TO MAGNIFICO RETTORE OF UNIVERSITA' DEGLI STUDI DI MILANO **ID CODE 5833**

I the undersigned asks to participate in the public selection, for qualifications and examinations, for the awarding of a type B fellowship at **Dipartimento di Fisica Aldo Pontremoli**

Scientist- in – charge: **Prof. Dr. Stefano Facchini**

Margot Leemker

CURRICULUM VITAE

PERSONAL INFORMATION

Surname	Leemker
Name	Margot

PRESENT OCCUPATION

Appointment	Structure
PhD candidate	4 year programme at Leiden Observatory, Leiden University

EDUCATION AND TRAINING

Degree	Course of studies	University	Year of achievement of the degree
PhD	Hot and cold: temperature structure of protoplanetary disks	Leiden Observatory, Leiden University	expected 2023
Master of Science in Astronomy **(cum laude)**	Astronomy (specialisation: research)	Leiden Observatory, Leiden University	2019
Honours college	Double bachelor plus programme	Leiden Observatory, Leiden University	2017
Bachelor of Science in Astronomy **(cum laude)**	Astronomy	Leiden Observatory, Leiden University	2017
Bachelor of Science in Physics **(cum laude)**	Physics	Leiden Observatory, Leiden University	2017

FOREIGN LANGUAGES

Languages	level of knowledge
Dutch	mother tongue
English	fluent
German	basic

TRAINING OR RESEARCH ACTIVITY

During my PhD I learned to work with DALI, a thermo chemical code to model protoplanetary disks. I have used this code to model the effect of a deep cavity seen in transition disks on the expected line emission of ^{13}CO, including the high frequency J=6-5 transition. Additionally, I have modelled disks with extreme physical conditions such as an outburst of the central star or a major asymmetric ice trap with DALI. To further extend its capabilities I have coupled it to my custom chemical network and the radiative transfer code LIME. In addition to DALI and LIME, I have experience with numerous other astronomically relevant codes (see 'Computing experience').

I compare my modelling results to ALMA observations to learn more about the physical and chemical conditions under which planets are forming. Furthermore, I have used high frequency ALMA observations to determine if planets could be causing the deep cavity seen in two transition disks. To further deepen our knowledge of the environment where planets are forming, I have successfully applied for ALMA data and I plan to continue to do so during this postdoc. Furthermore, I have excellent communication skills and gave a number of contributed talks at conferences and different research institutes.

PROJECT ACTIVITY

Year	Project
2023	**Chemistry across gas and dust gaps in protoplanetary disks: modelling the co-spatial molecular rings in the HD 100546 disk** *Activities:* I am modelling the rings observed in molecular gas (HCO^+, CN, HCN, C_2H, and NO) in the HD 100546 disk. This disk has the unique property that the rings seen in these molecules are co-spatial with a weak ring seen in the dust at much larger radii. I have modelled this disk using the thermochemical code DALI and I find that the rings in HCO^+, CN, HCN, C_2H, and NO do not coincide with those seen in the dust in general. Leemker et al. in preparation.
2023	**Resolving the 2D snow surfaces of HDO and complex organic molecules in the young outbursting source V883 Ori** *Activities:* I am analysing the channel maps of ALMA observations of HDO, an isotopologue of water, methanol and other complex organic molecules to derive their 2D snow surface. This analysis is done using the ALFAHOR package. I find that the snow surfaces of HDO and methanol are much steeper than predicted in a thermochemical DALI model for this source. Leemker et al. in preparation.

2023	**A major asymmetric ice trap in a planet-forming disk. IV. Nitric oxide gas and a lack of CN tracing sublimating ices and a C/O ratio < 1** *Activities:* I analysed the first ALMA detection of nitric oxide gas in a protoplanetary disk. Additionally, I derived upper limits on a number of other related molecules that were not detected. I used DALI to model the nitrogen chemistry in this extreme dust trap and constrain the origin of the NO emission. Leemker et al., A&A, 673, A7, 2023.
2022	**Gas temperature structure across transition disk cavities,** *Activities:* I have analysed high spatial resolution, high frequency ALMA Band 9 data covering the ^{13}CO J=6-5 transition and compared this to the more commonly observed J=2-1 line to derive the temperature and column density in the cavity, needed to infer if planets could be present. Additionally, I modelled these emission lines with DALI to quantify the effects of optical depth and emitting heights. Published in Leemker et al., A&A, 663, A23, 2022.
2021	**Chemically tracing the water snowline in protoplanetary disks with HCO^+** *Activities:* I have build a small custom chemical network to model the abundance of HCO^+, a tracer of the water snowline in disks. Coupling this with the thermochemical code DALI and the raytracer LIME allowed me to make synthetic observations. I compared this to archival ALMA observations and located the water snowline in the young outbursting disk V883 Ori. *Supervisor of second master project and PhD:* Prof. Dr. E. F. van Dishoeck Published in Leemker et al., A&A, 646, A3, 2021.
2017 — 2018	**SPH simulations of tidal disk truncation in a small cluster** *Activities:* I used the AMUSE framework to couple an SPH code with an N-body code to model the tidal truncation of protoplanetary disks due to the passing of nearby stars in a small stellar cluster. *Supervisor of my first master project:* Prof. Dr. S. F. Portegies Zwart
2017	**High frequency amplifier for the detection of shot noise in Scanning Tunneling Microscopy** *Activities:* I have used MATLAB to model the amplification of the electrical current measured in a Scanning Tunneling Microscope. This was done for several designs of a resonant electrical circuit to find the optimal balance between amplification and bandwidth. *Supervisor of my bachelor project:* Dr. M. P. Allan

CONGRESSES AND SEMINARS

Date	Title	Place
04-2023	**Resolving snow surfaces of water and methanol in V883 Ori** *poster*	Protostars and Planets VII, Kyoto, Japan
12-2022	**Hot or cold: finding the temperatures in transition disks using ALMA** *contributed talk*	6th Netherlands ALMA science day, Leiden, The Netherlands

10-2022	**Gas temperature across the cavities of transition disks** *contributed talk*	Nova Network II meeting, Groningen, The Netherlands
10-2022	**Freezing conditions in a warm disk: resolving the 2D snow surfaces** *contributed talk*	From Clouds to Planets II: the Astrochemical Link, Berlin, Germany
10-2022	**Hot or cold: temperature in transition disk cavities** *poster*	From Clouds to Planets II: the Astrochemical Link, Berlin, Germany
09-2022	**Lord of the rings: molecular tracers in protoplanetary disks** *contributed talk*	Heidelberg group meeting, Heidelberg, Germany
09-2022	**Lord of the rings: molecular tracers in protoplanetary disks** *contributed talk*	ESO lunch talk, Garching, Germany
09-2022	**Hot or cold: temperature in transition disk cavities** *poster*	The Inner Region of Protoplanetary disks, Ringberg, Germany
07-2022	**Lord of the rings: molecular tracers in protoplanetary disks** *contributed talk*	University of Leeds seminar, Leeds, England
07-2022	**Lord of the rings: molecular tracers in protoplanetary disks** *contributed talk*	UCL group meeting, London, England
07-2022	**Lord of the rings: molecular tracers in protoplanetary disks** *contributed talk*	Imperial College London group meeting, London, England
06-2021	**Chemically tracing the water snow line in V883 Ori with HCO^+** *poster*	European Astronomical Society Annual Meeting, Online
12-2020	**Icy conditions in protoplanetary disks: how and where to find the water snowline** *contributed talk*	Five years after HL Tau: a new era in planet formation, Online
11-2020	**Icy conditions in protoplanetary disks: how and where to find the water snowline** *contributed talk*	Nova Network II meeting, Online
07-2020	**Chemically tracing the water snow line in V883 Ori with HCO^+** *poster*	European Astronomical Society Annual Meeting, Online

PUBLICATIONS

Published Articles in journals
A major asymmetric ice trap in a planet-forming disk. IV. Nitric oxide gas and a lack of CN tracing sublimating ices and a C/O ratio < 1 **Leemker**, Booth, van Dishoeck et al. A&A, 673, A7, 2023
Gas temperature structure across transition disk cavities **Leemker**, Booth, van Dishoeck et al. A&A, 663, A23, 2022
Chemically tracing the water snowline in protoplanetary disks with HCO^+ **Leemker**, van 't Hoff, Trapman et al. A&A, 646, A3, 2021
A measurement of the water D/H ratio and snowline in a protoplanetary disk Tobin, van 't Hoff, **Leemker** et al. Accepted for publication in Nature, 2022
A chemical map of the outbursting V883 Ori system: vertical and radial structures Ruíz-Rodríguez, Williams, Kastner, Cieza, **Leemker**, et al. MNRAS, 515, 2646, 2022
Disentangling protoplanetary disk gas mass and carbon depletion through combined atomic and molecular tracers Sturm, Booth, McClure, **Leemker**, et al. Accepted for publication in A&A, 2022
The young embedded disk L1527 IRS: constraints on the water snowline and cosmic-ray ionisation rate from HCO^+ observations van 't Hoff, **Leemker**, Tobin et al. ApJ, 932, 6, 2022
A major asymmetric ice trap in a planet-forming disk. III. First detection of dimethyl ether Brunken, Booth, **Leemker** et al. A&A, 659, A29, 2022
A major asymmetric ice trap in a planet-forming disk. II. Prominent SO and SO_2 pointing to C/O < 1 Booth, van der Marel, **Leemker** et al. A&A, 651, L6, 2021
A major asymmetric ice trap in a planet-forming disk. I. Formaldehyde and methanol van der Marel, Booth, **Leemker** et al. A&A, 651, L5, 2021

Articles in preparation
Chemistry across gas and dust gaps in protoplanetary disks: modelling the co-spatial molecular rings in the HD 100546 disk **Leemker**, Booth, van Dishoeck, et al. in preparation
Resolving the 2D snow surfaces of HDO and complex organic molecules in the young outbursting source V883 Ori **Leemker**, Paneque-Carreño, van Dishoeck et al. in preparation

OTHER INFORMATION

Programming languages	Level of knowledge
python	proficient
MATLAB, C, C++	familiar
SQL, LabVIEW	basic

Modelling programs	Description	Level of knowledge
DALI	Chemical modelling and radiative transfer code	proficient
LIME	Radiative transfer code	familiar
CASSIS	Spectral line fitting program	familiar
FARGO3D	3D magnetohydrodynamics code	basic
RADEX	One-dimensional non-LTE radiative transfer program	basic
TRICKS	TRainer for Interstellar Chemical Kinetics Simulations, astrochemical kinetics model	basic
RADMC-3D	Radiative transfer code	basic
AMUSE	Astrophysical Multipurpose Software Environment to couple e.g., SPH simulations with N-Body dynamics	basic

Observing experience

Year	Observing proposals
10-2022 — present	**ALMA**, 2022.1.00958.S, 10.6 hours as **PI**, rank B, part of the data already observed.
11-2021	**ALMA**, 2021.1.00186.S, 8.0 hours as Co-I, rank A
12-2021 — 05-2022	**ALMA**, 2021.1.00738.S, 29.6 hours as Co-I, rank B
04-2016	**Isaac Newton Telescope (INT)**, Wide-Field Camera (WFC), 2.5 hours

Data reduction

Program	Description
casa	I have used casa to image line and continuum emission in ALMA data of different projects including rarely observed Band 9 data (2016.1.00344.S, 2017.1.00727.S, 2018.1.00945.S, 2018.1.01255.S).
ALFAHOR	I have used ALFAHOR to derive the emitting heights of various molecules in protoplanetary disk observations.
Keplerian masking	I have used the Keplerian masking package by Dr. R. Teague to make keplerian masks in casa.
python	I use python to extract key data product of the ALMA data including integrated intensity maps, velocity maps, azimuthally averaged radial profiles, and line profiles.

Mentoring experience

Year	Student
09-2020 — 07-2021	**N. G. C. Brunken** Master student Astronomy, Leiden University, Leiden Observatory, together with Dr. A. S. Booth
09-2020 — 07-2021	**D. Natoewal** Master student Astronomy, Leiden University, Leiden Observatory, together with Dr. A. S. Booth

Teaching experience

Year	Project
11-2022 — present	**Teaching Assistant Observational Molecular Astronomy in Galaxies** masters course
05-2022 — 06-2022	**Teaching Assistant Astrochemistry** masters course
02-2021 — 06-2021	**Teaching Assistant Radiative processes** third year bachelor course
05-2020 — 07-2020	**Teaching Assistant Astrochemistry** masters course
03-2017 — 06-2018	**Teaching Assistant Electric and Magnetic Fields** first year bachelor course
11-2016 — 06-2018	**Tutor first year Physics and Astronomy** first year Physics and Astronomy bachelor
10-2016 — 11-2016	**Laboratory Assistant Experimental Physics 2** first year bachelor course

Service and outreach

Year	Event
08-2022	**ESO Press release**, Brunken, Booth, Leemker et al. 2022
2021— present	**Outreach using a 1:10 JWST scale model**, Model operator and presentor
12-2019	**Astronomy Gala**, Co-organiser

Summer and fall schools

Year	School
08-2022	**Astronomy, Astrochemistry & the Origin of Life** *Scope:* Learn about the three pillars of astrochemistry: observations, lab and modelling using a chemical network (TRICKS). Heidelberg, Germany
09-2020	**Planet Formation in Protoplanetary Disks** *Scope:* Learn about the key processes involved in planet formation and get familiar with modelling programs such as FARGO3D (hydrodynamical modelling) and RADMC-3D (radiative transfer). Heidelberg, Germany
10-2019	**NOVA Fall School** *Scope:* broaden general knowledge of astronomy. Dwingeloo, The Netherlands
07/2017	**Physics at All Scales** *Scope:* 10-day summer school with lectures about physics on all scales and lab visits. Leiden, The Netherlands

Declarations given in the present curriculum must be considered released according to art. 46 and 47 of DPR n. 445/2000.

The present curriculum does not contain confidential and legal information according to art. 4, paragraph 1, points d) and e) of D.Lgs. 30.06.2003 n. 196.

Please note that CV WILL BE PUBLISHED on the University website and It is recommended that personal and sensitive data should not be included. This template is realized to satisfy the need of publication without personal and sensitive data.

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Place and date: Leiden, 14/08/2023