Editorial for the special issue of biophysical reviews on the 9th Congress of the Russian society for photobiology held in Shepsi, Krasnodar region, Russia, on September 12–19, 2021

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Introduction to Russian Society for Photobiology

This Special Issue is devoted to the latest conference event of the Russian Society for Photobiology (RSP)—the 9th Congress of the RSP held in Shepsi, Krasnodar region, Russia, on September 12–19, 2021. The RSP was organized in 1993 and from its very beginning the RSP has promoted activities of scientists, engineers, professors, and students in photobiology and the related fields of science. The main mission of the RSP is the organization of workshops, meetings, and congresses focused on photobiological research, particularly welcoming young researchers. A brief history of the RSP can be found in this SI of Biophysical Reviews (Koppel and Krasnovsky 2022). Notably, RSP does not levy membership fees, and its management is elected to work on a voluntary basis. The RSP plays a significant role in the organization of, and contributes significantly to, photobiological research in Russia.

The 9th Congress of the Russian Photobiological Society

The 9th Congress of the RSP was originally scheduled in 2020 but it was postponed to 2021 due to COVID-19 restrictions. The Congress has been held as a hybrid online-in-person event and it ran in 8 sections with 144 attendees, 18 of whom delivered their talks online. Including their listed coauthors, overall 314 participants joined the meeting. The Congress organization ran through several phases. First, the Program Committee suggested the title for the Congress “Actual Problems in Photobiology” and set the 8 Sessions of the Congress program. When Coordinators volunteered for each Session (Table 1), they cooperated with the Program and Organizing Committees to appoint Chairs for each Session’s meetings. The Congress was concluded by taking the joint photo (Fig. 1).

Scientific content of the Congress

The content of the key talks delivered at the Congress was shaped into invited review papers that made up this Special Issue of Biophysical Reviews. These contributions are listed, together with their outlines, and the commentary papers pertinent to each session of the Congress, in Table 2.

Young scientist competition

Forty young scientists participated in the Congress. The Award Committee evaluated their presentations, though with some difficulties in comparison of contribution coming from different levels of BSc, MSc, and PhD. Eventually, 20 young scientists were selected as winners. The winners presented...
| Session                                      | Coordinators                                                                 | Chairs                                                                                           | Reference                                                      |
|----------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Primary processes of photosynthesis          | Ivan Proskuryakov and Alexey Semenov                                         | Ivan Proskuryakov, Lyudmila Vasilieva, Mahir Mamedov, Alexander Ashikhmin, Roman Pishchalnikov, Galina Riznichenko | Proskuryakov and Semenov (2022)                                |
| Regulation of photosynthesis                 | Marina Kozuleva, Boris Ivanov, Olga Voiitsekhovskaja                          | Marina Kozuleva, Olga Voiitsekhovskaja, Vladimir Sukhov, Maria Borisova-Mubarakshina, Vasily Terentyev, Lyudmila Kabashnikova, Lada Petrovskaya | Kozuleva et al. (2022)                                         |
| Photoreception                               | Larisa Koppel, Lada Petrovskaya                                               | Lada Petrovskaya, Olga Voiitsekhovskaja, Larisa Koppel, Konstantin Neverov                      | Petrovskaya and Koppel (2022)                                  |
| Basics of photodynamic, laser, and PUVA therapy | Mikhail Grin, Alexander Krasnovsky, Andrew Mironov                           | Vitaly Plavsky, Mikhail Grin, Daniil Gvozdev, Alexander Firsov                                 | Grin et al. (2022)                                              |
| Biophotonics of molecules and nanoparticles  | Viktor Nadtochenko, Valery Tuchin                                             | Polina Bikmulla, Ioanna Gorbunova                                                              | Tsygankov and Tuchin (2022)                                    |
| Bioluminescence and photonics of fluorescent proteins | Evgeny Vysotsky, Anvar Ismailov, Valentina Kratasyuk                      | Evgeny Vysotsky, Nadezhda Kudryashveva, Svetlana Markova, Elena Nemtseva, Galina Lomakina, Elena Eremeeva | Vysotsky, (2022)                                               |
| Microalgae as converters of light energy into biofuels and high-value products | Anatoly Tsygankov, Evgeny Solovchenko                                      | Anatoly Tsygankov, Olga Voiitsekhovskaya, Tatyana Kozlova, Maria Sinetova                      | Tsygankov and Solovchenko (2022)                               |
| Ecological photobiology                      | Olga Koksharova, Sergey Pogosyan, Galina Riznichenko                        | Sergey Khruschev, Marina Grinberg, Galina Riznichenko, Elena Senatskaya                        | Riznichenko et al. (2022)                                      |
short talks (3 min talks with 2 min questions) at the special session; they were awarded Winner’s Certificates and souvenirs (Fig. 2).

**Heroes of the Congress organization**

Together with the RSP, the Institute of Basic Biological Problems Russian Academy of Sciences (The Separate Subdivision of Federal Research Center “Pushchino Center of Biological Research of the Russian Academy of Sciences”) and M.V. Lomonosov Moscow State University organized the 9th Congress of the Russian Photobiological Society. Many volunteers worked hard as Program and Organizing Committee members, organizing communication with participants of the Congress, providing registration, technical assistance, realization of smooth sessions and online talks of participants, preparation of advertisements about program changes and reminders about different events, etc. All authors of this SI bid thanks on behalf of RSP Central Committee. Particular acknowledgement should be given to Darya Vetoshkina, Tatyana Fedorchuk, Irina Sterelyukhina, Elena Korovina, Larissa Koppel, Aleksey Semenov, Sergey Khrushchev, Marina Kozuleva, Lada Petrovskaia, Olga Koksharova, Olga Voitsekhovskaya, Evgeniy Vysotsky, and Ivan Proskuryakov for their enormous contribution to the Congress preparation.

**The venue of the Congress**

In 2011, the Mayak lodging house in Shepsi village, Krasnodar region, Russia, has been chosen as the venue for the RSP congresses. It is located at a beach of the Black Sea shore and gives an excellent opportunity to combine comfortable meetings in conference room (more than 200 seats) and convenient accommodation as well as pleasant rest at the beach, in the park, or using sport facilities. In addition, informal meetings that take place at any scientific forums are possible almost anywhere in the park zone, recreation rooms, and other premises. The RSP has a long-standing partnership with Mayak, so we never miss an opportunity to say thanks to our hosts especially to Alexander Kovalev, the Director; Olga Yarzhinskaya, the Administrator of the hotel; Anna Zhorova, the restaurant Manager; and Elena Kovaleva, responsible for keeping and explaining rare plants in the lodging house garden, for their heartfelt kindness and hospitality for all guests of “Mayak.”

In conclusion, the 9th Congress of the RSP, in spite of COVID-19 restrictions, brought together many researchers enabling them to exchange their thoughts and share their latest results. Participants received a lot of new information from the presentations and, most importantly, exchanged new ideas, agreed to continue their cooperation, and created new connections. So, in view of what is said above, the 9th Congress of the RSP appears to be quite successful.
Table 2  Key contributions to the Special Issue of Biophysical Reviews dedicated to the 9th Congress of the Russian Society for Photobiology (RSP)

| Title                                                                 | Outline of the content                                                                                                                                                                                                 | Reference           |
|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| **Commentaries**                                                     |                                                                                              |                     |
| Thirty years of the Russian Society for photobiology (1992 to 2022) | A historical overview of the development of RSP is given from its conception to its current state. The key influencers and their roles are highlighted, the mission of RSP is presented                                      | Koppel and Krasovsky (2022) |
| Commentaries on Sect. 1 "Primary processes of photosynthesis"       | In each commentary, a brief summary of the topic of the session is presented together with a short overview of the key talks delivered at that session. For detailed information, please see corresponding commentary papers in this special issue |                     |
| “Fundamental principles of photodynamic, laser and PUVA therapy”: a session of the Russian Photobiology Society 9th Congress (Shepsi, Krasnodar region, Russia; September, 12–19, 2021) |                                                                                               |                     |
| Commentary to “Biophotonics of molecules and nanoparticles”: a session of the Russian Photobiology Society 9th Congress (Shepsi, Krasnodar region, Russia; September 12–19, 2021) |                                                                                               |                     |
| “Microalgae as converters of light energy into biofuels and high-value products”: a session of the Russian Photobiology Society 9th Congress (Shepsi, Krasnodar region, Russia, September 12–19, 2021) |                                                                                               |                     |
| “Bioluminescence and Photonics of Fluorescent Proteins” session at the 9th Congress of the Russian Photobiology Society (Shepsi, Krasnodar region, Russia; September 12–19, 2021) |                                                                                               |                     |
| Overview of the “Photoreception” session at the 9th Congress of the Russian Photobiological Society: understanding structure and function of photoreceptors |                                                                                               |                     |
| ‘Regulation of photosynthesis’ session of the Russian Photobiology Society 9th Congress (Shepsi, September 12–19, 2021) |                                                                                               |                     |
| ‘Ecological photobiology’ session of the Russian Photobiology Society 9th Congress (Shepsi, September 12–19, 2021) |                                                                                               |                     |
| **Scientific reviews**                                               |                                                                                               |                     |
| Current state of the primary charge separation mechanism in photosystem I of cyanobacteria | New data on the mechanism of ultrafast reactions of primary charge separation in photosystem I (PS I) of cyanobacteria obtained in the last decade by methods of femtosecond absorption spectroscopy are presented and analyzed | Cherepanov et al. (2022) |
| Macromolecular conformational changes in photosystem II: interaction between structure and function | An account of the current knowledge about the possible conformational changes in proteins in the PSII super-complex and describes their proposed influence on PSII function | Terentiev (2022) |
| Measurements of the light-induced steady state electric potential generation by photosynthetic pigment-protein complexes | Methods of measurements of the light-induced steady state transmembrane electric potential (Δψ) generation by photosynthetic systems, e.g. photosystem I (PS I) are considered. The microelectrode technique and the detection of electrochromic band shifts of carotenoid pigments are praised as the most appropriate for Δψ measurements in situ and in vivo. Connections with solar-to-electric energy conversion are elaborated on | Mamedov et al. (2022) |
| Light quality as a driver of photosynthetic apparatus development     | Perception of environment light signals by plants via their five families of photoreceptors and by the PSA as a “light energy sensor” is depicted. The effects of the perceived signals including those delivered by artificial narrow-band LED-based lighting, on metabolism and development are outlined | Kochetova et al. (2022) |
| Cooperative pathway of O2 reduction to H2O2 in chloroplast thylakoid membrane: new insight into the Mehler reaction | A growing evidence on hydrogen peroxide formation in chloroplasts via reaction of superoxide radical generated in the membrane with the reduced plastoquinone molecule, plasto hydroquinone is reviewed. Redox signaling and scavenging of reactive oxygen species is discussed | Ivanov et al. (2022) |
| Molecular, Brownian, kinetic and stochastic models of the processes in photosynthetic membrane of green plants and microalgae | The results of recent work at the Department of Biophysics of the Biological Faculty, Lomonosov Moscow State University on the kinetic and molecular modeling of processes in the photosynthetic membrane are presented | Riznichenko et al. (2022) |
| Application of direct electrometry in studies of microbial rhodopsins reconstituted in proteoliposomes | The foundations of the method and recently published experimental results obtained using the time-resolved direct electrometry in the studies of the internal charge transfer and coupled energy conversion during the photocycle of microbial rhodopsins from different sources are discussed | Petrovskaya et al. (2022) |
Phytochrome A in plants comprises two structurally and functionally distinct populations — water-soluble phyA′ and amphiphilic phyA″. A concept is presented that the complex picture of the phyA action is due to the existence of two phyA types in the cell differing by the structure of the N-terminus, probably, by its serine phosphorylation. Functional interaction between phyA and the defense-related hormone jasmonic acid is also considered.

Sineshchekov and Koppel (2022)

Photobiology of lipofuscin granules in the retinal pigment epithelium cells of the eye: norm, pathology, age. Lipofuscin granules (LGs) are accumulated in the retinal pigment epithelium (RPE) cells. The progressive LG accumulation can somehow lead to pathology and accelerate the aging process. The review examines composition, spectral properties and photoactivity of LGs isolated from the human cadaver eyes.

Feldman et al. (2022)

Advantages of combined photodynamic therapy in the treatment of oncological diseases. Photodynamic therapy is depicted as an approved medical technology for the treatment of various malignant neoplasms, and several precancerous and non-cancer diseases. The evidence on the advantages of combined use of PDT with traditional and innovative methods of treatment are reviewed.

Grin et al. (2022)

Optical clearing and testing of lung tissue using inhalation aerosols: prospects for monitoring the action of viral infections. Optical clearing of the lung tissue aims to make it more transparent to light thus allowing reconstruction of the three-dimensional structure with better resolution. This review presents general principles and advances in the field of tissue optical clearing technology and analyses the impact of microbial and viral infections on tissue response.

Bucharskaya et al. (2022)

Cardiovascular biomarkers in body fluids: Progress and Prospects in Optical Sensors. The biomarker detection plays a crucial role in the early diagnosis of several non-infectious and life-threatening diseases like cardiovascular diseases and many cancers, which in turn will help in more successful therapy, reducing the mortality rate. The current progress and prospects in biomarker research for the diagnosis of cardiovascular diseases are reviewed.

John et al. (2022)

Bioluminescent test systems based on firefly luciferase for studying stress effects on living cells. State of art of the studies on and application of the bioluminescent luciferin-luciferase reaction is presented. The possibilities of using this reaction to study the effects of temperature, drugs, membrane-active compounds, etc. on living cells are considered.

Lomakina and Ugarova (2022)

The effects of secondary bacterial metabolites on photosynthesis in microalgae cells. Secondary metabolites of bacteria are regulatory molecules that act as "infochemicals" that control some metabolic processes in the cells of microorganisms. The main purpose of this review is to highlight recent experimental results that demonstrate the impact of several types of common bacterial metabolites (volatile organic compounds, non-protein amino acids, and peptides) on photosynthetic activity in cells of microalgae.

Koksharova and Safronov (2022)

Chlorophyll fluorescence as a valuable multistool for microalgal biotechnology. Variable fluorescence of chlorophyll (CF-PAM) of the photosynthetic apparatus is presented as an ample source of valuable information on physiological condition of photosynthetic organisms. Applications and limitations of the CF-PAM technique in microalgal biotechnology are discussed.

Solovchenko et al. (2022)

The relationship between photosystem II regulation and light-dependent hydrogen production by microalgae. An overview of the functional link between the photosynthetic machinery and light-dependent hydrogen production is presented along with physiological significance of this process. The light-dependent hydrogen production is suggested to form a part and parcel of the sophisticated regulatory network for stress adaptation of microalgae.

Grechanik and Tsygankov (2022)

Machine learning methods for assessing photosynthetic activity: environmental monitoring applications. Machine learning methods proposed for determining the functional parameters of photosynthesis based on local and remote optical measurements (hyperspectral imaging, solar-induced chlorophyll fluorescence, local chlorophyll fluorescence imaging, and various techniques of fast and delayed chlorophyll fluorescence induction) are reviewed.

Khruschev et al. (2022a, b)

Structural organization, evolution, and distribution of viral pyrimidine dimer-DNA glycosylases. An outline of the current evidence on the structure and mechanism of operation of best-known viral glycosylase DenV and its homologs. The biological importance and distribution of the enzyme and its homologs among viruses are considered.

Karanova et al. (2022)
Author contribution All authors contributed to the study conception and design. All authors read and approved the final manuscript.

Declarations

Ethics approval Not applicable

Consent to participate Not applicable

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Fig. 2 Young scientists — awardees of Young Scientists Competition at 9th Congress of Russian Photobiological Society (from left to right; from up to down). Aleksandr Ashikhmin, Konstantin Chekanov; Anna Vishnevskaya (primary processes of photosynthesis); Valeria Dmitrieva, Anna Shukshina, Darya Vetoshkina (regulation of photosynthesis); Artemiy Sukhanov (photoreception); Anton Benditks, Ioanna Gorbunova, Daniil Grozdev, Dmitriy Pritinov, Natalya Shilyagina, Polina Starygina (basics of photodynamic, laser, and PUVA therapy); Marina Larionova, Pavel Natashin (bioluminescence and photonics of fluorescent proteins); David Gabrielyan, Makhmadysusuf Khasimov, Darya Zharova (microalgae as converters of light energy into biofuels and high-value products); Ekaterina Grinova, Alexander Khmarik (ecological photobiology)
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