

Curriculum vitae

PIERRE, Frédéric

Born December 7, 1974
 Married with two children
 French

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Experimental research on quantum and correlated phenomena in electronic circuits.

Research fields:

- Mesoscopic physics, strongly-correlated electron phenomena, quantum transport of electricity and heat, quantum simulation.
- Nanoscale devices, semiconductor-based 2D electron gas, few-quantum channel circuits.
- Ultra-low temperatures, ultra-sensitive electrical and noise measurements.

CURRENT POSITION

2004- Tenured CNRS research scientist at C2N/LPN, Marcoussis.
 Principal investigator (PI) of the team ‘Quantum Physics in Circuits’ ([QPC](#)).
 CNRS Research Director grade (senior research scientist) since 2014.

PREVIOUS POSITIONS AND EDUCATION

2011 ‘Habilitation’ at LPN, Marcoussis: ‘Experimental investigation of interactions in mesoscopic circuits: quantum decoherence, energy transfers, Coulomb blockade, proximity effect’.

2002-2003 Postdoctoral research scientist, Devoret group, Yale.

2000-2002 Postdoctoral research scientist, Birge group, Michigan State University.

1997-2000 Ph.D. at Quantronics, Saclay: ‘Electron-electron interactions in mesoscopic wires’.

1995-1997 Master at Ecole Normale Supérieure, Paris.

AWARDS

- French academy of Sciences award ‘Grand prix Madame Victor Noury’ (2018).
- ERC grant (‘consolidator’ sub-category, 2010).
- Bronze medal of the CNRS (2008).

SELECTION OF TEN INTERNATIONAL FIRSTS AS PRINCIPAL INVESTIGATOR

1. **Observation of the three-channel Kondo effect and of interaction induced super-ballistic transport.** Tunable ‘charge’ Kondo circuits constitute powerful analog quantum simulators to explore the many-body physics of strongly-correlated electrons (*Science* 2018)
2. **Observation of the systematic heat Coulomb blockade of one ballistic channel.** Coulomb interaction is found to influence heat and electricity profoundly differently (*Nat. Phys.* 2017)
3. **6 mK temperature for the electrons in small quantum circuits**, a world record for micrometer and nanometer-scale devices (*Nat. Commun.* 2016)
4. **Controlling charge quantization with quantum fluctuations**, in metallic circuits (*Nature* 2016)
5. **Observation of the ‘charge’ Kondo effect**, previously believed out of reach (*Nature* 2015)
6. **Measurement of the quantum limit of heat flow across a single electronic channel** (*Science* 2013)
7. **Characterization of the single-channel conductance renormalization in dissipative circuits.** A quantum back-action / Luttinger liquid problem with direct implications for future nanoelectronics quantum engineering (*PRL* 2007, *Nat. Phys.* 2011, *Nat. commun.* 2013, *PRX* 2018)

8. **Discovery of unexpected neutral heat currents in the fractional quantum Hall regime**, away from the sample edges. This finding, now systematically reproduced by several teams, challenges the theoretical description of the correlated fractional quantum Hall state (*PRL* 2012)
9. **Paradigm changing observation of strong energy exchanges along quantum Hall channels**, towards the now dominant collective magnetoplasmons picture of quantum Hall excitations (*PRLs* 2010)
10. **Out-of-equilibrium spectroscopy of the electronic distribution function in a 1D conductor**, the quantum Hall channel (*Nat. Phys.* 2010)

PUBLICATIONS

Highlights: 2 *Nature*, 2 *Science*, 3 *Nature physics*, 2 *Nature communications*, 1 *PRX* as PI; 13 *PRL* as PI or among first authors; 1 monograph; 2 articles for the diffusion to a broader scientific audience; 1 dedicated full article in a mainstream scientific magazine (in ‘*La Recherche*’ by S. Guilbaud, 09/2015).

45 peer-reviewed publications, most of them (41) as a main author (among first authors or as PI, [list](#)).

ADVANCEMENT OF YOUNG RESEARCHERS

2004-2017 2 postdocs / 5 Ph.D. (two on-going) / 3 co-supervised Ph.D.

All previous postdocs and fully supervised Ph.D. students obtained a tenured academic research position and/or received a distinction:

- Hélène le Sueur (postdoc, 2007-2009) is now a tenured CNRS researcher (Univ. Paris-Sud).
- Carles Altimiras (Ph.D., 2007-2010), now a tenured CEA researcher (Saclay), was awarded an ERC Starting Grant (2015).
- François Parmentier (postdoc, 2010-2013), now a tenured CNRS researcher (CEA, Saclay), was awarded the 2017 Nicholas Kurtis European prize.
- Sébastien Jezouin (Ph.D., 2011-2014), now postdoc (Université de Sherbrooke), was awarded the ‘Triangle de la Physique’ Ph.D. prize (2015).
- Zubair Iftikhar (Ph.D, 2013-2016), now postdoc (CEA, Saclay), was distinguished by the ‘outstanding PhD’ selection of university Paris Sud, his PhD was published by Springer and he was awarded a national C’NANO Ph.D. prize.

ORGANISATION OF SCIENTIFIC MEETINGS

Main organizer with B. Plaçais and X. Waintal of the workshop ‘Mesoscopic Physics’ (Aussois, December 5-8, 2011, 127 participants).

Main organizer with F. Portier and P. Roche of a mini-colloquium at the 12th ‘Journées de la Matière Condensée’ (JMC12) : ‘L’effet Hall quantique : du micro au meso’ (Troyes, 23-27 août 2010).

INSTITUTIONAL RESPONSIBILITIES

2013-2017 Committee member of the research association (GDR) ‘Mesoscopic Physics’, rallying French research activities on this topic (34 laboratories involved).

COMMISSIONS AND REVIEWER ACTIVITIES

- Member of recruitment committees for tenured positions of Assistant Professor and Professor (Université Joseph Fourier, Ecole Normale Supérieure, Université Paris Diderot).
- Project reviewer for ERC, French National Research Agency ANR, ETH Zurich, ENS Paris, etc.
- Referee for Science, Nature, Nature Physics, Physical Review X/Letters/B, Physica Status Solidi.

MAJOR COLLABORATIONS

We have established fruitful collaborations, mostly with theorists for the understanding of our experiments. The collaborations rewarded by shared publications are with the groups of (alphabetical order):

H. Bouchiat (Univ Paris-Sud), E. Boulat (Univ Paris Diderot), P. Degiovanni (ENS, Lyon), L. Glazman (Yale), C. Mora (ENS, Paris), I. Safi (Univ Paris-Sud), P. Simon (Univ Paris-Sud), E. Sukhorukov (Basel).

Ten years track-record

My research deals with quantum physics in electrical circuits. Over the last ten years, I have established and developed my own independent research team ‘Quantum Physics in Circuits’ (QPC). We explore a broad spectrum of fundamental physics, from correlated electronic matter to quantum transport (conductance, noise, heat) down to the most elementary level of single quantum channel conductors.

One remarkable characteristic of our research, repeatedly demonstrated on a variety of topics, is the very innovative approaches (e.g. quantum dot energy filters for the non-equilibrium energy distribution spectroscopy, determination of heat flow across a single channel, novel metal-semiconductor hybrid devices, implementation of a Kondo impurity with degenerate charge states of a circuit). A second characteristic of our works is the very important systematic effort to allow for precise quantitative comparisons with theory, at a level rarely seen in condensed-matter physics. The last essential characteristic is the strong involvement into key instrumental developments. Our outstanding technical expertise in ultra-low temperatures and ultra-sensitive electrical measurements were central in many of the team’s scientific breakthroughs.

This ten years track-record starts soon after my arrival at LPN, in 2004, as a tenured CNRS researcher, which marks the beginning of my Principal Investigator career. It took two intense years to install and fabricate the required advanced cryogenic equipment with very limited startup funding, and to develop an experimental know-how at LPN for the quantum transport across sophisticated semiconductor-based devices.

CAREER MILESTONES IN LAST TEN YEARS

- 2006 **Effective start of my own research projects.** With the lab mostly setup, I could recruit the first Ph.D. student under my full supervision in 2007 (C. Altimiras).
- 2010 **New young researcher** joining my team: Anne Anthore, ‘Maître de Conférence’ at University Paris-Diderot. Recently, Anne spent two years in sabbatical at Cambridge University (09/2014-08/2016).
- 2010 **Award of an ERC grant.** It has allowed us, in particular, to dramatically improve our measurement capabilities. We now hold the low electronic temperature record of 6.0 mK for mesoscopic, micro/nano-scale circuits, as well as the highest resolution on current noise ($\pm 5 \cdot 10^{-32} \text{ A}^2/\text{Hz}$) reported in the field of mesoscopic physics.
- 2018 **Laboratory relocation** into the new C2N building, presently under construction at Palaiseau. The new central location in Université Paris-Saclay will end the LPN isolation at Marcoussis.

TOP TEN PUBLICATIONS AS PRINCIPAL INVESTIGATOR

The larger weight of recent years reflects the effective start of my team QPC in 2006. Prestigious distinctions are pointed out¹.

1. Z. Iftikhar, A. Anthore, A.K. Mitchell, F.D. Parmentier, U. Gennser, A. Ouerghi, A. Cavanna, C. Mora, P. Simon, F. Pierre. **Tunable Quantum Criticality and Super-ballistic Transport in a ‘Charge’ Kondo Circuit.** *Science* DOI: 10.1126/science.aan5592 (2018). (Selected for the *First Release* program of *Science*; published as a Research Article).
2. E. Sivre, A. Anthore, F.D. Parmentier, A. Cavanna, U. Gennser, A. Ouerghi, Y. Jin, F. Pierre. **Heat Coulomb blockade of one ballistic channel.** *Nature Physics* **14**, 145 (2018). (Put forward on cover page).
3. Z. Iftikhar, A. Anthore, S. Jezouin, F.D. Parmentier, Y. Jin, A. Cavanna, A. Ouerghi, U. Gennser, F. Pierre. **Primary thermometry triad at 6 mK in mesoscopic circuits.** *Nature Communications* **7**, 12908 (2016).

¹ ~1/3 of *Nature* publications are selected for a *Nature News & Views*; ~1/3 (~1/4) of *Science* publications are selected for a *Science Perspectives* (for the *First Release* program previously called *Science Express*); ~3 publications are selected each month for the *Journal Club for Condensed Matter Physics*, among ~1500 articles.

4. S. Jezouin, Z. Iftikhar, A. Anthore, F.D. Parmentier, U. Gennser, A. Cavanna, A. Ouerghi, I.P. Levkivskyi, E. Idrisov, E.V. Sukhorukov, L.I. Glazman, F. Pierre. **Controlling charge quantization with quantum fluctuations.** *Nature* **536**, 58 (2016). (Dedicated *Nature News & Views*).
5. Z. Iftikhar, S. Jezouin, A. Anthore, U. Gennser, F.D. Parmentier, A. Cavanna, F. Pierre. **Two-channel Kondo effect and renormalization flow with macroscopic quantum charge states.** *Nature* **526**, 233 (2015). (Dedicated *Nature News & Views*).
6. S. Jezouin, F.D. Parmentier, A. Anthore, U. Gennser, A. Cavanna, Y. Jin, F. Pierre. **Quantum limit of heat flow across a single electronic channel.** *Science* **342**, 601 (2013). (Selected for *Science Express*; Dedicated *Science Perspectives*; Dedicated full article in the mainstream science magazine *La Recherche*).
7. S. Jezouin, M. Albert, F.D. Parmentier, A. Anthore, U. Gennser, A. Cavanna, I. Safi, F. Pierre. **Tomonaga-Luttinger physics in electronic quantum circuits.** *Nature Communications* **4**, 1802 (2013).
8. F.D. Parmentier, A. Anthore, S. Jezouin, H. le Sueur, U. Gennser, A. Cavanna, D. Mailly, F. Pierre. **Strong back-action of a linear circuit on a single electronic quantum channel.** *Nature Physics* **7**, 935 (2011).
9. H. le Sueur, C. Altimiras, U. Gennser, A. Cavanna, D. Mailly, F. Pierre. **Energy relaxation in the integer quantum Hall regime.** *Phys. Rev. Lett.* **105**, 056803 (2010).
10. C. Altimiras, H. le Sueur, U. Gennser, A. Cavanna, D. Mailly, F. Pierre. **Non-equilibrium edge channel spectroscopy in the integer quantum Hall regime.** *Nature Physics* **6**, 34 (2010). (Selected for *Journal Club for Condensed Matter Physics*, 11/2009).

INVITED PRESENTATIONS

Although I have for policy the sharing of invited presentations with my team, I have personally given over 40 invited talks around the world within the past ten years.

Fifteen representative invited presentations personally given in conferences and advanced schools:

1. International workshop ‘Quantum Information and Correlation in Quantum dots’, Daejeon, 2018.
2. International Conference ‘Quantum dynamics of Disordered Interacting Systems’, Trieste, 2018.
3. 28th International Conference on Low Temperature Physics (LT28), Gothenburg, 2017 (Keynote ‘half plenary’ speaker).
4. International Conference ‘Nanophysics, from fundamental to applications’, Quy Nhon, 2017.
5. International advanced school ‘Aux frontières de la physique mésoscopique’, Quebec, 2017 (3x1.5h).
6. International workshop on materials and quantum circuits (LIA-Sherbrooke), Saint Lambert des Bois, 2017.
7. 33rd International Conference on the Physics of Semiconductors (ICPS 2016), Beijing, 2016.
8. 2016 French Congress of Thermic (SFT2016), Toulouse, 2016 (Keynote opening speaker).
9. International workshop ‘Onedim-15’, Dresden, 2015.
10. International workshop ‘30 Years of Quanonics’, Paris, 2015.
11. International workshop ‘Non-equilibrium dynamics of low-dimensional electronic systems’, Leipzig, 2015.
12. International advanced school ‘Quantum Nano-Electronic Training’, Pisa, 2014.
13. International workshop ‘Equilibration and glassiness in classical and quantum systems’, Oxford, 2014.
14. 24th International Conference of the Condensed Matter Division (CMD24), Edinburgh, 2012.
15. International workshop ‘Quantum Transport in Correlated Systems’, Seoul, 2012.

PRIZE / AWARDS

- French Academy of Sciences award ‘Grand prix Madame Victor Noury’ (2018).
- Starting Grant from the European Research Council (‘Consolidator’ sub-category, 2010).
- Bronze medal of the CNRS (2008).