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Guillaume Hupin

Nationality :French
Current position:Staff scientist

Education & Research Experience

2017– **Staff scientist**, CNRS

2015–2017 **PostDoc**, "Towards description of resonances within the MPMH method and improved mean field interactions using renormalized chiral interactions", **Collaborator**: Dr. habil. Nathalie Pillet
CEA bruyères-le-châtel, Arpajon, France.

2015–2015 **Visiting Scholar**, "Effective field theory of infinite nuclear matter connecting *ab initio* to EDF methods", **Collaborator**: Dr. habil. Denis Lacroix
IPN Orsay, CNRS/IN2P3, France.

2012–2014 **PostDoc**, "Study of the effects of the chiral three-nucleon interaction in light-nuclei reactions within the *ab initio* No-Core Shell Model combined with the Resonating Group Method", **Collaborator**: Dr. Sofia Quaglioni
Lawrence Livermore National Laboratory (LLNL), California USA.

2008–2011 **Ph.D.**, *Theoretical Nuclear Physics*, "Functional Approach of Pairing in Nuclei", (with highest honors), **Supervisor**: Dr. habil. Denis Lacroix
University of Caen Basse-Normandie– Grand Accélérateur National d'Ions Lourds (GANIL), Caen, France.

2007–2008 **Master of Physics**, *Section Condensed Matter and Radiation*, (with distinction)
University Joseph Fourier, Grenoble, France.

2006–2008 **Master of Engineering**, *Section Functional Materials and Nanotechnology*, (with high distinction)
École Nationale Supérieure de Physique de Grenoble (INPG-Phelma), Grenoble, France.

2005–2006 **Bachelor of Engineering**, *Section Physics*, (with distinction)
École Nationale Supérieure de Physique de Grenoble (INPG-Phelma), Grenoble, France.

2003–2005 **Classes préparatoires aux grandes écoles**, *Section Mathematics and Physics*
Lycée de Kérichen, Brest, France.

2003 **Baccalauréat**, *Section Sciences*, (with high distinction)
Lycée Charles de Foucauld, Brest, France.

Research Interests

- How to derive a modern mean-field from first principles ?
- Nuclei, an open quantum laboratory to study emergence of universality

- Nuclear reactions and structure for Astrophysics and exotic nuclei in *ab initio* No-Core Shell Model with Continuum method
- Nuclear interaction from first principles using Effective Field Theory

Funding and Support

ANR JCJC Nectar — Our goal is to work out the annihilation properties of antiprotonic atoms up to the first halo nuclei starting from the interactions between nucleons and nucleon-antinucleon with *ab initio* methods

Fellowship des 2 infinis — The aim of the thesis project is to develop the *ab initio* tools for studying the emission of 2p clusters, charged breakup and to participate to the modeling effort of beta-delayed particle emission

References

- **Dr. Sofia Quaglioni**
  LLNL, PO Box 808 L-414, Livermore, CA, 94551 USA
  ✉ quaglioni1@llnl.gov
  ☎: +1 (925)-422-8152
- **Dr. habil. Denis Lacroix**
  IPN, 15 rue Georges Clémenceau, 91406 ORSAY Cedex, France
  ✉ lacroix@ipno.in2p3.fr
  ☎: +33 (0)1 69 15 71 51
- **Dr. Petr Navrátil**
  TRIUMF, 4004 Wesbrook Mall, Vancouver, BC V6T 2A3, Canada
  ✉ navratil@triumf.ca
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- **Dr. habil. Nathalie Pillet**
  CEA/DIF, Bruyères-le-Châtel, 91297 ARPAJON Cedex
  ✉ nathalie.pillet@cea.fr

Other Scientific Experience

Master Thesis

May – Sept 2008 — **Exact Quantum Monte-Carlo for Open Quantum System dynamics**

Supervisor — **Dr. habil. Denis Lacroix**

Laboratory — **GANIL**, *Caen*

One of the challenges in the dynamics of a nuclear system coupled to its internal degrees of freedom, is to incorporate memory effects. In this work, a novel method that treats the dynamics with a Quantum Monte-Carlo sampling has been applied to an harmonic and inverted harmonic potential. A comparison to well known techniques has been done to assess the effectiveness of the theory. Generalization of the method to any kind of potential revealed numerical instabilities which have not yet been solved.

Training period

May – Sept 2007 — **Electrospinning of nanowires**

Supervisor **PD Dr. Alexander Bittner**

Laboratory **Max Planck Institute for Solid State research**, *Stuttgart*
Electrospinning is a technique to draw nanoscale fibers from a charged liquid. The goal of the internship was to make the first investigation on metal electrospinning. A new setup was built that was fitted for high temperature and high voltage, but it was not possible to draw firm conclusions.

Science outreach and Professional Activities

2016- **Reviewing**, *Grant for the Polish National Science Center, Physical Review Letters, Physical Review C, European Physical Journal A, Springer Nature academic journal*

Nov 2010 **Atelier du Chercheur**, *Science outreach certification*
Outreach training and physics lectures for high school students during the French science fair.

2009-2011 **Student seminar organizer at GANIL**

Languages

French Native

English Bilingual

German Basic

Computer Skills

Languages Fortran, MPI, OpenMP, OpenACC, Shell Unix, `C`, `C++`, Julia and Python

Graphics GLE, Gnuplot, Grace, Python

Office Latex, OpenOffice, MS Office

High performance computing and profiling tools

Publications

Articles Published in Refereed Journals

[1] J. Carbonell, G. Hupin, and S. Wycech, "Comparison of $\bar{N}N$ optical models," *Eur. Phys. J. A*, vol. 59, p. 259, nov 2023.

[2] P. Gysbers, P. Navratil, K. Kravvaris, G. Hupin, and S. Quaglioni, "Ab initio investigation of the ^{7}Li$(p, e^{+}e^{-})^{8}$Be process and the X17 boson," aug 2023.

[3] C. Hebborn, G. Hupin, K. Kravvaris, S. Quaglioni, P. Navrátil, and P. Gysbers, "Ab Initio Prediction of the ^{4}He (d,γ) ^{6}Li Big Bang Radiative Capture," *Phys. Rev. Lett.*, vol. 129, p. 042503, jul 2022.

[4] M. C. Atkinson, P. Navrátil, G. Hupin, K. Kravvaris, and S. Quaglioni, "Ab initio calculation of the β decay from ^{11}Be to a ^{10}Be+p resonance," *Phys. Rev. C*, vol. 105, p. 054316, may 2022.

[5] T. Aumann, W. Bartmann, O. Boine-Frankenheim, A. Bouvard, A. Broche, F. Butin, D. Calvet, J. Carbonell, P. Chiggiato, H. De Gersem, R. De Oliveira, T. Dobers, F. Ehm, J. F. Somoza, J. Fischer, M. Fraser, E. Friedrich, A. Frotscher, M. Gomez-Ramos, J. L. Grenard, A. Hobl, G. Hupin, A. Husson, P. Indelicato, K. Johnston, C. Klink, Y. Kubota, R. Lazauskas, S. Malbrunot-Ettenauer, N. Marsic, W. F. O Müller, S. Naimi, N. Nakatsuka, R. Necca, D. Neidherr, G. Neyens, A. Obertelli, Y. Ono, S. Pasinelli, N. Paul, E. C. Pollacco, D. Rossi, H. Scheit, M. Schlaich, A. Schmidt, L. Schweikhard, R. Seki, S. Sels, E. Siesling, T. Uesaka, M. Vilén,

M. Wada, F. Wienholtz, S. Wycech, and S. Zacarias, "PUMA, antiProton unstable matter annihilation: PUMA collaboration," *Eur. Phys. J. A*, vol. 58, p. 88, may 2022.

[6] K. Kravvaris, P. Navrátil, S. Quaglioni, C. Hebborn, and G. Hupin, "Ab initio informed evaluation of the radiative capture of protons on ^{7}Be," *Phys. Lett. Sect. B Nucl. Elem. Part. High-Energy Phys.*, vol. 845, p. 138156, oct 2023.

[7] C. McCracken, P. Navrátil, A. McCoy, S. Quaglioni, and G. Hupin, "Microscopic investigation of the ^{8}Li (n,γ) ^{9}Li reaction," *Phys. Rev. C*, vol. 103, p. 035801, mar 2021.

[8] R. J. Charity, T. B. Webb, J. M. Elson, D. E. Hoff, C. D. Pruitt, L. G. Sobotka, P. Navrátil, G. Hupin, K. Kravvaris, S. Quaglioni, K. W. Brown, G. Cerizza, J. Estee, W. G. Lynch, J. Manfredi, P. Morfouace, C. Santamaria, S. Sweany, M. B. Tsang, T. Tsang, K. Zhu, S. A. Kuvin, D. McNeel, J. Smith, A. H. Wuosmaa, and Z. Chajecki, "Using spin alignment of inelastically excited nuclei in fast beams to assign spins: The spectroscopy of O 13 as a test case," *Phys. Rev. C*, vol. 104, p. 024325, aug 2021.

[9] D. Carbone, A. Bonaccorso, F. Cappuzzello, M. Cavallaro, G. Hupin, P. Navrátil, and S. Quaglioni, "Transfer to the continuum of ^{11}Be with the application of ab-initio S-matrix," *J. Phys. Conf. Ser.*, vol. 1643, p. 012119, dec 2020.

[10] G. Hupin, S. Quaglioni, and P. Navrátil, "Ab initio predictions for polarized deuterium-tritium thermonuclear fusion," *Nat. Commun.*, vol. 10, p. 351, dec 2019.

[11] A. Bonaccorso, F. Cappuzzello, D. Carbone, M. Cavallaro, G. Hupin, P. Navrátil, and S. Quaglioni, "Application of an ab initio S matrix to data analysis of transfer reactions to the continuum populating ^{11}Be," *Phys. Rev. C*, vol. 100, p. 024617, aug 2019.

[12] M. Vorabbi, P. Navrátil, S. Quaglioni, and G. Hupin, "^{7}Be and ^{7}Li nuclei within the no-core shell model with continuum," *Phys. Rev. C*, vol. 100, p. 024304, aug 2019.

[13] M. Vorabbi, A. Calci, P. Navrátil, M. K. Kruse, S. Quaglioni, and G. Hupin, "Structure of the exotic ^{9}He nucleus from the no-core shell model with continuum," *Phys. Rev. C*, vol. 97, p. 034314, mar 2018.

[14] S. Quaglioni, C. Romero-Redondo, P. Navrátil, and G. Hupin, "Three-cluster dynamics within the ab initio no-core shell model with continuum: How many-body correlations and α clustering shape ^{6}He," *Phys. Rev. C*, vol. 97, p. 034332, mar 2018.

[15] F. Raimondi, G. Hupin, P. Navrátil, and S. Quaglioni, "^{7}Li(d,p)^{8}Li transfer reaction in the NCSM/RGM approach," *J. Phys. Conf. Ser.*, vol. 981, p. 012006, mar 2018.

[16] A. Kumar, R. Kanungo, A. Calci, P. Navrátil, A. Sanetullaev, M. Alcorta, V. Bildstein, G. Christian, B. Davids, J. Dohet-Eraly, J. Fallis, A. T. Gallant, G. Hackman, B. Hadinia, G. Hupin, S. Ishimoto, R. Krücken, A. T. Laffoley, J. Lighthall, D. Miller, S. Quaglioni, J. S. Randhawa, E. T. Rand, A. Rojas, R. Roth, A. Shotter, J. Tanaka, I. Tanihata, and C. Unsworth, "Nuclear Force Imprints Revealed on the Elastic Scattering of Protons with ^{10}C," *Phys. Rev. Lett.*, vol. 118, p. 262502, jun 2017.

[17] N. Pillet, C. Robin, M. Dupuis, G. Hupin, and J. F. Berger, "The self-consistent multiparticle-multihole configuration mixing: Motivations, state of the art and perspectives," *Eur. Phys. J. A*, vol. 53, no. 3, 2017.

[18] A. Calci, P. Navrátil, R. Roth, J. Dohet-Eraly, S. Quaglioni, and G. Hupin, "Can Ab Initio Theory Explain the Phenomenon of Parity Inversion in ^{11}Be ?," *Phys. Rev. Lett.*, vol. 117, p. 242501, dec 2016.

[19] C. Romero-Redondo, S. Quaglioni, P. Navrátil, and G. Hupin, "How Many-Body Correlations and α Clustering Shape ^{6}He," *Phys. Rev. Lett.*, vol. 117, p. 222501, nov 2016.

[20] P. Navrátil, S. Quaglioni, G. Hupin, C. Romero-Redondo, and A. Calci, "Unified ab initio approaches to nuclear structure and reactions," *Phys. Scr.*, vol. 91, p. 053002, may 2016.

[21] J. Dohet-Eraly, P. Navrátil, S. Quaglioni, W. Horiuchi, G. Hupin, and F. Raimondi, "^{3}He(α,γ)^{7}Be and ^{3}H(α,γ)^{7}Li astrophysical S factors from the no-core shell model with continuum," *Phys. Lett. Sect. B Nucl. Elem. Part. High-Energy Phys.*, vol. 757, pp. 430–436, jun 2016.

[22] G. Hupin, S. Quaglioni, and P. Navrátil, "Unified description of ^{6}Li structure and deuterium-^{4}He dynamics with chiral Two- and Three-nucleon forces," *Phys. Rev. Lett.*, vol. 114, p. 212502, may 2015.

[23] J. Langhammer, P. Navrátil, S. Quaglioni, G. Hupin, A. Calci, and R. Roth, "Continuum and three-nucleon force effects on ^{9}Be energy levels," *Phys. Rev. C - Nucl. Phys.*, vol. 91, p. 021301, feb 2015.

[24] C. Romero-Redondo, S. Quaglioni, P. Navrátil, and G. Hupin, "^{4}He +n+n continuum within an Ab initio framework," *Phys. Rev. Lett.*, vol. 113, p. 032503, jul 2014.

[25] G. Hupin, S. Quaglioni, and P. Navrátil, "Predictive theory for elastic scattering and recoil of protons from ^{4}He," *Phys. Rev. C - Nucl. Phys.*, vol. 90, p. 061601, dec 2014.

[26] G. Hupin, J. Langhammer, P. Navrátil, S. Quaglioni, A. Calci, and R. Roth, "Ab initio many-body calculations of nucleon-^{4}He scattering with three-nucleon forces," *Phys. Rev. C - Nucl. Phys.*, vol. 88, p. 054622, nov 2013.

[27] G. Hupin and D. Lacroix, "Number-conserving approach to the pairing problem: Application to Kr and Sn isotopic chains," *Phys. Rev. C - Nucl. Phys.*, vol. 86, p. 024309, aug 2012.

[28] G. Hupin and D. Lacroix, "Description of pairing correlation in many-body finite systems with density functional theory," *Phys. Rev. C - Nucl. Phys.*, vol. 83, p. 024317, feb 2011.

[29] G. Hupin, D. Lacroix, and M. Bender, "Formulation of functional theory for pairing with particle number restoration," *Phys. Rev. C - Nucl. Phys.*, vol. 84, p. 014309, jul 2011.

[30] G. Hupin and D. Lacroix, "Quantum Monte Carlo method applied to non-Markovian barrier transmission," *Phys. Rev. C - Nucl. Phys.*, vol. 81, p. 014609, jan 2010.

Seminars and contributions

Invited talks

- "*Ab Initio* description of thermonuclear fusion reactions" at the "36th Mazurian Lakes Conference on Physics", (Mazurian Lakes, Poland), *2 – 7 September 2019*.

- "Unified nuclear structure and reactions: from *ab initio* to EDF" at the internatinal workshop "IVth Topical Workshop on Modern Aspects in Nuclear Structure The Many Facets of Nuclear Structure", (Bormio Italy), *20 – 24 February 2018*.

- "*Ab Initio* Structure and Reactions of Light Nuclei" at the international conference DREB 2016 , (Halifax Canada), *11 July 2016*.

- "Nuclear Structure and Reactions from Chiral Interactions" at the 6$^{\text{th}}$ TRIUMF *ab initio* workshop "Progress in Ab Initio Techniques in Nuclear Physics", (Vancouver Canada), *23 Feb. 2016*.

- "*Ab Initio* Structure and Reactions of Light Nuclei with Effective Nuclear Interactions" at the First Gogny conference CEA/DIF, (Arpajon France), *11 Dec. 2015*.

- "From the Chiral Nuclear Interaction to Ab Initio Description of Light-ion Fusion Reactions" nuclear seminar at CEA-Saclay, (Gif-sur-Yvette France), *21 Oct. 2014*.

- "From the Chiral Nuclear Interaction to Ab Initio Description of Light-ion Fusion Reactions" theory seminar at Argonne National Laboratory, (Lemont USA), *14 Oct. 2014*.

- "First Steps Towards an Ab Initio Description of Light-ion Fusion Reactions" theory seminar at Michigan State University, (East Lansing USA), *16 Sept. 2014*.

- "Toward Realistic Description of Low-energy Fusion of Light Ions for Astrophysics" nuclear seminar at the University of Notre Dame, (Notre Dame USA), *8 April 2013*.

- "Toward Realistic Description of Low-energy Fusion for Astrophysics: Application to N-^{4}He and d-^{4}He Scattering" at the XLI Hirschegg workshop, (Kleinwalsertal Austria), *26 Jan. – 1 Feb. 2013*.

- "On the Formulation of a Functional Theory for Pairing with Particle Number Restoration" at CEA-ESNT workshop, (CEA-Saclay France), *13 – 15 Sept. 2011*.

- "Quantum Monte-Carlo for non-Markovian Dynamics" at ECT* workshop, (Trento Italy), *26 – 30 April 2010*.

Talks

- "Towards an exact computation of antiprotonic atoms" at the ECT* workshop ""Antiproton-Nucleus interactions", (Trento Italy), *17 – 21 June 2019*.

- "*Ab initio* Description of Thermonuclear Fusion Reactions" at the PREFER workshop, (Gatchina Russia), *4 – 6 June 2019*.

- "*Ab initio* theory for reactions and exotic nuclei" at the ECT* workshop "Recent advances and challenges in the description of nuclear reactions at the limit of stability", (Trento Italy), *5 – 9 March 2018*.

- "*Ab Initio* Calculations of Light-nucleus Reactions" at the international conference ND 2016 , (Bruges Belgium), *13 September 2016*.

- "*Ab Initio* Structure and Reactions of Light Nuclei" at the ECT* workshop "Towards consistent approaches for nuclear structure and reactions", (Trento Italy), *6 – 10 June 2016*.

- "Recent Progress towards *Ab Initio* Calculations of Light-Nuclei Reactions" at the 2nd EMMI program, (Darmstadt Germany), *1 – 14 Feb. 2014*.
- "Progress on Light-Ion Fusion Reactions with Three-Nucleon Forces" at the FB22 international conference, (Cracow Poland), *7 – 15 Sept. 2013*.
- "*Ab Initio* Light-Ion Reactions with Chiral Two- and Three-Body Interactions" at the 3rd TRIUMF *Ab Initio* workshop, (Vancouver Canada), *21 – 23 Feb. 2013*.
- "Toward Realistic Calculations of Light-Ion Fusion Reactions" at INT program, (Seattle Washington USA), *7 – 21 Oct. 2012*.
- "Three-nucleon Interaction in Light Ion Reactions" at the DNP fall meeting, (Newport Beach California USA), *23 – 27 Oct. 2012*.
- "*Ab Initio* Calculations of Light-Ion Fusion Reactions" at the NSDII international conference, (Opatija Croatia), *9 – 13 July 2012*.
- "Revisiting Particle Number Projection in Energy Density Functional Theory" at the FUSTIPEN inauguration, (Caen France), *18 – 19 Jan. 2011*.
- "Revisiting Particle Number Projection" at the 2010 Joliot Curie school, (Lacanau France), *27 Sept. – 3 Oct. 2010*.
- "Monte-Carlo for Dissipative Dynamics and Pairing in Nuclear Energy Density Functional" at the GANIL topical seminar, (GANIL France), *29 June 2010*.
- "Exact Monte-Carlo Method for Open Quantum Systems" at the French theoretical annual meeting, (IPN-Orsay France), *15 – 16 Oct. 2009*.
- "Monte-Carlo Method for Dissipative Dynamics" at the 2009 Joliot Curie school, (Lacanau France), *27 Sept. – 3 Oct. 2009*.

Posters

- "*Ab Initio* Reactions of Light Nuclei from First Principles" at LLNL postdoc poster symposium, (Livermore California USA), *17 July 2012*.
- "Functional Approach for Pairing in Finite Systems" at the international conference EFES – IN2P3, (Paris France), *15 – 18 Feb. 2011*.
- "Non-Markovian Effects in Quantum Systems: an Exact Stochastic Mean-Field Treatment" at the international conference NSRT, (Dubna Russia), *30 June – 4 July 2009*.

Conferences and Workshops attended

- "36th Mazurian Lakes Conference on Physics", (Mazurian Lakes, Poland), *2 – 7 September 2019*.
- ECT* workshop ""Antiproton-Nucleus interactions", (Trento Italy), *17 – 21 June 2019*.

- PREFER workshop, (Gatchina Russia), *4 – 6 June 2019*.
- "IVth Topical Workshop on Modern Aspects in Nuclear Structure The Many Facets of Nuclear Structure", (Bormio Italy), *20 – 24 February 2018*.
- Nuclear Data For Science and Technology (ND) 2016 international conference, (Bruges Belgium), *11 – 16 September 2016*.
- Direct Reactions with Exotic Beams (DREB) 2016 international conference, (Halifax Canada), *11 – 15 July 2016*.
- ECT* workshop "Towards consistent approaches for nuclear structure and reactions", (Trento Italy), *6 – 10 June 2016*.
- FUSTIPEN workshop "Future directions for nuclear structure and reaction theories: *Ab Initio* approaches for 2020" (Caen France) *14 – 18 March 2016*.
- 6$^{\text{th}}$ TRIUMF *Ab Initio* workshop "Progress in *Ab Initio* Techniques in Nuclear Physics", (Vancouver Canada), *23 – 26 Feb. 2016*.
- First Gogny conference CEA/DIF, (Arpajon France), *8 – 11 Dec. 2015*.
- EMMI program "Halo Physics at the Neutron Drip Line", (Darmstadt Germany), *1 – 14 Feb. 2014*.
- International conference "22$^{\text{nd}}$ European Conference on Few-body Problems in Physics", (Cracow Poland), *7 – 15 Sept. 2013*.
- TRIUMF 3$^{\text{rd}}$ *Ab Initio* workshop "Progress in *Ab Initio* Techniques in Nuclear Physics", (Vancouver Canada), *21 – 23 Feb. 2013*.
- XLI Hirschegg workshop "Gross Properties of Nuclei and Nuclear Excitations", (Kleinwalsertal Austria), *26 Jan. – 1 Feb. 2013*.
- INT program "Light Nuclei from First Principle", (Seattle Washington USA), *7 – 21 Oct. 2012*.
- International conference "Nuclear Structure and Dynamics II", (Opatija Croatia), *9 – 13 July 2012*.
- TRIUMF 2$^{\text{nd}}$ *Ab Initio* workshop "Perspectives of the *Ab Initio* No-Core Shell Model", (Vancouver Canada), *22 – 26 Feb. 2012*.
- International conference EFES – IN2P3 "Many-body Correlations from Dilute to Dense Nuclear Systems", (Paris France), *15 – 18 Feb. 2011*.
- FUSTIPEN inauguration "Bridging the Atlantic with Exotic Isotope Physics", (Caen France), *18 – 19 Jan. 2011*.
- CEA-ESNT workshop "Superfluidity in Nuclear Matter, Finite Nuclei and Ultra-cold Fermion Gases", (CEA-Saclay France), *31 May – 4 June 2010*.

- ECT* workshop “Decoherence in Quantum Dynamical Systems”, (Trento Italy), *26 – 30 April 2010.*
- French Theoretical Annual Meeting, (IPN-Orsay France), *15 – 16 Oct. 2009.*
- International Conference “Nuclear Structure and Related Topics”, (Dubna Russia), *30 June – 4 July 2009.*
- SPIRAL 2 Week, (Caen France), *26 – 29 Jan. 2009.*

Schools

- “Third UiO-MSU-ORNL-UT School on Topics in Nuclear Physics: The computational Quantum Many-body Problem”, (ORNL Oak Ridge Tennessee USA), *23 – 27 Jan. 2012.*
- Joliot Curie school “Symmetries in Subatomic Systems”, (Lacanau France), *27 Sept. – 3 Oct. 2010.*
- Joliot Curie school “Strong Interaction in Nuclear Matter: New trends”, (Lacanau France), *27 Sept. – 3 Oct. 2009.*
- Rencontre Jeunes Chercheurs, (Les Houches France), *4 – 9 Jan. 2009.*