

Hubert Bretonnière

Computer Scientist
specialised in Astrophysics

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Professional Experience

- 2019–2022 **PhD in Astrophysics**, [Institut d'Astrophysique Spatiale](#), Université Paris-Saclay.
Simulation of galaxies using a VAE, conditioned 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 correlation between gas dynamics and stellar morphology for 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.

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.

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. Submitted to Astronomy and Astrophysics.

- 2021 **Probabilistic segmentation of overlapping galaxies for large cosmological surveys**, *H. Bretonnière et al.*,
Refereed and accepted for the [NeurIPS](#) conference.

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 internships 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>.

Talks and Conferences

- Invited talks** *Euclid annual meeting* (2021). Presentation of my paper on the forecast of Euclid capacities regarding galaxy morphologies.
Debating the potential of Machine Learning in astronomical surveys (2021). Presentation of my PhD work.
- Short talks** *Euclid France meetings* (2019, 2020). Presentation of the galaxies generated by deep learning, and the probabilistic segmentation of overlapping galaxies.
- Posters** *Bayesian Deep Learning workshop* (2020): probabilistic segmentation of overlapping galaxies.
European Astronomical Society annual meeting (2020): simulation of realistic galaxies.

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, mountain bike, 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