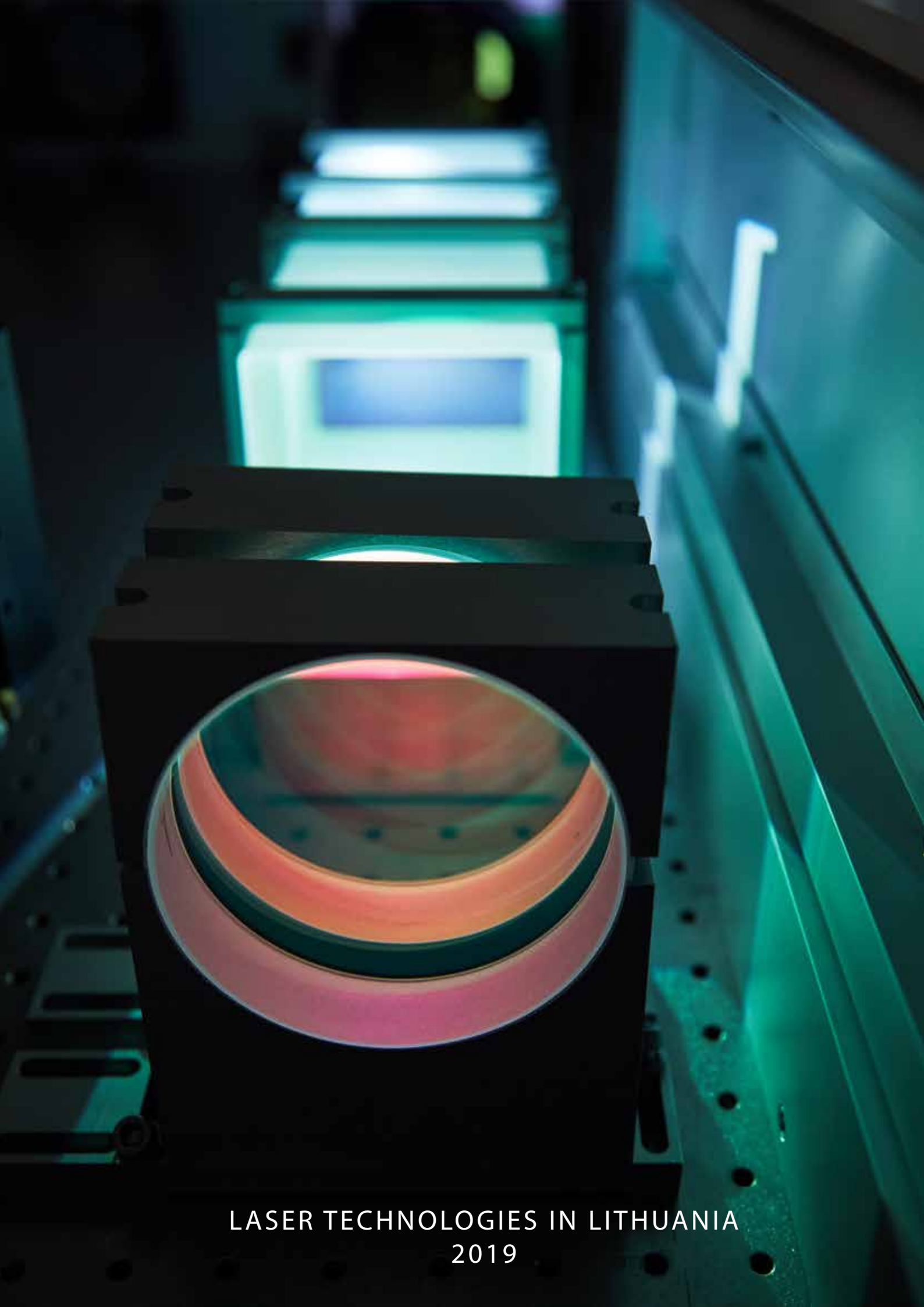

LASER TECHNOLOGIES IN LITHUANIA
2019

Publication initiated and published by the
Lithuanian Laser association

LIETUVOS LAZERIŲ ASOCIACIJA LITHUANIAN LASER ASSOCIATION

LASER TECHNOLOGIES IN LITHUANIA 2019

Fifth revised edition

Members of the Association:
Vilnius University, Center of Physical Sciences and Technology, Altechna , Altechna Coatings, Brolis Semiconductors, Direct Machining Control, Eksma, Eksma Optics, Ekspla, ELAS, Femtika, Holtida, Integrated Optics, Lidaris, Light Conversion, Lyncis, Optogama, Optoman, Optonas, Optronika, Quantum Light Instruments, QS Lasers, Sprana, Standa, Teravil, Workshop of Photonics.

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The publication uses the materials of the Lithuania Laser Technology sector feasibility study prepared by the Lithuanian Innovation Center.

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Vilnius, 2019

Foreword

The main reason for the success of the Lithuanian laser industry is top-level laser scientists and flawless knowledge transfer due to enabling infrastructure, general creative mindset and deep-rooted traditions of laser R&D in Lithuania. I'd like to take every opportunity to highlight the importance of further strengthening and development of scientific potential to maintain high positions which are established by Lithuanian scientists and all members of the laser community. The combination of science and business drives the future in a sustainable and forward-looking manner. It facilitates the creation of new jobs and promotes the industry of high value-added output. The development of laser technology industry in Lithuania is a prospective field of industry that has achieved strong positions in the world. It is one of the underlying fields of Lithuanian economy that closely links the three main chains of creation of added value – science, innovations and production. The achievements of Lithuanian researchers in the field of lasers are particularly appreciated, whereas the production developed by national laser specialists is demanded across the world. I wish all scientists, engineers and laser community professionals to make bold and smart moves to ensure high standards of science and business development further.

The French scientist Prof. Gérard Mourou, winner of the Nobel Prize in Physics 2018

Prof. Algis Piskarskas,
President of Lithuanian Laser Association

Lithuania, with an impressive track record in laser manufacturing and innovative academic laser science, is among world leaders in laser technologies. The strong cohesion between R&D activities in laser companies and academic research centers enables Lithuania to maintain a leading position in the global marketplace. Scientific research started in academia five decades ago has resulted in an impressive number of breakthroughs and important commercial developments, such as OPCPA technology and TW&PW femtosecond lasers that are currently pushing the frontiers of attosecond science.

The output of the Lithuanian laser industry covers a variety of fs/ps/ns tunable lasers, optical, electronic, mechanical laser components, assemblies, parts or different combinations thereof. Among a large number of customers, there are European extreme light centers as ELI-DC pillars in Hungary and the Czech Republic, along with most of the best universities in the world (90 out of worlds' top 100). Scientific centers are valuable partners of major universities and research institutions across the world. Lasers are the critical enabling technology for the future as it underpins modern innovations that are fundamental across many aspects of modern life and business.

Dr P. Balkevičius,
Executive Director of Lithuanian Laser Association

The last years have been truly impressive for the industry. Today Lithuanian laser sector contains 130 M€ industry providing more than 1000 highly skilled jobs at a value-added per employee that is more than three times larger than the national average. The major part of the production, over 80%, is exported. Ten years ago, laser sector consisted of 15 companies, whereas in 2019 the count exceeded 40, with roughly 10% of employees having PhD degrees. Although the entire industry was previously focused on the scientific laser niche, rapidly growing activities in laser material processing and improvements in laser technology allowed Lithuanian laser products to enter the industrial market, where nearly a half of total sales is currently taking place. Lithuanian laser products have even secured a reputation to warrant the applications by space exploration agencies. In Lithuania, laser technology is among the four key smart specialisation topics of H2020.

Agenda for the future

Currently, the laser technologies sector is one of the strongest Lithuanian industrial sectors. Since its beginnings in fundamental research 50 years ago, it has grown to a fully self-sustaining ecosystem that builds on a strong cooperation of research institutions and business enterprises and that occupies most segments of the laser market. Lithuanian companies are securely leading the global supply of scientific lasers, while entire sectors' companies generated around 1% of the world's laser revenues of €13.8 billion in 2018.

Solid growth of the laser sector
Moreover, the sector demonstrates a stable growth that surpasses the growth of the global laser market, which was 5.3% in 2018 and is expected to be around 5-6% in 2019 as well. In the last five years alone, the Lithuanian laser technologies sector has grown 13% on average, and sector's revenues crossed €100 million mark in 2017. The sector is expected to continue growing faster than the global market in the next couple of years since it has successfully integrated into value chains attributed to industrial lasers. Lithuanian industrial lasers, their components and other integral parts take an essential place in the world's laser landscape since they belong to international high value-added value chains and during 2017 almost half of the sector's sales were made in this area. This contributes to the sector's strong orientation towards foreign markets, as up to 90% of the sector's production is exported abroad.

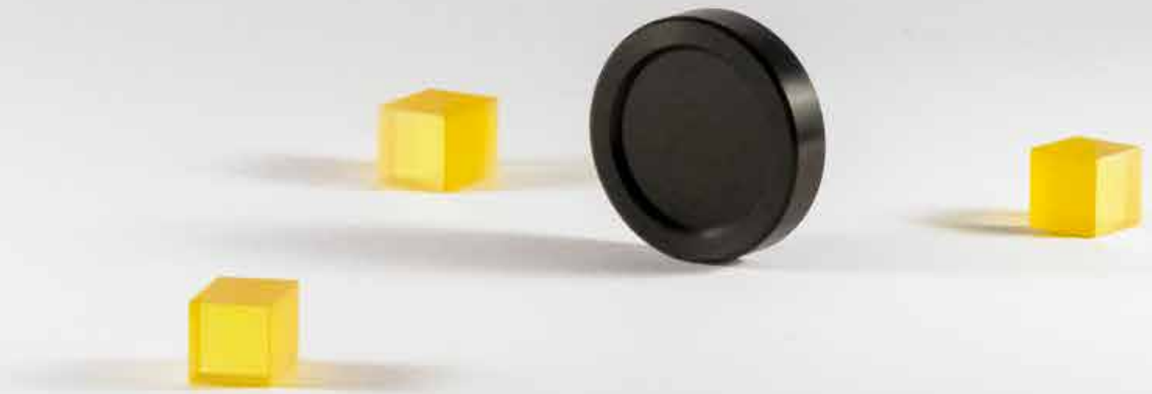
Intellectual potential
The Lithuanian laser technologies sector is of significance not only abroad, but also locally. Although it comprises less than 1% of Lithuania's GDP, the created added value per employee is three times higher than that created by the rest of the industry. Furthermore, high demand for Lithuanian laser products abroad enables the sector to create jobs for highly educated professionals - 1 in 10 of the sector's employees is a PhD. The sector employs close to a thousand specialists whose wages are above the country's average and thus significantly contributes to the country's budget in terms of paid taxes, and therefore makes the sector of national importance.

The priority of the national economy
Its national importance can also be substantiated by the inclusion of laser technologies among Lithuania's smart specialisation priorities. Based on the smart specialisation strategy implementation progress assessments, laser technologies priority is considered as an only priority out of 20 that has both accumulated the critical mass, and that is considered as the most prospective and of highest relevance to Lithuania according to multicriteria evaluations. It is regarded as such due to high funding provided for research, a high number of scientific publications and registered patents, relatively high investments in R&D, cluster development potential and a high proportion of researchers in relation to all workers in companies.

Fuels Industry 4.0
The importance of laser technologies is also highlighted in the industrial transformation processes, following the Industry 4.0 developments across Europe. Laser technologies are acknowledged in Lithuanian Industry Digitisation Roadmap 2019-2030 under Photonics sector. As one of breakthrough and key enabling technologies, laser technologies were included in the list of most influential technologies that will have the highest impact on the manufacturing industry's digitisation, as many industrial applications nowadays are unimaginable without lasers.

The Roadmap
Representatives from the Lithuanian laser technologies industry and academia have agreed on the following vision:

> *Contribution of the Lithuanian laser technologies sector to GDP will reach 1% by 2025*



To achieve this vision, the actions will be focused on three strategic directions:
• To increase exports by integrating into international laser applications value chains;
• To increase sales in the internal market by offering digitisation solutions for Lithuanian companies;
• To attract foreign investments by attracting strategic investors to the sector.
The efforts to achieve the vision will be concentrated in three laser market segments: **medicine, industrial and high-power lasers, and sensors.**

The actions to accomplish the vision are needed in three areas:

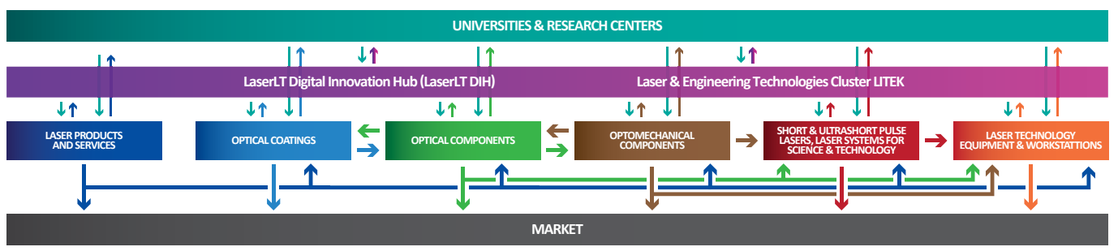
KNOWLEDGE	• *creation of synergies between high-power lasers, compact lasers and components, lasers for material processing, scientific lasers, and precise mechanics* • *increased focus on laser applications implementation of R&D projects in collaboration with Research institutes* • *active participation in international R&D projects*
HUMAN RESOURCES	• *interdisciplinary higher education programmes that would prepare specialists required by the sector* • *creation of high-value-added jobs (for researchers and supporting personnel)* • *the attraction of specialists from abroad*
INFRASTRUCTURE	• *continued support for the maintenance of infrastructure* • *creation of prototype testing and small series manufacturing infrastructure* • *creation of demonstration infrastructure* • *establishment of a factory for laser products for end-users*

Figure 1. Strategic areas and actions to be taken to accomplish the sector's vision

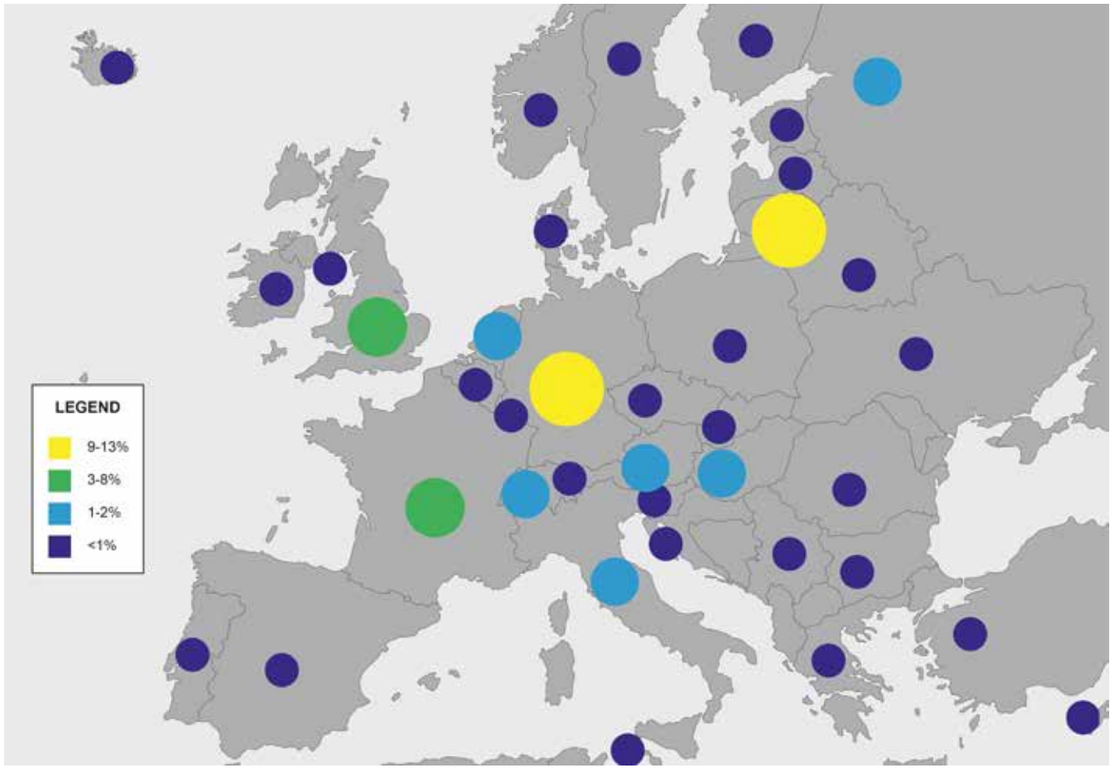
If measures are implemented to improve these areas, the following results are expected:

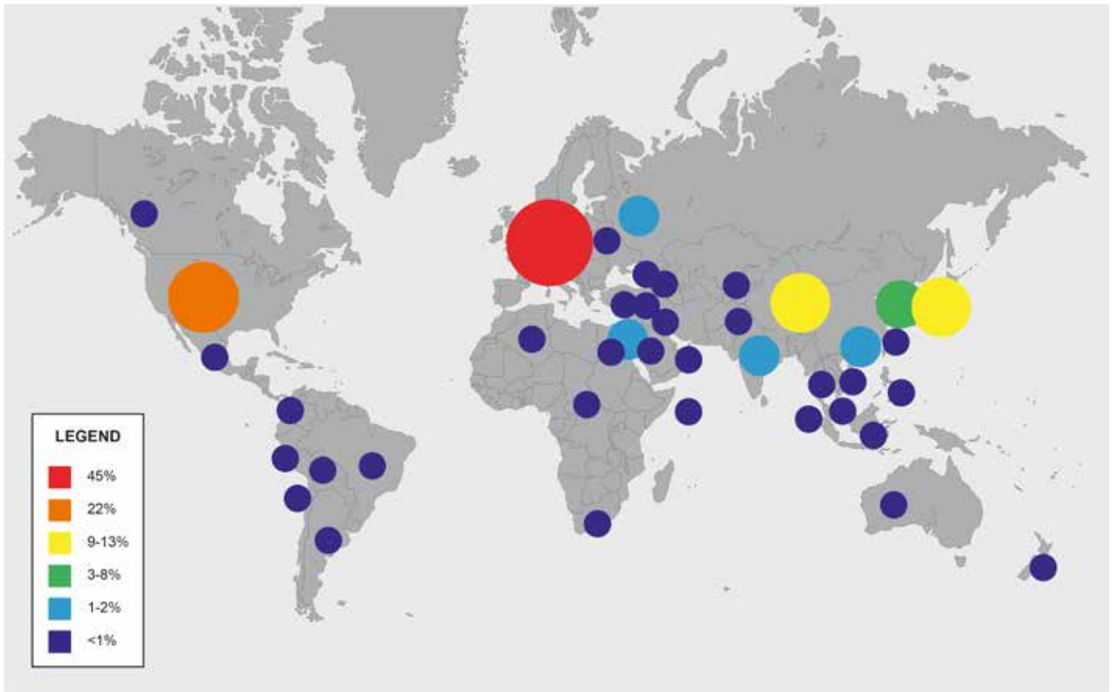
- In terms of revenue, the sector will be able to maintain its 10-15% annual growth for the next decade and will continue growing faster than the global market;
- The sector also would be able to increase its current export rate of 90%, especially in strategic laser applications areas and attributable value chains;
- Support for a traditionally strong science and business cooperation in the sector and successful commercialisation of new products would significantly increase sales in the internal market as well, promoting industrial and other uses;
- Actions taken would also satisfy the sector's demand for a highly-educated workforce, as 3000 high value-added workplaces are expected to be created by 2030;
- It would further raise the sector's added value;
- Additional investments in prototype testing, small series manufacturing and end-user product development infrastructure would maintain 10% and higher sector's expenditure on R&D.

Ecosystem of Lithuanian Laser sector



World sales of Lithuanian lasers, laser equipment and components





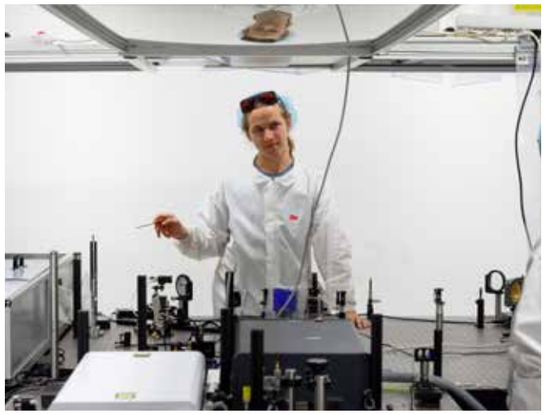
Laser Research and Academia in Lithuania

Laser science and technology in Lithuania started its journey almost 50 years ago, just a few years after lasers were invented. Over time, lasers have become ubiquitous in a wide range of research and development areas, from laser physics and optical technologies, all the way to laser biomedicine. While there are a dozen of academic institutions and departments having laboratories which utilise lasers for their research, the two main players in the laser-related research in Lithuania are Vilnius University Laser Research Centre and the Center for Physical Sciences and Technology (abbreviated FTMC in Lithuanian). They are accompanied by the research labs of laser companies, who are becoming more and more versatile and capable. Below, the recent research highlights from these organisations are presented.

Vilnius University

Paving the way for the laser companies to become the suppliers of large scale laser facilities

The quest for higher laser pulse energies, more powerful and stable laser systems was always at the heart of the laser-related research performed at Vilnius University Laser Research Center. The latest development – high average power laser system Naglis was designed and built at the labs of Vilnius University over the period of 2005-2012. Its development harnessed optical chirped pulse amplification (OPCPA) technique – a brainchild of the scientists of Vilnius University. Building the laser system with unprecedented parameters was itself a formidable task, with no less than 5 PhD theses defended on the subjects of operating and managing the highest laser powers achievable using table-top systems. However, the results of the project reach far beyond the academic interest: Naglis became the prototype of the SYLOS laser system produced jointly by two Lithuanian laser companies, Ekspla and Light Conversion, for ELI-ALPS. The graduates of Vilnius University, now working at Light Conversion and Ekspla used the skills and techniques developed during their graduate work to produce this 'big brother' of Naglis. In the meantime, the 'little brother' has become a workhorse used for moderate-to-high energy experiments in laser physics at Vilnius University.



Building bridges between laser physics, medicine and nanotechnology.

Nanophotonics Lab at Vilnius University Laser Research Center is researching artificial biomimetic scaffolds for cell growth. These microarchitectured structures are produced using direct laser writing (DLW) technology based on multi-photon polymerisation (MPP). They are designed to become the habitats for cell cultures. By changing the structure of the scaffold, which is easily allowed by DLW-MPP technique, optimal conditions for different types of cells can be created. Such engineered tissues made of biopolymer and recipient cells could then be used in the manufacturing of individually adapted prosthetic devices, such as replacement joints, heart valves, stents, etc. The tricky part is not only making the scaffolds, where the required type of cells could preferentially be cultivated, but also finding bio-compatible and biodegradable photopolymers that would harmlessly dissolve in the recipient's body without adverse effects. Vilnius University group led by Dr Mangirdas Malinauskas was the first to demonstrate that artificial cartilage tissues, grown on the scaffolds produced by DLW 3D lithography, can be used for pre-clinical tests in vivo. In many cases, the response of test animals to the cell pre-grown artificial tissue was better than to the standard collagen-based cartilage replacements. Another advantage over collagen is the fact that mechanical properties of such tissues can be varied tuning the material, microarchitecture and filling ratio of the structure in the significantly higher range - from elastic to bone-hard.

Center for Physical Sciences and Technology (FTMC)

Laser technologies are becoming a commodity in many areas of production as well as installed into consumer products. The Department of Laser Technologies with its six laboratories covers a significant part of the photonics related activities, ranging from newly discovered optical effects to laser machines, and stepping through all technology readiness levels.

Laboratory of Optical Coatings
The smart optical coatings developed in the Laboratory of Optical Coatings convert the pieces of glass into valuable products able to control the spectral and temporal properties of the light. All modern thin film deposition techniques are utilised with adaptation of Atomic Layer Deposition technology as well. Novel optical coating approaches including sculptured optical coatings, optical coatings with metal nanofilms are under development with significant increase in laser-induced damage threshold and functionality of optical elements.
The main limiting factor for higher LIDT (Laser induced damage threshold) values is the intrinsic damage threshold at high refractiove index (H) material and/or H-L layer interface. Optimization by redistribution of electric field in chirped mirror coatings can lead to increased resistance to laser irradiation by at least a factor of two.
Ultra-thin metal films are increasingly applied as functional optical coatings. The broad-angle non-polarizing beam splitter prototype with an ultrathin metal layer, combined with dielectric films, was designed, prepared and characterised. It was shown that magnetron sputtering is a suitable technology for fabrication of this kind of optics in a single process.
Comprehensive investigations of dependence between stoichiometry, phase composition and roughness, density, wetting and optical properties of scandium oxide deposited by reactive magnetron sputtering were performed. As a result, newly developed procedures were developed for high-rate deposition at low substrate temperatures (<90 °C) with a high refractive index, a wide bandgap and low compressive stress.

Fiber Laser and Solid-State Laser Laboratories
New laser sources, which are based on tiny but smart fibres or active bulk crystals and are under development in the Fiber Laser and Solid-State Laser Laboratories, provide not only new wavelengths of coherent radiation but high peak power, ultra-short pulses and controlled wavefront as well. Combining of the coherent beams makes the lasers even more powerful.

Comprehensive research was carried out to study the operation of the linear fibre pulse generator scheme, based on self-phase modulation-induced spectral broadening and offset-alternating spectral filtering.

Innovative solutions for fibre lasers also include high-efficient second harmonic generation from broad spectrum fiber lasers and high-power lasers with temperature management along nonlinear crystal and a few patented approaches for coherent combining of laser beams.

Developing new laser micromachining technologies

- **Laser interference ablation of silicon using pulsed lasers**
  An analytical method for evaluation of thermal diffusion influence to the quality of structures, formed during the laser interference ablation in silicon using femto-, pico-, and nanosecond pulses, was developed. The temperature modulation depth was introduced as a parameter for quality assessment of the laser processing. The model can used for optimising process parameters in periodical structuring with the required resolution and quality.

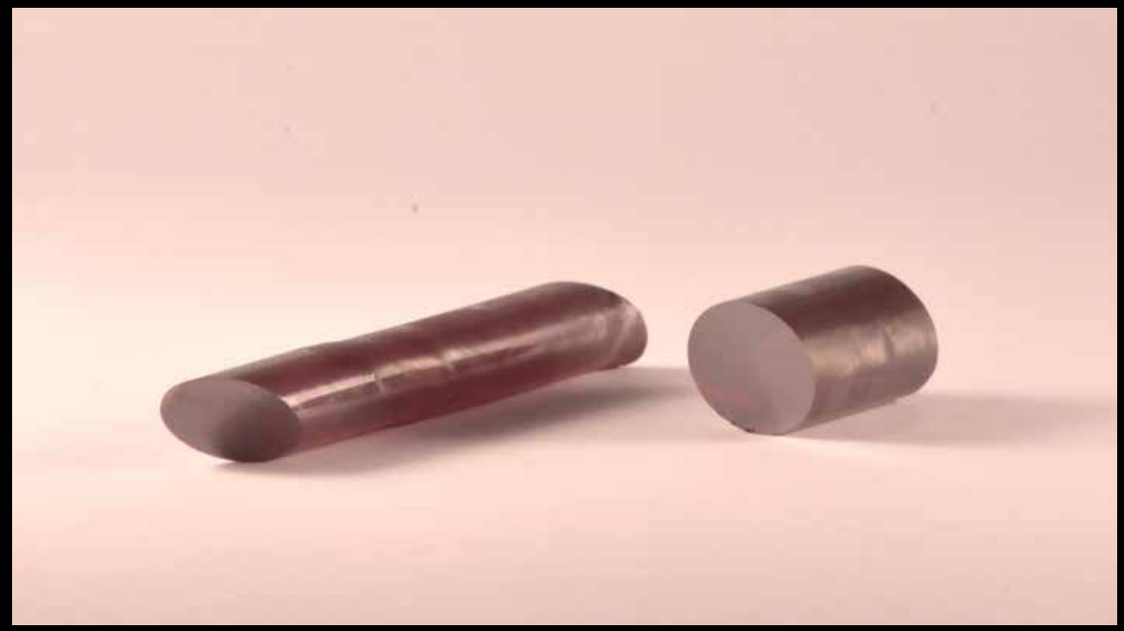
- **Efficient material removal using ultra-short pulse lasers**
  The efficiency of the material removal rate using ultra-short pulse lasers is a limiting factor for their broader application. Numerous process parameters including the scanning speed, the distance between scanned lines, and the spot size should be optimised. A new model of rectangular cavity ablation was developed, considering the decrease in the ablation threshold, as well as saturation of the ablation depth with an increasing number of pulses per spot. High speed mimicking of bio-inspired functional surfaces by laser irradiation has been demonstrated.
  Various glass processing technologies with short and ultrashort pulse laser are under development. The high-speed cutting of thick glass was proceeded to industrial implementation. The method was extended to free shape milling of fused silica and glass by manufacturing gas capillary nozzles of complex shape for laser plasma wakefield acceleration.

- **High-density gas capillary nozzles manufactured by hybrid 3D laser machining technique from fused silica**
  The enhanced interest in advanced X-ray sources, driven by laser-accelerated electrons, for the spectroscopic absorption measurement at modest scale research facilities and the demand of higher X-ray energy for the investigation of the warm dense matter, raise the requirement of manufacturing and characterisation of tailored gas targets with micrometric dimensions. An efficient hybrid laser technique, nanosecond laser rear-side processing and femtosecond laser-assisted selective etching (FLSE) for the manufacturing of high-density gas capillary targets, is demonstrated. The nozzles were validated at Lund laser facility and ELI-Beamlines.

Laboratory of Laser Microfabrication Technologies
Efficient surface texturing utilising laser beam interference, glass processing utilising smart pulsed lasers or distorted Bessel beams, nano-textures decorated by nanoparticles, 3D metal sculpturing by subtractive technologies, laser-induced transformations in graphene-like materials make up the main working topics of the Laboratory of Laser Microfabrication Technologies.

Laboratory of 3D Technologies and Robotics
The scope in the material processing using ultrashort pulse lasers includes the investigations of the laser-matter interaction as well as hardware development in the Laboratory of 3D Technologies and Robotics. Laboratory is advancing the development of new 3D additive manufacturing technologies, including laser-based.

Laboratory of Plasmonics and Nanophotonics
To intensify merge nanotechnologies with photonics, the Laboratory of Nanophotonics is on transformations to Laboratory of Plasmonics and Nanophotonics, involving new researches from various fields and revised goal of photonics-based bio-medical sensing.



Laser and Engineering Technologies Cluster (LITEK): accelerating cooperation

The members of the Laser and Engineering Technology Cluster (LITEK) unanimously state that LITEK is particularly essential for small and medium-sized enterprises in both cross-sectoral and international activities, discovering and creating new business opportunities abroad as well as implementing R&D and innovation actions. At the moment, the cluster unites 17 companies that are famous for their inventions and products all over the world. "One of the biggest challenges in cluster work is building mutual trust and fostering strong collaborative relationships despite competition. LITEK demonstrates by its performance that it is not only possible but also economically beneficial. Fostering and strengthening clustering in Lithuania is a substantial investment: EU-wide clusters are prioritised for numerous reasons, but most of all for their potential for innovation, "Kęstutis Šetkus, Director of Science, Innovation and Technology Agency (MITA) commented on the benefits of clusters. LITEK cluster can be proud of the international certificate - Bronze Label.

> *I think it is fair to say that Lithuania as a nation can be proud of its achievements in photonics, which are truly remarkable for a small country. Lithuanian scientists are internationally recognized for their numerous and significant contributions to the field, and leading Lithuanian companies have a well established reputation for their advanced cutting-edge products, especially laser systems, and for their competitiveness and a very visible presence in the worldwide marketplace. I am amazed that a small country of 3 million people has a fully developed photonics industry ecosystem, ranging from optical and optomechanical components, coatings, characterization services, to complex and advanced laser systems, and workstations incorporating these lasers for industrial processing and other applications. This success is due to a vibrant photonics community of scientists and engineers with close-knit interactions between academic institutions and industry, both established companies and numerous start-ups. My impression is that the relatively large size of the photonics community compared to the whole population of the country, as well as the fraction of its contribution with respect to the overall economy is unparalleled in the world. Every time I visit Lithuania I am delighted to observe that this community is continuously growing, with young people in their 20s and 30s constituting a very significant part, which shows that photonics in Lithuania has a great potential for growth and future achievements.*
>
> *- Almantas Galvanauskas*
> *University of Michigan, Ann Arbor, USA*

LITEK Cases: Innovation and shared value creation

Center of Physical and Technological Sciences (FTMC)

Dr Karolis Ratautas from the Department of Laser Technologies at cluster member Center for Physical Sciences and Technology (FTMC) together with colleagues from Catalysis Department developed a technology that attracts the interest of such giants as MacDermid Enthone and Molex (USA), FCA (Fiat Chrysler Automobiles, Italy) concern and others. In collaboration with the FIAT Research Center, electronic circuits prototypes have already been produced: a touch-sensitive glove compartment opening mechanism for the FIAT 500. "Molded Interconnect Devices (MID) allows integration of electrically conductive tracks on moulded thermoplastic surfaces and helps to integrate electronic components such as antennas, sensors, switches directly. It helps to save materials, reducing the weight of the device, and production is less complex, – says inventor Dr Karolis Ratautas – MID has great potential in the automotive, aerospace, lighting, computer or medical equipment production, where fast-growing innovations require an increase in the number of electronic components on the device". The biggest MID technological challenge is the production of electrically conductive tracks. Because the technology is geared towards complex three-dimensional plastic parts, standard techniques are not suitable for production. FTMC has developed a combined laser-chemical technology for selective metal deposition to form electrically conductive paths on dielectric surfaces. The circuit diagram can be written with a laser beam directly on plastic, glass or ceramic surfaces by modifying them and further selectively depositing with copper. This technology is more cost-effective compared to the current state-of-the-art LDS technology.

Altechna Coatings

Dr. Kęstutis Juškevičius, the Head of R&D at JSC Altechna Coatings, the company that has been producing optical coatings for lasers and laser systems for 22 years, says that the greatest asset of the cluster is the ability to work closely with both science and business, as well as to share Structural Fund investments with the other cluster members. "It is difficult for a single company to create an environment where research and technology can be carried out. But by working closely and effectively with different companies and scientists, higher quality and more creative work can take place, and the results are achieved faster. This is because we are all playing in the same courtyard – scientists, laser component makers, and manufacturers of lasers and mechanical processing bars – and together, we have almost everything that is needed to create innovations," said Dr Kęstutis Juškevičius. According to Julius Paužolis, the Head of LITEK™, from the outside it may appear simple and easy to act in a cluster and to gain value, but the reality is much more complicated because different companies have different interests as well as various business cultures, expectations and understanding of innovation – and this needs to be coordinated. However, sharing experiences, knowledge and competences with your partners in a cluster creates the possibility to enrich others and yourself. Therefore, the cluster offered a great environment for a company to grow at a tremendous rate, provided it can understand and exploit its opportunities.

Ekspla

Vytautas Gatelis, the Head of Production of Lasers and their Components in JSC Ekspla, which is one of the initiators of LITEK™ and the main financial sponsor, says that it is always more difficult do something alone than to join forces. As a result, JSC Ekspla, which is world renowned for its production, initiated cooperation between science and business still before the creation of the cluster.

"Today I can assert that relations with LITEK™ members are multifaceted, and includes our product buyers, our suppliers, and joint project executives. The technical capabilities have also been expanded by the acquisition of various machine tools, other sophisticated and necessary equipment, which for individual member there is no sense to buy,"- says Vytautas Gatelis. He also notes that the cluster has greatly increased the attention to each member because it is visited by top state delegations and business missions.

Building lasers for frontier science: SYLOS

Going extreme: SYLOS laser

ELI (Extreme Light Infrastructure) was designed to be the first exawatt class laser facility, equivalent to 1000 times the National Ignition Facility (NIF) power. Producing kJ of power over 10 fs, ELI will afford wide benefits to society ranging from improvement of oncology treatment, medical and biomedical imaging, fast electronics and our understanding of aging nuclear reactor materials to the development of new methods of nuclear waste processing.

The facility will be based on four sites. Three of them are implemented in the Czech Republic, Hungary and Romania.
ELI-ALPS based in Szeged (Hungary), one of the three pillars of the Extreme Light Infrastructure, will further deepen knowledge in fundamental physics by providing high repetition rate intense light pulses on the attosecond timescale. Current technological limitations will be overcome by the use of novel concepts. The main technological backbone of ELI-ALPS will be Optical Parametric Chirped-Pulse Amplification (OPCPA) technique - a brainchild of scientists of Vilnius University – operating at few-cycle to sub-cycle laser pulses.

Joint forces for international cooperation: Ekspla and Light Conversion
The Single-Cycle Laser SYLOS1(2A) (the first and the second stage of the SYLOS project), which employs OPCPA technology, has been designed and manufactured by a consortium of two Lithuanian companies – Ekspla and Light Conversion.

The two biggest Lithuanian laser companies have pooled their two technologies together. In this way, we have obtained a result which, in our opinion, would not have been possible for a single company alone: we have created **the biggest laser** among the fastest – and therefore also **the fastest laser** among the biggest – the SYLOS1 laser.

In creating this laser, we applied the latest knowledge based on the most recent scientific studies and general projects carried out in collaboration with Laser Research Center of Vilnius University (Paradigma, Phasecontrol) funded by national science funding agencies.

The consortium won SYLOS1 procurement tender in 2014. The system was finished in 2017 and produces Carrier-Envelope Phase (CEP) stabilised, <9 fs laser pulses with a peak power of >5.5 TW and average power of >53W at 1 kHz repetition rate. To the best of our knowledge, this is currently the highest average power produced by a multi-TW few-cycle OPCPA system. Despite its uniqueness and extremely high power, the current state of SYLOS laser system already sets a new standard of reliability in ultrafast laser technology. During the first implementation phase finished in 2017 and subsequent trial period, the laser system demonstrated outstanding performance and reliability while it was running with full specifications for six months at least 8 hours a day.

Acknowledgement by Berthold Leibinger Innovationspreis 2018
Achievements and innovations related to SYLOS1 laser have been presented for the Berthold Leibinger Innovationspreis 2018. The joint team of researchers from Ekspla, Light Conversion and Vilnius University has been selected as one of the 8 finalists.

Recently, the second stage of the project (SYLOS2A) has been finished. The system has been upgraded to produce even shorter pulse duration: 6.4 fs laser pulses with a peak power of 5.8 TW and average power of 37 W at 1 kHz repetition rate.

Unique results

We have obtained end parameters that cannot be achieved using any other technology.

1. Innovations in the laser market: we have created a monitoring and interface level that was never seen before, where the diagnostic system accumulates and analyses the data, displays specific warnings and not only warns the users about deviations but allows them to adjust many parameters using software without the need to touch the laser components and disturb the system operations.

2. Having utilised reliable and industry-tested technologies, we have obtained a unique combination: extreme parameters plus extreme user-friendliness, including the fact that the later usage is cheaper and more convenient as the industrial modules are easier to manufacture and replace.

Additional benefits from the physical and economic perspectives:
1. The product that we have created will allow us to generate an XUV spectral range radiation with unique parameters, which is necessary for the research involving materials and biological objects. This XUV radiation can be used as a means of diagnostics to create future generations of extremely fast electronic components.

2. New products were developed during this project. They will be manufactured as separate products.

G. Vilda, Vice-minister, Ministry of Economy and Innovation of the Republic of Lithuania at the official opening of SYLOS laser, May, 2019

Gérard Mourou, winner of the Nobel Prize in Physics 2018, at the official opening of SYLOS laser, May, 2019

I live and work in Japan, far away from my native country of Lithuania. Still, I often get reminded about it through my work, when I hear about new results achieved by Japanese companies and Universities using lasers made in Lithuania. By being able to design and deliver state-of-the-art laser systems and photonic components, Lithuanian laser industry increasingly contributes to new scientific discoveries and technological breakthroughs on the global scale.

- Vygantas Mizeikis
Shizuoka University · Research Institute of Electronics

International collaboration platform: LaserLab-Europe in Lithuania

Vilnius University Laser Research Center (VULRC) has been a part of Laserlab-Europe since its inception in 2004, and on October 29th 2018 VULRC has become a full member of a newly established international non-profit organisation Laserlab-Europe AISBL. Laserlab-Europe is a network of European laser research infrastructures funded by the European Union. It brings together 33 leading organisations in laser-based inter-disciplinary research from 16 countries. 22 facilities (including VULRC) offer access to their labs for research teams from Europe and beyond. Together, they foster collaboration and know-how transfer and offer training for researchers. Laserlab-Europe is pushing the laser concepts into new directions and opening new application fields, both for the benefit of the European user community and for optical sciences and technologies as a whole.
Since the start of Laserlab-Europe, VULRC has given access to more than 100 scientists (47 projects) from 14 EU countries. The main research topics on which VULRC offers transnational access are: ultrafast nonlinear optics, femtosecond filamentation in solids and liquids, spatio-temporal characterization of light wave packets, ultrafast pump-probe spectroscopy in wide spectral range, ultrafast terahertz time domain spectroscopy, ultrashort pulse interaction with matter, multiphoton polymerization and femtosecond micromachining, and research on laser-induced damage.
Transnational Access is granted based on the scientific excellence of research proposals, reviewed by an external and independent selection panel.
If you would like to perform your own experiments at Laserlab-Europe facilities, including VULRC, please see **www.laserlab-europe.eu.**

Map of Laserlab-Europe IV facilities

Case Studies by Lithuanian laser companies

Light Conversion: 25 years of femtosecond solutions

The key driver at Light Conversion is consistency, persistent quest for the corporate goals, close attention to the clients' needs, and assurance of the exclusive quality of the products developed by the company. For 25 years now, we have been devel-oping things that alter the worlds of science and industry. Using our knowledge, experience, and leading position, we strive for perfection and continued growth. On the day our company was founded, we chose the path of research and have been following it ever since. Investments into this field have opened up a doorway to global markets for us. For 25 years, we have been searching for and discovering new ways to apply femtosecond laser technology. The clients of LIGHT CONVERSION range from research centres and labs and industrial corporations to medical companies.

With more than 3000 systems installed worldwide, Light Conversion has established itself as an innovative producer of ultrafast optical devices and the largest manufacturer of femtosecond optical parametric amplifiers (OPAs) and non-collinear OPAs. In addition to selling the products via a wide range of distributors, the company also provides OEM devices for other major laser manufacturing companies.

Light Conversion is the world leading manufacturer of wavelength tunable femtosecond optical parametric amplifiers (OPA) based on TOPAS and ORPHEUS series as well as diode pumped solid state femtosecond lasers PHAROS and CARBIDE. Both PHAROS, the most versatile femtosecond laser amplifier on the market, and the ultra-compact and cost-efficient CARBIDE feature market-leading output parameters along with a robust design attractive both to industrial and scientific customers. With major industrial customers operating in display, automotive, LED, medical device, and other industries, PHAROS and CARBIDE reliability has been proven by hundreds of systems operating in 24/7 production environment. The lasers are mainly used for drilling and cutting of various metals, ceramics, sapphire, glass, and material ablation for mass-spectrometry.

Ekspla: committed to innovation

Ekspla invests in the development of new products (R&D), develops new technologies and presents new products or modifications every year.

Femtosecond optical and hybrid laser products by Ekspla
In recent years, Ekspla has developed several new femtosecond optical and hybrid laser products for the industrial and scientific markets. UltraFLux is among them. Research on OPCPA technology helped to develop a world-class laser system. It consists of a broadband fiber optic laser and a solid-state diode-powered amplifier. The system is integrated with a parametric amplifier for pulse generation of multiple optical cycles with high peak power.
Systems of this type with extreme parameters have already been successfully installed at the ELI-ALPS Research Center in Hungary, called SYLOS and SYLOS Alignment. SYLOS system in 2019 was developed and produced by Ekspla and Light Conversion. SYLOS Alignment, which is a „smaller brother" of SYLOS, was developed and produced by Ekspla engineers.

Ultra-high intensity laser applications span a number of scientific disciplines, such as plasma physics and fusion research, atomic molecular & optical physics, femtosecond chemistry, astrophysics, high energy physics, materials science, biology, and medicine.

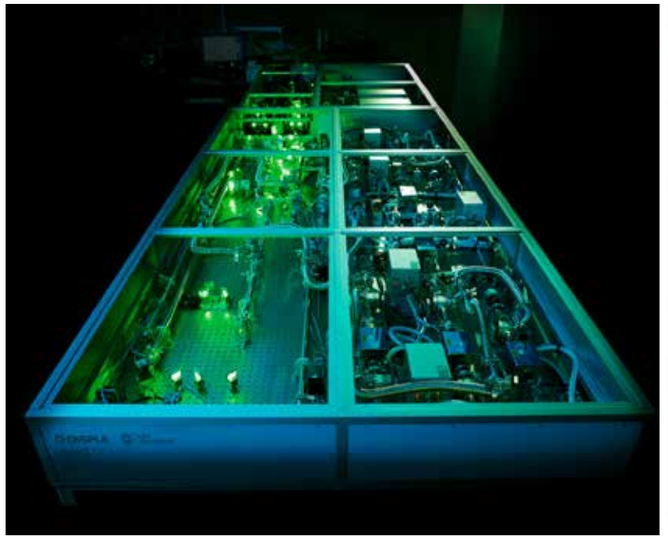
Areas where a strong impact is possible include:
• High harmonic generation and attosecond science
• Relativistic effects in interactions with atoms, molecules and electrons
• Ultrafast X-ray science
• High density science
• Fusion energy research
• Particle accelerators
• Thomson scattering

Laser systems for Photoacoustic
Following the demand of high output energies in the photoacoustic market for imaging larger volumes of tissue, PhotoSonus, an updated high energy tunable laser source for photoacoustic imaging has been introduced. Time-tested Ekspla nanosecond pump laser, parametric oscillator, power supply and cooling unit are integrated in a single robust housing to provide mobility, ease of use and low maintenance cost. Highly flexible PhotoSonus platform makes it easy to be integrated and used in a photoacoustic imaging system: it is fully motorized and computer controlled, have user trigger outputs /inputs and special functions as fast tuning between OPO wavelengths.
Photoacoustic imaging is a valuable high-contrast in vivo imaging technique for pre-clinical and clinical applications. This technique uses laser-induced ultrasound. Ultrasound signal is generated in tissue, when it absorbs laser light and expands thermo-elastically, and their waves are detected by ultrasonic transducers. 2D or 3D images are then reconstructed from the accumulated data.

High Power industrial picosecond lasers
In the industrial market, increased reliability and decreased cost of ownership of high power and UV components is critical. typo Ekspla-designed one of the first industrial lasers Atlantic: increased maximum laser power, installed unique solutions for laser reliability and durability. Atlantic UV30 - a picosecond high power UV laser optical layout was optimized for longevity and stable operation in UV range. As a result, 8000 hours UV optics lifetime is guaranteed, which is more than 11 months 24/7 service free operation.
Short, 10 ps pulse duration minimizes the heat-affected zone of processed material. The laser can be adapted for tough processes, like OLED cutting; sapphire processing, ceramics micromachining

In 2018 Ekspla introduced the femtosecond fiber optic lasers FemtoLux, designed for both R&D and industrial integration

APPLICATIONS
• Marking and structuring
• Volume modification of transparent materials
• Micromachining of brittle materials
• Photopolymerization
• Ophthalmologic surgery
• Biological Imaging
• Pumping femtosecond OPO/OPA



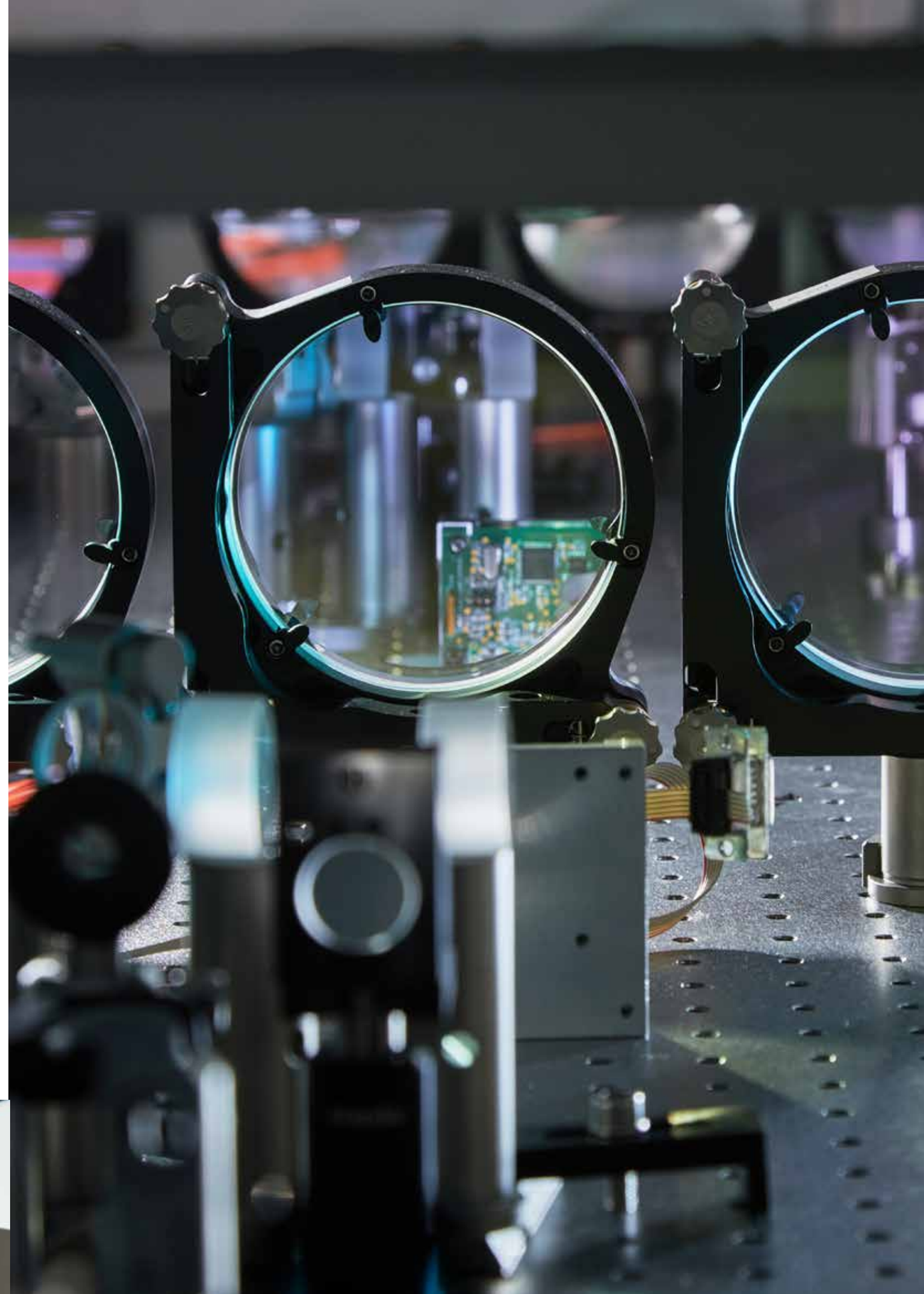
If you are in the laser and photonics industry, knowing about the Lithuanian laser industry is a MUST! Lithuania is ranked among the top 30 countries in Doing Business Index (World Bank), and the prestigious American business magazine Forbes has ranked Lithuania 15th globally in its annual Best Countries for Business. The Lithuanian laser community and businesses is often highlighted as a commendable example of a community of highly qualified specialists successfully competing in the international markets.

The country offers a very dynamic ecosystem with many startups being created every year, leading experts are recognized internationally, most advanced world scientists in the field join Lithuanian academia community: In January, the former CEO of Light Conversion Dr. Algirdas Juozapavičius was awarded the St. Christopher's statue for his business and science merits. In February Professor Gérard Mourou was elected a foreign member of the Lithuanian Academy of Sciences.

Lithuania is the country where, in proportion to the population, EPIC (European Photonics Industry Consortium) has the highest number of members. We are pleased to be supported by 17 excellent companies all centered around Vilnius. Hence I fully support an active role of Lithuania in ELI (Extreme Light Infrastructure), as multi-terawatt lasers are manufactured in Lithuania and is home to world renowned experts such as Algis Petras Piskarskas (worthy of a Nobel Prize), and internationally recognized companies such as Altechna, Eksma, Ekspla, Light Conversion.

The entrepreneurs in Lithuania are very international minded and I come across of them all over the world, they are present at exhibitions worldwide, they attend worthwhile meetings worldwide, they are open to collaborations. I am sincerely pleased that the 17th EPIC Annual General Meeting will take place in Vilnius 15-17 April 2020.

Carlos Lee
Director General, EPIC (European Photonics Industry Consortium)



Hybrid micro-fabrication by Femtika

Femtika specialises in hybrid additive-subtractive microfabrication realised in universal femtosecond laser based Laser Nanofactory workstation capable of multiphoton polymerisation, laser ablation, selective laser etching, laser welding and related technologies.

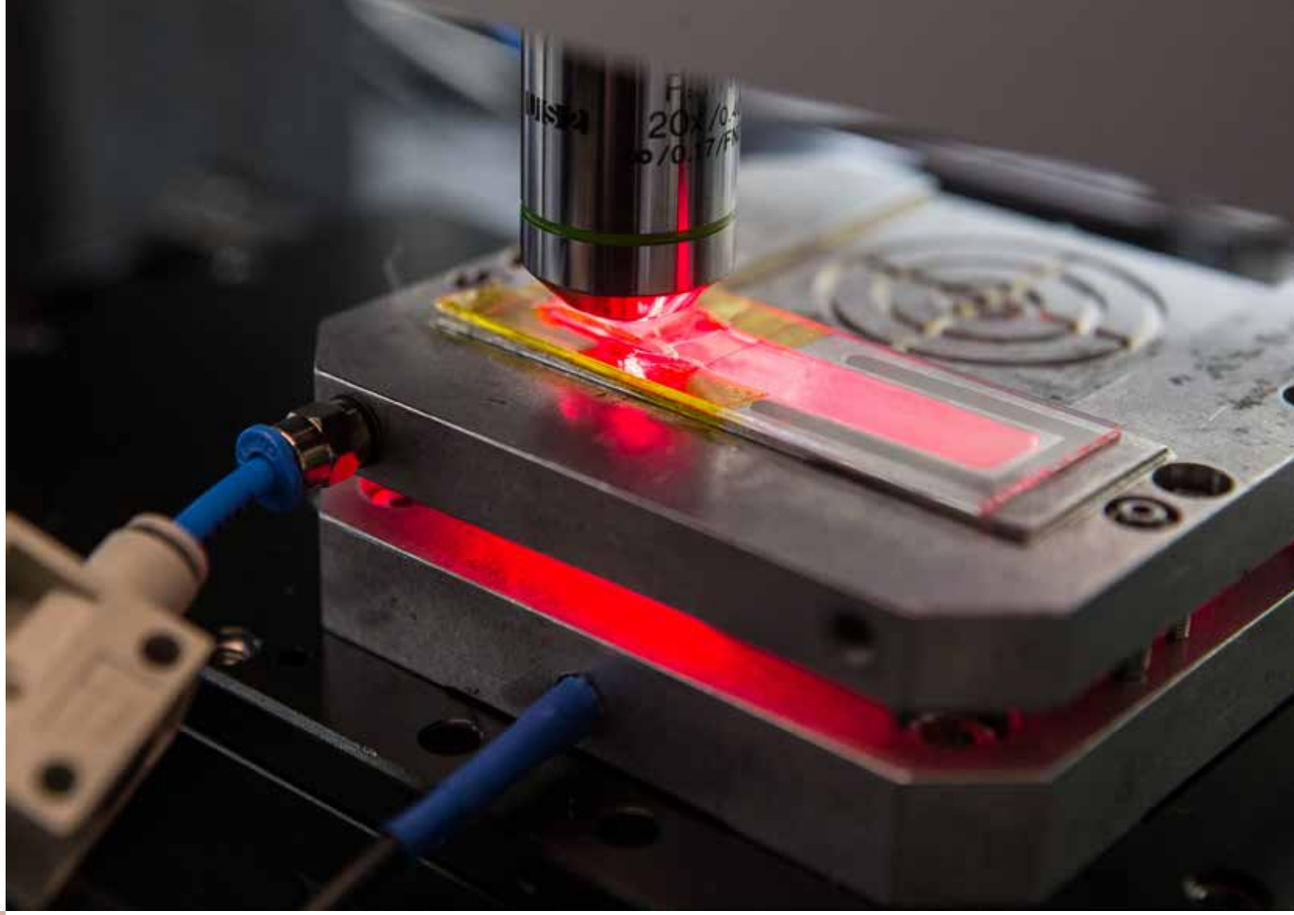
Priority areas for development

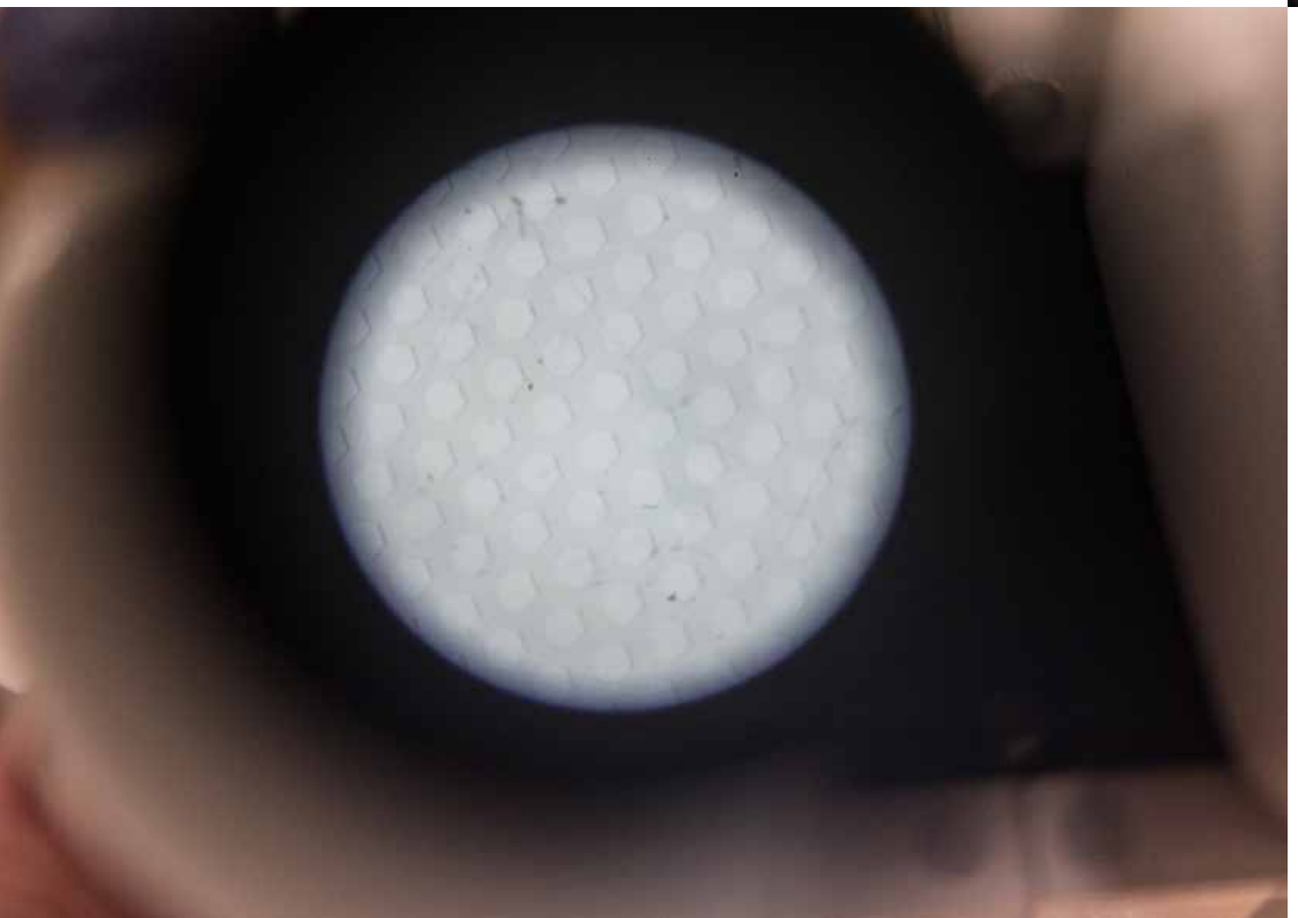
Femtika is currently developing several key micro-fabrication areas:
1) Universal subtractive processing of arbitrary materials via laser ablation. This allows cutting, drilling or texturing samples with application-dictated shapes. Because of peculiarities of fs-pulse and matter interaction such processing can be made "cold" resulting in superb fabrication quality and ultra-high resolution.

2) Laser-assisted selective etching is another area where Femtika is shining. At the moment, it is possible to produce true 3D structures out of the glass with free-movable features. This is expected to have huge implications in fields of microfluidics, micromechanics and sensorics, as glass is chemically and optically inert material with relative resilience to mechanical or chemical stress.

3) Multiphoton-polymerization is a kind of 3D printing that allows producing structures with arbitrary geometry with feature sizes below diffraction limit and surface roughness below 10 nm RMS. This makes it an ideal tool to produce micro-optical elements on-demand or other arbitrary shaped 3D elements for various applications.

4) Hybrid micro-fabrication is the key development path undertaken by the Femtika. The goal is to create micro-mechanical parts from at least two materials (for example, glass and polymer) while using several different technologies (laser ablation, selective laser etching, photo-polymerisation and laser welding). Hybrid technology enables fabrication of complex functional micro-elements or even whole devices for various applications, such as micro-robotics, micro-sensors, micro-fluidics, etc.





Currently, Femtika is working in two main directions:
-Providing academia with world-leading research equipment and research services needed to propagate ever-expanding field of laser material processing.

-Penetrating industry with completely new methods for femtosecond laser material processing.

Femtika has an extensive network of academic partners both in Lithuania and abroad. These connections allow to keep up with the fast-changing scientific landscape of the field and transform scientific discoveries to practical know-how. It results in new products that are beyond state of the art. As an example, one of the newest developments available in Laser Nanofactory is special module used to correct aberrations in arbitrary focusing depth and achieve near-spherical voxels or new breeds of specialised materials for additive structuring. Additionally, tight cooperation with other laser companies enables otherwise unavailable, specially tuned and application-inspired solutions for laser sources and other hardware/software. Due to this, Laser Nanofactory can be constantly improved in terms of laser parameter tunability, fabrication throughput and ease of use.

Workshop of Photonics (WOP) is all about ultrashort pulsed laser micromachining

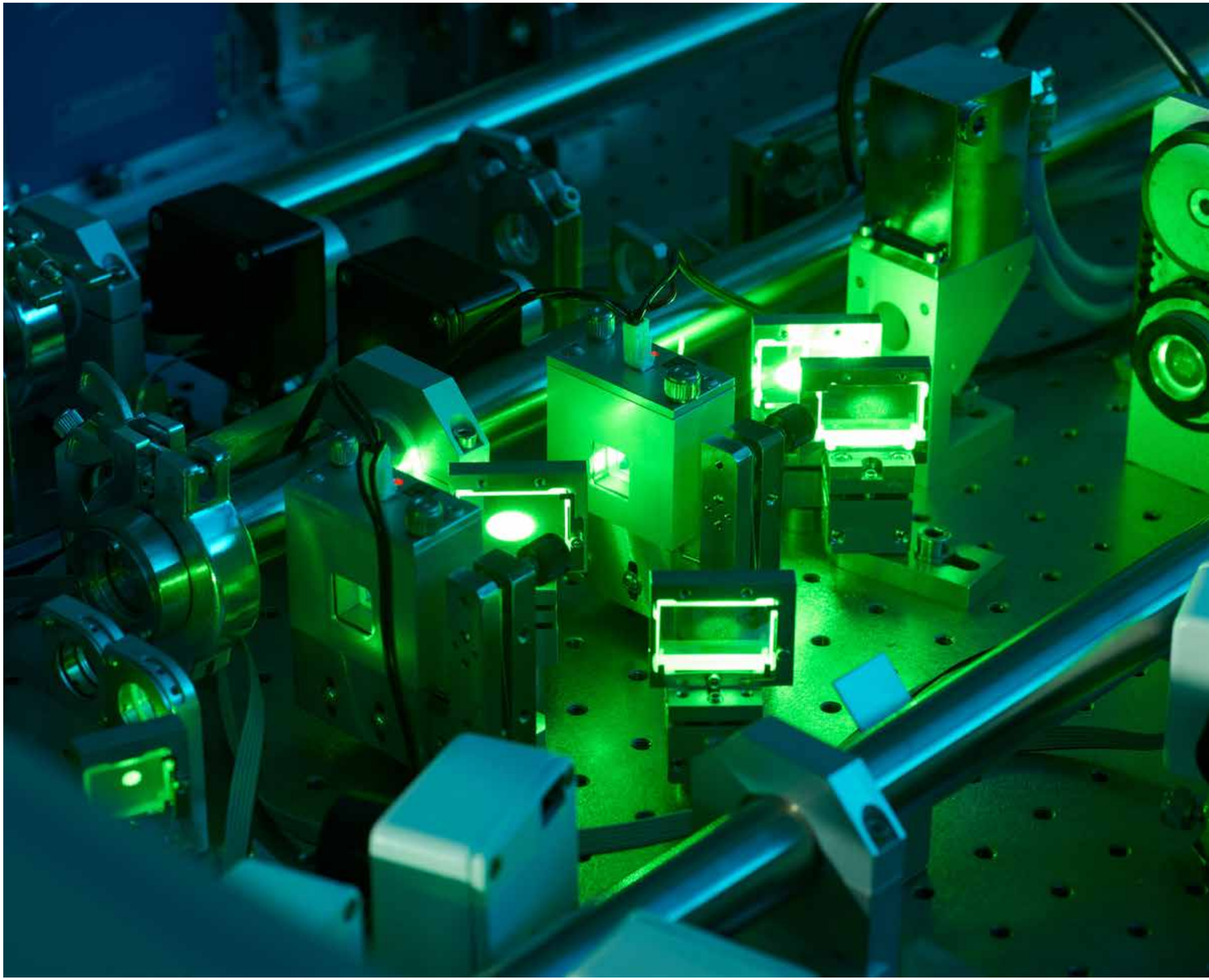
Workshop of Photonics is dedicated to developing instruments and solutions for ultrashort laser micromachining tasks. The key competencies are femtosecond laser micromachining applications' development, including special optical elements and contract manufacturing services. The services are aimed at industrial and academic customers, and the products range from small scale production to development of custom ultrashort laser micromachining systems. Currently, Workshop of Photonics most closely works with semiconductor, medical, automotive, telecommunication and other industry players.

Ultrashort laser micromachining
Since 2007 Workshop of Photonics has been heavily investing and carrying out extensive research and development in the field of ultrashort laser micromachining. Our key R&D projects are focused on:

• **Glass Processing Services.** We have gathered significant knowledge base in developing unique laser glass processing methods and created production ready facility in Lithuania, therefore can confidently say - our high throughput and yield glass processing services are perfect for small-scale production.
We can process up to 2.5 mm thickness glass (thicker under the demand) and perform straight and curved cuts, as well as round and rectangular hole drilling. High accuracy, great repeatability, high speed and ability to fabricate difficult objects with submicron resolution are just a few advantages of our offered laser processing services.

• **Laser Micro Drilling.** Workshop of Photonics developed a solution that enables machining of holes with controlled (positive, zero, negative) taper in various materials at high drilling speed, good surface quality and a wide range of diameters (tens of micrometres to millimetres). Both transparent and absorbing materials can be drilled using ultrashort laser technology.

• **Development of custom ultrashort laser micromachining workstations.** The equipment is customized to fully meet customers' requirements in laboratories for industrial processes, scientific research, or R&D centers.



New Product Development

• **MPP Cube** - a workstation, optimized for multiphoton polymerization (MPP) technology. Multiphoton polymerization can be used in micro-optics, fiber micro-optics, 3D photonics, medicine for growing tissues on scaffolds, custom structures for individual applications.

• **Laser Surface Structuring.** Laser surface structuring can be used to enhance various properties of surfaces or even induce new properties that material does not possess by itself, for example: friction reduction, diffractive structures for optical applications, micromolds for micro/nano feature replication, roughness modification, hydrophobicity/hydrophilicity, marking, etc.

• **Space-Variant Waveplates.** S-waveplate is a super-structured waveplate which converts incident linear polarization to radial or azimuthal polarization. S-waveplate can also be used to convert incident circular polarization to a beam carrying optical angular momentum. The product is unique for its high damage threshold 100 times exceeding alternative devices

Key activity fields:
• Development and production of custom ultrashort laser micromachining workstations
• Industrial laser micromachining solutions and technologies (cutting, scribbing, drilling, etc.)
• Small-scale production in the area of laser micromachining
• Special optics waveplates

Joint Development Agreement with Corning Incorporated
Workshop of Photonics has already participated in several joint research projects using laser technologies with partners aiming to develop interdisciplinary products and technologies. Since 2016 Workshop of Photonics has a Joint Development Agreement with Corning Incorporated (NYSE: GLW). This joint-partnership is focused on accelerating the development of new laser processing technologies for extra-resistant glass. Michael Müller, Managing Director of Corning Laser Technologies, one of the world's leading innovators in materials science, said: "We believe this strategic relationship with Workshop of Photonics will enhance our ability to deliver innovative laser processing solutions for glass".

"This strategic partnership with the global speciality glass production leader is a recognition of the unique glass processing laser technology developed by Workshop of Photonics," said Gintas Šlekys, chairman of the Board of Altechna R&D (Workshop of Photonics). "We see this as a great opportunity to grow alongside Corning Incorporated by providing laser application R&D services".

The company growth is fueled by the culture of open innovation and partnership with the local laser sector companies and worldwide partners. Workshop of Photonics has collaborated with leading academic teams, notably the Center for Physical Sciences and Technology, Vilnius University, Optoelectronics Research Centre (ORC) at the University of Southampton, University of Insubria, and Swinburne University of Technology.

Laser community: geographical proximity creates benefits

Laser science and industry were active participants of the new stage of R&D development in Lithuania, defined by the national programs of development of integrated science, studies, and business centres (valleys), approved in November 2008. Saulėtekis (Sunrise) Valley played a special role in laser development.

Historically, almost all laser companies in Lithuania have spun off from two strongest scientific institutions – Vilnius University Laser Research Center, located on Saulėtekio Avenue, and the Institute of Physics of the Center for Physical Sciences and Technology, situated on Savanorių Avenue. Most of the companies are still located next to their parent institutions. However, some new companies are scattered around the city, with a discernible third cluster formed on the intersection of Geležinio Vilko and Mokslininkų streets.

Three geographical locations bring key players into meaningful and advantageous proximity to benefit from fast and operation-friendly exchange and shared service.

VU Laser Research Center

Sunrise Walley Technology and Innovation Center

Center for Physical Sciences and Technology

Interesting facts about laser community

A unique golden coin dedicated to Physics

A golden €5 coin dedicated to Physics was issued by the Bank of Lithuania. The obverse of the coin features, a stylised Vytis in the centre, depicted against a background of interfering coherent light waves, surrounded by the inscription LIETUVA (Lithuania), year of issue (2016), denomination (€5), and the mintmark of the Lithuanian Mint. The reverse shows a laser beam, symbolising laser physics.

Post stamp as a recognition of laser potential and perspectives in Lithuania

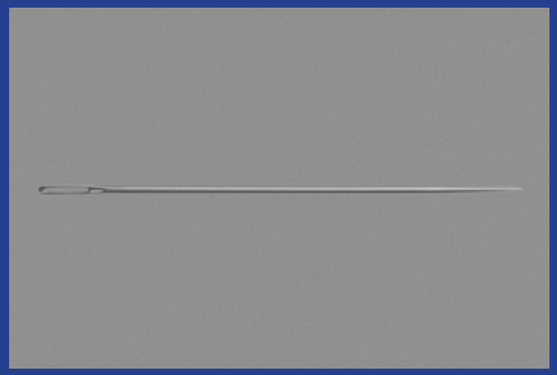
A special post stamp was developed and released in circulation to emphasise the value of laser sector in the national economy. Lithuania is demonstrating its pride in laser science and industry.

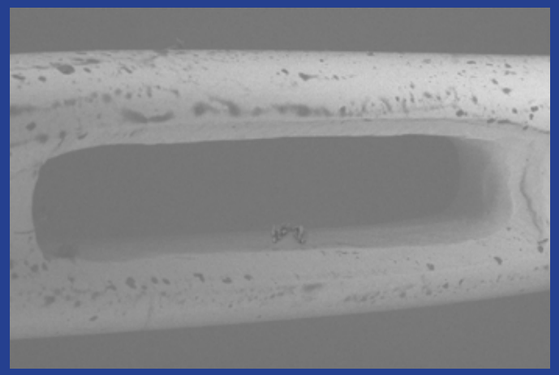
A unique gift for Pope Francis by President of Lithuania

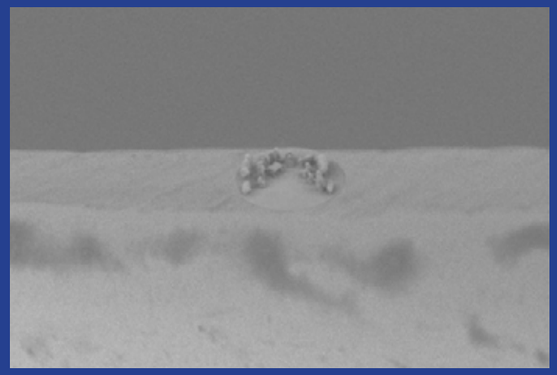
Sometimes the most important and impressive things are invisible to the naked eye, but we all know that they are real and true. This is the world's smallest Nativity Scene; and although you cannot see it with your naked eye, it is real and it is here. In this nanoscale, Baby Jesus is smaller than the a human cell!

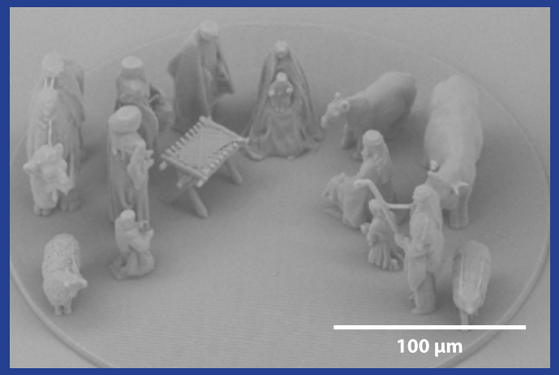
The idea was implemented by the joint team of Vilnius Gediminas Technical University LinkMenų Factory together with the Vilnius University Laser Research Center and the private companies Femtika and Idea 3D. The production of a nano-nativity scene took three months. VGTU students and researchers together private sector companies have joined three technological processes: 3D scanning, 3D modeling and 3D laser nano printing. This extraordinary project sends a message about the opportunities and achievements of the Lithuanian scientists and high technology market as well as the harmonious Vilnius city academic and cultural spirit. Lithuanian President Dalia Grybauskaitė presented one of the five nano-Nativity Scenes to Pope Francis as a gift.

President of Lithuania Dalia Grybauskaitė observing the gift to Pope Francis









Annex: Members of Lithuanian laser ecosystem

Scientific institutions involved in the development of laser technologies

Vilnius University
Laser Research Center

Acting director: Dr. Rytis Butkus
Professors: 7
Researchers with PhD degrees: 20
PhD students: 19

Laser research at Vilnius University was started in 1969 and a few years later the Department of Astronomy and Quantum Electronics (QED) was founded in Vilnius University Faculty of Physics. In 1983 the Laser Research Center (VULRC) was established and this dedicated facility has significantly expanded the experimental infrastructure available for research. Since its foundation, the department has graduated more than 600 students in laser physics, and more than 50 young researchers have completed their PhD research. Each year, the department hosts around 25 graduate students and more than 40 students follow MSc programs. There are two laser laboratories dedicated for training of students. Currently, the LRC has more than 30 permanent employees. In modern labs, covering more than 2 000 square meters, the research groups investigate phenomena of ultrashort pulse optics, biophotonics, laser nanophotonics, laser-induced breakdown and optics testing, femtosecond laser microfabrication and material modification and ultrafast spectroscopy.
LRC has been a member of the European Integrated Laser Infrastructure LaserLab since its inception in 2004, providing transnational access for the researchers from all around the EU. LRC became a full member of Laserlab-Europe AISBL in 2018. The scientists are involved in joint research activities with the colleagues from the best European scientific centers. The infrastructure for science and studies was further expanded using the funds provided by several recent European Structural Fund projects.
VULRC maintains close collaboration with laser industry, not only in training the students for laser related jobs, but also performing research projects to test the ideas for potential products and developments.

Address: Saulėtekio Ave. 10, LT-10223 Vilnius, Lithuania
Website: http://www.lasercenter.vu.lt/en/

Core research and services:
• Optics characterization and laser damage testing
• Femtosecond laser fabrication
• Laser 3D micro/nanostructuring
• Nonlinear optics
• Ultrafast spectroscopy

State-of-the-art laboratories with wide range of ns and fs laser systems open to business and researchers:
• R&D technology development services. We develope new laser sources and technologies in cooperation with laser industry companies
• Joint business and science projects
• Laboratory facilities and equipment for rent. We provide access to unique laser systems and measurement devices for qualified employees of business companies

Address: Saulėtekio Ave. 10, LT-10223 Vilnius, Lithuania
E-mail: laser.apc@ff.vu.lt
Website: http://www.lasercenter.vu.lt/en/

Vilnius University
Institute of Photonics and Nanotechnology

Director: Prof. Dr. Saulius A. Juršėnas
Professors: 8
Researchers with PhD: 30
PhD students: 13

The study of optical properties of semiconductors by using lasers was started at the Semiconductor Physics Department in the late 1960s. Today, the research activities have evolved into extended investigation of both organic and inorganic semiconductors and their structures for electronic and optoelectronic applications. Luminescence spectroscopy with picosecond time and submicrometer spatial resolution and nonlinear optical techniques in femtosecond and picosecond domains are employed as tools to study the light-material interaction. Research results enable the development of novel solid-state light sources, radiation-hard and fast radiation detectors for high-energy physics experiments and medical imaging, photosensitive and photovoltaic devices. Most of the major ongoing projects, totalling over 2 million EUR yearly, depend on laser light sources as the tools to study or fabricate semiconductor devices, structures, or materials.

Address: Saulėtekio Ave. 3, Vilnius
Website: https://www.ff.vu.lt/en/ipn/

Open Access Center/Facility
Laser Research Center Facility Naglis

Vilnius University Laser Research Center Facility Naglis
Head of the open access center: Dr. Domas Paipulas

Vilnius University Laser Research Center in 2013 started to provide access to their R&D resources at the open access center Laser Research Center Facility Naglis of Vilnius University.

Centre for Physical Sciences and Technology (FTMC)
Department of Laser Technologies (DLT)

Head: Dr. Gediminas Račiukaitis
Researchers with PhD degrees: 27
Graduate students: 16

DLT consists of six laboratories: Laser Microfabrication Technologies, Fiber Lasers, Solid-State Lasers, Optical Coatings, Nanophotonics and 3D Technologies and Robotics.

The main topics of research include the development of optical components and optical coating technologies, fiber and solid-state lasers and their applications in material processing. The research results are used in the production of sophisticated dielectric optical coatings, high pulse energy fiber lasers, and high power pulsed solid-state lasers for custom applications. The interactions between laser radiation and materials are investigated with a focus on novel laser micromachining methods. Part of the research is also directed at the modelling, formation, and characterisation of nanophotonic structures, waveguides and metamaterials for light control.
FTMC DLT offers its services for the development and implementation of customised integrated laser-based micromachining technologies, specialised solid-state and fiber lasers. It also provides design services, and small-scale production of dielectric optical coatings; in addition, it performs the modelling of light propagation in waveguides and photonic crystal structures.

Address: Savanoriu Ave. 231, Vilnius, Lithuania
Website:
https://www.ftmc.lt/en/
https://www.ftmc.lt/department-of-laser-technologies

Open Access Center/Facility
BALTFAB

Manager Dr Romualdas Trusovas

BALTFAB is an open-access facility within FTMC with tools and expertise in emerging micro/nanofabrication techniques. Our key feature is multidisciplinary research and competences from photonics and light manipulation to biomaterials and nanobiotechnology. Laser physicists with theoreticians, cell biologists, experts in electro- and organic chemistry and biophysicists are gathered under one roof from the Departments of Laser Technologies and Nanoengineering.

Core research and services:
• Biocompatible surfaces and biochips
• Electrochemical and plasmonic sensor development
• Laser equipment development: e.g. fiber laser system with control software
• Laser micromachining technologies and lithography
• Soft and scanning probe nanolithography
• Optical coatings, waveguides and photonic crystals
• Ellipsometric SPR simulations and measurements of self-assembling
• Synthesis of custom organic materials
• Laser-based selective metallization of plastics and glass
• 3D additive manufacturing technologies

Our multidisciplinary team is ready to investigate the synergies between unconventional fabrication methods and explore the possible combinations. BALTFAB is open for technology consultation, training and education.

Address: Savanoriu Ave. 231, Vilnius, LT-02300, Lithuania
Website: http://www.baltfab.com

LaserLT Digital Innovation Hub (LaserLT DIH)

Coordinator Dr Gediminas Račiukaitis

The vision of LaserLT DIH is to become the strongest one-stop-shop on lasers, photonics and advanced manufacturing in Northern-East part of Europe providing services for digital transformations in the industry. Its strength is based on three main pillars:
1. Competence in laser technologies (FTMC DLT);
2. Business support and access to finance (Science and Technology Park);
3. Access to industry (LITEK™ cluster).

LaserLT DIH is specialising in the development, validation of the world-class laser and engineering technologies for manufacturing SMEs (small and medium enterprises). Services provided by DIH are research, development, designing, prototyping, pre-production of laser- and photonics-based solutions to companies, the attraction of funds, market research, incubation and commercialisation. Pilot lines combining laser technologies with complementary ones are under construction to speed up the technology transfer to SMEs. Connections with similar DIHs on laser-based manufacturing and advanced manufacturing is started. APPOLO HUB (www.appolo-hub.eu) is an initial point. We are part of the regional network of DIHs.

Services provided by of LaserLT DIH:
• Technological audit
• Consultation on the application of photonics-based production technologies
• Development and validation of new technologies
• Run of pilot line and prototyping service
• Access to Funding and Investor Readiness Services
• Mentoring

Address: Savanoriu Ave. 231, Vilnius, LT-02300,
Lithuania Website: http://www.laserLT-DIH.lt/en/

Science and Technology Park of Institute of Physics

Founded: 1994
Director: Julius Paužolis

Science and Technology Park of Institute of Physics (FIMTP) dedicated for growing spin-offs in laser, optical and engineering technologies and promoting these technologies to the industry as well as an overall partnership between science and business. FIMTP providing young companies with a full package of services beginning with the formulation of the idea until prototyping and access to the market. The package includes business development consultations, planning R&D activities and access to laboratories, access to funding, engineering and prototyping, acquiring office and laboratory type premises, search for local and international clients and partners. FIMTP organizes internships for students in the fields of laser, optical and engineering technologies that a high-tech sector should get more and better-prepared professionals. FIMTP continuously developing infrastructure projects tailored to a company's needs. Science and Technology Park of Institute of Physics is also

one of the stakeholders and initiators of specialized Laser LT Digital Innovation Hub.

Address: Savanorių Ave. 235, Vilnius, Lithuania
Website: http://www.fimtp.lt/en/

LASER & ENGINEERING TECHNOLOGIES CLUSTER

Laser & Engineering Technologies Cluster LITEK

Founded: 2011

Cluster Manager: Julius Paužolis

Laser&Engineering Technologies Cluster LITEK™ brings together companies and organizations operating in the sectors of lasers and associated technologies. The aim of the cluster - to increase profit and international competitiveness of cluster companies through high value-added products and innovations which are coming from synergetic cooperation. Today cluster unifies 20 companies which are linked in a production chain of lasers & laser systems, laser micro-machining units. Such integration promotes the international competitiveness of laser and laser-related engineering technologies and contributes to the dissemination of the knowledge and well-being of the individual members of the cluster. LITEK™ is Bronze labeled cluster in management excellence providing for members innovation potential audits, TRL assessment, development of innovation strategy, value chain analysis as well as organizing specific training, business missions, matchmaking events and promoting the sector in overseas markets. We are always looking for new ways to support the development of new cross-sectoral industrial value chains across the EU. LITEK™ initiated and has been coordinating since 2015 the European Strategic Cluster Partnership in Photonics for Health (LASER-GO) supported by the European Commission through the COSME programme.

Address: Savanorių Ave. 235, Vilnius, Lithuania
Website: http://www.litek.lt?lang=en

Center for Physical Sciences and Technology (FTMC)
Department of Molecular Compound Physics (DMCP)

Head: Prof. Dr. Vidmantas Gulbinas
Professors: 2
Researchers with PhD degrees: 11
PhD students: 4

DMCP is comprised of Ultrafast Spectroscopy and Biophysical Research laboratories. Research at DMCP is directed towards better understanding of optoelectronic properties and photo-induced electronic processes in various organic and hybrid systems designed for applications in organic optoelectronics, as well as in natural biological objects. The investigations are mainly focused on application of organic, hybrid and perovskite materials for solar cells and light emitting diodes. Dynamics of optically excited states, charge carrier photogeneration, transport and recombination are addresses by combining ultrafast photoluminescence, transient absorption, optical electric field probing, as well as conventional photoelectrical measurements. Single molecule spectroscopy, CARS, multi-photon fluorescence and second harmonic generation microscopy techniques are used to visualize details of biological and other molecular objects with sub-micrometer resolution.

Website:
https://www.ftmc.lt/en/
https://www.ftmc.lt/department-of-molecular-compound-physics

Center for Physical Sciences and Technology (FTMC)
Department of Optoelectronics (DO)

Head: Prof. Habil. Dr. Gintaras Valušis
Professors: 2
Researchers with PhD degrees: 28

Department activities are focused on applied and fundamental research in the fields of semiconducting materials physics and technology, development of optoelectronic devices, their systems and applications.

The Department consists of five laboratories – Laboratory of Ultrafast Optoelectronics, Optoelectronics Technology laboratory, Semiconductor Optics laboratory, Terahertz Photonics Laboratory, and Optoelectronics Systems Characterization laboratory. The staff is 46 researchers – 28 doctor of sciences, 9 PhD students, and 9 engineers.

In addition, the DO contains Terahertz (THz) photonics and technology Cluster – inter-laboratory unit which includes collection of modern THz experimental facilities for development of THz technology and THz photonics components as well as investigation of novel materials properties using various THz techniques. The facilities embrace 6 femtosecond lasers including optical parametric amplifier with tunable wavelength of 0.3 microns up to 2.6 microns.
The THz spectra of time-domain THz spectroscopy extends up to 6 THz, while in a time domain the pulse duration can be varied within 20-150 fs. Two types of THz imaging set-ups are available – time-domain spectroscopy based and electronic sources – based continuous wave operation mode at 100 GHz, 300 GHz and 600 GHz frequencies. The DO exploits full chain of scientific and innovation activities – starting from novel materials design, their growth employing modern molecular beam epitaxy equipment, their structural and optical/electrical investigation, semiconductor-compatible processing technologies including laser lithography, fabrication and development of optoelectronic components for infrared and terahertz spectral ranges, – up to their direct implementation.

Address: Sauletekio Ave. 3, Vilnius, Lithuania
Website:
https://www.ftmc.lt/en/
https://www.ftmc.lt/department-of-optoelectronics

ktu kaunas university of technology 1922

Kaunas University of Technology
Faculty of Mechanical Engineering and Design

Dean: Dr. Andrius Vilkauskas
Professors: 20
Researchers with PhD degrees: 107
PhD students: 47

The faculty pursues research activities related with the applications of lasers in materials processing and measurement technologies.
Directions of research include the effects of laser irradiation in processing of engineering materials, textiles and functional materials as well as laser applications in rapid production (prototyping) systems, and integration of laser technologies in production systems.
Research activities are also related with optical measurements and characterization of materials and micro mechanical structures, laser and photonic technologies in experimental mechanics and microtechnology.
The faculty collaborates with SPIE (the International Society for Optics and Photonics, USA), Johannes Kepler University Linz in Austria, Tallinn University of Technology in Estonia and other universities and research centres.

Address: Studentų St. 56, LT–51424, Kaunas, Lithuania
Website: https://en.ktu.edu/

Kaunas University of Technology
Institute of Materials Science
Department of Surface and Thin Film
Research Laboratory of Optical Technologies

Head: Dr. Mindaugas Andrulevičius
Professors: 2
Researchers with PhD degrees: 4
PhD students: 3

The laboratory is involved in the applications of laser technologies and optical spectroscopy methods. Ultra-fast Yb:KGW laser system is employed for precise multiple wavelength micro/nano fabrication of broad range of materials as well as for the transient absorption spectroscopy measurements. The techniques based on continuous wave and pulsed laser interference as well as focused laser beam exposure are used for the formation of periodic microstructures for development on the novel optical security features towards anti-counterfeiting applications. Optical sensors for real-time monitoring of refractive index in liquids are developed and applied in the analysis of biological processes. Soft lithography replication techniques together with capillary assisted particle deposition methods are employed for plasmonic nanoparticle and fluorescent microparticle deposition in regular arrays for photonic applications. Plasmonic properties of nanocomposites are studied by the spectroscopic ellipsometry. The laboratory collaborates with the University of Southern Denmark, National Institute of Materials Science (Japan) and other scientific centers abroad.

Address: K. Baršausko St. 59, Kaunas, Lithuania
Website: http://materials.ktu.edu

NATIONAL CANCER INSTITUTE NCI

National Cancer Institute
Laboratory of Biomedical Physics

Head: Prof. Dr. Ričardas Rotomskis
Professors: 1
Researchers with PhD degrees: 3
PhD students: 4

Research of interactions between laser radiation and biological objects began at Vilnius University Laser Research Centre in the 1970s. In 1989, the Lithuanian Oncology Center has started applying photodynamic cancer therapy employing lasers. More than 700 patients received treatment. The Biomedical Physics Laboratory was founded in 2004. It continues research of interactions between laser radiation and biological objects, including techniques and methods of optical biopsy, photosensitized cancer therapy, biomedical imaging, nanobiophotonics and nanomedicine. Temporally and spatially resolved luminescence spectroscopy and nonlinear optical techniques are employed as tools to study the interaction between light and different types of nanoparticles (semiconductor, gold, magnetic, fluorescent, up-converting etc.) in aqueous solutions and bio-models. Fluorescence lifetime imaging, confocal microscopy of biologicaly active molecules and nanoparticles are performed in cells cultures and experimental animals. The laboratory maintains close collaboration with the University of Oslo and the Norwegian Radium Hospital in Norway, Leibniz-Institute of Photonic Technology (Jena) in Germany.

Address: Baublio St. 3B, Vilnius, Lithuania
Website: https://www.nvi.lt/en/

VYTAUTAS MAGNUS UNIVERSITY MCMXXII

Vytautas Magnus University
Department of Physics
Group of Modeling of Nonlinear Optical Phenomena

Head: Ass. Prof. Dr. Valdas Girdauskas

Researchers with PhD degrees: 3

The group works on the theoretical modeling of the interaction of short laser pulses with the gaseous and solid state
media. Numerical methods formodeling these phenomena are developed and applied in solving research problems. Other research intersts of the group is the laser-induced breakdown and optical spectroscopy. The group collaborates with Ekspla and the Department of Laser Technologies
of Center for Physical Sciences and Technology.

Address: Vileikos St. 8, Kaunas, Lithuania
Website: https://www.vdu.lt/en/

General Jonas Žemaitis Military Academy of Lithuania
Department of Defence Technologies

Head: Prof. Dr. Aušrius Juozapavičius
Professors: 2
Researchers with PhD degrees: 6

The department was founded in 1994. One of the directions of research pursued was the detection of explosives and pollutants using laser-based methods. The scientists of the department had developed selective methods and sensitive equipment for detecting pollutants on army training grounds and the environs, using modern laser techniques. Currently the department is involved in a research of detection of THz radiation from quantum cascade lasers and ultrashort pulse Ti: sapphire lasers using silicon CMOS and AlGaN/GaN detectors in close collaboration with the Noise and THz Labs of Vilnius University.

Address: Šilo St. 5A, Vilnius, Lithuania
Website: http://www.lka.lt/en/

Annex: Members of Lithuanian laser ecosystem

Companies developing and producing lasers, laser solutions and services

3photon

Founded: 2017
CEO: Marius Šemeta
Employees: 4

Area of activity: Laser and non-linear crystals, optical components, simulations & technical consulting, crystals repair service.
3photon (three-photon) stands in front of optical coatings and polishing facilities by design and commerce of laser & non-linear crystals and optical components. Experience combined with technology enable to successfully employ and process various hardness and sensitive crystals with high laser damage threshold like LBO, BBO, DKDP, $AgGaS^2$, Cr:CdSe, Cr:ZnSe, Nd:YAG, Nd:YLF and others.
Optical coatings such as mirrors, beamsplitters or more complex like polarizers and variable reflectivity coatings can be deposited as well. Highly experienced team merges technical competencies and capabilities of key stages of optical component production, starting from optical glass, crystal polishing, continuing to coating process employing optimal coating technology and finalizing with precise characterization with particular emphasis on high precision and high-power optical products development.

Address: Savanoriu ave. 235; Vilnius, LT-02300; Lithuania;
Website: http://www.3photon.com

Altechna Group

Founded: 1996
CEO, Antanas Laurutis,
Employees: 110

Altechna Group is a Lithuanian-based custom laser optics company with worldwide customers. The company employs more than 110 talented minds and skilled professionals to develop and provide complex technological solutions and typo custom-tailored designs of laser optics and accessories for laser applications for the industrial, defense and academic customer.
Our focus is on listening to and understanding needed requirements, selecting the best method for producing quality laser optics, and shipping them in a timely manner. We have accumulated all the necessary know-how to evaluate and complete every order with attention to the finest details.
Customers choose Altechna Group for the premier quality, custom-tailored designs of laser optics and accessories for laser applications. Know-how is the key.

Website: https://www.altechna.com/
Address: Mokslininkų St. 6A, LT-08412, Vilnius, Lithuania

ADOS-TECH

Founded: 2017
CEO Robertas Grikšas
Employees: 5

ADOS-TECH assemblies various optical and digital systems for laboratories, scientific research, surveillance, defense-related applications.
Company develops fusion and augmented optical systems for improved vision during severe atmospheric conditions.
ADOS-TECH is developing multispectral fusion technology based on artificial intelligence (AI) for overlay of different spectral regions: NIR and LWIR. This technology enables user to see through various atmospheric obstacles such as smoke, fog or total darkness.

Address: Mokslininku st. 2A, LT08412 Vilnius, Lithuania
Website: http://www.ados-tech.com

Aštuonetas

Founded: 1994
Director: Artūras Greičius
Employees: 7

Aštuonetas offers the services of laser marking, microwelding and cutting. The company develops in-house laser marking software and equipment. The customers of the company include advertisement producers, manufacturers of optomechanical and electronic equipment, printers, jewelry producers, organizers of events and shows etc.

Address: A. Goštauto St. 12, LT-01108, Vilnius, Lithuania
Website: http://www.astuonetas.lt

AtoID

Founded: 2014
Director: Evaldas Pabrėža, CEO
Employees: 1

AtoID is sensor supplier for companies working in explosive and narcotics detection. One of the key customer is a company working with early cancer detection, demonstrating a breakthrough in this field.

Address: Kalvarijų str. 125B, Vilnius, Lithuania
Website: http://www.atoid.com

Brolis Semiconductors

Founded: 2011
Director: Dominykas Vizbaras
Employees: 30

Brolis Semiconductors is a vertically integrated semiconductor high-tech company developing advanced electro-optic systems for defence, healthcare and industrial markets. Company runs own in-house semiconductor technology from epitaxy to a complete final end-user system. Specialty technology includes hybrid GaSb/Si integrated photonic sensors for biomedical applications and advanced warrior systems for defence.
Company has won numerous awards including Deloitte Fast 50 most disruptive innovation award in 2018 and has been ranked #6 in CEE in Deloitte Fast 50 technology company ranking.

Address: Molėtų pl. 73, LT-14259, Vilnius, Lithuania
Website:
http://www.brolis-sensor.com
http://www.brolis-photonics.com
http://www.brolis-group.com

Direct Machining Control

Founded: 2014
CEO: Tadas Kildušis
Employees: 6

Direct Machining Control creates DMC software that controls laser machines. Applications range from laser micromachining like laser etching, drilling, engraving to laser additive manufacturing (SLS, SLM, SLA, 2PP).
DMC is a fusion between CAD/CAM and machine control software focused specifically on laser applications. It combines motion trajectory generation based on 2D or 3D CAD models and controlling a wide range of hardware (positioning stages, galvo scanners, lasers, cameras, and various sensors) to perform laser machining with user defined parameters. This allows saving a lot of time for process preparation and development.
Direct Machining Control works together with a variety of motion control companies, laser micromachining R&D centers and system integrators to provide laser system users a user-intuitive and efficient way to control their laser machines.

Address: Mokslininkų g. 2A, LT-08412, Vilnius, Lithuania
http://www.directmachining.com

Eksma

Founded: 1983
Director: Dr. Petras Balkevičius

Employees: 12

Eksma is an umbrella company of a group that has been working in high technologies for over 35 years. Eksma Group includes five companies involved in laser technologies, Ekspla, Eksma Optics, PhotoSana, E&EO UK and Shanghai Eksma Laser Technologies Co., Ltd. The start of Eksma Group was in 1983, when the Experimental Plant of Laser and Electronic Equipment was established at the Institute of Physics of the Academy of Sciences. In 1988, Eksma was the first company in Lithuania, rented out by the state to its employees. Eksma is a shareholder of the joint Lithuanian-Russian company Sibirskij Monokristall-Eksma specializing in the growth of nonlinear and laser crystals. In addition to laser business, the company is involved in the sales, installation and support of medical and laboratory equipment (Eksma is one of the large shareholders of JSC Bioeksma).

Address: Mokslininkų St. 11, LT-08412, Vilnius, Lithuania
Website: http://www.eksma.lt

EKSMA Optics

Founded: 2006
CEO: Dainius Tumosa
Employees: 56

EKSMA Optics is a manufacturer and global supplier of precision optical components that are used in industrial and scientific lasers, laser systems and other optical instruments. Company's product range includes laser optics, nonlinear and laser crystals, electro-optic Pockels cells, ultrafast pulse picking systems and laser electronics.
EKSMA Optics owns optics production facility, covering a wide range of manufacturing activities, starting from the stage of optical elements or optical system design and engineering, to optical polishing, CNC spherical, aspherical and conical lenses manufacturing and advanced IBS coating deposition. Company's polishing facility also specializes in processing and final polishing of DKDP, BBO, KTP, LBO and ZnGeP2 crystals. EKSMA Optics owns clean room facilities for assembling of electro-optical and optical systems.
The company participates in various international R&D projects under Framework 7, EuroStars, Horizon 2020 and other programs, together with partners from EU countries by developing system components used in the laser systems for life science, medical and industrial applications.
All components provided by EKSMA Optics are subject to high quality testing, performed in in-house quality control laboratory.
The company is ISO 9001:2015 certified.

Address: Mokslininku st. 11, LT-08412 Vilnius, Lithuania
Website: http://www.eksmaoptics.com

Ekspla

Founded: 1992
Director: Kęstutis Jasiūnas
Employees: 126

Ekspla is an innovative manufacturer of solid state & fiber lasers from unique custom system for basic research to small OEM series. Employing more than 26 years' experience and close partnership with scientific community, Ekspla is focused on design and manufacturing of advanced lasers & systems. Ability to effectively tailor product for specific applications and/or according specific requirements is one of the main competences of Ekspla.
The company is leading in the global market for scientific picosecond lasers. More than 700 picosecond lasers are delivered to the customers in all continents (except Antarctica).
Ekspla lasers can be found in 66 out of 100 top universities. Clients like CERN, NASA, ELI, Max Planck Institute, Cambridge University, Massachusetts Institute of Technology or Japan University of Science have chosen Ekspla as their partner.
Unique OPCPA based laser system, providing 5 terawatts of output power at 1 kHz repetition rate has been produced by Ekspla and Light Conversion led consortium. Sylos 1 named system was designed and built for Extreme Light Infrastructure – Attosecond Light Pulse Source facilities (ELI-ALPS) located in Szeged, Hungary.
ELI-Beamlines (Dolní Břežany, Czech republic) is another Extreme Light Infrastructure project, where EKSPLA is participating together with another partner - National Energy Laboratories in Austin, (Texas, USA). EKSPLA was the first company in Central and Eastern Europe to receive the Prism Award for Photonics Innovation for the world's most advanced product in the scientific laser category.
Employing more than 120 employees Ekspla is based in Vilnius, Lithuania. In-house design and manufacturing ensure operative design, manufacturing and customization of the new products. In addition to representatives' network in 20 countries worldwide, established EKSPLA service team is ready to support customers all over world.
Main products are as follows: femtosecond, picosecond and nanosecond lasers, tunable wavelength systems, ultrafast fiber lasers, high energy lasers, spectroscopy systems.

Address: Savanoriu Ave. 237; LT-02300 Vilnius, Lithuania
Website: http://www.ekspla.com

Elas Ltd.

Founded: 2010
Director: Saulius Mikalauskas
Employees: 10

ELAS Ltd. is a Lithuanian manufacturer of highly customizable micromachining systems with micrometer scale machining precision and modern design. Workstations are suitable for industrial and scientific applications. Elas offers a range of systems: a desktop-sized compact device Master Micro for laboratory research, equipped with sub-micron accuracy and resolution linear positioning stages, high performance galvo-scanners and versatile micromachining software workstation Master 1 for unlimited range of materials, systems Master R2R designed for laser micromachining on flexible substrates while winding these from roller to roller, and others.
In-depth knowledge of micromachining processes constantly created in two associated application labs is the major strength of Elas' engineers. Processes are tested for feasibility, tuned for performance and skillfully implemented into reliable and efficient workstations.
Know-how is accumulated mainly for ablation, drilling, scribing and intro-volume marking processes, whilst the evergrowing range of materials, already includes silicon, SIC, sapphire, diamond, tungsten carbide, biological materials, biodegradable polymers, glasses, majority of metals, ferroelectric ceramics, etc.
Special attention is always paid to ergonomics and safety of the systems. Company's advantage is the ability to meet sophisticated functionality requirements. Elas' customers vary from world-famous universities, research centers to industrial companies.

APPLICATIONS:
•CUTTING of Glass, Silicon, Sapphire, Metal Foil, Polymer, Implantable medical devices (stents)
•MARKING of metals cold micro-marking (medical devices, mobile phones, jewelry, watch parts), transparent materials (Glass, Sapphire, Quartz) marking with high accuracy and precision
•DRILLING through and blind holes in Ceramic, Glass, Quartz, Sapphire, Polymer, Metal (Fuel injector nozzles)
•SCRIBING of Sapphire, Quartz, Glass, Silicon carbide
•STRUCTURING like Milling, Mechanical tools treatment, Synthetic diamond treatment
•PATTERING Laser beam interference patterning, Metal coating pattering, Selective coating removal
•SELECTIVE MATERIAL ABLATION Wire stripping, Selective polymer ablation, Scribing on thin films, Flexible electronics and PCB manufacturing, Solar cell processing

Address: Savanoriu Ave. 235, LT-02300, Vilnius,
Lithuania Website: http://www.e-lasers.com

Evana Technologies

Founded: 2012
Director: Dr. Egidijus Vanagas
Employees: 5

We specialize in scribing hard semiconductor and dielectric materials by utilizing an ultrashort pulse laser beam. Our main products include technologies and state of the art OEM systems, i.e. optical engines for semiconductor wafer scribing designed to fulfil the needs of our clients in the semiconductor device industry. The company has eleven patents issued for advanced technological processes of sapphire scribing and silicon carbide scribing. Also we are working with soft materials and related processes as well, plastics processing for different purposes in bio and med tech segments.

Address: Mokslininkų st. 2A – 120; Vilnius, Lithuania, LT-08412
Website: http://evanatech.com/

Femtika

Founded: 2013
Director: Vidmantas Šakalys
Employees: 25

Femtika is a fast growing spinoff company of Vilnius University Laser Research Centre. The company has deep working knowledge in the area of laser-based precision 3D microfabrication technologies. Highly skilled personnel of Femtika employ cutting-edge laser equipment in the following two directions:
1. development of automated microfabrication equipment driven by high-average power amplified femtosecond lasers;
2. research services for scientific institutions and industry in microfabrication of different products in milli-, micro- and nano-scale.
Femtika has a wide expertise and know-how in several microfabrication processes, namely hybrid microfabrication technologies that allow combination of different fabrication regimes and methods using a single femtosecond laser source. This not only enables the precise fabrication of complex components or structures required by the customers, but also allows expanding the range of materials used for fabrication.
Today Femtika has mastered the following microfabrication technologies:
• Three-dimensional polymer micro and nanofabrication technology based on ultrafast laser-initiated polymerization reaction;
• Direct laser witting inside transparent materials;
• Laser assisted etching in glasses;
• High throughput laser cutting and micromachining;
• Fast manufacturing and replication of microstructures by UV lithography and soft lithography.

Address: Saulėtekio al. 15, LT-10224 Vilnius,
Lithuania Website: http://www.femtika.lt

Geola Digital

Founded: 2003
Director: Dr. Ramūnas Bakanas
Employees: 8

Geola Digital is the world holography technology leader and inventor of digital holography printing machinery by using pulsed lasers, R-2-R hologram copying machinery and instruments used in modern imaging and security holography. It is the biggest pulsed laser-based analogue, digital holography equipment (including security holography) supplier. It is only one company in the world printing poster-sized (up to 1 x 1.5m single piece) digital color holograms and supplying surface relief master holograms with deep 3D image for security holography market. Geola Digital is the largest distributor of holography related photosensitive materials, from various Silver-Halides, Positive-tone photoresist plates for optical lithography or new photopolymer material for HOE recording.
Since lasers used for holography must possess exceptionally good Temporal (SLM – 0.001cm-1) and Transversal (TEM00) output beam parameters, Geola Digital developed custom pulsed laser, which was introduced and accepted with respect in various non-related to holography applications (Material research, Plasma diagnostic, TOFMS, LIBS, etc.). Lasers manufactured by Geola Digital are employed and successfully used by such R&D centers as SIOM, RAL, IGARC and others. Along with pulsed lasers Geola Digital also supplies new generation VCSEL gain modules and optomechanical components such as SBS phase conjugation/pulse compression cells for laser photonics market.

Address: Naugarduko 41, LT03227 Vilnius, Lithuania
Website: http://www.geola.com

Holtida

Founded: 2014
Director Dr. Rasa Žostautienė
Employees: 2

JSC Holtida specializes in development of advanced optical security means. JSC Holtida was established in 2014 as spin-off company, which extends over 20 years of experience developed by a team of scientists in the field. The company took over all the good experience and traditions in producing the holographic security labels.
Currently JSC Holtida produces the original holographic labels and seals for security applications, product authentication, and protection against counterfeiting.
These products are used for the protection of trademarks, excise marks, goods, documents and copyrights against counterfeiting and forgery.
Products:
• Origination of the hologram with the original graphical image containing micro and nano texts
• Formation of the nickel shim from the hologram in the photoresist or replication of the surface provided by the customer
• Production of holographic security labels (provides tamper-evident protection)
• Arbitrary shape labels and seals with original design or standard graphical image of choice
• Serial numbering of holographic labels and authorization
• Special marks
• Degradable polymer seals protected by holographic effects
• Recording of the holographic effect directly on the metal surface
• Rendering of the hologram image prior fabrication
JSC Holtida was awarded by BZN start Startup Award 2016.

Address: K. Baršausko g. 59-214, LT-51423 Kaunas, Lietuva
Website: http://holtida.lt/en/

Integrated Fiber Optics

Founded: 2015
Director: Nikolajus Gavrilinas
Employees: 4

Integrated Fiber Optics sets new standards in high-end fiber lasers based on novel optical pulse fiber generator technology. The ad-

vantage of our company is revolutionary new method based on world-class patent, ready for mass production, applicable to multiple industries, unheard-of low price

Address: Savanoriu pr. 235, LT-02300 Vilnius, Lithuania
Website: http://www.ifoptics.com

Integrated Optics

Founded: 2012
Director: Evaldas Pabreza, CEO
Employees: 40

Integrated Optics is a manufacturer of world's most compact laser sources for spectroscopy and LiDAR applications. Its famous MatchBox laser platform offers more than 200 product configurations in a single footprint. These lasers are based on four different technologies: CW laser diode, DPSS, dichroic combiners, passive Q-Switch. Being diverse in their technology, all of them share the same enclosure, unified control interface (UART/USB), and a rich set of accessories. MatchBox lasers are used in such applications as Raman spectroscopy, fluorescence imaging, food sorting, gemstone sorting and medical diagnostics.
The company also carries out custom laser development for industrial and medical applications, especially in SWAP (Size, Weight and Power) sensitive use cases.
'MatchBox series' is a Prism awards finalist of 2017.

Address: Kalvarijų str. 125B, Vilnius, Lithuania
Website: http://www.integratedoptics.com

Lidaris

Founded: 2012
Director: Dr. Andrius Melninkaitis
Employees: 14

LIDARIS is a "destruction company" offering a wide range of Laser-Induced Damage Threshold (LIDT) metrology services for companies that manufacture, trade or integrate laser optics. LIDT numbers are measured in house and enable to describe optical resistance (safe light intensity operation limit) of optical parts such as lenses, mirrors, windows or similar with intended use in high power laser systems. Thus, LIDT numbers are bringing evidence related to optics quality and help to make important decisions. In example organizations who purchase a large amount of optics can check if LIDT performance is directly related to offered pricing. In this way, a lot of time and money can be saved by selecting the most reliable optics vendors and their manufacturing technologies. Organizations who develop optics use LIDT numbers in process optimization projects. Among 14 employees of Lidaris 5 coworkers currently hold Ph.D. degree in physics or technical science, therefore, LIDARIS is a desired partner in R&D projects. Companies who produce optics use dedicated LIDT service when tracking every manufacturing batch: such monitoring is preventing mistakes in a very early phase. Finally, optical parts optimized and certified for high laser-induced damage threshold with support of LIDARIS adds a unique selling point for those companies who trade laser optics.
LIDARIS was founded in 2012 as a spin-off of the Vilnius University Laser Research Center by a group of scientists working intensively in the field of laser-induced damage phenomena. LIDARIS team gained more than 18 years of research experience in the field of laser-induced damage of optical elements and thin films. Currently LIDARIS acts in the global market serving European, American and Asian companies - the leaders of today's laser market, including manufacturers, suppliers of optics and laser systems and Space Agencies. More than 90 organizations use LIDARIS services on a daily basis. Scientific contributions of LIDARIS members were awarded by the SPIE Laser Damage community. The dynamic team is committed to delivering its customers with state of the art knowledge required to survive laser damage.

Address: Saulėtekio ave. 10, LT-10223, Vilnius, Lithuania
Website: http://www.lidaris.com

Lifodas

Founded: 1994
Director: Piotr Levin
Employees: 93

Fiber Optic Devices Ltd. (FOD) is a complete fiber optic technology company offering a variety of products and services to the OEM and End-user markets. Founded in 1991, FOD is a recognized leader in partnerships in the design and manufacturing of Fiber Optic Components and Fiber Optic Test & Measurement solutions. FOD invests over 20% of revenue into R&D activities, creating new and innovative solutions for Components and Test & Measurement products. FOD continues to provide market leading features in compactness, cost-of-manufacturing, optical specifications and quality.

Address: Naugarduko St. 41, LT-03227, Vilnius, Lithuania
Website: http://www.fods.com

Light Conversion

Founded: 1994
CEO: dr. Martynas Barkauskas
Employees: >245

Light Conversion is a pioneer and worldwide leader of wavelength tunable femtosecond laser sources based on TOPAS and ORPHEUS series of optical parametric amplifiers (OPA) as well as diode pumped solid state femtosecond lasers PHAROS and CARBIDE. Established in 1994, with the roots from Vilnius University Laser Research Center, the company has built its strength on profound knowledge in the field of optical parametric generation and amplification.
In 2018 company opened > 6500 m^2 facility that accommodates design, R&D, and production teams. All key manufacturing processes are managed in-house. The product portfolio ranges from standard autocorrelator systems, powerful and flexible ultrafast laser systems to custom built OPCPAs.

The Single-Cycle Laser SYLOS, which employs OPCPA technology, has been designed and manufactured by a consortium of Light Conversion and Ekspla. High-intensity laser system SYLOS has been launched in ELI-ALPS facility in Hungary on 15th of May, 2019.
In industry the majority of the ultrashort pulse lasers are mainly used for applications in medicine, semicon and electronics. Meanwhile our scientific systems serve for various kinds of spectroscopy and other material determining processes.
Light Conversion exports about 98 % of production in more than 40 countries. The majority of the production is exported to EU, China, USA, Japan and Korea. Besides headquarters in Lithuania, the company has offices in China, Korea, USA as well as 5 service centers and 24 representatives in Europe, America and Asia.

Address: Keramikų St. 2B, LT-10233, Vilnius, Lithuania
Website: http://www.lightcon.com

Light Density

Founded: 2018
CEO: Dr. Paulius Gečys
Employees: 3

MB Light Density provides high-tech laser micro-fabrication solutions and service, delivers precision processing of glass.

Address: Address: Savanorių pr. 235, LT-02300, Vilnius, Lithuania
Website: http://www.lightdensity.eu

Lyncis

Founded: 2017
Director: Natalia Usenko
Employees:

UAB LYNCIS possesses remarkable experience in the development of the customized LIBS (Laser Induced Breakdown Spectroscopy) analyzers for prompt process control with the online elemental analysis of material flows in most of the industrial applications.
We are the only company, who has installed and maintained LIBS online analyzers in the industrial environment operating 24/7 for number of years in various technological applications (steel plants, fertilizers, refractories, industrial minerals, coal power plant, etc.), harsh conditions included.
Our LIBS analyzers based on powerful diode-pumped lasers with the original design of optic system, special lens coating and high-resolution detectors provide simultaneous analysis of all elements and compounds of interest, including light ones even in low concentration both in solid and liquid streams. They use fully safe laser optical emission technology without hazardous radiation, provide long-term stable calibration, easy and low-cost maintenance. To ensure stable accurate measurements in real time, Lyncis implements a range of chemometrics methods and optimization approaches.
Based on continuous real-time information about chemistry variation, the operator can influence the process before it is too late – reject off-grade product, change direction of materials flow, optimize addition of fluxes, reagents and blending, adjust beneficiation and processing parameters. As a result, most our customers demonstrate return on investment in less than one year.

Worldwide operation: USA, Canada, Europe, South Korea, Belarus, Turkey, Russia, Ukraine.

Address: Mokslininkų g. 6A-449, LT-08412 Vilnius
Website: http://www.lyncis.lt

Luvitera

Established: 2013
Director: Marius Vinciūnas
Employees: 1

Luvitera has emerged from cooperation between the teams of terahertz optics and microelectronics within the frame of different projects and intense scientific cooperation between Center for Physical Sciences and Technology (Lithuania) and University of Ljubljana (Slovenia). The main activity of Luvitera is the development of innovative technologies and products for terahertz photonics, imaging and spectroscopy, both for scientific laboratories and industry. Luvitera produces broadband and wavelength-selective micro-bolometer arrays, to measure spatial terahertz beam profiles of various terahertz sources. The company offers an antenna-coupled titanium microbolometers and scanners as sensitive room temperature terahertz detectors and imagers. The company's components can be integrated into customized security and diagnostic systems.

Address: Savanoriu av. 235, LT-02300 Vilnius, Lithuania
Website: http://www.luvitera.com

Optinės Dangos

Founded: 2003
Director: Kęstutis Niaura
Employees: 1

Optinės Dangos offers a wide range of unique optical coatings that match the highest quality standards. The company's products are used in lasers and other optical systems that are applied in a number of areas. Optinės Dangos uses in-house developed technologies allowing the company's products to achieve unprecedented reliability, innovativeness and meet very high technical requirements.

Address: A. Goštauto St. 12, LT-01104, Vilnius
Website: http://www.opticalcoatings.lt

Optogama

Founded: 2015
Director: Tadas Lipinskas
Employees: 17

Optogama designs, develops and manufactures custom laser related products and develops technologies for material processing, spectroscopy & analytical instrumentation, aerospace, security, vision and other applications.
Company's products and services cover:
• Laser beam expanders, attenuators, beam delivery and beam shaping systems
• R&D of 1,54 um "eye-safe" range laser sources
• Contract manufacturing of lasers and optical devices
• R&D of lasers for material processing, spectroscopy and medical applications
• Laser crystal materials development and manufacturing
• NIR and MIR Optical components and assemblies

Optogama main competences and specialties:
More than 15 years of experience in R&D, prototyping and production of lasers, optical systems and related components offer innovative solutions and products for dedicated application
High-quality innovative laser products and solutions dedicated to individual applications
Dedicated laser and metrology laboratories
Optical & optomechanical design

Address: Mokslininkų St. 2A, LT-08412, Vilnius, Lithuania
Website:
Lasers and optical devices https://www.optogama.com
Laser components https://4lasers.com

Optonas

Founded: 2009
Director: Gintas Jakubėnas
Employees: 19

Optonas is a professional Lithuanian company specializing in vacuum coating technologies: IBS and Magnetron Sputtering, E-beam and Thermal evaporation. It is a regional leader of UV, VIS, Mid IR, Far IR, Variable Reflectivity and crystal coatings. Company operates the largest PVD coating chamber in the Baltic states. Most advanced IBS sputtering machines are running at 24/7 regime to ensure fastest product manufacturing time.
The company makes coatings of ultimate performance and durability on AGS, DKDP, LBO, LiIO3, ZGP, YAG, KTA, KTP, YVO4, ZnSe, RTP, KGW, CaF2, BBO and other optical materials. Optonas offers customized production, providing customers with solutions tailored to their specific application. The coating materials include thin-film dielectrics, metals and semiconductor, ensuring highest quality and durability. They find applications in lasers devices and other optical systems.
The coatings produced by Optonas are extremely robust and resilient under long-term laser illumination, mechanical impact and varying ambient conditions. Coatings for infrared, visible and ultraviolet spectral ranges from as low as 190nm to as far as 20000nm are available.
Optonas expands business activity by establishing 3photon company for optical components solution and OS Lasers as advanced lasers manufacturer with focus on medical, industrial and scientific application.

Address: Savanoriu pr. 235, LT-02300 Vilnius, Lithuania
Website: http://optonas.com/

Optoman

Founded: 2017
CEO: Remigijus Šliupas
Employees: 7

OPTOMAN manufactures custom dielectric thin films and high-power laser optics, where we aim for the highest possible accuracy, repeatability and quality. This is possible with the innovative ion-beam sputtering technology. Progressive control and automated processes allow the deposition of complex structures of several hundred thin film layers.
The advantages of spectral control include sharper features, higher contrasts, repeatable performance and tighter tolerances.
We are ready to design, develop and manufacture cost effective yet advanced, high accuracy and repeatability thin film coatings and laser optics for universities, laser and laser systems manufacturers worldwide.

Address: Ukmergės g. 427, LT-14185, Vilnius, Lithuania
Website: http://www.optoman.com

Optoteka

Optoteka, Rimkevičius and Gintautas, general partnership
Founded: 1991
Director: Remigijus Rimkevičius
Employees: 26

Optoteka is a developer and manufacturer of precision optical components from optical glasses and crystals. Such components are used in the manufacturing of optical equipment for research, industry, medicine, lighting, etc. Component production is based on the unique in-house technologies, created in 1993, which are constantly being developed. This enables the manufacturing with extremely high quality. In addition to the main production, the company is a manufacturer of mechanical components for lasers. The company exports 40 % of its production. The ultrathin scatter-free optical crystals and linear optical components are widely known in more than 30 countries worldwide. The company has a number of regular customers and maintains long-term close collaborations.

Address: Kalvarijų St. 125, LT-08221, Vilnius, Lithuania
Website: http://www.optoteka.lt

Optronika

Founded: 2006
Director: Mindaugas Stankevičius
Employees: 5

Optronika is a producer of RGB laser projectors for industry and advertisements, unique shutters for laser micromachining, chillers for research equipment, optical analyzers of cleaning quality and freezing point of liquids and other spectrometric equipment. Currently, Optronika is involved in a cluster project developing a new generation laser-based orthopedic devices and energy-efficient building solutions. The company also manufactures laboratory and education equipment for research institutions. The company is the largest provider of laser advertisement and illumination services for events, exhibitions, and concerts.

Address: Kalikstiškės, Maišiagala, LT-14247, Vilnius Distr., Lithuania
Website: http://www.optronika.lt

Oriental Technology Solutions

Founded: 2015
Director: Algirdas Rukšėnas
Employees: 1

Oriental Technology Solutions supplies laser systems for:
- Marking and engraving,
- Welding, hardening, laser cladding and mould repair,
- Cutting of metals and nonmetals,
- Textile, leather, shoes, fashion products manufacturing,
- Positioning and measurement.

The company represents professional laser systems manufacturers from Germany and China Alpha Laser, Z-laser, HG Laser, and Golden Laser in Baltic and neighbouring countries.
Oriental Technology Solutions provides warranty and afterwarranty services for equipment sold.
The company offers laser technology consulting services, as well as adaptation of laser equipment for the users' requirements.
Oriental Technology Solutions is a member of Engineering Industries Association of Lithuania LINPRA.

Address:Mokslininkų 11, LT-08412, Vilnius, Lithuania
(EU) Website http://orientaltechnology.eu/en/

PhotoSana

Established: 2018
Director: Dr. Zenonas Kuprionis
Employees: 5

PhotoSana UAB was created joining experience of Lithuanian lasers manufacturers and Korean medical devices professionals. We create, manufacture and distribute innovative medical equipment.
Close relations with life-science community enables us to create strong scientific background of efficiency, safety, uniqueness of our products.
We are working now on certification of picosecond aesthetic laser PicoClarans™. It will be the most advanced picosecond Nd:YAG treatment solution on the market.
It features 150 ps pulse duration – shortest pulses of aesthetic-medical laser systems in the world.
Special shape pulse profile provides the most effective way to remove pigmented lesions and tattoo, to perform skin remodeling and lifting, while minimizing the risk of damage to surrounding tissue.
Our other projects are as follows: diode laser system for laser lipolysis and wide field second harmonic microscope.

Address: Mokslininkų st. 11, LT-08412 Vilnius, Lithuania
Website: http://www.photosana.eu

Quantum Light Instruments, Ltd.

Founded: 2014
Director: Andrius Rinkevičius
Employees: 5

Quantum Light Instruments, Ltd. (legal name in Lithuanian is UAB Kvantiniai šviesos instrumentai) is a privately owned limited liability company located in Vilnius.
The company was founded in 2014 by laser scientists and engineers with more than 40 years accumulated experience in lasers and photonics industry.
We are designing and producing compact, diode-pumped, air-cooled (and water-free!), passively or actively Q-switched, diode-pumped, solid-state lasers and accessories for them (harmonics generators, OPOs, Raman shifters, attenuators, energy monitors, fiber couplers etc.).
QLI key innovation is water-free laser crystal cooling technology combined with high power laser diode radiation shaping for laser crystal end-pumping geometry.
Our innovation works best for applications that require nanosecond pulses with short pulse duration (typically in 1-10 ns range) and pulse energy up 200 mJ at relatively low pulse repetition rates (typically in the range of 10-100 Hz): LIBS (Light Induced Breakdown Spectroscopy), LIF (Light Induced Fluorescence), LIDAR (LIght Detection and Ranging), TOFS (Time Of Flight Spectroscopy), Laser Ablation, Laser Designation and many others.

Address: Mokslininkų St. 6A-351, LT-08412, Vilnius, Lithuania.
Website: http://www.qlinstruments.com

QS Lasers

Established: 2018
CEO: Rokas Šulcas,
Employees: 2

QS LASERS is a manufacturer of ultra-compact, short pulse diode pumped lasers. Since the beginning main activity of QS LASERS includes development, production and sales of lasers, laser systems for medical and industrial OEMs. Company is specialized in production of advanced Q-switched short pulse (sub-nanosecond, picosecond) compact design lasers. Long standing solid background in lasers, experienced and skilled staff is the key for the competitive prices and advanced features we may offer.
The choice of different wavelengths (1064 nm, 1053 nm, 1342 nm, 671 nm, 447 nm, etc.) is widely used in applications like equipment manufacturing, biomedical experiment, precision measurement, radar communication, material processing, process control, online detection, investigation equipment and many other fields.

Address: Savanoriu Ave 178F; LT-03154 Vilnius, Lithuania
Website: http://www.qslasers.com

Standa

Founded: 1987
Director: Dr. Michail Berba
Employees: about 200

Standa is one of the largest European companies designing and manufacturing a wide range of high quality "off-the-shelf" & customized products for cutting edge research and industrial applications, such as: high-precision manual or motorized linear and rotary stages, motion controllers, robotics, precision holders and positioning devices for optical elements, optical tables, vibration isolation systems, DPSS sub-nanosecond SLM micro lasers.
Wide range of challenges are being solved or simplified by implementing STANDA's motion control solutions: from small research lab to big synchrotron; from mobile scribing or scanning setup to entire high-precision CNC micro machine.
More than 90% of its manufactured products are exported to more than 100 countries.

Standa's factory' area is about 10000 m^2 and it is located in Vilnius, Lithuania (EU). The factory is equipped with modern CNC machines and other production with unique equipment for high level quality control.
Every year 50-100 new products are developed, expanding nomenclature of production, which consists of:
Optical Tables
Vibration Isolation Systems
Optical Mirror Holders
Optical Mirror Positioners
Motion Control
Translation and Rotation Stages
Opto-mechanics
Lasers
Precision Custom Designed Devices

Address: Švitrigailos g. 4-39, LT-03222 Vilnius, Lithuania
Website:
http://www.standa.lt/
http://www.standaphotonics.com/

Sprana

Founded: 2012
Director: Dr. Raimundas Steponavičius
Employees: 6

We are experts in applied spectroscopy (UV-Vis-NIR-MIR) providing Process Analytical Technology (PAT) solutions for on-line/in-line/at-line monitoring and analysis of industrial processes (product streams). Sprana has a modern applied spectroscopy laboratory and high-quality researchers (including a number of PhDs) that carry out cutting edge research and development in this field.
It closely collaborates with science (universities, research centres and other). Continuous innovation is one of the main pillars of the company.
We currently offer products (analyzers) for on-line/in-line colour analysis of liquid product streams such as: petroleum products (paraffin wax, oil, diesel, naphtha, etc.), sugar, edible oils, beers and malts, beverages, chemicals etc.
For on-line/in-line quantitative analysis of liquid fertilizer such as Urea Ammonium Nitrate (UAN), Urea with additives and folio fertilizer (total content of ammonium N, NO_3, NH_2, H_2O, concentration of additives etc.);

Address: Mokslininkų St. 6A, LT-08412 Vilnius
Website: http://www.sprana.eu

Teravil

Founded: 2006
Director: Dr. Andžej Urbanovič
Employees: 5

Teravil is a developer and manufacturer of the terahertz (THz) range spectroscopic systems and components: emitters, detectors, registration hardware and software, as well development and applications of THz time-domain systems for spectroscopy and imaging. Company's competence are in developing and manufacturing of THz radiation spectroscopy systems based on solid state or fiber lasers and photoconductive antennas. Currently, the company manufactures and sells THz radiation sources and receivers, for use with ~800 nm and ~1000 nm wavelength lasers. New developed product is THz time-domain ellipsometer, based on THz spectrometer T-Fiber produced by TERAVIL. THz spectral ellipsometry system allows non-contact determination of nonequilibrium carrier densities and mobilities. Nearly 100% of the production is exported.

Address: Savanoriu ave. 235, LT-02300, Vilnius
Website: http://www.teravil.lt

Workshop of Photonics

Founded: 2007
CEO: Dr. Rimantas Vaitkus
Employees: 24

Workshop of Photonics is dedicated to developing instruments and solutions for ultrashort laser micromachining tasks. Our key competencies are femtosecond laser micromachining applications' development, including special optical elements and contract manufacturing services. Key activity fields:
• Development and production of custom ultrashort laser micromachining workstations
• Industrial laser micromachining solutions and technologies (cutting, scribbing, drilling, etc.)
• Small-scale production in the area of laser micromachining
• Special Optics waveplates
Awards: Technological Innovation of the Year by Swedish Business Awards in 2017

Website: http://www.wophotonics.com
Address: Mokslininkų st. 6A, 08412 Vilnius, Lithuania

Branch officies and subsidiaries abroad

Altos Photonics Inc.

Country: USA
Founded: 1995

Altos Photonics, Inc. offers lasers & laser systems, optics, crystals, opto-electronics, and opto-mechanical components to research institutes and industrial customers.
Since 1995, we have worked with our customers and suppliers to enable groundbreaking technologies, innovative products, and cutting-edge research. We match of matching our clients' application requirements by supplying the products from our partners EKSPLA, Light Conversion, EKSMA Optics, and Standa.
Our pulsed lasers range from high-energy systems used in high-energy physics and non-linear spectroscopy to DPSS systems used in micro-machining and ultrafast spectroscopy applications. Our femtosecond, mode locked, and Q-switched lasers and tunable OPO/OPA systems are used by leading scientists in their quests to understand chemical processes and interactions, biologic processes, and to understand basic questions of physics.
Passive laser components include UV and IR optics, non-linear crystals (BBO, KTP, ZGP, KYW, KGW, etc), optical mounts, and motorized stages & positioners. Opto-Electronic products include high energy flashlamp drivers, Pockel's cell drivers, laser pump chambers.
Together with our outstanding customers, we are working to improve our environment and human health by enabling advances in clean energy, bio-medical polymers, heart stent manufacturing, battery technology, cancer treatment, eye cataract surgery, and in understanding of environmental interactions related to climate change.
We actively encourage laser safety by promoting laser safety products and by participating in ANSI Z136 the committee for laser safety, working to define and implement standards for the safe use of lasers.
Altos Photonics is managed by Lucian Hand, president and shareholder, together with major shareholders Light Conversion and EKSPLA.

Address: 201 South Wallace, Suite B-2C, Bozeman, MT 59715, USA
Website: http://www.altosphotonics.com

Shanghai EKSMA Laser Technology Co., Ltd.
(上海爱恪斯码激光技术有限公司)

Country: China, P.R.
Founded: 2016 by UAB EKSMA

Shanghai EKSMA Laser Technology Co., Ltd. is the successor to the EKSPLA Shanghai Representative Office. The purpose of this company is to expand sales, provide technical support and service to customers from mainland China and far Asia countries. We sell and support industrial lasers made by EKSPLA and distribute the laser components – laser optics, crystals and electro-optical devices made by EKSMA Optics.
The success of previous representative office led to the upgrade to a legal entity capable of providing better sales and service support to Mainland China and other customers in the region.
The sales of picosecond and fiber lasers and reliable, high-quality laser components are expected to increase further due to the concentration of advanced manufacturing industries such as electronics, medical devices, transportation vehicles, new energy solutions and other fields where high power lasers or ultrafast solid-state laser based micro-processing equipment is used.
Besides managing the sales of EKSPLA and EKSMA Optics products Shanghai EKSMA Laser Technology Co, Ltd. provides marketing support to other Lithuanian partners or associated companies in far east Asia.

Address:
Shanghai EKSMA Laser Technology Co., Ltd.
Room 3071, Bldg 1, No.399 Shengxia Road,
Pudong, Shanghai, 201203, P.R. China
Websites: http://www.ekspla.cn
http://www.eksmaoptics.cn

Light Conversion – China (来特激光（深圳）有限公司)

Country: China
Founded: 2016

Light Conversion – China was opened in Shenzhen – technology capital in China in 2016. During a few recent years, the sales of Light Conversion products in China saw a significant growth. The growing number of scientific and industrial customers created a need to be closer to the clients for faster communication and better availability of technical support. Currently Light Conversion – China is a service center focusing on aftersales customer support. We provide fast on-site service and support of Pharos and Carbide femtosecond lasers and different models of Orpheus OPA systems. The company also has a service laboratory, where most common laser problems can be solved without sending the equipment back to the factory in Lithuania. As a number of customers in China continues to grow, we plan to expand our activities to include the advertisement and sales of Light Conversion products in Chinese market.

Address: Room 1106, Gongyuandao Building B, 26 Dengliang Rd, Nanshan district, Shenzhen 518054, China
Website: http://www.lightcon.cn/

Light Conversion – Korea

Country: South Korea
Founded: 2018

Trusted in increasing scientific and industrial interests and encouraged by the success of having own subsidiary in China, Light Conversion opened their own facility in South Korea. Being closer to the customer in Korea opens new possibilities to fulfill the consumer's needs. The local office also ensures faster communication and better availability of technical support in the prospective market of South Korea.

Address: Yuseong-gu, Techno 3-ro, #65, No. 510 (Gwanpyeong-dong, Hansin S Meca), Daejeon Metropolitan City, South Korea 34016
Website: http://www.lightcon.com

Sibirskij Monokristall – EKSMA

Sibirskij Monokristall – EKSMA (Сибирский монокристалл – ЭКСМА)
Country: Russia
Founded: 1999

Sibirskij Monokristall-EKSMA is a joint Lithuanian-Russian venture. Almost 50 % of the shares of this company are owned by the company EKSMA. The company is a manufacturer of nonlinear optical and laser crystals. The manufacturing is based on unique in-house developed crystals growth and further processing technologies. The company has an extensive experience in crystals characterization. A major part of the production of the company is marketed and sold through EKSMA Optics, another company of the EKSMA Group. Sibirskij Monokristall-EKSMA closely collaborates with the Institute of Geology and Mineralogy of the Russian Academy of Sciences, and the Institute of Applied Physics.

Address: Ul. Russkaya 43, Novosibirsk, Russia

E&EO UK Ltd

Country: UK
Founded: 2018

E&EO representative office is responsible for EKSPLA & Eksma Optics sales and service in UK and Ireland. The office is located centrally in the UK with great links to the rest of the country, based in Lincolnshire.
Serving of all current cases as well as supporting of already established customers will be carried out by newly established entity.
EKSPLA has been working in UK and Ireland photonics market for more than 10 years. Famous universities like Cardiff, Oxford, Cambridge, University College London, Durham, and Heriot Watt are already using EKSPLA lasers today. UK is one of the top 3 countries in Europe where EKSPLA are exporting their lasers.
Clive Morrison with total of more than 30 years of experience in Photonics industry appointed as head of office. Clive began his career in lasers working on high energy short pulse lasers at a premier research establishment near Reading. From there he has developed a very wide understanding of lasers, optics and photonic processes and products. Working in industries from Aerospace and Defense to Research and Development, packaging to fine jewelry.
Two main stakeholders EKSPLA and Eksma Optics found newly established company. To acknowledge this, first letters of names of two parental companies constituted the name of newly established company – E&EO.

Address: The Shires, Burnham Road, Barton Upon Humber, North Lincolnshire,
DN18 6EF, UK
Tel: + 01469 530055
e-mail: c.morrison@ekspla.com
Website: http://www.ekspla.com
http://www.eksmaoptics.com


LIETUVOS LAZERIŲ ASOCIACIJA
LITHUANIAN LASER ASSOCIATION


VILNIAUS UNIVERSITETAS
1579
UNIVERSITAS VILNENSIS


CENTER
FOR PHYSICAL SCIENCES
AND TECHNOLOGY


Altechna
Coatings


Altechna


BROLIS
SEMICONDUCTORS


DMC
DIRECT MACHINING CONTROL


EKSMA


EKSMA
OPTICS


EKSPLA


elas


femtika


HOLTIDA


integrated
optics


LIDARIS
LIDT Service


LIGHT
CONVERSION

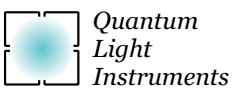

LYNCIS


OPTOGAMA


OPTOMAN
IBS HERO


Optical thin film coatings
optonas


Optronika


Quantum
Light
Instruments


QS LASERS


SPRANA
PROCESS ANALYTICAL TECHNOLOGY


standa


TERAVIL


wop
Workshop of Photonics