

Julien Barrier, PhD

Current position: Marie Skłodowska-Curie Actions Postdoctoral Fellow
Affiliation: ICFO, Barcelona Institute of Science and Technology, Castelldefels, Spain
Nationality: French (born in Paris, 03/01/1994)
E-mail: julien.barrier@icfo.eu
Phone: +33 631 308 826
Webpage: julienbarrier.eu

Research Interests Optoelectronics, IR and THz for studying quantum materials. Josephson junctions, superconducting nanostructures, quantum communications and metrology. Quantum transport including mesoscopic systems, 2DEG, quantum Hall effect, graphene and van der Waals heterostructures.

Professional Appointments & Education

19/06/2023 – 18/05/2025 Marie Skłodowska-Curie Actions Postdoctoral Fellow, ICFO, Spain.
01/07/2022 – 16/06/2023 EPSRC Doctoral Prize Fellow, University of Manchester, U.K.
12/09/2018 – 30/06/2022 PhD in Condensed Matter Physics, University of Manchester, UK. “*Electronic properties of graphene heterostructures below 1K*”. Advisor: Prof. AK Geim. (viva: 12/09/2022)
01/10/2018 – 31/12/2021 Graduate Teaching Assistant, University of Manchester, UK.
07/05/2018 – 21/08/2018 Visiting student researcher, SLAC National Accelerator Laboratory, CA, USA.
01/09/2014 – 30/08/2018 MSc from École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI ParisTech), France, diplôme d’Ingénieur (engineering degree).
01/10/2016 – 30/06/2017 Test preparation instructor, French ministry for higher education, Paris, France.

Prizes, Awards & Distinctions

- The Engineer’s Collaborate to Innovate “Highly Commended Award” for 1D superconductivity, 02/2024
- Franks **Doctoral Thesis Prize** in Nanoscale Physics and Technology, Institute of Physics, 12/2023 (£500),
- Finalist for Falling Wall Labs Madrid, 05/2023 –young researchers’ competition, 3-min presentation,
- MSCA total score: 99.4%, 02/2023 – **top 1% applicants in Physics**,
- Graphene Week student grant, EU Graphene Flagship (Munich, Germany), 09/2022 (€300),
- CR Barber Trust travel grant, Institute of Physics, 06/2022 (£100),
- APS Distinguished Student Award, 03/2022 (\$500) – **International award to 9 outstanding graduate students by the Forum of International Physics of the American Physical Society**,
- EPSRC Doctoral Prize, 02/2022 – top 5% PhD students at The University of Manchester,
- Best Student Talk, Graphene Conference (Grenoble, France), 10/2020 (€200) – international conference, 1 laureate among ~50 talks,
- Graphene Conference travel grant, 10/2020 (cancelled because of covid-19) – international conference, awarded to top 10% based on abstract proposal,
- Engineer of the Future for Research (Ingénieur du futur dans la catégorie Recherche), L’Usine Nouvelle, UTC & Sorbonne Université, 12/2019 (€2,500) – **national award, candidates nominated by French higher education institutions, 1 laureate**,
- Graphene Week student grant, EU Graphene Flagship (Helsinki, Finland), 09/2019 (€300),
- Finalist for Distinguished Student Prize, ESPCI Alumni, 05/2018 – **top 5 students in a cohort of 100**,
- Excellence Scholarship for Visiting Student Researcher at SLAC, Fonds ESPCI Paris, 03/2018 (€3,000) – top 10 students in a cohort of 100.

Research funding

- Humboldt Stiftung (Germany) – Research Fellowship, 07/2023 (€83,280 – 2 years, declined);
- Leverhulme Trust (UK) – Early Career Fellowship, 05/2023 (£170,268 – 3 years, declined);
- Horizon Europe – MSCA Postdoctoral Fellowship, 02/2023 (HE #101105218 – €181,153 – 2 years);
- EPSRC – Doctoral Prize Fellowship, 02/2022 (UKRI #EP/T517823/1– £51,320 – 1 year);
- EPSRC – Doctoral Training bursary, 03/2018 (UKRI #2109254 – ~£80,000 – 4 years).

Invited talks & Seminars

- Invited seminar, Department of Physics, Hong Kong University of Science and Technology, China, 21/11/2023,
- Department seminar, Condensed Matter Physics, University of Manchester, UK, 19/04/2023,
- Invited seminar, Graphene group, Instituto IMDEA Nanociencia, Madrid (online), Spain, 30/03/2023,
- Invited seminar, National Physical Laboratory, Teddington, UK, 17/02/2023,
- Invited seminar, Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany, 30/11/2022,
- Invited seminar, van der Waals heterostructures group, Budapest University of Technology, Hungary, 19/10/2022,
- Faculty seminar, National Graphene Institute, Manchester, UK, 25/02/2022,
- Seminar, Low Temperature Physics Group, Lancaster University, UK (online) 11/09/2020,
- Seminar, Toney group, Stanford Synchrotron Radiation Lightsource, (online), USA, 15/05/2020,
- Invited talk, Kluster, Paris, France, 03/12/2019.

Teaching experience

Tutor (2020-2021), University of Manchester:

- Quantum Mechanics, Waves and Electromagnetism (2nd year UG):
Corrected assignments and provided individual feedback to address student learning gaps.
2h per week, 2 sessions with groups of 5/6 students.

Graduate Teaching assistant (2018-2021), University of Manchester:

- Introduction to programming for physicists, lab-based course (2nd year UG):
Coding in Python and C++ in 2018-2019; Python & numerical methods in 2019-2020.
Assessed and advised students, marked assignments.
7h per week, class of ~40 students.
- Condensed Matter Physics lab-course (3rd year UG):
Experiments included AFM, STM, NMR, spin echo, Hall effect, graphene characterization.
Online support (students in the lab, remote teaching) in 2020-2021, Presential support in S1 2021-2022.
Assessed and advised students.
7h per week, class of ~40 students working in groups of 3.
- Physics Project, lab-based course (UG foundation year):
Experiments based on optical diffraction. Online demonstration in S1 2020-2021.
Participated in devising the curriculum.
Demonstrated, assessed, and advised students.
Marked the exam papers and oral presentations.
6h per week, 2 sessions with groups of 4 students.

Test preparation instructor (2016-2017), Lycée Saint Louis, Paris, France

- Algebra and Analysis tutorials (1st year UG):
Oral examination. Assessed through individualized exercises.
Provided personalized feedback and support to enhance student success.
2h per week, 2 sessions with groups of 3 students.

Outreach, communication and industrial participation

- Interview for “Epsilon”, (French popular science magazine), 01/2024
- Animation of the Twitter account @RealSci_Nano for one week, 08/2022,
- Interviews in scientific podcasts: Manchester Physics Society 03/0222, RealSci Nano 08/2022,
- Talks at Pint of Science in 05/2019, 05/2022,
- Interview for “Laboratory News” (British popular science magazine), 11/2020,
- 2 Talks for Oxford Instruments Nanoscience Virtual Roadshow, 07/2020,
- Advising the science based Youtube channel “Le Reveilleur”, 07/2018,
- Use of twitter for outreach between 2014 and 2023: @JulienBarrier (1800+ followers),
- Blog for outreach since 2017: julienbarrier.eu/blog.

Leadership & Activities

- Referee for Best Poster Prize, Quantum Matter 2023 International Conference (06/2023)
- Member of the board, ESPCI Alumni Association, in charge of digital communications (05/2023-04/2026)
- Representative for the Condensed Matter Physics Group – University of Manchester Early Career Researcher Forum (07/2022–06/2023),
- Cohort representative, ESPCI Alumni Association (09/2018–ongoing),
- Communication and Public Relations Officer, ESPCI Students Sport Union (06/2015–06/2016), raised €25k.

Software

1. mesoscoPy – Python library for instrumentation and measurements (github.com/condmatphys/mesoscopy),
2. Qcodes – Python-based data acquisition framework (contributed, github.com/microsoft/Qcodes)
3. QCoDeS_contrib_drivers – Instrument drivers (contributed, github.com/qcodes/qcodes_contrib_drivers),
4. station2004 – LabView interface for instrumentation (github.com/julienbarrier/station2004),
5. Jappix – JavaScript communication platform, based on XMPP (github.com/jappix/jappix).

List of publications

Summary: 7 publications including 3 in Nature, 1 in Nature Physics, 1 in Nature Communications, totalling over 400 citations. H-index: 6.

Publication list includes 4 as first-author and 1 as corresponding author (marked †).

In preparation

1. *Electrically controlled thermal switch using gated aligned carbon nanotube films*
P. Steiner, S. Adnan, X. Yu, V. Orts, **J. Barrier**, C. Zeng, P. Cataldi, M. Bisset, E. Bilotti, M. Khafizov, and C. Kocabas†. To be submitted to ACS Nano.
2. *Tunable superconductivity in multi-twisted tetralayer graphene*
J. Barrier, S.G. Xu, P. Liangtao, I. Yudhistira, A.K. Geim, S. Adam and A.I. Berdyugin†. Prepared for publication in Science (ready to be submitted simultaneously with a paper with similar conclusions from C.N. Lau)

Submitted

3. *Terahertz photocurrent probe of quantum geometry and interactions in magic-angle twisted bilayer graphene*
R. Krishna Kumar†, G. Li, R. Bertini, S. Chaudhary, K. Nowakowski, J.M. Park, S. Castilla, Z. Zhan, P.A. Pantaleón, H. Agarwal, S. Battle-Porro, E. Icking, M. Ceccanti, A. Reserbat-Plantey, G. Piccini, **J. Barrier**, E. Khestanova, T. Taniguchi, K. Watanabe, C. Stampfer, G. Refael, P. Guinea, P. Jarillo-Herrero, J. Song, P. Stepanov, C. Lewandowski, F.H.L. Koppens†. Submitted to Nature.
4. *Optical Spectroscopy for Diagnosing Superlattice Minibands in Magic-angle Twisted Bilayer Graphene*
G. Li, R. Krishna Kumar†, P. Stepanov, P.A. Pantaléon, Z. Zhan, H. Agarwal, A. Bercher, **J. Barrier**, K. Watanabe, T. Taniguchi, A.B. Kuzmenko, F. Guinea, I. Torre and F.H.L. Koppens†. Submitted to Nature Materials.

In revision

5. *Electrically controlled heat transport in graphite films via reversible ionic liquid intercalation*
P. Steiner, S. Adnan, M.S. Ergoktas, X. Yu, V. Orts, **J. Barrier**, G. Bakan, J. Aze, Y. Malevich, K. Wang, P. Cataldi, M. Bisset, S. Balci, S. Suzer, K. Novoselov, M. Khafizov and C. Kocabas†. Under review (Nano Letters).

Published

6. *One-dimensional proximity superconductivity in the quantum Hall regime*
J. Barrier†, M. Kim, R. Krishna Kumar, N. Xin†, P. Kumaravadivel, L. Hague, E. Nguyen, A.I. Berdyugin, C. Moulsdale, V.V. Enaldiev, J.R. Prance, F.H.L. Koppens, R.V. Gorbachev, K. Watanabe, T. Taniguchi, L.I. Glazman, I.V. Grigorieva, V.I. Fal'ko and A.K. Geim†. **Nature**, in press (2024)

7. *Giant magnetoresistance of Dirac plasma in high-mobility graphene*
N. Xin, J. Lourembam, P. Kumaravadivel, A.E. Kazantsev, Z. Wu, C. Mullan, **J. Barrier**, A.A. Geim, I.V. Grigorieva, A. Mishchenko, A. Principi, V.I. Fal'ko, L.A. Ponomarenko, A.K. Geim† and A.I. Berdyugin†. **Nature**, 616 (7956), 270-274 (2023)
8. *Compositional heterogeneity in $FA_{1-y}Cs_yPb(I_{1-x}Br_x)_3$ perovskite films and its impact on phase behavior*
J. Barrier, R.E. Beal, A Gold-Parker, J.A. Vigil, E. Wolf, L. Waquier, N.J. Weadock, Z. Zhang, L.T. Schelhas, A.-F. Nogueira, M.D. McGehee and M.F. Toney†. **Energy & Environmental Science**, 14 (12), 6394-6405 (2021)
9. *Tunable van Hove singularities and correlated states in twisted monolayer-bilayer graphene*
S. Xu, M.M. Al Ezzi, N. Balakrishnan, A. Garcia-Ruiz, B. Tsim, C. Mullan, **J. Barrier**, N. Xin, B.A. Piot, T. Taniguchi, K. Watanabe, A. Carvalho, A. Mishchenko, A.K. Geim, V.I. Fal'ko, S. Adam, A.H. Castro Neto, K.S. Novoselov† and Y. Shi†. **Nature Physics** 17, 619-626 (2021)
10. *Long-range ballistic transport of Brown-Zak fermions in graphene superlattices*
J. Barrier, P. Kumaravadivel, R. Kirshna-Kumar, L.A. Ponomarenko, N. Xin, M. Holwill, C. Mullan, M. Kim, R.V. Gorbachev, M.D. Thompson, J.R. Prance, T. Taniguchi, K. Watanabe, I.V. Grigorieva, K.S. Novoselov, A. Mishchenko, V.I. Fal'ko, A.I. Berdyugin† and A.K. Geim†. **Nature Communications**, 11, 5756 (2020)
11. *Electronic phase separation in multilayer rhombohedral graphite*
Y. Shi, S. Xu, Y. Yang, S. Slizovskiy, S.V. Morozov, S.-K. Son, S. Ozdemir, C. Mullan, **J. Barrier**, J. Yin, A.I. Berdyugin, B.A. Piot, T. Taniguchi, K. Watanabe, V.I. Fal'ko, K.S. Novoselov, A.K. Geim and A. Mishchenko†. **Nature**, 584 (7820), 210-219 (2020)
12. *Structural origins of light-induced phase segregation in organic-inorganic halide perovskite photovoltaic materials*
R.E. Beal, N.Z. Hagström, **J. Barrier**, A. Gold-Parker, R. Prasanna, K.A. Bush, D. Passarello, L.T. Schelhas, K. Brüning, C.J. Tassone, H.-G. Steinrück, M.D. McGehee, M.F. Toney† and A.-F. Nogueira†. **Matter**, 02 (01) 207-219 (2020)

List of peer-reviewed conference abstracts

1. *Robust 1D proximity superconductivity along graphene domain walls in quantizing fields*, oral communication, APS March 2024, Minneapolis, MN, U.S.A. 03/03/2024
2. *1D Andreev bound states along domain walls in bilayer graphene*, **plenary talk**, Graphene 2023 Conference, Manchester, UK, 27/06/2023,
3. *1D Andreev bound states along domain walls in bilayer graphene*, oral communication, Bound states in superconducting nanodevices workshop, Budapest, Hungary, 13/06/2023,
4. *1D Andreev bound states along quantum Hall edges*, **plenary talk**, Quantum Matter 2023 Conference, Madrid, Spain, 25/05/2023,
5. *Superconductivity in quantum Hall edge states*, oral communication, APS March 2023, Las Vegas, NV, U.S.A. 06/03/2023,
6. *1D Andreev bound states in a graphene heterostructure*, poster communication, APS March 2023, Las Vegas, NV, U.S.A. 07/03/2023,
7. *Inducing superconductivity in quantum Hall channels*, poster communication, Graphene Week 2022, Munich, Germany, 06/09/2022,
8. *Topological superconductivity in proximitized bilayer graphene*, oral communication, CMD29, Manchester, UK, 24/08/2022,
9. *Engineering topological superconductivity in twisted bilayer graphene*, oral communication, QuantumMatter 2022, Barcelona, Spain, 22/06/2022,
10. *1D supercurrent in a graphene heterostructure*, oral communication, APS March 2022, Chicago, IL, U.S.A, 18/03/2022,
11. *Long-range ballistic transport of Brown-Zak fermions in graphene superlattices*, oral communication, Graphene Workshop, Basel, Switzerland, 02/11/2021,
12. *Tuneable correlated states, topological flat bands and anomalous Hall effect in twisted monolayer-bilayer graphene*, oral communication, CMQM 2021, online, 21/06/2021,

13. *Long-range ballistic transport of Brown-Zak fermions in graphene superlattices*, oral communication, APS March 2021, online, 16/03/2021,
14. *Ballistic transport in the magnetic Bloch states of graphene superlattices*, oral communication, Graphene Conference 2020, online, 22/10/2020, **best talk prize**,
15. *Direct observation of Brown-Zak minibands in graphene superlattices*, poster communication, Graphene Week 2019, Helsinki, Finland, 24/09/2019,
16. *Tetragonal to cubic phase transition in $FA_{1-x}Cs_xPb(I_{1-y}Br_y)_3$: temperature dependence and impact on band gap*, oral communication, MRS Fall 2018, Boston, MA, U.S.A. 30/11/2018