Andrija Kostić — Curriculum Vitae

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Education

Max Planck Institute for Astrophysics — **Garching, Germany**
PhD, International Max Planck Research School, Bayesian forward modelling of LSS — *2020 – present*

Ludwig Maximilians University — **Munich, Germany**
Master in Theoretical Physics — *2018 – 2020*
GPA: 1.19/1.0

University of Belgrade, Faculty of Mathematics, Department of Astronomy — **Belgrade, Serbia**
Bachelor in Astronomy and Astrophysics — *2014 – 2018*
GPA: 9.78/10.00

Gymnasium "Svetozar Marković" — **Niš, Serbia**
Grammar school class for students gifted in physics — *2010 – 2014*

Music high school "Vojislav Vučković" — **Niš, Serbia**
Guitar, Piano, Music Theory, Choir, Composing — *2010 - 2012*

Publications and Conference Proceedings

No evidence for p- or d-wave dark matter annihilation from local large-scale structure :
Kostić A., Bartlett J. D., Desmond, H.; arXiv preprint arXiv:2304.10301 – submitted to Physical Review D
Consistency tests of the field level inference with the EFT likelihood:
Kostić A., Nguyen M., Schmidt F., Reinecke M.; arXiv preprint arXiv:2212.07875 – submitted to JCAP
Constraints on dark matter annihilation and decay from the large-scale structure of the nearby universe:
Bartlett J. D., *Kostić A.*, Desmond H., Jasche J., Lavaux G.; Accepted for publication in Physical Review D
Optimal machine-driven acquisition of future cosmological data:
Kostić A., Jasche J., Ramanah K.D., Lavaux G.; A&A 657, L17 (2022)
Towards Moment-Constrained Causal Modeling:
Guardiani M., Frank P., *Kostić A.*, Enßlin T.; Proceedings of the 41st MaxEnt2022 conference
Non-parametric Bayesian Causal Modeling of the SARS-CoV-2 Viral Load Distribution vs. Patient's Age:
Guardiani M., Frank P., *Kostić A.*, Edenhofer G., Roth J., Uhlmann B., Enßlin T.; Accepted for publication in PLOS
Programming the LED cube with the Raspberry-Pi microcomputer:
Kostić A.; Aleksić D.; Proceedings of the IEEESTEC 7th Student project conference; Niš, Serbia; 2014; 131-136
Dynamical evolution of dust particles ejected from the surface of comets C/2012 S1 (ISON) and C/2011 W3(Lovejoy):
Kostić. A.; Mentored by Smolić. I. and Bošković. M.; Proceedings of the 13th Petnica's annual conference for high school students; Petničke sveske; Petnica Science Center, Serbia; 2014;

Deep Learning Research Experience

Throughout my MSc and PhD theses I have been implementing differentiable Bayesian hierarchical forward models using `C/C++`,`python`, `jupyter`, `pybind11`, `JAX` with deployment of my codes onto large CPU clusters. The nature of the models I have been developing so far is very close to the standard Deep Learning frameworks, both in conceptual and architecture sense, with sizes ranging between 10^6 to 10^7 degrees of freedom. In the next section, I list main results of these endeavors and link to my (publically available) codes and papers. Alongside, in my spare time, I learned the fundamentals of the `PyTorch` framework (projects available on my github repo)

Work Experience

Max Planck Institute for astrophysics **Garching, Germany**
PhD thesis research *October 2020 - July 2023*

- Research subject: **Bayesian forward modelling of galaxy clustering and large-scale structure** mentored by Fabian Schmidt
  - Developing differentiable forward models using lagrangian perturbation theory, effective field theory for modelling biased tracers of the large-scale structure
  - Extensive use of FFTs, Hamiltonian Monte Carlo, slice-sampling techniques and `OpenMP` optimization
  - Side projects:
    - Extending the code for simulating dark-matter annihilation from the large-scale structure called `clumpy`
    - Bakend binding of our `C/C++` operators into `JAX` using `pybind11`
  - Coding done mostly in `C/C++`, `python` and some parts in `R`
  - Results: papers are available on my arXiv page here

Max Planck Institute for astrophysics **Garching, Germany**
Master thesis research *September 2019 - October 2020*

- Research subject: **Application of information field theory concepts to causal inference, quasi periodic signal reconstruction and variational inference algorithms** mentored by Torsten Ensslin and Reimar Leike
  - Developing differentiable forward models within `NIFTy package`
  - Extensive use of gaussian processes, variational inference, conjugate gradient methods for sampling and minimization
  - Code: github repo `link`
  - Results: MSc thesis is available `here`

Leiden Observatory **Leiden, Netherlands**
Research Internship *5th June - 11th August, 2017*

- Research subject: **Galaxy image modeling using Shapelets and sparse techniques** mentored by Arun Kannawadi and Henk Hoekstra
  - Producing a code for image feature extraction using shapelets as decomposition basis
  - Making simulated dataset of galaxy images from classifications done by K-means clustering, SOMs,MDS algorithm
  - Code: github repo `link`
  - Results: Here is a `link` to a report I made

Max Planck Institute For Astronomy **Heidelberg, Germany**
Research Internship *22nd June - 31st August, 2016*

- Research subject: **Hunting for Intermediate Mass Black Holes in Milky Way Globular Clusters** mentored by Glenn van de Ven, Paolo Bianchini, Alessandra Mastrobuono
  - Modelling globular cluster internal dynamics and exploring the parameter space with the use of `emcee` code
  - Incorporating energy equipartition with a goal to improve the existing models
  - Results: Here is a `link` to a modest report I made

Max Planck Institute For Solar System Research **Göttingen, Germany**
Research Internship *1st - 31st August, 2015*

- Research subject: **Kuiper belt structure** mentored by Pedro Lacerda
  - N-body simulations of the Kuiper belt region with and without Nice model event
  - `MERCURY` and `REBOUND` integration packages used, along with `Fortran`, `C/C++` and `python` codes written for data analysis and visualization
  - Results: Here is a `link` to a small report

Petnica Science Center **Valjevo, Serbia**
Senior Teaching Assistant *2014-Present*

Petnica Science Center **Valjevo, Serbia**
High school student research *2011 - 2014*

- Research project name:
  Dynamical evolution of dust particles ejected from the surface of comets C/2012 S1 (ISON) and C/2011 W3(Lovejoy)
- Code: github repo `link`
- Results: `link` to a summary of research I wrote (abstract and figure captions are in English)
  - Modeling the comet's nucleus and the thermodynamical processes which lead to ejection of the dust particles
  - Writing an N-body integration code and ejection physics in `C/C++` with addition of `Matlab` for image processing

Computer skills

Proficient: `python`

Intermediate: `C/C++`, `bash`, `JAX`

Basic: `PyTorch`

Scientific Software: `R`, `Wolfram Mathematica`, `jupyter`

HPC libraries:

- Basic knowledge of `OpenMP`, `SLURM`

Awards

2018: "Best student research paper" award, awarded by the University of Belgrade

2018: "Zaharije Brkić" prize, awarded to the best astrophysics student of the generation 2017/2018

2014: 1st place at IEEESTEC 7th Student projects conference for the best graded paper (practical and theoretical realisation), held in Niš, Serbia

Grants and Scholarships

DAAD scholarship (2019 - 2020): Merit based scholarship awarded to foreign students studying in Germany

Dositeja fund (2018-2023): Merit based award of Serbian Ministry of education granted to students studying outside Serbia

Languages

•**Serbian**: Native speaker •**English**: Fluent •**German**: Intermediate

Interests

•Guitar, Violin and Piano •Composing music •Poetry •Tennis