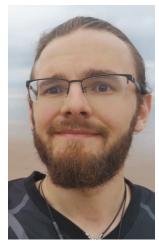
# **Oliver Herbort**



# Title

From clouds to crust - Cloud diversity and surface conditions in atmospheres of rocky exoplanets

# Abstract

One of the fundamental questions for planetary science is how surfaces of other planets similar to the rocky bodies in our solar system look like. What is the rock structure like? Will there be water? Are there any active atmospheric cycles? How can we detect these different conditions?

The current space missions and ground based instruments allow the detection of specific gas species and some cloud compositions in atmospheres of giant exoplanets. With instruments installed in the near future and space crafts currently being build or planned, these kind of observations will be available for planets with smaller sizes and an overall rocky composition. We aim to further understand the connection of the conditions of the upper atmosphere with the conditions on the crust of the planet (temperature, pressure, composition).

Our equilibrium chemistry models allow us to investigate the expected crust and nearcrust-atmosphere composition based. With this, we investigate the conditions under which liquid water is actually stable at the surface of a planet and not incorporated in hydrated rocks. Based on this crust - near-crust-atmosphere interaction we build an atmospheric model, which allows us to investigate what kind of clouds are stable and could be present in atmospheres of rocky exoplanets. This allows us to link the high altitude gas phase and cloud compositions to the surface conditions.

| Contact information<br>St Andrews Centre for Exoplanet Science<br>School for Physics and Astronomy |  |                |   |  |  |
|--|--|----------------|---|--|--|
|  | School for Earth and Environmental Studies   |                |   |  |  |
| Adress:  | University of St Andrews<br>North Haugh<br>KY169SS St Andrews<br>Scotland, United Kingdom  | email:<br>web: | oh35@st-andrews.ac.uk<br>oliver.herbort.wordpress.com |  |  |
| Academic Career  |  |                |   |  |  |
| 2018 - 2022  | <b>PhD Student Astrophysics</b><br>University of St Andrews, Scotland<br>Thesis title: Atmospheres of Rocky Exoplanets<br>Supervisors: Dr. Peter Woitke and Dr. Aubrey Zerkl | e              |   |  |  |
| 2016 - 2018  | Master of Science Physics  |                |   |  |  |

# 2016 - 2018 Master of Science Physics Georg August Universität, Göttingen, Germany Thesis title: Stellar activity of CN Leo Supervisor: Prof. Ansgar Reiners CARMENES consortium 2016 - 2017 Erasmus Semester at Uniwersytet Jagielloński, Cracow, Poland 2013 - 2016 Bachelor of Science Physics Georg August Universität, Göttingen, Germany Thesis title: Intermediate Mass Black Holes in Globular Clusters Supervisor: Prof. Stefan Dreizler

#### **Research Interest**

My research focusses on combining astrophysical and geological knowledge in order to understand the interaction of atmospheres and the surface of rocky exoplanets. The observable composition of the atmosphere of an exoplanet provides clues on its surface conditions (rock composition, surface temperature and pressure). The diversity of cloud species can help to understand these surface conditions.

Rocky exoplanets - habitable worlds to magma oceans; what they are made of and how can information on the surface conditions be inferred from observations; understanding habitable conditions (Stability of liquid water, further potential life cycles comparable and beyond those on Earth); interaction of host stars and exoplanets; how can stellar activity affect atmospheres; diversity of clouds (various temperature regimes)

#### Publications (as of 17/12/2020)

Publications:5 (1 first author, 1 second author, 1 submitted)Citations:63 (4 as first author)

Coexistence of CH4, CO2 and H2O in exoplanet atmospheres <u>Woitke, Herbort et al. 2020</u>, A&A, Forthcoming article

The atmospheres of rocky exoplanets. I. Outgassing of common rock and the stability of liquid water Herbort et al. 2020, A&A, 636 (2020) A71

Understanding the atmospheric properties and chemical composition of the ultra-hot Jupiter HAT-P-7b Helling et al. 2019 A&A 631, A79 (2019)

CARMENES: high-resolution spectra and precise radial velocities in the red and infrared Quirrenbach et al. 2018 Proc. SPIE 10702

# Conferences and Colloquia (full list here)

| CHAMELEON Introduction Meeting                            | Nov 2020   | talk   |
|---|------------|--------|
| Colloquium Thüringische Landessternwarte Tautenburg,      | Nov 2020   | talk   |
| Diversity of Rocky Exoplanets, Lorentz Center Leiden      | Oct 2020   |        |
| NOVO Nordisk Meeting                                      | July 2020  | talk   |
| Scottish Exoplanet and Brown Dwarf Meeting 10, St Andrews | Oct 2020   | talk   |
| Exoplanets III, Heidelberg/online                         | July 2020  | Poster |
| Rocky World Workshop, Cambridge                           | Jan 2020   | Poster |
| Scottish Exoplanet and Brown Dwarf Meeting 9, Edinburgh   | Sep 2019   | talk   |
| Scottish Exoplanet and Brown Dwarf Meeting 8, St Andrews  | April 2019 | talk   |
| Universität Bielefeld Astrobiology Colloquium             | Jan 2019   | talk   |
| Cloud Academy, École des physique des Houches             | Sep 2018   |        |

# **Teaching experience**

2018 - Tutor, lab demonstrator (Astronomy undergraduate courses), University of St Andrews
2018 - Telescope teaching for undergraduate students, University of St Andrews
2018 - 2020 Journal Club organisation, St Andrews Centre for Exoplanet Science
2017 - 2018 Lab demonstrator (physics lab for physicists and non physicists), Georg August Universität

#### **Outreach and Public engagement**

- 2018 Mobile planetarium, University of St Andrews lead organiser
- 2018 Various science outreach days, University of St Andrews
- 2016 Physics experiments in schools in South Africa during an excursion (Georg August Universität, Universität Kassel)