Jonas Elias El Gammal

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Personal details

Born 04.05.1997 in Bochum, Germany

German and British nationalities

unmarried

Education

University of Insubria, Postdoctoral researcher 2024-today

- My task is to accelerate Pulsar Timing Array inference using GPUs and differentiable programming with `JAX` as part of the EPTA collaboration.

CERN, Visiting scientist 2024

- Three-month research visit to the CERN theory department as part of a mobility grant awarded by the Norwegian research council.
- Work with M. Pieroni and G. Franciolini on writing a data analysis pipeline for inferring second-order, scalar induced gravitational waves from inflation with LISA.

University of Stavanger, Research fellow/PhD candidate 2021 – 2025

- Title of PhD thesis: Cutting edge data analysis for gravitational wave detection with LISA. Research includes:
  - Observability of gravitational wave signals from scalar induced gravitational waves coming from ultra-slow roll inflation and non-standard thermal histories with LISA.
  - Accelerating Planck and LISA inference with machine learning.

Grenoble INP, PHELMA, ERASMUS semester 2019 – 2020

- Specialization in nuclear engineering (Génie énergétique et nucléaire)

RWTH Aachen University, M. Sc. in Physics 2018 – 2020

- Average grade: 1.3
- Specialization: Astroparticle physics and Cosmology
- Title of master thesis: Accelerating Bayesian Inference of expensive Likelihoods with Gaussian Processes
  Supervisors: Prof. J. Lesgourgues, Jesús Torrado

RWTH Aachen University, B. Sc. in Physics 2015 – 2018

- Average grade: 1.7
- Title of bachelor thesis: Investigation of Propagation Distances of Extragalactic Nuclei with CRPropa3 Simulations
  Supervisor: Prof M. Erdmann

Teaching Experience

Numerical Methods, full course, University of Stavanger 2023, 2024

- Bachelor-level course in numerical methods for Physics, Mathematics and Engineering. I taught the course twice.
- The course included an introduction to python programming, as well as several algorithms for numerical differentiation, integration, and for solving ODEs and PDEs.

Electromagnetism and Special Relativity, full course, University of Stavanger 2023

- Bachelor-level course in Electromagnetism and Special Relativity.
- The course followed the book by Purcell & Morin.

Data processing and experimental physics, tutor, RWTH Aachen University 2017-2019

- Three different tutoring jobs correcting exercises, presenting solutions and correcting exams for bachelor-level courses.

- Topics included, optics, quantum-, atomic- and nuclear physics, data processing and statistics.

Publications

Accelerating LISA inference with Gaussian processes Apr 2025

Jonas El Gammal, Riccardo Buscicchio, Jesús Torrado, Germano Nardini

ArXiv:2503.21871

Reconstructing Primordial Curvature Perturbations via Scalar-Induced Gravitational Waves with LISA Jan 2025

Jonas El Gammal et al. (LISA Cosmology Working Group)

ArXiv:2501.11320

Parallelized Acquisition for Active Learning using Monte Carlo Sampling May 2023

Jesús Torrado, Nils Schöneberg, ***Jonas El Gammal***

ArXiv:2305.19267

Fast and robust Bayesian Inference using Gaussian Processes with GPry Nov 2022

Jonas El Gammal, Nils Schöneberg, Jesús Torrado, Christian Fidler

ArXiv:2211.02045

Packages

GPry github.com/jonaselgammal/GPry

- A tool for accelerating Bayesian inference on expensive-to-compute likelihoods by interpolation the log-posterior with Gaussian Processes and active sampling.
- The algorithm works by
  - Creating a Gaussian Process surrogate of the log-posterior
  - Optimizing for a set of sampling locations using nested sampling reweighed by a reward function
  - Iteratively adding samples until the prediction matches the shape of the log-posterior.

SIGWAY github.com/jonaselgammal/SIGWAY (minimal public version)

- A tool for computing second-order scalar-induced gravitational waves from inflation.
- Contains modules for
  - solving the Mukhanov-Sasaki equation for single field ultra-slow roll inflationary models and computing the primordial scalar power spectrum $\mathcal{P}_\zeta$
  - computing the second order gravitational wave power spectrum $\Omega_{\rm GW}$ from $\mathcal{P}_\zeta$ for reentry during radiation domination or a phase of early matter domination.
  - interfacing to the LISA likelihood from ArXiv: 1906.09244
  - Scripts to run inference with (a) an inflationary potential, (b) a template function in $\mathcal{P}_\zeta$, (c) using a model-independent approach allowing for any shape of $\mathcal{P}_\zeta$.

I am the primary developer of both repositories.

Technologies

Programming languages: `python` (lately with a focus on `jax`), limited knowledge of `C++` and `R`

Technologies: git, ReadTheDocs, etc.

Languages

German: native, **English:** (almost) native, **French:** Fluent (B2/C1)

Personal interests

- (Extreme) sports: Hiking, Climbing, Mountaineering, Surfing, Skydiving, Skiing, ...
- Playing guitar and piano.
- Occasional shenanigans, see ArXiv: 2403.20219