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**Leading Researcher**

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Research group homepage: [http://new.isvch.ru/sotr/khabibullin\\_en/](http://new.isvch.ru/sotr/khabibullin_en/)

**Education**

**Ph.D. in Physics, Moscow State Institute of Radio Engineering, Electronics and Automation (MIREA)** 2012

*Dissertation title:* "Investigation of electronic properties of quantum wells AlGaAs/InGaAs/AlGaAs with combined and delta-doping"

Research advisor: Ivan S. Vasil'evskii

**Specialist in Physics and Math, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)** 2009

**Professional appointments**

**Institute of ultra-high frequency semiconductor electronics of Russian academy of sciences (IUHFSE RAS)**

Leading Researcher 2017–  
Scientific Secretary 2014–  
Senior Researcher 2013–2014  
Researcher 2012–2013

**Bauman Moscow State Technical University**

Senior Researcher 2014–2016

**Institute of Applied Physics of Russian academy of sciences**

Senior Researcher 2016

**National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)**

Professor's Assistant 2012  
Engineer 2009–2012

**Research interests**

- Development of THz sources and detectors: quantum-cascade lasers, photoconductive antennas, plasmonic HEMTs

- THz visualization based on self-mixing effect in QCL
- Low-dimensional systems (quantum wells, wires and dots): fabrication and investigation
- Microwave and mm-wave semiconductor devices and physics: HEMTs based on GaAs, InP and GaN

#### Honors/Awards/Grants/Other

- Laureate of the Annual Prize for the physicists of the Government of Moscow for his contribution to the development of photonics and optoelectronics THz devices 2020
- Gold medal Winner of the Russian academy of Sciences for his contribution to the development of THz quantum-cascade lasers 2019
- Winner of the President of Russia scholarship for young scientists MK-6081.2016.8 2016
- Winner of Skolkovo Summer school for young leaders (at OpUS) 2014
- Scholarship Diploma of the Mokerov foundation for the support of science and education 2011
- Diplomas for the best issue on Kurchatov school for young scientists 2009, 2011
- Certificated expert of the Russian academy of Sciences 2016
- Certificated expert of the Russian Science Foundation 2019
- Full member of scientific council at IUHFSE RAS 2014

#### Reviewer service

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Member of the Editorial board of the "Journal of Nano and microsystem technique" (ISSN 1813-8586).

The expert of the Russian Academy of Sciences (Identification number - 2016-01-4279-3116).

Regular reviewer for IEEE Transactions on Terahertz Science and Technology, Laser Physics Letters, Applied Physics A.

#### Teaching experience

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- Scientific consultant of PhD Thesis: 2016  
Sergei V. Mikhailovich "Frequency and noise parameters of the nanoheterostructure AlGa<sub>N</sub>/Ga<sub>N</sub> HEMT with different thickness of barrier layer"
- Author of two textbook for student:  
"Modeling band diagrams of heterostructures based on A<sup>3</sup>B<sup>5</sup> semiconductors" 2016  
(ISBN - 978-5-9909382-0-5)
- "Fundamentals of molecular beam epitaxy and characterization of thin films" 2016  
(ISBN - 978-5-9909382-1-2)

#### Language proficiency

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Russian: native  
English: advanced  
Spanish: basic

#### Peer-reviewed publication list

- [1] I. E. Ilyakov, B. V. Shishkin, V. L. Malevich, D. S. Ponomarev, R. R. Galiev, A. Yu. Pavlov, A. E. Yachmenev, S. P. Kovalev, M. Chen, R. A. Akhmedzhanov, and **R. A. Khabibullin**, *Efficient optical-to-terahertz conversion in large-area InGaAs photo-Dember emitters with increased indium content*, Optics Letters, 46 (14), 3360-3363 (2021), DOI: 10.1364/OL.428599,

- [2] D. V. Lavrukhin, A. E. Yachmenev, Y. G. Goncharov, K. I. Zaytsev, **R.A. Khabibullin**, A. M. Buryakov, E. D. Mishina, and D. S. Ponomarev, *Strain-Induced InGaAs-Based Photoconductive Terahertz Antenna Detector*, IEEE Trans. THz. Sci. Technol., 11(4), 417 – 424 (2021), DOI: 10.1109/TTHZ.2021.3079977,
- [3] A. S. Sobolev, S. V. Zaitsev-Zotov, M. V. Maytama, E. A. Klimov, A. Y. Pavlov, D. S. Ponomarev, and **R. A. Khabibullin**, *Microwave characterization of a double-barrier GaAs/AlAs resonant tunneling diodes for active microstrip transmission lines*, Optical Engineering 60(8), 082018. <https://doi.org/10.1117/1.OE.60.8.082018>
- [4] R. Henri, K. Nallappan, D.S. Ponomarev, H. Guerboukha, D.V. Lavrukhin, A.E. Yachmenev, **R.A. Khabibullin**, M. Skorobogatiy, *Fabrication and Characterization of an 8x8 Terahertz Photoconductive Antenna Array for Spatially Resolved Time Domain Spectroscopy and Imaging Applications*, IEEE Access, 9, 117691-117702 (2021); DOI: 10.1109/ACCESS.2021.3106227,
- [5] I. V. Minin, O. V. Minin, I. A. Glinskiy, **R. A. Khabibullin**, R. Malureanu, A. Lavrinenko, D. I. Yakubovsky, V. S. Volkov, and D. S. Ponomarev, *Experimental verification of a plasmonic hook in a dielectric Janus particle*, Appl. Phys. Lett. 118, 131107 (2021); DOI: 10.1063/5.0043923,
- [6] Y. V. Lobanov, Y. B. Vakhtomin, I. V. Pentin, V. A. Rosental, K. V. Smirnov, G. N. Goltsman, O. Y. Volkov, I. N. Dyuzhikov, R. R. Galiev, D. S. Ponomarev, and **R. A. Khabibullin**, *Time-resolved measurements of light-current characteristic and mode competition in pulsed THz quantum cascade laser*, Optical Engineering 60(8), 082019. <https://doi.org/10.1117/1.OE.60.8.082019>
- [7] D. V. Lavrukhin, A. E. Yachmenev, Y. G. Goncharov, K. I. Zaytsev, **R.A. Khabibullin**, A. M. Buryakov, E. D. Mishina, and D. S. Ponomarev, *Strain-Induced InGaAs-Based Photoconductive Terahertz Antenna Detector*, IEEE Trans. THz. Sci. Technol., 11(4), 417 – 424 (2021), DOI: 10.1109/TTHZ.2021.3079977
- [8] D. Ushakov, A. Afonenko, **R. Khabibullin**, D. Ponomarev, V. Aleshkin, S. Morozov, and A. Dubinov, *HgCdTe-based quantum cascade lasers operating in the GaAs phonon Reststrahlen band predicted by the balance equation method*, Optics Express, 28(17), 25371-25382 (2020), DOI: 10.1364/OE.398552
- [9] O. Volkov, V. Pavlovskiy, I. Gundareva, **R. Khabibullin** and Y. Divin, *In Situ Hilbert-Transform Spectral Analysis of Pulsed Terahertz Radiation of Quantum Cascade Lasers by High-Tc Josephson Junctions*, IEEE Trans. THz. Sci. Technol., vol. 11, no. 3, pp. 330-338, doi: 10.1109/TTHZ.2020.3034815.
- [10] G. K. Rasulova, I. V. Pentin, Yu. B. Vakhtomin, K. V. Smirnov, **R. A. Khabibullin**, E. A. Klimov, A. N. Klochkov, and G. N. Goltsman, *Pulsed terahertz radiation from a double-barrier resonant tunneling diode biased into self-oscillation regime*, Journal of Applied Physics 128, 224303 (2020) <https://doi.org/10.1063/5.0022052>
- [11] A.E. Yachmenev, S.S. Pushkarev, R. R. Reznik, R.A. Khabibullin, D.S. Ponomarev, *Arsenides- and related III-V materials-based multilayered structures for terahertz applications: various designs and growth technology*, *Progress in Crystal Growth and Characterization of Materials*, 66(2), 100485, 2020, DOI: 10.1016/j.pcrysgrow.2020.100485, IF = 4.463
- [12] I.V. Minin, O.V. Minin, I.A. Glinskiy, **R.A. Khabibullin**, R. Malureanu, A.V. Lavrinenko, D.I. Yakubovsky, A.V. Arsenin, V.S. Volkov, D.S. Ponomarev, *Plasmonic nanojet: an experimental demonstration*, *Optics Letters*, 45(12), 3244, 2020, DOI: 10.1364/OL.391861, IF = 3.866
- [13] D S Ponomarev, D V Lavrukhin, A E Yachmenev, **R A Khabibullin**, I E Semenikhin, V V Vyurkov, K. Marem'yanin, V.I. Gavrilenko, M Ryzhii, M. Shur, T Otsuji and V Ryzhii, *Sub-terahertz FET detector with self-assembled Sn-nanowires*, *J. Phys. D: Appl. Phys.* 53 075102, 2020, DOI: 10.1088/1361-6463/ab588f, IF = 2.829
- [14] A.E. Yachmenev, D.V. Lavrukhin, I.A. Glinskiy, N.V. Zenchenko, Yu.G. Goncharov, I.E. Spektor, R.A. Khabibullin, T. Otsuji, and D.S. Ponomarev, *Metallic and dielectric metasurfaces in*

- photoconductive terahertz devices: a review, *Optical Engineering*, 59(6), 061608, 2019, DOI: 10.1117/1.OE.59.6.061608, IF = 1.40
- [15] Lavrukhin, D.V., Yachmenev, A.E., Pavlov, A.Y., Khabibullin, R.A., Goncharov, Y.G., Spektor, I.E., Komandin, G.A., Yurchenko, S.O., Chernomyrdin, N.V., Zaytsev, K.I., Ponomarev, D.S. Shaping the spectrum of terahertz photoconductive antenna by frequency-dependent impedance modulation, *Semiconductor Science and Technology*, 34 (3), 034005, 2019, DOI: 10.1088/1361-6641/aaff31, IF = 2.654
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- [17] D.V. Lavrukhin, A.E. Yachmenev, I.A. Glinskiy, R.A. Khabibullin, Y.G. Goncharov, M. Ryzhii, T. Otsuji, I.E. Spektor, M. Shur, M. Skorobogatiy, K.I. Zaytsev, D.S. Ponomarev, Terahertz photoconductive emitter with dielectric-embedded high-aspect-ratio plasmonic grating for operation with low-power optical pumps, *AIP Advances* 9, 015112 5p., 2019, DOI: 10.1063/1.5081119, IF = 1.731
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- [22] I. A. Glinskiy, R. A. Khabibullin, D. S. Ponomarev, "Total efficiency of the optical-to-terahertz conversion in photoconductive antennas based on LT-GaAs and In<sub>0.38</sub>Ga<sub>0.62</sub>As," *Russian Microelectronics*, vol. 46, no. 6, pp. 408–413, 2017.
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- two-frequency radiation forming for terahertz carriers generation in optical range," *Proc. IEEE, Systems of Signal Synchronization, Generating and Processing in Telecommunications 2017*.
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- [44] D. V. Lavrukhin, R. A. Khabibullin, D. S. Ponomarev, and P. P. Maltsev, "Photoluminescence of heterostructures containing an  $\text{In}_x\text{Ga}_{1-x}\text{As}$  quantum well with a high In content at different excitation powers," *Semiconductors*, vol. 49, no. 9, pp. 1218–1221, 2015.
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- [46] D. V. Lavrukhin, A. E. Yachmenev, R. R. Galiev, R. A. Khabibullin, D. S. Ponomarev, Y. V. Fedorov, and P. P. Maltsev, "MHEMT with a power-gain cut-off frequency of  $f_{\text{max}} = 0.63$  THz on the basis of a  $\text{In}_{0.42}\text{Al}_{0.58}\text{As}/\text{In}_{0.42}\text{Ga}_{0.58}\text{As}/\text{In}_{0.42}\text{Al}_{0.58}\text{As}/\text{GaAs}$  nanoheterostructure," *Semiconductors*, vol. 48, no. 1, pp. 69–72, 2014.
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- [50] R. A. Khabibullin, I. S. Vasil'evskii, D. S. Ponomarev, G. B. Galiev, E. A. Klimov, L. P. Avakyantz, P. Y. Bokov, and A. V. Chervyakov, "The built-in electric field in P-HEMT heterostructures with near-surface quantum wells  $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{In}_y\text{Ga}_{1-y}\text{As}/\text{GaAs}$ ," *Journal of Physics: Conference Series*, vol. 345, p. 012015, 2012.
- [51] R. A. Khabibullin, I. S. Vasil'evskii, G. B. Galiev, E. A. Klimov, D. S. Ponomarev, R. A. Lunin, and V. A. Kulbachinskii, "Scattering and electron mobility in combination-doped HFET-structures AlGaAs/InGaAs/AlGaAs with high electron density," *Semiconductors*, vol. 45, no. 10, pp. 1321–

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## Patent

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- [1] *Patent Number: RU113072-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev, I.S. Vasilevskii et al. Semiconductor nano-heterostructure has stepped quantum well that has upper and lower interfacial gallium-arsenide layers, each having two layers separated by gallium-arsenide layer and alloyed indium-gallium-arsenide layer.
- [2] *Patent Number: RU113071-U1.* D.S. Ponomarev, R.A. Khabibullin, E.A. Klimov, G.B. Galiev, I.S. Vasilevskii. Semiconductor nanoheterostructure, has semi-insulating base layer, buffer layer and active layer, where one of three layers is arranged in delta-layer of donor atoms, and active layer is symmetrical about center of quantum well.
- [3] *Patent Number: RU2581744-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev et al. The method of determining the lattice parameter in the selected small region of the epitaxial layer with a gradient of chemical composition.
- [4] *Patent Number: RU2582440-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev et al. The semiconductor nanoheterostructures on a GaAs substrate with a modified stop layer  $\text{Al}_x\text{Ga}_{1-x}\text{As}$ .

## Book Chapters

- [1] "Terahertz quantum-cascade laser based on the resonant-phonon depopulation scheme", Rustam A. Khabibullin, Nikolay V. Shchavruk, Aleksandr Yu. Pavlov, Alexey N. Klochkov, Dmitry S. Ponomarev, Igor A. Glinskiy and Petr P. Maltsev, *Fundamental and applied problems of terahertz devices and technologies- Selected Topics in Electronics and Systems*, vol. 58, pp. 103-108 edited by M. Ryzhii, A. Satou, T. Otsuji, (World Scientific Publishing Co. Pte. Ltd., 2017), ISBN 978-981-3223-27-1
- [2] "Intensive terahertz radiation from  $\text{In}_x\text{Ga}_{1-x}\text{As}$  due to photo-dember effect", Dmitry S. Ponomarev, Rustam A. Khabibullin, Aleksandr E. Yachmenev and Petr P. Maltsev, *Fundamental and applied problems of terahertz devices and technologies- Selected Topics in Electronics and Systems*, vol. 58, pp. 109-116 edited by M. Ryzhii, A. Satou, T. Otsuji, (World Scientific Publishing Co. Pte. Ltd., 2017), ISBN 978-981-3223-27-1