

# Hynek Němec – Curriculum Vitae

## Research interests

I'm interested in three mutually related research areas:



- **Charge transport and their terahertz response in semiconductor nanostructures.** Charge transport in complex nanostructures is influenced by a plethora of processes, including namely charge motion inside individual nanoparticles and charge transfer among the nanoparticles. While measurements of dc conductivity contain information on the process with the worst conductivity (which is typically the charge transfer among nanoparticles), measurements of terahertz conductivity spectra selectively monitor charge motion inside the nanoparticles. Our interpretation of the terahertz spectra is based on combined semi-classical simulations of charge motion, and effective medium approximation [[Adv. Opt. Mater. 7, 1900623 \(2019\)](#)].
- **Photonic structure and metamaterials for terahertz spectral range.** Terahertz radiation may be used for wireless communications transferring large amounts of data. The applications require a large number of key elements allowing manipulation with the terahertz radiation. In our research, we focused on the development of tunable resonant structures; for example, we achieved an artificial (effective) magnetic activity in TiO<sub>2</sub> microspheres at terahertz frequencies [[Appl. Phys. Lett. 100, 061117 \(2012\)](#)].
- **Developments of methods in time-domain terahertz spectroscopy.** While measurements of terahertz transmission and reflection spectra is nowadays a routine task performed using commercial setups, an accurate and reliable analysis of these spectra is still not fully mastered. For example, in the work [[Opt. Exp. 24, 10157 \(2016\)](#)] we explained the fundamental influence of the depth-profile of the excitation beam on the retrieval of terahertz photoconductivity from reflection terahertz spectra.

## Grants and scholarships

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| 2023-     | Co-investigator of Grant by Czech Science Foundation (project 23-05640S: Electron tunneling in coupled semiconductor nanostructures triggered by plasmon resonance at terahertz frequencies); 415 k€.  |
| 2020-2021 | Principal investigator of Grant by Czech Science Foundation (project 19-03765S: Controllable GHz-THz nonlinear optics in semiconductor superlattices); 150 k€.   |
| 2019-2022 | Co-investigator of Grant Erasmus+ (project 2019-1-SK01-KA201-060798: Development of Inquiry Based Learning via IYPT [DIBALI]); 234 k€.   |
| 2017-2019 | Principal investigator of Grant by Czech Science Foundation (project 17-04412S: Charge transport and phase transitions in cobalt oxides investigated by terahertz spectroscopy); 250 k€.   |
| 2016-2022 | Principal investigator of Support of Talented Basic- and High-School Students by Czech Ministry of Youth and Education (project Vydra – Výlet do reálné vědecké práce ve fyzice; nr. 0044/7/NAD/2021, 0039/7/NAD/2019, 0022/7/NAD/2018, 0049/7/NAD/2017, 0057/7/NAD/2015); 5 – 7 k€ for each year. |
| 2012-2015 | Principal investigator of Grant supporting international collaboration by Academy of Sciences of the Czech Republic (project M100101218: Localization and transport of   |

charge carriers in functional semiconductor nanostructures and applications for terahertz technologies); 70 k€, 7 researchers.

- 2009-2011 Principal investigator of Grant by Czech Science Foundation (project 202-09-P099: Ultrafast electron dynamics in disordered organic and inorganic semiconductors studied by time-resolved terahertz spectroscopy); 30 k€.
- 2006-2007 Guest Scholarship Programme (Swedish Institute); 9 month
- 2006-2007 Various travel grants in Sweden (3 k€ in total)

## Miscellaneous

- 2022 – Member of the editorial and advisory board of [J. Phys. D](#)
- 2017-2021 Member of the advisory board of [Czech Science Foundation](#) (panel P204)
- 2021– Member of the committee for state exams in the master's study program Physics of Condensed Matter and Materials, at Faculty of Mathematics at Physics, Charles University
- Referee for journals such as Phys. Rev., Opt. Exp., outstanding referee of J. Phys. D (2017).
- Leader of various activities with high school students (courses [VYDRA](#), juror and co-organizer of [Young Physicist's Tournament](#)).
- Member of the [Union of Czech Mathematicians and Physicists](#)

## Positions

- since 2016 Senior scientist at Institute of Physics, Academy of Sciences of the Czech Republic
- 2008-2015 Research scientist at Institute of Physics, Academy of Sciences of the Czech Republic
- 9/2011 Invited professor at Bordeaux University (development of technologies for fabrication of terahertz metamaterials)
- 2006-2007 Postdoctoral fellow at [Chemical Center at Lund University](#), Sweden
- 2003-2006 Research scientist at Institute of Physics, Academy of Sciences of the Czech Republic
- 2000-2002 Student position at Institute of Physics, Academy of Sciences of the Czech Republic

## Academic education

- 2002-2006 PhD in Physics of condensed matter and material research, and Optics and optoelectronics at Charles University in Prague, and Institut National Polytechnique de Grenoble, respectively.
- Thesis title: [Time-resolved terahertz spectroscopy applied to the investigation of magnetic materials and photonic structures](#).
- Supervisors: Petr Kužel, and Lionel Duvillaret (co-tutelle)
- 1997-2002 Masters Degree in Condensed matter physics at Charles University in Prague
- Thesis title: [Application of methods in THz time domain spectroscopy for studying the ultrafast dynamics in condensed matter](#).