Nakib Haider Protik

theoretical / computational physicist

Humboldt University of Berlin

Head of Theoretical Transport Physics (T2P), Institute of Physics [2024 -]

- *Emmy Noether Grant, DFG*
  - Principal investigator

Postdoc, Institute of Physics & IRIS Adlershof [2022 - 2024]

- *Research Fellowship, Alexander von Humboldt Foundation*
- *German Language Fellowship, Alexander von Humboldt Foundation*
- *Research Fellowship, Max Planck Institute Stuttgart*
  - Conducted research in the field of thermoelectric transport and superconductivity.

Catalan Institute of Nanoscience and Nanotechnology

Postdoc, Theory and Simulation [2021 - 2022]

- Developed scientific software (elphbolt) for thermoelectricity simulations.

Harvard University

Postdoc, School of Engineering & Applied Sciences [2019 - 2021]

- Developed scientific software for thermoelectricity and superconductivity simulations.

Boston College

PhD student, Department of Physics [2014 - 2019]

- *Conference travel grants, Boston College*
  - Developed an original theoretical and computational framework for thermoelectric transport simulations, solving a century-old problem.
  - Developed scientific software for simulating thermoelectric transport.
  - Taught undergraduate level physics.

University of Ottawa

Master's student, Department of Physics [2011 - 2013]

- *Differential Admission Scholarship, University of Ottawa*
  - Implemented a many-body quantum chemistry method for studying laser-matter interactions.
  - Taught undergraduate level physics.

Brac University

Teaching assistant, Department of Physics [2010 - 2011]

- Taught undergraduate level physics and mathematics.

Bachelor's student, Department of Physics [2006 - 2010]

- *Highest Distinction & Vice Chancellor's Medal, Brac University*
- *Full ride scholarship, Brac University*
- *6-month scholarship to Romania, Erasmus Mundus*
  - Got training in physics (major) and computer science (minor).
  - Wrote scientific software for simulating quantum field theories on non-commutative geometries.

Contact

nakib.haider.protik@gmail.com
LinkedIn
Theoretical Transport Physics (T2P)
Github
Google Scholar

Education

2019	PhD Physics, Boston College
2013	MSc Physics, U of Ottawa
2010	BSc Physics, Brac U

Skills

- ⋆ Physics ●●●
- ⋆ Research ●●●
- ⋆ Project management ●●●
- ⋆ Scientific communication ●●●
- ⋆ Peer reviewing ●●●
- ⋆ Funding acquisition ●●●
- ⋆ Teaching ●●●
- ⋆ Mentoring ●●●
- ⋆ Software development ●●●
- ⋆ Scientific computation ●●●
- ⋆ High-performance computing ●●●
- ⋆ Modern Fortran [coarrays and OO] ●●●
- ⋆ Python [`numpy`, `matplotlib`, `scipy`] ●●○
- ⋆ Linux ●●●
- ⋆ Lisp ●○○
- ⋆ Bangla ●●●
- ⋆ English ●●●
- ⋆ German ●○○

Attachments

I Grants & selected awards

2024	Emmy Noether Grant, DFG, ≈ 1.76 million EUR
2022	Humboldt Postdoctoral Fellowship, Alexander von Humboldt Foundation, ≈ 64 thousand EUR
2011	Differential Admissions Scholarship, University of Ottawa
2010	Highest Distinction & Vice Chancellor's Medal, Brac University
2009	6-month scholarship to Romania, Erasmus Mundus
2006	Full ride scholarship, Brac University

II Supervision

Humboldt University of Berlin

- Supervisor of PhD student Dwaipayan Paul
- Supervisor of postdoc Dr. Sally Issa
- Co-supervisor of bachelor student William Wenig
- Co-supervisor of bachelor student Marten Pretorius's research project.

  Thesis title: *Superconductivity in MgB_2 combining Eliashberg theory with density-functional theory based methods.*

III Research

My research focus is on the physics of interactions and transport phenomena in condensed matter. Specifically, using *ab initio* theoretical and computational tools, I study how the scattering processes in matter – electron-phonon, phonon-phonon, phonon-defects, electron-defects, etc. – affect the transport properties.

Published code

2021 elphbolt

A solver for the coupled and decoupled electron and phonon Boltzmann transport equations.

Theses

2019 **PhD Thesis, Physics, Boston College**.
Topic: Theoretical/computational condensed matter physics with an emphasis on semiclassical transport.
Title: *Phonon and carrier transport in semiconductors from first principles*.
Committee: David Broido (chair), Kenneth Burch, Krzysztof Kempa, Fazel Tafti, and Natalio Mingo.

2013 **MSc Thesis, Physics, University of Ottawa**.
Topic: Attosecond phenomena in laser-matter interaction using computational many-body quantum methods.
Title: *The multiconfiguration time dependent Hartree-Fock method for cylindrical systems*.
Advisor: Thomas Brabec.

2010 **BSc Thesis, Physics, BRAC University**.
Topic: Numerical studies of quantum field theories on non-commutative geometries.
Title: *Chern-Simons action on the noncommutative plane*.
Advisor: Arshad Momen.

Publications (*= equal contribution)

2025 Katharina Dudde, Mahmoud Elhajhasan, Guillaume Würsch, Julian Themann, Jana Lierath, Dwaipayan Paul, **Nakib H. Protik**, Giuseppe Romano, Gordon Callsen.
Phonon Mean Free Path Spectroscopy By Raman Thermometry.
arXiv, 2505.14506.

2024 Wilken Seemann, Mahmoud Elhajhasan, Julian Themann, Katharina Dudde, Guillaume Würsch, Jana Lierath, Joachim Ciers, Åsa Haglund, **Nakib H. Protik**, Giuseppe Romano, Raphaël Butté, Jean-François Carlin, Nicolas Grandjean, Gordon Callsen.
Thermal analysis of GaN-based photonic membranes for optoelectronics.
arXiv, 2410.12515.

2024 **Nakib H. Protik** and Claudia Draxl.
Beyond the Tamura model of phonon-isotope scattering.
Physical Review B, 109, 165201.

2023 Mahmoud Elhajhasan, Wilken Seemann, Katharina Dudde, Daniel Vaske, Gordon Callsen, Ian Rousseau, Thomas F. K. Weatherley, Jean-François Carlin, Raphaël Butté, and Nicolas Grandjean, **Nakib H. Protik**, and Giuseppe Romano.
Joined optical and thermal characterization of a III-nitride semiconductor membrane by micro-photoluminescence spectroscopy and Raman thermometry.
Physical Review B, 108, 235313.

2023 Krzysztof Kempa, **Nakib H. Protik**, Tyler Dodge, Claudia Draxl, and Michael J. Naughton.
Enhancing superconductivity with resonant anti-shielding and topological plasmon-polarons.
Physical Review B, 107, 184518.

2023 Yu Xie, Jonathan Vandermause, Senja Ramakers, **Nakib H. Protik**, Anders Johansson, and Boris Kozinsky.
Uncertainty-aware molecular dynamics from Bayesian active learning for phase transformations and thermal transport in SiC.
npj Computational Materials, 9, 36.

2023 Chunhua Li, **Nakib H. Protik**, Navaneetha K. Ravichandran, and David Broido.
High-frequency phonons drive large phonon-drag thermopower in semiconductors at high carrier density.
Physical Review B, 107, L081202.

2022 Chunhua Li, **Nakib H. Protik**, Pablo Ordejón, and David Broido.
Colossal phonon drag enhanced thermopower in lightly doped diamond.
Materials Today Physics, 27, 100740.

2022 **Nakib H. Protik**, Chunhua Li, Miguel Pruneda, David Broido, and Pablo Ordejón.
The `elphbolt` *ab initio* solver for the coupled electron-phonon Boltzmann transport equations.
npj Computational Materials, 8, 28.

2021 Zhe Cheng, Weifang Lu, Jingjing Shi, Daiki Tanaka, **Nakib H. Protik**, Shangkun Wang, Motoaki Iwaya, Tetsuya Takeuchi, Satoshi Kamiyama, Isamu Akasaki, Hiroshi Amano, and Samuel Graham.
Quasi-Ballistic Thermal Conduction in 6H-SiC.
Materials Today Physics, 20, 100462.

2021 Mauro Fava*, **Nakib Haider Protik***, Chunhua Li, Navaneetha Krishnan Ravichandran, Jesús Carrete, Ambroise van Roekeghem, Georg K. H. Madsen, Natalio Mingo, and David Broido.
How dopants limit the ultrahigh thermal conductivity of boron arsenide: a first principles study.
npj Computational Materials, 7, 54.

2020 **Nakib Haider Protik** and Boris Kozinsky.
Electron-phonon drag enhancement of transport properties from a fully coupled *ab initio* Boltzmann formalism.
Physical Review B, 102, 245202.

2020 **Nakib Haider Protik** and David Broido.
Coupled transport of phonons and carriers in semiconductors: A case study of n-doped GaAs.
Physical Review B, 101, 075202 [Editors' Suggestion].

2019 Xueyuan Wu*, Jiantao Kong*, **Nakib Haider Protik***, David Broido, and Krzysztof Kempa.
Tailoring the electron-phonon interaction with metallic plasmonic structures.
Materials Today Physics 8, 86-91.

2017 **Nakib Haider Protik**, Ankita Katre, Lucas Lindsay, Jesús Carrete, Natalio Mingo, and David Broido.
Phonon thermal transport in 2H, 4H and 6H silicon carbide from first principles.
Materials Today Physics 1C, 31-38.

2016 **Nakib Haider Protik**, Jesús Carrete, Nebil A. Katcho, Natalio Mingo, and David Broido.
Ab initio study of the effect of vacancies on the thermal conductivity of boron arsenide.
Physical Review B 94, 045207.

2014 G. Orlando, C. R. McDonald, **N. H. Protik**, G. Vampa, and T. Brabec.
Tunneling time, what does it mean?
Journal of Physics B 47, 204002.

2014 G. Orlando, C. R. McDonald, **N. H. Protik**, and T. Brabec.
Identification of the Keldysh time as a lower limit for the tunneling time.
Physical Review A 89, 014102.

Invited/Workshop/Long Talks

2025 Computing electron and phonon transport including drag: current state-of-the-art and what comes next.
APS March Meeting, Anaheim, March 18.

2024 Completing the transport circuit in the interacting electron-phonon system.
ETSF Electron-phonon collaboration team workshop, UCLouvain, Louvain-la-Neuve, September 24.

2024 Probing the transport of the interacting electron-phonon system self-consistently and *ab initio*.
At DPG Meeting, Berlin, March 19.

2022 Coupled transport of the interacting electron-phonon gas – state of the art and the future.
At Solid State Seminar, Institute of Solid State Physics and Institute of Theoretical Physics, University of Bremen, Bremen, November 1.

2021 **Nakib Haider Protik**, Chunhua Li, Miguel Pruneda, David Broido, and Pablo Ordejón.
`elphbolt` - A free software for coupled electron-phonon Boltzmann transport. Video here.
At International Workshop on Advanced Materials-to-Device Solutions for Synaptic Electronics, Session 4, Barcelona, November 12.

Other Selected Talks

2023 Dragful electron-phonon transport – `elphbolt` a year and a half on.
HoW exciting! 2023, Berlin, August 9.

2023 **Nakib Haider Protik** and Claudia Draxl.
When does the Tamura model of phonon-isotope scattering break down?.
- DPG Meeting, Dresden, March 27.
- APS March Meeting, Virtual, March 21.

2022 **Nakib Haider Protik** and Claudia Draxl.
Electron-phonon drag in MgB_2.
DPG Spring Meeting, Regensburg, September 7.

2022 **Nakib Haider Protik**, Chunhua Li, Miguel Prudena, David Broido, and Pablo Ordejón.

elphbolt: An ab initio solver for the coupled and decoupled electron and phonon Boltzmann transport equations.
APS March Meeting, March 15.

2021 **Nakib Haider Protik** and Boris Kozinsky.
Electron-phonon drag enhancement of transport properties from fully coupled *ab initio* Boltzmann formalism.
APS March Meeting, Online, March 17.

2019 **Nakib Haider Protik**, Mauro Fava, Natalio Mingo, Jesús Carrete, George Madsen, Navaneetha Ravichandran and David Broido.
Effect of substitutional defects on the thermal conductivity of boron arsenide.
APS March Meeting, Boston, March 4.

2018 **Nakib Haider Protik** and David Broido.
Effect of plasmon-LO phonon coupling on the mobility of GaN.
APS March Meeting, Los Angeles, March 7.

2017 **Nakib Haider Protik**, Ankita Katre, Lucas Lindsay, Jesús Carrete, Bonny Dongre, George K. H. Madsen, Natalio Mingo, David Broido.
Phonon thermal transport in 2H, 4H and 6H silicon carbide from first principles.
APS March Meeting, New Orleans, March 13.

2016 **Nakib Haider Protik**, Jesús Carrete, Natalio Mingo, Nebil A. Katcho and David Broido.
Ab initio study of the effect of vacancies on the thermal conductivity.
APS March Meeting, Baltimore, March 15.

IV Teaching

- **Humboldt University of Berlin**

  Introduction to Transport Physics: 6 ECTS course, Summer 2025

  Many-body seminar series: syllabus preparation, organization, lectures
- **Teaching Assistant @ Boston College**

  Quantum Physics I: generating homework solutions and grading.

  Intro to Physics Recitation I, II: recitations and grading.

  1st year physics labs: experiments demonstration and lab report grading.
- **Teaching Assistant @ University of Ottawa**

  Fundamentals of Applied Physics III: grading.

  Advanced Optics & Introduction to Photonics: grading.

  Principles of Physics I: recitations and grading.

  Electricity and Magnetism: recitations and grading.

  Fundamentals of Physics for Engineers: recitations and grading.

  1st year physics lab: experiments demonstration and lab report grading.
- **Teaching Assistant @ BRAC University**

  Applied Physics Lab I: lab management, experiments demonstration, exam preparation and grading.

  Principles of Physics I, II labs: lab management, experiments demonstration, exam preparation and grading.

  Mathematics II lab: lectures, exam preparation and grading.
- **Lab Assistant @ BRAC University**

  Physics Lab I, III: experiments demonstration and lab report grading.

V Service

PhD thesis committee member

- International expert and jury member in Dr. Martí Raya Moreno's PhD dissertation committee at Universitat Autonoma de Barcelona.

  Thesis title: *Heat transport in binary semiconductor polytypes and devices based on 2D materials: an ab initio study*.

Journal reviewer

- *Physical Review Letters*, *Physical Review B*, *Physical Review Materials*, *Materials Today Physics*, *Acta Physica Polonica A*, *Journal of Physics and Chemistry of Solids*

Other

- Student representative in Graduate Affairs Committee (2018-2019), Boston College.
- Graduate Teaching Committee liaison person (2017-18), Boston College.