Photonics in Sweden

Sweden's photonics ecosystem is anchored by leading academic research, innovative industrial actors, and national coordination through PhotonicSweden. With more than 200 companies and 8,000 employees, Sweden continues to advance cutting-edge photonics technologies across sectors. Close collaboration between universities, research institutes, and industry fosters innovation, talent development, and international engagement—positioning Sweden as one of the key players in the European photonics landscape.

Nobel Light Week in Stockholm.
Photo by Lennart BM Svensson

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Petra Bindig[1]*, Lennart B.M. Svensson[1], Fredrik Laurell[2]

[1]PhotonicSweden, Stockholm, Sweden
[2]Royal Institute of Technology (KTH), Stockholm, Sweden
***petra@photonicsweden.org**

Development of Optical Science and Photonics Infrastructure in Sweden

The evolution of optics and photonics in Sweden during the second half of the 20th century was driven by institutional and academic initiatives. A key period began in 1966 with the expansion of optics research at the Royal Institute of Technology (KTH), supported by international collaboration.

At the European level, the formation of the European Optical Society (EOS) in 1991 marked a significant milestone, with active participation from Swedish researchers. That same year, the Swedish Optical Society (SOS) was founded as a non-profit organization uniting academia, industry, and government to advance optics and photonics. Symbolically launched on St. Lucy's Day, the society has been dedicated to knowledge dissemination, interdisciplinary collaboration, and ecosystem development.

One of SOS's key contributions was establishing a recurring national optics conference. Initially biennial, it attracted participants from both academia and industry and has since evolved into an annual tradition organized by PhotonicSweden.

These efforts laid the foundation for Sweden's robust and coherent national infrastructure for optical science, research, and innovation.

Photonics Research and Education in Sweden

Sweden has built a strong ecosystem for photonics research and education, where universities and research institutes work closely with industry to drive technological breakthroughs. These institutions not only provide cutting-edge education to train future photonics specialists but also generate high-impact research that feeds into global innovation networks.

Key Universities and Research Institutes

• KTH Royal Institute of Technology (Stockholm)

KTH plays a pivotal role in Swedish photonics through research and education programs spanning biophotonics, quantum photonics, laser physics, nanophotonics, and integrated photonics. The Division of Micro and Nanosystems and the Department of Applied Physics host several pioneering groups working on photonic chips, optoelectronics, and light–matter interaction. KTH is also active in quantum technology initiatives, contributing to Sweden's position in the European Quantum Flagship program.

• Lund University

Lund has long been recognized as a hub for optics and laser physics. Its Lund Laser Centre (LLC) is one of the largest laser research facilities in Europe, attracting both academic and industrial collaborations. Research covers ultrafast

optics, high-power lasers, nanophotonics, optical design, and medical optics. The university also hosts NanoLund, a major interdisciplinary research environment dedicated to nanoscience and nanotechnology, where photonics is a key area.

Professor Anne L'Huillier of Lund University was awarded the Nobel Prize in Physics, together with Pierre Agostini and Ferenc Krausz. The prize was awarded "for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter." This groundbreaking work in ultrafast optics has not only advanced fundamental science but also reinforced Sweden's position at the forefront of global photonics research.

(Read more in the press release from the Royal Swedish Academy of Sciences: https://www.nobelprize.org/prizes/physics/2023/press-release/).

• Chalmers University of Technology(Gothenburg)
Chalmers is internationally known for research in quantum photonics, optoelectronics, nanofabrication, and advanced optical communications. The university is home to the FORCE Center (Fiber Optic Research Center) and is active in bio-nanophotonics and semiconductor photonics. Around 50 researchers are engaged in photonics-related projects, contributing to both fundamental science and industry-oriented solutions. Chalmers has also fostered spin-off companies such as EXFO Sweden AB, exemplifying successful technology transfer from research to market.

• Luleå University of Technology (LTU)
LTU specializes in industrial applications of photonics, particularly in Sweden's mining, forestry, and bioenergy sectors. Research areas include laser manufacturing processes, optical sensing for harsh environments, and environmental diagnostics. LTU collaborates extensively with local industries to implement photonics-based solutions that increase sustainability and efficiency in resource-heavy sectors.

• Umeå University
Umeå conducts research in organic electronics, photonics materials, and optical physics, bridging the gap between fundamental material science and photonics applications. Its interdisciplinary approach links photonics with energy storage, biomedical applications, and sustainable electronics.

• Mid Sweden University
Mid Sweden University is recognized for research in advanced materials for photonics, detector technologies, and optical sensors. Their work often focuses on applied photonics, with strong industry connections in areas such as digital imaging, environmental monitoring, and security systems.

• Uppsala University
At Uppsala, photonics research is integrated across disciplines, particularly in biomedicine, electronics, renewable energy, and nanotechnology. The university is active in microscopy, optical materials, and light-based energy harvesting technologies, contributing to sustainable and medical applications of photonics.

• Stockholm University
The Quantum Photonics Group at Stockholm University is engaged in quantum light generation, entangled photon sources, and quantum dot technologies for applications in quantum communication and quantum sensing. This research supports Sweden's contributions to the emerging quantum technology ecosystem in Europe.

• RISE Research Institutes of Sweden AB
As Sweden's largest independent research institute, RISE bridges academia and industry. It offers applied research capabilities in fiber optics, organic electronics, optical metrology, and semiconductor photonics. With access to state-of-the-art laboratories, clean rooms, and pilot production facilities, RISE plays a key role in scaling up laboratory research into industrial innovation.

• SWERIM AB
SWERIM applies photonics in laser processing, optical measurements, and materials characterization, with a strong focus on industrial manufacturing and materials innovation. Its collaborations with Swedish and European industries enable photonics to be embedded in next-generation production technologies.

Thematic Clusters in Swedish Photonics

Quantum Photonics & Fundamental Light Science
Sweden has strong representation in quantum photonics, ultrafast optics, and light–matter interaction, contributing to Europe's quantum technology initiatives.

- KTH Royal Institute of Technology – quantum photonics, nanophotonics, photonic chips.
- Lund University – ultrafast optics, attosecond science (home of Nobel laureate Anne L'Huillier).
- Stockholm University – quantum photonics group: entangled photons, quantum dots, quantum light sources.
- Chalmers University of Technology – quantum photonics, semiconductor nanostructures, optoelectronics.

Biophotonics, Health & Life Sciences Applications
Photonics is widely used in Swedish biomedical and life sciences research, especially for imaging, sensing, and diagnostics.

- KTH – biophotonics, biomedical optics.
- Lund University – medical optics, ultrafast lasers for bio-imaging.
- Uppsala University – optical microscopy, biomedical photonics.
- Chalmers University of Technology – bio-nanophotonics.
- Industrial & Applied Photonics
- Photonics is directly applied to Swedish key industries, including manufacturing, forestry, mining, and energy.
- Luleå University of Technology (LTU) – laser-based manufacturing, harsh-environment sensing, mining applications.
- SWERIM AB – laser processing, optical metrology, materials analysis.

- Mid Sweden University – photonics for imaging, detector technologies, environmental monitoring.
- RISE – applied photonics for industry: fiber optics, semiconductors, metrology.

Materials, Nanophotonics & Energy Applications
Materials research underpins Sweden's photonics innovation, with a focus on nanostructures, organic electronics, and sustainable energy.
- Lund University / NanoLund – nanophotonics, semiconductor nanostructures.
- Umeå University – organic electronics and photonics, optical physics.
- Uppsala University – photonics in renewable energy and nanomaterials.
- Chalmers University of Technology – wide-bandgap optoelectronics, semiconductor photonics.
- RISE – organic electronics, advanced materials.

Communication, Connectivity & Fiber Optics
- Photonics plays a central role in advancing communication systems, fiber optics, and future internet technologies.
- Chalmers University of Technology – FORCE center: fiber optics, optical communications.
- KTH – photonic integrated circuits for communications.
- RISE – fiber optic technologies and testing facilities.

Summary Insight:
Sweden's photonics ecosystem can be seen as four interconnected pillars:
1. **Quantum & Fundamental Science** (KTH, Lund, Stockholm, Chalmers)
2. **Biomedical & Biophotonics** (KTH, Lund, Uppsala, Chalmers)
3. **Industrial & Applied Photonics** (LTU, SWERIM, Mid Sweden, RISE)
4. **Materials, Energy & Communication** (Lund, Umeå, Uppsala, Chalmers, RISE)

This balance between fundamental breakthroughs (like attosecond science) and real-world industrial impact (laser processing, fiber optics, sensing) makes Sweden highly competitive in the global photonics landscape.

The Swedish Photonics Industry
Photonics, the science and technology of generating, controlling, and detecting photons, underpins many advanced systems in modern society. It is widely regarded as a key enabling technology (KET) because of its cross-cutting impact across multiple sectors, including telecommunications, manufacturing, healthcare, defence, transportation, and environmental monitoring. Despite its critical role, photonics often remains embedded and "hidden" within end-user products, making its presence less visible to the general public while being indispensable for technological progress.

Sweden stands out as a significant hub for photonics innovation in Europe, hosting a dynamic ecosystem of companies that develop and commercialize cutting-edge photonic components, systems, and integrated solutions. These companies range from specialized SMEs to globally recognized industrial leaders, addressing applications from biophotonics and quantum technologies to LiDAR and precision manufacturing. The sector's strength lies in its high-value engineering expertise, advanced manufacturing capabilities, and strong integration with global supply chains.

Key Swedish Photonics Companies and Their Core Contributions
Sweden's photonics industry is highly diversified, with companies spanning defence, healthcare, telecom, industrial automation, and consumer electronics. These firms bridge cutting-edge research with commercial solutions, strengthening Sweden's position as a global hub for photonics innovation.

Defence, Security & Imaging
- Aimpoint AB – Global pioneer in red dot reflex sights, widely used by hunters, law enforcement, and armed forces worldwide. Known for robust, energy-efficient, and high-precision optical systems, Aimpoint's technology has become a standard in modern targeting solutions.
- FLIR Systems AB (Teledyne FLIR) – Leader in infrared (IR) imaging and thermal sensing for defense, industrial inspection, and predictive maintenance. Swedish R&D has contributed to miniaturized IR cameras and drone-mounted sensors, critical for both civilian and military use.
- SAAB AB – Integrates advanced optoelectronics and photonics in defense systems, including surveillance radars, optical targeting systems, and communication technologies. Photonics enables SAAB's leadership in next-generation situational awareness and electronic warfare.
- Ir-Nova AB – Specializes in infrared detector modules used in demanding environments, supporting FLIR, SAAB, and international defense applications.
- Spectrogon AB – Produces optical filters, holographic gratings, and thin-film coatings essential for spectroscopy, laser systems, and IR imaging. Its high-precision filters are deployed in military, aerospace, and industrial monitoring systems.

Lasers, Optics & Industrial Photonics
- Cobolt AB (HÜBNER Photonics) – Internationally recognized for single-frequency, ultra-stable CW to fs lasers with superior beam quality. Applications span life sciences, quantum optics, materials processing, and terahertz research.
- Excillum AB – Developer of the brightest X-ray sources in the world, using proprietary metal-jet anode technology. These sources enable breakthroughs in semiconductor metrology, non-destructive testing, and biomedical imaging.
- Optoskand AB (Coherent) – Provides fiber-optic beam delivery systems for industrial lasers used in cutting, welding, and additive manufacturing. Its technology enables precision and reliability in heavy-duty laser machining.

- Latronix AB – Builds laser-based measurement systems for railway monitoring and industrial quality control, ensuring high safety and efficiency in transport and manufacturing.
- Optronic Partner AB – A contract developer specializing in custom optical measurement solutions, from prototyping to full-scale production, serving industrial automation, medical devices, and environmental sensing.
- TYRI Sweden AB – Focuses on advanced photonic lighting systems for off-road vehicles, mining, and construction machinery, enhancing visibility, safety, and energy efficiency in harsh environments.

Telecom, Optical Networks & Fiber Technologies

- Finisar Sweden AB (Coherent) – Designs tunable lasers and photonic integrated circuits (PICs) for ultra-high-speed optical communications. Expertise in InP wafer processes enables 100+ Gbit/s optical transceivers, crucial for data centers and 5G/6G backbone networks.
- NOKIA (former Infinera AB) – Develops optical networking solutions and photonic semiconductors for scalable, high-capacity fiber networks. Swedish operations contribute to global deployments of coherent transmission technologies.
- Nyfors Teknologi AB – Produces precision fiber-optic processing equipment, critical for splicing, coating, and preparing fibers in telecom networks and photonics sensing applications.
- Proximion AB – Specialist in Fiber Bragg Gratings (FBGs), enabling telecom signal processing, structural health monitoring, and harsh-environment sensing (e.g., oil & gas pipelines, aerospace).

Automotive & Consumer Photonics

- Magna Electronics Sweden AB – Designs LiDAR, vision sensors, and advanced driver-assistance systems (ADAS) for the automotive industry. Plays a crucial role in enabling autonomous and semi-autonomous driving technologies.
- Tobii AB – World leader in eye-tracking technologies, with applications in assistive technologies, medical diagnostics, gaming, and AR/VR. Tobii's solutions combine AI and photonics-based sensing for real-time gaze detection.
- Trimble AB – Provides high-precision geospatial solutions, including 3D laser scanning, GNSS, and robotic total stations for construction, surveying, and agriculture.

Advanced Materials, MEMS & Components

- Mycronic AB – Global leader in photolithography and precision dispensing equipment for electronics and flat-panel display manufacturing. Its systems are critical in producing semiconductors and advanced displays.
- Silex Microsystems AB – World-leading MEMS foundry, integrating microfabricated optical and photonic structures into sensors for consumer electronics, automotive, and healthcare.
- SiTek Electro Optics AB – Produces position sensing detectors (PSDs) used in beam alignment, radiation detection, and precision metrology.

- Thorlabs Sweden AB – Supplies a wide range of optomechanical components, lasers, detectors, and integrated photonic systems, supporting both research and industrial photonics globally.

Summary Insight:

Sweden's photonics industry is globally competitive across several sectors:

1. **Defence & Security**
   (SAAB, FLIR, Aimpoint, Ir-Nova, Spectrogon)
2. **Lasers & Industrial Photonics**
   (Cobolt, Excillum, Optoskand, Latronix, TYRI, Optronic)
3. **Telecom & Networks**
   (Finisar, Nokia, Nyfors, Proximion)
4. **Automotive & Consumer**
   (Magna, Tobii, Trimble)
5. **Materials & Components**
   (Mycronic, Silex, SiTek, Thorlabs)

Together, these firms complement Sweden's academic and research ecosystem, forming a strong photonics value chain from fundamental science to global market leadership.

Strategic Importance and Global Impact

The Swedish photonics industry is deeply interconnected with global markets, supplying critical components and systems to sectors such as semiconductors, automotive, aerospace, healthcare, and communications. By investing in laser technologies, imaging systems, optical sensors, and photonic integration, Sweden contributes significantly to Industry 4.0, smart mobility, and the digital transformation.

Moreover, photonics plays an increasingly vital role in addressing societal challenges, including energy efficiency, environmental monitoring, and healthcare diagnostics, aligning with the European Green Deal and sustainable development goals (SDGs).

Sweden's Photonics Ecosystem, Global Networks, and Activities

Sweden has developed a well-connected and innovation-driven photonics ecosystem, where research, industry, and policy converge to support technological advancement and international competitiveness. This ecosystem is anchored by PhotonicSweden, the national technology platform, and reinforced by active participation in European and global networks.

PhotonicSweden – The National Platform

Founded in 2011, PhotonicSweden serves as the primary coordination and networking body for photonics in Sweden. PS was created through the merger of Swedoptronics, a network of photonics companies, and the outreach and networking activities of the Swedish Optical Society.

- **Membership:** Over **50 organizations** (SMEs, large companies, research institutes, universities) and numerous individual members.
- **Core functions:**
  - **Innovation Support** – Helping companies, especially SMEs, to accelerate the commercialization of photonic technologies.
  - **Networking** – Creating strong connections across academia, industry, and government to promote collaboration.
  - **Policy Engagement** – Acting as Sweden's voice in European and international photonics initiatives, ensuring alignment with EU research and industrial strategies.
  - **Knowledge Exchange** – Organizing workshops, conferences, and training programs that bring together stakeholders across sectors.

EU and International Engagement

Sweden plays an active role in shaping the European photonics agenda.

- **EU-funded projects:** PhotonicSweden participated in 13 EU projects under FP7, Horizon 2020, and Horizon Europe, covering areas such as biophotonics, quantum technologies, smart manufacturing, and optical communications.
- **Photonics21:** Sweden is an active contributor to Photonics21, the European Technology Platform for photonics, which defines Europe's Strategic Research and Innovation Agenda (SRIA) and influences EU funding priorities. Swedish representatives are involved in several Photonics21 working groups (including quantum, life sciences, and manufacturing).
- **Nordic Collaboration:** Strong ties exist with neighboring Nordic countries (Denmark, Finland, Norway) through joint research programs, conferences, and industry partnerships. These collaborations leverage regional strengths in optics, imaging, and telecommunications.

The Optics & Photonics Conference: Sweden's Annual Gathering

Originally initiated by the Swedish Optical Society, the Optics & Photonics Conference has become PhotonicSweden's flagship event. This two-day conference includes academic and industrial sessions, exhibitions, poster presentations, and pitch talks for exhibitors. This event attracts not only attendees and exhibitors from the Nordic countries but also participants from across Europe.

A key addition is the Nordic Photonics Forum, held the day before the conference. This half-day session highlights regional collaboration and funding opportunities across the Nordic countries.

The conference serves as a central meeting point for Sweden's photonics stakeholders and a catalyst for new partnerships and projects.

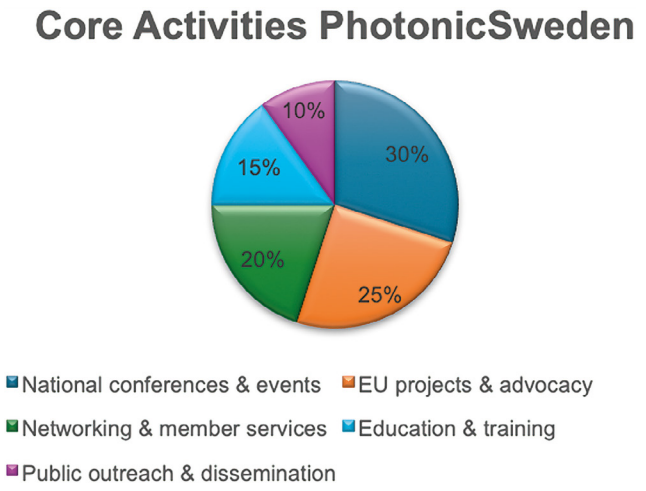
Optopubs: Informal Networking and Knowledge Sharing

Optopubs are informal seminar sessions that combine technical talks with social interaction. Typically featuring one academic and one industry speaker, they offer a relaxed setting for learning and networking over food and drinks.

Held regularly in Stockholm, Gothenburg, Lund, and Hudiksvall, these events attract 25–70 participants and are hosted by local companies, offering varied perspectives and fostering community engagement.

Key Facts: The Swedish Photonics Industry at a Glance

- **200+** active photonics companies
- **8,000+** professionals employed nationwide
- Estimated annual turnover: **€2–3 billion**
- All major universities engaged in photonics research and education
- Strong international presence and EU project participation
- Semicon Sweden – A new initiative co-funded by the European Union to strengthen the ecosystem and Sweden's position in semiconductors, launched in February 2025, Semicon Sweden is a national effort led by the Swedish Electronics Association with backing from agencies like Vinnova, RISE, Lund University, and PhotonicSweden. The goal is to strengthen Sweden's semiconductor and photonics ecosystem, improve national coordination, and position Sweden as a key European player—especially as part of the EU Chips Joint Undertaking (Chips JU).



- Most Swedish companies involved in photonics primarily identify as part of the broader electronics industry. The Swedish electronics sector directly employs approximately 66,000 individuals and generates an annual turnover of nearly €20 billion. However, when including companies whose products and services critically depend on both electronics and photonics technologies—such as those in telecommunications, automation, medical technology, and advanced manufacturing, the industry's scale expands significantly. This broader category comprises an estimated 8,000 companies, employing around 260,000 people and contributing to a combined turnover of approximately €90 billion annually. These figures underscore the extensive integration and economic impact of photonics as an enabling technology within Sweden's high-tech industrial landscape.