# Fran Bartolić

*Curriculum Vitae*

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## Personal information

Nationality Croatian

Languages Croatian (Native), English (Fluent)

## Education

2017–2021 (expected) **Ph.D. Astrophysics**, *University of St Andrews*, St Andrews, Scotland.

This PhD position is a part of a new scheme funded by the UK government with a strong focus on producing PhD graduates with Data Science and industry relevant skills. In my research, I am primarily interested in building interpretable probabilistic models, using advanced statistical methods such as Bayesian models and Machine Learning, and applying them to research problems in astrophysics.

2015–2017 **M.Sc. Physics with Astrophysics**, *University of Rijeka*, Rijeka, Croatia.

Cumulative GPA: 4.7/5. I spent the first three semesters doing courses in theoretical physics and astronomy. In the final semester I worked on a research project at Lund University in Sweden for 7 months.

2012–2015 **B.Sc. Physics**, *University of Split*, Split, Croatia.

Cumulative GPA: 4.5/5. I took courses in theoretical physics and programming. In the final semester I did a short research project as an exchange student in Lund, Sweden.

## Research Experience

09/2017–today **Ph.D. project**, *School of Physics & Astronomy, University of St Andrews*, St Andrews, Scotland.

I am working on modeling astrophysical time series data using advanced Bayesian methods. The main challenges I am working on is how to build probabilistic models of complex astrophysical phenomena in order to extract useful physical information about populations of extrasolar planets. These models are complex, non-linear, and have degenerate parameter spaces, a regime where even the most sophisticated statistical methods regularly fail. The statistical methods I use in my research include Gaussian Processes, Hamiltonian Monte Carlo, linear models, and neural networks. I am approaching the thesis project bottom-up, starting with simple interpretable models, solving one challenging problem at the time, and writing usable and scalable open-source code in the process.

*Supervisor: Dr. Martin Dominik*

02/2017–09/2017 **Master's thesis project**, *Lund Observatory, Sweden*, Lund, Sweden, 30 weeks FTE work.

The title of my master's thesis is *Planets Orbiting Evolving Binary Stars*, and the subject of the thesis was to construct analytical and numerical models describing the dynamics of extrasolar planets. In this project I developed both an analytical pen and paper model, and used numerical simulations to understand the relevant physical phenomenon. The project involved writing `Python` code for solving symbolic equations and making plots, and interfaced `Python` code with a solver for differential equations written in `C++`.

*Supervisors: Dr. Alexander J. Mustill & Prof. Dijana Dominis Prester*

07/2016–08/2016 **Summer student programme**, *Nicolaus Copernicus Astronomical Center*, Warsaw, Poland, 4 weeks FTE work.

I worked on astrophysical fluid dynamics simulations using a popular astrophysics code written in `C++`. I spent my time running simulations and writing a data visualization code in `Python`. I learned to work with Linux systems computer & clusters.

*Supervisors: Dr. Miljenko Čemeljić & Prof. Włodzimierz Kluźniak*

## Technical skills

Programming My main language of choice is `Python`. I use it extensively together with numerical/scientific libraries `NumPy`, `SciPy` and `matplotlib`, and `Jupyter` notebooks. Besides Python, I also use `C/C++`, and I have used `C#` and `MATLAB` in the past.

Data science In my research I use the probabilistic programming library `PyMC3` extensively together with `theano`. I have basic knowledge of `Tensorflow` and `PyTorch`.

Statistics MCMC, Bayesian model comparison, linear models, dimensionality reduction.

Other `Git` version control, `Vim`, LaTeX, Linux systems, Bash shell.

## Publications

2019 **F. Bartolić** et. al. (in prep). Paper on building a hierarchical Bayesian model for predicting properties of on going microlensing events.

2019 **F. Bartolić** et. al. (in prep). Paper on Bayesian modeling of microlensing events using Gaussian Processes and Hamiltonian Monte Carlo.

2018 V. Bozza, E. Bachelet, **F. Bartolić**, T. M. Heintz, A. R. Hoag, and M. Hundertmark. *VBBINARYLENSING: a public package for microlensing light-curve computation.*, 479:5157–5167, October 2018. doi: 10.1093/mn-ras/sty1791

## Awards, Competitions and Honors

2016 *Erasmus+ Internship* scholarship

2015 *Dean's Award for undergraduate academic excellence*, University of Split

2014 *Erasmus+ Exchange* scholarship

## Talks

12/2018 *Automatic Differentiation*, talk at the weekly *Code & Cake* meeting, St Andrews, UK

08/2018 *Bayesian modeling of gravitational microlensing events*, ScotDIST annual conference, Glasgow, UK

05/2018 *Fitting a model to data*, talk at the weekly "Code& Cake" meeting, St Andrews, UK

04/2018 *Modeling gravitational microlensing events*, short talk at the Scottish Exoplanet/Brown Dwarf Spring meeting, St Andrews, UK

09/2017 *Dynamics of circumbinary planets and the role of mean-motion resonances*, astronomy seminar, Lund, Sweden

05/2017 *Dynamics of circumbinary planets*, Astro Journal Club presentation, Lund, Sweden

05/2015 *The Giants of Ragnarök*, bachelor's thesis public defense, Lund, Sweden

## Organizational skills

2018–today Co-organiser of the weekly "Code & Cake" meeting at the School of Physics and Astronomy, University of St Andrews.

05/2017 LOC member for the *Impacts in planetary systems* conference, Lund, Sweden

04/2017 Organization of *Interstellar communication; a not-so-simple, interdisciplinary response* talk for the general public by Paul Quast

04/2017 Helped with organizing the workshops at the *Big Questions in Astrophysics* jubilee meeting in Lund, Sweden

04/2017 Organization of *The Extremely Large Telescope* talk for the general public by E-ELT programme scientist Michele Cirasuolo, Lund, Sweden

## Supervision

Summer 2018 Drew Millard, summer student at St Andrews. I supervised him on a project on using machine learning to classify astrophysical time series data.

## Teaching experience

2018 Tutor for the course *Astronomy and Astrophysics 1*, an introductory undergraduate astronomy course, University of St Andrews.