

# Lukáš Nádvorník

Faculty of Mathematics and Physics  
Charles University in Prague

Ke Karlovu 3  
12116 Prague 2  
Czech Republic

☎ (+420) 951 551 377

✉ [nadvornik@karlov.mff.cuni.cz](mailto:nadvornik@karlov.mff.cuni.cz)

## Scientific experience

### Working positions

- 2019–present **Faculty of Mathematics and Physics, Charles University, Prague, Czechia.**
  - assistant professor, Department of Chemical Physics and Optics
- 2017–2019 **Free University of Berlin, Berlin, Germany.**
  - postdoctoral position, THz group in the Department of Physics (prof. Tobias Kampfrath)
- 2016–2019 **Fritz-Haber Institute of Max-Planck Society, Berlin, Germany.**
  - postdoctoral position, THz group in the Department of Chemical Physics (prof. Tobias Kampfrath)
- 2009–2016 **Institute of Physics, Academy of Sciences of CR, v.v.i., Prague, Czechia.**
  - Ph.D. student, Department of Spintronics and Nanoelectronics (prof. Tomáš Jungwirth)
- 2012–2016 **Faculty of Mathematics and Physics, Charles University, Prague, Czechia.**
  - Ph.D. student, Joint Laboratory of Optical Spintronics (prof. Petr Němec)
- 2011–2014 **Hitachi-Cavendish Laboratory, University of Cambridge, Cambridge, UK.**
  - multiple Ph.D. internships (Dr. Joerg Wunderlich)
- 2008–2011 **National laboratory of high magnetic fields, CNRS, Grenoble, France.**
  - multiple longer term internships, Far infrared laboratory (Dr. Milan Orlita)

### Education

- 2011–2016 **Ph.D. degree in Physics, Faculty of Mathematics and Physics, Charles University.**
  - Program: Quantum Optics and Optoelectronics
  - Focus on Spintronics: relativistic spintronic effects in non-magnetic semiconductors
  - RNDr. academic title obtained in June 2013
  - Ph.D. thesis defended in September 2016
- 2009–2011 **Master degree in Physics, Faculty of Mathematics and Physics, Charles University.**
  - Program: Optics and Optoelectronics
  - Focus: Artificial graphene concept, creating Dirac fermions in conventional materials
  - Defended with distinction in September 2011
- 2006–2009 **Bachelor degree in Physics, Faculty of Mathematics and Physics, Charles University.**
  - Program: General physics
  - Focus: Far infrared spectroscopy on natural graphene
- 2000–2006 **Bilingual leaving exam, Bilingual French-Czech grammar school in Tábor.**
  - French leaving exams according to French Ministry of Education
  - Selected subjects were taken in French language

## Actual field of interest

### Science

- Ultrafast Spintronics THz & optical investigation of the ultrafast response of spin-orbit-interaction or topology-driven effects (spin and anomalous Hall effects, spin torques, anisotropic and spin-Hall magnetoresistance, spin Seebeck effect) in various metallic and semiconductor systems with and without magnetic order, including novel materials as transition metal dichalcogenides, antiferromagnetic CuMnAs/Mn<sub>2</sub>Au or altermagnets

Novel THz emission sources	Development and optimization of novel type of THz sources based on spin-to-charge current conversion in ferromagnetic/non-magnetic interfaces
Modeling	Modeling of ultrafast spin transport in THz frequency range
Semiconductor Spintronics	Spin Hall effect and spin relaxation in nonmagnetic semiconductors in high mobility regime (2D electron systems based on GaAs/AlGaAs heterostructures, undoped bulk GaAs), time and spatially resolved optical injection and detection of spin-polarized carriers/currents; optospintronic devices

### Popularization of science

Public talks	Lectures and articles for broader public on spintronic and general physics topics, e. g. talks in National Museum, Sisyfos club or Comic-Con Prague, articles in Vesmír journal or Tiscali News (2010–present)
"Physics in your hands"	Organizing multiple series of scientific exhibitions focused on high school students, popularizing the modern parts of the general physics, optics in particular (2013–2016)

### Other

Writing and publishing fiction, photography, economic sociology and contemporary philosophy

## Skills

### Experimental

Optics	Emission and transmission terahertz spectroscopy; THz-pump/optical-probe methods, optical spin injection and detection in semiconductors; spatially and time-resolved pump and probe magneto-optical techniques; femtosecond and high-power laser systems; far infrared Fourier spectroscopy in high magnetic fields; photoluminescence; cryogenic operations
Transport	Time-resolved electrical measurements; ballistic and diffusive electronic transport in low dimensions
Technology	Electron-beam and UV lithography, plasma and chemical etching, thin layer sputtering and thermal vapor deposition, microbonding, cryogenic and vacuum techniques
Technical	Remote-control and automation programming using various environments (LabView, Matlab, Python), signal noise analysis

### Theoretical

Modelling	Modelling of ultrafast spin transport in multilayer systems driven by terahertz/optical excitation
-----------	--

### Academic

Supervisions	Supervisor of 2 Doctoral, 2 Master and 4 Bachelor theses
Teaching	1 course in Doctoral programme, 2 courses in Master programme, 2 tutorials in Bachelor programme, practical tutorials

### Languages

English	<b>Fluent</b>	<i>University exam</i>
French	<b>Fluent</b>	<i>Degree DALF-C1, French highschool-leaving exam</i>
Czech	<b>Native</b>	<i>Rhetoric University courses</i>
Esperanto	<b>Intermediate</b>	<i>Amateur</i>

## Computer skills

Scientific	Matlab, LabView, Origin, Python	Programming	Delphi, Matlab, HTML, Python, automation and remote-control
Typography	L <sup>A</sup> T <sub>E</sub> X, MS Office	Presentation	Beamer, MS Powerpoint
Graphics	Adobe Photoshop, Adobe Illustrator, RAW processing		

## Other

Driving licence – B

---

## Awards and Memberships

### Awards

Bernard Bolzano Foundation	Award of the Bernard Bolzano Foundation, section Physics (2021)
Milan Odehnal's Award	Milan Odehnal's Award for Young Physicists, Czech Physical Society, Union of Czech Mathematicians and Physicists (2016)
Spectroscopic Society Award	1 <sup>st</sup> prize in the Best Young Scientists' Publication in Spectroscopy Award, Ioannes Marcus Marci Spectroscopic Society (2016)
Dean's Award	Dean's Award for representation and propagation, Faculty of Mathematics and Physics, Charles University in Prague (2014)
Best Oral Presentation	First Prize in Best Student Oral Award, 3 <sup>rd</sup> International Symposium on Optics and its Applications (2015)
Best Oral Presentation	Award for the most understandable oral presentation, 3KK Conference and Meeting of Czech and Slovak physicists and mathematicians, Prague (2016)
Best Poster	Best Poster Award, 59 <sup>th</sup> Conference on Magnetism and Magnetic Materials (2014)
Best Student Paper	Chief organizer of the Best Master Student Paper Award, held by the Charles University in Prague Student Chapter of the SPIE (2015)

### Grants

GAČR	Joint international project with DFG (2021–2024)
GACU	Student funding from the Grant Agency of the Charles University (2011–2012)

### Memberships

SPIE	Member of Executive committee of the Charles University in Prague Student Chapter of the SPIE (2011–2016)
OSA	Member of Executive committee of the Charles University in Prague Student Chapter of the OSA (2012–2016)
Charlie	Member of Revision committee of the Student society for minorities of the Student Union of the Charles University in Prague (2010–2016)

## Publications

### Metrics

- Papers 21 publications, 317/494 citations, h-index: 9/10 (Web of Science / Google Scholar)  
Patents 1 patent at European Patent Office  
Talks 20 oral contributions at international conferences (7 invited talks)  
Posters 9 poster presentations at international conferences

### Papers

- Oct 2022 **Terahertz Spin-to-Charge Current Conversion in Stacks of Ferromagnets and the Transition-Metal Dichalcogenide NbSe<sub>2</sub>,**  
L. Nádvořník, O. Gueckstock, L. Braun, C. Niu, J. Gräfe, G. Richter, G. Schütz, H. Takagi, M. Zeer, T. S. Seifert, P. Kubaščík, A. K. Pandeya, A. Anane, H. Yang, A. Bedoya-Pinto, S. S. P. Parkin, M. Wolf, Y. Mokrousov, H. Nakamura, T. Kampfrath, *Adv. Mater. Interfaces*, 2201675 (2022).
- Oct 2022 **Laser-Induced Terahertz Spin Transport in Magnetic Nanostructures Arises from the Same Force as Ultrafast Demagnetization,**  
R. Rouzegar, L. Brandt, L. Nádvořník, D. A. Reiss, A. L. Chekhov, O. Gueckstock, C. In, M. Wolf, T. S. Seifert, P. W. Brouwer, G. Woltersdorf, and T. Kampfrath, *Phys. Rev. B* **106**, 144427 (2022).
- May 2022 **Transition of Laser-Induced Terahertz Spin Currents from Torque- to Conduction-Electron-Mediated Transport,**  
P. Jiménez-Cavero, O. Gueckstock, L. Nádvořník, I. Lucas, T. S. Seifert, M. Wolf, R. Rouzegar, P. W. Brouwer, S. Becker, G. Jakob, M. Kläui, Ch. Guo, C. Wan, X. Han, Z. Jin, H. Zhao, D. Wu, L. Morellón, and T. Kampfrath, *Phys. Rev. B* **105**, 184408 (2022).
- Feb 2022 **Impact of Gigahertz and Terahertz Transport Regimes on Spin Propagation and Conversion in the Antiferromagnet IrMn,**  
O. Gueckstock, R. L. Seeger, T. S. Seifert, S. Auffret, S. Gambarelli, J. N. Kirchhof, K. I. Bolotin, V. Baltz, T. Kampfrath, and L. Nádvořník, *Appl. Phys. Lett.* **120**, 062408 (2022).
- Dec 2021 **Optically Gated Terahertz-Field-Driven Switching of Antiferromagnetic CuMnAs,**  
J. J. F. Heitz, L. Nádvořník, V. Balos, Y. Behovits, A. L. Chekhov, T. S. Seifert, K. Olejník, Z. Kašpar, K. Geishendorf, V. Novák, R. P. Campion, M. Wolf, T. Jungwirth, and T. Kampfrath, *Phys. Rev. Appl.* **16**, 064047 (2021).
- Jul 2021 **Modulating the Polarization of Broadband Terahertz Pulses from a Spintronic Emitter at Rates up to 10 KHz,**  
O. Gueckstock, L. Nádvořník, T. S. Seifert, M. Borchert, G. Jakob, G. Schmidt, G. Woltersdorf, M. Kläui, M. Wolf, and T. Kampfrath, *Optica* **8**, 1013 (2021).
- Jul 2021 **Superradiant Emission from Coherent Excitons in van Der Waals Heterostructures,**  
G. Haider, K. Sampathkumar, T. Verhagen, L. Nádvořník, F. J. Sonia, V. Valeš, J. Sýkora, P. Kapusta, P. Němec, M. Hof, O. Frank, Y. Chen, J. Vejpravová, and M. Kalbáč, *Adv. Funct. Mater.* **31**, 2102196 (2021).
- May 2021 **Broadband Terahertz Probes of Anisotropic Magnetoresistance Disentangle Extrinsic and Intrinsic Contributions,**  
L. Nádvořník, M. Borchert, L. Brandt, R. Schlitz, K. A. de Mare, K. Výborný, I. Mertig, G. Jakob, M. Kläui, S. T. B. Goennenwein, M. Wolf, G. Woltersdorf, and T. Kampfrath, *Phys. Rev. X* **11**, 021030 (2021).

- March 2021 **Frequency-Independent Terahertz Anomalous Hall Effect in DyCo<sub>5</sub>, Co<sub>32</sub>Fe<sub>68</sub>, and Gd<sub>27</sub>Fe<sub>73</sub> Thin Films from DC to 40 THz**,  
T. S. Seifert, U. Martens, F. Radu, M. Ribow, M. Berritta, L. Nádvořník, R. Starke, T. Jungwirth, M. Wolf, I. Radu, M. Münzenberg, P. M. Oppeneer, G. Woltersdorf, and T. Kampfrath, *Adv. Mater.* **33**, 2007398 (2021).
- Jan 2021 **Ultrafast Photocurrents in MoSe<sub>2</sub> Probed by Terahertz Spectroscopy**,  
D. Yagodkin, L. Nádvořník, O. Gueckstock, C. Gahl, T. Kampfrath, and K. I. Bolotin, *2D Mater.* **8**, 025012 (2021).
- Jan 2021 **Terahertz Spin-to-Charge Conversion by Interfacial Skew Scattering in Metallic Bilayers**,  
O. Gueckstock, L. Nádvořník, M. Gradhand, T. S. Seifert, G. Bierhance, R. Rouzegar, M. Wolf, M. Vafae, J. Cramer, M. A. Syskaki, G. Woltersdorf, I. Mertig, G. Jakob, M. Kläui and T. Kampfrath, *Adv. Mater.* **33**, 2006281 (2021).
- Sep 2020 **Quasi-nondegenerate pump-probe magneto-optical experiment in GaAs/AlGaAs heterostructure based on spectral filtration**,  
M. Surýnek, L. Nádvořník, E. Schmoranzarová and P. Němec, *New J. Phys.* **22**, 093065 (2020).
- Sep 2018 **Terahertz spectroscopy for all-optical spintronic characterization of the spin-Hall-effect metals Pt, W and Cu(80)Ir(20)**,  
T.S. Seifert, N.M. Tran, O. Gueckstock, S.M. Rouzegar, L. Nádvořník, S. Jaiswal, G. Jakob, V.V. Temnov, M. Munzenberg, M. Wolf, M. Klaui and T. Kampfrath, *J. Phys. D* **51**, 364003 (2018).
- July 2018 **Femtosecond formation dynamics of the spin Seebeck effect revealed by terahertz spectroscopy**,  
T.S. Seifert, S. Jaiswal, J. Barker, T.S. Weber, I. Razdolski, J. Cramer, O. Gueckstock, S.F. Maehrlein, L. Nádvořník, S. Watanabe, C. Ciccarelli, A. Melnikov, G. Jakob, M. Munzenberg, S.T.B. Goennenwein, G. Woltersdorf, B. Rethfeld, P.W. Brouwer, M. Wolf, M. Klaui and T. Kampfrath, *Nature Commun.* **9**, 2899 (2018).
- July 2018 **Voigt effect-based wide-field magneto-optical microscope integrated in a pump-probe experimental setup**,  
T. Janda, L. Nádvořník, J. Kuchařík, D. Butkovičová, E. Schmoranzarová, F. Trojánek and P. Němec, *Rev. Sci. Instrum.* **89**, 073703 (2018).
- Sep 2017 **Fast Optical Control of Spin in Semiconductor Interfacial Structures**,  
L. Nádvořník, M. Surýnek, K. Olejník, V. Novák, J. Wunderlich, F. Trojánek, T. Jungwirth and P. Němec, *Phys. Rev. Appl.* **8**, 034022 (2017).
- July 2016 **Enhancement of the spin Hall voltage in a reverse-biased planar pn-junction**,  
L. Nádvořník, K. Olejník, P. Němec, V. Novák, T. Janda, J. Wunderlich, F. Trojánek and T. Jungwirth, *Phys. Rev. B* **94**, 075306 (2016).
- March 2016 **Long-range and high-speed electronic spin-transport at a GaAs/AlGaAs semiconductor interface**,  
L. Nádvořník, P. Němec, T. Janda, K. Olejník, V. Novák, V. Skoromets, H. Němec, P. Kužel, F. Trojánek, T. Jungwirth and J. Wunderlich, *Sci. Rep.* **6**, 22901 (2016).
- March 2015 **Efficient conversion of light to charge and spin in Hall-bar microdevices**,  
L. Nádvořník, J. A. Haigh, K. Olejník, A. C. Irvine, V. Novák, T. Jungwirth and J. Wunderlich, *Phys. Rev. B* **91**, 125205 (2015).
- May 2012 **From laterally modulated two-dimensional electron gas towards artificial graphene**,  
L. Nádvořník, M. Orlita, N. A. Goncharuk, L. Smrčka, V. Novák, V. Jurka, K. Hruška, Z. Výborný, Z. R. Wasilewski, M. Potemski and K. Výborný, *New J. Phys.* **14**, 053002 (2012).

Oct 2012 **Infrared magnetospectroscopy of graphite in tilted fields**,  
N. A. Goncharuk, L. Nádvořník, C. Faugeras, M. Orlita and L. Smrčka *Phys. Rev. B*  
**86**, 155409 (2012).

### Patents

European **Spintronic terahertz emitter**, *European Patent Office, Nr. EP4080178A1*,  
T. Kampfrath, T. S. Seifert, O. Gueckstock, L. Nadvornik, M. Klauui.

### Theses

Doctoral **Relativistic spintronic effects in semiconductor structures**, *defense at Faculty of Mathematics and Physics, Charles University in Prague, planned to September 2016*,  
Supervisor: prof. Tomáš Jungwirth.

Master **Electronic structure of graphene-based materials**, *defended at Faculty of Mathematics and Physics, Charles University in Prague, grade excellent*, Supervisor and consultant: Dr. Milan Orlita and Dr. Karel Výborný.

Bachelor **Magneto-optical spectroscopy of multi-layer epitaxial graphene**, *defended at Faculty of Mathematics and Physics, Charles University in Prague, grade excellent*,  
Supervisor: Dr. Milan Orlita.

### Conference contributions

Oral invited **Magnetoresistive phenomena revealed by time-domain terahertz spectroscopy**,  
*Photonics West: Ultrafast Phenomena and Nanophotonics*, San Francisco, USA,  
(2023).

Oral invited **Spin transport at terahertz frequencies**,  
*International Young Scientists Conference Optics and High Technology Material Science*, Kyiv, Ukraine, (2022).

Oral invited **Spin and magneto-transport at THz frequencies (tutorial)**,  
*International Workshop on Terahertz Phenomena in Magnetism and Ultrafast Spin Transport*, Istanbul, Turkey, (2022).

Oral invited **Spintronic terahertz emitters and their applications**,  
*ELI Summer School*, Szeged, Hungary, (2022).

Oral invited **Terahertz spectroscopy of antiferromagnetic CuMnAs and spin-Hall magnetoresistance**,  
*Spin, waves and interactions*, Greifswald, Germany, (2022).

Oral **Intrinsic and extrinsic components of anisotropic magnetoresistance revealed by terahertz spectroscopy**,  
*Ultrafast Magnetism Conference*, Nancy, France, (2022).

Oral **Broadband terahertz spectroscopy of anisotropic magnetoresistance reveals intrinsic contributions**,  
*Joint Conference on Magnetism and Magnetic Materials & INTERMAG*, New Orleans, USA, (2022).

Oral invited **Time-resolved optical and terahertz studies of thin-film ferromagnets and antiferromagnets**,  
*Conference of Czech and Slovak Physicists*, Prague, Czech Rep., (2020).

Oral invited **Terahertz radiation at service of spintronics: anisotropic magnetoresistance from DC to THz**,  
*International Young Scientists Conference Optics and High Technology Material Science*, Kyiv, Ukraine, (2019).

- Oral **Ultrafast spin dynamics in transition metal dichalcogenides probed by terahertz spectroscopy**, *Joint European Magnetism Symposia*, Mainz, Germany, (2018).
- Oral **Ultrafast magnetization dynamics triggered by intense terahertz pulses**, *Ultrafast Magnetism Conference*, Kaiserslautern, Germany, (2017).
- Oral **Electronic spin transport over tens microns in a nanosecond time-scale in a bare GaAs/AlGaAs layer**, *International Conference of the Physics of Semiconductors*, Beijing, China, (2016).
- Oral **Long-range and high-speed electronic spin transport at a GaAs/AlGaAs semiconductor interface**, *Joint European Magnetic Symposia*, Glasgow, Scotland, (2016).
- Oral **Resolving Hall cross response function by optically injected spin currents**, *International Symposium on Optics and its Applications*, Yerevan, Armenia, (2015).
- Oral **Local and non-local spin dynamics in GaAs-based heterostructures**, *International Colloquium on Magnetic Films and Surfaces*, Kraków, Poland, (2015).
- Oral **Efficient conversion of light to charge and spin in Hall-bar microdevices**, *OPTICS+PHOTONICS*, San Diego, USA, (2015).
- Oral **Artificial graphene – a useful playground for THz spectroscopy**, *International Conference on Semiconductor Mid-IR Materials and Optics*, Prague, Czech Republic, (2015).
- Oral **Spin-orbit interaction of optically injected spin-polarization in a semiconductor**, *Three Kings Conference*, Banská Bystrica, Slovakia, (2013).
- Oral **Artificial graphene concept**, *Colloquium in Department of Physics, State University of New York in Buffalo*, New York, USA, (2011).
- Oral **Perspectives of artificial graphene**, *Colloquium in National Enterprise for nanoScience and nanoTechnology, Scuola Normale Superiore*, Pisa, Italy, (2011).
- Poster **Spin to charge current conversion in transition metal dichalcogenide**, *DPG Meeting*, Berlin, Germany, (2018).
- Poster **Room temperature polarimeter based on the inverse spin Hall effect**, *Conference on Magnetism and Magnetic Materials*, Honolulu, USA, (2014).
- Poster **High sensitivity room temperature polarimeter based on the inverse spin Hall effect**, *SpinTech 2013*, Chicago, USA, (2013).
- Poster **Optically injected spin-polarization in quantum wells**, *European School on Magnetism*, Cargèse, France, (2013).
- Poster **From laterally modulated two-dimensional electron gas towards artificial graphene**, *International Winterschool on New Developments in Solid State Physics*, Mauterndorf, Austria, (2012).
- Poster **Steps towards artificial graphene**, *International Conference on Electronic Properties of Two-Dimensional Systems*, Tallahassee, USA, (2011).
- Poster **Towards artificial graphene**, *International Conference on Low Dimensional Structures and Devices*, Merida, Mexico, (2011).
- Poster **Dirac cones in miniband spectra of artificial graphene**, *International Conference on the Physics of Semiconductors*, Seoul, South Korea, (2010).
- Poster **Miniband-structure of artificial graphene**, *International Winterschool on New Developments in Solid State Physics*, Mauterndorf, Austria, (2010).

## Popularization outputs

- Public lecture **Laser jako světelný meč vědy,**  
*Comic-Con Junior*, Brno, Czech Republic, (2022).
- Public lecture **Technologické sny Star Treku,**  
*Comic-Con Prague*, Prague, Czech Republic, (2022).
- Podcast **Je spintronika budoucností elektroniky?,**  
*Podcasty z Matfyzu: Věda na Matfyzu*, Prague, Czech Republic, (2022).
- Article **Spintronika na terahertzových vlnách,**  
L. Nádvorník, *Vesmír* **101**, 24–27 (2022).
- Public lecture **Spintronika na terahertzových vlnách,**  
*Pátečníci, Sisyfos*, <https://www.youtube.com/watch?v=a39naYdfLV8>, (2021).
- Interview **Vývoj nelze zastavit, musíme se přizpůsobit,**  
*Tiscali News*, Jaroslav Bican, online zpravy.tiscali.cz: Dec 11, 2019 15:01, (2019).
- Public lecture **Ultrarychlá spintronika dneška a zítřka,**  
*Jednota českých matematiků a fyziků*, Pardubice, Czech Republic, (2019).
- Public lecture **Spintronika,**  
*Společnost Ignáce Borna, Národní Muzeum*, Praha, Czech Republic, (2016).
- Public lecture **Spintronika – od teorie relativity k pevným diskům,**  
*Kavárna Universitas, Univerzita Pardubice*, Pardubice, Czech Republic, (2015).