Hubert Bretonnière

PhD student in Astrophysics and Cosmology

51-53 rue de Charonne
75011 Paris
France
+33 752 07 81 74
hubert.bretonniere@universite-paris-saclay.fr
hbretonniere.github.io

Professional Experience

2019–2022 **PhD in Astrophysics**, *Institut d'Astrophysique Spatiale*, Université Paris-Saclay.
Simulation of galaxies using a VAE, conditionned to physical parameters using a regressive flow (MADE). Implementation in the Euclid pipeline.
Adaptation of a Probabilistic U-Net for the probabilistic segmentation of overlapping astronomical objects. Data analysis of a high dimensional dataset. Development of an interactive tool for data visualisation and reproducibility.
Supervised by Marc Huertas-Company, Hervé Dole and Alexandre Boucaud, with long-term stays at IAC (Spain) and APC (France).

2019 **Three months internship**, *Institut d'Astrophysique de Paris*, Sorbonne Université.
Calibration of the charge transfer inefficiency for Euclid using Deep Learning algorithms (WGAN). Supervised by Henry J. McCracken and Tom Charnock.

2018 **Two months internship**, *LERMA*, Observatoire de Paris.
Study of the potential correlations between gas dynamics and stellar morphology in galaxies using random forests and convolutional neural networks (classifiers). Supervised by Marc Huertas-Company.

2015-2017 **Various internships (less than 3 months each)**, *IRAP*, *APC*, *MPQ*, Toulouse, Paris.
Verification of the universe accelerated expansion with supernovae. Study of the scanning strategy for LiteBird. Test of a mono-atomic layer machine.

Education

2017–2019 **Double Master's Degree in Astrophysics and Astronomy**, *Observatoire de Paris*.
Specialisation in Theory and Data Analysis for cosmology, plasma and galaxies.

2013–2017 **Bachelor Degree in Fundamental Physics**, *Université de Paris*.
Fundamental Physics and Engineering.

Publications

2021 **Euclid preparation: XIII. Forecasts for galaxy morphology with the Euclid Survey using Deep Generative Models**, *Euclid Collaboration: H.Bretonnière et al.*,
Reviewed and accepted by the Euclid Collaboration. Accepted for publication in Astronomy & Astrophysics.

2021 **Probabilistic segmentation of overlapping galaxies for large cosmological surveys**, *H.Bretonnière et al.*,
Refereed and accepted for the NeurIPS conference.

In prep **Euclid Preparation. Analysis of the Euclid Morphology Challenge**, *Euclid Collaboration: H.Bretonnière et al.*,
Simulation of realistic fields and analysis of the results of the Euclid Morphology Challenge. Development of a web page for interactive reproduction of the paper results.

Talks and Conferences

2021 **CNRS Astro-Informatics school**, *Classes*, November.
Introduction to deep generative models (VAE, GAN, Regressive Flows).

Debating the potential of machine learning in astronomical surveys, *Invited talk*, October.
Presentation of my expertise in developing Deep Learning tools for astronomical pipelines, with my work on simulation and probabilistic segmentation.

Euclid Consortium meeting, *Invited Talk*, May.
Forecast of Euclid capacities regarding galaxy morphologies.

2020 **Euclid France meeting**, *Short Talk*, November.
Deep learning generated galaxies with the FVAE.

European Astronomical Society annual meeting, *Poster*, June.
Simulation of realistic galaxies.

Bayesian Deep Learning workshop, *Poster*, March.
Probabilistic Segmentation of overlapping galaxies.

2019 **Euclid France meeting**, *Short Talk*, November.
The deblending problem for Euclid.

Mentoring

2021 **Engineering School student (6 months)**.
Main supervisor. Adptation of our VAE to produce multi-band simulations of galaxies.

2020 **Astrophysics Master's Degree student (6 months)**.
Co-supervisor. Use of VAE to cluster galaxy spectra in the latent space.

2020 **Astrophysics Master's Degree student (3 months)**.
Main supervisor. Understanding and use of Self Organizing Maps for galaxy catalogues comparison.

Computer science skills

Python Five-year experience with common scientific libraries (especially `numpy`, `scipy`, `astropy` and `pandas`) as well as typical machine learning frameworks (`scikit-learn`, `keras`, `tensorflow`). High interest in innovative ways for data visualisation and exploration (`matplotlib` animations, `streamlit`, `ipywidgets`).

ML/DL Strong expertise on generative and probabilistic models for image processing, built over several interships and PhD work. Adaptation of U-Nets, VAEs, Regressive Flows and SOMs for astrophysics projects. Development of GANs and WGANs from scratch in pure `tensorflow`.

Languages Familiarity with `bash` and `bash` scripting. Work on large clusters with job scheduling (with `slurm`).
Fortran90, C, C++: classes during Master's degree, used for short academic projects.

Software Daily basis: Jupyter, Visual Studio Code, LaTeX, Blender, Keynote.
Astrophysics: TOPCAT, SExtractor, Galapagos, Galsim.

OS macOS on laptop, Ubuntu, CentOS on servers.

Versioning Everyday use of Git for code development. Collaborative workflows on GitHub and GitLab.

Projects See some of my professional and personal projects on GitHub: https://github.com/Hbretonniere.

Languages

French Mother tongue.

English Full professional efficiency. TOEFL score: 103/120 (January 2019).

Spanish Good professional efficiency. Two years of practice working at IAC in Canary Islands.

Hobbies

Theatre Two years in a professional drama school, between 2016 and 2018.

Others Photography, literature, cinema, astronomy, tennis, chess, hiking.

References

Marc Huertas-Company, PhD, Researcher – mhuertas@iac.es, Instituto de Astrofísica de Canarias

Alexandre Boucaud, PhD, Research engineer – aboucaud@apc.in2p3.fr, Laboratoire AstroParticule & Cosmologie