To the 50th Anniversary of Professor V.S. Pavelyev

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Abstract. The paper briefly describes the scientific and pedagogical achievements of the Head of the Department of Nanoengineering of Samara National Research University, Doctor of Physical and Mathematical Sciences Vladimir Sergeevich Pavelyev.

1. Introduction
In April 2020, Doctor of Physical and Mathematical Sciences, Professor, Head of Department of Nanoengineering of the Samara National Research University named after academician S.P. Korolev and the Chief Researcher of the Laboratory of Micro- and Nanotechnology of the Image Processing Systems Institute of RAS, Branch of the Federal Scientific Research Center “Crystallography and Photonics” of the Russian Academy of Sciences (IPSI RAS), Vladimir Sergeevich Pavelyev, is celebrating his anniversary. The article gives a brief summary of scientific and pedagogical achievements of V.S. Pavelyev.

2. IPSI RAS
In 1993, V.S. Pavelyev graduated from the Faculty of System Engineering of the Samara State Aerospace University named after academician S.P. Korolev (SSAU); his major was Applied Mathematics. Following his graduation, he started working as a software engineer at the Samara Branch of the Central Design Bureau of Unique Instrumentation (CDB UI) of the RAS. In 1993, the Samara Branch of CDB UI was reorganized into Image Processing Systems Institute of the RAS (IPSI RAS), and in 2016 IPSI RAS became the branch of the Federal Scientific Research Center “Crystallography and Photonics” of the Russian Academy of Sciences (IPSI RAS). Vladimir Sergeevich Pavelyev, is celebrating his anniversary. The article gives a brief summary of scientific and pedagogical achievements of V.S. Pavelyev.
In 2000-2002, V.S. Pavelyev was the co-supervisor of the Russian-German project supported by the German foundation DLR (BMBF) and implemented by the fellows of IPSI RAS and the Institute of Applied Optics of the Friedrich Schiller University (Jena, Germany).

In 2003, V.S. Pavelyev became the Laureate of the State Award of the Russian Federation for young scientists for outstanding merit in the field of science and technology for his work “Development of methods of calculation, modeling and manufacturing of elements of power diamond diffraction optics for IR spectrum lasers” (in cooperation with D.L. Golovashkin and V.V. Kononenko).

Today, V.S. Pavelyev is the author and co-author of 263 scientific works including 9 monographs: the RSCI database lists 263 publications and 2393 references (H factor: 20), the Scopus database lists 134 publications and 823 references (H factor: 15). He is a member of the Scientific Board of the Image Processing Systems Institute – branch of the Federal Scientific Research Center “Crystallography and Photonics” of the Russian Academy of Sciences, and a member of the Editorial Board of the journal Computer Optics.

Figure 1. Prof. V.S. Pavelyev.

3. Samara University
Since 1997, V.S. Pavelyev has combined his scientific research with teaching at the Samara University (until 2015, the Samara State Aerospace University, SSAU). He was Assistant Lecturer and Associate Professor of the Department of Technical Cybernetics of SSAU. In 2006-2008, he was the Director of the Institute of Fundamental Sciences of SSAU. Since 2006, he has been a member of the Scientific Board of the Samara University. Since 2007, he has chaired the newly organized Department of Nanoengineering of SSAU. At the moment, this department is responsible for the bachelor program “Electronics and Nanoelectronics” as well as for the master program “Applied mathematics and physics”. He reads lectures on “Theoretical basics of integrated optics”, “Waveguide optics” and supervises scientific research of bachelor, master and postgraduate students. He was supervisor of 3 defended candidate (PhD) dissertations on optics. Since 2008, he has been the Director of Research and Educational Center of Nanotechnology of the Samara University. The Research and Educational Center of Nanotechnology is equipped with modern analytical and technological instruments enabling research in the field of design and manufacturing of elements of micro-optics, nano-photonics, nano-sensors, and in the field of synthesis of nanomaterials and nanocomposites. V.S. Pavelyev is a renowned scientific expert: he is a member of the Dissertation Council D 212.215.01 of the Samara University, peer-reviewer of various international journals, expert of the Russian Foundation for Basic Research, and the expert of the Federal Target Program. He has taught abroad as well: in 2017, he was invited as a lecturer to the JMI University (Central University) (New Delhi, India).
4. Major Scientific Achievements

V.S. Pavelyev designed the iterative algorithms and methods for calculation of diffractive optical elements (DOEs) forming laser beams with a predefined transversal mode content with high efficiency [5-9]. In particular, he designed and studied the algorithm for calculation of highly efficient phase DOEs to form dispersionless multimode beams from an illuminating beam [3,9]. The designed algorithms and calculated optical elements were studied at the IPSI RAS, the Institute of Applied Optics, Friedrich Schiller University and the Institute for Physical High Technology (now Leibniz Institute of Photonic Technology, Jena, Germany) during V.S. Pavelyev’s internships at these institutions that were organized with the support of the German Academic Exchange Service (DAAD).

V.S. Pavelyev conducted research in the sphere of technologies of infrared (IR) diffractive optical elements [10-21]. He calculated and studied the first diffractive optical elements on diamond films manufactured at the General Physics Institute of RAS (Moscow) by means of UV laser ablation of diamond surface, designated for the focusing of radiation of powerful IR lasers [3,13-17]. In order to factor in the tolerances of the technology used for the fabrication of the elements, V.S. Pavelyev designed and studied the stochastic methods of optimization of micro-relief based on the analysis of influence of subwavelength errors within the electromagnetic light theory [3,16,17]. This topic was then furthered in the works on application and research of antireflective coatings for diamond film based IR optical elements [19,20]. Later the technology of laser structuring designed by the researchers of the General Physics Institute of RAS that enabled forming of a micro-relief with continuous profile on the surface of the diamond film, allowed creation of diamond DOE's of IR spectrum with diffraction efficiency over 97% [21].

V.S. Pavelyev supervised, and was directly involved in, the design and studies of methods of manufacturing of silicon diffractive optical elements [22-27] designated for the formation of powerful beams with orbital angular momentum (OAM) (or “rotating beams”) of terahertz range coherent radiation. The use of these elements by the group of Prof. B.A. Knyazev at the G I. Budker Institute of Nuclear Physics, Siberian Branch of the Russian Academy of Sciences (Novosibirsk) (INP SB RAS) for the first time allowed formation of powerful rotating beams in the terahertz range. The advent of tools to control the transversal structure of terahertz laser beams (including powerful beams) enabled the scientists of INP SB RAS to obtain new experimental results in the field of research of propagation of diffraction-free beams in the terahertz range in homogenous [24] and non-homogenous media [26], in the field of research of possibility of making multi-channel systems of data transmission in the terahertz range with transverse mode multiplexing [27], and in the field of excitation of surface plasmon-polariton in terahertz range [22]. The development of this topic resulted in the advent of elements that allow simultaneous control of transverse modal composition of the terahertz laser beam and its polarization state [28]. Apart from the elements forming terahertz laser beams with predefined transverse mode content [22-29], reflecting [30] and transmitting [31-39] elements of terahertz optics were designed and studied, in particular, elements forming the predefined distribution of intensity from the illuminating beam of terahertz laser: Fresnel lenses [31-33], cylindrical lenses [37], and focusators [35,36,38]. The importance of creation of these elements is accounted for by the prospects of their use in the scanning systems of terahertz range.

The cooperation with the scientific group of the Academician of the RAS V.I. Konov in the General Physics Institute of the RAS was formed during the work on elements of diamond optics and continued in the development of technology of producing effective elements of terahertz silicon focusing diffraction optics. In [33,34] for the first time the technology of pulse ablation of silicon surface (designed at the General Physics Institute of the RAS) was studied in its application to making a terahertz DOE with a multi-level diffractive micro-relief. In [37] the method of pulse ablation was used to manufacture and do experimental studies of the terahertz cylindrical diffraction lens with a diffraction efficiency of 93%.

V.S. Pavelyev’s works focus on research of applying micro- and nanotechnologies, much different from the well-known technologies of lithography, to create 2D and 3D elements of diffractive micro-optics with broad functional properties [40-48], design of methods of optimization of DOE
considering the limitations of the technology [35,38,42,46,47,49,50], and technologies of synthesis of nanomaterials for photonic and sensor applications [51-57]. These works were performed in the Samara University and IPSI RAS, and within cooperation programs with other research institutions and companies. Supervised by V.S. Pavelyev, several contracts and agreements were completed including those with "Hitachi Via Mechanics" (USA), “Tydex” LLC (St.-Petersburg, Russia), and others. He has been and is supervising projects supported by the Russian Foundation for Basic Research, Russian Scientific Foundation, and the Program of the Presidium of RAS.

5. Conclusion
In conclusion, the author would like to take the opportunity to wish Vladimir Sergeevich Pavelyev many talented students to continue and expand the scientific research!

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