CONTACT INFORMATION

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WORK EXPERIENCE

Marie Curie Fellow **2025-now**
University of Oslo
MSCA fellow under Grant Agreement #101126636. Project title: PROMISES*: PolaRized view Of the MagnetIc heartS of Extreme galaxieS*

Postdoctoral Fellow **2021-2025**
Leiden Observatory & Chalmers University of Technology
Research project funded by the Swedish Research Council (VR) on a personal grant (3.45 MSEK). Project title: A polarized view on stars, planets and life.

PhD. Student **2016-2021**
Chalmers University of Technology

Project Assistant **2015-2015**
Chalmers University of Technology

EDUCATIONAL QUALIFICATIONS

PhD. Astronomy **2021**
Chalmers University of Technology
Thesis: Tracing cosmic magnetic fields using molecules. Advisor: Prof. Wouter Vlemmings.

Radboud University Honors Program **2015**
University of Warwick
Project: a study of the quantum-mechanical smoothing of aqueous nano droplets by means of path-integral molecular dynamics techniques. Advisor: Dr. Scott Habershon.

MSc. Theoretical Chemistry **2015**
Radboud University Nijmegen
Minor in physics. Thesis: Hyperfine structure and Zeeman effects in methanol. Advisors: Prof. Gerrit C. Groenenboom and Prof. Ad van der Avoird. Thesis was awarded the KNCV (Royal Dutch Chemical Society) Golden Master award, a prize for the best Master Thesis of the year in Chemistry.

BSc. Chemistry **2013**
Radboud University Nijmegen
Minor in physics. Thesis: The Equation-of-Motion Coupled-Cluster Technique: ab-initio calculations on the electron-attached state of $NaHe^+$ and $ScHe^+$. Advisor: Prof. Gerrit C. Groenenboom.

DEDUCTIBLE TIME

Parental Leave **2022-2023** (period of 6 months)
2024-2025 *(*period of 5 months)

RESEARCH GRANTS

European Research Council Starting Grant **2026**
Starting Grant: NEOMAGIC: New Eyes On MAGnetIC fields. Advanced to second-round evaluation after competitive selection.

Marie-Sklodowska Curie Actions fellowship **2025-**
Awarded a MSCA (COFUND) fellowship under Grant Agreement #101126636, within the UiO DSTrain (Data Science Training) programme. Project title: PROMISES: PolaRized view Of the MagnetIc heartS of Extreme galaxieS.

VR International postdoc grant (3 years) **2021-2025**
Project title: "A polarized view on stars, planets and life". Swedish host institution: Chalmers University, foreign host institution: Leiden Observatory. Total grant: 3.45 MSEK.

SUPERVISION EXPERIENCE

Akhil Lasrado **2025-**
PhD student co-supervision. University of Oslo.

Francesco Chiti'Tegli **2024**
MSc CASSUM (Chalmers Astrophysics & Space Science Summer program)

TEACHING EXPERIENCE

Assistant Lecturer **2016-2019**
Chalmers University of Technology
Electromagnetism for 'basår' students. Problem classes. Each year, for half semester. Taught about 3 groups of each ~20 students.

Student Assistant **2013-2015**
Radboud University Nijmegen
Courses: classical mechanics (40 hours), quantum mechanics (160 hours) and mathematics (80 hours). Assisted in writing the quantum mechanics course syllabus.

Teacher's Assistant **2011-2014**
Montessori College Nijmegen
Natural science for first and second year HAVO-VWO high-school students (13-15 years old). For 3 school years, assisted twice a week four hours of classes.

PEDAGOGICAL COURSES

Teaching, Learning and Evaluation **2017**
Chalmers University of Technology

Advanced communication **2017**
Chalmers University of Technology

ACADEMIC CITIZENSHIP

Member of the Institution Council **2018-2020**
Department of Space, Earth and Environment, Chalmers University of Technology

Member of the Local Organizing Committee **2019-2019**
conference: "Astrochemistry: From nanometers to megaparsecs – A symposium in honor of John H. Black".

Member of the Local Organizing Committee **2019-2019**
conference: "From stars to Planets II – Connecting our understanding of star and planet formation".

Member of the PhD Council **2017-2019**
Department of Space, Earth and Environment, Chalmers University of Technology

Member of the promotion committee **2022**
Mathieu Besemer, Radboud University

Referee work
I refereed in total about 20 papers for Nature, Nature Astronomy, Nature Communications, the Astrophysical Journal, Monthly Notices of the Royal Astronomical Society and Astronomy & Astrophysics.

INVITED TALKS

EAS annual meeting **2025**
Invited to review, and give my perspective, on the contributions of line polarization methods to our understanding of magnetic fields in star formation.

Western University **2025**
London, Ontario, Canada. Invited colloquium. Measuring the magnetic fields of AGN and protoplanetary accretion disks

"CON-quest" workshop **2021**
Invited to present a prospect on line polarization observations towards obscured luminous infrared galaxy sources.

"magnetic field awakens" conference **2020**
Invited to give a review on line polarization in protoplanetary disks.

Dutch Astrochemical Network **2018**
Invited to give a review on "The gaseous universe" for the Dutch Astrochemical Network

RESEARCH UTILIZATION

I have actively contributed to public outreach. I have given interviews for Dutch national radio (Radio 1) and have been featured in weekly magazines (Elsevier Weekblad) and newspapers (ETC Göteborg). I have given several public lectures as part of the Gothenburg Science Festival as well as for the local Astronomical Club. At the Onsala Space Observatory, I have given numerous tours and on a yearly basis guided high-school students as part of the Swedish 'prao' program. A highlight of my outreach activities is a popular science video, which accompanied my publication in Nature Astronomy ["https://www.youtube.com/watch?v=2X2d5ZbTdIY&ab_channel=Onsalarymdobservatorium"] (>7800 views, 01-05-2026) and facebook (~10.000 views). Title: Magnetic secrets of methanol in space.

MEMBERSHIP

International Astronomical Union **2021-**

European Astronomical Union **2025-**

Maser Monitoring Organisation **2025-**

PRIZES AND PEER RECOGNITION

Attended the 70th Lindau Nobel Laureate Meeting **2021/2022**
Selected through competitive national process. Conference visit fully funded by the Ragnar Söderberg Foundation.

Hypatia Colloquium **2021**
After a competitive selection I was awarded to give a Hypatia colloquium: a colloquium series hosted by ESO where early career scientists have the opportunity to describe their research to a broad audience.

KNCV Golden Master award **2015**
Prize for the best Master Thesis of the year in Chemistry in the Netherlands.

Radboud University Honors program **2015**
Included funding for an exchange program

LANGUAGES

English (fluent)
Swedish (fluent)
Dutch (fluent, native language)
German (limited working proficiency)

COMPUTATIONAL SKILLS

Python (including: SciPy, Numpy, Pandas)
FORTRAN
MATLAB
Astronomy program packages: CASA / Astropy
Quantum Chemistry program packages: CFOUR, DARWIN
C, C++ (limited experience)

SELECTED PUBLICATIONS

Authored 11 peer-reviewed (+1 under review) publications as a first-author and 16 peer-reviewed publications as a co-author. Publication corpus grossed 459 citations (h-index=12, i10 index=16), as counted by google scholar. Here follows a list of 10 selected publications.

Lankhaar, B., Vlemmings, W.H.T., 2020. PORTAL: Three-dimensional polarized (sub) millimeter line radiative transfer. Astronomy & Astrophysics 636, A14. doi: 10.1051/0004- 6361/202037509
Here, I introduced the numerical code PORTAL that is the only in its kind that can model polarized (submm/radio) line radiative transfer in three dimensions. I conceptualized the approximations that made PORTAL feasible, wrote the code, and wrote the paper.

Lankhaar, B., Vlemmings, W.H.T., 2020. Collisional polarization of molecular ions: a signpost of ambipolar diffusion. Astronomy & Astrophysics 638, L7. doi: 10.1051/0004-6361/202038196
In this paper, I have developed the, as of now, most sensitive method of the detection and characterization of ambipolar diffusion, by observing the polarized emission from molecular ions. I show that molecular ions polarize due to ambipolar diffusion because collision between them and the neutral medium have a preferred direction. I conceptualized the collisional polarization method, set up a toy-model that formed the basis of exploratory simulations, and wrote the paper.

Lankhaar, B., Teague, R. Three-dimensional magnetic field imaging of protoplanetary disks using Zeeman broadening and linear polarization observations. *Astronomy & Astrophysics* 678, A17*.* doi: 10.051-0004-6361/202345840
In this paper, I refine the theory on Zeeman effects in spectral lines and apply it to the (polarized) radiative transfer of CN excited in protoplanetary disks. I show that line broadening due to the Zeeman effect is the most sensitive tool to detect magnetic field in protoplanetary disks. Together with Richard Teague, I came up with the method of Zeeman broadening to apply it to protoplaneatry disks, I performed the simulations in the paper, and wrote it.

Teague, R., **Lankhaar, B.**, Andrews, S. M., Qi, C., Fu, R. R., Wilner, D. J., Biersteker, J. B., Najita, J. R. (2025). A Radially Resolved Magnetic Field Threading the Disk of TW Hya. *The Astrophysical Journal Letters*, *991*(1), L6.
Here, we present the first positive radially resolved magnetic field characterization of a protoplanetary disk, using the Zeeman broadening method that I developed. I developed the observational method, and designed the fitting scheme to extract magnetic field information from the observational data.

Lankhaar, B., Surcis, G., Vlemmings, W., Impellizzeri, V., 2024. Maser polarization through anisotropic pumping. *Astronomy & Astrophysics 683, A117. doi: 10.1051/0004-6361/202348420*
This work introduces the first comprehensive code for the modeling of maser polarization. In it, I combine polarization-resolved excitation modeling with proper polarized maser radiative transfer, to model the maser polarization properties of masers towards regions of star formation, evolved stars and active galactic nuclei. I devised the method, wrote the code, performed the simulations and wrote the paper.

Lankhaar, B., Vlemmings, W.H.T., Surcis, G., van Langevelde, H.J., Groenenboom, G.C., van der Avoid, A., 2018. Characterization of methanol as a magnetic field tracer in star-forming regions. *Nature Astronomy* 2, 145–150. doi: 10.1038/s41550-017-0341-8
This paper constituted the definite characterization of methanol masers as magnetic field tracers towards high-mass star forming regions. Before this paper, methanol had been used for a decade as a magnetic field tracer, using the circular polarization of methanol masers, but the exact Zeeman coefficients that relate the circular polarization to the magnetic field strength had been unknown. Through quantum chemical modeling of methanols Zeeman effects, I extracted the Zeeman coefficients and were able to interpret a decade worth of circular polarization data. I performed the quantum chemical modeling, did the astronomical analysis, and wrote the paper.

Vlemmings, W.H.T., **Lankhaar, B.**, Cazzoletti, P., Ceccobello, C., Dall'Olio, D., van Dishoeck, E.F., Facchini, S., Humphreys, E.M.L., Persson, M.V., Testi, L., Williams, J.P., 2019. Stringent limits on the magnetic field strength in the disc of TW Hya. ALMA observations of CN polarisation. Astronomy & Astrohpysics 624, L7. doi: 10.1051/0004-6361/201935459
This paper set the first limits to the magnetic field of a protoplanetary disk. I contributed as a second-author to this work, was closely involved in the interpretation of the observations, wrote the appendix, and performed the modeling of the observations.

Larsson, R., **Lankhaar, B.**, and Eriksson, P., "Updated Zeeman effect splitting coefficients for molecular oxygen in planetary applications", *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 224, pp. 431–438, 2019. doi:10.1016/j.jqsrt.2018.12.004.

This paper is an analysis of the impact of the Zeeman effect to remote sensing observations of molecular oxygen in the Earth's atmosphere. I wrote sections of the paper and set up the model of oxygens Zeeman effect. We show that broadening due to the Zeeman effect needs to be accounted for when deriving a temperature from the remote sensing observations.

Houde, M., **Lankhaar, B.**, Rajabi, F., and Chamma, M.A., 2022. The generation and transformation of polarization signals in molecular lines through collective anisotropic resonant scattering. *Monthly Notices of the Royal Astronomical Society 511,* 295-315. doi: 10.1093/mnras/stab3806
This paper explores the application of forward resonance scattering to the radiative transfer in interstellar molecules. I helped improve on the theory of resonance scattering and co-developed the formalism.

Lankhaar, B. "A quantum theory of the alignment and polarization of very small dust grains." *arXiv preprint arXiv:* (2026).
In this work, that is under review at A&A, I use techniques from the theory of spectral line polarization to model the (polarized) signatures of very small dust grains. In absorption and vibrational emission, as well as through their rotational (spinning dust) emission that is thought to be responsible for anomalous microwave emission. It constitutes the most complete and rigorous model of the polarization of very small dust grains.

REFERENCES

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