

Tristan Hoellinger

Master's degree in Mathematics - PhD candidate in Cosmology at Institut d'Astrophysique de Paris

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Academic Employment

October 2023 - September 2026 **PhD Candidate**, *Institut d'Astrophysique de Paris (CNRS – Sorbonne Université)*, Paris, France
Title : Constraints on cosmological physics from cosmic web probes using Euclid data.
Subject : development of novel statistical tools to obtain constraints beyond state-of-the-art on Dark Energy and the sum of neutrino masses from cosmic web additional probes, i.e. galaxy clustering probes that are not standard correlation functions, while efficiently accounting for systematics. This involves using and extending advanced methods (SELI, BOLFI) to perform simulation-based inference of complex Bayesian hierarchical models while keeping the required number forward model evaluations tractable, and computational physics techniques to make these evaluations perfectly parallel (sCOLA).
Memberships : *Aquila Consortium* (2023-), *Euclid consortium* (?-)
Advisors : *Guilhem Lavaux* (CR CNRS INSU ; HDR) and *Florent Leclercq* (CR CNRS/INSU & INS2I).

Research Internships

March 2023 - July 2023 **Research Trainee in Cosmology**, *Institut d'Astrophysique de Paris*, Paris
Trainee in Cosmology in the "Large-scale structure and distant Universe" group at IAP. I studied novel simulation-based inference techniques to optimally extract cosmological information from astronomical data, while efficiently checking for systematics.
Advisors : *Florent Leclercq* & *Guilhem Lavaux*

February 2022 - February 2023 **Master thesis in Fluid Dynamics**, *ONERA - The French Aerospace Lab*, Châtillon
Research trainee in the NFLU (Digital methods for fluid dynamics) and MSAT (Advanced turbulence modelling and simulation) teams. I developed analytically and implemented in a 3d massively parallel discontinuous galerkine solver new arbitrary order confinement schemes to preserve vorticity in direct numerical simulations of turbulent flows. Advisor : *Jean-Baptiste Chapelier* & *Lucas Manuenco*.

September 2020 - January 2022 **Bioinformatics Scientist**, *Inserm, National Institute for Health and Medical Research*, Toulouse
In parallel to my Master's degree in Mathematics, I worked as a junior bioinformatics scientist at INSERM. I studied statistical learning and heuristic methods to predict enhancer-gene relations in the human genome, based on high-throughput data, with application to the detection of new variants potentially involved in haemochromatosis and complex genetic disorders. Advisor : *Sarah Djebali*.

July 2021 - August 2021 **Research Trainee**, *CRG - Centre for Genomic Regulation*, Barcelona (Spain)
Traineeship in Guigó's lab at CRG Barcelona. I created a Nextflow pipeline based on Surrogate Variable Analysis for the identification and analysis of genetic variants associated with intron retention estimated from RNA-sequencing in blood cell types from the European Blueprint Project. Advisor : *Diego Garrido*.

July 2020 **Research Trainee**, *IMT (Toulouse Mathematics Institute)*, Toulouse
Stochastic calculus. I studied recent theoretical developments about the convergence of repeated quantum non-demolition measurements. Advisors : *Tristan Benoist* and *Clément Pellegrini*.

April 2020 - June 2020 **Research Trainee**, *IRAP - Institut de recherche en astrophysique et planétologie*, Toulouse
French laboratory of space astrophysics operated by CNRS and Paul Sabatier University. I studied kinetic scale plasma turbulence in the solar wind. Advisor : *Philippe Louarn*.

June 2019 - **AI Trainee**, *Inria, National Institute for Research in Digital Science and Technology*, Strasbourg
August 2019 AI trainee in MIMESIS team. I analysed the robustness of a deep learning method for real-time data-driven biomechanical simulation, with respect to data sparsity and noises, in the context of real-time intraoperative augmented surgery. As a result, we implemented an efficient transfer learning solution to learn new patient-specific physical parameters with few data. Advisor : [Andréa Mendizabal](#).

Education

- 2023 - 2026 **PhD Candidate**, *Sorbonne Université (Institut d'Astrophysique de Paris)*, Paris, France
Title : [Constraints on cosmological physics from cosmic web probes using Euclid data](#).
- 2020-2022 **Double Master's degree in Mathematical Modelling**, *INSA Toulouse, ENSEEIHT*, Toulouse
This is a transversal curriculum leading to 2 MS degrees (*Diplômes d'ingénieur*) and built around 3 major axes : numerical mathematical modelling, statistical mathematical modelling, and artificial intelligence. Major scientific courses undertaken :
— deterministic and stochastic optimization, (variational) data assimilation, optimal control theory
— PDEs, finite volumes and galerkine methods, resolution of large linear systems, HPC
— signal/image and wavelets, advanced statistics, advanced and physically constrained machine learning
Master thesis : [Development of an arbitrarily high order Vorticity Confinement correction](#) for the discretization of Navier-Stokes equation by Discontinuous Galerkin Methods.
- 2019-2020 **Academic exchange and Research Internships**, *Paris-Saclay University*, Gif-sur-Yvette
I took a full year off with respect to my education in Mathematics at INSA Toulouse, in order to develop my knowledge of fundamental physics. I was enrolled in the selective *Magistère de Physique Fondamentale d'Orsay*, where I studied for one successful semester (hamiltonian mechanics, quantum mechanics, general relativity, cosmology, astrophysics, statistical physics, complex analysis). I completed my academic year with [2 internships in fundamental physics](#).
- 2016–2019 **Bachelor of Science**, *INSA Toulouse*, Toulouse
3-year preparatory cycle (Bachelor's degree) in Fundamental and Applied sciences, with emphasis on mathematics. Those 3 years are part of a highly selective 5-year curriculum leading to a *Diplôme d'ingénieur*.
- 2013–2016 **High school diploma in sciences**, *Lycée Charles-Emile Freppel*, Obernai
Highest Honors (18,1/20). Classical Latin, ancient Greek..

Languages

French	Mother Tongue	German	basic notions (A2)
English	Fluent (C2) - Cambridge Linguaskill Business : C1+ (highest score, 180+/180)		

Miscellaneous

- Former Mentor of 8 High School students for 6 month, in the context of the Equal Opportunity Program "Ô Talents", former President of the Theatre Troupe "La Catin"
- National scholarship holder during my studies (level 6/7)
- Attended the Summer School "Future Cosmology 2023" at IESC Cargèse
- Hobbies : photography, sport (martial arts, running, hiking, bouldering)

Concrete Skills in Applied Mathematics and Computer Science

Modelling and numerical simulation	solving PDEs and ODEs, finite volumes methods, (discontinuous) galerkin methods, dynamical systems, fluid dynamics, lagrangian perturbation theory	Generalities	Optimal control theory and (variational) data assimilation, signal and image processing, smooth / non-smooth and stochastic optimization, inverse problems
Statistics and machine learning	probability theory, (non-)parametric tests, metamodeling, stochastic processes, machine learning : kernel methods, boosting, neural networks (CNNs, recurrent networks, adversarial networks), variational data-assimilation networks, wavelet scattering transforms, reinforcement learning		

HPC solving large linear systems, multiprocessing, parallel computing (OpenMP, MPI)
Programming C++, Fortran, Python (JAX, scikit-learn, PyTorch, classy, multiprocessing), Julia
Others OpenMP, MPI, SLURM, Docker, AWS, Git, Github, Bitbucket, Google Colab, AWS

Publications

- As co-author : Data-driven simulation for augmented surgery, Andrea Mendizabal et al., 2020, Developments and Novel Approaches in Biomechanics and Metamaterials. Advanced Structured Materials, vol 132. Springer [10.1007/978-3-030-50464-9_5](https://doi.org/10.1007/978-3-030-50464-9_5)
- As principal author : Enhancer/gene relationships: need for more reliable genome-wide reference sets, T. Hoellinger et al., 2023, Front. Bioinform., Insights in Integrative Bioinformatics, [10.3389/fbinf.2023.1092853](https://doi.org/10.3389/fbinf.2023.1092853)

Referees

References available upon request.