Benjamin Thorne

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SPECIALIZATION

Computational astrophysicist with expertise in Bayesian inference, probabilistic machine learning, computer vision, signal processing, linear algebra and high performance computing. Extensive experience developing open source PYTHON projects and high performance scientific code in JULIA. Member of *South Pole Telescope* and BICEP / *Keck* collaborations, and previously *Simons Observatory* and *LiteBIRD* collaborations.

EDUCATION

PhD in Astrophysics, University of Oxford and Princeton University   Oct. 2015 – Jun. 2019
Challenges in Probing Inflation with Primordial Gravitational Waves

Master of Physics with first class honors, University of Oxford   Oct. 2011 – Jul. 2015

EXPERIENCE

Postdoctoral Research Scholar   *Jul. 2019 – Present*
University of California, Davis

- Developed generative machine learning models of 2D Galactic emission maps. Convolutional variational autoencoder and generative adversarial network were built in Tensorflow, and applied to Bayesian inverse problems in image reconstruction. *Paper*, *code*.
- Co-developed Bayesian inference pipeline for statistical analysis of high-resolution ($\sim 10^6$ pixel) astronomical images. Sampling implemented using automatic differentiation and CUDA-based GPU acceleration in JULIA. This pipeline will deliver the key science results of the ~ 50 person collaboration for future datasets. *In prep*, *code in private repository*.
- Developed a neural network emulator of a cosmological Boltzmann code in Tensorflow to accelerate sampling of high-dimensional cosmological models and save significant computational time and resources. *In prep*, *code in private repository*.
- Co-developed third public release of the `pysm` PYTHON package. Contributed to non-Gaussian foreground model development and model validation. *Paper*, *code*.
- Supervised two graduate students conducting projects in machine learning, and cosmological data analysis.
- Co-organized departmental seminar series.

Doctoral Researcher   *Oct. 2015 – Jun. 2019*
Princeton University, University of Oxford, University of Tokyo, Kavli IPMU

- Original author of widely-used (over 100 citations) open source PYTHON package, `pysm` (~ 1000's of lines). Crucial simulation software for scientific pipeline testing, designed to run on hundreds of nodes in high performance computing environments. This software now underpins CMB simulation pipelines for the *CMB Stage 4* collaboration and *Simons Observatory* collaboration, and is widely used by individual researchers in the community. *Paper*, *code*.
- Performed numerical calculations of theoretical predictions for astrophysical observables in a parity-violating cosmological model, and predicted the constraining power of the LISA laser interferometer, and LiteBIRD satellites for such a model. *Paper*.
- Developed Bayesian pixel-fitting code in PYTHON and applied it to forecast constraints on primordial gravitational waves from the *Simons Observatory*. *Paper 1*, *paper 2*, *code*.

SKILLS

- **Machine Learning**: *Coursera* Machine Learning Specialization. Generative machine learning in computer vision applications, variational autoencoder, GANs, normalizing flows.

- **Programming**: PYTHON: `numpy`, `scipy`, `scikit-learn`, `tensorflow`, `tensorflow-probability`, `jax`, `pytorch`, `dask`, `xarray`; JULIA: `CUDA.jl`, `Zygote.jl`; MATLAB; Unix and shell scripting; Git and CI/CD workflows, Docker.

- **Communication**: delivered invited and submitted talks at departmental seminars and conferences throughout academic career, as well as technical public talks through local *Astronomy on Tap* events and departmental outreach events.