

Adrien Houge

Astrophysicist interested in how the coagulation of tiny dust grains can build habitable planets



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01

EDUCATION

2015	2018	2020
Bachelor's degree in Physics <ul style="list-style-type: none">University of Liège, BelgiumInternship at the Royal Meteorological Institute of Belgium	Master's degree in Space Science <ul style="list-style-type: none">University of Liège, BelgiumErasmus exchange at the University of Oulu, Finland (6 months)Research project at TRAPPIST-North Observatory, MoroccoDissertation Title: Constraining the dynamics and masses of the TRAPPIST-1 planets with the TTV methodSupervisor: Dr. Michael GillonGrade: <i>summa cum laude</i>	Ph.D. student <ul style="list-style-type: none">University of Exeter, UKEuropean Southern Observatory, Germany (Visitor Studentship, 8 months)Thesis Title: Modelling the formation of planetary building blocksSupervisor: Dr. Sebastiaan KrijtExpected Submission Date: May 2024

02

RESEARCH PROJECTS

I. PhD Research

Modelling the formation of planetary building blocks

My PhD research project concerns the [coagulation and evolution of dust grains](#) in protoplanetary discs, focusing on their composition and internal structure. I developed a 0D coagulation code (C++) based on the Monte Carlo approach, best suited when characterising several [dust properties](#). Currently, I am investigating the impact of [accretion outbursts](#) on the evolution of dust and ice.

Supervisor: Dr. Sebastiaan Krijt

II. Observational Research at the European Southern Observatory

Surviving the Fire: Using V883 Ori as a laboratory for dust properties

Upon [ice sublimation](#), it is unclear how the structure of refractory dust grains is impacted, as laboratory experiments found they could both [survive](#) or totally [disintegrate](#). In this observational project, I perform new analysis of archival ALMA data of V883 Ori, currently undergoing an accretion outburst. From the multi-wavelength dataset, we obtain the [spectral indices](#) and compare them to 1D dust evolution models (using DustPy). From that, we are able to constrain how dust grains responded to the sublimation of their water mantles at the onset of the outburst.

Collaborators: Dr. Enrique Macias & Dr. Sebastiaan Krijt

III. The water snowline in HL Tau

We observed HL Tau with the Band 9 of ALMA to obtain the [highest resolution](#) data ever achieved with this disc at sub-mm-wavelengths. It allows us to characterise the dust population down to 1 au, and analyse for the first time the impact of the [water snowline](#) on dust particles. As a part of this collaboration, I performed 1D dust evolution simulations, from which I obtained the intensity at sub-mm-wavelengths. From comparisons with observed data, we aim at investigating the fragmentation limit of [dry silicates vs. water-rich](#) respectively inside and outside the water snowline.

Collaborators: Dr. Enrique Macias & colleagues

IV. ICAPS experiment: Brownian motion and porous growth

The ICAPS experiment is a [laboratory experiment](#) on board of a TEXUS-56 rocket launched from Kiruna (Sweden), designed to study the growth of porous aggregates when their relative velocities are driven by the Brownian motion. This phase is characterised by the hit-and-stick regime, where the [fractal dimension](#) of dust grains is close to 2. Using my Monte Carlo coagulation code, I simulated the conditions of the ICAPS experiment to better understand the measured data, notably exploring the fractal dimension and the impact of the [electric charge](#).

Collaborators: Prof. Jurgen Blum, Dr. Rainer Schräpler, and Ingo von Borstel

V. Master Thesis

Constraining the dynamics and masses of the TRAPPIST-1 planets with the transit timing variations method

My Master research project focused on analysing [new transits](#) of the TRAPPIST-1 planets obtained from the telescope Io of the SPECULOOS Southern Observatory, between May and December 2019. My goal was to acquire new transit timings to support the next generation of [TTV study](#), helping to constrain the masses and bulk densities of the seven planets with high precision.

Supervisor: Dr. Michaël Gillon
Collaborators: Dr. Elsa Ducrot, Prof. Eric Agol, and Lionel Garcia

VI. Master Research Project

Observation of globular and open clusters

As a part of this Master research project, I travelled to the TRAPPIST-North Observatory, in Morocco, to observe the globular cluster M3 and the open cluster M67. The data were reduced using AstrolmageJ and analysed with SExtractor to build the [Hertzsprung-Russell \(HR\) diagram](#). The goal of the project was to compare the HR diagrams to constrain the [age](#) of the clusters.

Collaborators: Sarah Joiret, Prof. Emmanuel Jehin

03

RESEARCH EXPERTISE

- Dust coagulation & evolution
Dust properties, growth simulations with Monte Carlo and Smoluchowski approaches, lab experiments
- Protoplanetary discs
ALMA observations, accretion outbursts, snowlines
- Exoplanets
TRAPPIST-1, transit, TTV methods

04

TECHNICAL SKILLS

- C++
- CASA
- Python
- Fortran
- LaTeX
- Adobe Illustrator
- Other tools: DustPy, dsharp-opac, RADMC-3D

05

CONFERENCES / WORKSHOPS

SPIDI23 conference - The inner disk of young stars : accretion, ejection, and planet formation (poster)	May 2023	Corsica, France
AlumNight (organiser & talk)	April 2023	ULiège, Belgium
Alien Earths All-Hands Meeting	February 2023	virtual
Seminar at Til Birnstiel's group (talk)	December 2022	LMU, Germany
Exeter EMPS PGR Conference (talk & poster)	April 2022	University of Exeter, UK
The Volatile Content of Planets that Form Early	November 2021	virtual
Sagan Exoplanet Summer Virtual Workshop	July 2021	virtual
UKRI STFC Introductory Course in Astronomy (poster)	January 2021	virtual
Five years after HL Tau: a new era in planet formation	December 2020	virtual
Planetesimal Formation Workshop	November 2020	virtual
TRAPPIST-1 conference	June 2019	ULiège, Belgium

06

PUBLICATION LIST

A. Houge, S. Krijt, **Collisional evolution of dust and water ice in protoplanetary discs during and after an accretion outburst**, MNRAS, Volume 521, Issue 4, June 2023, Pages 5826–5845

07

MENTORING / TEACHING

- MSc final projects (2021 - ...)
Helping Dr. Sebastiaan Krijt to supervise MSc students in their final project about pebble drift and planet formation.
- Mentorship for prospective PhD students (2021 - ...)
Providing advice concerning PhD applications to 2nd year Master's student in Space Sciences.
- Mentorship for international students (2019 - 2020)
Guiding international students moving in Belgium for their studies.
- Mentorship for 1st year student (2016 - 2019)
Mentoring new students in the Physics faculty (time management, mental health, introducing the University, teaching if needed).
- Laboratory assistant, Electromagnetic physics (2018)
- Personal teacher, Physics and Mathematics (2017 - ...)

08

AWARDS

- Astro Plot of the Week**
@AstroPlot, 2023
- 2nd price for best poster**
Exeter EMPS PGR Conference, 2022
- 1st price for best poster**
UKRI STFC Introductory Course in Astronomy, 2021
- Master's degree with summa cum laude**
University of Liège, 2020

09

AFFILIATIONS

- | | |
|-------------------------------|----------------------------|
| University of Exeter | Royal Astronomical Society |
| European Southern Observatory | Alien Earths |

10

OUTREACH

Pint of Science, Exeter, May 2022 (**co-organiser**)

Livestream: The Great Conjunction of Saturn and Jupiter - December 2020 (**co-organiser**)

12

LANGUAGES

French



English



German



Swedish



11

PERSONAL INTERESTS

Multi-days hiking

Ice and sea swimming

Chess

Climbing & Bouldering

Graphic design for science communication

Analog photography

Music (guitar, bass)