Dr. Carolina von Essen – Teaching Portfolio

This document describes my teaching expertise thoughtfully. Through the years, and specially during my stay at Aarhus University, I have been heavily involved in all levels of teaching. This includes individual courses, bachelor, master and PhD theses. I have supervised several students in different academic levels, both as main supervisor as co-supervisor, within Denmark but also internationally.

Conducted teaching

Year	Title of Course	Applicant's Role	ECTS	NoP	Levels	Institution
2014	ASS	Teaching assistant (1)	-	4	All levels	AU
2015	Exoplanets	Teaching assistant	5	∼10	Kandidat	AU
2016	EAT	Teaching assistant	5	∼10	Kandidat	AU
2016	MSS	Teacher (2)	-	∼30	All levels	MU
2017	Delphini-1	Teaching assistant (3)	5	∼20	Kandidat	AU

NoP: number of participants.
AU: Aarhus University; MU: Moletai University.
ASS: Aarhus Summer School; MSS: Moletai Summer School.
EAT: Exoplanet Advanced Topics.

(1) Teaching assistant at Aarhus Summer School, Denmark. I trained students how to analyze Kepler Space Telescope data and derive from these transit timing variations. Conducted during the Summer of 2014.

(2) Main lecturer at Moletai Summer School, Lithuania. I trained students how to acquire, reduce and analyze photometric data in one week. Conducted during the Summer of 2016.

(3) Course lecturer for the Delphini-1 project, 2 lectures on photometry and image analysis.

Supervision experience

PhD theses

- Supervisor of Sean McCloat. Topic: "Transit Timing Variation Analysis of recently discovered hot Jupiters", University of North Dakota, United States of America. PhD expected in 2021.
- Co-supervisor of MhD. Marina Sosa. Topic: "Observational study of the optical emission of blazares detected at high energies", National University of La Plata, Argentina. PhD expected in March, 2019.
- Supervisor of Jantje Freudenthal. Topic: "Follow-up of Kepler targets with transit timing variations"., Göttingen University, Germany. PhD expected in 2019.
- Supervisor of Romina Miculán. Topic: "Characterization of exoplanet atmospheres using ground-based observations", National University of La Plata, Argentina. PhD expected in 2021.

Master theses

- Supervisor of Helene Hestbech Jørgensen. Topic: "Linking the physical properties of hot and ultra-hot Jupiters with their evaporating atmospheres", ongoing.
- Supervisor of Sofie Hermansen. Topic: "Proving oxides in the atmospheres of the hottest exoplanets known", Aarhus University, Denmark. Degree awarded in 2019. Grade: 12/12.
- Supervisor of Sean McCloat. Topic: "Transit Timing Variation Analysis of recently discovered hot Jupiters", University of North Dakota, United States of America. Degree awarded in 2017. Grade: 10/10.

- Supervisor of Romina Miculán. Topic: "Characterization of the atmosphere of HD-189733b", National University of La Plata, Argentina. Degree awarded in 2016. Grade: 10/10.
- Supervisor of Jantje Freudenthal. Topic: "Estimation of the orbital parameters of 60 KOIs for KOINet-related studies", Göttingen University, Germany, and Aarhus University, Denmark. Degree awarded in 2015. Grade: 1/1.
- Supervision of Sandra Vazquez. Topic: "Timing analysis of the eclipsing binary CM Draconis", Göttingen University, Germany. Degree awarded in 2014. Grade: 9.14/10.

Bachelor theses

- Supervisor of Julie Thiim Gadeberg. Topic: "Helping TESS be on time - A time verification method using eclipsing binaries", Aarhus University, Denmark. Degree awarded in 2019. Grade: 12/12.
- Supervisor of Sissel Nørgaard Stilling. Topic: "Determination of periodicity in light curves", Aarhus University, Denmark. Degree awarded in 2019. Grade: 12/12.
- Supervisor of Dina Sofia Mortensen. Topic: "Photometric and Spectroscopic Analysis of Exoplanet Transit Light Curves", Aarhus University, Denmark. Degree awarded in 2018. Grade: 12/12.
- Supervisor of Kristine Kousholt Mikkelsen. Topic: "Observation of Exoplanet at Wasp-121 Using Transit Photometry", Aarhus University, Denmark. Degree awarded in 2018. Grade: 10/12.
- Supervisor of Helene Jørgensen. Topic: "Characterization of Exoplanets in the Search for Extraterrestrial Life", Aarhus University, Denmark. Degree awarded in 2018. Grade: 12/12.
- Supervisor of Peter Wels Hansen. Topic: "Pulsation Analysis of two transits of WASP-33", Aarhus University, Denmark. Degree awarded in 2018. Grade: 7/12.
- Supervisor of Sofie Hermansen. Topic: "Assessing the power of broad-band transit data for exoatmospheric studies", Stellar Astrophysics Centre, Denmark. Degree awarded in 2017. Grade: 12/12.
- Supervisor of Marcus Marcussen. Topic: "Assessing the quality of ground- based light curves to recover the transmission spectrum of exoplanet atmospheres", Aarhus University, Denmark. Degree awarded in 2016. Grade: 12/12.
- Supervisor of Niels Petersen. Topic: "Photometric Characterization of the Planet Transit Studies Telescope", Hamburg University, Germany. Degree awarded in 2012. Grade: 1/1.

Projects

- Supervisor of Julie Thiim Gadeberg, Anders Ploug Hansen and Esben Hygum Larsen. Topics related to photometric exoplanet data reduction and analysis, Aarhus University, Denmark. Ongoing course.
- Supervisor of Sofie Hermansen. Topic: "Assessing the power of broad-band transit data for exoatmospheric studies", Aarhus University, Denmark. Successfully finalized in 2018.
- PhD course lecturer of Maria Hjorth. Topic: "Advanced python statistics in Astronomy", Aarhus University, Denmark. Successfully finalized in 2018.
- Supervisor of fulbright fellowship student Vaishali Parkash. Topic: "Development of DI2Pol: Differential Photometry Pipeline for Optimum Lightcurves", Göttingen University, Germany, and Aarhus University, Denmark. Successfully finalized in 2015.

Teacher Training Programme at Aarhus University, Autumn 2018

The aim of the program is to contribute to the professionalization and quality of university teaching through the development of our practical teaching skills and by fostering a scholarly approach to teaching. Here we learn how to analyze and discuss teaching based on knowledge about quality teaching, didactical tools to increase our teaching quality, assessment, evaluation and students as learners. We acquire tools to plan, execute and evaluate well-aligned teaching and assessment activities within their own disciplines and organizational contexts. We use and evaluate educational technologies to promote learning activities

for groups and individual students. We demonstrate practical teaching skills through teaching examples. We collect data, analyze, and communicate information about our teaching practices and experiences to colleagues and other stakeholder in a teaching portfolio. The program (5 ECTS), finalized in December, 2018.

Course planning and execution

Teaching is to me one of the most fulfilling tasks in academia. I believe it is our duty to transfer knowledge to the younger generations in the best way possible. I do not like to introduce a concept to the students making them learn it by heart or by repetition, but by making them carry out the process of self-understanding. During class, I try to guide the students through the concepts by being as clear as possible and by connecting complicated concepts to real life situations, not providing to them direct answers to their questions, but making them new ones to see their problematic from another point of view. Through this process the students usually derive quickly to their own conclusions, creating in this process a feeling of self-confidence and satisfaction that constantly motivates them to continue with their work and to move forward. To assess my teaching strategy, I discuss here a project I have been recently teaching at the Stellar Astrophysics Centre, entirely designed by me and diagrammed to be fit for students between bachelor and master level. The main goal of the project is for the students to be able to extract information from astronomical data completely independently. To do so, the project is divided into two main components. The first one is related to data reduction, and the second one is focused in data analysis techniques and statistical tools. The course is based upon the "Flipped classroom" technique, this is, a course where students are introduced to content at class during face-to-face interaction, and practice working through these new concepts at home, with help of technology (cookbooks, a FAQ web page, constant email exchange, etc). The course corresponds to 5 ECTS points. Lectures and practice assignments take place once a week for 2 hours each class. The course comprises the following main topics, which are deeply discussed during class and also tested during the lectures, and that should be also considered as learning outcomes:

1. Introduction to photometry and concepts associated to it, such as seeing, CCDs, calibration frames, cosmic rays, relative and absolute fluxes.
2. Proper use of IRAF for pre-reduction of astronomical data, alignment, and extraction of photometric fluxes.
3. Construction of differential light curves and the concepts associated to this, such as aperture size, choice of reference stars, and minimization of light curve noise.
4. Brief introduction to statistics.
5. Basic concepts of modeling, minimization of certain statistics, and parameter fitting. Correlation between parameters.
6. Use of python to fit a model to astronomical data.

The driving principle behind the course is to give the students the confident and the tools needed to tackle future problems similar to the ones proposed in this course, completely independently. To build up this confidence I create an atmosphere where peer discussion is used to clear doubts (this is, discussions among students properly guided by me), and open and constant discussion with "down to Earth" examples are constantly used to fix new concepts. The activities carried out during the classes are designed to ensure that the students will reach the expected gals in the right time, without requiring to invest extra time on the assignments. The goals and learning outcomes can be found under the course description in Blackboard. At the end of the course, the students must be able to:

1. Access physical information from astronomical data.
2. Interpret the obtained physical information comparing these to models.
3. Reflect on the quality of their results.

To test if the students have understood the concepts acquired during a specific class, I provide them with an anonymous questionnaire, where they can reflect their experience during the class. This is extremely useful to me, as the students are actually learning completely brand new concepts and tools during each

class, helping me refine and readjust the concepts from a class to the next one. During each class, students are required to carry out tasks at home, delivered to me within a given week. The students receive, before the next class, a detailed feedback from me, describing the pros and the cons of their delivered work. Finally, the assessment of the course consists on a 20 minutes individual oral examination. After a thoughtful examination of the learning outcomes, the student will pass or not pass.

Student evaluations

My teaching strategy and quality lack of formal evaluation. In consequence, I have requested my students at Aarhus University to describe their experiences with me as an educator in a short paragraph. Next, I attach the provided descriptions, hoping they will help the reader assess my teaching quality.

Sofie Hermansen: I have worked with Carolina many times, first when doing my Bachelor thesis, second when doing a project on exoplanets and currently she is supervising my Master thesis. All my experiences with Carolina have been extremely positive, as she is very helpful and good at pushing one forward in a task without just giving the answer. It is during these projects with Carolina that I feel that I have learned the most during my studies, as I got to be more independent and work very hands on, for example with developing my own code for my Bachelor thesis and now working with HST archival data in IRAF. Carolina is always happy and provide a very good working environment, where there is always room for questions and discussions.

Dina Sofia Mortensen: My experience with Carolina as an educator is that she is very dedicated, investing both time and energy in her students. She is always open to answering questions or helping in getting to the next step in the project and would answer questions in depth without unnecessarily oversimplifying anything. She is encouraging, and would always have new suggestions on how to carry on further with the data processing. When working with unfamiliar concepts in for example statistics she was very thorough in making sure that we understood what we were working with, and making step-by-step questions that could help clarify the concepts. The material we have worked with which she had produced (a guide to data reduction using IRAF), is easy to follow and extensive enough to use without further instructions.

Kristine Mikkelsen: Carolina von Essen was my bachelor advisor in 2018 spanning over a semester. During this period she guided and taught me a lot of useful things. Through our weekly meetings I learned to analyze and interpret photometric data in the search of exoplanets. During the project she focused on teaching us things that where not only useful for my project but where good to know in our later education. She managed to attend to each of our projects and made sure that we understood the necessary for us to work on the projects individually. Furthermore, she where always enthusiastic in answering our questions and teaching us new ways of solving the problems at hand. As well as always being ready to help us. In conclusion I learned a lot of useful tools over a short period of time.

Peter Weis Hansen: Having Carolina as a supervisor has been a blessing and a joy for me. I have not only found her more than able to effectively convey information on what was, to me, rather complex topics, she also that she has another qualify as an educator that I consider at least as important as simply offering information: namely, the ability to quickly understand my questions when I'm confused, identify the problems, and explain to me what I didn't know in a way that never made me feel like I was ignorant for not getting something right the first time, meaning that I never had to fear disapproval when I came to her with questions. This has continued even past the completion of my Bachelor project, and I have since popped by her office to ask her questions, and known that if she's in her office I will be readily met with a smile and an explanation.

Helene Jørgensen: Carolina is exceptionally knowledgeable about her areas of research and is great at communicating her knowledge to students in a clear and understandable way. She is always manages to set relevant and challenging tasks and asks questions that allow you to dive even further into your topic of interest. In addition, she is supportive, good at giving constructive criticism, and at pushing you in the right direction. She is an excellent supervisor.

Esben Hygum Larsen: Carolina has been very good as a teacher, helping us to a successful project where we had little to no prior knowledge and experience with the subject.

Julie Thiim Gadeberg: Carolina has been my supervisor for a semester on a project concerning photometry. During this process she has been very helpful providing us with information while still allowing us to process this through communication at weekly group meetings. In general, I would say that her teaching philosophy is a balance between making us seek the knowledge on our own, and sensing when we need her to step in. This philosophy has been very important for my own personal development as an astrophysicist because it has allowed me to have scientific debates with my peers, understand where and how to obtain information that I need, as well as giving me the courage to make mistakes - all while knowing that I have a trustworthy supervisor to turn to if everything goes wrong. I am very happy to have her as my supervisor.