Jonas El Gammal

Quantitative researcher | Scientific software developer | PhD in physics

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PROFILE

Quantitative researcher and scientific software developer working across probabilistic machine learning, Bayesian inference, and computational physics. I turn expensive mathematical models into tested, documented tools for inference and decision-making under uncertainty. My work spans method development, numerical implementation, validation, publication, and open-source delivery.

SELECTED TECHNICAL IMPACT

- Developed **GPry**, an active-learning Gaussian-process framework that reduced expensive posterior evaluations by roughly two orders of magnitude in published benchmark problems.
- Built and maintained open-source Python/JAX packages for surrogate inference, differentiable gravitational-wave modelling, astrophysical population simulation, and sampler interoperability.
- Build tool-using AI agents and agent loops with structured plans, deterministic validation, traceable execution, and bounded repair.
- Designed analyses that connect statistical assumptions to observable consequences, including calibrated tests of non-Gaussianity in pulsar-timing-array data.
- Teach and communicate technical material from Python and numerical methods to Bayesian inference and gravitational-wave data analysis.

EXPERIENCE

Postdoctoral Researcher - KBFI / NICPB, Tallinn 2026-present
- Research in gravitational-wave inference, cosmology, and scientific machine learning; develop reusable computational methods alongside domain analyses.

Postdoctoral Researcher - University of Insubria 2025-2026
- Developed GPU-accelerated and differentiable pulsar-timing-array inference with JAX in the EPTA collaboration.

Visiting Researcher - CERN 2024
- Developed a data-analysis pipeline for LISA, the ESA-led space-based gravitational-wave mission with NASA as a major partner.

SELECTED PROJECTS

GPry	Probabilistic ML	Gaussian-process surrogate modelling, failure classification, active learning, convergence diagnostics, and parallel acquisition for expensive Bayesian inference.
SIGWAY	Differentiable modelling	Modular JAX framework connecting primordial physics, cosmological kernels, numerical integration, and Bayesian reconstruction.
fastropop	Stochastic simulation	Reproducible simulation of black-hole-binary populations, spectra, and skymaps for population-level statistical studies.
Graphsmith	Reliable AI systems	Experimental typed graph planning with deterministic compilation, validation, local repair, and traceable execution.

METHODS AND TECHNOLOGY

Methods: Bayesian inference, Gaussian processes, active learning, uncertainty quantification, Monte Carlo methods, numerical optimisation, stochastic simulation, time-series and signal analysis, MCMC, nested sampling, differentiable programming, model validation.

AI systems: LLM agents, tool use, agent loops, multi-agent workflows, planning and execution, structured outputs, prompt and context design, validation, repair, tracing, and evaluation harnesses.

Engineering: Python, JAX, NumPy, SciPy, scikit-learn, PyTorch, TensorFlow, and C++; FastAPI and REST APIs; Svelte; Docker; OAuth/OIDC; encrypted data workflows; Git, Linux, CI/CD, HPC/GPU computing, testing, documentation, and releases.

EDUCATION

PhD in Physics - University of Stavanger 2021-2025
Developed Gaussian-process-accelerated Bayesian inference and primordial-spectrum reconstruction methods for LISA; taught full courses in Numerical Methods and Electromagnetism.

MSc and BSc in Physics - RWTH Aachen University 2015-2020
Astroparticle physics and cosmology; MSc thesis on Gaussian-process acceleration of expensive Bayesian inference.

LANGUAGES

German - native | **English** - near-native | **French** - B2/C1