

# Antoine Boulet

HIGHER EDUCATION TEACHER · PHYSICS, CHEMISTRY, MATHEMATICS, PROGRAMMING

ISMANS CESI, 44 avenue Frédéric Auguste Bartholdi, 72000 Le Mans, France

☎ (+33) 6 26 97 41 96 | ✉ antoine.boulet@protonmail.com | 🏠 antoineboulet.github.io | 📍 0000-0003-3839-6090

## References

Available upon request.

## Personal Details

### VITAL RECORD

- French citizen, married
- Born on March 30, 1993 [30 y/o] in Argentan (61), France

LANGUAGES *French (native), English (fluent)*

## Computer Skills

OPERATING SYSTEMS *MacOS, Unix, Microsoft Windows*

PROGRAMMING *Python, C/C++, Fortran, Mathematica*

HPC CODE *Contributor to the W-SLDA Toolkit*

GITHUB *<https://github.com/AntoineBoulet>*

### TECHNIQUES

- Monte Carlo methods (multi-dimensional integrals)
- numerical methods for optimization problems
- numerical methods for differential equations
- diagonalization of HFB-like kernel

## CNU qualifications

section 29 - elementary constituents

## Research Interests

My research interests as theoretical physicist are mainly focused on the quantum many-body problems and the development of non-empirical Density Functional Theories and their applications for nuclear and atomic physics.

### SYSTEMS

- atomic nuclei
- infinite nuclear matter, neutron stars
- ultracold atomic Fermi systems

### METHODS

- diagrammatic resummation
- path integral and effective action formalism
- regularisation/renormalisation methods

### THEORIES

- static and time-dependent Density Functional Theory (DFT)
- Effective Field Theory (EFT)
- Many-Body Perturbation Theory (MBPT)
- Variational Perturbation Theory (VPT)
- Superfluid Local Density Approximation (SLDA)

### STUDIES

- equation of states and thermodynamics
- linear response and hydrodynamical collective response
- self-energy and Landau-Fermi liquid theory
- structure and dynamics of superfluid vortices
- Higgs and Nambu-Goldstone collective modes
- quantum quench dynamics

## Professional Experiences

### RESEARCH

#### Faculty of Physics, Warsaw University of Technology

*Warsaw, Poland*

##### RESEARCH ASSOCIATE

*Feb. 2021 – Aug. 2022*

- development and implementation of an extended SLDA functional
- numerical simulation (static and dynamics) of fermionic superfluid systems
- help with thesis supervision of Andrea Barresi  
*Dissipative Dynamics of Quantum Vortices in Fermionic Superfluid, Phys. Rev. Lett. **130**, 043001 (2023)*

#### FRIB/NSCL, Michigan State University

*East Lansing, MI USA*

##### RESEARCH ASSOCIATE

*Nov. 2019 – Nov. 2020*

- development of microscopically-motivated DFT using *ab initio* theories and their implementation for large-scale calculations of nuclei

#### IPN Orsay, Paris-Sud University

*Orsay, France*

##### PH.D. STUDENT

*Oct. 2016 – Oct. 2019*

- development of DFT for Fermi systems with large s-wave scattering length and application to atomic and nuclear physics

### TEACHING

#### ISMANS CESI engineering school

*Le Mans, France*

##### HIGHER EDUCATION TEACHER

*Sep. 2022 – now*

- head teacher for the integrated preparatory cycle (undergraduate) [from Sep. 2022 to Aug. 2023]
- undergraduate and graduate physics, chemistry, mathematics, and programming education (600 h/y)

## IUT Orsay, Paris-Saclay University

GRADUATE TEACHING ASSISTANT

Orsay, France

Sep. 2017 – Aug. 2019

- Directed Studies: electromagnetism (36 h) and metrology, quality, statistics (12 h)
- Practical Works: metrology, quality, statistics (68 h) and chains of measurement, control, tests (12 h)

## Education & Diplomas

---

### Paris-Saclay University

IPN Orsay

PH.D. THEORETICAL PHYSICS

2019

- Title: *Density Functional Theory for Fermi systems with large s-wave scattering length: application to atomic and nuclear physics*
- Advisor: D. Lacroix
- Jury: G. Colò, D. Davesne, M. Grasso, D. Lacroix, D. Petrov, A. Rios Huguet, and V. Somà

### Paris-Saclay University

Various universities in Ile de France

M.SC. FUNDAMENTAL CONCEPTS OF PHYSICS

2016

- ICFP master program, condensed matter physics speciality

### Paris-Sud University

UFR sciences Orsay

B.SC. FUNDAMENTAL PHYSICS

2014

- *Magistère* of fundamental physics

## Outreach & Professional Developments

---

### PRESIDENT OF THE END-OF-STUDIES INTERNSHIP JURY

2022 **ISMANS CESI - Mechanics engineering cycle**, 1 student (F. Tadjouzem Zomo)

Le Mans, France

### MEMBER OF THE END-OF-STUDIES INTERNSHIP JURY

2023 **ISMANS CESI - Materials engineering cycle**, 2 students (C. Jililot, G. T. Prévot)

Le Mans, France

2022 **ISMANS CESI - Materials engineering cycle**, 3 students (P. Cornueil, A. Derouet, F. Rosier)

Le Mans, France

### ADMINISTRATIVE RESPONSIBILITY

2023 **Working groups member**, preparation of the *Commission des Titres d'Ingénieur* (CTI) audit at ISMANS CESI engineering school

2023 **Working groups member**, establishment of a quality system at ISMANS CESI engineering school

### SERVICE AND OUTREACH

2023 **Organizing Committee Member**, introduction to research for engineering students at ISMANS CESI engineering school

2022 **Committee Member**, International Experience at WUT

2018 **Organizer**, Welcome day for new entrants at IPN Orsay

2017 **Organizing Committee Member**, PHENIICS doctoral school conference

### DOCTORAL SCHOOLS

2018 **Doctoral School of the GGI for Theoretical Physics**, Frontiers in Nuclear and Hadronic Physics

Florence, Italy

2017 **ECT\* Doctoral Training Program**, Microscopic Theories of Nuclear Structure, Dynamics, and Electroweak Currents

Trento, Italy

### RESEARCH INTERNSHIPS

#### LPTMS, Paris-Sud University

Orsay, France

M.SC. TRAINING STUDIES

2 months, 2016

- Title: *Separation of Variables and Correlation Functions of Quantum Integrable Systems*
- Advisor: V. Terras

#### QGLab, University of Nottingham

Nottingham, UK

M.SC. TRAINING STUDIES

3 months, 2015

- Title: *Hydrodynamic simulation of rotating black holes*
- Advisor: S. Weinfurter

## LPT, Paris-Sud University

B.SC. TRAINING STUDIES

- Title: *Weak interaction and CP symmetry violation: mesons mixing*
- Advisor: S. Descotes-Genons

Orsay, France

2 months, 2014

## GANIL

B.SC. TRAINING STUDIES

- Title: *Persistence of magic numbers far from stability*
- Advisor: J.-C. Thomas

Caen, France

2 weeks, 2013

## Publications

---

### PUBLISHED

- A. Barresi, **A. Boulet**, G. Wlazłowski, and P. Magierski, *Sci. Rep.* **13**, 11285 (2023).  
*Generation and decay of Higgs mode in a strongly interacting Fermi gas*
- A. Barresi, **A. Boulet**, P. Magierski, and G. Wlazłowski, *Phys. Rev. Lett.* **130**, 043001 (2023).  
*Dissipative Dynamics of Quantum Vortices in Fermionic Superfluid*
- A. Boulet**, G. Wlazłowski, and P. Magierski, *Phys. Rev. A* **106**, 013306 (2022).  
*Local energy density functional for superfluid Fermi gases from effective field theory*
- A. Boulet** and D. Lacroix, *J. Phys. G: Nucl. Part. Phys.* **46**, 105104 (2019).  
*Approximate self-energy for Fermi systems with large s-wave scattering length: A step towards density functional theory*
- A. Boulet** and D. Lacroix, *Phys. Rev. C* **97**, 6337 (2018).  
*Static response, collective frequencies, and ground-state thermodynamical properties of spin-saturated two-component cold atoms and neutron matter*
- D. Lacroix, **A. Boulet**, M. Grasso, and C.-J. Yang, *Phys. Rev. C* **95**, 22726 (2017).  
*From bare interactions, low-energy constants, and unitary gas to nuclear density functionals without free parameters: Application to neutron matter*

### THESIS

- A. Boulet**. Ph.D. thesis, Paris-Saclay University (2019). ⟨NNT: 2019SACLS212⟩ ⟨tel-02355418⟩  
*Density functional theory for Fermi systems with large s-wave scattering length: Application to atomic and nuclear physics*

### OTHERS

- A. Barresi, **A. Boulet**, *Bulletin of the American Physical Society* **66**, 6 (2021).  
*Dipole collision and energy dissipation in 2D Unitary Fermi Gases and BCS*

### IN PREPARATION

- A. Boulet** and R. Photopoulos  
*Many-body perturbation theory for strongly correlated effective Hamiltonians using effective field theory method*

## Presentations

---

### CONFERENCES

#### INT program, University of Washington

Seattle, WA USA

NUCLEAR STRUCTURE AT THE CROSSROADS

2019

*Approximate self-energy for Fermi systems with large s-wave scattering length: A step towards density functional theory*

#### GANIL symposium

Caen, France

NUCLEAR STRUCTURE AND REACTIONS: THE NEXT SIGNIFICANT BREAKTHROUGHS

2019

*Quasi-particle properties of Fermi gas from low density to unitary limits*

### WORKSHOPS

#### IPN Orsay, Paris-Sud University

Orsay, France

BRIDGING NUCLEAR AB-INITIO AND EDF THEORIES

2017

*Static and dynamical responses of neutron systems*

## SEMINARS

### **Hadron and Nuclear Theory group, University of Barcelona**

Barcelona, Spain

SEMINAR

2022

*Towards ab initio Density Functional Theory from atomic to nuclear systems*

### **Nuclear Theory Group, Warsaw University of Technology**

Warsaw, Poland

SEMINAR

2020

*Density Functional Theory for Fermi systems with large s-wave scattering length: application to nuclear and atomic physics*

### **FRIB/NSCL, Michigan State University**

East Lansing, MI USA

RESEARCH DISCUSSION

2020

*Variational Perturbation Theory for Density Functional Theory:*

*Towards a systematic improvement of the Hartree-Fock-Bogoliubov approximation*

### **IPN Orsay, Paris-Saclay University**

Orsay, France

PH. D. DEFENSE

2019

*Density functional theory for Fermi systems with large s-wave scattering length: application to atomic and nuclear physics*

### **DPhN/IRFU, CEA Saclay**

Orme des Merisiers, France

SNIF MEETING

2019

*Connecting EFT to DFT for strongly interacting fermions*

### **IPN Orsay, Paris-Sud University**

Orsay, France

THEORY GROUP SEMINAR

2019

*Quasi-particle properties of Fermi gas from low density to unitary limits*

### **ECT\* Doctoral Training Program**

Trento, Italy

MICROSCOPIC THEORIES OF NUCLEAR STRUCTURE, DYNAMICS, AND ELECTROWEAK CURRENTS

2017

*Density Functional Theory based on bare interaction: from ultra-cold atoms to nuclear matter*

## POPULARIZATIONS

### **LAL, Paris-Sud University**

Orsay, France

PHENIICS FEST

2018

*Bridging nuclear ab-initio methods and Energy Density Functional Theories: from ultracold atoms to nuclear matter*

### **IPN Orsay, Paris-Sud University**

Orsay, France

DOCTORAL STUDENT SEMINAR

2018

*Bridging nuclear ab-initio methods and Energy Density Functional Theories: from ultracold atoms to nuclear matter*