Christophe De Beule

Dr. Sc. Physics

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Work Experience

03.2023 – present **Postdoc**, *University of Pennsylvania (USA)*, Mele group.

- Research: quantum-geometric responses from Bloch oscillations in moiré superlattices

03.2022 – 02.2023 **Visiting Researcher**, *University of Pennsylvania (USA)*, Mele group, Supported by an INTER Mobility grant of the Luxembourg National Research Fund (FNR).

- Research: scattering networks in periodically-buckled graphene and moiré graphene; topological Andreev rectification

10.2020 – 02.2022 **Postdoc**, *University of Luxembourg (Luxembourg)*, Schmidt Group.

- Research: artifical event horizons in Weyl semimetals

04.2018 – 09.2020 **Postdoc**, *Technical University of Braunschweig (Germany)*, Recher group.

- Research: topological scattering networks and mesoscopic transport in twisted bilayer graphene
- Teaching: topological systems and quantum computation, one-dimensional Fermi liquids, introduction to Wolfram Mathematica

10.2016 – 03.2017 **Visiting Researcher**, *University of Würzburg (Germany)*, TP4.

2012 – 2017 **PhD Student**, *University of Antwerp (Belgium)*, CMT group, Supported by an aspirant PhD fellowship of the research foundation Flanders (FWO).

- Research: topological insulator heterostructures
- Teaching: analytical mechanics and quantum mechanics
- Organization of departmental colloquia (Antwerp Young Minds)

Education

2012 – 2017 **PhD in Physics**, *Felicitations of the jury*, Condensed Matter Theory Group at the University of Antwerp (Belgium).

- Thesis: *Confined quantum systems in topological insulator heterostructures*
- Supervisors: Prof. Bart Partoens & Prof. Björn Trauzettel
- Research visit: University of Würzburg (Germany) (03.2015 – 06.2015)

2010 – 2012 **MSc in Physics**, *Greatest distinction*, University of Antwerp (Belgium).

- Thesis: *Quantum spin Hall effect and topological edge states in graphene*
- Supervisor: Prof. Bart Partoens

- Internship: IMEC Leuven (Ellipsometry of vanadium compounds)

2007 – 2010 **BSc in Physics**, *Great distinction*, University of Antwerp (Belgium).
- Thesis: *Scattering of Dirac fermions in graphene at electrostatic and magnetic barriers*
- Supervisor: Prof. Bart Partoens

Grants

2022 – 2023 **INTER Mobility grant**, *Luxembourg National Research Fund (FNR).*
2012 – 2016 **Aspirant PhD fellowship**, *Research Foundation Flanders (FWO).*
03.2015 – 06.2015 **Travel grant**, *Research Foundation Flanders (FWO).*

Memberships of Scientific Societies

10.2020 – Present **American Physical Society**.
2014 – 2015
2016 – 2017 **European Physical Society**, EPS Young Minds.
2012 – 2013 **Belgian Physical Society**.

Publications

Peer-reviewed Articles

[1] **Christophe De Beule** and E. J. Mele. *Berry Curvature Spectroscopy from Bloch Oscillations.* Phys. Rev. Lett. 131, 196603 (2023). DOI: 10.1103/PhysRevLett.131.196603.

[2] **Christophe De Beule**, Võ Tién Phong, and E. J. Mele. *Roses in the nonperturbative current response of artificial crystals.* Proc. Natl. Acad. Sci. U.S.A. 120.43, e2306384120 (2023). DOI: 10.1073/pnas.2306384120.

[3] Patrick Wittig, Fernando Dominguez, **Christophe De Beule**, and Patrik Recher. *Localized states coupled to a network of chiral modes in minimally twisted bilayer graphene.* Phys. Rev. B 108, 085431 (2023). DOI: 10.1103/PhysRevB.108.085431.

[4] Pok Man Tam*, **Christophe De Beule***, and Charles L. Kane. *Topological Andreev rectification.* Phys. Rev. B 107, 245422 (2023). Editors' Suggestion. DOI: 10.1103/PhysRevB.107.245422.

[5] Andreas Haller, Suraj Hegde, Chen Xu, **Christophe De Beule**, Thomas L. Schmidt, and Tobias Meng. *Black hole mirages: Electron lensing and Berry curvature effects in inhomogeneously tilted Weyl semimetals.* SciPost Phys. 14, 119 (2023). DOI: 10.21468/SciPostPhys.14.5.119.

[6] **Christophe De Beule**, Võ Tién Phong, and E. J. Mele. *Network model for periodically strained graphene.* Phys. Rev. B 107, 045405 (2023). DOI: 10.1103/PhysRevB.107.045405.

[7] Lena Bittermann, **Christophe De Beule**, Daniel Frombach, and Patrik Recher. *Probing Majorana bound states via a pn junction containing a quantum dot.* Phys. Rev. B 106, 075305 (2022). DOI: 10.1103/PhysRevB.106.075305.

[8] **Christophe De Beule**, Solofo Groenendijk, Tobias Meng, and Thomas L. Schmidt. *Artificial event horizons in Weyl semimetal heterostructures and their non-equilibrium signatures.* SciPost Phys. 11, 095 (2021). DOI: 10.21468/SciPostPhys.11.5.095.

[9] **Christophe De Beule**, Fernando Dominguez, and Patrik Recher. *Network model and four-terminal transport in minimally twisted bilayer graphene*. Phys. Rev. B 104, 195410 (2021). DOI: 10.1103/PhysRevB.104.195410.

[10] **Christophe De Beule**, Fernando Dominguez, and Patrik Recher. *Effective Floquet model for minimally twisted bilayer graphene*. Phys. Rev. B 103, 195432 (2021). DOI: 10.1103/PhysRevB.103.195432.

[11] **Christophe De Beule**, Peter G. Silvestrov, Ming-Hao Liu, and Patrik Recher. *Valley splitter and transverse valley focusing in twisted bilayer graphene*. Phys. Rev. Res. 2, 043151 (2020). DOI: 10.1103/PhysRevResearch.2.043151.

[12] **Christophe De Beule**, Fernando Dominguez, and Patrik Recher. *Aharonov-Bohm Oscillations in Minimally Twisted Bilayer Graphene*. Phys. Rev. Lett. 125, 096402 (2020). FEATURED ON COVER. DOI: 10.1103/PhysRevLett.125.096402.

[13] **Christophe De Beule**, Rolando Saniz, and Partoens Bart. *Crystalline topological states at a topological insulator junction*. J. Phys. Chem. Solids 128, 144–151 (2018). DOI: https://doi.org/10.1016/j.jpcs.2017.12.027.

[14] **Christophe De Beule**, Mohammad Zarenia, and Bart Partoens. *Transmission in graphene–topological insulator heterostructures*. Phys. Rev. B 95, 115424 (2017). DOI: 10.1103/PhysRevB.95.115424.

[15] **Christophe De Beule**, Niccolò Traverso Ziani, Mohammad Zarenia, Bart Partoens, and Björn Trauzettel. *Correlation and current anomalies in helical quantum dots*. Phys. Rev. B 94, 155111 (2016). DOI: 10.1103/PhysRevB.94.155111.

[16] Matthias Van der Donck, **Christophe De Beule**, Bart Partoens, François M. Peeters, and Ben Van Duppen. *Piezoelectricity in asymmetrically strained bilayer graphene*. 2D Mater. 3.3, 035015 (2016). DOI: 10.1088/2053-1583/3/3/035015.

[17] Kirsten Govaerts, Kyungwha Park, **Christophe De Beule**, Bart Partoens, and Dirk Lamoen. *Effect of Bi bilayers on the topological states of* $\mathrm{Bi_2Se_3}$*: A first-principles study*. Phys. Rev. B 90, 155124 (2014). DOI: 10.1103/PhysRevB.90.155124.

[18] Kyungwha Park, **Christophe De Beule**, and Bart Partoens. *The ageing effect in topological insulators: evolution of the surface electronic structure of Bi2Se3 upon K adsorption*. New J. Phys. 15.11, 113031 (2013). DOI: 10.1088/1367-2630/15/11/113031.

[19] **Christophe De Beule** and Bart Partoens. *Gapless interface states at the junction between two topological insulators*. Phys. Rev. B 87, 115113 (2013). DOI: 10.1103/PhysRevB.87.115113.