# Morgan **Fouesneau**

**Astrophysicist | Data Scientist | Engineer | Project manager**

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*I am an astronomer and an engineer with 10+years of experience in terabyte data manipulation technologies, cloud computing, pipeline design, machine learning, as well as more than 5 years as a project manager in astronomy. In 2014, I joined the European Space Agency mission Gaia, where I lead a team of 40 scientists assessing the quality of the scientific products before their release to the community. I have also led the classification group in the 4MOST ground-based telescope project from the European Southern Observatory since 2016. I regularly contribute to many data modeling and probabilistic inference in computer science projects, organic components studies, particle detector calibration, and space weather applications. My personal research focuses primarily on where stars form in galaxies linking them to the cosmological context through their chemical patterns and dynamical properties.*

## Technical Expertise

| | |
|---|---|
| Software Development | </> **Python**, **C++**, **Java**, Javascript, CSS |
| Databases | MySQL, PostgreSQL |
| Tools | **IntelliJ Idea**, **Eclipse**, Maven, SVN, git |
| Operating Systems | |

## Skills

| | |
|---|---|
| Software development | ●●●●● |
| Machine learning | ●●●●● |
| Project management | ●●●●○ |
| Communication | ●●●●○ |

## Experience

**Since 2014** — **Postdoc | Gaia & 4MOST unit manager** — Max Planck Institute for Astronomy, Germany

- Leading validation of astrophysical parameter in the Gaia consortium (Coordination Unit 8)
- Consulting on the Gaia classification and spectral analysis development – DSC & GSP-Phot
- Leading the spectral classification unit and pipeline for the 4MOST observations
- Initiating and developing of the 4MOST classification pipeline – 4CP

Python · Java · C++ · IntelliJ Idea · Eclipse · HPC · Machine Learning · project management · databases

**2014 2011** — **Postdoc | Semi-resolved populations in galaxies** — University of Washington, WA, USA

"The Panchromatic Hubble Andromeda Treasury (PHAT)"

- Coordinating development of new inference methods of star and cluster formation histories
- Consulting on probabilistic analysis of stellar populations : initial mass function & extinction
- Leading computing resources transitions to national cluster (XSEDE), Amazon Cloud
- Co-leading the development of the Bayesian Extinction and Stellar Tool – BEAST
- Leading development the photometric tool PyPhot – PyPhot
- Consulting on "the Andromeda project" Zooniverse platform – andromeda-project

Python · C++ · Database · SQL · HPC · Cloud Computing · Citizen Science · Probabilistic Modeling

## Publications

**h-index** 34

- 56 refereed publications,
- 20 refereed publications from large collaborations,
- 1 Submitted publications,
- 32 conference contributions,
- 1 book participation
- 19 technical notes,
- 2 blog type publication : "Gaia image of the week",
- 1 press release,
- 49 Acknowledged contribs.,
- contributions to various codes (incl. 9 public.)

## Education

**2011** **Ph.D. in Astronomy** from the University of Strasbourg, France

- "Study of stellar cluster populations in galaxies, a Bayesian approach" manuscript

**2007** **Master degree in Astronomy** from the University of Strasbourg, France

- Master project with Matthew Ashby and Joseph Hora at CfA - Harvard on temporal analysis in the Spitzer's "IRAC calibration field" (IRACCF)

compact objects · high energy · galactic evolution · forward modeling · big data

**2007** **Engineer's degree** from the ENSPS/Superior & National School of Physics of Strasbourg, France

Fundamental physics · signal processing · parallel computing · databases · Engineering

## Participations in Inter-Disciplinary Research Projects

**2015 – 2013** | **Consulting Scientist | Calibration of the gamma ray detector AGATA** — **GSI, Germany**
*Ph.D project of Damian Ralet at the* The Helmholtz Centre for Heavy Ion Research
› Probabilistic calibration model of AGATA Ralet, Fouesneau et al. 2015
Python | Probabilistic Modeling | Machine Learning | Instrument Calibration | Nuclear Physics | High Energy

**2014 – 2013** | **Consulting Scientist | Machine learning to detect artifacts in astronomical images** — **UW, USA**
*Master project of Martina Unutzer & prof. Magdalena Balazinska* University of Washington
› RandomForest to detect cosmic ray artifacts Unutzer, Fouesneau et al. 2014
Computer Science | Image segmentation | Machine Learning | Distributed databases | Dashboard

**2014 – 2010** | **Consulting Scientist | Organic solar cells & Carbon Nanotube Networks** — **ICube, France**
*Collaboration with Dr. Yann Leroy at the* Ingineer, Informatics & Imaging Laboratory
› Stochastic model of physical parameters of organic solar cells Raba et al. 2017
› Probabilistic percolation modeling in Carbon Nanotube Networks Heitz et al. 2011
Python | Java | Comsol | Stochastic model | Monte-Carlo methods | probabilistic inference

**2009 – 2006** | **Consulting Engineer Scientist | Solar Weather Research** — **LESIA, France**
*Collaboration with Dr. Isabelle Scholl from* ISU/IfA *& Dr. Jean Aboudarham at* LESIA
› Automated detection and tracking of solar activity structures Aboudarham et al. 2008
Solar weather | feature tracking | Neural Networks | Probabilistic Inference | temporal analysis | IDL

## Detailed Tools Development & Activities

Most of my codes and tools are publicly available and maintained on my Github : mfouesneau
I give below a curated list of codes I developed that are widely used by the community.

| | |
|---|---|
| pyphot | **A tool for computing photometry from spectra dealing with units** |
| pystellibs | **Making synthetic spectra from spectral and atmosphere libraries** |
| ezData | **A column-based data manipulation and visualization framework.** |
| BEAST | **Bayesian Extinction and Stellar Tool** (Gordon, Fouesneau et al., 2016, ApJ, 826, 104) |
| ezpadova | **PADOVA isochrones**, a python interface to their website |
| ezmist | **MESA/MIST isochrones**, a python interface to their website |
| NUTS | **No-U-Turn Sampler (NUTS) for python**, an implementation of Hoffman & Gelman, (2011). |
| Faststats | **fast algorithms to do statistics on big data**, in python. |
| Sparsegrid | **Smolyak Sparse Grid Interpolation**, in python (Smolyak, 1963). |
| Arxiv on Deck | **A pythonic version of the Arxiver** for institutes or groups. |

Other code with significant contribution

| | |
|---|---|
| Chempy | Flexible one-zone open box chemical evolution modeling. |
| AstroML | Python module for Machine Learning for Astronomy (associated with the Book) |

## Teaching Activities

› statistics, machine learning, hierarchical modeling, programming, SQL, image processing.
**11h** lectures
**44h** lab classes
**level** master, PhD, & above.
(detailed list below)

## Mentoring and Supervision Activities

**5 Ph.D. Thesis** Sara Rezai-Kh. (MPIA, 2018); Yumi Choi (UW, 2016), Maria Kapala (MPIA, 2015), Cliff Johnson (UW, 2015), Lori Beerman (UW, 2015);
**1 Intern** Peter Senchyna (UW, undergraduate)
**1 Team lead** Automated solar activity detection (2009; 5 undergraduates; ENSPS)

## Languages

| | |
|---|---|
| French | Mother tongue |
| English | Fluent (C2) |
| German | Intermediate (B2) |

## Professional service and activities

- Co-organize the MPIA Königstuhl colloquium
- Co-lead a working group on career developement at MPIA
- Active Referee for the journals : A&A, ApJ, MNRAS, AJ.
- Co-organized 3 conferences : "Astronomical Time Series 2019" ; "Piercing the Galactic Darkness" (2017) ; "Astrophysical calibration of Gaia and other surveys" (2014) ; "Intermediate Mass Stars ↔ Massive Stars" (2009) ;
- Organized the workshop "Python for Astronomers and Curious" (2012)
- Outreach presentation : "Spectra of stars and stellar evolution" (2008)

## Detailed Teaching Activities

**2018 (3h)** — "A primer on Astrosatistics" — Winter School, Obergurgl, Germany
A short introduction to statistical methods and tutorials for Ph.D students. School page
Statistics | Probabilities | MCMC | blackboard lectures | python

**2017 (3h)** — "Star clusters in the Gaia era" — International School on Star Clusters, Zanjan, Iran
Good practice and statistical usage of the Gaia catalogs for undergraduate and Ph.D students.
School page
astronomy | statistics | Gaia | big data | astrometry | star clusters | lecture

**2016 (1h)** — "Hierarchical modeling of star cluster dissolution" — IMPRS school, Heidelberg, Germany
A concrete application to science of statistical methods for graduate students School page
Astronomy | statistical methods | hierarchical modeling | lecture

**2015 (24h)** — "Introduction to Bayesian statistics" — University, Heidelberg, Germany
collaboration with C.A.L. Bailer-Jones (MPIA), Lecture page
Creating lecture content, exercises, and final exam.
statistics | probabilities | lectures | lab class | exams | 2h × 12 weeks | spring semester

**2014 (2h)** — "Introduction to MCMC and Nested sampling" — "Gaia Challenge", 2014, Heidelberg, Germany
Pragmatic use of sampling methods for model fitting for researchers of all levels
Sampling methods | Differential Evolution | MCMC | nested sampling | lecture | blackboard

**2013 (2h)** — "Introduction to python and object-oriented programming" — UW, Seattle, USA
OOP code development in science applications for Ph.D students and scientists page link
created lecture & exams
Python | object-oriented programming | lecture | exams

**2010 (20h)** — Reduction of astronomical data — University, Strasbourg, France
Lectures to master level students preparing for an observing run. french slides
astronomy | data reduction | IRAF | python | imaging | lecture | lab

## References


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