

## Curriculum vitae: Roman Efremov



### Address

Shemyakin–Ovchinnikov Institute of  
bioorganic chemistry RAS, Moscow,  
Russia

### Contacts

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## Education

1970– 2007	Russia, Moscow	M.V. Lomonosov Moscow State University (biological faculty)	Awarded professor dedree in biophysics
1970– 1999	Russia, Moscow	M.V. Lomonosov Moscow State University (biological faculty)	DSc in physics & mathematics; specialization: molecular biophysics (thesis: Molecular modeling of membrane-bound domains of proteins and peptides)
1970– 1986	Russia, Moscow	M.V. Lomonosov Moscow State University (biological faculty)	PhD in physics & mathematics (thesis: Topography and microenvironment of chromophore-binding sites in bacterial and visual rhodopsins. Resonance Raman spectroscopy and quantum chemical calculations)
1977– 1983	Russia, Moscow	Moscow Engeneering and Physical Institute, Department of Experimental and Theoretical Physics	Ms in biophysics and radiation physics (thesis: «Mathematical algorithms in protein secondary structure determination based on Raman spectroscopic data and prediction techniques»)

## IBCh positions

2018–to date	Principal research fellow
2018–to date	Leading research fellow
2021–to date	Deputy sci-director

## IBCh memberships

Educational-methodical commission
Dissertation council
Scientific council
Certifying committee

## Titles

2007	Professor
2000	Doctor of Science (Physico-mathematical sciences)
1986	Doctor of Philosophy (Physico-mathematical sciences)

## Contacts

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[Google Scholar](https://scholar.google.com/citations?user=0000-0002-5474-4721)

## Grants and projects

2024– to date	<a href="#">Oncotheranostics and problems of resistance to antitumor and antibacterial drugs</a>
2014– 2016	<a href="#">Компьютерный анализ структурно-функциональных аспектов олигомеризации трансмембранных доменов рецепторов сигнальных систем клетки</a>
2023– to date	<a href="#">Молекулярно-биофизическая платформа для изучения мембранных белков: роль олигомеризации и белок-липидных взаимодействий</a>
2018– 2022	<a href="#">Молекулярно-биофизические аспекты олигомеризации мембранных доменов рецепторов, определяющие клеточную сигнализацию в норме и онкогенезе</a>
2018– 2021	:
2019– 2021	:
2019– 2022	<a href="#">Structural biology of membrane proteins for the development of new drugs and diagnostics</a>

## Publications

1. Maryasevskiy XA, Krasilnikov MS, Straková P, Holoubek J, Frčková T, Panina IS, Krylov NA, Gvozdev DA, Denisov VS, Semenov AN, Lotosh NY, Selishcheva AA, Chistov AA, Gulyak EL, Kozhemyakin GL, Korshun VA, **Efremov RG**, Ustinov AV, Růžek D, Eyer L, Alferova VA (2025). Membrane-Active Singlet Oxygen Photogenerators as a Paradigm for Broad-Spectrum Antivirals: The Case of Halogenated (Boron)-DIPYromethenes. *ACS Appl Mater Interfaces* 17 (3), 4502–4528, [10.1021/acsami.4c17482](https://doi.org/10.1021/acsami.4c17482)
2. Volynsky PE, Urban AS, Pavlov KV, Bershatsky YV, Bocharova OV, Kryuchkova AK, Zlobina VV, Gavrilenkova AA, Dolotova SM, Kamynina AV, Zangieva OT, Taldaev A, Batishchev OV, Okhrimenko IS, Rakitina TV, **Efremov RG**, Bocharov EV (2025). Diverse Interactions of Sterols with Amyloid Precursor Protein Transmembrane Domain Can Shift Distribution Between Alternative Amyloid- $\beta$  Production Cascades in Manner Dependent on Local Lipid Environment. *Int J Mol Sci* 26 (2), 553, [10.3390/ijms26020553](https://doi.org/10.3390/ijms26020553)
3. Neuberger A, Shalygin A, Trofimov YA, Veretenenko II, Nadezhdin KD, Krylov NA, Gudermann T, **Efremov RG**, Chubanov V, Sobolevsky AI (2024). Structure-function analyses of human TRPV6 ancestral and derived haplotypes. *Structure* 33, , [10.1016/j.str.2024.10.018](https://doi.org/10.1016/j.str.2024.10.018)
4. Konshina AG, Bocharov EV, Konovalova EV, Schulga AA, Tolmachev V, Deyev SM, **Efremov RG** (2024). Structural Basis of Activity of HER2-Targeting Construct Composed of DARPIn G3 and Albumin-Binding Domains. *Int J Mol Sci* 25 (21), 11370, [10.3390/ijms252111370](https://doi.org/10.3390/ijms252111370)
5. Polyansky AA, **Efremov RG** (2024). Lipid-Mediated Adaptation of Proteins and Peptides in Cell Membranes. *Biochem (Mosc) Suppl Ser A Membr Cell Biol* 18 (3), 241–256, [10.1134/S1990747824700235](https://doi.org/10.1134/S1990747824700235)
6. Veretenenko II, Trofimov YA, Krylov NA, **Efremov RG** (2024). Nanoscale lipid domains determine the dynamic molecular portraits of mixed DOPC/DOPS bilayers in a fluid phase: A computational insight. *BIOCHIM BIOPHYS ACTA* 1866 (7), 184376, [10.1016/j.bbamem.2024.184376](https://doi.org/10.1016/j.bbamem.2024.184376)
7. Polyansky AA, **Efremov RG** (2024). Transmembrane Domains of Bitopic Proteins as a Key to Understand the Cellular Signaling (A Review). *Russ. J. Bioorganic Chem.* 50 (4), 1202–1214, [10.1134/S1068162024040095](https://doi.org/10.1134/S1068162024040095)
8. Serebrennikova M, Grafskaia E, Maltsev D, Ivanova K, Bashkirov P, Kornilov F, Volynsky P, **Efremov R**, Bocharov E, Lazarev V (2024). TripleP-CPP: Algorithm for Predicting the Properties of Peptide Sequences. *Int J Mol Sci* 25 (13), 6869, [10.3390/ijms25136869](https://doi.org/10.3390/ijms25136869)

9. Trofimov YA, Krylov NA, Minakov AS, Nadezhdin KD, Neuberger A, Sobolevsky AI, **Efremov RG** (2024). Dynamic molecular portraits of ion-conducting pores characterize functional states of TRPV channels. *Communications Chemistry* 7 (1), 119, [10.1038/s42004-024-01198-z](https://doi.org/10.1038/s42004-024-01198-z)
10. Lohan S, Konshina AG, Tiwari RK, **Efremov RG**, Maslennikov I, Parang K (2024). Broad-Spectrum Activity of Membranolytic Cationic Macrocyclic Peptides Against Multi-Drug Resistant Bacteria and Fungi. *Eur J Pharm Sci* 197, 106776, [10.1016/j.ejps.2024.106776](https://doi.org/10.1016/j.ejps.2024.106776)
11. Polyansky AA, **Efremov RG** (2024). Lipid-Mediated Adaptation of Proteins and Peptides in Cell Membranes. *BIOL MEMBRANY* 41 (5-6), 473–491, [10.31857/S0233475524050093](https://doi.org/10.31857/S0233475524050093)
12. Karnaukhov VK, Shcherbinin DS, Chugunov AO, Chudakov DM, **Efremov RG**, Zvyagin IV, Shugay M (2024). Structure-based prediction of T cell receptor recognition of unseen epitopes using TCRen. *NAT COMPUT SCI* 4 (7), 510–521, [10.1038/s43588-024-00653-0](https://doi.org/10.1038/s43588-024-00653-0)
13. El-Mowafi SA, Konshina AG, Mohammed EHM, Krylov NA, **Efremov RG**, Parang K (2023). Structural Analysis and Activity Correlation of Amphiphilic Cyclic Antimicrobial Peptides Derived from the [W4R4] Scaffold. *Molecules* 28 (24), 8049, [10.3390/molecules28248049](https://doi.org/10.3390/molecules28248049)
14. Mikhnovets IE, Holoubek J, Panina IS, Kotouček J, Gvozdev DA, Chumakov SP, Krasilnikov MS, Zhitlov MY, Gulyak EL, Chistov AA, Nikitin TD, Korshun VA, **Efremov RG**, Alferova VA, Růžek D, Eyer L, Ustinov AV (2023). Alkyl Derivatives of Perylene Photosensitizing Antivirals: Towards Understanding the Influence of Lipophilicity. *Int J Mol Sci* 24 (22), 16483, [10.3390/ijms242216483](https://doi.org/10.3390/ijms242216483)
15. Aliper ET, **Efremov RG** (2023). Inconspicuous Yet Indispensable: The Coronavirus Spike Transmembrane Domain. *Int J Mol Sci* 24 (22), 16421, [10.3390/ijms242216421](https://doi.org/10.3390/ijms242216421)
16. Neuberger A, Trofimov YA, Yelshanskaya MV, Khau J, Nadezhdin KD, Khosrof LS, Krylov NA, **Efremov RG**, Sobolevsky AI (2023). Molecular pathway and structural mechanism of human oncochannel TRPV6 inhibition by the phytocannabinoid tetrahydrocannabivarin. *Nat Commun* 14 (1), 4630, [10.1038/s41467-023-40362-2](https://doi.org/10.1038/s41467-023-40362-2)
17. Chugunov AO, Dvoryakova EA, Dyuzheva MA, Simonyan TR, Tereshchenkova VF, Filippova IY, **Efremov RG**, Elpidina EN (2023). Fighting Celiac Disease: Improvement of pH Stability of Cathepsin L In Vitro by Computational Design. *Int J Mol Sci* 24 (15), 12369, [10.3390/ijms241512369](https://doi.org/10.3390/ijms241512369)
18. Polyansky AA, Gallego LD, **Efremov RG**, Köhler A, Zagrovic B (2023). Protein compactness and interaction valency define the architecture of a biomolecular condensate across scales. *Elife* 12, , [10.7554/eLife.80038](https://doi.org/10.7554/eLife.80038)
19. Neuberger A, Trofimov YA, Yelshanskaya MV, Nadezhdin KD, Krylov NA, **Efremov RG**, Sobolevsky AI (2023). Structural mechanism of human oncochannel TRPV6 inhibition by the natural phytoestrogen genistein. *Nat Commun* 14 (1), 2659, [10.1038/s41467-023-38352-5](https://doi.org/10.1038/s41467-023-38352-5)
20. Goryacheva E, **Efremov R**, Krylov N, Artemyev I, Bogdanov A, Mamontova A, Pletnev S, Pletneva N, Pletnev V (2023). Crystal Structure of Bright Fluorescent Protein BrUSLEE with Subnanosecond Fluorescence Lifetime; Electric and Dynamic Properties. *Int J Mol Sci* 24 (7), 6403, [10.3390/ijms24076403](https://doi.org/10.3390/ijms24076403)
21. Bershatsky YV, Kuznetsov AS, Idiatullina AR, Bocharova OV, Dolotova SM, Gavrilenkova AA, Serova OV, Deyev IE, Rakitina TV, Zangieva OT, Pavlov KV, Batishchev OV, Britikov VV, Usanov SA, Arseniev AS, **Efremov RG**, Bocharov EV (2023). Diversity of Structural, Dynamic, and Environmental Effects Explain a Distinctive Functional Role of Transmembrane Domains in the Insulin Receptor Subfamily. *Int J Mol Sci* 24 (4), , [10.3390/ijms24043906](https://doi.org/10.3390/ijms24043906)
22. Trofimov YA, Minakov AS, Krylov NA, **Efremov RG** (2023). Structural Mechanism of Ionic Conductivity of the TRPV1 Channel. *Dokl Biochem Biophys* 508 (1), 1–5, [10.1134/S1607672922600245](https://doi.org/10.1134/S1607672922600245)
23. Panina IS, Balandin SV, Tsarev AV, Chugunov AO, Tagaev AA, Finkina EI, Antoshina DV, Sheremeteva EV, Paramonov AS, Rickmeyer J, Bierbaum G, **Efremov RG**, Shenkarev ZO, Ovchinnikova TV (2023). Specific Binding of the  $\alpha$ -Component of the Lantibiotic Lichenicidin to the Peptidoglycan Precursor Lipid II Predetermines Its Antimicrobial Activity. *Int J Mol Sci* 24 (2), 1332, [10.3390/ijms24021332](https://doi.org/10.3390/ijms24021332)
24. Polyansky AA, **Efremov RG** (2023). On a mechanistic impact of transmembrane tetramerization in the pathological activation of RTKs. *Comput Struct Biotechnol J* 21, 2837–2844, [10.1016/j.csbj.2023.04.021](https://doi.org/10.1016/j.csbj.2023.04.021)
25. Lohan S, Konshina AG, **Efremov RG**, Maslennikov I, Parang K (2022). Structure-Based Rational Design of Small  $\alpha$ -Helical Peptides with Broad-Spectrum Activity against Multidrug-Resistant Pathogens. *J Med Chem* 66 (1), 855–874, [10.1021/acs.jmedchem.2c01708](https://doi.org/10.1021/acs.jmedchem.2c01708)
26. Goncharuk MV, Baleeva NS, Nolde DE, Gavrikov AS, Mishin AV, Mishin AS, Sosorev AY, Arseniev AS, Goncharuk SA, Borshchevskiy VI, **Efremov RG**, Mineev KS, Baranov MS (2022). Structure-based rational

- design of an enhanced fluorogen-activating protein for fluorogens based on GFP chromophore. *Commun Biol* 5 (1), 706, [10.1038/s42003-022-03662-9](https://doi.org/10.1038/s42003-022-03662-9)
27. Panina IS, Krylov NA, Chugunov AO, **Efremov RG**, Kordyukova LV (2022). The Mechanism of Selective Recognition of Lipid Substrate by hDHHC20 Enzyme. *Int J Mol Sci* 23 (23), 14791, [10.3390/ijms232314791](https://doi.org/10.3390/ijms232314791)
  28. Gigolaev AM, Lushpa VA, Pinheiro-Junior EL, Tabakmakher VM, Peigneur S, Ignatova AA, Feofanov AV, **Efremov RG**, Mineev KS, Tytgat J, Vassilevski AA (2022). Artificial pore blocker acts specifically on voltage-gated potassium channel isoform KV1.6. *J Biol Chem* 298 (11), 102467, [10.1016/j.jbc.2022.102467](https://doi.org/10.1016/j.jbc.2022.102467)
  29. Aliper ET, Krylov NA, Nolde DE, Polyansky AA, **Efremov RG** (2022). A Uniquely Stable Trimeric Model of SARS-CoV-2 Spike Transmembrane Domain. *Int J Mol Sci* 23 (16), , [10.3390/ijms23169221](https://doi.org/10.3390/ijms23169221)
  30. Panina I, Krylov N, Gadalla MR, Aliper E, Kordyukova L, Veit M, Chugunov A, **Efremov R** (2022). Molecular Dynamics of DHHC20 Acyltransferase Suggests Principles of Lipid and Protein Substrate Selectivity. *Int J Mol Sci* 23 (9), , [10.3390/ijms23095091](https://doi.org/10.3390/ijms23095091)
  31. Dubovskii PV, Dubova KM, Bourenkov G, Starkov VG, Konshina AG, **Efremov RG**, Utkin YN, Samygina VR (2022). Variability in the Spatial Structure of the Central Loop in Cobra Cytotoxins Revealed by X-ray Analysis and Molecular Modeling. *Toxins (Basel)* 14 (2), , [10.3390/toxins14020149](https://doi.org/10.3390/toxins14020149)
  32. Volynsky P, Maltseva D, Tabakmakher V, Bocharov EV, Raygorodskaya M, Zakharova G, Britikova E, Tonevitsky A, **Efremov R** (2022). Differences in Medium-Induced Conformational Plasticity Presumably Underlie Different Cytotoxic Activity of Ricin and Viscumin. *Biomolecules* 12 (2), , [10.3390/biom12020295](https://doi.org/10.3390/biom12020295)
  33. Lohan S, Mandal D, Choi W, Konshina AG, Tiwari RK, **Efremov RG**, Maslennikov I, Parang K (2022). Small Amphiphilic Peptides: Activity Against a Broad Range of Drug-Resistant Bacteria and Structural Insight into Membranolytic Properties. *J Med Chem* 65 (1), 665–687, [10.1021/acs.jmedchem.1c01782](https://doi.org/10.1021/acs.jmedchem.1c01782)
  34. Bocharov EV, Gremer L, Urban AS, Okhrimenko IS, Volynsky PE, Nadezhdin KD, Bocharova OV, Kornilov DA, Zagryadskaya YA, Kamynina AV, Kuzmichev PK, Kutzsche J, Bolakhrif N, Müller-Schiffmann A, Dencher NA, Arseniev AS, **Efremov RG**, Gordeliy VI, Willbold D (2021). All-d-Enantiomeric Peptide D3 Designed for Alzheimer's Disease Treatment Dynamically Interacts with Membrane-Bound Amyloid- $\beta$  Precursors. *J Med Chem* 64 (22), 16464–16479, [10.1021/acs.jmedchem.1c00632](https://doi.org/10.1021/acs.jmedchem.1c00632)
  35. Panina I, Taldaev A, **Efremov R**, Chugunov A (2021). Molecular dynamics insight into the lipid ii recognition by type a lantibiotics: Nisin, epidermin, and gallidermin. *Micromachines (Basel)* 12 (10), , [10.3390/mi12101169](https://doi.org/10.3390/mi12101169)
  36. Kulbatskii D, Shenkarev Z, Bychkov M, Loktyushov E, Shulepko M, Koshelev S, Povarov I, Popov A, Peigneur S, Chugunov A, Kozlov S, Sharonova I, **Efremov R**, Skrebitsky V, Tytgat J, Kirpichnikov M, Lyukmanova E (2021). Human Three-Finger Protein Lypd6 Is a Negative Modulator of the Cholinergic System in the Brain. *Front Cell Dev Biol* 9, 662227, [10.3389/fcell.2021.662227](https://doi.org/10.3389/fcell.2021.662227)
  37. Chernykh MA, Kuldyushev NA, Peigneur S, Berkut AA, Tytgat J, **Efremov RG**, Vassilevski AA, Chugunov AO (2021). Derivative of Scorpion Neurotoxin BeM9 Is Selective for Insect Voltage-Gated Sodium Channels. *Russ. J. Bioorganic Chem.* 47 (4), 854–863, [10.1134/S1068162021040063](https://doi.org/10.1134/S1068162021040063)
  38. Tabakmakher VM, Gigolaev AM, Peigneur S, Krylov NA, Tytgat J, Chugunov AO, Vassilevski AA, **Efremov RG** (2021). Potassium channel blocker crafted by  $\alpha$ -hairpinin scaffold engineering. *Biophys J* 120 (12), 2471–2481, [10.1016/j.bpj.2021.04.020](https://doi.org/10.1016/j.bpj.2021.04.020)
  39. **Efremov RG** (2021). Dynamic “molecular portraits” of biomembranes drawn by their lateral nanoscale inhomogeneities. *Int J Mol Sci* 22 (12), , [10.3390/ijms22126250](https://doi.org/10.3390/ijms22126250)
  40. Tabakmakher VM, Kuzmenkov AI, Gigolaev AM, Pinheiro-Junior EL, Peigneur S, **Efremov RG**, Tytgat J, Vassilevski AA (2021). Artificial Peptide Ligand of Potassium Channel KV1.1 with High Selectivity. *J Evol Biochem Physiol* 57, 386–403, [10.1134/S0022093021020186](https://doi.org/10.1134/S0022093021020186)
  41. Krylov NA, **Efremov RG** (2021). libxtc: an efficient library for reading XTC-compressed MD trajectory data. *BMC Res Notes* 14 (1), 124, [10.1186/s13104-021-05536-5](https://doi.org/10.1186/s13104-021-05536-5)
  42. Konshina AG, Dubovskii PV, **Efremov RG** (2021). Stepwise Insertion of Cobra Cardiotoxin CT2 into a Lipid Bilayer Occurs as an Interplay of Protein and Membrane “Dynamic Molecular Portraits”. *J Chem Inf Model* 61 (1), 385–399, [10.1021/acs.jcim.0c01137](https://doi.org/10.1021/acs.jcim.0c01137)
  43. Nadezhdin KD, Neuberger A, Trofimov YA, Krylov NA, Sinica V, Kupko N, Vlachova V, Zakharian E, **Efremov RG**, Sobolevsky AI (2021). Structural mechanism of heat-induced opening of a temperature-sensitive TRP channel. *Nat Struct Mol Biol* 28 (7), 564–572, [10.1038/s41594-021-00615-4](https://doi.org/10.1038/s41594-021-00615-4)



44. Albrecht C, Kuznetsov AS, Appert-Collin A, Dhaideh Z, Callewaert M, Bershatsky YV, Urban AS, Bocharov EV, Bagnard D, Baud S, Blaise S, Romier-Crouzet B, **Efremov RG**, Dauchez M, Duca L, Gueroult M, Maurice P, Bennasroune A (2020). Transmembrane Peptides as a New Strategy to Inhibit Neuraminidase-1 Activation. *Front Cell Dev Biol* 8, 611121, [10.3389/fcell.2020.611121](https://doi.org/10.3389/fcell.2020.611121)
45. Kuznetsov AS, Zamaletdinov MF, Bershatsky YV, Urban AS, Bocharova OV, Bennasroune A, Maurice P, Bocharov EV, **Efremov RG** (2020). Dimeric states of transmembrane domains of insulin and IGF-1R receptors: Structures and possible role in activation. *BIOCHIM BIOPHYS ACTA* 1862 (11), 183417, [10.1016/j.bbamem.2020.183417](https://doi.org/10.1016/j.bbamem.2020.183417)
46. Sosorev A, Dominskiy D, Chernyshov I, **Efremov R** (2020). Tuning of Molecular Electrostatic Potential Enables Efficient Charge Transport in Crystalline Azaacenes: A Computational Study. *Int J Mol Sci* 21 (16), 1–18, [10.3390/ijms21165654](https://doi.org/10.3390/ijms21165654)
47. Belozerova OA, Osmakov DI, Vladimirov A, Koshelev SG, Chugunov AO, Andreev YA, Palikov VA, Palikova YA, Shaykhutdinova ER, Gvozdn AN, Dyachenko IA, **Efremov RG**, Kublitski VS, Kozlov SA (2020). Sevanol and Its Analogues: Chemical Synthesis, Biological Effects and Molecular Docking. *Pharmaceuticals (Basel)* 13 (8), 1–21, [10.3390/ph13080163](https://doi.org/10.3390/ph13080163)
48. Gigolaev AM, Kuzmenkov AI, Peigneur S, Tabakmakher VM, Pinheiro-Junior EL, Chugunov AO, **Efremov RG**, Tytgat J, Vassilevski AA (2020). Tuning Scorpion Toxin Selectivity: Switching From KV1.1 to KV1.3. *Front Pharmacol* 11, 1010, [10.3389/fphar.2020.01010](https://doi.org/10.3389/fphar.2020.01010)
49. Zalygin A, Solovyeva D, Vaskan I, Henry S, Schaefer M, Volynsky P, Tuzikov A, Korchagina E, Ryzhov I, Nizovtsev A, Mochalov K, **Efremov R**, Shtykova E, Oleinikov V, Bovin N (2020). Structure of Supramers Formed by the Amphiphile Biotin-CMG-DOPE. *ChemistryOpen* 9 (6), 640, [10.1002/open.202000139](https://doi.org/10.1002/open.202000139)
50. Panina I, Krylov N, Nolde D, **Efremov R**, Chugunov A (2020). Environmental and dynamic effects explain how nisin captures membrane-bound lipid II. *Sci Rep* 10 (1), 8821, [10.1038/s41598-020-65522-y](https://doi.org/10.1038/s41598-020-65522-y)
51. Lubova KI, Chugunov AO, Volynsky PE, Trofimov Y, Korolkova YV, Mosharova IV, Kozlov SA, Andreev YA, **Efremov RG** (2020). Probing temperature and capsaicin-induced activation of TRPV1 channel via computationally guided point mutations in its pore and TRP domains. *Int J Biol Macromol* 158, 1175–1183, [10.1016/j.ijbiomac.2020.04.239](https://doi.org/10.1016/j.ijbiomac.2020.04.239)
52. Albrecht C, Appert-Collin A, Bagnard D, Blaise S, Romier-Crouzet B, **Efremov RG**, Sartelet H, Duca L, Maurice P, Bennasroune A (2020). Transmembrane Peptides as Inhibitors of Protein-Protein Interactions: An Efficient Strategy to Target Cancer Cells? *Front Oncol* 10, 519, [10.3389/fonc.2020.00519](https://doi.org/10.3389/fonc.2020.00519)
53. Pakhomov AA, Frolova AY, Tabakmakher VM, Chugunov AO, **Efremov RG**, Martynov VI (2020). Impact of external amino acids on fluorescent protein chromophore biosynthesis revealed by molecular dynamics and mutagenesis studies. *J Photochem Photobiol B* 206, 111853, [10.1016/j.jphotobiol.2020.111853](https://doi.org/10.1016/j.jphotobiol.2020.111853)
54. Kudryavtsev DS, Tabakmakher VM, Budylin GS, Egorova NS, **Efremov RG**, Ivanov IA, Belukhina SY, Jegorov AV, Kasheverov IE, Kryukova EV, Shelukhina IV, Shirshin EA, Zhdanova NG, Zhmak MN, Tsetlin VI (2020). Complex approach for analysis of snake venom  $\alpha$ -neurotoxins binding to HAP, the high-affinity peptide. *Sci Rep* 10 (1), 3861, [10.1038/s41598-020-60768-y](https://doi.org/10.1038/s41598-020-60768-y)
55. Dubovskii PV, Ignatova AA, Feofanov AV, Utkin YN, **Efremov RG** (2020). Antibacterial activity of cardiotoxin-like basic polypeptide from cobra venom. *Bioorg Med Chem Lett* 30 (3), 126890, [10.1016/j.bmcl.2019.126890](https://doi.org/10.1016/j.bmcl.2019.126890)
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