The chemistry of planet-forming disks: a story from inner to outer disk

Temmink, M.

Publications

First-author publications

1. *MINDS: Water reservoirs of compact planet-forming dust discs: A diversity of H_2O distributions*
   M. Temmink, A. D. Sellek, D. Gasman, E. F. van Dishoeck, M. Vlasblom, A. Pranger, M. Güdel, T. Henning, P.-O. Lagage, A. Caratti o Garatti, I. Kamp, G. Olofsson, A. M. Arabhavi, S. L. Grant, T. Kaeu fer, N. T. Kurtovic, G. Perotti, M. Samland, K. Schwarz, and B. Tabone (2025), Astronomy and Astrophysics, 699, A134

2. *Characterising the molecular line emission in the asymmetric Oph-IRS 48 dust trap: Temperatures, timescales, and sub-thermal excitation*
   M. Temmink, A. S. Booth, M. Leemker, N. van der Marel, E. F. van Dishoeck, L. Evans, L. Keyte, C. J. Law, S. Notsu, K. Öberg, and C. Walsh (2025), Astronomy and Astrophysics, 693, A101

3. *MINDS: The DR Tau disk: II. Probing the hot and cold H_2O reservoirs in the JWST-MIRI spectrum*
   M. Temmink, E. F. van Dishoeck, D. Gasman, S. L. Grant, B. Tabone, M. Güdel, T. Henning, D. Barrado, A. Caratti o Garatti, A. M. Glauser, I. Kamp, A. M. Arabhavi, H. Jang, N. Kurtovic, G. Perotti, K. Schwarz, and M. Vlasblom (2024), Astronomy and Astrophysics, 689, A330

4. *MINDS: The DR Tau disk. I. Combining JWST-MIRI data with high-resolution CO spectra to characterise the hot gas*
   M. Temmink, E. F. van Dishoeck, S. L. Grant, B. Tabone, D. Gasman, V. Christiaens, M. Samland, I. Argyriou, G. Perotti, M. Güdel, T. Henning, P.-O. Lagage, A. Abergel, O. Absil, D. Barrado, A. Caratti o Garatti, A. M. Glauser, I. Kamp, F. Lahuis, G. Olofsson, T. P. Ray, S. Scheithauer, B. Vandenbussche, L. B. F. M. Waters, A. M. Arabhavi, H. Jang, J. Kanwar, M. Morales-Calderón, D. Rodgers-Lee, J. Schreiber, K. Schwarz, and L. Colina (2024), Astronomy and Astrophysics, 686, A117

Submitted first-author publications

1. *The asymmetric carbon-rich chemistry of the planet-forming disk of HD 142527 triggered by late infall*
   M. Temmink, E. F. van Dishoeck, A. S. Booth, N. van der Marel, M. Benisty, M. R. Hogerheijde, submitted to Astronomy and Astrophysics.

Co-author publications

1. *The chemical diversity of giant-planet nurseries as revealed by ALMA*
   A. S. Booth, J. Calahan, **M. Temmink**, L. Wölfer, J. Pegues, C. J. Law, L. Evans, M. Leemker, S. Notsu, K. Öberg, C. Walsh, and E. F. van Dishoeck (2026), The Astronomical Journal, 171, 128

2. *MINDS: the molecule-rich disc of the Herbig star HD 35929 revealed with JWST/MIRI*
   T. Kaeufer, R. Waters, D. Gasman, **M. Temmink**, H. Jang, E. F. van Dishoeck, M. Güdel, T. Henning, A. Caratti o Garatti, I. Kamp, A. M. Arabhavi, P. Esteve, S. L. Grant, J. Kanwar, N. T. Kurtovic, G. Perotti, K. Schwarz, L. M. Stapper, and B. Tabone (2026), Monthly Notices of the Royal Astronomical Society, 545, staf2056

3. *MINDS. Anatomy of a water-rich, inclined, brown dwarf disk: Lack of abundant hydrocarbons*
   G. Perotti, N. T. Kurtovic, T. Henning, G. Olofsson, A. M. Arabhavi, K. Schwarz, J. Kanwar, R. van Boekel, I. Kamp, I. Pascucci, E. F. van Dishoeck, M. Güdel, P.-O. Lagage, D. Barrado, A. Caratti o Garatti, A. M. Glauser, F. Lahuis, V. Christiaens, R. Franceschi, D. Gasman, S. L. Grant, H. Jang, T. Kaeufer, M. Morales-Calderón, **M. Temmink**, and M. Vlasblom (2026), The Astrophysical Journal, 997, 281

4. *Observational evidence for a possible link between PAH emission and dust trap locations in protoplanetary disks*
   N. van der Marel, N. F. W. Ligterink, R. van der Werf, **M. Temmink**, P. Pinilla, B. Jia, and Q. Bosschaart (2026), Astronomy and Astrophysics, 706, A214

5. *MINDS: Young binary systems with JWST/MIRI: Variable water-rich primaries and extended emission*
   N. T. Kurtovic, S. L. Grant, **M. Temmink**, A. D. Sellek, E. F. van Dishoeck, T. Henning, I. Kamp, V. Christiaens, A. Banzatti, D. Gasman, T. Kaeufer, L. M. Stapper, R. Franceschi, M. Güdel, P.-O. Lagage, M. Vlasblom, G. Perotti, K. Schwarz, and A. Somigliana (2026), Astronomy and Astrophysics, 705, A97

6. *Understanding JWST water spectra: What can thermochemical models tell us about the (cold) water in protoplanetary disks?*

M. Vlasblom, **M. Temmink**, A. D. Sellek, and E. F. van Dishoeck (2025), Astronomy and Astrophysics, 703, A52

7. *MINDS: Cha Hα 1, a brown dwarf with a hydrocarbon-rich disk*
M. Morales-Calderón, H. Jang, A. M. Arabhavi, V. Christiaens, D. Barrado, I. Kamp, E. F. van Dishoeck, T. Henning, L. B. F. M. Waters, **M. Temmink**, M. Güdel, P.-O. Lagage, A. Caratti o Garatti, A. M. Glauser, T. P. Ray, R. Franceschi, D. Gasman, S. L. Grant, T. Kaeufer, J. Kanwar, G. Perotti, M. Samland, K. Schwarz, M. Vlasblom, L. Colina, and G. Östlin (2025), Astronomy and Astrophysics, 703, A18

8. *MINDS: A transition from H_2O to C_2H_2 dominated disk spectra with decreasing stellar luminosity*
S. L. Grant, **M. Temmink**, E. F. van Dishoeck, D. Gasman, A. M. Arabhavi, B. Tabone, T. Henning, I. Kamp, A. Caratti o Garatti, V. Christiaens, P. Esteve, M. Güdel, H. Jang, T. Kaeufer, N. T. Kurtovic, M. Morales-Calderón, G. Perotti, K. Schwarz, A. D. Sellek, L. M. Stapper, M. Vlasblom, and L. B. F. M. Waters (2025), Astronomy and Astrophysics, 702, A126

9. *MINDS: Detection of an inner gas disk caused by evaporating bodies around HD 172555*
M. Samland, T. Henning, A. Caratti o Garatti, T. Giannini, J. Bouwman, B. Tabone, A. M. Arabhavi, G. Olofsson, M. Güdel, N. Pawellek, I. Kamp, L. B. F. M. Waters, D. Semenov, E. F. van Dishoeck, O. Absil, D. Barrado, A. Boccaletti, V. Christiaens, D. Gasman, S. L. Grant, H. Jang, T. Kaeufer, J. Kanwar, G. Perotti, K. Schwarz, and **M. Temmink** (2025), The Astrophysical Journal, 989, A132

10. *MINDS: The very low-mass star and brown dwarf sample: Detections and trends in the inner disk gas*
A. M. Arabhavi, I. Kamp, T. Henning, E. F. van Dishoeck, H. Jang, L. B. F. M. Waters, V. Christiaens, D. Gasman, I. Pascucci, G. Perotti, S. L. Grant, M. Güdel, P.-O. Lagage, D. Barrado, A. Caratti o Garatti, F. Lahuis, T. Kaeufer, J. Kanwar, M. Morales-Calderón, K. Schwarz, A. D. Sellek, B. Tabone, **M. Temmink**, M. Vlasblom, and P. Patapis (2025), Astronomy and Astrophysics, 699, A194

11. *Ice sublimation in the dynamic HD 100453 disk reveals a rich reservoir of inherited complex organics*
A. S. Booth, L. Wölfer, **M. Temmink**, J. Calahan, L. Evans, C. J. Law, M. Leemker, S. Notsu, K. Öberg, and C. Walsh (2025), The Astrophysical Journal, 986, L9

12. *MINDS: The very low-mass star and brown dwarf sample hidden water in carbon-dominated protoplanetary disks*
A. M. Arabhavi, I. Kamp, E. F. van Dishoeck, T. Henning, H. Jang, V. Christiaens, D. Gasman, I. Pascucci, G. Perotti, S. L. Grant, D. Barrado, M. Güdel, P.-O. Lagage, A. Caratti o Garatti, F. Lahuis, L. B. F. M. Waters,

T. Kaeufer, J. Kanwar, M. Morales-Calderón, K. Schwarz, A. D. Sellek, B. Tabone, **M. Temmink**, and M. Vlasblom (2025), The Astrophysical Journal, 984, L62

13. *ALMA reveals thermal and nonthermal desorption of methanol ice in the HD 100546 protoplanetary disk*
L. Evans, A. S. Booth, C. Walsh, J. D. Ilee, L. Keyte, C. J. Law, M. Leemker, S. Notsu, K. Öberg, **M. Temmink**, and N. van der Marel (2025), The Astrophysical Journal, 982, 62

14. *MINDS. JWST-MIRI observations of a spatially resolved atomic jet and polychromatic molecular wind toward SY Cha*
K. R. Schwarz, M. Samland, G. Olofsson, T. Henning, A. Sellek, M. Güdel, B. Tabone, I. Kamp, P.-O. Lagage, E. F. van Dishoeck, A. Caratti o Garatti, A. M. Glauser, T. P. Ray, A. M. Arabhavi, V. Christiaens, R. Franceschi, D. Gasman, S. L. Grant, J. Kanwar, T. Kaeufer, N. T. Kurtovic, G. Perotti, **M. Temmink**, and M. Vlasblom (2025), The Astrophysical Journal, 980, 148

15. *MINDS: The influence of outer dust disc structure on the volatile delivery to the inner disc*
D. Gasman, **M. Temmink**, E. F. van Dishoeck, N. T. Kurtovic, S. L. Grant, A. Sellek, B. Tabone, T. Henning, I. Kamp, M. Güdel, D. Barrado, A. Caratti o Garatti, A. M. Glauser, L. B. F. M. Waters, A. M. Arabhavi, H. Jang, J. Kanwar, J. L. Lienert, G. Perotti, K. Schwarz, and M. Vlasblom (2025), Astronomy and Astrophysics, 694, A147

16. *MINDS. JWST-MIRI reveals a peculiar CO_2-rich chemistry in the drift-dominated disk CX Tau*
M. Vlasblom, **M. Temmink**, S. L. Grant, N. Kurtovic, A. D. Sellek, E. F. van Dishoeck, M. Güdel, T. Henning, P.-O. Lagage, D. Barrado, A. Caratti o Garatti, A. M. Glauser, I. Kamp, F. Lahuis, G. Olofsson, A. M. Arabhavi, V. Christiaens, D. Gasman, H. Jang, M. Morales-Calderón, G. Perotti, K. Schwarz, and B. Tabone (2025), Astronomy and Astrophysics, 693, A278

17. *Measuring the ^{34}S and ^{33}S isotopic ratios of volatile sulfur during planet formation*
A. S. Booth, M. N. Drozdovskaya, **M. Temmink**, H. Nomura, E. F. van Dishoeck, L. Keyte, C. J. Law, M. Leemker, N. van der Marel, S. Notsu, K. Öberg, and C. Walsh (2024), The Astrophysical Journal, 975, 72

18. *Dust mineralogy and variability of the inner PDS 70 disk: Insights from JWST/MIRI MRS and Spitzer IRS observations*
H. Jang, R. Waters, T. Kaeufer, A. Tamanai, G. Perotti, V. Christiaens, I. Kamp, T. Henning, M. Min, A. M. Arabhavi, D. Barrado, E. F. van Dishoeck, D. Gasman, S. L. Grant, M. Güdel, P.-O. Lagage, F. Lahuis, K. Schwarz, B. Tabone, and **M. Temmink** (2024), Astronomy and Astrophysics, 691, A148

19. *MINDS. Hydrocarbons detected by JWST/MIRI in the inner disk of Sz28 consistent with a high C/O gas-phase chemistry*
J. Kanwar, I. Kamp, H. Jang, L. B. F. M. Waters, E. F. van Dishoeck, V. Christiaens, A. M. Arabhavi, T. Henning, M. Güdel, P. Woitke, O. Absil, D. Barrado, A. Caratti o Garatti, A. M. Glauser, F. Lahuis, S. Scheithauer, B. Vandenbussche, D. Gasman, S. L. Grant, N. T. Kurtovic, G. Perotti, B. Tabone, and **M. Temmink** (2024), Astronomy and Astrophysics, 689, A231

20. *MINDS: A multi-instrument investigation into the molecule-rich JWST-MIRI spectrum of the DF Tau binary system*
S. L. Grant, N. T. Kurtovic, E. F. van Dishoeck, T. Henning, I. Kamp, H. Nowacki, K. Perraut, A. Banzatti, **M. Temmink**, V. Christiaens, M. Samland, D. Gasman, B. Tabone, M. Güdel, P.-O. Lagage, A. M. Arabhavi, D. Barrado, A. Caratti o Garatti, A. M. Glauser, H. Jang, J. Kanwar, F. Lahuis, M. Morales-Calderón, G. Olofsson, G. Perotti, K. Schwarz, M. Vlasblom, R. Garcia Lopez, and F. Long (2024), Astronomy and Astrophysics, 689, A85

21. *MINDS: Mid-infrared atomic and molecular hydrogen lines in the inner disk around a low-mass star*
R. Franceschi, T. Henning, B. Tabone, G. Perotti, A. Caratti o Garatti, G. Bettoni, E. F. van Dishoeck, I. Kamp, O. Absil, M. Güdel, G. Olofsson, L. B. F. M. Waters, A. M. Arabhavi, V. Christiaens, D. Gasman, S. L. Grant, H. Jang, D. Rodgers-Lee, M. Samland, K. Schwarz, **M. Temmink**, D. Barrado, A. Boccaletti, V. Geers, P.-O. Lagage, E. Pantin, T. P. Ray, S. Scheithauer, B. Vandenbussche, and G. Wright (2024), Astronomy and Astrophysics, 687, A96

22. *Abundant hydrocarbons in the disk around a very-low-mass star*
A. M. Arabhavi, I. Kamp, T. Henning, E. F. van Dishoeck, V. Christiaens, D. Gasman, A. Perrin, M. Güdel, B. Tabone, J. Kanwar, L. B. F. M. Waters, I. Pascucci, M. Samland, G. Perotti, G. Bettoni, S. L. Grant, P. O. Lagage, T. P. Ray, B. Vandenbussche, O. Absil, I. Argyriou, D. Barrado, A. Boccaletti, J. Bouwman, A. Caratti o Garatti, A. M. Glauser, F. Lahuis, M. Mueller, G. Olofsson, E. Pantin, S. Scheithauer, M. Morales-Calderón, R. Franceschi, H. Jang, N. Pawellek, D. Rodgers-Lee, J. Schreiber, K. Schwarz, **M. Temmink**, M. Vlasblom, G. Wright, L. Colina, and G. Östlin (2024), Science, 384, p.1086

23. *MINDS: The JWST MIRI Mid-INfrared Disk Survey*
T. Henning, I. Kamp, M. Samland, A. M. Arabhavi, J. Kanwar, E. F. van Dishoeck, M. Güdel, P.-O. Lagage, C. Waelkens, A. Abergel, O. Absil, D. Barrado, A. Boccaletti, J. Bouwman, A. Caratti o Garatti, V. Geers, A. M. Glauser, F. Lahuis, M. Mueller, C. Nehmé, G. Olofsson, E. Pantin, T. P. Ray, S. Scheithauer, B. Vandenbussche, L. B. F. M. Waters, G. Wright, I. Argyriou, V. Christiaens, R. Franceschi, D. Gasman, S. L. Grant, R. Guadarrama, H. Jang, M. Morales-Calderón, N. Pawellek, G. Perotti, D. Rodgers-Lee, J. Schreiber, K. Schwarz, B. Tabone, **M. Temmink**, M. Vlasblom, L.

Colina, T. R. Greve, and G. Östlin (2024), Publications of the Astronomical Society of the Pacific, 136, 054302

24. *MINDS: JWST/NIRCam imaging of the protoplanetary disk PDS 70. A spiral accretion stream and a potential third protoplanet*
V. Christiaens, M. Samland, T. Henning, B. Portilla-Revelo, G. Perotti, E. Matthews, O. Absil, L. Decin, I. Kamp, A. Boccaletti, B. Tabone, G.-D. Marleau, E. F. van Dishoeck, M. Güdel, P.-O. Lagage, D. Barrado, A. Caratti o Garatti, A. M. Glauser, G. Olofsson, T. P. Ray, S. Scheithauer, B. Vandenbussche, L. B. F. M. Waters, A. M. Arabhavi, S. L. Grant, H. Jang, J. Kanwar, J. Schreiber, K. Schwarz, **M. Temmink**, and G. Östlin (2024), Astronomy and Astrophysics, 685, L1

25. *An ALMA molecular inventory of warm Herbig Ae disks. II. Abundant complex organics and volatile sulphur in the IRS 48 disk*
A. S. Booth, **M. Temmink**, E. F. van Dishoeck, L. Evans, J. D. Ilee, M. Kama, L. Keyte, C. J. Law, M. Leemker, N. van der Marel, H. Nomura, S. Notsu, K. Öberg, and C. Walsh (2024), The Astronomical Journal, 167, 165

26. *An ALMA molecular inventory of warm Herbig Ae Disks. I. Molecular rings, asymmetries, and complexity in the HD 100546 disk*
A. S. Booth, M. Leemker, E. F. van Dishoeck, L. Evans, J. D. Ilee, M. Kama, L. Keyte, C. J. Law, N. van der Marel, H. Nomura, S. Notsu, K. Öberg, **M. Temmink**, and C. Walsh (2024), The Astronomical Journal, 167, 164

27. *MINDS. JWST/MIRI reveals a dynamic gas-rich inner disk inside the cavity of SY Cha*
K. R. Schwarz, T. Henning, V. Christiaens, D. Gasman, M. Samland, G. Perotti, H. Jang, S. L. Grant, B. Tabone, M. Morales-Calderón, I. Kamp, E. F. van Dishoeck, M. Güdel, P.-O. Lagage, D. Barrado, A. Caratti o Garatti, A. M. Glauser, T. P. Ray, B. Vandenbussche, L. B. F. M. Waters, A. M. Arabhavi, J. Kanwar, G. Olofsson, D. Rodgers-Lee, J. Schreiber, and **M. Temmink** (2024), The Astrophysical Journal, 962, 8

28. *MINDS. Abundant water and varying C/O across the disk of Sz 98 as seen by JWST/MIRI*
D. Gasman, E. F. van Dishoeck, S. L. Grant, **M. Temmink**, B. Tabone, T. Henning, I. Kamp, M. Güdel, P.-O. Lagage, G. Perotti, V. Christiaens, M. Samland, A. M. Arabhavi, I. Argyriou, A. Abergel, O. Absil, D. Barrado, A. Boccaletti, J. Bouwman, A. Caratti o Garatti, V. Geers, A. M. Glauser, R. Guadarrama, H. Jang, J. Kanwar, F. Lahuis, M. Morales-Calderón, M. Mueller, C. Nehmé, G. Olofsson, É. Pantin, N. Pawellek, T. P. Ray, D. Rodgers-Lee, S. Scheithauer, J. Schreiber, K. Schwarz, B. Vandenbussche, M. Vlasblom, R. L. B. F. M. Waters, G. Wright, L. Colina, T. R. Greve, and G. Östlin (2023), Astronomy and Astrophysics, 679, A117

29. *Tracing snowlines and C/O ratio in a planet-hosting disk. ALMA molecular line observations towards the HD 169142 disk*

A. S. Booth, C. J. Law, **M. Temmink**, M. Leemker, and E. Macías (2023), Astronomy and Astrophysics, 678, A146

30. *The chemical inventory of the inner regions of planet-forming disks - the JWST/MINDS program*
I. Kamp, T. Henning, A. M. Arabhavi, G. Bettoni, V. Christiaens, D. Gasman, S. L. Grant, M. Morales-Calderón, B. Tabone, A. Abergel, O. Absil, I. Argyriou, D. Barrado, A. Boccaletti, J. Bouwman, A. Caratti o Garatti, E. F. van Dishoeck, V. Geers, A. M. Glauser, M. Güdel, R. Guadarrama, H. Jang, J. Kanwar, P.-O. Lagage, F. Lahuis, M. Mueller, C. Nehmé, G. Olofsson, E. Pantin, N. Pawellek, G. Perotti, T. P. Ray, D. Rodgers-Lee, M. Samland, S. Scheithauer, J. Schreiber, K. Schwarz, **M. Temmink**, B. Vandenbussche, M. Vlasblom, C. Waelkens, L. B. F. M. Waters, and G. Wright (2023), Faraday Discussions, 245, p.112

31. *MINDS. The detection of $^{13}CO_2$ with JWST-MIRI indicates abundant CO_2 in a protoplanetary disk*
S. L. Grant, E. F. van Dishoeck, B. Tabone, D. Gasman, T. Henning, I. Kamp, M. Güdel, P.-O. Lagage, G. Bettoni, G. Perotti, V. Christiaens, M. Samland, A. M. Arabhavi, I. Argyriou, A. Abergel, O. Absil, D. Barrado, A. Boccaletti, J. Bouwman, A. Caratti o Garatti, V. Geers, A. M. Glauser, R. Guadarrama, H. Jang, J. Kanwar, F. Lahuis, M. Morales-Calderón, M. Mueller, C. Nehmé, G. Olofsson, E. Pantin, N. Pawellek, T. P. Ray, D. Rodgers-Lee, S. Scheithauer, J. Schreiber, K. Schwarz, **M. Temmink**, B. Vandenbussche, M. Vlasblom, L. B. F. M. Waters, G. Wright, L. Colina, T. R. Greve, K. Justannont, and G. Östlin (2023), The Astrophysical Journal, 947, L6

Submitted co-author publications

1. *MINDS survey of silicates in T Tauri disks: correlation between dust and gas*
J. Varga, T. Henning, L. B. F. M. Waters, I. Kamp, Á. Kóspál, P. Ábrahám, O. Absil, A. M. Arabhavi, D. Gasman, S. L. Grant, M. Güdel, H. Jang, T. Kaeufer, J. Kanwar, N. T. Kurtovic, P.-O. Lagage, G. Perotti, A. Somigliana, L. M. Stapper, B. Tabone, **M. Temmink**, E. F. van Dishoeck, and M. Vlasblom, submitted to Astronomy and Astrophysics.

2. *MINDS. Disc diversity, ice features, and extended molecular emission in the binary system HK Tau*
A. Somigliana, G. Perotti, N. T. Kurtovic, T. Henning, M. Benisty, A. D. Sellek, M. K. McClure, Z. L. Smith, A. M. Arabhavi, A. Caratti o Garatti, V. Christiaens, E. F. van Dishoeck, D. Gasman, Sierra L. Grant, M. Güdel, T. Kaeufer, I. Kamp, L. Stapper, B. Tabone, **M. Temmink**, and M. Vlasblom, submitted to Astronomy and Astrophysics.

3. *MINDS: Intertwined evolution of dust and gas in large planet-forming disks. A diversity driven by halted pebble drift?*
   B. Tabone, **M. Temmink**, L. B. F. M. Waters, E. F. van Dishoeck, A. D. Sellek, P. Esteve, N. T. Kurtovic, I. Kamp, T. Henning, D. Gasman, S. L. Grant, J. Varga, A. Guerras, D. Semenov, A. M. Arabhavi, A. Caratti o Garatti, A. Dutrey, E. Chapillon, S. Guilloteau, M. Güdel, H. Jang, T. Kaeufer, J. Kanwar, G. Olofsson, G. Perotti, V. Piétu, T. P. Ray, and M. Vlasblom, submitted to Astronomy and Astrophysics.

4. *Comparing the localization of complex organic molecules in the Oph-IRS 48 disk using ALMA data*
   K. A. Kipfer, A. S. Booth, **M. Temmink**, N. van der Marel, and N. F. W. Ligterink, submitted to Astronomy and Astrophysics.

Curriculum Vitae

I was born on Thursday, the 6th of May, 1999, in a small village in the east of the Netherlands called Wesepe. I grew up with my parents and my two older brothers. My childhood mainly consisted of playing outside and, in particular, playing a lot of football. That did, however, not mean that my nose was not stuck in books quite often. I liked (and still do) reading a lot, and fantasy stories have always been my favourite. After all, what is more interesting than imagining a world different from our own, that is ruled by magic, and where everything is possible?

After finishing my education at our local primary school, I went to the "Carmel College Salland" in Raalte for my secondary education. During my studies, it became clear that the STEM courses, such as mathematics, physics, and chemistry, suited me best. Surprisingly, I struggled quite a bit with biology, but that did not deter me from choosing it as part of my curriculum. My love for fantasy stories also led to a large interest in Greek mythology and my choice to pursue ancient Greek as one of my courses. During my secondary education, playing video games became my main hobby, which did not always lead to me being as invested in my courses as I should have been...

Nearing the end of my secondary education, choosing a follow-up study was not hard. While I always thought that I would follow in my mom's footsteps and choose a healthcare-related study, one physics chapter on the topic of astrophysics during my final year of secondary education really caught my eye. While I always had a passing interest in space, its vastness, and the possibility of alien life, I never really considered that one could study astronomy. This chapter changed everything for me, and once I told my parents that I wanted to study astronomy, I visited both an open day and an orientation day at Leiden University. Partaking in these days only confirmed for me that I wanted to study astronomy.

While adapting to student life took a bit of time, I found my pace and what study methods worked best for me. I managed to pass all my courses in the first year of my bachelor's at Leiden University, and I was allowed to go to La Palma during the second year. This was an amazing experience and it also opened my eyes to astronomical research. My love for research only grew during the third year of my bachelors, when I completed my first research project - together with Sam de Regt - on the colour-magnitude diagrams of the Magellanic Clouds using the second data release of Gaia. I knew that I wanted to continue doing research,

and the choice to take on the general "Astronomy Research" master's at Leiden University was easily made. For my first master's research project, I wanted to do a topic related to exoplanets, and I ended up picking a project with prof. dr. Ignas Snellen to detect transiting exoplanets around red-giant stars.

This first research project already confirmed for me that I wanted to do a PhD after my Master's and to pursue an academic career. Discussing this with Ignas, he suggested to me that I ask prof. dr. Ewine van Dishoeck about potential research projects for my Master's thesis. Multiple projects were offered, but one caught my eye. This project aimed to study the chemical composition of azimuthally asymmetric planet-forming disks, following the recent discovery that the disk of Oph-IRS 48 hosts an ice trap. Under the supervision of Ewine, dr. Nienke van der Marel, and dr. Alice Booth, I learned how to work with ALMA observations of disks and I found the topic that inspired me most. Eventually, I had really found my footing, and my love for astronomy and astrochemistry only grew with time. I even managed to graduate Cum Laude for my master's studies.

Having made the prior choice to follow an academic career, I applied to PhD positions all over Europe. However, I realised that I was not yet ready to leave the Netherlands, and when Ewine offered me a PhD position at Leiden, I accepted it immediately. The topic of my PhD allowed me to continue my work on the chemistry of asymmetric disks, but it also took me in a completely new direction. During my master's thesis, a little bit over half a year before the start of my PhD, JWST launched. The launch was perfectly on time for my PhD and for me to become part of the MINDS collaboration, a team of international researchers that has access to over 100 hours of JWST time on the chemistry of planet-forming disks. Being part of this collaboration allowed me to work on the first observations of disks released with JWST, an opportunity for which I will forever be grateful.

During my PhD, I was not only always staring at my computer, processing either ALMA or JWST observations. I was a teaching assistant for different courses, ranging from the observations of molecular astrophysics in galaxies to stars. During my final year of the PhD, the University offered a new minor, "Our Universe" for non-astronomy students, and I became a teaching assistant for the course "The Habitable Universe". It was an eye-opening experience to teach these students about astronomy. I have also partaken in various outreach events, from providing tours and explanations at different JWST exhibitions to giving multiple public lectures. Each of these events has shown me how rewarding it is to make a difficult topic, such as astronomy, comprehensible to everyone. I also (co-)supervised multiple bachelor's (Philip and Olivier) and master's (Ryan, Bin, Angèl, and Victor) students during their research projects. Finally, I also had the great opportunity during my PhD to travel the world, participate in in-person meetings of the MINDS collaboration, attend conferences, and present my work. My travels have brought me to multiple places in Germany (Garching, Heidelberg, and Ringberg), Austria, France, Italy, Ireland, Spain, Sweden, and even twice to the USA.

However, everything has to come to an end. While I will finish my PhD this Summer, I am excited to continue my research as a Postdoctoral Fellow at the Planet-Formation & Exoplanets department at the Max-Planck Institute for Astronomy in Heidelberg, where I will work together with dr. Myriam Benisty.

Acknowledgements

Having spent 9 years at Leiden University, I have met many amazing people who have made this entire journey possible below. Here, I want to thank each and all of you for all your support, the fun discussions, and for making Leiden the beautiful place it is.

First of all, I want to thank Ewine for the past five years of teaching me science, how to be a researcher, how to write proposals and papers, and, finally, the importance of conveying science to the general public. Your excitement for science is infectious. I am grateful for everything you have taught me, and I feel like I learned something new every single day. I also want to express my gratitude to my other supervisors, Alice and Nienke. Both of you have been there since I started studying the chemistry of disks. Alice, even though our ways parted quickly as you moved to the USA, I am grateful for all your guidance on working with ALMA and your scientific insights and ideas over these past years. Nienke, I want to thank you for all our scientific discussions and for organising the Pangolin group meetings. I have learned a lot from you. I hope that a particular one-liter beer glass has proven useful to you. Michiel and Melissa, I also want to thank you both; our useful discussions and aid with proposals have proven to be invaluable.

One benefit of pursuing a PhD at Leiden is the ability to be part of a large scientific family, where you can learn from everyone around you and go through struggles together. I want to thank every one of you for all the discussions and, most importantly, all the joy: Alessia, Andrés, Andrew, Ardjan, Femke, Franciele, Ioannis, Jerry, Julia, Katie, Lisa, Logan, Lucas, Lukas, Łukasz, Margot, Mariana, Marissa, Martijn, Mulan, Nashanty, Nico, Osmar, Pooneh, Pranjal, Sierra, Teresa, Tobias, Will, Xinyu, Yuan, and Zak (also thank you for all the lunch walks, I am going to miss them!).

I also am grateful for everybody from the MINDS collaboration; these past few years have been really inspiring. In particular, I want to express my gratitude towards my MINDS partner in crime, Danny, and I am grateful for the friendship that we have built. I am looking forward to joining you in Heidelberg.

I also want to thank Sam and Victorine for all the fun times and discussions, from our time studying together to each doing our PhD at Leiden. Sam, I hope we can continue our somewhat bi-monthly dinners to catch up once we are both in Heidelberg.

And finally, but most certainly not least, I am grateful for my parents, my brothers Lars and Rik, and Charlie. Lieve mama en papa, ik denk niet dat ik ooit onder woorden kan brengen hoe belangrijk jullie voor mij zijn en hoe dankbaar ik ben voor alle steun van deze afgelopen jaren. Ik vond het heel fijn dat ik altijd even met jullie kan bellen als alles even te veel werd en dat ik met jullie over alles kan praten. Lars en Rik, ik besef me dat ik het waarschijnlijk nooit verwoord, maar ik wil jullie ook bedanken voor jullie interesse en steun. Ik ben enorm dankbaar dat jullie mijn broers zijn. Charlie, ik ben enorm blij dat jij onderdeel bent van onze familie en jouw bestaan vrolijkt me elke dag op.