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# PHOTONICS IN FINLAND

• MEDICAL TECHNOLOGIES • CLEANTECH • AGRICULTURE



# PHOTONICS IN FINLAND



Finland – a Northern lighthouse  
of photonics expertise!

Finland has emerged as a world leader in photonics research and innovation, with a thriving ecosystem of academic and industrial players collaborating to advance cutting-edge technologies and applications across diverse fields.

Photonics is the science and technology of light, which encompasses generating, guiding, manipulating, amplifying, and detecting light. It is behind many of the innovations which have transformed the way we live over the last few decades making it one of the most significant enabling technologies of our time.

Finland has a long tradition of high-tech research and industry, and since the 1960s, a significant level of expertise in photonics with many pioneer photonics-related technologies developed in the country.

Educational excellence with a world-class research environment, wide range of competencies and know-how in sensing and imaging, micro- and nanophotonics, lasers and fiber-optics and extended reality makes Finland an ideal place for innovations in photonics, the commercialization of new products, the growth of companies in the field, and international success.

Join Finland's photonics ecosystem to collaborate with world-class researchers and industry leaders in advancing photonics innovation for a brighter future.





■ **OPTICAL SENSING  
AND IMAGING**

■ **MICRO- AND  
NANOPHOTONICS**

■ **LASERS AND  
FIBER OPTICS**

■ **EXTENDED REALITY (XR)**

- VIRTUAL REALITY (VR)
- AUGMENTED REALITY (AR)
- MIXED REALITY (MR/XR)

## Content

|                                      |    |
|--------------------------------------|----|
| Photonics in Finland .....           | 2  |
| Facts and Figures .....              | 4  |
| FinnLight – Infrastructure .....     | 7  |
| Photonics Finland .....              | 8  |
| PREIN Photonics Flagship .....       | 10 |
| Photonics Research in Finland.....   | 12 |
| Photonics Education in Finland ..... | 14 |
| Student Associations .....           | 16 |

|                                    |    |
|------------------------------------|----|
| Outreach .....                     | 18 |
| Finnish Research Excellence .....  | 20 |
| Photonics Finland Projects .....   | 22 |
| Photonics Top Expert .....         | 24 |
| Studying Photonics in Finland..... | 26 |
| Photonics Events in Finland .....  | 28 |
| The Role of Business Finland.....  | 30 |



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# Facts and figures about photonics in Finland



Photonics stays on the fast track to growth in Finland.

The total annual revenue of photonics business in Finland is over 2 billion euros, and the photonics industry directly employs more than 6 000 workers in at least 300 photonics companies in Finland. With indirect employment included, the number of employees exceeds 40 000.

Following the global trend in photonics industry, the majority (62 %) of Finnish photonics companies are small with approximately 5 M € annual turnover. The median Finnish photonics company has around 10 employees.

The growth in the Finnish photonics industry has remained strong despite challenging times vis-a-vis global pandemics, geopolitical instability, and economic recession. Compared to the results from 2020 survey, the size of the industry has grown 25 % since with over 40 new companies. The annual growth rate of the industry has been approximately 18% since the previous survey in 2020. The Finnish photonics companies also continue to have high growth expectations for the next three years with an annual rate of 26 %.

## **An export-intensive industry focusing on manufacturing**

Finnish photonics companies are export intensive with their key markets lying in Europe, Asia and USA, whereas Latin America is an emerging market. The proportion of export to Europe has increased, however, increasing number of companies supply also domestic markets. The target markets of the Finnish photonics companies are evenly distributed with industrial manufacturing continuing as the largest target market.

Photonics manufacturing continues as the most significant target market. The largest output is in the manufacture of optical components, systems and instruments at 60%, followed by services, raw materials and distribution.

Finding domestic and foreign partners, recruiting and market and technology analysis are the most important facilitators for the growth of photonics companies. International collaborators are welcomed to the Finnish photonics ecosystem and Photonics Finland facilitates access to the Finnish market and finding partners.

## **Shared interest for collaboration**

Majority of photonics companies are hoping for collaborative projects with research institutes to utilize the whole potential of Finnish photonics infrastructure. Similarly, industrial collaboration is seen as the most important collaboration activity where photonics research organizations need assistance. In many aspects the industry and academia have similar needs in the enhancement of their collaboration.

Finnish photonics companies want to continue and further improve co-operation with universities and research institutions. Companies have positive opinion on the PREIN Flagship initiative and the collaborative opportunities it offers as a research platform. Research collaboration, access to research infrastructure as well as meetings and thematic events were considered the most important ways for increasing collaboration with industry and the flagship by both industry and research organization representatives. Researchers also expect PREIN to ease research cooperation.



## COMPANIES



- ✓ TOTAL 300 COMPANIES
- ✓ +40 COMPANIES / +25% SINCE 2020
- ✓ NEW COMPANIES FOUND-ED +8% ANNUALLY

## TURNOVER



- ✓ TOTAL 2 BILLION EUROS
- ✓ +1200 MILLION EUROS / +67% SINCE 2020
- ✓ COMPANIES TURNOVER GREW +18% ANNUALLY

## EMPLOYEES



- ✓ TOTAL 6 000 EMPLOYEES
- ✓ +1800 EMPLOYEES / +43% SINCE 2020
- ✓ AMOUNT OF EMPLOYEES GREW +13% ANNUALLY

with other research organizations and industry and facilitate joint research project applications for EU funding. Finnish research centers and universities are pursuing photonics research in various ways, with experimental research and applied research being the most prominent.

Material science is the most prevalent photonics-related research field in Finland. Research in light sources has decreased as researchers have steered their interest towards other themes, whereas photovoltaics and bioimaging are new emerging fields.

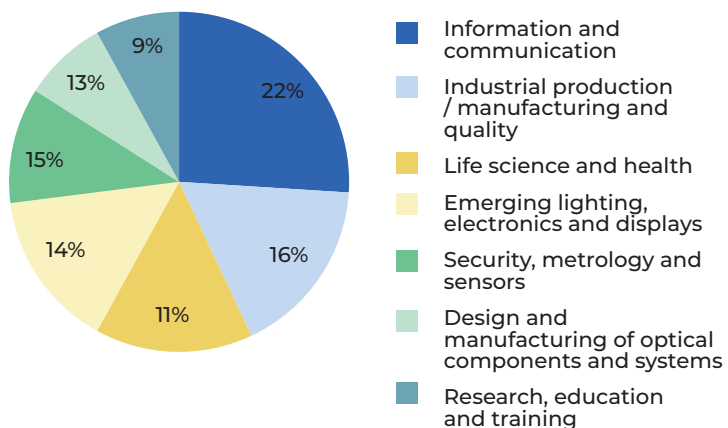
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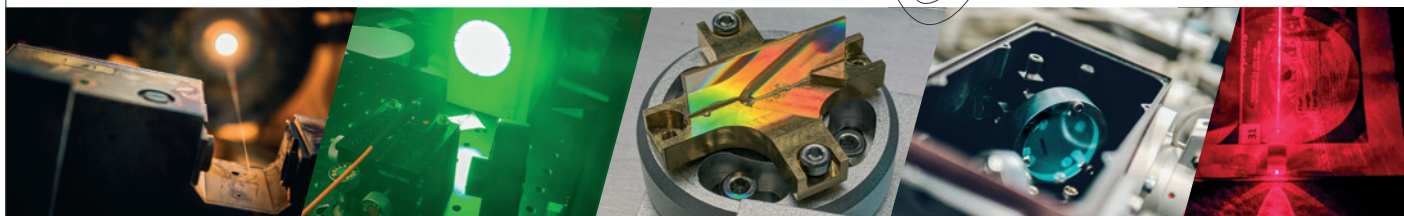
There is constant need to further increase and enhance collaboration between photonics research carried out in universities and research centers, and photonics companies and organizations in related fields of industry. The photonics research-industry nexus is also boosted through establishing start-up companies based on academic research or licensing research results to industry. Companies that apply photonics to other fields, benefit from fundamental and applied research, allowing them to take advantage from the results without needing their own photonics department requiring major investments.

### Need for increased media visibility

One challenge facing the photonics industry is a dire shortage of STEM field students and experts in Finland and globally. To address this issue, Photonics Finland and PREIN flagship strive to highlight the importance of photonics and attract new students and employees to the field. Outreach activities are essential for reaching potential future professionals. Industry and research organization representatives have named increasing the visibility of photonics in media as one of the most important activities for the photonics community in Finland. Rising the awareness of the general public about photonics, and the meaning and importance of the technology, which is the solution for many of today's global challenges, is also pivotal. Many decision-makers do not fully realize the importance of photonics, and that the future of humankind is dependent on photonics solutions. When companies and governments fully realize the potential of photonics and invest in it, we can solve grand challenges together.

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# FinnLight – Finnish Research Infrastructure at Your Service!

FinnLight provides photonics services and equipment for researchers and companies via [FinnLight.fi](http://FinnLight.fi) website.



FinnLight is a consortium between Tampere University, VTT and University of Eastern Finland offering unique expertise and infrastructure services for research, development, and innovation in Photonics.

The infrastructure and services cover the whole innovation value chain from the development of materials and structures with specific optics properties, to the fabrication of fully functional photonic devices and components, and up to systems integration and instruments. Examples of application fields include industrial process control, pharmaceutical analysis, health care, environmental monitoring, safety, and security.

FinnLight partners have a long history of photonics research with complementary skills

ranging from the design and fabrication of nanomaterials and optical components to the development of advanced light sources with tailored properties, up to system integration, instrumentation, and transfer of scientific results towards commercialization. The FinnLight platform is accessible to external users from academic institutions and industrial actors.

Visit the website, choose the service you need and connect by using the contact form!

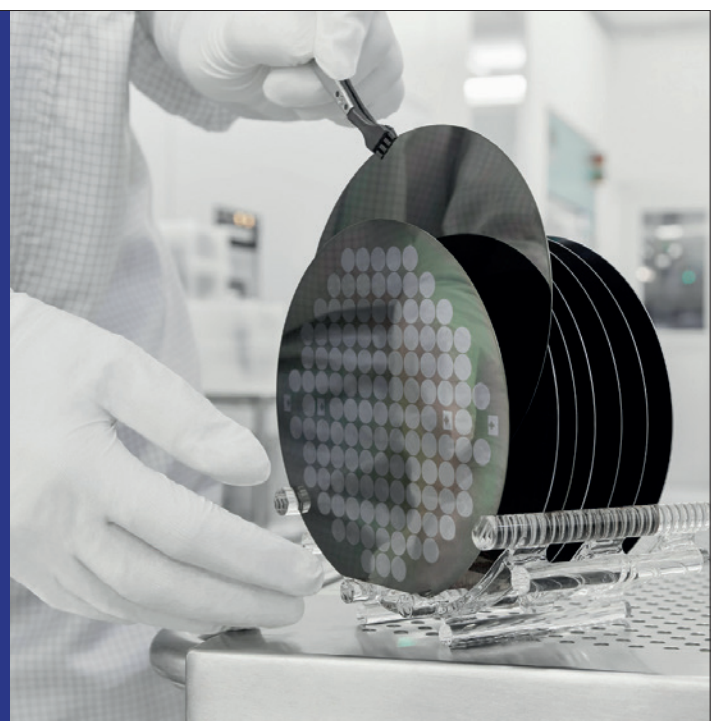
**Read more at [finnlight.fi](http://finnlight.fi)**



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# Photonics Finland

Photonics Finland is a technology cluster that drives forward photonics industry and research in Finland. It is the single point of contact for the whole photonics ecosystem in Finland.

The history of Photonics Finland started in the year 1996, when the Finnish Optics Society was first established as a research association. In 2014, Photonics Finland was re-launched as a cluster with 19 members to provide better service and visibility for the emerging photonics industry, as well as to the academia members.

Today, Photonics Finland is a growing technology cluster with over 250 individual and over 110 organizational members, it connects photonics companies, universities, research institutes, and public authorities. Especially startups and companies utilizing photonics are strongly represented in the new members.

## Global networks, activities, talents, and growth

Photonics Finland supports the development of new business and research opportunities and helps realize the full potential of photonics in industry and society in areas such as life science, health care, ICT, energy efficiency, safety, industrial manufacturing, agriculture,

forestry, and sustainability. Photonics Finland also coordinates the national collaboration by working closely with the international photonics clusters and industry that utilizes photonics.

Photonics Finland supports its members by creating networking and matchmaking opportunities through Photonics technology and solutions related events and webinars. The annual main event is the Optics and Photonics Days (OPD) which gathers over 350 photonics experts from industry and academy from Finland and abroad.

Photonics companies in Finland are growing significantly and recruiting actively. New employees are needed from vocational expertise to doctoral level. Companies and organizations benefit from the Photonics Job Board platform together with Photonics Finland social media channels to receive visibility to their open positions, especially when looking for talents from abroad.

## PiBond

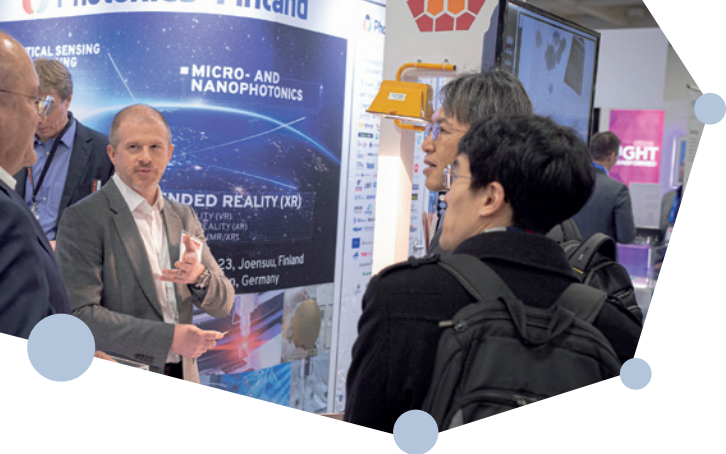
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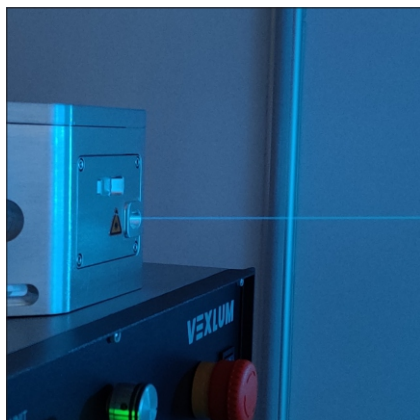
Watch our video



“Our company has grown a lot during the year, and we have hired many new employees throughout 2022. Photonics Finland has been a great partner as we continue to recruit talents across multiple areas of our business”, says Antti Sunnari, CEO and co-founder of the company Dispelix.

Most of the photonics companies in Finland are export intensive and global exhibitions provide a key platform for visibility, and when seeking new business opportunities. Photonics

Finland has more than ten years of experience in organizing the Finnish Pavilions at Photonics West in San Francisco, USA, and at Laser World of Photonics in Munich, Germany. The Photonics Finland pavilion provides a turnkey solution for growing companies that wish to receive the best possible visibility and hall placement for their booth, easily and with additional services. The Finland Pavilion is highly recognized among other exhibitors and well-known for its great and welcoming atmosphere.

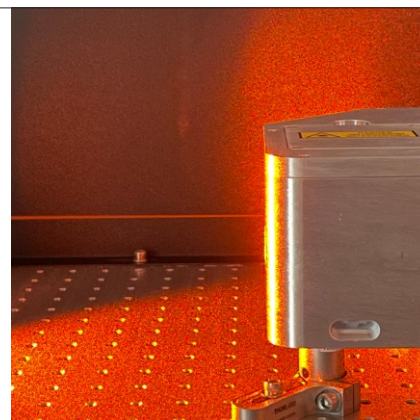


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# Flagship for Photonics Research and innovation (PREIN)

PREIN - a Photonics Consortium of 3 Universities and a Technical Research Center.

PREIN is a joint venture of photonics research excellence and education between highly internationally recognized institutions in Finland: Tampere University, University of Eastern Finland, Aalto University and VTT Technical Research Centre of Finland. Together, we generate future knowledge in photonics, develop the next generation of light-based technologies and promote the Finnish know-how by expanding frontier research into business opportunities. We educate the professionals of tomorrow and raise awareness of the central role of light and related technologies for our society and well-being.

The PREIN Flagship includes about 400 researchers that have complementary backgrounds in optics, physics, chemistry, materials science, nanotechnology, and electrical engineering, creating together a multidisciplinary environment that provides significant added value to the Finnish innovation ecosystem enabled by photonics technologies.

Combining the extensive resources and infrastructures of all its partners, PREIN offers a wide range of collaboration opportunities and services covering the whole value chain from fundamental research to applied research, product development, commercialization, and spinoffs.







## Flagship for Photonics Research and Innovation, PREiN

Accelerate your company's technology competitiveness with the help of best photonics experts!

### DESIGN

- Optical systems and components
- Light sources
- Nano and integrated photonics

### FABRICATION

- Epitaxy and lithography
- Atomic layer deposition
- Free-form optics
- Semiconductors
- Coatings and thin-films

### INTEGRATION

- Components assembly and packaging
- Micro-optic assembly
- Optical interconnects and waveguides

### CHARACTERIZATION

- Materials
- Surface analysis
- Components and light sources

[prein.fi](http://prein.fi) | [finnlight.fi](http://finnlight.fi)



Photos: Jonne Renvall, Tampere University



# Photonics Research in Finland

Photonics research is mainly carried out in universities and specialized research institutes.

Dozens of photonics research groups operate in Finland, employing more than 700 full-time researchers and several hundreds more who are involved in photonics-related projects as part of their work. Most research groups operate with a less than 1M€ annual research budget. Total annual research budget in Finland is more than 80 M€. Research is funded by basic funding, but to a significant extent by external sources: Business Finland, the Academy of Finland, EU and industry. Photonics research covers the whole scientific spectrum from fundamental phenomena to cutting-edge applications.

## **Aalto University**

Aalto University's photonics research focuses on light-matter interaction, optical coherence and polarization, quantum phenomena, development of methods to manipulate light with nano- and microstructures, design and construction of novel light sources and detectors, optical metamaterials and optical imaging. Research activities include silicon-based photovoltaics and photodetectors, advanced characterization and nanofabrication techniques. The Department of Electronics and Nanoengineering is located in the Micro- and nanotechnology center Micronova, with the largest clean rooms with world-class research facilities and instruments in the Nordic countries.

[www.aalto.fi](http://www.aalto.fi)

## **University of Helsinki**

The photonics research at University of Helsinki, Laboratory of Physical Chemistry is focused on light-matter interactions for fundamental and applied research on materials, laser- and infrared spectroscopy and, especially, developing new methods of laser spectroscopy.

[www.hy.fi](http://www.hy.fi)

## **Finnish Meteorological Institute**

The Finnish Meteorological Institute makes observations of the atmosphere, sea and space at over 400 stations around Finland, utilizing photonics applications of remote sensing instruments such as radars and satellites. In addition to weather observations they monitor air quality, radioactivity and properties of the upper atmosphere.

[www.en.ilmatieteenlaitos.fi](http://www.en.ilmatieteenlaitos.fi)

## **University of Eastern Finland**

The multidisciplinary Center for Photonics Sciences combines photonics related research in biology, chemistry, information technology and physics at the University of Eastern Finland. The research covers various topics from fundamental properties of light to large scale fabrication of optical nanostructures, coherence theory, micro and nano photonics, biophotonics, optical materials research and quantum photonics.

[www.uef.fi](http://www.uef.fi)

## **University of Jyväskylä**

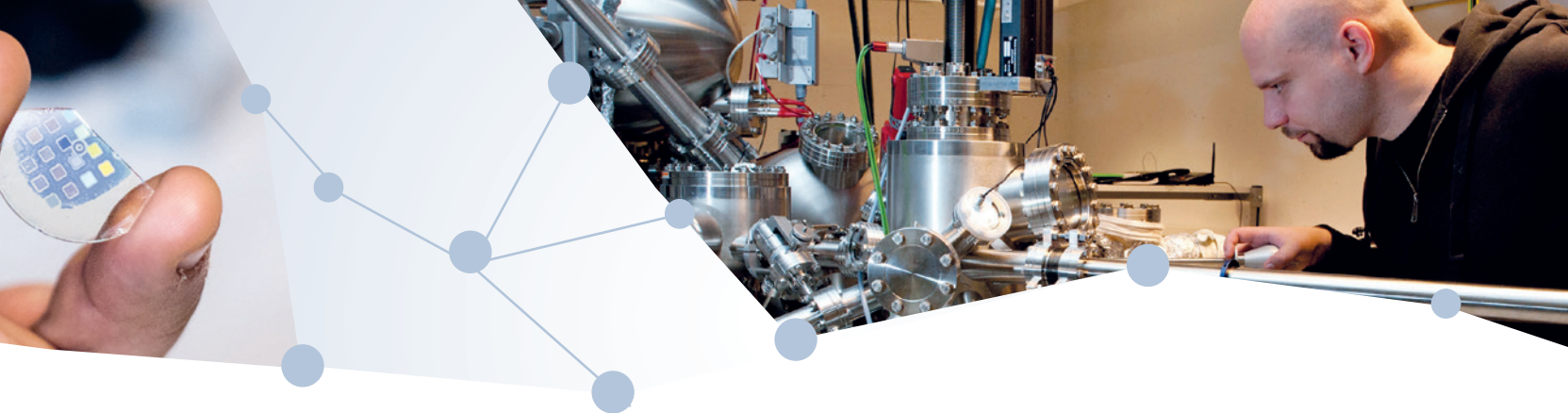
In the University of Jyväskylä, photonics multidisciplinary research focuses on the utilization and development of time-resolved laser methods and the utilization of optical confocal and near-field microscopy and spectroscopy. The Nanoscience Center combines biological and environmental sciences, chemistry and physics covering both experimental and theoretical investigation of molecules, materials and structures.

[www.jyu.fi](http://www.jyu.fi)

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### **LUT University**

LUT University has photonics research in the Department of Physics and on optical measurement technology, nonlinear laser spectroscopy, semiconductor and superconductor physics and nanophysics, and in the Department of Mechanical Engineering on laser welding.

**[www.lut.fi](http://www.lut.fi)**

### **University of Oulu**

The Laboratory of Optoelectronics and Measurement Technology at the University of Oulu carries out research and development of measurement methods for highly scattering materials. The research unit is specialized in demanding application within the fields of biophotonics, biomedical and industrial measurements as well as printed intelligence.

**[www.oulu.fi](http://www.oulu.fi)**

### **Measurement Technology Research Unit**

The Measurement Technology Research Unit operates as a part of University of Oulu carrying out research on optical measurement methods and technology in two application areas: cleantech and health and wellness.

**[www.oulu.fi/en/mittaustekniikka](http://www.oulu.fi/en/mittaustekniikka)**

### **Tampere University**

Research related to photonics in Tampere University is carried out in the Photonics laboratory and in the Chemistry and Advanced Materials laboratory. Light based technologies are one of the university's strategic profiling areas. Tampere University develops new light sources and methods for utilizing and controlling the properties of light. There is

research on nonlinear optics, metamaterials, and quantum optics, ultrafast photonics, epitaxy, nanostructuring, and integration of a wide range of III/V-semiconductors, as well as functional materials for light-driven technologies. On the applications side, innovative solar energy technologies, medical applications, soft robotics, as well as precise measurement techniques are the main areas.

**[www.tuni.fi](http://www.tuni.fi)**

### **University of Turku**

At the University of Turku, photonics research is carried out in the Laboratory of Quantum Optics and Laboratory of Optics and Spectroscopy. The research focuses on the manipulation of cold atoms by external laser and magnetic fields, measurement methods and devices. Photonics research is carried out also in the Faculty of Medicine, where research is concentrated on study of fluorescence-based molecules.

**[www.utu.fi](http://www.utu.fi)**

### **VTT**

VTT Technical Research Centre of Finland is one of Europe's leading research institutions and is owned by the Finnish state. At VTT, photonics research is carried out by almost 400 people involved in photonics research projects mainly in Espoo and Oulu. VTT's areas of expertise include silicon photonics, hyperspectral imaging, packaging from wafer-level to modules, industrial optical devices and systems as well as machine vision. Research is linked to numerous applications from optical communication and quantum computing to medical imaging, gas sensing and autonomous vehicles.

**[www.vtt.fi](http://www.vtt.fi)**



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# Photonics Education in Finland

Photonics degree education in Finnish universities is based on top-level research and is closely integrated with the photonics industry and its their needs.

Academic research and education are closely intertwined, with research-informed degree programmes providing workforce with theoretical competences and application skills. There is a constantly growing demand on master's and doctoral graduates in Finnish photonics companies due to the rapid growth of the sector. It is possible to study photonics in several Finnish universities from the bachelor level to the doctoral degree. Finnish photonics education is very international with programs attracting students from around the world, and there are joint and double degrees with renowned international universities.

## University of Eastern Finland

University of Eastern Finland offers several photonics programmes on all degree levels. The international Master's Degree in Photonics provides expert skills needed globally in careers in optics, photonics and related fields covering aspects from theory to practical work and has a strong connection with working life. In addition, there are three Erasmus Mundus joint master's degree programs, which have a more multidisciplinary approach towards photonics applications offered in collaboration with international partners. In 2023, University of Eastern Finland opened the intake for the Bachelor's and Master's degree in Photonics in Finnish to answer to the growing need for photonics experts nationally. The doctoral education in Photonics is included in the Doctoral Programme in Science, Technology and Computing and there is also a Double Doctoral Degree with Beijing Institute of Technology.

## Tampere University

Tampere University offers the opportunity study photonics in the master's and doctoral levels. In addition, students can enroll in an international bachelor's programme offering direct access to photonics masters' studies. The master's programme in Photonics Technologies provides students with in-depth knowledge ranging from fundamental light-matter interactions, laser physics and nonlinear dynamics to the design of optical systems, semiconductor technologies, advanced nanofabrication methods and measurement techniques. Tampere University is also involved in an Erasmus Mundus joint master's programme and a double degree programme with Bordeaux University. The doctoral programme in Engineering and Natural Sciences offers the profiling area of light-based technologies to doctoral researchers.

## Aalto University

Photonics is offered as a specialization in the master's programme in Nano and Radio Sciences. The major in Photonics and Nanotechnology gives the student theoretical and practical skills in electromagnetic radiation, modeling, optics, and in materials-related topics that can be applied from nanoscience to space physics. The programme focuses strongly on researching and building hardware for these technologies, paving the way for a fluent shift towards a career in the industry or an academic postgraduate path. The Doctoral Programme in Electrical Engineering is a broad multidisciplinary programme providing graduates with possibility to specialize in photonics and to work in a variety of application fields ranging from energy production to biomedical applications, robotics, nanotechnology and communications.



[prein.fi/home/studies](https://prein.fi/home/studies)





### University of Jyväskylä

The master's degree in Nanoscience combines physics, chemistry and biology in multidisciplinary way allowing students to select either chemistry, physics or cell and molecular biology as their major. University of Jyväskylä is also involved in the Erasmus Mundus joint master's programme in Radiation and its Effects on Micro Electronics and Photonics Technologies.

### University of Oulu

Photonics education at the University of Oulu is related to the Electrical Engineering master's degree programme where students may select the specialization module on Photonics and measurement technology to get acquainted with advanced optical and electrical measurement techniques in the application fields of biomedical measurements, photonics, and printed electronics.

### University of Helsinki

The master's programme in Materials Research is based on physics, chemistry, biology and medical sciences, mathematics and computer science, all taught in a cohesive, and self-contained way and one study track in optics and photonics.

### University of Turku

In the master's programme in Physical and Chemical Sciences, photonics is a theme of one of the specialization tracks. The programme aims at training graduates for research and development of new materials in biomedical or electronic applications.

[www.tuni.fi](http://www.tuni.fi) | [www.uef.fi](http://www.uef.fi) | [www.aalto.fi](http://www.aalto.fi) | [www.jyu.fi](http://www.jyu.fi) | [www.oulu.fi](http://www.oulu.fi) | [www.helsinki.fi](http://www.helsinki.fi) | [www.utu.fi](http://www.utu.fi)

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# Student Associations

There are several different student associations in the Finnish universities which offer photonics studies.

For Photonics students, there are student chapters, organizations and clubs affiliated with different international associations such as the Society for Optics and Photonics SPIE, the Optical Society, Optica and the European Optical Society EOS. The associations are for students in all study levels from bachelor to doctoral levels..



You can find all the Finnish photonics student chapters.

## **EOS Finland Student Club**

The EOS Finland Student Club is a national student association.

The purpose of the EOS Finland student club is to promote the discipline of optical sciences and optical engineering among students. In addition, the student club will collaborate closely with industry and academic institutes to support students in continuing their study in optics and photonics and start a successful career by establishing interaction between students, senior researchers, companies and representatives from industry. All students studying optics related courses are welcome to join as members of the students' club from all universities in Finland.

The European Optical Society is a non-profit society, and an umbrella organization for all

national optical societies around Europe, but there are members all over the world. The EOS invites student members to join or create their own EOS Student clubs. These clubs serve all photonics students in order to get new contacts, exchange their experiences and discuss their concerns. EOS Student club members are encouraged to meet, organize or participate to events, propose visits of laboratories or companies from their country.



## **Finnish SPIE Student Chapters**

SPIE, the international society for optics and photonics, is a non-profit society advancing emerging technologies through interdisciplinary information exchange, education, publications, career and professional growth. SPIE affiliated student groups are studying optics and photonics at universities around the world. SPIE Student chapters offer opportunities to collaborate with colleagues, perform outreach in the community, develop professional and leadership skills, form partnerships with industries.

There are SPIE student chapters in Tampere University and in the University of Oulu.







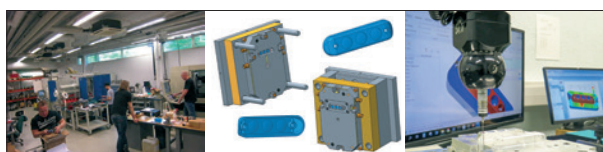
### Finnish Optica student chapters

The Optical Society, Optica promotes and delivers scientific and technical information on optics and photonics worldwide that is authoritative, accessible and archived. With a global network of 7,000 student members participating in over 400 chapters in more than 60 countries. Optica student chapters support your academic studies and research and provide career opportunities in optics and photonics. In addition to their benefits for members, many chapters are heavily involved

with community and youth education outreach to provide both a service to their community and work to disseminate the knowledge of optics and photonics worldwide.

There are Optica student chapters in Tampere University and Aalto University.

# OPTICA



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**[www.karelia.fi/tarkkuustekniikka](http://www.karelia.fi/tarkkuustekniikka)**  
juha.vayrynen@karelia.fi  
kari.monkkonen@karelia.fi



# Outreach



The photonics industry and research organisations in Finland have a shared interest in promoting photonics and attracting new employees and students to the field.

The Flagship for Photonics and Photonics Finland participate in several events targeted at the general public and arrange activities for children and youngsters. In these activities we partner with the outreach experts in universities and collaborate with photonics companies.

The aim for outreach activities is to promote technical fields as a study and career option to future students and employees, as well as raise awareness on photonics and its role as a key enabling technology. The activities also promote diversity and inclusiveness to attract underrepresented groups, particularly girls to STEM fields and photonics.

There are certain outreach activities which have already become reoccurring and part of the annual activities, but every year we also come up with new activities. We also participate in national and local science outreach events, such as the European Researchers' Night, Shaking up Tech, Millennium Youth Prize and The Science Forum.

## **Celebrate light in May and offer glimpses of light around the year**

The International Day of Light on May 16 has become an important time of the year for our outreach activities. To celebrate it we organize several workshops, trainings and events on-line and on campuses during the whole week. The thematic week is directed at children, young people, schools and teachers.

## **Experimental learning for schools with the Photonics Explorer Kit**

The Photonics Explorer Kit (PEK) is an experimental educational kit, which inspires children and youngsters to learn about light by experimenting and doing. Each package includes high-quality, durable components, such as lasers, polarizers, optical fiber and LEDs for the entire class. The hands-on approach aims to increase interest in STEM fields and encourage in pursuing scientific careers.

The Photonics Explorer Kit is developed by the Brussels-based non-profit organization EYEST and designed for upper secondary and high school levels, being also suitable for vocational training. The content of the package is designed so that it can be easily incorporated into the teaching curriculum.

The teacher's guide and lesson plans, as well as the students' work instructions cover eight different topics: optical communication, colors, lenses, eye and vision, polarization, diffraction, and light sources, addressed through a variety of group experiments, tasks, and discussion. The instructions for the kit are available currently in 16 different languages, including Finnish.

The cost of the package is kept low to make it possible for companies and individual to donate kits to schools. One kit can be used by the whole class at a time and can benefit hundreds of students in one school during the years. Hundreds of thousands of teachers and students have already taken advantage of the Photonics Explorer Kit across Europe.





### Inspire children to photonics studies – donate a Photronics Explorer Kit

PREIN and Photonics Finland have a campaign to increase the numbers of Photronics Explorer Kits in Finnish schools. Join PREIN and Photonics Finland in the donation campaign for the Photronics Explorer Kit in Finland. In the campaign PREIN and Photonics Finland have committed to donate one kit each for all the donations made.

The donors will have their brochure and logo included in the package, and visibility on the Photonics Finland and PREIN websites.

Participation in the campaign increases the visibility of the companies also towards potential future employees. Together we can offer the opportunity to learn about light to more schools and children.



Donate a Photronics Explorer Kit to a Finnish school.



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# Extensive benefit from Finnish research excellence



*Paula Eerola  
President  
The Academy  
of Finland*

The Flagship Programme of the Academy of Finland is a form of funding that aims to promote the impact of Finnish research excellence. The best value for public money has been obtained by tendering actors on the basis of the desired goal and implementation of the plan.

- The objective of the programme is to transfer the excellent research results of Finnish universities and research organisations for a wider benefit, says Paula Eerola, President of the Academy of Finland.


The benefits can take many forms, such as development and commercialization of new technologies and thus the renewal of business life. In addition, achieving new forms of treatment in the health care sector and practices that improve the functioning of society will be possible, for example in tackling climate change and in related knowledge-based decision-making.

## **Impressive achievements**

There are currently ten flagships. The photonics flagship PREIN is also among the first flagships that started operating in 2019. In 2021, an interim assessment was made of the first six flagships with results that have exceeded all expectations.

- The flagships have been very effective in their operation, states Eerola. In addition to academic results - publications and degrees - the achievements include more than 160 new startups as well as a large number of patents, new jobs and business contacts. Compared with the investments by the Academy, private funding has been more than double and EU funding more than five times more. The flagship programme has also provided a good platform for international cooperation. The research networks created by the flagship programme are pull factors in international cooperation and attracting top talent to Finland - whether we're talking about researchers, students or experts in the business sector.





Since the concept has been so successful, a new flagship call was launched in the spring of 2023.

- The hope is to get a couple of new flagships, Eerola says.

### Significance of PREIN

Scientific impact of the photonics flagship includes consolidation and growth of the Finnish research community. Expansion has taken place in the internal cooperation within the sector in Finland and also in international contacts. Commercial and innovation ecosystems have also developed. Optics replaces traditional electronics in many cases - whether new generation wireless technologies or new types of sensors are in question.

- Photonics is a grateful sector because the fields of application are very diverse, states Eerola. Photonics is of great importance in everyday life – not to mention bigger things like quantum technology. According to Eerola, quantum technology in particular is a significantly growing future field, where photonics acts as an enabler - as well as in the

green transition, digitalization and artificial intelligence. Society is constantly becoming more technical, and photonics can be used to develop reliable and easy-to-use, low-energy solutions.

Funding of the Academy of Finland's flagship programme has been unusually long-standing. The first-generation flagships are covered by financing until the end of 2026. Each flagship has its own action plan for the duration of the funding period and also after it. The Academy's hope is that the flagships will strengthen the impact of research also in the future.

- Depending on the type of flagship, the exit plans are slightly different, Eerola states. For example, national or even international centers can be planned as extensions of the flagships. According to Eerola, as regards the PREIN flagship, the universities of Tampere and Eastern Finland, as well as Aalto University, are strong actors in the university sector, having enabled the development of photonics for decades and doing so also in the future.



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# Photonics Finland Projects

Photonics Finland is an active member of the European photonics community and is a partner in multiple EU projects.

Through international collaboration Photonics Finland develops the Finnish photonics industry and academic collaboration and creates new export, training and partnership opportunities based on the strategic cluster and project partnerships. European projects also have a key role of developing Photonics Finland cluster and improve the services for its members.

Photonics Finland is partner of the Photonics4Industry, PhotonHub Europe, and Pimap4Sustainability projects and took part in multiple proposals under reviews. All the information about our current and past projects can be found here:

**[www.photonics.fi/projects](http://www.photonics.fi/projects)**

## **Photonics4Industry**

**[www.photonics4industry.eu](http://www.photonics4industry.eu)**

Photonics4Industry connects international photonics organisations through financially supported study visits and provides access to project funding along with research and business development opportunities. Photonics4industry is also helping the cluster partners to develop their level of services for their members.

During the project, partner clusters and their members have exclusive opportunities to network and create valuable connections in different photonics ecosystems through partially funded study visits.

## **PhotonHub Europe**

**[www.photonhub.eu](http://www.photonhub.eu)**

PhotonHub Europe project aims to accelerate the uptake of photonics technologies by European industry, help to boost competitiveness and foster new business and business models.

To reach that aim the project has established a unique European full-service one-stop-shop Photonics Innovation Hub in a manner which is deeply rooted within the wider ecosystem of innovation hubs and manufacturing right across the European continent for maximum coverage, leverage, impact, and long-term sustainability.

Photonhub Europe is a pan-European initiative that brings together more than 500 photonics experts from 15 member states. Through 23 local Photonics Hub partners the project links closely with those European regions that smartly invest in photonics innovation.

## **Pimap4Sustainability**

**[www.linkedin.com/company/pimap4s](https://www.linkedin.com/company/pimap4s)**

This new project is part of the new Eurocluster initiative launched by the European Commission and will help SMEs in the photonics value chain to become more resilient. To this end, PIMAP4Sustainability will support their double transition (green and digital) and the internationalisation of their activities. To achieve these objectives, the project is based on cascade funding and will provide financial support to SMEs to develop innovative projects in the following three themes:

- Metalworking
- Aerospace
- Industrial production

SMEs will have the opportunity, through a first open call, to have their cross-border projects funded up to €60K. And in a second call, the partners will provide funding to help SMEs train on two themes: Green Transition with a grant that could go up to €5K and internationalisation of your activities with a grant of up to €10K.





## INTERNATIONAL NETWORKS AND FUNDED SERVICES

Photonics Finland is active part of European projects which provides new networks but also funded services and training for photonics companies in Finland. Photonics Finland members receive first-hand information from new opportunities through members email-list but are also able to send their requests for others within community.



**FLAGSHIP PROGRAMME**  
ACADEMY OF FINLAND

[www.aka.fi/flagships](http://www.aka.fi/flagships)

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# Photonics Top Expert

The aim of the Photonics Top Expert -training is to find jobseekers with an expert profile and a university or applied sciences degree and to train them in photonics and high-tech industry, which is growing and suffering from a shortage of experts.

## Extensive benefit from Finnish research excellence

Dispelix Oy was founded in 2015 in Espoo. The operations of the company that develops augmented reality displays have grown significantly, as there are constantly more and more advanced possibilities for integrating digital content into the surrounding world. In 2017, the operation was expanded to Joensuu. Later, sales offices were established in the US Silicon Valley and China. In Finland, Espoo and Joensuu have been selected as the locations of the offices because the universities operating in these cities offer public cleanrooms and equipment that are suitable for the manufacture of nanophotonics and can be used in the manufacture of prototypes. In Joensuu, Dispelix is located in the same premises as the University of Eastern Finland - this brings a lot of synergistic benefits to a company that carries out research and product development, production preparation and production chain management. In addition, personnel are needed to build the company's own design software.

## Growth challenges recruitment

The business activities of Dispelix Oy, which operates internationally, are directed abroad, and the personnel already represent more than thirty nationalities. Having initially employed three employees, the company now employs already 150 people. In 2022, the number of employees almost doubled. Strong growth has posed challenges for recruitment.

- During the intensive growth phase, we tested different recruitment channels and piloted the Top Expert program tailored to find photonics experts, says **Petri Stenberg**, who is in charge of the company's production.

## TOP EXPERT RECRUITMENT TRAINING

- 80 days on-job-learning
- 8 group training days
  - Development task
  - Personal sparring





 **Photonics Finland**

**kasve** 

With the help of the program, a data analysis expert with photonics training was sought. According to Stenberg, the process went excellently, and could be used to respond to the company's real need. The person who came to work for the orientation period was immediately capable and able to produce added value. The prerequisite for success was the company's own understanding of what kind of person was being looked for. The process was smooth too.

- The project's recruitment partner Kasve Oy searched for candidates, introduced them to us and took care of the familiarisation training, during which the person underwent traineeship with us, says Stenberg.

During the training period, there was time from both sides to decide on the salary. The company's risk of recruitment failure was non-existent. Dispelix has also found new talent thanks to close cooperation with universities.

- Owing to our presence at the University of Joensuu we now have dozens of PhDs and Masters in photonics who graduated there, Stenberg says.

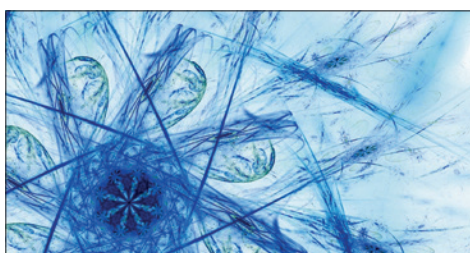
Dispelix has been involved in running working life-oriented courses and has informed the university of its own vision of Master of Science education in Technology. It is important to bring into focus what kind of competence is needed in the field in addition to researcher competence. In Espoo, Aalto University is an important partner.

Through Photonics Finland's job board, Dispelix has also managed to find talented people from abroad. Finnish photonics experts may be lost in the crowd alone - through the association, the Finnish photonics industry appears larger, whereby finding suitable candidates becomes easier. In addition, Photonics Finland combines academic science and industrial expertise.

- Photonics Finland creates a good hub for recruitment in the industry, Stenberg states. For example, job advertisements receive a lot of visibility through LinkedIn channels, regardless of whether experts are needed for research or development.

Thanks to successful recruitments, there has been no need for Dispelix to open new offices abroad. Skilled people have moved to Finland from other parts of the world - not only to the capital region, but also to Eastern Finland. Flow also takes place in the opposite direction, whereby Eastern Finnish expertise in photonics has spread around the world through large international companies.



- Finnish expertise in photonics is hard currency in the world, and has also helped establish several Finnish companies. Finnish expertise in photonics should not be kept hidden but instead be boldly brought to the fore. With ten years of personal experience in international photonics business, I can say that Finnish expertise is on the leading edge in the world, Stenberg concludes.



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# Studying Photonics in Finland

Asli Pekman is working at Microsoft and studying Photonics at Tampere University.

I have been working at Microsoft Surface Tampere Camera Hardware Team as an Optical Engineer for the past two years. My main responsibility is designing optical components for cameras on Surface devices. It's exciting to contribute directly to consumer products that have millions of users around the world. The best part of my job is reading tech reviews after a new product launch.

I am currently in my first year as a student of the Tampere University Photonics Technologies Master's Degree Program. Everything I learn here is relevant to my work. All the compulsory courses are tied to the latest technology trends of the industry. In addition to that, I am also taking elective courses, such as Project Management and Entrepreneurship, since I would like to learn also about these topics. I came to Tampere as a Microsoft employee, and I didn't want to miss the opportunity of pursuing a Master's education in Tampere University since my company supports me for all sorts of education opportunities. Finland, especially Tampere, is the best in Photonics education and for future job opportunities. All the Big Tech companies are establishing their Camera sites here to hire young talents.

## Balance between work and studies

In addition to having flexible working hours and understanding colleagues, I have also developed effective time management and prioritization skills. I create a schedule for myself that includes both my work tasks and study goals, and I make sure to allocate enough time for each task. I try to avoid procrastination by breaking down larger tasks into smaller, more manageable ones, and by setting deadlines for myself.

In my thesis research, I am combining my work and studies. My thesis research is about Addressable Multidirectional Metasurface-Integrated NIR VCSELs, aiming to solve power consumption problems of 3D sensing and face detection applications in consumer electronics. My goal is to continue learning and growing in order to provide solutions to the industry's challenges. I know I need academic support if I wish to achieve big accomplishments in my career.

*Asli Pekman*





Microsoft

A woman with long brown hair, wearing a light blue t-shirt and a lanyard, is holding a tablet and looking at it. She is standing next to a white robotic arm with blue joints. In the background, there is a laptop on a desk and a whiteboard with a grid of numbers. The scene is set in a modern office or laboratory environment. The image is framed by a blue geometric overlay with white circles and lines.

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# Photonics events in Finland

The Finnish photonics ecosystem actively participates in national and international fairs and events.

Photonics Finland coordinates and organizes the Finnish photonics pavilion in international fairs and events as well as is the organizer or co-organizer in the photonics events in Finland inviting both the industry and research organizations together. The Flagship for Photonics Research and Innovation, PREIN brings the research-informed approach to the events and also organizes thematic events in collaboration with the other flagships.

## **International visibility and networking through fairs**

Finnish companies and research organizations join the most important global and European photonics fairs to increase the visibility of the Finnish photonics activities. Photonics West Fair and adjacent academic conferences in San Francisco are important opportunities for academics as well as for Photonics Finland's company members. Since Photonics West involves leaders from academia and industry, the exhibition and conference have been defined as a key event where PREIN and Photonics Finland participate annually. The event provides opportunities to learn about the latest research, see the newest innovations, and meet with the global community during the week.

Another notable fair is Laser World of Photonics in Munich, that annually gathers international professionals around laser and photonics industry. It is a leading trade fair for photonics components, systems and applications with an adjacent academic congress with up to 4000 congress lectures and presentations.

## **The main national event - Optics and Photonics Days in Finland**

The Optics and Photonics Days is organized by Photonics Finland with a rotating co-organizing responsibility of Finnish universities, with the venue located in a different Finnish city each year. The event gathers extensively both academic and industrial participants, not to mention also participants from the various thematic areas. There are several side vents to the academic and industrial programme, for instance, the PREIN Flagship Networking Event and Panel Discussion, Student Meet-up Event, Women in Photonics, and Photonics Exhibition. OPD provides a unique opportunity to learn from interesting presentations, network with companies, students, and researchers in the field of photonics and optics, but also to explore products and services in OPD exhibition, which is held during the conference. The event consists traditional networking dinner and Photonics Finland Awards for the Best PhD Thesis, Best Posters and for The Photonics Company of the Year.

## **Thematic events with application fields**

Each year Photonics Finland and PREIN organize a number of different thematic events, conferences, seminars, symposiums, and workshops in Finland, in collaboration with various stakeholders in photonics industry, research institutes, and universities. The themes vary from different application fields such as forestry to medical, artificial intelligence and sustainability. The aim is to attract both photonics experts and as well as experts from other related disciplines and application fields.





## Courses and trainings to boost continuing education

In addition to degree education, the PREIN Flagship partners organize various courses, trainings, and summer schools for professionals and students during the year. Often, the courses are carried out in

collaboration with a company or a project group. There are also continuing education and training projects that are carried out in collaboration with regions and other funders.



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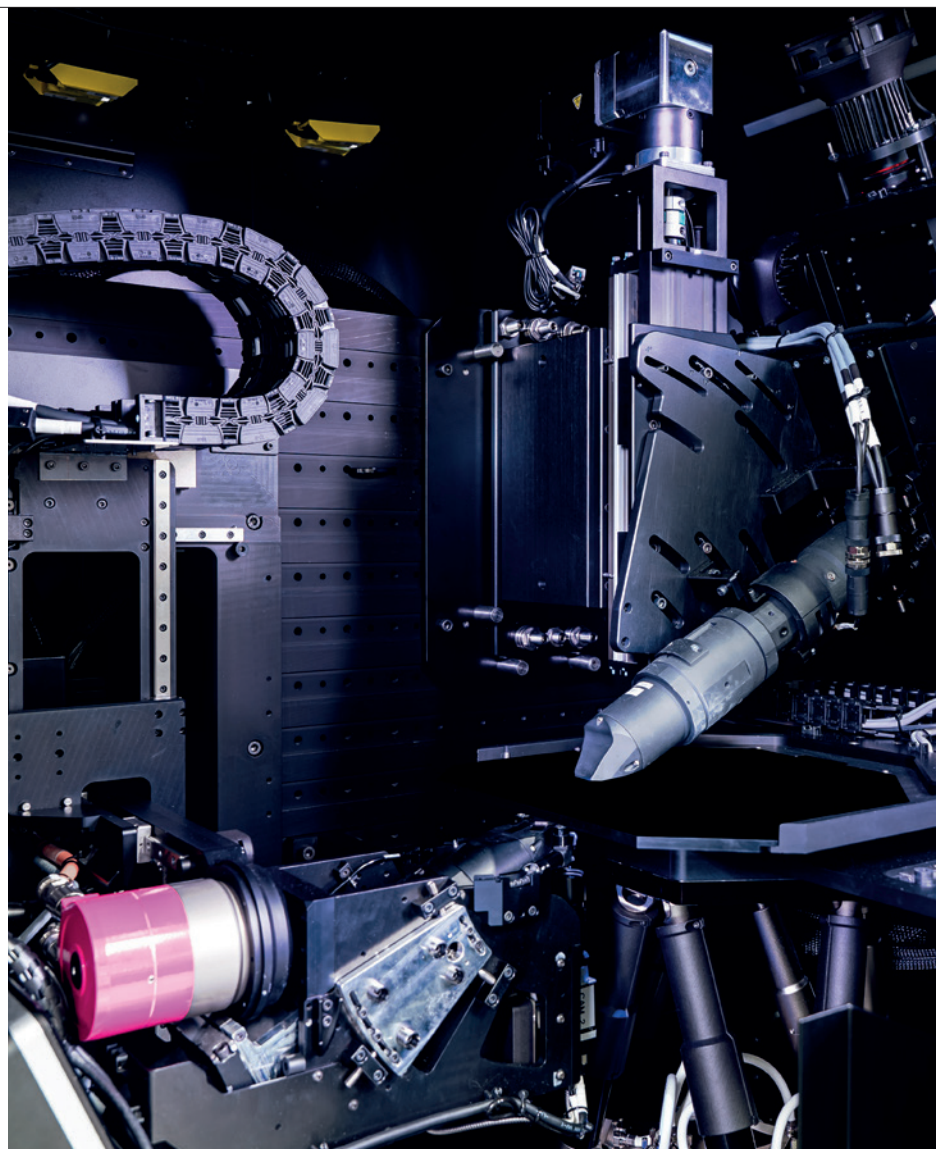
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# The role of Business Finland in the photonics industry and research

Photonics is fundamental to all ICT technologies. Business Finland is about innovation funding, developing export business for SMEs and invest in. Photonics and related research is very relevant for all these areas.

It is important to invest in photonics in Finland, if you want to be at the forefront of technology evolution. Finland has great networks and partners and the collaboration capability is proven. We work together very much. So if your company is growing and sees a next photonics technology development need, Finland might be a solution.

Finnish research and innovation ecosystems have been very essential and Photonics Finland has been bringing the industry together. Judging by the international interest, the Finnish research seems of very high quality.

Finland is a stable, well educated society, cost level is very reasonable and our R&D productivity is excellent. Let's discuss more!

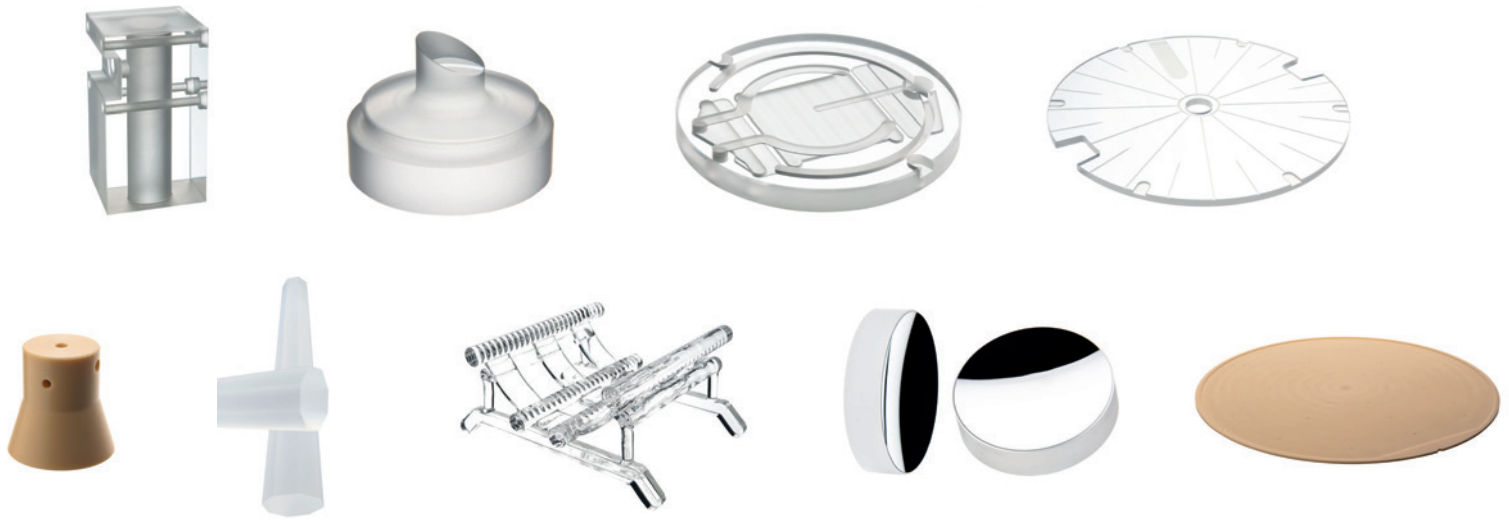
*Janne Kari  
Head of Industry  
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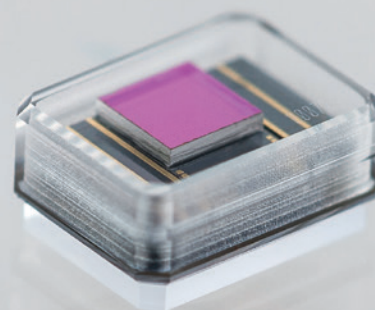


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