# Dr. Vasily Kravtsov

Assistant Professor, Faculty of Physics
School of Physics and Engineering
ITMO University, Saint Petersburg, Russia
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## EDUCATION

**University of Colorado at Boulder** — Boulder, CO, USA
PhD, Physics — 2017
Dissertation: "Femtosecond Nonlinear Optical Imaging and Spectroscopy on the Nanoscale"

**Lomonosov Moscow State University** — Moscow, Russia
Diploma, Physics — 2009
Specialty: Fundamental Radiophysics and Physical Electronics

## ACADEMIC EXPERIENCE

**Faculty of Physics, ITMO University** — St Petersburg, Russia
Assistant Professor — 2021 – present
Head of laboratory "Low-dimensional quantum materials"

**ITMO University** — St Petersburg, Russia
Leading Research Fellow — 2018 – present
Research interests: nanophotonics, quantum materials, strong light–matter coupling, exciton-polaritons, single photon emitters, ultrafast dynamics, nonlinear optics

**University of Colorado at Boulder** — Boulder, CO, USA
Research Assistant with Prof. Markus B. Raschke — 2012 – 2017
Research interests: near-field optical microscopy and spectroscopy, 2D materials, ultrafast and nonlinear optics, plasmonics

## FUNDED PROJECTS (PI)

**Russian Science Foundation & DST India** — 2025–2027
21,000,000 RUB
Harnessing 2D van der Waals semiconducting heterostructures for quantum optoelectronic devices (25-42-01019)

**Ministry of Science and Education of Russian Federation** — 2025–2027
24,000,000 RUB
Frontier Laboratory: Semiconductor van der Waals heterostructures for optoelectronics (Priority 2030)

**Ministry of Science and Education of Russian Federation** — 2024–2024
19,000,000 RUB

Hybrid nanostructures for quantum optical technologies (Goszadanie 2019-1246)

**Ministry of Science and Education of Russian Federation** 2022–2024
50,000,000 RUB
Frontier Laboratory: Functional materials for polaritonic quantum logic (Priority 2030)

**Russian Science Foundation** 2021–2024
18,000,000 RUB
Nonlinear nanophotonics in resonant structures based on 2D materials (21-72-10100)

**Russian Foundation for Basic Research & NRF Korea** 2020–2022
5,000,000 RUB
Investigation of valleytronic quantum emitters in 2D van der Waals heterostructures with local strain engineering (19-52-51010)

**Russian Science Foundation** 2019–2021
3,000,000 RUB
Investigation of spin–valley dynamics in 2D van der Waals heterostructures with local strain control (19-72-00146)

## AWARDS

**KNVSh award of Saint Petersburg for scientific research** 2024–2024
Project title: "Electrically tunable photonic crystals based on 2D van der Waals semiconductors"

**China Overseas Experts Scholarship** 2022–2023
Project title: "Nano-spectroscopy and imaging of 2D polaritons"

**ITMO Fellowship** 2018–2021
Project title: "Optical nonlinearity of exciton-polaritons in nanophotonic systems based on 2D transition metal dichalcogenides"

## TEACHING EXPERIENCE

**ITMO University** 2018–present
Experimental Methods of Nanophotonics (MSc course, guest lectures)
Introduction to Quantum Optics (MSc course, lecturer)
Optical and transport properties in the strong light-matter coupling regime (MSc course, lecturer)

**University of Colorado at Boulder** 2011–2012
General Physics I and II (BSc course, teaching assistant, seminars/consultations/grading)
Introduction to Modern Physics (BSc course, teaching assistant, consultations/grading)

## STUDENT SUPERVISION

| | |
|---|---|
| **Aleksey Liubomirov**, SPbU, MSc 2020, co-supervision | 2018–2020 |
| **Fedor Benimetskiy**, ITMO, PhD 2021, co-supervision | 2018–2021 |
| **Ekaterina Alimova**, SPbPU, BSc 2022 | 2021–2022 |
| **Mikhail Tiugaev**, ITMO, MSc 2023 | 2021–2023 |
| **Alexey Mikhin**, ITMO, PhD 2024 | 2022–2024 |
| **Valery Kondratyev**, ITMO, MSc 2021 | 2020–2024 |
| **Artem Abramov**, ITMO, MSc 2022, PhD student | 2019–present |
| **Ivan Kalantaevskii**, ITMO, MSc 2024, PhD student | 2023–present |
| **Tatiana Oskolkova**, ITMO, MSc student | 2024–present |
| **Egor Neklyudov**, ITMO, BSc 2025, MSc student | 2023–present |
| **Tatiana Gorelkina**, ITMO, MSc student | 2024–present |
| **Dmitry Berezin**, ITMO, MSc student | 2024–present |

## SELECTED ORAL TALKS

- "Nonlinear exciton-polaritons in 2D semiconductors as a platform for on-chip optical information processing," presented at Tongji University, December 2024, Shanghai, China (invited).
- "Imaging of single-photon emitters within nanoscale strain profiles in a monolayer semiconductor," presented at ISPSA 2024, June 2024, Jeju, South Korea (invited).
- "Nonlinear exciton-polaritons in waveguides based on monolayer semiconductors," presented at OYSS2023, October 2023, Changsha, China (invited).
- "2D semiconductor platform for single photon sources," presented at Skoltech ReNEW workshop, July 2023, Moscow, Russia (invited).
- "Near-field spectroscopy and control of excitons in 2D van der Waals heterostructures," presented at APNFO14, June 2023, Busan, South Korea (invited).
- "Probing and controlling excitons in 2D semiconductors under weak and strong light-matter coupling," presented at Polaritonics Seminar Series at Skoltech, February 2023, Moscow, Russia (invited).
- "Nonlinear polaritonics with 2D semiconductors," presented at Winter School on Photonics, December 2022, Saint Petersburg, Russia (invited).
- "Control of nonlinear exciton-polaritons in resonators based on atomically thin semiconductors," presented at XV Russian Conference on Semiconductor Physics, October 2022, Nizhny Novgorod, Russia.
- "Valley dynamics in heterobilayers of alloy-based transition metal dichalcogenides," presented at METANANO, September 2021, online.

- "Nonlinear nano-optics with 2D van der Waals materials," presented at IV International Summer School on Nonlinear Photonics, August 2021, Novosibirsk, Russia (invited).
- "Nonlinear polaritons in monolayer $MoSe_2$ coupled to optical bound states in the continuum," presented at SPIE Photonics Europe, April 2020, online.
- "Ultrafast coherent dynamics in nonlinear nano-optics and nano-imaging of graphene," presented at METANANO, July 2019, St Petersburg, Russia.
- "Strong coupling of excitons in $MoSe_2$ and optical bound states in the continuum," presented at ICP2DC4, June 2019, Hangzhou, China.
- "Near-field spectroscopy of single molecules, 2D materials, and localized plasmonic modes," presented at St Petersburg State University, March 2018, St Petersburg, Russia.
- "Coherent femtosecond spectroscopy and nonlinear optical imaging on the nanoscale," presented at ICFO, June 2017, Barcelona, Spain (invited).
- "Plasmonic nano-focused four-wave mixing for femtosecond nano-imaging," presented at APS March Meeting, March 2016, Baltimore, MD, USA.
- "Plasmonic nano-focused four-wave mixing," presented at CLEO, May 2015, San Jose, CA, USA.
- "Control of plasmonic coupling and radiative emission in plasmon-enhanced photoluminescence," presented at APS March Meeting, March 2014, Denver, CO, USA.
- "Femtosecond adiabatic nanofocusing on a tip: spatio-temporal control and slow light," presented at SPP6, May 2013, Ottawa, Canada.

## PUBLICATIONS

- A. O. Mikhin, A. A. Seredin, R. S. Savelev, D. N. Krizhanovskii, A. K. Samusev, and **V. Kravtsov**, "Planar Bragg microcavities with monolayer $WS_2$ for strong exciton-photon coupling," *arXiv preprint*, arXiv:2409.06335.
- Y. Koo, D. K. Oh, J. Mun, A. N. Abramov, M. Tyugaev, Y. B. Kim, I. Kim, T. H. Kim, S. Yang, Y. Kim, J. Kim, **V. Kravtsov**, J. Rho, and K.-D. Park, "High momentum two-dimensional propagation of emitted photoluminescence coupled with surface lattice resonance," *Light: Science & Applications* **14**, 218 (2025).
- P. Alekseev, I. A. Milekhin, K. A. Gasnikova, I. A. Eliseyev, V. Yu. Davydov, A. Bogdanov, **V. Kravtsov**, A. Mikhin, B. R. Borodin, and A. G. Milekhin, "Engineering whispering gallery modes in $MoSe_2/WS_2$ double heterostructure nanocavities: Towards developing all-TMDC light sources," *Materials Today Nano* **30**, 100633 (2025).
- A. Kuznetsov, M. A. Anikina, A. N. Toksumakov, A. N. Abramov, V. V. Dremov, E. Zavyalova, V. M. Kondratev, V. V. Fedorov, I. S. Mukhin, **V. Kravtsov**, K. S. Novoselov, A. V. Arsenin, V. S. Volkov, D. A. Ghazaryan, and A. D. Bolshakov, "In-plane directional $MoS_2$ emitter employing dielectric nanowire cavity," *Small Structures* **6**, 2400476 (2025).

- N. V. Glebov, M. A. Masharin, A. Yulin, A. Mikhin, M. R. Miah, H. V. Demir, D. N. Krizhanovskii, **V. Kravtsov**, A. K. Samusev, and S. V. Makarov, "Room-temperature exciton-polariton-driven self-phase modulation in planar perovskite waveguides," *ACS Nano* **19**, 14097 (2025).
- Z. Zhao, **V. Kravtsov**, Z. Wang, Z. Zhou, L. Dou, D. Huang, Z. Wang, X. Chen, M. Raschke, and T. Jiang, "Ultrafast nano-spectroscopy and nano-imaging with tip-based microscopy," *eLight* **5**, 1 (2025).
- H. Lee, S. Kim, S. Eom, G. Ji, S. H. Choi, H. Joo, J. Bae, K. K. Kim, **V. Kravtsov**, H.-R. Park, and K.-D. Park, "Quantum tunneling 8 MHz nano-excitonic modulator," *Nature Communications* **15**, 8725 (2024).
- E. Khestanova, V. Shahnazaryan, V. K. Kozin, V. I. Kondratyev, D. N. Krizhanovskii, M. S. Skolnick, I. A. Shelykh, I. V. Iorsh, and **V. Kravtsov**, "Electrostatic control of nonlinear photonic-crystal polaritons in a monolayer semiconductor," *Nano Letters* **24**, 7350–7357 (2024).
- Y. Koo, T. Moon, M. Kang, H. Joo, C. Lee, H. Lee, **V. Kravtsov**, and K.-D. Park, "Dynamical control of nanoscale light-matter interactions in low-dimensional quantum materials," *Light: Science & Applications* **13**, 30 (2024).
- F. A. Benimetskiy, A. V. Yulin, A. O. Mikhin, **V. Kravtsov**, I. V. Iorsh, M. S. Skolnick, I. A. Shelykh, D. N. Krizhanovskii, and A. K. Samusev, "Nonlinear self-action of ultrashort guided exciton-polariton pulses in dielectric slab coupled to 2D semiconductor," *2D Materials* **10**, 045016 (2023).
- A. N. Abramov, I. Y. Chestnov, E. S. Alimova, T. Ivanova, I. S. Mukhin, D. N. Krizhanovskii, I. A. Shelykh, I. V. Iorsh, and **V. Kravtsov**, "Photoluminescence imaging of single photon emitters within nanoscale strain profiles in monolayer $WSe_2$," *Nature Communications* **14**, 5737 (2023).
- V. I. Kondratyev, D. V. Permyakov, T. V. Ivanova, I. V. Iorsh, D. N. Krizhanovskii, M. S. Skolnick, **V. Kravtsov**, and A. K. Samusev, "Probing and control of guided exciton-polaritons in a 2D semiconductor-integrated slab waveguide," *Nano Letters* **23**, 7876–7882 (2023).
- A. Kuznetsov, E. Moiseev, A. N. Abramov, N. Fominykh, V. A. Sharov, V. M. Kondratev, I. I. Shishkin, K. P. Kotlyar, D. A. Kirilenko, V. V. Fedorov, S. A. Kadinskaya, A. A. Vorobyev, I. S. Mukhin, A. V. Arsenin, V. S. Volkov, **V. Kravtsov**, and A. D. Bolshakov, "Elastic gallium phosphide nanowire optical waveguides — versatile subwavelength platform for integrated photonics," *Small*, 2301660 (2023).
- Y. Koo, H. Lee, T. Ivanova, R. S. Savelev, M. I. Petrov, **V. Kravtsov**, and K.-D. Park, "Nanocavity-integrated van der Waals heterobilayers for nano-excitonic transistor," *ACS Nano* **17**, 4854–4861 (2023).
- W. Luo, B. G. Whetten, **V. Kravtsov**, A. Singh, Y. Yang, D. Huang, X. Cheng, T. Jiang, A. Belyanin, and M. B. Raschke, "Ultrafast nanoimaging of electronic coherence of monolayer $WSe_2$," *Nano Letters* **23**, 1767–1773 (2023).
- E. Khestanova, T. Ivanova, R. Gillen, A. D. Elia, O. N. G. Lacey, L. Wysocki, A. Gruneis, **V. Kravtsov**, W. Strupinski, J. Maultzsch, V. Kandyba, M. Cattelan, A. Barinov, J. Avila, P. Dudin, and B. V. Senkovskiy, "Robustness of momentum-indirect interlayer excitons in $MoS_2/WSe_2$ heterostructure against charge carrier doping," *ACS Photonics*, **10**, 1159–1168 (2023).

- Y. Koo, H. Lee, T. Ivanova, A. Kefayati, V. Perebeinos, E. Khestanova, **V. Kravtsov**, and K.-D. Park, "Tunable interlayer excitons and switchable interlayer trions via dynamic near-field cavity," *Light: Science & Applications* **12**, 59 (2023).

- **V. Kravtsov**, T. Ivanova, A. N. Abramov, P. V. Shilina, P. O. Kapralov, D. N. Krizhanovskii, V. N. Berzhansky, V. I. Belotelov, I. A. Shelykh, A. I. Chernov, and I. V. Iorsh, "Valley polarization of trions in monolayer $MoSe_2$ interfaced with bismuth iron garnet," *2D Materials* **9**, 015019 (2022).

- **V. Kravtsov**, A. D. Liubomirov, R. V. Cherbunin, A. Catanzaro, A. Genco, D. Gillard, E. M. Alexeev, T. Ivanova, E. Khestanova, I. A. Shelykh, et al., "Spin–valley dynamics in alloy-based transition metal dichalcogenide heterobilayers," *2D Materials* **8**, 025011 (2021).

- **V. Kravtsov**, E. Khestanova, F. A. Benimetskiy, T. Ivanova, A. K. Samusev, I. S. Sinev, D. Pidgayko, A. M. Mozharov, I. S. Mukhin, M. S. Lozhkin, et al., "Nonlinear polaritons in a monolayer semiconductor coupled to optical bound states in the continuum," *Light: Science & Applications* **9**, 56 (2020).

- F. Benimetskiy, V. Sharov, P. Alekseev, **V. Kravtsov**, K. Agapev, I. Sinev, I. Mukhin, A. Catanzaro, R. Polozkov, E. Alexeev, et al., "Measurement of local optomechanical properties of a direct bandgap 2D semiconductor," *APL Materials* **7**, 101 126 (2019).

- T. Jiang, **V. Kravtsov**, M. Tokman, A. Belyanin, and M. B. Raschke, "Ultrafast coherent dynamics in nonlinear nanooptics and nanoimaging of graphene," *Nature Nanotechnology* **14**, 838–843 (2019).

  News and Views: A. Giugni, "Plasmonics: Non-locality by nanoconfinement", *Nature Nanotechnology* **14**, 814–815 (2019).

- **V. Kravtsov**, S. AlMutairi, R. Ulbricht, A. R. Kutayiah, A. Belyanin, and M. B. Raschke, "Enhanced third-order optical nonlinearity driven by surface-plasmon field gradients," *Physical Review Letters* **120**, 203 903 (2018).

- A. Damodaran, J. Clarkson, Z. Hong, H. Liu, A. Yadav, C. Nelson, S.-L. Hsu, M. McCarter, K.-D. Park, **V. Kravtsov**, et al., "Phase coexistence and electric-field control of toroidal order in oxide superlattices," *Nature Materials* **16**, 1003 (2017).

  News and Views: M. Dawber, "Oxide superlattices: Balancing polar vortices and stripes", *Nature Materials* **16**, 971–972 (2017).

- **V. Kravtsov**, R. Ulbricht, J. M. Atkin, and M. B. Raschke, "Plasmonic nanofocused four-wave mixing for femtosecond near-field imaging," *Nature Nanotechnology* **11**, 459–464 (2016).

  News and Views: H. Petek, "Imaging: Nano meets femto", *Nature Nanotechnology* **11**, 404–405 (2016).

- M. Mueller, **V. Kravtsov**, A. Paarmann, M. B. Raschke, and R. Ernstorfer, "Nanofocused plasmon-driven sub-10 fs electron point source," *ACS Photonics* **3**, 611–619 (2016).

- K. D. Park, E. A. Muller, **V. Kravtsov**, P. M. Sass, J. Dreyer, J. M. Atkin, and M. B. Raschke, "Variable-temperature tip-enhanced Raman spectroscopy of single-molecule fluctuations and dynamics," *Nano Letters* **16**, 479–487 (2016).

- K. D. Park, O. Khatib, **V. Kravtsov**, G. Clark, X. D. Xu, and M. B. Raschke, "Hybrid tip-enhanced nanospectroscopy and nanoimaging of monolayer $WSe_2$ with local strain control," *Nano Letters* **16**, 2621–2627 (2016).
- **V. Kravtsov**, S. Berweger, J. M. Atkin, and M. B. Raschke, "Control of plasmon emission and dynamics at the transition from classical to quantum coupling," *Nano Letters* **14**, 5270–5275 (2014).
- C. Blum, L. Opilik, J. M. Atkin, K. Braun, S. B. Kammer, **V. Kravtsov**, N. Kumar, S. Lemeshko, J. F. Li, K. Luszcz, T. Maleki, A. J. Meixner, S. Minne, M. B. Raschke, B. Ren, J. Rogalski, D. Roy, B. Stephanidis, X. Wang, D. Zhang, J. H. Zhong, and R. Zenobi, "Tip-enhanced Raman spectroscopy - an interlaboratory reproducibility and comparison study," *Journal of Raman Spectroscopy* **45**, 22–31 (2014).
- **V. Kravtsov**, J. M. Atkin, and M. B. Raschke, "Group delay and dispersion in adiabatic plasmonic nanofocusing," *Optics Letters* **38**, 1322–1324 (2013).

## PATENTS

- A. N. Abramov, V. Kravtsov, and I. V. Iorsh, "Two-dimensional semiconductor based single photon source with radiation into a nanophotonic waveguide", RU0000204747 (2021), in Russian.

## CONFERENCE PROCEEDINGS

- A. O. Mikhin, N. Glebov, M. Masharin, A. V. Yulin, S. V. Makarov, D. N. Krizhanovskii, A. K. Samusev, and V. Kravtsov, "Nonlinear propagation of ultrashort pulses in nanophotonic halide perovskite waveguides," in *2024 International Conference Laser Optics (ICLO)* **2024**, 282 (2024).
- A. N. Abramov, I. Yu. Chestnov, I. V. Iorsh, and V. Kravtsov, "Localization microscopy of single photon emitters in locally strained monolayer semiconductor," in *St. Petersburg State Polytechnical University Journal. Physics and Mathematics* **16**, 273 (2023).
- W. Luo, B. G. Whetten, V. Kravtsov, A. Singh, Y. Yang, D. Huang, X. Cheng, T. Jiang, A. Belyanin, and M. B. Raschke, "Nonlinear nano-optics and ultrafast nano-imaging of electronic coherence in monolayer $WSe_2$," in *Conference on Lasers and Electro-Optics* p. FF2G.6 (2023).
- V. I. Kondratiev, T. I. Ivanova, M. D. Tyugaev, A. K. Samusev, and V. Kravtsov, "Experimental study of all-van-der-Waals waveguide polaritons at room temperature," in *St. Petersburg State Polytechnical University Journal. Physics and Mathematics* **15**, 223 (2022).
- F. Benimetskiy, A. Yulin, V. Kravtsov, A. Mikhin, I. Iorsh, A. Samusev, and D. Krizhanovskii, "Guided exciton-polaritons in a subwavelength dielectric slab integrated with a 2D semiconductor," in *Journal of Physics: Conference Series* **2015**, 012 014 (2021).

- V. Kondratyev, D. Permyakov, V. Kravtsov, D. Krizhanovskii, and A. Samusev, "Probing guided monolayer semiconductor polaritons below the light line," in *Journal of Physics: Conference Series* **2015**, 012 069 (2021).
- W. Luo, T. Jiang, V. Kravtsov, M. Tokman, A. Belyanin, and M. B. Raschke, "Nano-imaging the Few-fs Coherent Dynamics of Graphene," in *Conference on Lasers and Electro-Optics* p. FTu4I.3 (2021).
- F. A. Benimetskiy, V. A. Sharov, P. A. Alekseev, V. Kravtsov, K.-D. Park, A. K. Samusev, and I. V. Iorsh, "Measurement of local optomechanical properties of MoSe2 monolayers," in *AIP Conference Proceedings* **2300**, 020 008 (2020).
- V. Kondratyev, F. Benimetskiy, T. Ivanova, A. Samusev, K.-D. Park, D. N. Krizhanovskii, M. S. Skolnick, E. Khestanova, V. Kravtsov, and I. Iorsh, "Electrically tunable trion-polaritons in MoSe2/hBN heterostructure integrated with a photonic crystal slab," in *AIP Conference Proceedings* **2300**, 020 062 (2020).
- F. A. Benimetskiy, V. Kravtsov, E. Khestanova, I. Sinev, A. Samusev, and I. Iorsh, "Propagation of exciton-polaritons in monolayer semiconductor coupled to at-Γ bound state in the continuum," in *AIP Conference Proceedings* **2300**, 020 009 (2020).
- T. Jiang, W. Luo, V. Kravtsov, M. Tokman, A. Belyanin, and M. B. Raschke, "Femtosecond nano-imaging of the few-femtosecond coherent dynamics of two-dimensional materials," in *The 22nd International Conference on Ultrafast Phenomena 2020*, p. W2B.5 (2020).
- A. Liubomirov, V. Kravtsov, and R. Cherbunin, "Spin-Valley Dynamics of Interlayer Excitons in Heterobilayers MoxW1–xSe2/WSe2," in *Semiconductors* **54**, 1518–1521 (2020).
- F. A. Benimetskiy, V. Kravtsov, E. Khestanova, I. S. Mukhin, I. S. Sinev, A. K. Samusev, I. A. Shelykh, D. N. Krizhanovskii, M. S. Skolnick, and I. V. Iorsh, "Strong coupling of excitons in 2D MoSe2/hBN heterostructure with optical bound states in the continuum," in *Journal of Physics: Conference Series* **1461**, 012 012 (2020).
- T. Jiang, V. Kravtsov, M. Tokman, A. Belyanin, and M. B. Raschke, "Nonlinear Nanoimaging of Ultrafast Coherent Dynamics of Graphene," in *CLEO: 2019*, p. FM2C.1 (2019).
- V. Kravtsov, R. Ulbricht, J. M. Atkin, and M. B. Raschke, "Femtosecond Near-Field Imaging with Plasmonic Nanofocused Four-Wave Mixing," in *International Conference on Ultrafast Phenomena*, p. UW1A.5 (2016).
- V. Kravtsov, R. Ulbricht, J. M. Atkin, and M. B. Raschke, "Plasmonic Nano-Focused Four-Wave Mixing," in *CLEO: 2015 Postdeadline Paper Digest*, p. JTh5B.5 (2015).
- K.-D. Park, V. Kravtsov, P. Sass, J. Atkin, E. Muller, and M. Raschke, "Single molecular vibrational relaxation dynamics and adsorbate fluctionality," in *CLEO: 2015*, p. 1551 (2015).
- V. Kravtsov, J. M. Atkin, and M. B. Raschke, "Slow Light Femtosecond Pulses by Adiabatic Plasmonic Nanofocusing," in *CLEO: 2013*, p. QTu2B.6 (2013).