Vanessa Martina Böhm

Berkeley Center for Cosmological Physics
Department of Physics
Univ. California, Berkeley
Berkeley, CA 94720

[vboehm@berkeley.edu]
[GITHUB]
[PUBLICATION LIST]

EDUCATION AND DEGREES

PhD - Ludwig-Maximilian University (LMU), Munich, Germany, July 2017

graduated *summa cum laude*

Master of Science (Physics)- Heidelberg University, Germany, July 2013

Graduation with *1.0* (4.0 in the US system)

RESEARCH

Postdoctoral Fellow

Nov 2017 - present, UC Berkeley

- novel machine learning methods specifically designed for scientific applications
  - robust generative models for sample generation and outlier detection
  - applications: mortality from COVID-19, robustness of ML-based estimators
  - efficient and computationally tractable Bayesian inference and uncertainty quantification (posterior analysis) for high dimensional data
- highly parallelized, non-linear and differentiable lensing simulations
- a fast code for computing higher order lensing corrections to correlation functions

PhD Candidate - Max-Planck Institute for Astrophysics, Garching, Germany

Oct 2013 - Oct 2017

- first algorithm for Bayesian weak lensing reconstruction featuring a non-linear forward model (in 10^6 dimensions)
- first to identify an important bias to CMB lensing measurements originating from the bispectrum of the lensing field
- a Bayesian, model independent approach to reconstruct the expansion history of the Universe

COMPUTATIONAL SKILLS

- Python, C++, PyStan
- tensorflow, keras, scikit learn
- pandas, dask, mpi4py
- git, anaconda, bash

TEACHING AND SUPERVISION

Student Supervision

- Graduate Students: Avirukt Mittal (Nov 2018 - present)
  towards optimal parameter extraction from non-Gaussian lensing maps with machine learning
- Undergraduate Students: Tess Werhane, Jamie Li, Lister Chen, Max Lee, Mrunal Puram
  (Oct 2019 - present)
  various projects, e.g. code development (differentiable simulations) and testing likelihood-free and ML based inference schemes.
- Master Students: Natalia Porqueres
  A Bayesian, non-parametric reconstruction of the cosmic expansion history (published, arxiv:1608.04007)
- Summer Students: Jean-Paul Breuer (2014)
  code development for CMB lensing reconstruction

Teaching and Mentoring

- Information Theory & Signal Reconstruction Tutorial, Ludwig-Maximilians-University Munich (LMU), summer term 2014
- Mentor for the Astrophysics and Environmental Physics Groups at the Heidelberg-Life-Science Lab, Heidelberg, 2007-2013

FELLOWSHIPS AND AWARDS

- Graduate Scholarship of the Max-Planck Society, 2013-2017
- Graduate Scholarship of the German Academic Exchange Service (DAAD), 2013
- Physical Review D editor's suggestion, August 2016, for *A bias to CMB lensing measurements from the bispectrum of large-scale structure*

SELECTED INVITED TALKS

- Physics & Astronomy Colloquium, UC Riverside, 05/202
- Applied Artificial Intelligence Initiative Seminar, UC Santa Cruz, 02/2020
- Stanford Cosmology Seminar, Stanford University, Stanford, CA, 11/2016
- Berkeley Cosmology Seminar, UC Berkeley, 11/2016

SELECTED CONTRIBUTED TALKS AND POSTERS

- Bayesian Deep Learning Workshop at NeurIPS 2019, Vancouver
  Deep uncertainty quantification with generative models (poster)
- Cosmology with CMB-S4, Princeton, 2018
  Higher order corrections to CMB lensing cross correlations (talk)
- The Non-Linear Universe Workshop, Smartno, Slovenia, 2017
  Bayesian weak lensing reconstruction with a lognormal field (talk)
- 51st Rencontre de Moriond 2016, Cosmology
  A bias to CMB lensing measurements from the bispectrum of large-scale structure (talk)

WORKSHOP ORGANIZATION AND SERVICE

- Co-organizer and chair of the BIDS Machine Learning and Science Forum (since Jan 2020)
- Co-organizer and chair of the weekly BCCP journal club (2018-2020)
- Co-Organizer of the 2nd *Non-Linear Universe Workshop*, Smartno, Slovenia, 2018 (joint workshop between Berkeley Center for Cosmological Physics and IAS Princeton)

OUTREACH

- Judge for 'Jugend Forscht', Germany's biggest youth science competition, 2014/2015/2016
- Mentor for various physics groups at the Heidelberg Life Science Lab, 2007-2013
- Selected Outreach Talks
  - QuarkNet Summer School, 2019
  - What's Up! Astronomy Talks at Berkeley Public Library, 2019
  - Open Day of the Max-Planck Institute for Astrophysics, 2017

PUBLICATIONS

Accepted

Böhm, V., Lanusse, F., & Seljak, U. (2019). Uncertainty Quantification with Generative Models. Bayesian Deep Learning Workshop at NeurIPS 2019, http://arxiv.org/abs/1910.10046

Böhm, V., Modi, C., & Castorina, E. (2020). Lensing corrections on galaxy-lensing cross correlations and galaxy-galaxy auto correlations. https://iopscience.iop.org/article/10.1088/1475-7516/2020/03/045

Böhm, V., Sherwin, B. D., Liu, J., Hill, J. C., Schmittfull, M., & Namikawa, T. (2018). On the effect of non-Gaussian lensing deflections on CMB lensing measurements. https://doi.org/10.1103/PhysRevD.98.123510

Böhm, V., Sherwin, B. D., Liu, J., Hill, J. C., Schmittfull, M., & Namikawa, T. (2018). On the effect of non-Gaussian lensing deflections on CMB lensing measurements. https://doi.org/10.1103/PhysRevD.98.123510

Böhm, V., Hilbert, S., Greiner, M., & Enßlin, T. A. (2017). Bayesian weak lensing tomography: Reconstructing the 3D large-scale distribution of matter with a lognormal prior. https://doi.org/10.1103/PhysRevD.96.123510

Böhm, V., Schmittfull, M., & Sherwin, B. D. (2016). A bias to CMB lensing measurements from the bispectrum of large-scale structure. https://doi.org/10.1103/PhysRevD.94.043519

Submitted

Böhm, V. and Seljak, U., Probabilistic Auto-Encoder, submitted to NeurIPS 2020

Modi, C., **Böhm, V.**, Ferraro, S., Seljak, U., Stein, G., Total COVID-19 Mortality in Italy: Excess Mortality and Age Dependence through Time-Series Analysis. https://www.medrxiv.org/content/10.1101/2020.04.15.20067074v2.full.pdf

In preparation

Böhm, V., Feng, Y., Dai, B., MADLens - a package for fast and differentiable non-Gaussian lensing simulations

Co-Authored

Liu, J., Hill, J. C., Sherwin, B. D., Petri, A., **Böhm, V.**, & Haiman, Z. (2016). CMB Lensing Beyond the Power Spectrum: Cosmological Constraints from the One-Point PDF and Peak Counts. https://doi.org/10.1103/PhysRevD.94.103501

Porqueres, N., Enßlin, T. A., Greiner, M., **Böhm, V.**, Dorn, S., Ruiz-Lapuente, P., & Manrique, A. (2016). Cosmic expansion history from SNe Ia data via information field theory -- the charm code. https://doi.org/10.1051/0004-6361/201629527

Dorn, S., Enßlin, T. A., Greiner, M., Selig, M., & **Boehm, V.** (2014). Signal inference with unknown response: Calibration-uncertainty renormalized estimator. https://doi.org/10.1103/PhysRevE.91.013311