation

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Publications

Lead author

- The Milky Way's bar structural properties from gravitational waves
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- Exploring the possibility of Peter Pan discs across stellar mass
  Wilhelm, Maite J. C.; Portegies Zwart, Simon F.; Monthly Notices of the Royal Astronomical Society, Volume 509, Issue 1, P44-51 (2022)

- Radiation shielding of protoplanetary discs in young star-forming regions
  Wilhelm, Maite J. C.; Portegies Zwart, Simon F.; Cournoyer-Cloutier, Claude; Lewis, Sean C.; Polak, Brooke; Tran, Aaron; Mac Low, Mordecai-Mark; Monthly Notices of the Royal Astronomical Society, Volume 520, Issue 4, P5331-5353 (2023)

- VENICE: a multi-scale operator-splitting algorithm for multi-physics simulations
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- A triple-induced merger in θ^1 Ori C solves the proplyd lifetime problem and the curiously young shell of M42
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Contributor

- External photoevaporation of circumstellar discs constrains the time-scale for planet formation
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- Effects of stellar density on the photoevaporation of circumstellar discs
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- Early-forming Massive Stars Suppress Star Formation and Hierarchical Cluster Assembly
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- Evolution of circumstellar discs in young star-forming regions
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- Early evolution and three-dimensional structure of embedded star clusters
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- Massive Star Cluster Formation I. High Star Formation Efficiency While Resolving Feedback of Individual Stars
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- Modeling protoplanetary disk evolution in young star forming regions
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- Modeling Evolution from Gas to Young Massive Star Clusters
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What's so amazing that keeps us stargazing
And what do we think we might see?
Someday we'll find it, the rainbow connection
The lovers, the dreamers and me

Kermit the Frog, The Rainbow Connection

Curriculum Vitae

I was born on October 2nd, 1995, in the town of Zeist in the central Netherlands. I was a curious kid who loved to learn about subjects from history to science (frequently from books obtained in library visits with my grandma), but my big fascination was with astronomy. In my grandparents' old house there was a bookcase under the stairs that held my grandpa's collection of astronomy books, and I would spend many visits combing through pictures of planets, nebulae, and spacecraft even when I could hardly read the text (although their collections of comic books and lego were also tempting).

When I was ten years old, and my siblings went off to scouting and pony camp, my dad asked me what kind of camp I would like to go to. The answer was not difficult: astronomy camp. I did not know if it even existed, but my parents managed to find it. I went that summer, and never really stopped going. For the next decade, most summers I spent one or two weeks at a remote farm with fellow astronomy nerds, learning about space and having a good time. These days I'm on the other side, organizing and leading camps for the next generation of space enthousiasts. I also did various other things in the organization, and was the chief editor of the Universum, our magazine, for a few years.

In 2008, I started at high school KSG De Breul in Zeist. I was always looking for more challenges, finding it in the gymnasium classes of Latin and Greek, an extra elective course of advanced mathematics, and the Junior College Utrecht program during the final two years. During this program I took the science courses at Utrecht University, in addition to extra modules and projects. I developed an interest in more areas, such as molecular biology, linguistics, and what would turn out to be the most consequential, computer science.

After finishing high school in 2014 with a cum laude diploma, the pull of astronomy was too hard to resist. The choice for Leiden University was easily made: it offered a challenging double bachelor in physics and astronomy, with courses in computer science and molecular physics, and the city was host to a board game student association.

My interest in computer science was redoubled when I discovered that computational astrophysics was an entire field, and that Leiden was a good place for it. My first open-ended research project was observational – using the Isaac Newton Telescope on La Palma to observe spectral lines of the peculiar nebula Simeis 57 – and seeing a reduced image appear on screen was truly magical, but all my later projects would be numerical. My third-year bachelor research project, in Prof. Christoph Keller's group, involved constructing a numerical model of the polarizing effects of thin slits on light.

After finishing my bachelor in 2017, I continued with an astronomy master in Leiden. My first master research project would turn out to be a prelude to my PhD. In Prof. Simon Portegies Zwart's group, I worked on simulations of external photoevaporation of protoplanetary disks in stellar clusters. These would be used as a prototype for some of the first published such simulations, as well as my own work later in my PhD. During

this project I also first came into contact with the development side of AMUSE, the astrophysical code framework I used for the project and during my PhD, by developing a new interface to an astrophysical code.

For my second master research project, I wanted to explore another interest: gravitational waves, which had caught my interest when LIGO made its first observation in 2015. In Prof. Elena Rossi's group I worked on predicting observations that the future LISA space-based gravitational wave detector could make of the Galactic population of double white dwarfs. LISA will be able to map the stellar population of the Milky Way, even where interstellar dust blocks electromagnetic radiation. I showed that it will be able to reveal the structure of the Galactic bar, but that the spiral arms would be difficult. This resulted in my first scientific publication as first author.

After finishing my master cum laude in 2019, I was given the chance to continue as a PhD researcher at Leiden Observatory the work on protoplanetary disks in stellar clusters I'd contributed to before. During the four years of my PhD I've been further developing the modelling of the stellar cluster environment and the protoplanetary disks, in addition to other projects. I joined the Torch collaboration, working on coupling their star cluster formation models to my protoplanetary disk population models. I've also been teaching assistent for the master courses Deep Learning in Astronomy in 2019 and Simulations and Modelling in Astrophysics in 2020 and 2021, in addition to being the daily supervisor of a master student's research project. Being in Leiden Observatory also gave me more opportunities for public outreach, such as an astronomy course for high school teachers, being one of the institute's public contacts, and contributing to an elementary school lesson series on astronomy and climate called Life in the Universe. With that team we won the ET Outreach Award 2021.

Although my time as a PhD saw the worst of the COVID-19 pandemic, I was still able to travel and attend conferences. I was a teaching assistant at the fall 2019 Strasbourg and summer 2022 Geneva AMUSE schools, had a poster at the spring 2023 Kyoto Protostars and Planets VII conference, and talks at the winter 2021 virtual IAU Symposium 362, summer 2022 New York Torch workshop and Hamilton McMaster cluster meeting, spring 2023 Leeuwarden Dutch astronomy conference NAC, and summer 2023 Milan external photoevaporation workshop.

Kindred spirits are not so scarce as I used to think.
It's splendid to find out there are so many of them
in the world.

L.M. Montgomery, Anne of Green Gables

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I also want to thank the JWG, my astronomy club. It, and the people there, have helped me develop into the person I am today in more ways than I can count. There are so many people I should thank that I could fill a page and still forget some, so I'll just thank my old camp counselors, my fellow participants, my fellow counselors, and the kids I've been camp counselor over.

During my years in Leiden, I've met many people, but two have been at my side for the whole trip from sjaars to doctor: Fedde and Margot, thank you for homework help and projects and dinners and everything else. Also, thank you Lucas, Luna, and Zephyr, for letting me take you on a journey away from the paper grind to our D&D world. Erik, it was a pleasure to organize the PhD talks with you, and I hope that that and our survey helped improve the observatory ever so slightly. Anniek, I really enjoyed working on Life in the Universe with you, that there may be many more aliens in Leiden and on Hawaii.

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It's been a pleasure to work in the CAstLe group. Thank you, Francisca, for letting me work with you on the disks-in-clusters problem, and thanks to you and Santiago for being there as my older PhD siblings. Verónica, thank you for being an awesome office mate to share the joys and sorrows of PhD life with. Shuo, it's been a pleasure to work with you, and I can't wait to see what planetary systems you can cook up. Stan, it's been an honour watching your project grow, and I hope you're enjoying blowing up stars in Stockholm. Also thanks to Alexander, Arjen, Jeroen, Lourens, Maxwell, Erwan, Wouter, Alberto, Ambar, Amber, Anouk, Arend, Brent, Brian, Colin, Gijs, Giliam, Jaro, Jasper, John, Julia, Julius, Mathias, Menno, Pim, Sam, Tünde, and Yiqi.

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