



SCHOOL OF PHOTONICS

| Laser & Light Engineering

| Photonics and Optoinformatics



50x

increase of volumes of information transmitted in the last ten years, continuing to grow at the same rate!

10%

of all electric energy in the world is consumed by Internet, this demand doubles every four years

400 Gb/s

IEEE already looking at options for 400G Ethernet. Need for extra bandwidth continues to increase rapidly

\$1/Gb/s

Facebook's well published target is \$1/Gb/s, has set another challenge for the optics/photonics industry



Only Photonics, i.e. light-based technologies, can meet these challenges!

Photonics of Information-Communication Systems

Internet/Clouds/Datacenters - the largest global market for photonics.

The largest Cloud providers (Google, Amazon, Microsoft, etc.) are all moving into photonics.

The 21st century is the era of photonics, as the 19th was the steam era, and the 20th was the electronics era

PHOTONICS - THE INDUSTRY OF THE FUTURE

The global photonics market
is already worth more than
\$500 billion

by 2020

the market will grow
to about \$800 billion

Development of the Science and Technology of Photonics —
a current global challenge!

ITMO University — a world class scientific and educational center
for photonics, an acknowledged leader in Russia!



The aim of creation and development of the School of Photonics at the ITMO University:

- establishment of a solid backlog of advanced scientific and technological knowledge
- training of highly qualified and well educated professionals

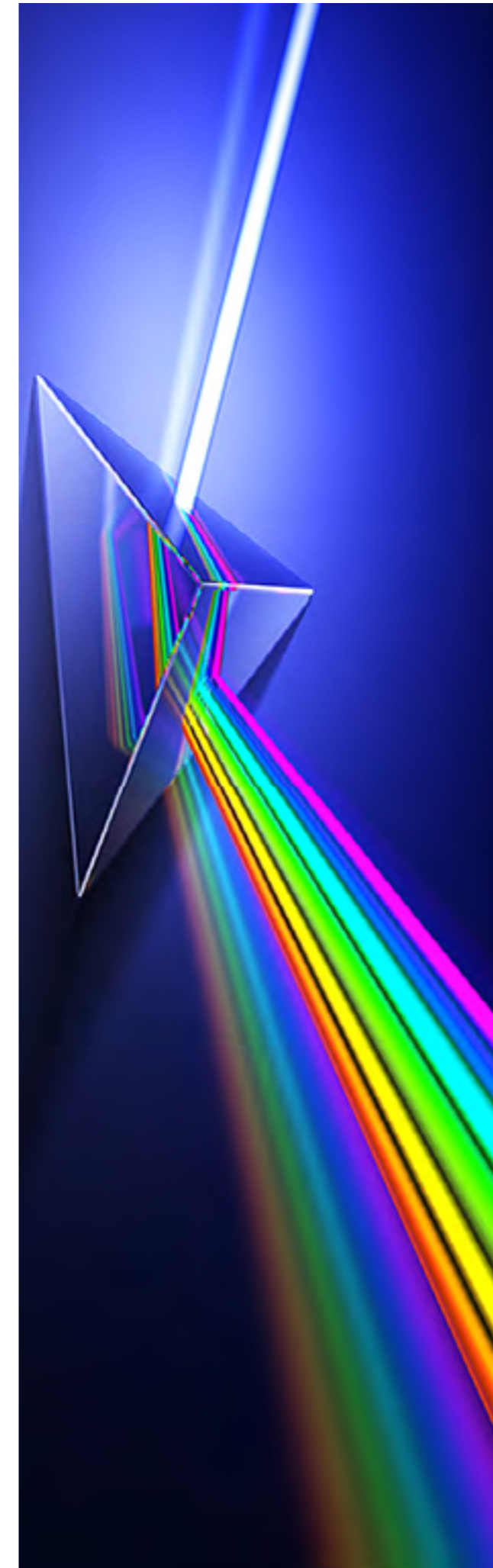
through the promotion of the “Photonics of Information-Communication Systems” initiative



Head of School: **Vladislav E. Bougrov**

42 years old, h=12, Master degree in optoelectronics from LETI University
Cand. Sci. in 1999 and Dr. Sci. in 2013 in physics from Ioffe Institute
Prize of the Government of Russia in science and engineering for 2014
inventor in > 100 patent applications, > 30 granted patents
extensive experience with management of international start-up companies
E-mail: vladislav.bougrov@niuitmo.ru

- **50 professors**, including
3 members of the Russian Academy of Sciences
- **220 personnel academic staff**, including
>50 researchers with Ph.D. (Cand.Sci.) degree
- **1800 students**, 240 Ph.D. students
- Opportunities for students for internships
in top universities in Europe, China, USA
- Unique advanced R&D for leading companies,
including the civil and military industries
- **11 world-class research centers**
- Research and Engineering/Technology
Educational Programs



> 600

scientific articles in 2015
in well-known international journals
(>60% of the total University)

100%

employment of graduates;
60% receive extra money for
participating R&D during education

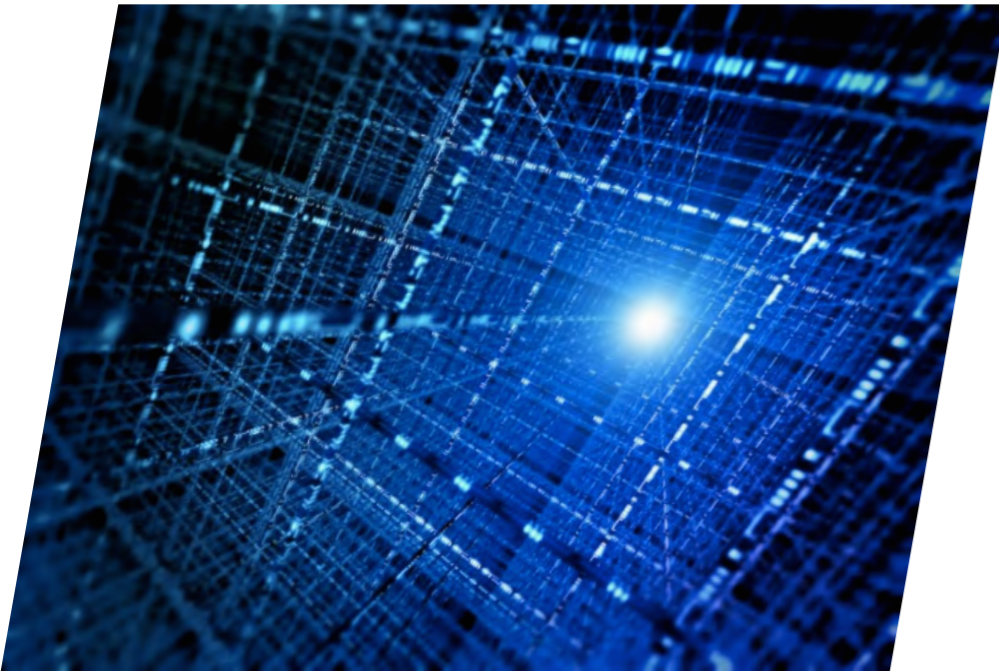
> 1 billion

rubles - ITMO Photonics R&D budget,
> 340 mln. contractual funding

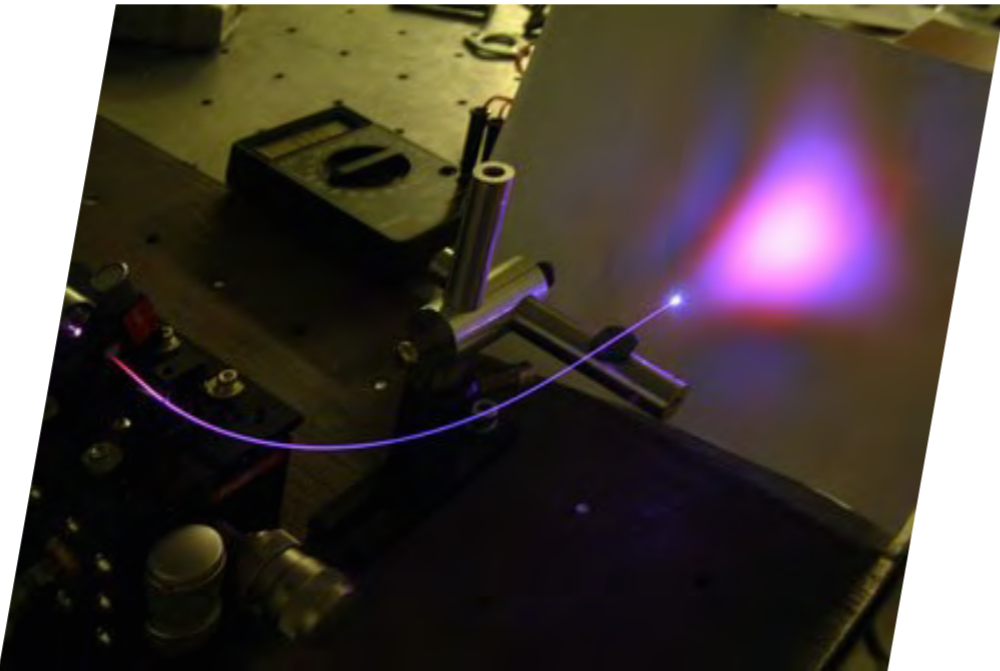
In 2015

ITMO University implemented
the first quantum network in Russia!

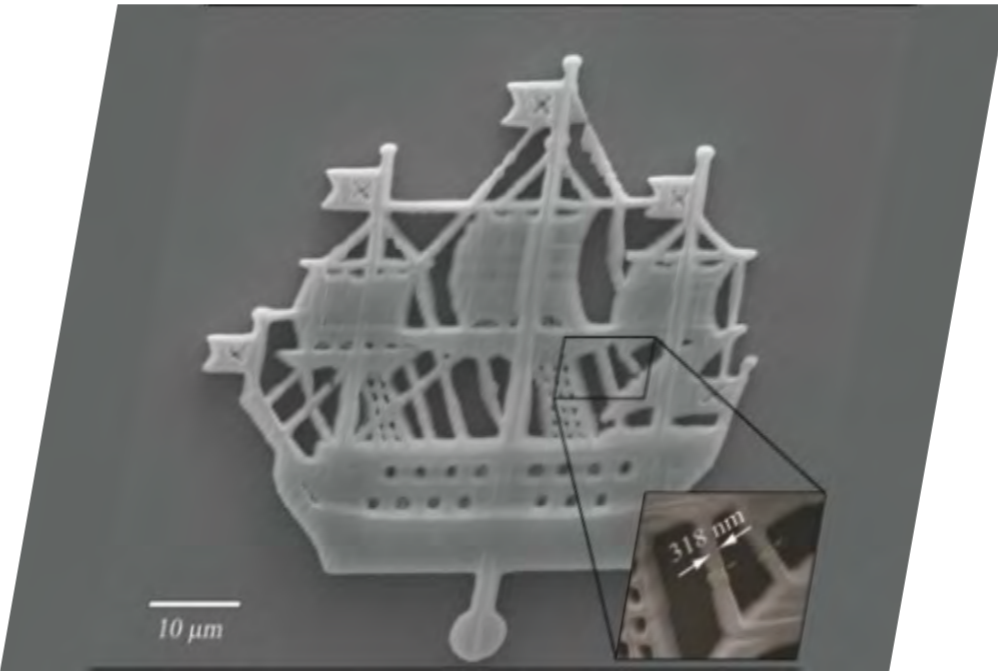
Semiconductor &
hybrid nanophotonics



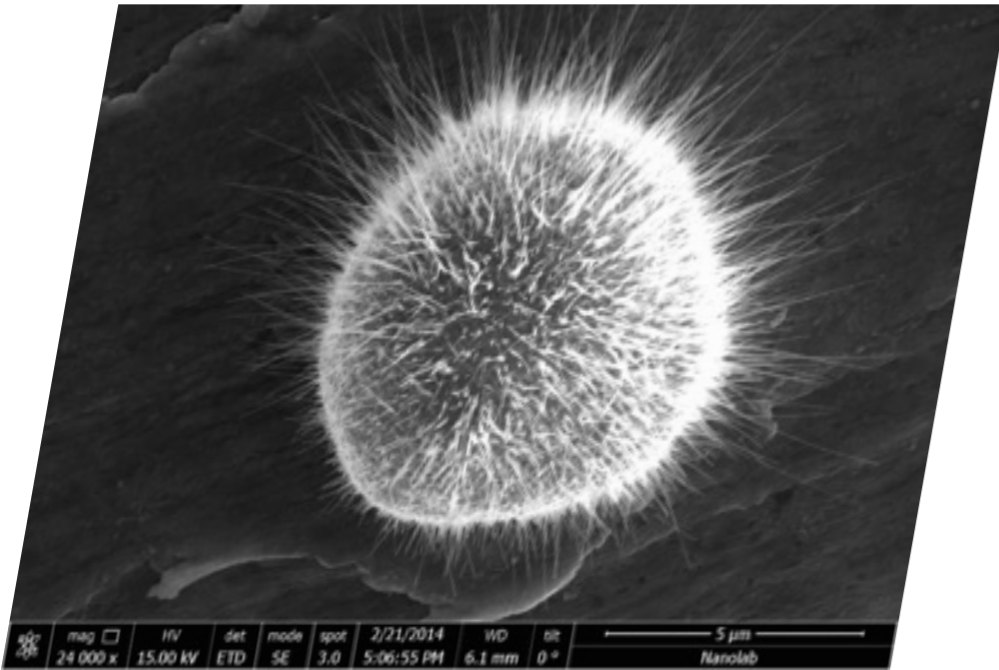
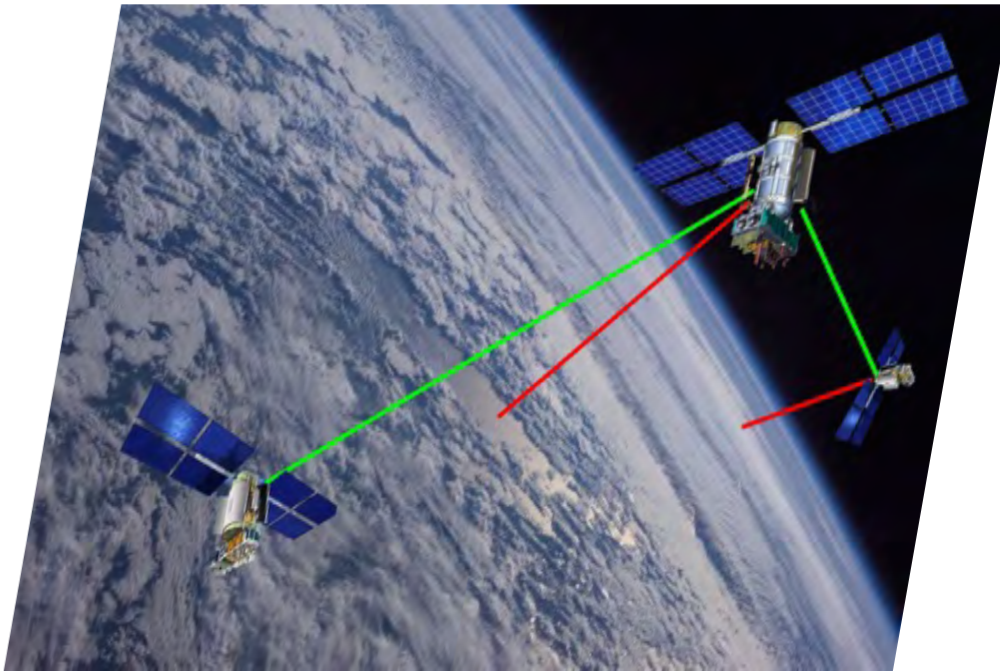
Quantum
Informatics



Metamaterials



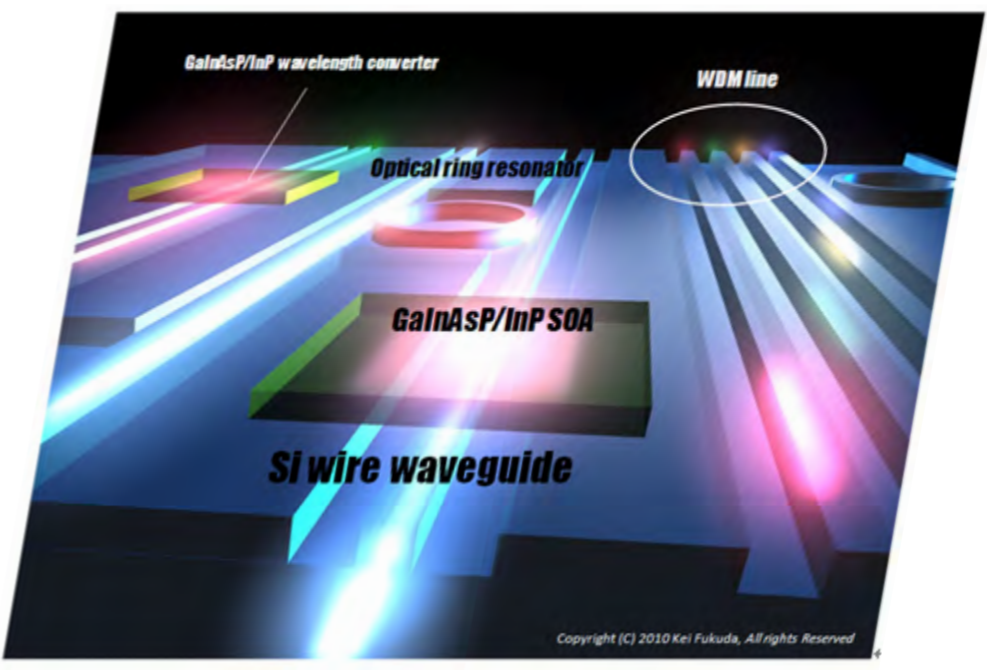
Solid-state laser
systems



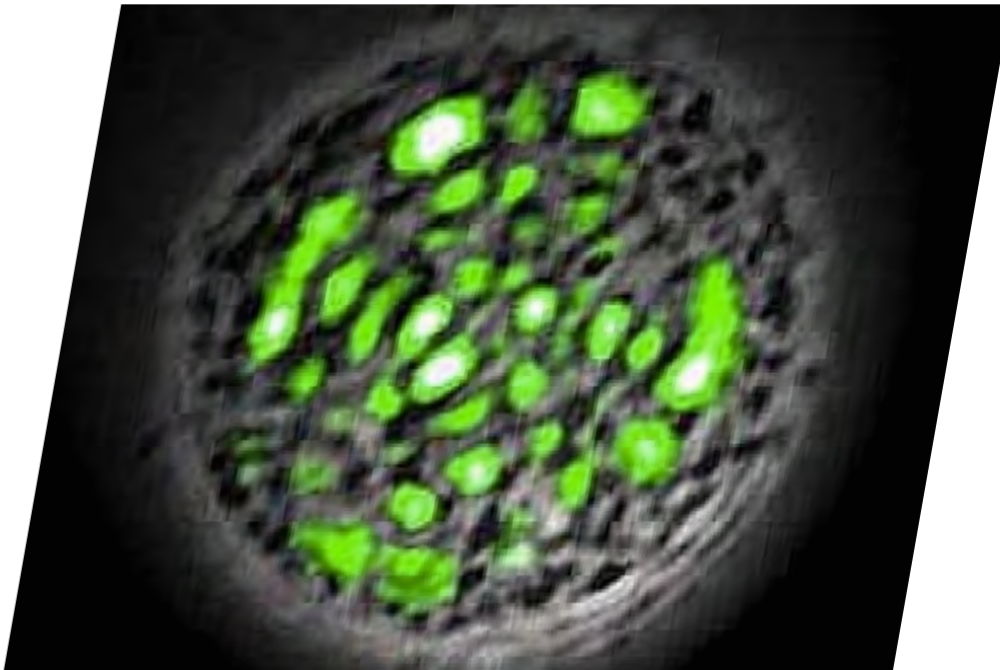
Advanced
functional materials



Optical
materials



Compound semiconductor
optoelectronics



Bio-photonics

- Average age is 45 years
- Average Hirsch index for 10 key persons is $h=31$
Average Hirsch index for 30 key persons is $h=26$
- Three leading schools in Russia in the field of photonics:
(former in the Soviet Union)
 - 1) the *classical school of opticians* (including, e.g., the founder of optical holography Y.N. Denisyuk); leading experts from the Vavilov State Optical Institute joined them in 2003
 - 2) School of *optical and quantum informatics* emerges in the mid-1990s
 - 3) The plaids of experts in the field of *optoelectronics and optoelectronic materials* from the Ioffe Institute joined in 2013-2014

Recent awards and grants:

Russian Federation **Government Prizes**:

- 1) in the field of science and technology for 2012 (V.E. Bougrov)
- 2) in the field of education for 2014 (A.V. Fedorov)

Megagrants from the Ministry of Education and Science of Russian Federation:

- 1) «The development of new chiral systems of quantum dots and their application» (leading scientist Y.K. Gun'ko)
- 2) «Non-linear, dynamic, and non-local metamaterials for the optical, microwave and telecommunications technologies» (leading scientist Y.S. Kivshar)

20 medals from the All-Russia D.S. Rozhdestvenskii Optical Society



Pavel A. Belov, 38 years, h=29, Nanophotonics and Metamaterials, International Research & Education Center (includes specialized Chair)



Anatoly V. Fedorov, 59 years, h=20, Physics of Nanostructures, International Research & Education Center (includes specialized Chair)



Sergey A. Kozlov, 59 years, h=11, Optical and Quantum Informatics, Bioinformatics, International Research Center



Alexey E. Romanov, 60 years, h=38, Functional Materials and Devices of Optoelectronics and Electronics, International Research Center



Evgeny A. Viktorov, 54 years, h=14, Laser Systems and Technologies International Research Center



Nikolay V. Nikonorov, 63 years, Optical Material Science, Research Center



Andrei A. Mak, 58 years, Laser Physics, Research Center



Maya V. Uspenskaya, 43 years, Bio-engineering, Research Center



Valerii V. Korotaev, 63 years, Optical-Electronic Devices, Research Center

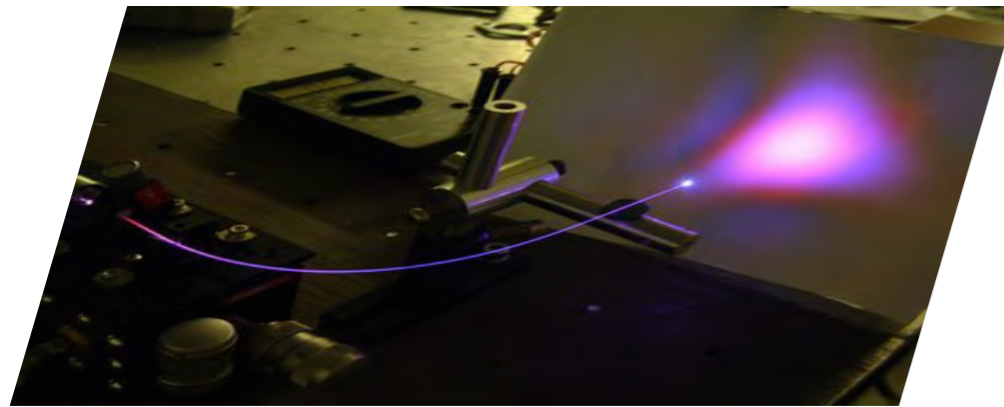


Vladislav E. Bougrov, 42 years, Integrated & Microwave Photonics,
Research Center



Vladimir E. Prokhorovich, 52 years, Technologies of Quality Control
in Space Systems, Research Center

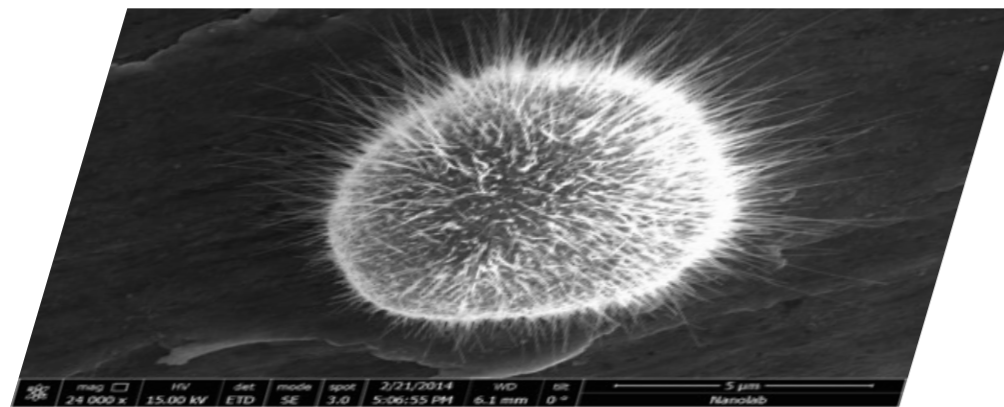
Quantum Informatics



The **quantum network** with dynamical control to connect all ITMO University buildings

Four-nod prototype **quantum network for city of Kazan**

International **quantum line Saint Petersburg/Helsinki** to connect RUNNet (Russia) and NORDNet (North Europe) science and educational networks



Advanced functional materials

New types of nanomaterials, e.g. nanowhiskers and nanoheterostructures, including those integrated with silicon substrates; Hybrid quantum nanocrystals synthesized via colloidal root

Bulk materials growth techniques from liquid phase or sol-gel precursors for glass-ceramics photonics media and advanced crystalline oxides, e.g. Ga_2O_3

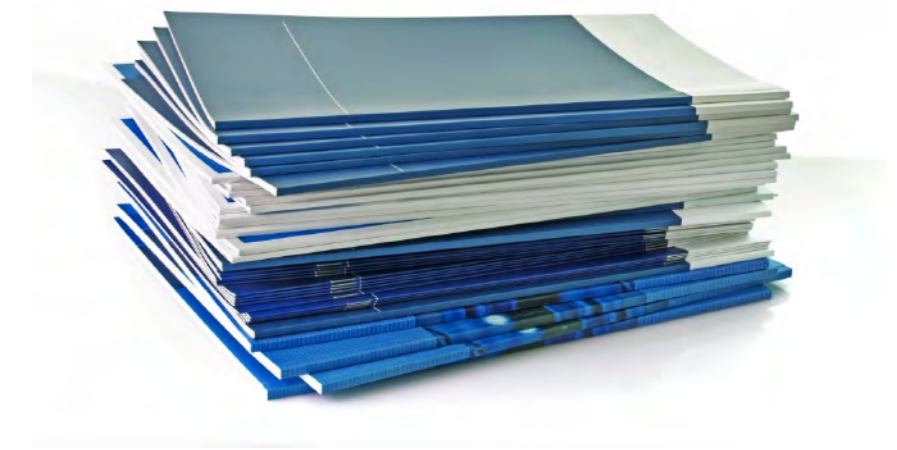
Nanophotonic components created by using metamaterials and metadevices

In 2015, ITMO University started the UniFEL Center for Advanced Methods of Materials Research for the preparation to the experiments at the European **X-Ray Free-Electron Laser Facility** (Hamburg, Germany), the largest instrument of such type in the World.

Activities in this field in Russia are coordinated by The National Research Center "Kurchatov Institute".



Special attention on **magazines**, published by the ITMO University



Commercialization of innovations through a number of spin-offs currently having strong connections with major industrial customers

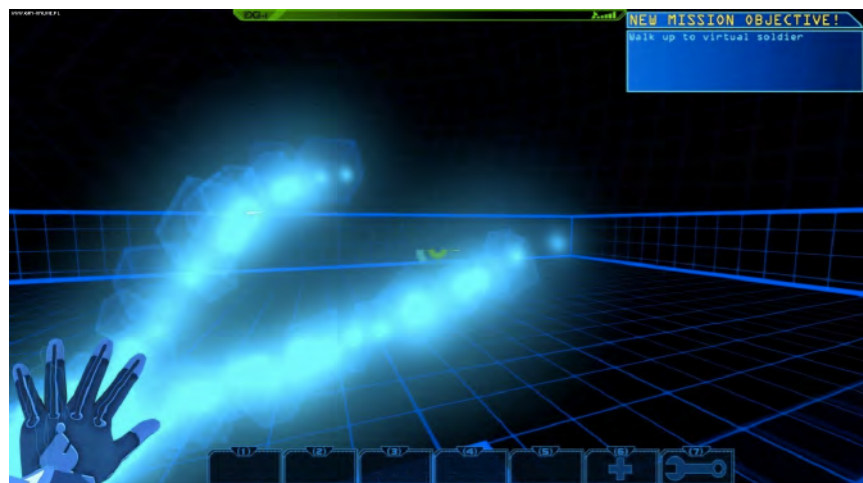


Outreach activities are on the rise in ITMO Photonics:

- International Congress "Lasers and Photonics" 2016
- IX International Congress of Optical Sciences "Optics-XXI Century"
- World-class "Magic of Light" exhibition



In December 2015, the ITMO University became the organizer of the **Quantum Consortium** that included 16 educational and commercial organizations of Russia.



- Student Union, which main goal is to involve students into the University scientific life of optics and photonics.
- Optical Student Chapter (project leader **Egor Gurvitz**)
- Student Scientific Laboratory of Optics (**Azaliya Saitgalina**)
- School of Laser Technologies (**Ekaterina Tiguntseva**)
- OptiLAB (**Elvira Timofeeva**)
- School of Light Design (**Anastasia Dubinovskaya**)



A large red circle is positioned in the upper right corner of the image. A thin white horizontal line extends from the left edge of the circle towards the center of the frame.

RUSSIA,
ST. PETERSBURG

IT's *MO*re than a UNIVERSITY

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