

- Research interests:** computational and statistical modeling of complex systems.
- My original training is in quantum physics. My PhD research has been focused on developing quantum-based atom-optic metrology.
  - My current research is on building quantitative statistical and descriptive models of brain activity through functional imaging.
  - In addition, I have a keen interest in developing scientific-computing tools and software-engineering best practices.

## EDUCATION

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- PhD** 2005–2007 Université Paris Sud Orsay, FRANCE, direction: Pr. Alain Aspect, defense January 18, 2008.  
Thesis: [Atomic sources for long-time-of-flight interferometric inertial sensors](#)
- Masters** 2004 Masters in quantum physics (DEA de physique quantique, ENS)
- ENS** 2001–2004 Undergraduate studies at École Normale Supérieure Paris (ENS). I ranked 17<sup>th</sup> at the selection exam (also accepted at École Polytechnique, 13<sup>th</sup>, and École des Mines de Paris, 4<sup>th</sup>)

## NEUROIMAGING Positions

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2008—Present

- INRIA** Oct. 2008–Present Post-doctoral fellow, Parietal team, NeuroSpin, supervision: B. Thirion, J.P. Poline.  
Development of statistical methods to study brain resting-state activity.

## Research

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I develop algorithms and models for extracting salient and reproducible features from the correlation structure of functional MRI images without using a paradigm, such as in resting-state studies. I focus on group models, opening the door to between-subject comparisons.

- Spatial ICA** Spatial Independent Component Analysis is a widely-used technique in neuroimaging to extract brain networks. I have introduced a multivariate group model [1] to conduct multi-subject analysis with good reproducibility [2] and high sensitivity and specificity [3]. I am collaborating with A. Kleinschmidt on applying the method to the extraction of detailed resting-state networks [1], G. Deshaene-Lambert to apply it to the study of network development in young children, as well as with S. Deshaene and B. Jaraya to study consciousness in awake and sedated monkeys, as well as in coma patients.

- Graphical models** I have developed Gaussian graphical models to study the correlation structure of the brain-activity signal for statistically-controlled inter-subject or inter-group comparisons. With new task-specific comparison methods we have isolated memory-refresh tasks modifications of functional connectivity in schizophrenia in collaboration with C. Huron and M.L. Grillon [4]. With A. Kleinschmidt, we have the first time extracted modifications of resting-state networks due to pathologies on single subjects, a methodology that we have applied to stroke patients.

## Publications

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### Peer-reviewed journals

- [1] G. Varoquaux, S. Sadaghiani, *et al.* *A group model for stable multi-subject ICA on fMRI datasets*, Accepted for publication in *NeuroImage*.

### Peer-reviewed proceedings

- [2] G. Varoquaux, S. Sadaghiani, *et al.* *Model-based extraction of reproducible group-level ICA patterns from fMRI time series*, MICCAI 2009: fMRI data analysis workshop (2009)
- [3] G. Varoquaux, M. Keller, *et al.* *ICA-based sparse features recovery from fMRI datasets*, IEEE ISBI 2010.

### International conferences

- [4] G. Varoquaux, S. Sadaghiani, *et al.*, *Model-based extraction of resting-state networks across subjects*, *NeuroImage*, **47**, p. 82, (2009), presented at the annual Organization for Human Brain Mapping meeting (2009).
- [5] M.-L. Grillon, F. Charbonneau, *et al.*, *fMRI study of the Refreshing Process in Schizophrenia*, *NeuroImage*, **159**, proceedings of the 50th Annual Meeting of the Psychonomic Society (2009).

## Other

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Reviewer for *Human Brain Mapping* (Wiley InterScience) and *NeuroImage* (Elsevier).

**LENS Fellow** EST Marie Curie European Fellow: LENS (European laboratory for non-linear spectroscopy, Florence, ITALY), quantum degenerate gases group, supervision: prof. M. Inguscio.  
Nov. 2007–March 2008

**PhD candidate** Atom optics group, Institut d’Optique Graduate School, Palaiseau, FRANCE  
2005–2007

**University of Toronto** Guest researcher. Degenerate quantum gases group, prof. J. Thywissen. I implemented a new camera on the world’s first Fermi degenerate gas experiment on chip [14].  
Sept.–Oct. 2006

**Internships** University of Otago, ultra-cold atom group, supervision A. Wilson. Design and construction of a rubidium magneto-optical trap for a new atomic quantum gases experiment.  
Jan.–Aug. 2003

Sept.–Oct. 2002 University of Lancaster, liquid-<sup>4</sup>He group, supervision: prof. P. Mc Clintock. Cryogenic work.

## Research

Atoms are promising candidates to replace photons in interferometric measurements of inertial forces, due to their strong gravitational coupling. In my research, I have addressed two fundamental limits to the scale of atom interferometers: divergence and fall of the atomic source.

**Quantum atomic sources** I have contributed to experimental techniques for well-controlled production of quantum gases to create *atom lasers*, that is maximally coherent and focused atomic sources. New developments include development of light-weight noise-controlled tunable lasers [6], design of a new atom cooling and trapping apparatus [7], and a new atom probing and imaging method [10].

**Free-fall atom interferometry** The ICE project is a collaboration between Institut d’Optique, ONERA, and Observatoire de Paris for atom interferometry in microgravity using a freely-falling plane as a platform for longer interrogation times of falling atoms. I developed the mobile laboratory and atom interferometer for the first test flight (March 2007). I was coordinator of the flight campaign, including designing, planning, and supervising the assembly of the interferometer and the in-flight operations [8]. Our experiment was the second to ever achieve cold atoms in flight and the apparatus is now used in bi-annual measurement campaigns [11].

**Matter-wave interferometry measure and estimation** The phase measured by atom interferometry is directly linked to the inertial fields [9], but in a freely-falling plane these fields are confounded by acceleration noise. I have introduced Bayesian statistical modeling to atom-interferometric inertial sensing and shown that tests of general relativity are possible using a noisy platform [12].

## Other

**YAO conference** Member of the scientific and organizing committees of the European Young Atom Opticians conference “YAO2006” (J.B. Trebbia, G. Varoquaux and F. Arcara, *Nature Physics* **8**, p. 287, 2007).  
2006

**Teaching** *Monitorat*: teaching students labs and tutorials in optics and electronics, at the “*Institut d’Optique Graduate School*” (SupOptique).  
2005–2007

**Student supervision** I supervised the work of several students: 3 undergraduates, and 2 masters students, on experimental and numerical work.

## Publications

### Peer-reviewed journals

- [6] R. A. Nyman, G. Varoquaux, *et al.*, *Tapered-amplified AR-coated laser diodes for Potassium and Rubidium atomic-physics experiments*, *Review of Scientific Instruments* **77**, p. 033105 (2006)
- [7] R. A. Nyman, G. Varoquaux, *et al.*, *I.C.E.: a Transportable Atomic Inertial Sensor for Test in Microgravity*, *Journal of Applied Physics B*, **84** pp. 673-681 (2006)
- [8] G. Varoquaux, N. Zahzam, *et al.*, *ICE: an ultra-cold atom source for long-baseline interferometric inertial sensors in reduced gravity*, *Proceedings of the international Moriond meetings on gravitational waves and experimental gravity* (2007)
- [9] E. Varoquaux and G. Varoquaux, *The Sagnac effect in superfluids*, *Uspekhi Fizicheskikh Nauk*, **2** p. 217 (2008)
- [10] J. P. Brantut, J. F. Clément, *et al.*, *Light-shift tomography in an optical-dipole trap for neutral atoms*, *Physical Review A*, **78**, 031401 (2008)
- [11] G. Stern, B. Battelier, *et al.*, *Light-pulse atom interferometry in microgravity* *European Physical Journal D* **53**, 3 pp. 353-357 (2009)
- [12] G. Varoquaux, R. A. Nyman, *et al.*, *How to estimate the differential acceleration in a two-species atom interferometer to test the equivalence principle*, *New Journal of Physics* **11**, 113010 (2009)

## Conference proceedings

- [13] P. Bouyer, G. Varoquaux, *et al.*, *Testing the universality of free fall in a freely-falling two-species atom interferometer: the I.C.E project*, Proceedings of the International Conference on Space Optics, Toulouse, France, October 2008

## International conferences

- *Building a double-species slow atomic source*, EGC workshop, June 26-30, 2005, Gif sur Yvette, FRANCE
- *A source for coherent atom-interferometry in micro-gravity*, EGC workshop, July 11-14, 2006, Stirling, UK
- *ICE: towards long-baseline atom interferometry*, International Conference on Optics and Laser Spectroscopy, June 24-29, 2007, Telluride, CO, USA
- *Atomic sources for long-interrogation-time interferometric inertial sensors*, ATLAS Workshop, March 17-21, 2008, Vrije Universiteit Amsterdam, NETHERLANDS
- *Towards atom-interferometric inertial sensing in free fall*, New Frontiers in Micro and Nano Photonics, April 23-26, 2008, Florence, ITALY

## SCIENTIFIC COMPUTING

2005—Present

I have been contributing to the elaboration of a general-purpose tool stack for scientific computing, using the Python language. My effort is shared between software development and improving communication and cooperation between scientific software projects and users. The various projects are driven by an emphasis on communication, readability, and quality of the code for more reproducible science and sharing of efforts and idea across scientific fields.

### Positions

**Enthought, consultant** 2008  
Consultant on scientific computing solutions in Python for Enthought Inc. (Austin). I contributed to customer-specific data processing and visualization code and general-purpose scientific computing frameworks.

**UC Berkeley** June–Sept. 2008  
Junior specialist, scientific computing: development of NeuroImaging computing in Python (Nipy project), supervision: F. Perez.

### Computing skills

- Proficient developer, with a specialization in scientific computing and data visualization.
- Very good knowledge of the Python language. Knowledge of C and Matlab.
- Experience in software project management and software architecture design.
- Experienced Linux system administrator on servers and desktops since 2001.
- Very good knowledge of L<sup>A</sup>T<sub>E</sub>X and publishing technologies.

### Software

**Mayavi** 2007–Present  
One of the two developers of [Mayavi](#), the lead 3D scientific data visualization library and application for Python [15]. This project won the FOSS India awards in 2008, and the second price at the MICCAI 2009 visualization awards. It is packaged in all the major Linux distributions and scientific Python environments and comes with a [300-pages long manual](#).

**Pyreport** 2005–Present  
Author of [pyreport](#), a tool for literate programming of scientific Python code, widely used in teaching and tutorials.

**Nipy** 2008–Present  
Contributing to and maintaining [Nipy](#), a cross-institute project to share neuroimaging algorithms in Python via a consistent library (actors: CEA, INRIA, UC Berkeley, MIT, Stanford).

**joblib** 2009–Present  
Author of [joblib](#), metaprograming for light-weight pipelining of scientific Python code.

## SciPy community

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- EuroScipy conference** 2010 Co-chair of the 3rd European Python in science conference (EuroScipy), ENS, Paris, (FRANCE), July 8-11 2010.
- SciPy conference** 2008–2009 Chair of the scientific committee for the Python in science conference (SciPy), Caltech, Pasadena (USA), 2008 and 2009. Also organizer and editor of the proceedings.
- Code contributions** 2007–Present Contributions to various key projects (IPython, Matplotlib, numpy). In particular, development of the graphical frontend to IPython.
- Server administration** 2008–Present Administration of the SciPy web servers and documentation and conference applications: [www.scipy.org](http://www.scipy.org), [planet.scipy.org](http://planet.scipy.org), [conference.scipy.org](http://conference.scipy.org), [docs.scipy.org](http://docs.scipy.org).

## Publications

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### Peer-reviewed journals

- [14] G. Varoquaux, *Agile computer control of a complex experiment*, Computing in Science and Engineering, **10**(2) p. 55 (2008).

### Peer-reviewed proceedings

- [13] P. Ramachandran, G. Varoquaux, *Mayavi: Making 3D Data Visualization Reusable*, Proceedings of the 7th Python in Science conference, G. Varoquaux, T. Vaught, J. Millman (Eds.), pp. 51-56 (2008).
- [16] G. Varoquaux, T. Vaught, J. Millman (Eds), *Proceedings of the 7th Annual Python in Science Conference – Pasadena, CA, August 19-24, (2008)*
- [17] G. Varoquaux, S. van der Walt, J. Millman (Eds), *Proceedings of the 8th Annual Python in Science Conference – Pasadena, CA, August 18-23, (2009)*

### International conferences

- *mlab: a pylab-like interface to Mayavi2*, SciPy, Aug. 16-17 2007, CalTech, Pasadena, CA, USA
- *Mayavi and Python in science*, Open Knowledge conference, March 15 2008, London School of Economics, London, UK
- *Mayavi2: from easy interactive 3D visualization, to scripting, to application building*, EuroSciPy, July 25-26, 2009, Leipzig, GERMANY

## Other

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**Reviewer** Reviewer for *Computing in Science and Engineering* (AIP/IEEE).

**Teaching and training** I teach various aspects scientific computing in Python on a regular basis, both introduction courses, and advanced courses, in conferences (SciPy, PyConFr), or in research labs.

## CONTACT

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