

OPTICS & PHOTONICS IN SWEDEN

PhotonicSweden

"Our vision is that photonics and optics shall have a strong impact on an expanding and profitable Swedish industry"





Facts about the Swedish Photonics There are more than 200 photonics companies in Sweden.

Over 8000 employees are working every day with photonics

The turnover is accumulated 2-3 billion Euros. All major Swedish universities have research and education in photonics.

Photonics in Sweden

Photonics is often hidden inside other products. It is an essential key enabler but often invisible to non-experts. Veoneer (auto safety), Mycronic (precision manufacturing), Tobii (eye tracking), Coherent-Optoskand (laser delivery), Senseair (gas sensing), FLIR Sweden (IR cameras), Silex (MEMS foundry) and Hübner-Cobolt (lasers) are just a few examples of companies in Sweden with photonics at their core, and with world leading technologies and unique products in their respective fields.

In academia, groups at KTH, Chalmers, and the universities of Lund, Umeå, Luleå, and Linköping ensure that new photonics experts are being trained. Universities and the Swerim and RISE institutes ensure that new technologies are being developed, and that photonics research is being implemented industrially, in Sweden and abroad.

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Light is the key

Photonics is the technological mastery of light in any form. Photonics focuses on the generation, control, measurement and, above all, use of light in almost all socially and economically important areas.

Photonics has been designated by the EU Commission as one of six so-called Key Enabling Technologies (KETs) to be targeted specifically in research and development to create new jobs and meet future competition outside the EU.

Photonics is currently used in a number of areas: Production engineering, power and lighting engineering, medical technology, environmental technology, plasma technology, and information and communication technology. In fact, new applications for photonics are appearing every day, and the potential applications for photonics are virtually unlimited.

Today we can use energy-efficient LED lamps due to the development in photonics, we can surf the Internet through fiber optic cables, and we can put up straight shelves in our homes using laser measurement. Photonics is all around us, all the time.

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Photonics is today a global business area generating thousands of billions of kronor every year, but the technology is also of huge benefit to society.

Through photonics, fantastic medical techniques are developed that save the lives of seriously ill patients.

Have you ever been to an ice hockey match and seen a laser show when the players skate out onto the rink? Photonics!

Photonics contributes to the development needed to work towards the UN Sustainable Development Goals.

Man's ability to develop solar energy, water treatment, and sustainable industry owes much to photonics. The future holds many and great challenges, but it also offers exciting and major possible solutions.



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An invaluable network

PhotonicSweden is the Swedish national platform for optics and photonics. Here we gather members from throughout Sweden and Europe, and we act as enablers, catalysts and drivers in the development of photonics.

PhotonicSweden was founded in 2011. Today we have about fifty company members and over a hundred personal members consisting mainly of representatives from industry and academia in the field of photonics. However, PhotonicSweden is open to everyone. If you have a great interest in photonics, want to get in touch with other like-minded people, and keep up to date on what is happening in this field, a membership of PhotonicSweden is a must.

As a member, you have access to a huge national and international network in which you will be able to keep up with the very latest news and trends in photonics! Our vision is that photonics and optics must have a strong impact on a viable, expanding, and profitable Swedish industry based on research and innovation.



We work together with the Photonics Public Private Partnership and contribute to the topics of future EU calls. We have a large network in Sweden, Europe and beyond and can connect partners for new collaborative projects.

PhotonicSweden can help you fund your innovations especially through PhotonHub Europe. We are involved in the strategic innovation programme Smarter Electronic Systems. You can benefit from it!

PhotonicSweden organizes conferences, workshops, and optopubs (seminars which are concluded with dinner mingling), arranges Nordic photonics forum meetings, and manages EU projects. By joining this network as a member, you get access to invaluable contacts.

PhotonicSweden can be compared to a switchboard for photonics in Sweden and functions as a trade association in practice. As a member, you also get a discount on exhibitions and participation fees for conferences and events organized by PhotonicSweden and our European partners. You will also receive a newsletter, you may post job advertisements on our website, and we can help you with arrangement of photonics-related contacts and activities.



Cooperation and devel



PhotonicSweden works continuously to promote photonics in Sweden. PhotonicSweden will work to:

- Catalyze fruitful cooperation between companies, universities, and institutes in the field of optics and photonics in Sweden and across the national borders.
 - Be a natural partner for Swedish and European funders and investors for product development and research.
 - Contribute to a healthy regrowth of engineers in optics and photonics.
 - Increase the awareness among the general public and politicians of the strategic importance of optics and photonics for the future of Sweden.

opment for the future



Sweden's authorities, foundations, and organizations invest in the future and fund photonics-related projects.

- The Foundation for Strategic Research (SSF) funds research in science, technology, and medicine with approximately EUR 96 million per year. In 2020, 37 projects focusing on photonics have been granted a total of EUR 36 million over five years to research groups.
- During the period 2014–2019, Vinnova invested a total of EUR 15.2 million in the innovation program Smarter Electronic Systems. Of the 114 projects that received funding, 25 are directly related to photonics these have received a share of EUR 3.4 million, which corresponds to just over 22 percent of the entire investment.
- The Swedish Energy Agency funds photonics related research in at least two programs: Energy Efficient Lighting, with EUR 10 million between 2017–2024, and Electricity from the sun with EUR 25 million between 2016–2023.

"37 projects focusing on photonics have been granted a total of EUR 36 million"





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Photonics and the Nob



Photonics has broken new ground in recent decades, and, as a direct result thereof, researchers in this field have repeatedly been awarded the finest scientific prize in the world – the Nobel Prize.

ARTHUR ASHKIN, GÉRARD MOUROU AND DONNA STRICKLAND THE NOBEL PRIZE IN PHYSICS

2018 the prize was shared between Ashkin for the development of optical tweezers and their application in biological systems, and Mourou and Strickland for the technique known as chirped pulse amplification. Mourou and Strickland's research is described as groundbreaking in laser physics and has, for example, made eye laser surgery possible. The prize winners were historic in many ways. Donna Strickland was the first woman to receive the Noble Price in Physics in 55 years, and 98-year-old Arthur Ashkin became the oldest prize winner in the history of the Nobel Prize.

SHUJI NAKAMURA, HIROSHI AMANO, ISAMU AKASAKI THE NOBEL PRIZE IN PHYSICS

STEFAN HELL, WILLIAM MOERNER, ERIC BETZIG THE NOBEL PRIZE IN CHEMISTRY

2014 Nakamura, Amano and Akasaki were awarded the Nobel Prize in Physics for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources.

In other words, they have invented the LED lamp. Due to the use of shorter wavelengths to increase the capacity of optically read data storage media and, together with red and green LEDs, to form light sources of optional color.

Hell, Moerner and Betzig were awarded the Nobel Prize in Chemistry for the development of super-resolved fluorescence microscopy. The microscope made higher resolution and clearer images possible than through a diffraction-limited system.

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el prize

In the past 25 years, researchers actively engaged in photonics have been prize winners more than 20 times.

DAVID WINELAND AND SERGE HAROCHE THE NOBEL PRIZE IN PHYSICS

2012 Wineland and Haroche were awarded the Nobel Prize in Physics for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems. Their research has led to the mastery of light particles in the world of quantum physics by capturing ions and then cooling them down using lasers. Through Wineland and Haroche's research, it has, for example, become possible to build a clock in which two ions in collaboration keep the time 100 times more accurately than the standard clocks of today. The technology is described as the first step towards quantum computers.

"In the past 25 years, researchers actively engaged in photonics have been prize winners more than 20 times."

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Rapid growth

Photonics is booming. According to the Photonics21 report, the field is showing twice as strong growth as global GDP and, through successful innovation, photonics is at the cutting edge of technology and a market leader in the development in a number of fields. The global photonics market generated revenue of EUR 654 billion in 2019 and the market is forecast to grow to EUR 900 billion by 2025. The growth rate is expected to be highest in manufacturing industry and the pharmaceutical industry, each with a growth rate of just over 6.5 per cent.

PHOTONICS HAS A PROVEN TRACK RECORD AS LONG-TERM GLOBAL GROWTH DRIVER

- Global CAGR 2005–2019: 7% corresponding to 2x of global GDP growth and is far above overall industry growth (OECD: 1.3%)
- Global market size in 2019 is \$733 (€654) bn
 forecasted to reach \$1000 bn (€905) in 2025 (subject to pandemic effects)

PHOTONICS EUROPE DEMONSTRATES STRONG GROWTH AND INNOVATION

- EU Photonics industry grew from €76 bn (2015) to
 €103 bn in 2019 which corresponds to a growth rate of 7% (CAGR) and a multiple of 3x EU GDP growth (2.3%) and about 5x EU IPI growth (1.5%)
 Conving factor than many other Useb Task
- Growing faster than many other High-Tech

Industries (e.g. the IT industry: 4.5%, Medtech: 4.9%, Microelectronics: 4,0%)

- Photonics industry employs ~ 390.000 people and created ~ 30,000 new jobs between 2015–2019 (a plus of 2.1%) vs. an EU Manufacturing employment growth of 1% (CAGR)
- European Photonics maintained its #2 global market share position behind China
- High Research and Innovation spending rate (Capex & R+I) of ~ 15% of turnover on average (up to 25% in some areas like MedTech)
- Strong core segments are Photonics in Industry 4.0. (> 40% global market share), Medical Technology (26%), Environmental Monitoring and Optical Instrumentation as well as Large Instruments and Space (30% each)

"...the market is forecast to grow to EUR 900 billion by 2025"





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Professor Sune Svanberg

"What is required is that the leadership can convey all the enthusiasm and confidence in the future needed for bold initiatives..."



Professor Katarina Svanberg

"... interesting as a diagnostic tool to identify early tumor growth..."

"Lasers have become obvious tools"

Professor Sune Svanberg is a true pioneer in photonics and has been active since 1980, among others at Chalmers and Lund University. His career achievements include the foundation of the Medical Laser Center

His career achievements include the foundation of the Medical Laser Center and the Center for Environmental Measurement Technology, and he is a member of the Swedish Research Council's Board.

– Photonics has seen significant growth in terms of both quality and volume in Sweden. Lasers have become obvious tools in both basic research and in an increasingly wide range of applications, he says.

Sune Svanberg sees PhotonicSweden as a highly useful platform.

- The organization offers valuable meeting places for those who are active in this field. On the large scale, the national photonics conference is very important for the exchange of information and as a national manifestation.

Svanberg believes that the future will show great progress in information technology, especially based on quantum optics. He also believes that photonics can play a crucial role as enabling technology.

– What is required is that the leadership can mediate all the enthusiasm and confidence in the future needed for bold initiatives in new research areas and applications, and that funding is available for risky, but potentially groundbreaking, projects in academia and industry.

"Has grown significantly"

Katarina Svanberg is Professor of Biophotonics and Chief Consultant of Oncology. Together with her husband Sune Svanberg, she has developed medical photonics in Sweden, including the development of laser spectroscopic methods for cancer diagnostics.

– We realized that there were areas where the combination of medicine and photonics offered clear possibilities. At the time, around the 1980s, Biophotonics was a fairly limited area globally, but it has grown significantly over the years, she says.

Svanberg describes the opportunities offered by biomedical photonics as huge.

- Within my and our area of interest in the borderland between medicine and technology/physics, photonics was interesting as a diagnostic tool for identifying early tumor growth. With laser-induced fluorescence, we were able to demonstrate that even miniscule tumors, completely invisible to the eye during endoscopy or via other conventional methods, could be visualized.

What does it mean for the development of photonics that there is a player like PhotonicSweden?

– PhotonicSweden is an important platform, not least for organization of conferences, where researchers, clinicians, and business people can meet and be offered opportunities to discuss and form important networks.

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Max Skoglund

" Our mission is to market and sell photonics related solutions to Swedish industry..."

"Important to have a joint forum"

Max Skoglund is Managing Director of Hamamatsu Photonics Europe GmbH, a company that focuses on research, development, and manufacturing in photonics. The essentially Japanese company has been represented in Sweden since 1966.

– Our mission is to market and sell photonics-related solutions to Swedish industry and research, in close cooperation with our customers. Our mission also includes following up on local trends in innovation and research and evaluating opportunities for collaboration projects and investment opportunities. Through PhotonicSweden, we can network and meet potential customers and partners, as well as utilize PhotonicSweden's ambitions to communicate to decision-makers how important photonics is to the Swedish economy, he says.

Hamamatsu was a member of the Swedish Optical Society already in the 1990s and when PhotonicSweden was established, it was natural to apply for membership directly. Max Skoglund sees great benefits from access to the network, the activities organized, and the cross-border cooperation.

- It is important that there is a joint forum in Sweden, where industrial and academic players with an interest in photonics can make contacts and develop collaborations. It is equally important to have a strong voice in Sweden that works to place photonics high up on both the national and European agendas among decision-makers when it comes to the allocation of resources for investments in technology development and research in Sweden and the EU.





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Charlott Samuelsson

" PhotonicSweden is already today an important player..."



Björn Hansson

"We also see that PhotonicSweden helps make our voice heard..."

" Important that companies in photonics collaborate"

Charlott Samuelsson is Senior Vice President at Mycronics, which is the world's leading supplier of mask writers for the manufacture of photomasks for monitors.

She emphasizes the importance of photonics for continued technological development.

– Photonics is a relatively narrow technology area in Sweden. It is therefore of the utmost importance that companies that work in Swedish photonics collaborate with each other to build up competence and develop new technology. This will be crucial for us to be able to continue to attract young engineers and create the conditions for them to specialize in photonics. This is necessary to ensure that we and other companies can remain competitive internationally also in the future.

What do you hope PhotonicSweden can do to further promote the development of the industry?

– PhotonicSweden is already today an important player in stimulating both national and international collaborations that drive forward new technology and improve the competence of Swedish companies. PhotonicSweden is an excellent platform for continuing to create new opportunities for collaboration between industry and academia both nationally and internationally.

"Here PhotonicSweden plays a unique role""

Dr. Björn Hansson, who is CTO at Excillum AB, which develops highly advanced X-ray sources for industries and research labs, sees great potential for the development of photonics in Sweden, but he says that hard work will be required to maintain the position achieved. Excillum works with X-ray photons and sees a great need for competence in the future.

- We already have great focus on R&D, but we will grow even more in this field in the future because we still see so many unexploited opportunities. Solid photonics expertise is also important in product management, sales, and marketing, says Hansson.

Excillum has been a member of PhotonicSweden since the beginning. The membership gives the company a natural platform for involvement in Swedish photonics and widens its network of contacts beyond the somewhat narrower world of radiology.

- We also see that PhotonicSweden helps make our voice heard about photonics being an important future industry for Sweden.

How important is it that there is a unifying voice like PhotonicSweden? – Very important. Each individual company and each individual research group must focus on their core business, which makes it difficult to broaden their outlook and provide information and influence matters relating to photonics in a wider perspective so that politicians and the general public understand the potential of this field. Here PhotonicSweden plays a unique role.

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Erika Göransson

"I see the development in photonics in Sweden as very important to the future."

"Here PhotonicSweden can help"

Erika Göransson is Sr Director of Teledyne FLIR, which develops and manufactures thermal imaging infrared cameras. In Täby they also have an optics production where they manufacture their own lenses. In PhotonicSweden, she sees a unique platform for photonics in Sweden.

– PhotonicSweden offers an opportunity to network through various events, which is very useful, for example in recruitment. The events also give companies in the industry a chance to meet. PS also helps market photonics to students where they connect companies with exciting thesis projects that may later lead to recruitment, she says.

Like many other players in the photonics sector, Erika Göransson sees a great need for future competence and believes that the development of photonics is important to Sweden.

– I see the development in photonics in Sweden as very important to the future. There are many interesting areas to explore: self-driving cars, smart lighting, and different types of sensors to name a few. Sensors will definitely play a bigger and more important role in our society and be part of everyone's day-to-day life.

What role do you think PhotonicSweden can play in the development of photonics in Sweden?

Sweden needs strong companies and universities that can drive innovation and change in photonics, both by themselves and through partnerships.
Here, PhotonicSweden can help and make a difference by continuing to create and maintain a networking platform for industry and academia.
PhotonicSweden can offer great support for small start-ups which may not have the resources or muscles themselves.

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