2/24

Suomen fotoniikan seura ry:n julkaisu

Fotoni

The story behind PhotonicSweden • OPD2024
Company of the year, Vaisala • Thesis of the year 2023

2/24

Fotoni 2/2024, 21. vuosikerta

Julkaisija: Suomen fotoniikan seura ry

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Ilmestyminen: Vuonna 2024 ilmestyy 2 numeroa.
Seuraava numero ilmestyy keväällä 2025.

Tilaukset ja osoitteenmuutokset:
Jäsenetuna Suomen fotoniikan seuran jäsenille. Vuoden kuluessa liittyvät uudet jäsenet saavat alkuvuoden numeron jäsenetuna niin kauan kuin painos riittää. Osoitteen muutokset suoraan jäsenasioiden hoitajalle, ks. http://www.photonics.fi

Taitto: Eero Sundvall

Kannen kuva: Visualization of coupling of quantum light in a single mode fiber by Markus Hiekkamäki

Paino: Eräsalon Kirjapaino Oy, Tampere

ISSN 1455-1071
ISSN-L 1455-1071

Puheenjohtajan palsta

Hyvä Suomen Fotoniikka Seuran jäsen ja Fotonilehden lukija!

Kirjoittaessani tätä palstaa huomaan, miten nopeasti aika kuluu! Tuntuu kuin olisimme juuri saaneet tämän vuoden OPD:n päätökseen, mutta siitä onkin jo puoli vuotta! OPD:stä puheen ollen, Helsinkiin saatiin houkuteltua ennätysmäärä osallistujia sekä teollisuus- että akateemisiin sessioihin, ja lisäksi kaikkien aikojen suurin määrä näytteilleasettajia, 45 kappaletta. Tästä kaikille osallistujille suurkiitokset!

Olen erittäin ylpeä siitä, että tämä seuran tärkein vuosittainen tapahtuma on kasvanut viime vuosina merkittäväksi tapahtumaksi, aivan kuten pitkän aikavälin toimintasuunnitelmassamme olemme määrittäneet. Eikä tässä vielä kaikki. Kaikilla rintamilla on tapahtunut paljon, ja talouden kannalta kansainvälisten projektien saaminen ja toteuttaminen on ollut keskeisessä roolissa. Tässä työssä olemme saavuttaneet merkittävän tason, joka mahdollistaa lyhyelläkin aikavälillä uusien palvelujen tarjoamisen jäsenistölle tavalla, joka ei aiemmin olisi ollut mahdollista.

Tavoitteisiin ei päästä ilman sitoutumista. Minulla on ollut nyt mahdollisuus johtaa hallitusta ja sitä kautta toimistohenkilökuntaa, ja ylpeydellä olen huomannut, miten ammattimaisesti henkilöt suorittavat annettuja ja sovittuja tehtäviä.

Syyskokouksessa hyväksyttiin muun muassa hallituksen ehdottama toimintasuunnitelma vuodelle 2025, joka on nähtävillä verkkosivuillamme. Perusasiat säilyvät ennallaan, mutta laajuus ja syvyys ovat kasvaneet. Jäsenille on edelleen luvassa verkostoitumismahdollisuuksia ja kanavointia, rahoitusinstrumenttien esille tuomista, koulutustoimintaa, teematapahtumien järjestämistä, näyttely- ja konferenssitoimintaa kotimaassa ja ulkomailla sekä erilaisia muita palveluja. Fotoni-lehti ilmestyy edelleen kaksi kertaa vuodessa kuten tähänkin saakka. Näkyvyys eri kanavien avulla laajenee ja paranee.

Tulevat suurimmat tapahtumat ovat ensi vuoden alussa Photonics West San Franciscossa, jossa seuralla on yhteisosasto/paviljonki, ja luonnollisesti OPD 2025, tällä kertaa Oulussa, sekä kesällä yhteisosasto Laser World of Photonics 2025 -tapahtumassa Münchenissä!

Vuosi on kohta lopussa, ja haluankin tässä vaiheessa toivottaa kaikille hyvää joulun odotusta ja menestyksekästä uutta vuotta 2025. Tavataan seuran tai muissa yhteistapahtumissa, joissa olemme osallisina. Toki, minuun voi aina ottaa yhteyttä!

Suomen Fotoniikka
Seuran puheenjohtaja
Kim Grundström

Auringonlasku Iniön aukolla
Kuva: Jouko Korppi-Tommola

Pää-toimittajalta

Arvoisa lukija,

Ajattelin, että FOTONI 1/24 10v. juhlanumeroa seuraava FOTONI 2/24 olisi ainakin sivumäärältään jonkin verran ohuempi, mutta toisin kävi. Sain houkuteltua Photonics Sweden:in perustajajäsenen Lennart Svenssonin kirjoittamaan omalle lukijakunnallemme siitä, mikä sisarusseuramme toiminnassa on ja on ollut keskeistä. Perinteitä noudattaen kirjoitimme Tuukka Pakarisen kanssa tiivistelmän ennätyksellisestä OPD2024 tapahtumasta. Hannu Talvitie kirjoitti hienon artikkelin vuoden 2023 Fotoniikka Yrityksen Väisälä Oyj:n toiminnoista fotoniikan alalla. Markku Hiekkamäki kirjoitti mainion artikkelin vuoden 2023 parhaan väitöskirjapalkinnon voittaneesta työstään. Voimme myös lukea Janne Ihalaisen tarinan hänen ryhmänsä kehittämästä fotoniikan opetukseen kouluissa soveltuvasta laitekehityksestä, edullisesta lähi-infrapuna kuvantamislaitteesta, jolla voi nähdä mm. lehtien pinnalla asustavia fotosynteettisiä bakteereja. Työ tukee teemaa, jota sekä Seuramme että lippulaivahanke PREIN pitävät keskeisenä fotoniikan tulevaisuuden osaajien houkuttamiseksi alalle. Seura on saanut uuden hallituksen ja siitä tiedote. Caroline Amiot, juuri ennen siirtymistään äitiyslomalle, valottaa Seuran kansainvälisten yhteyksien ja taloudenpidon kannasta tärkeitä projektihankkeita, joissa olemme mukana. Projektien saaminen on, sanoisinko kohtalon kysymys, Seuran henkilöstön palkkakulujen kattamiseksi. Lopuksi esittelyssä toimistotiimiin äskettäin liittynyt uusi työntekijä Sidra Muntala, jonka toimituskin toivottaa lämpimästi tervetulleeksi joukkoomme.

Kevään FOTONI 1/25 numerossa saamme lukea vuoden 2021 fotoniikka yrityksen Dispelix Oy:n onnistuneesta USA:n valloituksesta. Toimitus pyrkii myös saamaan kurkistuksen OURA Oy:n tulevaisuuteen samassa numerossa.

Säynätsalossa, vaurioituneen
riippusillan takaa
20.11.2024
Jouko Korppi-Tommola

A new team member at Photonics Finland office

Sidra Muntaha has started as a new Project Manager at Photonics Finland! Her main responsibilities will be to lead and manage our collaborative projects across the Europe during Caroline Amiot's maternity leave. She will act as the primary point of contact between Photonics Finland, project partners, and European institutions, also facilitate communication and collaboration among all stakeholders. She will participate in Photonics Finland activities such as the Optics & Photonics Days 2025 event, and collaborate with other European partners to apply to new projects.

Sidra is originally from Pakistan and six years ago she moved to Finland to build her academic and professional career. She has worked as a Research Scientist at VTT Technical Research Centre of Finland, gaining valuable experience on Silicon Photonics.

She graduated with a bachelor's degree in Electrical Engineering, followed by a master's degree in Photonics from University of Eastern Finland (UEF). Currently she is completing her PhD in Integrated Photonics through a collaboration between VTT and the UEF, with a focus on integrated optic devices for LiDAR applications.

Warm Welcome Sidra to join the
Photonics Finland Team!
Caroline, Juha, Tuukka, and Ana

The story behind Photonic-Sweden

Article written by
Lennart BM Svensson,
PhotonicSweden

Background

Swedish Optical Society (SOS)

It started with Klaus Biedermann's profound impact on the field of optics in Sweden, which cannot be overestimated. Arriving from Germany in 1966, he embarked on a scholarly journey as a postdoctoral researcher at the Royal Institute of Technology (KTH). He was appointed as Professor of Optics in 1978, and the following year also Director of the Institute for Optical Research (IOF, now part of RISE). In May 1991, Klaus Biedermann, as a co-founder, played an instrumental role in the establishment of the European Optical Society (EOS). Concurrently, he started the inception of the Swedish Optical Society (SOS) within the same year. This nonprofit entity was envisioned as a hub for individuals, organizations, and enterprises harboring a vested interest in optics and optical technology. Poetically, an inaugural meeting was called on St Lucy's Day. One of the society's greatest achievements was the biennial organization of optics conferences in Sweden, featuring esteemed speakers, poster presentations, and exhibitors. The conferences have been very popular and have developed into an annual tradition now under Photonic Sweden's auspices. Klaus keen interest in optics has also been instrumental in the work of the Swedish Optical Terms Group, which he founded in 1996, an initiative he stayed involved with throughout the years. With his help, the group has defined countless optical terms, facilitating discourse on modern optics in the Swedish language. Sadly, Klaus Biedermann passed away 30th March 2024 at the age of 88.

PhotonicSweden (PS)
On 10 March 2010 a meeting with Dr. Thomas Skordas, Head of the European Union's Photonics Unit (2009-2014) was arranged in Kista, Sweden, with approx. 15-20 representatives from photonics companies, Vinnova, ACREO, and academia to discuss how Sweden can contribute more in the photonics field. Dr. Thomas Skordas gave a presentation about "EU perspectives for Photonics in 2010 and beyond", where he had noted that very few research EU-applications came from Sweden. This meeting inspired Lennart and Pierre-Yves to arrange a meeting in 2010 with Prof. Klaus Biedermann (Laser Physics, KTH) and Roland Jakobsson (CEO Spectrogon AB) in an attempt to convert SOS to PhotonicSweden. But this process was difficult to implement, among other things that SOS was a Learned society and that PhotonicSweden was not considered to be, because it would become an economic association. Lennart, as a board member and the treasurer of SOS, together with Pierre-Yves, decided then to continue the process with a parallel organization. Both Pierre-Yves and Lennart were the driving forces and spent hundreds of unpaid hours in this process to make the new organization possible. The main difference between PS and SOS, is that SOS is a non-profit association that mostly relied on non-profit work, while PS is an economic association subject to Swedish legislation similar to a limited liability company.

To be able to register PhotonicSweden as an economic association, we needed to have a temporary board, an interim board, which functioned until the first general meeting. We were 6 private persons engaged in this process: Lennart BM Svensson (LS Lasertech Innovation KB) , Pierre-Yves Fonjallaz (Acreo and NETFIT AB), Fredrik Laurell (KTH), Emil Hällstig (Optronic and Adopticum), Magnus Burvall and Magnus Engholm (FOV-Fiber Optic Valley). We also had help from Elisabeth Stenman (FOV) helping us write the statues. An extraordinary general meeting was held on 2010-12-21 which decided to adopt the formation of an economic association and to adopt the proposed statutes, with the six persons involved as members of the new board and Elisabeth as auditor. The Swedish Companies Registration Office (Bolagsverket) acknowledged our application 2010-12-28.

It was also important that we got an approved VAT-number. Our new colleague Petra Bindig had just moved to Sweden from Germany, but still worked part-time remotely for VDI (Verein Deutscher Ingenieure) which is an organization with over 150,000 engineers and natural scientists. With Petra's help, we then got the opportunity to be a co-applicant for the EU project InnoPho21, but only if we had an organization number, why it was important as soon as possible register PhotonicSweden.

The economic association PhotonicSweden was then registered 2011-01-13 with the Swedish Companies Registration Office and aims of promoting the members' interest by representing and being a spokesperson for companies and organizations in the photonics industry and academia in Sweden, as well as to formulate national research and development agendas for growth, and communicate national needs internally in Sweden and internationally. This will create the prerequisites and conditions for the industry to develop positively by e.g. formulate and communicate the photonics industry's needs in education, research and development to universities, authorities and the EU. PhotonicSweden will work for a national network in optics and photonics open to all stakeholders from industry, academia and the public sector.

The new organization PhotonicSweden

During the first financial year 2011, the association's work was focused on bringing together the Swedish Optics Society's personal members and company/organization members as well as Swedoptronic's company members in PhotonicSweden. At Swedoptronic's annual meeting in May, 2011, it was decided to switch to PhotonicSweden. This resulted in 27 full members and 2 associated members being added in 2011.

The intention was to keep the more than 100 SOS members in the new association. Personal members of PhotonicSweden also automatically received membership in the Swedish Optics Society (SOS) and the European Optical Society (EOS).

OPS-2011
The Optics & Photonics Days 2011 were held 16-17 November in Hudiksvall together with Fiber Optic Valley as the main organizer and sponsor. In connection with this event, Fredrik Laurell as chairman of the Swedish Optics Society governed its Annual General Meeting where it was decided to allow a large part of the Swedish Optics Society's current operations to be run by PhotonicSweden, which through its office will have access to significantly greater resources than has been the case for SOS so far.

Working groups WG 1-WG7 in 7 different areas
In connection with the Optics & Photonics Days-2011 in Hudiksvall, a start-up of working groups in 7 different areas, WG 1-WG7 was arranged. The purpose of the working groups was to develop common goals, visions and strategies. These strategies could then be starting points for financing future investments in photonics. The working groups should also be a networking and communication tool for the photonics community.

The first public promotion of PhotonicSweden was held at Photonics West exhibition in San Fransisco, USA during 25-27 Jan, 2011. FiberOpticValley in Hudiksvall had a Vinnova-program 2008-2011, which made it possible for them to have a booth with approx. 6 Swedish companies exhibiting for a low cost. FiberOpticValley sponsored PhotonicSweden in the beginning, and we were invited to exhibit in their booth for free. Both Magnus Burvall CEO, and Susanne Nylén of FiberOpticValley were present at Photonics West, but also Magnus Enholm. Susanne Nylén was the organizer and responsible for the booth arrangement, and supporting Lennart who represented PhotonicSweden at the fair. Prof. Sune Svanberg, Lund University, visited our booth and saw our progress.

2011-11-16 *SOS-conference OPS and SOS-Annual meeting in Hudiksvall.*

The second public promotion of PhotonicSweden was at Photonics21 Stakeholder meeting in Brussels, Belgium, 23 Feb, 2011. Lennart attended as an invited speaker to present the status of the new organization PhotonicSweden, where Dr. Thomas Skordas was present and received the good news about our organization. Petra Bindig from PS was also present, co-responsible for organizing the Photonics21 Annual Meeting.

From the start, and even much earlier, PhotonicSweden has got a strong support from the Photonics Unit at the European Commission. In September 2011, a European project called *InnoPho21* had started and involving Photonics21, PhotonicSweden and 5 other national technology platforms in Europe. One of the main activities was to develop our national strategy in photonics and that is how the work behind this *Strategic Research and Innovation Agenda (SRIA)* started.

PhotonicSweden's 1st newsletter was published on 22 December 2011. An extraordinary general meeting was planned on 12 January 2012, to elect new members to the board and determine the annual fee and service fee for 2012 for full and associate members.

Swedoptronics & SOS

In May 2012 Photonic Sweden took over the baton after Swedoptronics and the Swedish Optical Society. The goal was to become a gathering place and opinion maker for Swedish optronics and photonics.

- We want to be more than a classic industry association; we want to strengthen Swedish industry. The EU has identified photonics as one of five key areas in the next framework program and I am personally convinced that it is a train that you must be on, says Emil Hällstig chairman of the board of Photonic Sweden.

The activity of Swedoptronics and the Swedish Optical Society had been quite low in recent years, a situation that is not entirely unusual in non-profit associations. The setup for Photonic Sweden is a little different. Right from the start, the organization has the opportunity to pay three people part-time to speed up the activities. To that can of course also be added the non-profit work that the 40 full members (companies and organizations) and about a hundred personal members contribute.

Photonics-SRIA

In July 2012 we got a financial support from *VINNOVA* (Swedish Governmental Agency for Innovation Systems) to develop a common strategy with other constellations in the field of electronics. In spring 2013, VINNOVA also decided to grant our Photonics SRIA. 109 people from academia, organisations, and companies were contributing in the Workgroups WG1 to WG7, which resulted in our SRIA-publication *"Photonics Agenda – Photonics, A Key Enabling Technology for Sweden"*. The photonics agenda was established at a meeting 2013-09-20.

Two years after the foundation of PhotonicSweden, there was no doubt that our association has fully succeeded in gathering the main actors in photonics, managed to represent the Swedish photonics and coordinated the work underlying the creation of this SRIA. Still, the Swedish photonics continues the process which will make it reach the level it deserves!

PhotonicSweden's first chairman was Emil Hällstig (Optronic), followed by Magnus Breidne (IVA), and then at this writing Åsa Claesson (RISE).

> This event is the most important activity for PhotonicSweden, by trying to bring all Swedish photonics stakeholders together once a year.

Optics & Photonics conference in Sweden

The Swedish Optical Society started the annual conferences with exhibition and poster sessions, which then was taken over by PhotonicSweden. The annual meeting today has 2 conference days now with parallel academic and industrial sessions. We introduced pitch-talks for our exhibitors at OPS-2013 in Uppsala. The day before the conference, we now arrange a half day Nordic Photonics Forum, which is more aim for presentations of funding and collaboration possibilities. This event is the most important activity for PhotonicSweden, by trying to bring all Swedish photonics stakeholders together once a year.

Photonics21 & EU-projects

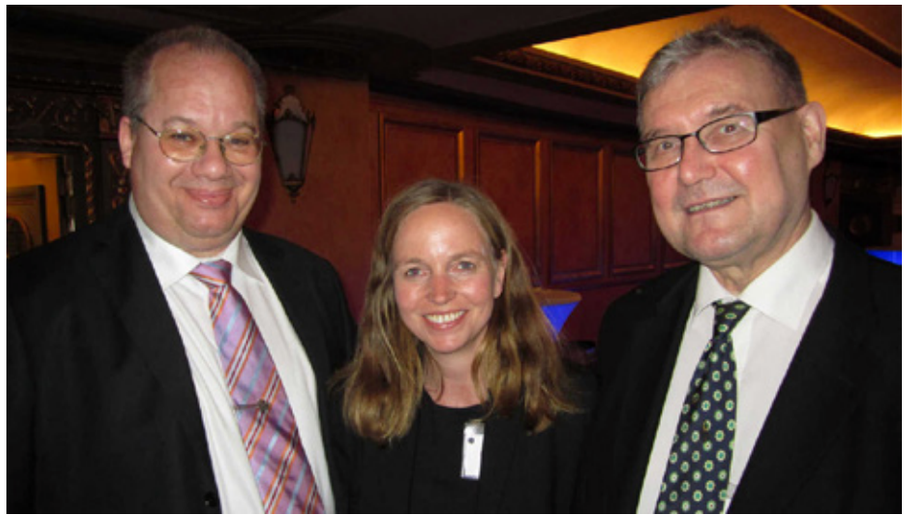
From the start PhotonicSweden has been a member of Photonics21, and we have participated in 13 different EU-projects, and expanding our network in the European photonics community. PhotonicSweden participates in Photonics21 AM every year and also has a member representative present in the Photonics21 Board of Stakeholder (BoS) currently through our colleague Staffan Tjörnhammar. EU has approved PhotonicSweden as a non-profit organisation.

Smarter Electronics System

2014-05-19 VINNOVA said YES to our (7 organisations) innovation program Smarter Electronics System! Vinnova, the Swedish Energy Agency and Formas finance seventeen strategic innovation programs (SIP). Through cooperation in areas that are strategically important for Sweden, conditions are created for sustainable solutions to global societal challenges and increased international competitiveness. Within the programs, companies, academia and organizations jointly develop the sustainable products and services of the future. The aim is to maintain and develop Swedish cutting-edge areas: Micro- & nanoelectronics, Printed electronics, Power electronics, Photonics, Antenna, microwave and terahertz, Sensors, Embedded systems, Construction method, Reliability, and Advanced production technology.

Optopubs

OptopuOptopubs are seminars series where we normally invite 2 speakers, one academic presentation and one industrial application presentation, followed by food & beer. The Optopubs are very appreciated, since it's a way of networking and meet old and new friends. Optopubs are also arranged by visiting companies. Optopubs are arranged in Stockholm, Gothenburg, Lund and Hudiksvall. Participation varies between 25-70 people. Lennart is responsible for Optopubs in Stockholm, where most Optopubs have been arranged (6-8/year) through financial support from ADOPT (Advanced Optics and Photonics) by Prof. Gunnar Björk at Dept. of Applied Physics at KTH. Lennart has arranged Optopubs for more than 20 years.



2013-04-29 *Lennart BM Svensson, Petra Bindig, and Ari Friberg at Photonics21 AM in Brussels*

2013-04-29 *Henrik Ludwigs, Petra Bindig, and Pierre-Yves Fonjallaz at Photonics21 AM in Brussels*

Photo from 1st Nordic Photonics Forum 2017-05-28 in Oulu the day before OPD2017.

> Interesting was at this time the majority of the Finnish speakers gave their presentations in Finnish, and not as we did in English. We had no clue what they were saying and could only guess from the slides.

2015-05-28 *Lennart BM Svensson and Juha Purmonen at Photonics21 Annual Meeting in Brussels*

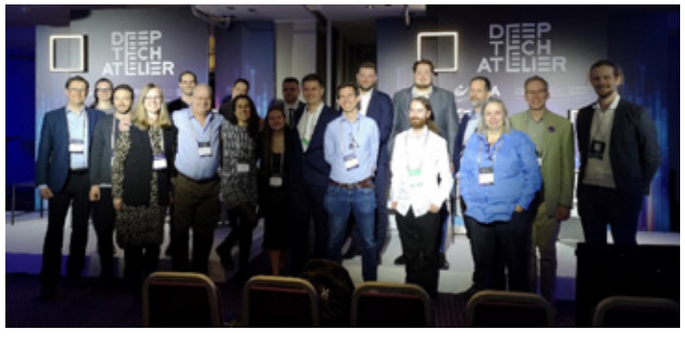


Photo from Nordic Photonics Forum 2023-04-21 at NOP-2023 in Riga, Latvia.

Nordic Photonics Forum

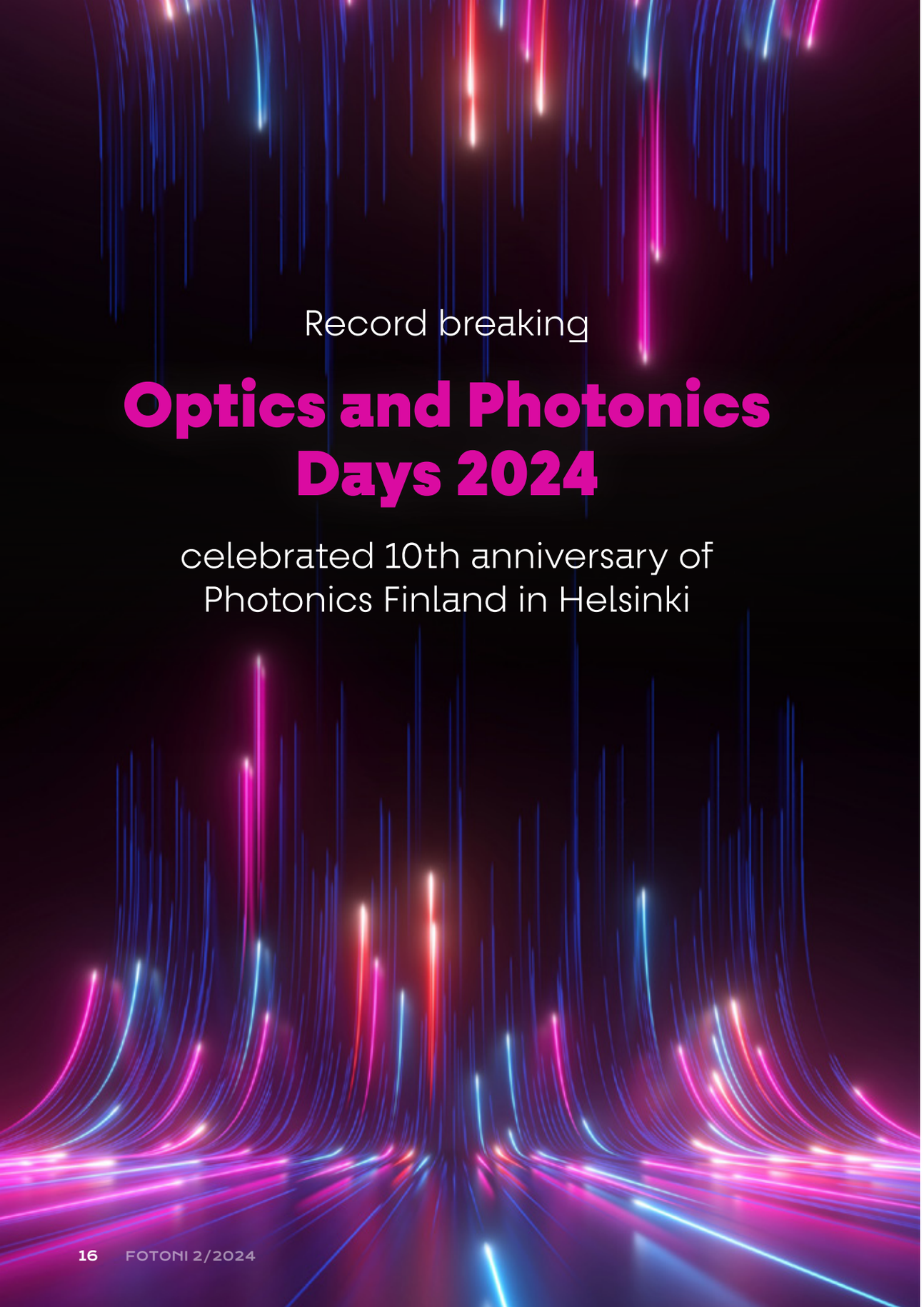
Photonics Finland, which started 1 February 2012, had Juha Laiho appointed as Chief Coordinating Officer of Photonics Finland at Optoelectronics Research Centre, Tampere University of Technology. Juha Laiho contacted PhotonicSweden for a meeting to discuss how we handled both organizations SOS and PhotonicSweden. The meeting took place in Kista, Sweden, between Juha Laiho, Pierre-Yves Fonjalaz, and Lennart BM Svensson.

Lennart was then invited by Juha Laiho (PF) and Lasse Orsila, Chairman of Finnish Optical Society (FOS), at a meeting held 8 October 2013 at Helsinki-Vantaa Airport. There were 10 people present, all but one of the boards of Finnish Optical Society (FOS) and 3 active Photonics Finland (PF) people, Jyrki Saarinen and Juha Purmonen included. The agenda was that they wanted to hear about our firsthand experience on how the SOS and Photonics Sweden were merged and what kind of benefits this resulted in. In Finland, there was the Finnish Optical Society (FOS) that mainly was an academic society, and Photonics Finland (FP) an industry driven organization. The discussion was about merging these into one, and different forms of co-operation or level of merger. In 2014 Finnish Optical Society (FOS) merged into Photonics Finland (Suomen fotoniikan seura ry), with companies, universities and individuals all together..

Lennart and Henrik Ludwigs (SAAB AB) participated in Photonics Finland's OPD in Tammerfors 14 June 2013, where Lennart presented PhotonicSweden's activities and Henrik presented SAAB's military projects and business with Finnish military. Interesting was at this time the majority of the Finnish speakers gave their presentations in Finnish, and not as we did in English. We had no clue what they were saying and could only guess from the slides. But that was about to change.

Today PhotonicSweden and Photonics Finland have a strong collaboration. We visit each others conferences and participate in the Nordic Photonics Forum, but also take part in our common EU-projects.

Lennart B. M. Svensson *received his PhD degree 1988 in Industrial Metrology at KTH in Stockholm. He has a background in holography and laser measurement technologies. He started his first company 1986 as an optronics consultant. Lennarts experiences are from industrial R&D and manufacturing at CelsiusTech AB, SaabTech AB, Linus AB, FLIR AB, and Mycronic AB. Has promoted photonics within Vinnova's strategic innovation program "Smarter Electronic Systems" for increasing competitiveness and growth in Swedish industry. He is co-founder of PhotonicSweden started in 2011, and responsible for industrial applications and exhibitions at yearly conferences Optics & Photonics in Sweden together with his colleague Petra Bindig. In 2017 he started Nordic Photonics Forum (NPF) during OPD2017 in Oulu in collaboration with Juha Purmonen at Photonics Finland, and has arranged 17 NFP-meetings during conferences in Sweden, Finland, Latvia, and Belgium. Since 2011 he has participated in 13 EU-funded photonics projects.*



Optics and Photonics Days 2024 (OPD2024) was organized at Scandic Marina Congress Center in Helsinki from 28th to 30th May, to celebrate 10th Anniversary of Photonic Finland. The event collected record-breaking numbers: 438 participants, and 45 exhibitors from Europe, US, and Japan. Following the tradition of OPD format, excellent parallel Academic and Industrial programs were experienced and poster sessions with 80 posters explored. In addition, the program included a student event by Aalto University Optica Student Chapter hosted by Suvi-Tuuli Akkanen, a Job fair, a Matchmaking event by the European Enterprise Network of Finland, the Photonics Flagship (PREIN) Annual Event including a video greeting from the Ministry of Education & Culture, by minister Sari Multala. As a new encounter The Nordic and Baltic Photonics Forums and representatives of Business France met to promote collaboration between the Nordic & Baltic countries and France in photonics research and innovation. During the day following the official program a delegation visit for foreign participants to VTT facilities MIKES and Micronova as well as to AR company Dispelix Oy was organized.

During the 10th anniversary jubileum dinner several high-lights were brought up. The anniversary speech was given by the first Chairman of the Photonics Finland board, Professor Jyrki Saarinen from the Centre for Photonics Sciences (UEF) & PREIN – Photonics Research and Innovation Flagship. The audience could learn how Photonics Finland had evolved from the former Photonics and Optics Society of Finland (Suomen Fotoniikan ja Optiikan Seura) by merging Finnish photonics and related companies into this early, mostly academically oriented, 1996 founded optical society. Professor Saarinen's contribution in the transformation process was fundamental. He could proudly announce that the development of the Society since its foundation has been remarkable, featuring now over 250 academic individual members and 129 company and institutional members. Photonics companies and companies making use of photonics in Finland today make more than two-billion-euro annual turnover, demonstrate an annual growth of between 15 to 20% and employ directly or indirectly some 6000 employers. Another significant milestone was mentioned, the 10th year anniversary edition of Photonics Finland newsletter FOTONI, where Editor-in-Chief Jouko Korppi-Tommola (his 25th edition) had written a fantastic article on the history of Photonics Finland. The jubileum edition was released as web version during the OPD and is freely available on Photonics Finland web pages. Later on the printed version was mailed to all members of the Society.

The anniversary dinner included announcements of Society Prizes, the Photonics company of the year, the best doctoral thesis of 2023, best presentation and best poster prices of the Days.

We continue to push growth with new innovations in the Photonics sector.

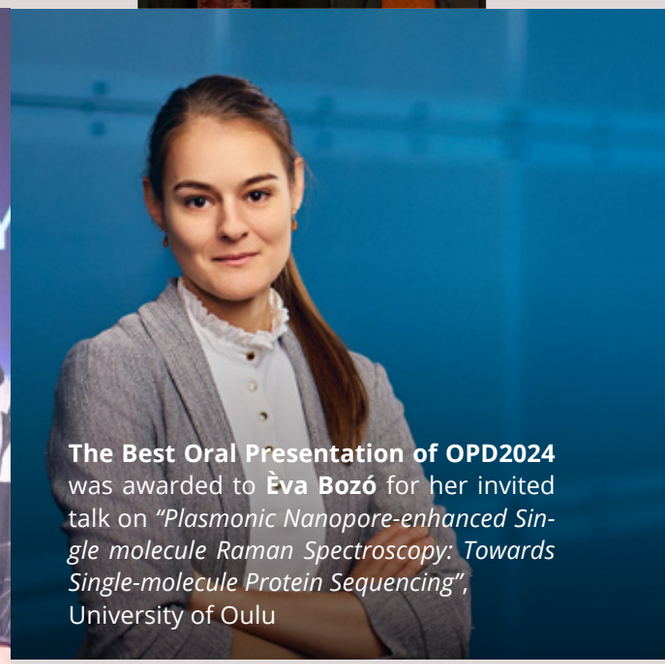
Hannu Talvitie,
Technology Strategy Director,
Vaisala

Photonics Finland awarded **Photonics Company of the Year prize to Vaisala Oy** for their pioneering work of merging photonics in their weather and industrial instrumentation. Vaisala is renowned for its innovative Photonics-based products that make up a substantial proportion of their portfolio and is a global leader in measurement instruments and intelligence. With over 2300 staff and almost a century of experience, Vaisala has a strong global presence and the ability to meet diverse customer needs in various markets.

"I want to thank Photonics Finland for this great and unexpected honor. We have been developing world leading optical and photonics instruments since the 1980´s, utilizing, e.g. diode laser LIDAR technologies, infrared absorption spectroscopy, and proprietary optical MEMS components to achieve the best performing products. I want to thank our great technology and R&D teams and well as research partners for making all that happen. We continue to push growth with new innovations in the Photonics sector", said **Hannu Talvitie**, Technology Strategy Director from Vaisala after receiving the prize. (see separate article about Vaisala Oy activities on the page 24.)

The best Doctoral Thesis of the year 2023 was awarded to **Markus Hiekkamäki** from Tampere University. His thesis topic was *"Quantum Interference in Transverse Spatial Modes of Photons"*.

See separate article about the Thesis on the page 30



The Best Oral Presentation of OPD2024 was awarded to **Èva Bozó** for her invited talk on *"Plasmonic Nanopore-enhanced Single molecule Raman Spectroscopy: Towards Single-molecule Protein Sequencing"*, University of Oulu

The Best Poster Awards of OPD2024 were given to: **Jokotadeola Odutola** (middle) *"Photo-generated carrier dynamics of N-doped graphene-based photo electrocatalysts for solar-to-chemical energy conversion,"* Tampere University.

and **Sami Vesamäki** (left) *"Optical Sensing Enabled by Azobenzene Isomerisation Kinetics"*, Tampere University.

The Plenary Talks focussed on the development of future technologies on high-performance optical communication systems and military optronics. Professor **Sara Ducci** from Université Paris Cité and the Research Unit Matériaux et Phénomènes Quantiques (UPCIté/CNRS) described the work of their group on fundamental quantum optics in view of practical applications in quantum information technology, in particular, on miniaturized semiconductor sources for creation of quantum light states and their use in device development. Dr. **Jean-Luc Beylat**, Head of Ecosystem, Nokia Corporation, Head of Strategy & Technology including Nokia Bel Lab activities in France, described R&D partnerships in developing future optical communication ecosystems together with academic partnerships. Professor **Victor Torres-Company**, Professor, Chalmers University of Technology, Sweden, described their pioneering work on the development of efficient chip-scale microcombs for high-performance optical communication systems. Their groundbreaking work on optical microcombs has led to record-breaking transmission speeds exceeding one petabit per second. Dr. **Jussi Rautiainen**, CTO, Senop Oy (Photonics Company of the Year), Jyväskylä, Finland, explained their mission to enable reliable situational awareness by modern imaging systems (ground based and air borne) to increase power and accuracy (time&space) of military operations. The company accomplishes their mission by developing high quality military optronics, control-centre integrations and reliable communication equipment, to ensure operability in the severe conditions of the battlefield.

The Academic Session offered 16 invited talks focussing on: fluorophore bound nanowire biosensors (**Antttu**, ÅA), plasmon-enhanced up-conversion for exosome detection (**Duc Le**, OU), diamond nanoneedles as theragnostics agents (**Quarshie**, UEF), quantum light fields at electromagnetic time interface (**Mirmoosa**, UEF), single molecule Raman spectroscopy towards protein sequencing (**Bozo**, OU), Fourier-transform rotational Doppler spectroscopy (**Larnimaa**, HU), ALD deposited erbium oxide on Si solar cells (**Radfar**, Aalto), no-loss plasmonic metasurfaces (**Kolkowski**, Aalto), cross talk in arrayed waveguides (**Hilden**, Aalto) , second harmonic generation of metasurfaces in multipass cells (**Mekhael**, TaU) , modified natural photochromic materials for sensing (**Vuori**, TuU), spatio-spectral vector beams (**Kopf**, TaU), epsilon-near-zero micro cavities (**Panahpour**, TaU), properties of defect tailored 2D materials (**Akkanen**, Aalto), mode-locked quantum well-lasers (**Quashef**, TaU) and slized nanobeam resonators at mK temperatures (**Kanniainen**, JU). An overall message from the presentations is clear, in advanced photonics applications nanofabrication has become the enabling technology be it optical sensing, medical treatment, quantum phenomena, optical microcircuits, solar efficiency, single particle, single molecule detection etc.... Another observation seems plausible, our fundamental photonics research is internationally competitive, and academic supervision is in good hands. Thanks belongs also to Academy of Finland for launching the flagship program PREIN, a positive sign of institutional understanding that our growing photonics industry does not continue to flourish without continued governmental support on fundamental research in the field. Very good investment of taxpayer's money in-light-of emerging new technologies in the societies, like artificial intelligence and quantum computing where photonics plays a fundamental role.

Helsinki City reception at the city hall for the OPD2024 participants

Company pitching

Professor Jyrki Saarinen delivering the 10 year jubileum talk.

Virtual reality was strongly visible during the days

The Industrial Session included four themes: Photonics & Semiconductors, Photonics for Agri-Food, Photonics for Industrial Spectroscopy and Photonics for Circular Economy. In total 16 presentations were heard. The sessions gave a glimpse on how photonics innovations in Finland have turned and operate in the photonics market and how these companies have contributed from their part to the total annual turnover of the Finnish photonics companies of more than 2 billion€. Note also the diversity of the markets, where these companies have to be competitive, semiconductor industry, communication industry, trafficking, medical instrumentation, agri-food, industrial and environmental monitor and circular economy. It becomes clear that Photonics is an enabling technology and hence often not understood as one of key technologies in future societies. Just to give a flavour of the presentations only snapshots are given here. Full abstracts can be found in the OPD2024 web pages.

Juha Kokkonen, *CEO Canatu Oy*, described the innovation of removing 'derbis' in EUV litography using their carbon nanotube 'pellicles' in pursuit to reach 3nm writing resolution in advanced chip production. Dr. **Altti Torkkeli**, *Fellow R&D, Murata Electronics Oy*, highlighted practical examples of photonics in semiconductor/MEMS manufacture and presented key points of the Finnish national semiconductor strategy. **Roosa Mäkitalo**, *Project Manager -AR, Optofidelity* presented their innovation of determining defects in optical waveguides by using Littrow configuration to measure diffraction grating pitch and orientation at unprecedented accuracy. Prof. **James Watkins**, *University of Massachusetts Amherst* described how to fabricate all-inorganic high refractive index optics via nanoimprint with TiO2 particle dispersions with superior mechanical and optical stability. **Alexey Shapiguzov**, *Senior Scientist, LUKE – Natural resources institute Finland*, discussed how to make use of chlorophyll fluorescence imaging in monitoring photosynthetic species in our environment, both on land and seas. **Harri Salo**, *CTO, KxS Technologies Oy* reminded us of the usefulness of use of process refractometers in food, pharma, semiconductor, pulp&paper, and chemical industries. **Kim Grundström**, *Witec GmbH / Kimmy Photonics Oy*, presented the benefits of confocal Raman spectroscopy, a label free imaging technology, in food and packaging industries. **Dr. Mikko Tikkanen**, *University of Turku / Versa Elements Oy*, addressed the emerging market in monitoring and controlling diode driven light levels and energy consumption in commercial indoor plant growth environments by monitoring CO_2 and volatile plant hydrocarbons and making use artificial intelligence. **Janne Paaso**, *Technology Manager, Quality Management Solutions R&D, Valmet Automation*, described how their new on-line reflection (RSM) and transmission (TSM) spectrometers working in the near-infrared spectral region give reliable data on plastics&binders and cellulose, water and binder weights, respectively, in

Just to give a flavour of the presentations only snapshots are given here. Full abstracts can be found in the OPD2024 web pages.

OPD2024 conference dinner at Scandic Marina Hotel

Prof. Sara Ducci rom Université Paris Cité and the Research Unit Matériaux et Phénomènes Quantiques (UPCIté/CNRS) presenting her plenary talk

manufacture of plastic containing packaging, special papers and nonwovens. **Vineeth Karuppasamy**, *Senior Research & Development Engineer, Timegate Instruments*, presented new unseen background fluorescence reduction obtained by their newly developed PicoRaman near-infrared 775 nm excitation instrument. The company has used a new mode-locked near-infrared excitation source and a CMOS SPAD detector to achieve the improved performance in time gated detection. **Dr. Philippe Monnoyer**, *Customer Account Lead, Hyperspectral Imaging and Microelectronics, VTT Ltd*, described their efforts in developing ultra-low cost, high performance and fully programmable hyperspectral cameras by making use of their MEMS Fabry-Perot interferometer for use in everyday life. **Dr. Toni Laurila**, *CEO, Sensmet Oy*, showed how their microdischarge optical emission spectrometer can be used in real-time monitor of battery metals and their impurities in hydrometallurgical processes, much needed technology for recovering precious metals from recycled automotive batteries. **Dr. Arto Aho**, *Winse Power Oy*, described a small size light-based power transfer concept immune to electromagnetic interference particularly suitable for use to transfer power and data in high-voltage environments. **Dr. Julius Lawson Daku**, *CEO, optoPartner*, presented their AI based visual inspection system SpotteurR which has shown promise in reducing losses in mass production industries such as agri-food industries. **Dr Faisal Ahmed**, *Agate Sensors R2B project*, promised to revolutionize hyperspectral imaging technology by making use of recently demonstrated miniaturized spectrometer powered by AI based reconstruction algorithm and offering the concept to our everyday life monitoring.

With the above summary of recent developments of photonics in fundamental research and of company advancements in mind, experienced from OPD2024, Photonics Finland is thrilled to announce that the next OPD – OPD2025 will be held in Oulu! Let's meet there and continue to advance the field of photonics together!

November 14th, 2024

Jouko Korppi-Tommola

Tuukka Pakarinen

VAISALA

Vaisala's ceilometer lidar for measuring cloud height and vertical visibility.

Photonics company of the year 2023

Vaisala, a Finnish company founded in 1936 by Professor Vilho Väisälä, has a rich history of innovation in environmental and industrial measurement. The company's journey began with the invention of the radiosonde, a device used to measure atmospheric parameters and transmit them to a ground receiver. This invention laid the foundation for Vaisala's future success and established its reputation as a leader in meteorological instruments.

From its humble beginnings in the basement of a residential building in Helsinki, Vaisala has grown into a global company with over 2,400 employees and operates in more than 150 countries with technology on two planets.

Photonics at Vaisala

The company's commitment to innovation and quality has driven its expansion into various fields, including photonics and optical technologies. Vaisala's first products using photonics technologies were cloud height lidar (i.e. ceilometer) and visibility instruments aimed at airports and aviation safety, developed in the mid-1980s.

Nowadays photonics technologies play a critical role in Vaisala's products. We have more than 20 different product families that use photonics and optics technologies. These technologies account for over 25% of Vaisala's total sales.

Vaisala has developed a range of advanced optical measurement technologies. Many of them utilize light scattering from aerosols or particles, like various atmospheric lidars, visibility and present weather sensors as well as particle monitors. These products are used for several weather applications supporting weather forecasting, safe transportation and air quality monitoring. On the other hand, Vaisala has also developed a range of spectroscopy-based technologies for infrared gas sensing in industrial processes and environmental applications.

Photonics remains central to Vaisala's innovation and product development. What is really special for us is how to develop photonics products that provide continuous, reliable and accurate measurement data even in the harshest ambient or process environments with minimal or no maintenance. That requires special skills and experience in product development as well as comprehensive product testing.

Infrared gas sensors

Vaisala's infrared gas sensors work by measuring how different gas molecules, like carbon dioxide (CO_2) and methane (CH_4), absorb at specific wavelengths of infrared light. By analyzing these absorption patterns, they can precisely determine gas concentrations.

Vaisala's CARBOCAP® technology is a major innovation in infrared gas measurement. It uses a silicon micro-machined (MEMS) Fabry-Pérot Interferometer (FPI) that allows for accurate multi-wavelength readings, offering long-term stability and low maintenance.

Besides carbon dioxide (CO_2), these sensors can measure e.g. methane (CH_4) and other hydrocarbons, water vapor. They are used in many applications across different industries: they monitor indoor air quality in building automation, ensure safety and quality in industrial processes, control fermentation in the food industry, track greenhouse gas emissions for environmental monitoring, and support CO_2 measurement in life sciences research.

> In industrial applications, Vaisala's solutions are essential for building automation, particularly in HVAC monitoring and control.

Atmospheric lidars (Light Detection and Ranging)

Lidar technology is used in meteorology, aviation, and environmental monitoring to measure wind speed, cloud height, and atmospheric conditions.

Vaisala's ceilometers are lidars designed to measure cloud height and vertical visibility. Using pulsed diode laser lidar technology, they can detect up to three cloud layers at once, with a range of up to 15 kilometers. The ceilometer is particularly useful in aviation and meteorology, even in challenging conditions like precipitation or low clouds. The higher end model takes things further with depolarization technology. It measures not only cloud height but also aerosol layers and boundary structures. By distinguishing between liquid and solid particles, e.g. liquid and ice crystals or particles and volcanic ash, it improves weather forecasts, air quality monitoring, and climate research.

Vaisala's wind lidar products specialize in wind energy. These lidars measure wind speed and direction at multiple heights utilizing heterodyne detection of Doppler shift from aerosol scattering. The basic models measure wind profiles up to 300 meters while the more advanced models measure even up to 16 kilometers. Accurate vertical profiling helps wind farm developers find the best locations and optimize turbine performance, maximizing energy output.

Vaisala´s latest lidar technology, Differential Absorption Lidar (DIAL), combines the lidar principle with spectroscopic analysis. The DIAL provides continuous monitoring of water vapor in the atmosphere, offering real-time humidity profiles up to 4 kilometers high. This data is critical for understanding moisture patterns, improving weather forecasting, and issuing early warnings for severe weather like thunderstorms and flash floods.

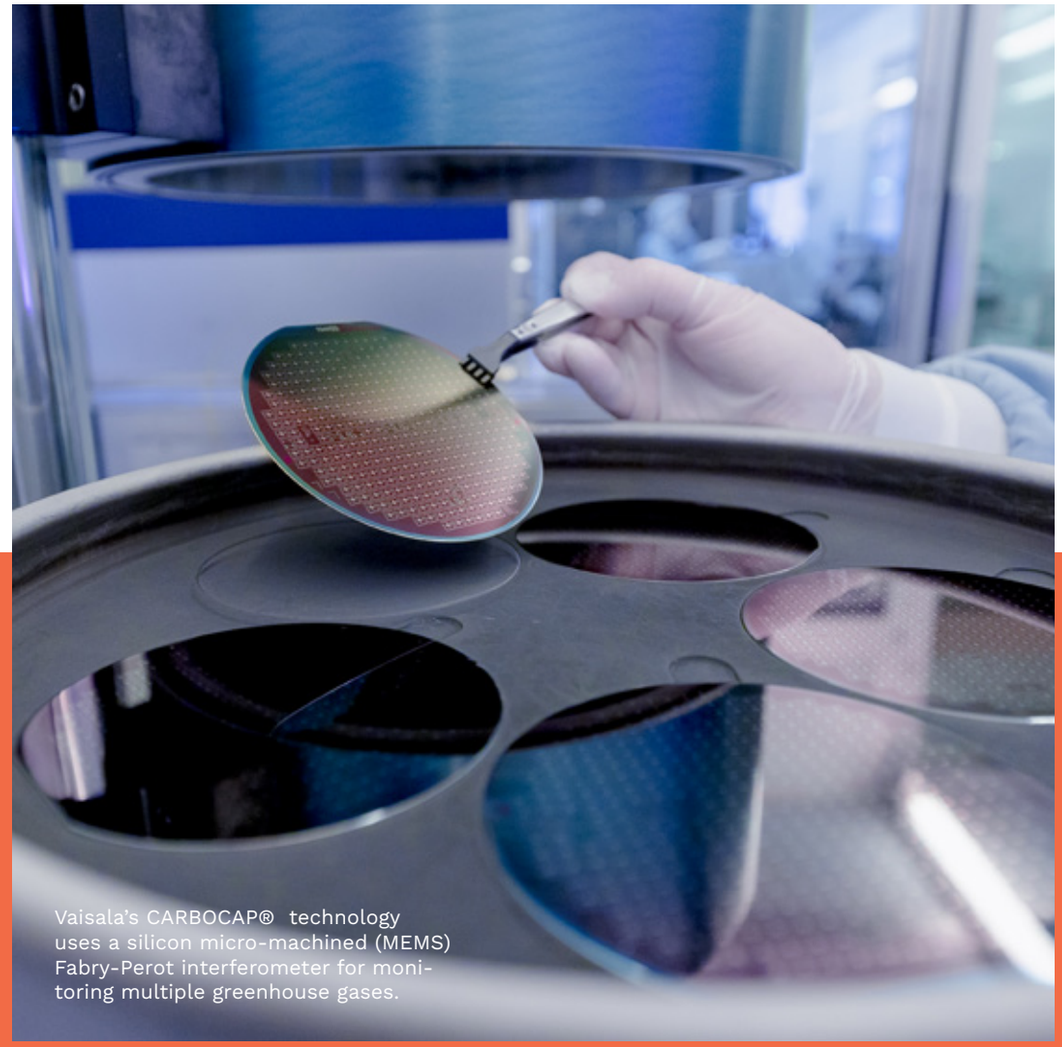
Industries in need of photonics technology

The primary industries that rely on Vaisala's technologies include meteorology, aviation, renewable energy, road safety, winter road maintenance, and air quality monitoring.

In industrial applications, Vaisala's solutions are essential for building automation, particularly in HVAC monitoring and control. In life sciences, our products are used in incubators to monitor CO_2 levels.

The power industry uses Vaisala's sensors to monitor transformers, while biogas monitoring is another growing application.

On top of that, our optical refractometer products support a wide range of industries that involve liquid processes, such as pulp and paper, food and beverage manufacturing, as well as semiconductor industries.



Vaisala's CARBOCAP® technology uses a silicon micro-machined (MEMS) Fabry-Perot interferometer for monitoring multiple greenhouse gases.

> We help businesses monitor environmental impacts and support industries in reducing their carbon footprints, making them a crucial tool in the fight for a more sustainable future.

How photonics technologies help us in fighting climate change

Photonics technologies are playing a direct role in Vaisala's efforts to enable climate action for its customers. One of the most significant applications is in the measurement of greenhouse gases, such as CO_2 and methane, which are major contributors to global warming. Vaisala's gas sensors help monitor emissions from various industrial processes, as well as in innovative areas like biogas production and carbon capture, utilization and storage (CCUS).

Photonics also contributes to energy efficiency in buildings, where Vaisala's CO_2 sensors are used to optimize ventilation, reducing energy consumption, and, as a result, CO_2 emissions. Moreover, in the renewable energy sector, Vaisala's wind lidars are critical for the assessment and optimization of wind farms, which are key to reducing reliance on fossil fuels.

We help businesses monitor environmental impacts and support industries in reducing their carbon footprints, making them a crucial tool in the fight for a more sustainable future.

Conclusion

Photonics technologies are integral to Vaisala's success, supporting a wide range of products and industries with precise and reliable measurements. From gas sensors used in industrial applications to lidars for environmental monitoring, photonics enables Vaisala to remain a leader in technological innovation.

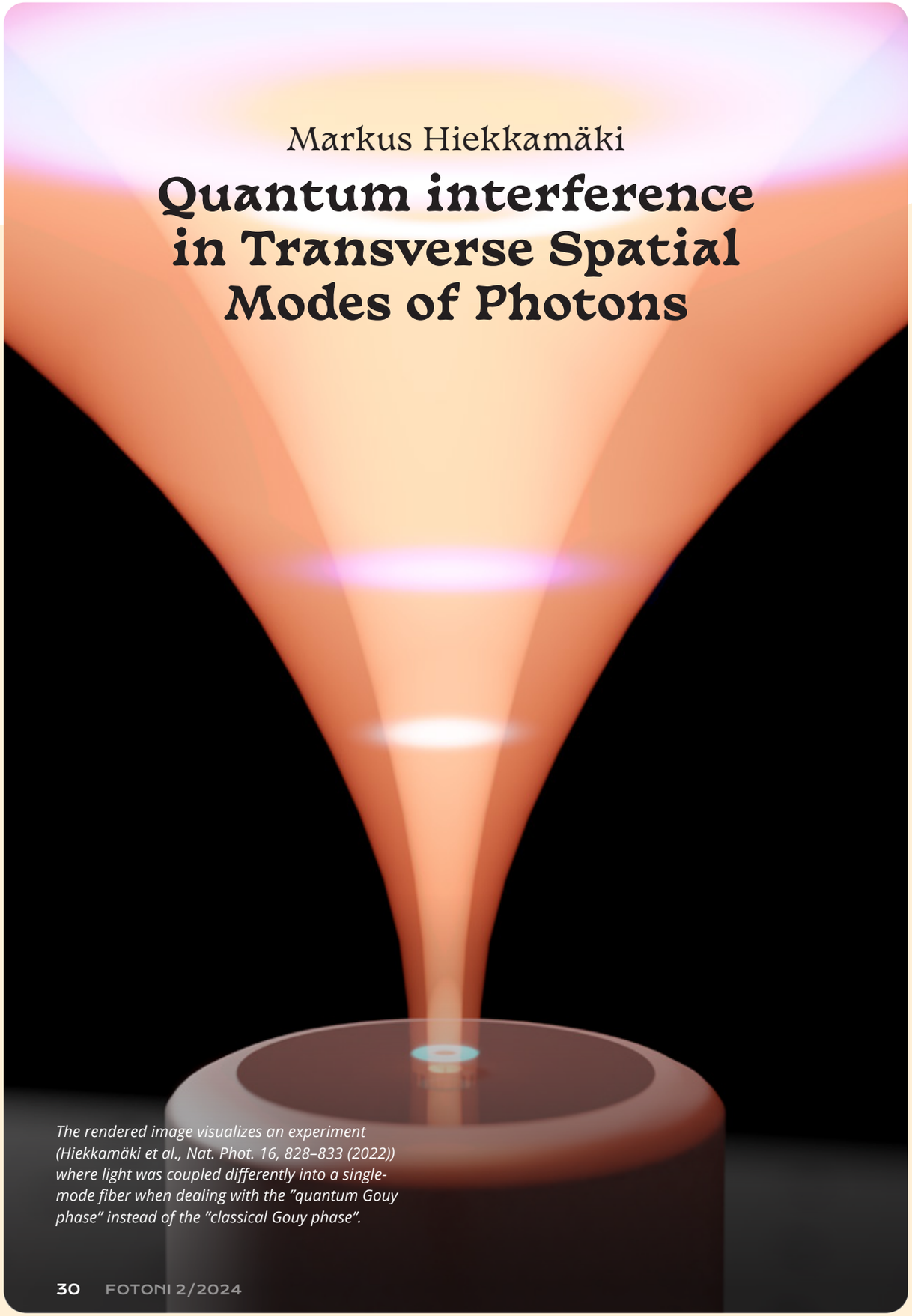
We will continue to innovate and make breakthrough products using photonics technologies. Connected to some of the biggest changes in the world, our technology enables shifting to cleaner energy, optimizing use of resources, and enhancing health, safety, and well-being.

Hannu Talvitie,
Vaisala Oy

Growth technology strategist Hannu Talvitie showing Vaisala's MPG241 multigas CO2 instrument for carbon capture.

Markus Hiekkamäki

Quantum interference in Transverse Spatial Modes of Photons



The rendered image visualizes an experiment (Hiekkamäki et al., Nat. Phot. 16, 828–833 (2022)) where light was coupled differently into a single-mode fiber when dealing with the "quantum Gouy phase" instead of the "classical Gouy phase".

> ...the research field of quantum optics has grown significantly, bringing more experimental and theoretical knowledge of the quantum mechanical behaviour of light and developing techniques for controlling and measuring light on a quantum level.

During the course of scientific development, many levels of abstraction for the theoretical description of light have been produced. These different theoretical models are useful in different scenarios; for example the description of light as rays in imaging system design or the usage of paraxial wave equations and Fourier optics when it comes to the description of some systems involving laser beams. That is to say that for most of the modern devices and applications utilizing or interacting with light, it is not necessary to involve the quantum nature of light into our models to describe its behaviour. In the recent decades however, some new potential applications directly harnessing the quantum nature of light have emerged. Hence, during the same recent decades, the research field of quantum optics has grown significantly, bringing more experimental and theoretical knowledge of the quantum mechanical behaviour of light and developing techniques for controlling and measuring light on a quantum level.

The most well known of these quantum technologies are quantum computing and quantum cryptography. Out of these two technologies, in quantum computing, it is not clear what physical system is the best carrier of quantum information. However, in quantum cryptography photons have become the quantum information carrier of choice due to their robustness, speed, and also the pre-existing infrastructure that could be utilized. Besides the two usual suspects for quantum technologies, other subsections of potential technological applications exist for quantum states of light. One common example is quantum sensing where the quantum properties of light are utilized in measuring physical properties with sensitivities that are not achievable with classical light states. The most prominent example of this being the so-called "squeezed light" utilized in the LIGO detectors.

One phenomenon, that is important in many proposed implementations of quantum computing, cryptography, and sensing, is quantum interference where multiple photons interfere with each other. In contrast to the "classical" interference of light, which can be described using classical electromagnetism, in quantum interference the quantized bosonic nature of multiple photons needs to be included into the description to fully understand the physical process. The most famous of such quantum interference effects is the so-called Hong-Ou-Mandel (HOM) effect where two indistinguishable photons brought to the two "entrance ports" of a beamsplitter always exit the beampslitter together, effectively bunching together as they exit. This interference phenomenon is also visualized in figure 1 a).

In the famous HOM effect, the quan-

tum interference occurs in the photon paths or propagation directions. However, the quantum interference itself can occur in any degree of freedom of the photons. For example, it has previously been investigated in polarization, waveguide modes, vector beams, and frequency. In my doctoral dissertation we investigated this effect in the free-space transverse-spatial degree of freedom with the help of a recently developed method called multi-plane light conversion (MPLC). By the transverse-spatial degree of freedom, I refer to the spatially varying amplitude and phase structure of a spatially coherent paraxial beam of light. Four examples of such structures can be seen in figure 1 b) where a cross section of a beam is shown. In the images, the brightness of the field refers to the amplitude and the colors refer to the relative phases in the different parts of the transverse structure. Although the images show many different colors via the colormap, the fields studied in my thesis were effectively monochromatic.

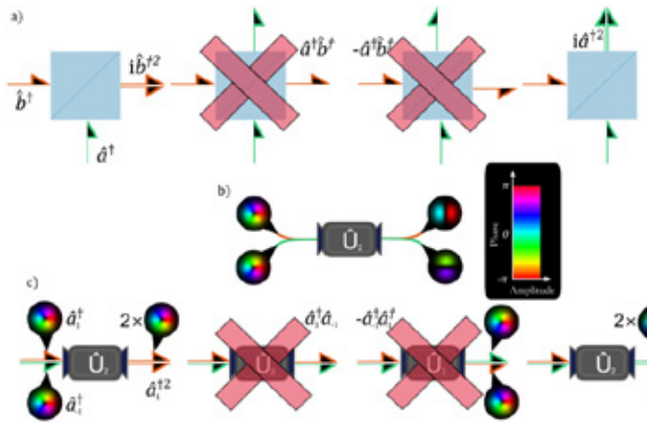


Figure 1. *a) represents the HOM interference pictorially, where two photons entering a beamsplitter, exit together. b) shows how a device that does the same "beamsplitter" operation for transverse-spatial modes. c) shows how this bunching effect would occur in the device shown in b).*

In order to facilitate quantum interference in the transverse-spatial degree of freedom, in my thesis we effectively used MPLC to build a beamsplitter for transverse-spatial modes. This concept is also shown in figure 1 b) and c). Since a beamsplitter effectively takes each photon to a superposition of two paths, we just needed the MPLC device to take two photons into orthogonal superpositions of two transverse-spatial modes. With such a device we were then able to demonstrate quantum interference in the transverse-spatial degree of freedom. The MPLC device was implemented using spatially varying phase delays on a spatial light modulator (SLM) as is visualized in figure 2.

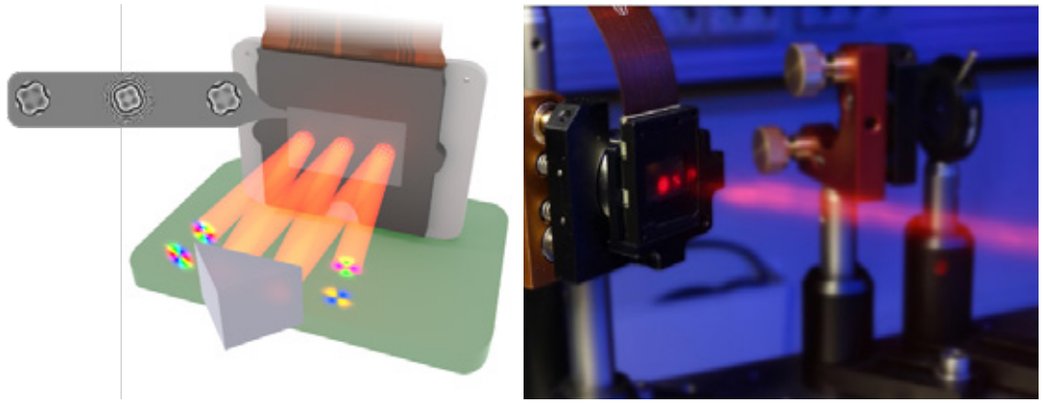


Figure 2. *A render of an MPLC system on the left where an SLM with 3 phase modulation screens is used to modulate an incoming light field. The modulations occur by reflecting the light beam three times at different sections of the SLM. The long exposure photo taken with a laser, on the right, gives an idea of how this looks like in the lab.*

Using the MPLC device we were able to additionally demonstrate different higher-dimensional quantum interference effects more of which can be found in the publication (Hiekkamäki & Fickler, Phys. Rev. Lett. 126, 123601 (2021)). In addition to this, being able to control this interference allowed us to investigate how the properties of transverse spatial modes could be harnessed in quantum sensing applications using this quantum interference (Hiekkamäki et al., Phys. Rev. Lett. 127, 263601 (2021)). Finally, these methods also opened the opportunity for us to investigate how a fundamental property of light called the Gouy phase behaves differently in quantum states of light (Hiekkamäki et al., Nat. Phot. 16, 828–833 (2022)).

Finally I would like to thank Photonics Finland for awarding my thesis as the best optics thesis of 2023. Additionally, I need to give credit to the people who helped me in the work performed during my thesis work and from whom I learnt a lot during the process. This includes the past and present members of the Experimental Quantum Optics team in Tampere University, the Team of Joel Carpenter at the University of Queensland, and our collaborators and co-authors.

Markus Hiekkamäki

Janne Ihalainen 1), Ole Franz 1), Heikki Häkkänen 1),
Kati Heikkilä-Huhta 2) ja Riitta Nissinen 1,3)

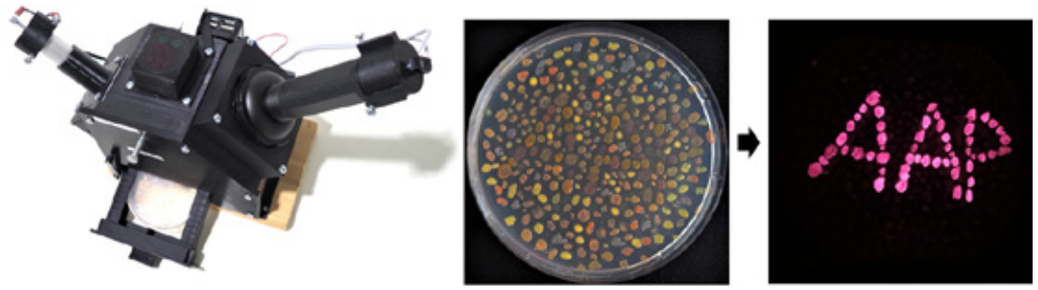
Missä tiede, taide ja koulutus kohtaavat

– 3D-tulostettava NIR-fluoresenssiin perustuva mikrobien kuvantamislaite ”NIRis”

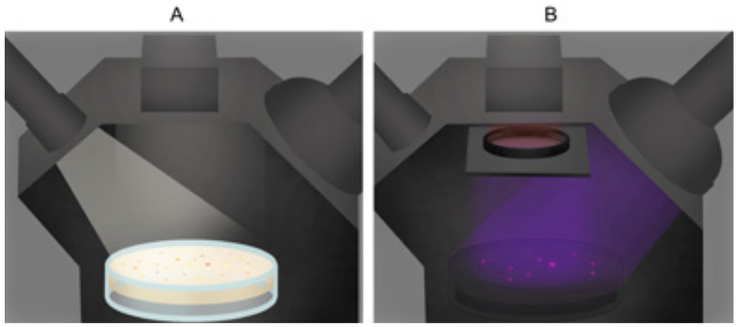
KONE säätiön rahoittama Jaettu valo – valon biologia ja pohjoisen muuttuvat ekosysteemit - on Jyväskylän yliopiston bio- ja ympäristötieteiden laitoksen monialainen tutkimusprojekti, joka pyrkii ymmärtämään kasveissa elävien valoa hyödyntävien bakteerien roolia luonnossa. Suomen kasvikartoituksen lisäksi projektissa on kerätty kasviassosioituneita bakteereita myös Huippuvuorilta, Grönlannista, Patagoniasta ja Antarktikselta. Projektissamme AAP bakteereita on löytynyt kaikista kasvillisuusvyöhykkeistä ja kokoelmissamme on noin 1000 eri bakteerin bakteerikantakokoelma. Vastaavia AAP bakteereita on löydetty tätä ennen lähtökohtaisesti vain vesiympäristöistä. Niiden mahdollinen vuorovaikutus isäntäorganismin kanssa on vielä hämärän peitossa.

1) Nanotiedekeskus, Bio- ja ympäristötieteiden laitos, Jyväskylän Yliopisto
2) Oulun Steinerkoulu
3) Biologian laitos, Turun Yliopisto

Optiikan ja fotoniikan koulutus lukioissa on näinä päivinä melko vähäistä. Näiden taitojen yhdistäminen muihin luonnontieteisiin, kuten biologiaan, on lähes olematonta. Vuonna 2020 aloitimme Jyväskylän yliopistossa projektin (Jaettu Valo – pohjoisen ekosysteemit), jossa etsimme luonnosta kasvien mikrobipopulaatioista bakteerikantoja, jotka pystyivät bakteereille ominaiseen happea tuottamattomaan fotosynteesiin (englanniksi Aerobic anoxygenic photosynthetic bacteria, AAP). AAP bakteerien tunnistus perustuu bakteeriklorofylleille ominaiseen NIR-alueen fluoresenssiin. Laite tuli olla helppokäyttöinen ja huokea. Syntyi 3D-tulostettava petrimaljojen kuvantamislaite “NIRis” (Kuva 1). Bakteeriklorofyllit viritetään UV valolla, jossa tarpeeksi suuri ja tehokas valokeila saadaan aikaiseksi 128 LED´n avulla. NIR fluoresenssi suodatetaan NIR pitkäpäästösuotimella ja kuvantaminen suoritetaan Rasberry Pi ohjattavalla kameralla, ilman niin kutsuttua ”lämpöfiltteriä” (Kuva 2). Petrimaljan bakteeripesäkkeistä otetaan myös valkoisen valon heijastuskuva. Valkoisen valon ja NIR-fluoresenssin kuvat yhdistetään analyysissä, mikä mahdollistaa nopean ja tarkan valoaktivoituvien bakteerien seulonnan laajasta mikrobijoukosta[1].

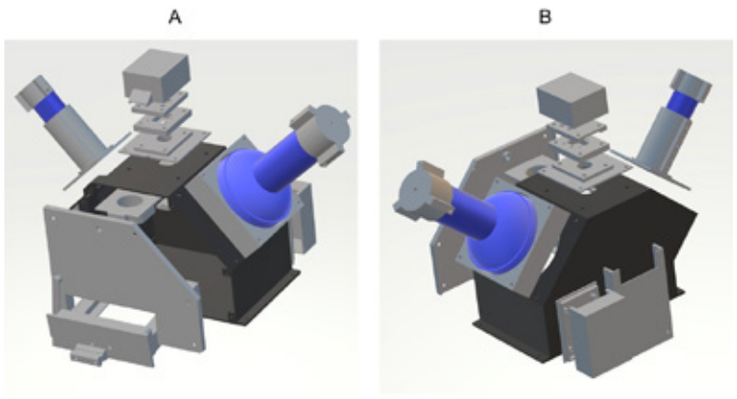


Kuva 1. *NIRis laite ja kuvattava kohde. Vasemmalta: NIRis laite, heijastuskuva bakteeripesäkkeistä ja sama petrimalja UV-viritteisellä NIR-fluoresenssi kuvantamisella. Bakteeripesäkkeet, joissa on bakteeriklorofyllia fluoresoivat NIR-aallonpituudella.*



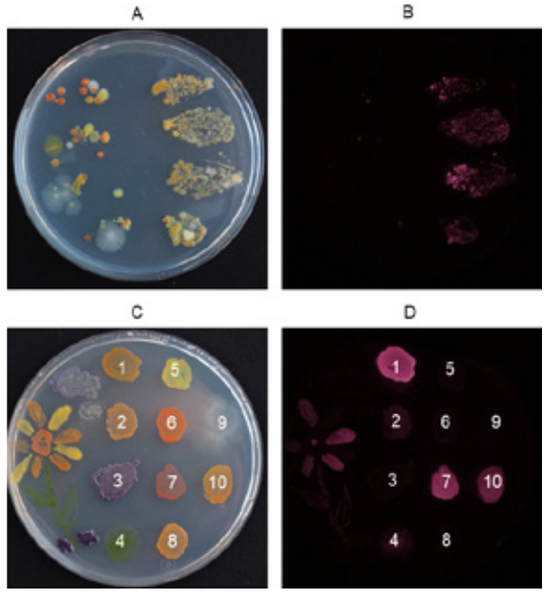
Kuva 2. *NIRis laitteen toimintaperiaate. A) Valkoinen valo mahdollistaa petrimaljalla olevien bakteerien heijastuskuvauksen. B) UV-valo virittää bakteeripesäkkeet, joissa on bakteeriklorofylliä. Fluoressikuva tallentuu NIR-suotimen läpi.*

Miten NIRis liittyy koulutukseen? Projektissamme kartoitimme AAP bakteerien esiintyvyyttä Suomen peruskasvistosta (koivu, kuusi, mänty, puolukka, mustikka) Lapin arktisilta alueilta aina Etelä-Suomen lehtimetsiin asti. Tähän tarvitsimme kansalaistiedettä. Projektiimme osallistui seitsemän lukiota Utsjoelta Turkuun. Lukiolaiset keräsivät kasveja lähiluonnosta kahden vuoden ajan ja lähettivät kasvit Jyväskylän yliopistoon analysoitavaksi. Koska 3D-tulostettavan NIRis laitteen osat optista filtteriä lukuun ottamatta ovat kuluttajatuotteita (Kuva 3), laitteen hinta on varsin maltillinen (n. 500€). Projektirahoituksen puitteissa pystyimme lahjoittamaan kaikille kouluille oman kuvantamislaitteen. Lukiolaiset pystyivät keräämään omia näytteitä biologian tunnilla, kasvattamaan mikrobeja petrimaljoilla ja kuvantamaan mahdolliset AAP-bakteerit. Joissain kouluissa laitetta käytettiin myös fysiikan tunneilla valon ominaisuuksien havainnollistamiseen. Tällöin pyrittiin hahmottamaan UV-säteilyn ja NIR-säteilyn eroja näkyvään valoon ja ylipäänsä ymmärtämään värien ja valon aallonpituuksien yhteyttä ja toisaalta pyrittiin ymmärtämään fluoresenssin ja heijastumisen eroja. Jyväskylän Lyseon opiskelijat tekivät jopa kiihdytinfysiikkaan liittyvän projektityön, jossa mikrobeja säteilytettiin korkea-energisellä gammasäteilyllä ja havainnoitiin AAP bakteerien fluoresenssin muutoksia (jotka olivat yllättävän pieniä).



Kuva 3. *Kaaviokuva 3D-tulostettavien osien määrästä. Opiskelijat voivat joko valmistaa vastaavanlaisen laitteen tai luoda uudenlaisia muotoja laitteeseen riippuen laitteen käyttötarpeista.*

Entä taide? Mitä NIRiksellä on annettavaa taidetunneille? Kuvantamislaitteena se pystyy kuvantamaan UV-indusoituja, valkoisen valon ja NIR-valon kombinaatioteoksia. 3D-tulostus mahdollistaa erilaisten kuvausmuotojen valmistamisen ja niiden värityksen hahmottamisen. Luonnollinen taidemuoto NIRikselle on biotaide. Biotaiteessa eläviä bakteereja, soluja tai jopa kudoksia kasvatetaan taideteoksiksi. Projektissamme valitsimme kymmenen eri bakteerikantaa, joiden väriskaala vaihteli bakteerien pigmentaation myötä. Luonnollisesti kantakokoelmassa oli AAP-bakteereita, jotka näyttävät aivan tavallisilta valkoisessa valossa (Kuva 4), mutta antavat NIR-fluoresenssi-kuvantamisella uudenlaisen kuvion. Tällainen taidemuoto on ollut erittäin suosittua kaikissa avoimien ovien tapahtumissa yliopistolla. Bakteeritaideteokset kun ”puhkeavat kukkaan” vasta bakteeripesäkkeiden kasvaessa petrimaljalla (Kuva4).



Kuva 4. *Biotaidetta. A) Puolukan lehden pintabakteerikokoelma, joista osa B) fluoresoi NIR-alueella ollen AAP bakteereita. Puolukan ”lehtiprinttikuvio” saadaan painamalla lehti petrimaljalle, jolloin bakteerit siirtyvät kasvatusalustaan. C) Projektissa kehitetty bakteerikantojen ”väripaletti”, joka näkyy heijastuskuvassa värikkäänä ja toisaalta D) vain AAP bakteerit tallentuvat NIR-suotimen läpi.*

Mitä tulevaisuudessa? NIRis mahdollistaa monitieteisen tutkimuksen ja opetuksen. Sen avulla voidaan yhdistellä esimerkiksi biologiaa, fysiikkaa, kemiaa, ohjelmointia, 3D-tulostusta tai valokuvataidetta. Laitteella voidaan opiskella esimerkiksi ohjelmointia, jossa luodaan vaikkapa bakteerien kasvukäyrämittaus tai kemiallisten reaktioiden kinetiikan mittauksia. 3D-tulostuksella laitetta ja esimerkiksi näytepidikettä voidaan muokata omien käyttötarkoitusten mukaisesti. Kuvantamisvärimaailman ei tarvitse pysähtyä UV- tai valkoisen valon viritykseen vaan LED teknologian avulla monipuolinen värimaailma opastaa koululaisia optiikan ja fotoniikan pariin. Tavoitteenamme on laajentaa NIRikseen perustuvia projektitöitä mahdollisimman moneen oppilaitokseen.

Lisää artikkelissa:

[1.] Ole Franz, Heikki Häkkänen, Salla Kovanen, Kati Heikkilä-Huhta, Riitta Nissinen and Janne A. Ihalainen*, NIRis: a low-cost imaging device for research and education. PLOS ONE 2024. 19(5): e0287088.

Janne Ihalainen

Kirjoittaja on Jyväskylän Yliopiston Biologisten nanotieteiden professori.

Haaste vasta valitulle uudelle hallitukselle:

Fotoniikka kuulostaa mystiikalta

– Tehdään fotoniikka tutuksi!

Maailman meno on muuttunut viimeisten vuosien aikana epävakaaksi. Tuoreesta globaalista pandemiasta on siirrytty epävarmuuden aikakauteen, jota ravistelevat muuttuva ilmasto, vallanhimoiset diktatuurit sekä globaalisti heittelevä talous. Hyvinvointiyhteiskunnan ylläpito on uuden edessä syntyvyyden jatkaessa heikkenevää trendiään.

Tästä huolimatta maailma muuttuu päivä päivältä paremmaksi ja useiden edessä olevien haasteiden ratkaisijaksi nousee fotoniikka; oli kyse sitten kansallisesta puolustuksesta ja turvallisuudesta, uusiutuvasta energiasta, kestävästä kehityksestä tai paremmasta terveydenhuollosta mukaan lukien uudet ja tehokkaammat keinot syöpien hoitamiseksi. Uudet kuvantamisratkaisut mahdollistavat mm. kohdussa kehittyvän sikiön hyvinvoinnin ja ihosyövän varhaisvaiheiden seurannan entistä tarkemmin eikä niiden merkitystä ympäristön seurannassa voi sivuuttaa.

Arkipäivän uutisiin sisältyy runsaasti nykyihmisen toiminnallisuuteen liittyvää piiloutunutta fotoniikkaa; avaruudessa leijuu mikrosatelliitteja, supernopea valokuitu ulottuu kaikkialle, aurinkopaneelit valtaavat teollisuushallien katot sekä laidunmaat, mahdollistaen myös vihreän vedyn tuotannon, lentäjät harjoittelevat virtuaalilasien avulla, modernit hävittäjät ja tankit ovat kuorensa alla pelkkää fotoniikkaa, uudet puhelimet ja muukin uusi teknologia – täyttä fotoniikkaa. Lähitulevaisuuden ihmeet, eli kvanttitietokoneet tarvitsevat myös fotoniikkaa toimiakseen kunnolla. Mikroelektroniikka on myös suurilta osin täyttä fotoniikkaa.

Fotoniikan ympärillä kuhisee valtaisa eri teknologioiden termiviidakko mutta se on täysin normaalia, koska fotoniikka on jo lähes kaikessa mukana. Kysymys kuuluu, että miten saisimme itse fotoniikka käsitteen syvimmän olemuksen tuotua esille, laajasti ymmärretyksi ja miksi pitäisi?

Miksi fotoniikka-sana tulisi mainita

Mahdollistavana teknologiana fotoniikka kärsii sovellusten sisään leivotusta asemastaan ja siksi on tärkeää, että päätöksentekijät, rahoittajat, media ja myös kansalaiset ymmärtävät kuinka laajasta kokonaisuudesta on lopulta kysymys. Alan yritysten kannalta tärkeimpiä perusteluita fotoniikka-sanan esille nostamiseksi ovat päätöksenteon sekä rahoituksen parempi ohjautuminen; Mitä laajemmin fotoniikka ja sen alle menevät teknologiat nousevat esille, sitä helpommin ne voidaan mieltää yhdeksi isoksi ja erittäin tärkeäksi kokonaisuudeksi, jolla on maailmanlaajuiset vaikutukset. Fotoniikka-sanana ei myöskään sulje pois siihen liittyvien teknologioiden esilletuontia.

Suomi on jo nyt kansainvälisesti arvostettu fotoniikan osaamisen maa, jonka etuja ovat tiivis tutkimuksen ja yritystoiminnan verkosto sekä yhteistyö. Tulevaisuudessa pelkän tuotekehityslaboratorion ja startup-hautomon lisäksi Suomi voisi olla myös fotoniikan teollisen tuotannon osaaja sekä houkutteleva kohde useiden suuryritysten sijoittumiselle. Tämä visio ei ole tuulesta (vaan valosta) temmattu mutta sen lunastamiseksi tarvitaan kaikkien toimijoiden yhteistyötä.

Photonics Finland on sitkeydestään huolimatta juuri niin vahva kuin sen jäsenistä muodostuva yhteisö, jossa jokainen yritys- ja organisaatio voivat tehdä oman osansa fotoniikan esilletuomiseksi tuottamansa teknologian tai tutkimuksen näkökulmasta. Toiveena on, että fotoniikka-sanana tulee mainituksi itse ydinteknologian ohessa; somessa, mediassa, tiedotteessa, verkkosivuilla tai muussa vastaavassa yhteydessä.

Samaa henkeä puhkuu Photonics Finlandin päivittynyt hallitus, jonka jokainen jäsen edustaa Suomen fotoniikan kärkeä. Tuorein hallituksen jäsen **Tapio Kallonen**, hyperspektrikameroita valmistavasta *Specim, Spectral Imaging Oy Ltd* yrityksestä, uskoo vahvaan kasvuun fotoniikan alalla. ”Meillä on Suomessa erinomaista osaamista ja aitoa kilpailuetua fotoniikan tutkimuksessa ja sen hyödyntämisessä eri sovelluksissa. Meidän koko fotoniikan yh-

teisön tulee varmistaa, että luomme myös jatkossa kilpailuetua Suomeen erityisesti uusien innovaatioiden kautta”, sanoo toimitusjohtaja Kallonen.

Fotoniikka-kasvatuksen tulee lähteä ruohonjuuritasolta; Seuran tieteellinen neuvottelukunta sai uudeksi puheenjohtajakseen professori Jyrki Saarisen, Itä-Suomen yliopistosta. Tähän saakka neuvottelukunnan tehtävänä on ollut vuoden väitöskirjapalkinnon valitseminen sekä Photonics Finlandin päätapahtuman Optiikan ja fotoniikan päivien (OPD) ohjelmatoimikuntaan osallistuminen. Nyt Saarisen johdolla toimintaa lähdetään kehittämään eteenpäin mm. lisäämällä korkeakoulujen yhteistyötä Photonics Finlandin kanssa, tiivistämällä neuvottelukunnan ja hallituksen yhteistyötä sekä ottamalla myös fotoniikan koulutus kaikilla opintoasteilla mukaan ohjelmaan, peruskoulusta yliopistoihin.

Photonics Finlandin hallitus

Puheenjohtaja **Kim Grundström**, Kimmy Photonics
Varapuheenjohtaja **Heidi Piili**, Turun yliopisto

Hallituksen jäsenet ja varajäsenet

Birgit Päivänranta, Microsoft, Espoo
// Jussi Rahomäki, Canatu, Espoo

Timo Vuorenpää, Peak PC, Jyväskylä
// Samuli Siitonen, Nanocomp, Joensuu

Niklas Saxen, Edmund Optics, Helsinki
// Jouko Korppi-Tommola, Jyväskylän yliopisto, Jyväskylä

Polina Kuzhir, Itä-Suomen yliopisto, Joensuu
// Antti Isomäki, Helsingin yliopisto, Helsinki

Juha Toivonen, Tampereen yliopisto, Tampere
// Göery Genty, Tampereen yliopisto, Tampere

Sanna Aikio, VTT, Oulu
// Harri Lipsanen, Aalto-yliopisto, Espoo

Tapio Kallonen, Specim Spectral Imaging
// Ana Gebejes, Itä-Suomen yliopisto, Joensuu

Photonics Finland hallitukseen uusina jäseninä nousivat Tapio Kallonen, Specim Spectral Imaging, ja varalle Ana Gebejes, Itä-Suomen yliopistosta. Photonics Finland hallituksen kokoonpano pysyi muilta osin ennallaan

Mitä on fotoniikka
Fotoniikka on valon tiedettä ja teknologiaa, jonka mahdollisuudet ovat rajattomat. Fotoniikan ansiosta valaisemme nyt hehkulampun sijaan led-valoilla, nopeat tietoliikenneyhteydet ovat yhä useamman saatavilla valokuidun kautta, älypuhelimet, pädit, tietokoneet ja näytöt ovat yhä ohuempia, kamerat parempia, pystymme keräämään auringon energiaa aurinkopaneeleiden avulla sekä virtuaalitodellisuuden ratkaisut lähestyvät arkeamme. Matkapuhelimen arvosta jopa 50% on fotoniikkaa, johon perustuvia komponentteja ovat mm. kamera ja näyttö.

Tästä kaikesta huolimatta vasta murto-osa Fotoniikan tarjoamasta potentiaalista on käytössämme. Fotoniikalla on merkittävä rooli maailmaa ravistelevien haasteiden, kuten ilmastonmuutoksen sekä kestävän kehityksen kannalta tärkeiden ratkaisujen tarjoamisessa mutta myös teollisuuden, ruuantuotannon, liikkumisen, kommunikoinnin, terveydenhuollon tai energiatuotannon uudistamisessa.

Photonics Finland

Lisätietoa: **photonics.fi**

Photonics Finland (Suomen Fotoniikan Seura) on teollisuusvetoinen innovaatioekosysteemi, joka kokoaa Suomen fotoniikan koulutuksen, tutkimuksen, tuotekehityksen, teollisuuden, loppukäyttäjät ja palvelut yhteen. Photonics Finland edustaa Suomen fotoniikka-alan yrityksiä ja toimijoita edistäen alan kehitystä sekä näkyvyyttä niin kansallisesti kuin kansainvälisesti.

Tuukka Pakarinen
Jyrki Saarinen
Tapio Kallonen
Jouko Korppi-Tommola

Tuukka Pakarinen
Photonics Finlandin tapahtuma- ja viestintäpäällikkö

About ongoing projects where Photonics Finland is a partner

International projects where Photonics Finland is a partner provide not only international co-operation and useful contacts but most importantly also financial support for everyday operations of the Society. In the following the ongoing projects are presented.

PIMAP4 Sustainability project

The PIMAP4 Sustainability project, launched in September 2022, has focused on promoting sustainable practices and technological innovation in European SMEs through photonics. Over the past two years, the project has carried out several significant activities aimed at supporting green transitions, enhancing industrial resilience, and fostering international cooperation.

PIMAP4 Sustainability funded 13 cross border innovation projects through Europe, supported financially 36 training projects on green transition and internationalization and 8 participants to join the international mission to Japan, reaching a total of 1.5M€ benefitting SMEs in their development.

One of the key initiatives was an international mission to Japan in 2024, where representatives from the project's partner countries, including Czech Republic, Finland, France, Italy, Portugal, and Sweden, participated in the "Manufacturing World" event. This mission facilitated networking with Japanese stakeholders, like the EU-Japan Centre and JETRO, the event included workshops to explore collaborative opportunities in photonics and manufacturing but also multiple networking activities where companies were able to create valuable contacts with local companies for future collaborations.

Visit of JETRO (Japan External Trade Organization) in Tokyo, Japan with Veikka Nikander (Winse Power), Mikko Utriainen (Chipmetrics) and Caroline Amiot (Photonics Finland),

360 CARLA consortium

Photonics Finland and EOS are joining the 360 CARLA consortium! The 360 CARLA project, launched in January 2024, is a 2.5-year European initiative aimed at advancing career development in the field of photonics. Building upon the success of the previous CARLA project, 360 CARLA focuses on fostering the next generation of photonics professionals. The project targets university students and early-stage researchers, providing them with comprehensive career guidance, mentorship, and practical experience across four key photonics application areas: Health (Biotech and Medical Photonics), Quantum Technologies and Communications, Energy and Environment, and Industry 4.0.

Key activities in 360 CARLA include symposiums, specialized workshops, networking events, and site visits to companies and research centers, all designed to enhance participants' knowledge and innovation skills in the field of photonics. The project also emphasizes diversity, entrepreneurship, and creating real-world opportunities through internships and hands-on experiences. It brings together a consortium of 12 partners across Europe, including research institutes and universities, to ensure that participants receive well-rounded training tailored to specific industry needs

During the coming months, Photonics Finland will collaborate with organizational members to organize "experiences" in companies and research facilities for Photonics Students on the thematic of Health and Sustainability, energy, and environment. During these 1-2 days events, the students will have the opportunity to discover the day-to-day work of the employee they will

shadow, and the company will have the chance to present their activities and needs in terms of future workforce. Both students and hosting organizations will benefit from these events and a relationship between mentors and mentees will create a bridge between the two ecosystems in the future.

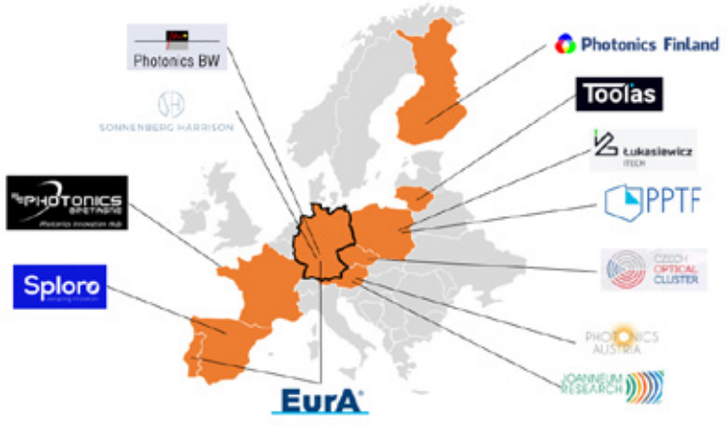
A special event dedicated to students, on Photonics for Health, will be implemented after the OPD2025 in Oulu on the Friday 6 June 2025. During this special day, students will have the opportunity to listen to inspirational talks but also to participate to workshops and networking activities.

More information on the website:
carlahub.eu

PhotonQBoost project

PhotonQBoost is a EU funded project that will be launched in December 2024 and has for main goal to advance SMEs sustainability through Photonics and Quantum innovation. During the 4 years of the project, 3.6M€ will be distributed to SMEs to develop their innovation and answer to different existing challenges in various application domains. With 12 partners coming from 9 different countries, PhotonQBoost will work towards empowering European SMEs to achieve sustainability, resilience, and global competitiveness by harnessing the transformative potential of Photonics and Quantum solutions.

Starting in the spring 2025, PhotonQBoost will implement 5 international technology working groups targeting Agrifood, Health, Manufacturing, Mobility, and Semiconductors. Through ideation workshops, the participants will uncover multiple existing challenges that will be feeding sub paths in the first call for innovation being launched in December 2025.



DEEPSUPPORT project

The DEEPSUPPORT project, launched in January 2024, is an EU-backed initiative aimed at fostering innovation through deeptech and photonics in manufacturing. It brings together six partners from five European regions—Austria, Finland, Hungary, Italy, and Slovenia. The project's core focus is to build an interregional network that promotes collaboration in deeptech (highly advanced technology) and photonics, which are considered key enabling technologiesfor Europe's digital transformation and industrial competitiveness.

The project addresses the need to enhance innovation ecosystems by connecting different regions, leveraging their strengths, and promoting best practices. It also aims to help SMEs access photonics technologies, which are often underutilized due to a lack of awareness and resources. DEEPSUPPORT will organize various workshops, focus groups, and networking events to encourage cross-regional cooperation and knowledge sharing.

On November 5th, the flagship event of the project will be taking place in Budapest, Hungary. It will consist in a thorough presentation of the project, workshops about regional photonics ecosystems and the presentation of the awarded projects of the Idea Challenge Call.

By the end of its one-year duration, the project hopes to lay the foundation for long-term partnerships and strategies that will continue to drive innovation in photonics and manufacturing across Europe through an Interregional Innovation Valley follow-up project.

PhotonHub Europe®

PHOTONICS INNOVATION HUB FOR EUROPE

PhotonHub Europe project

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 20 local Photonics Hub partners the project links closely with those European regions that smartly invest in photonics innovation.

Recently, the duration of the project was extended to April 2026, which will allow companies to have an extra opportunity to apply for funding, and a new funding rate for SMEs was implemented with 75% for prototyping and up to 85% for upscaling. You can find more information on the project webpage and register your interest to be contacted by experts.

More information on the website:
photonhub.eu

Dr. Caroline Amiot
Photonics Finland team

Argotech

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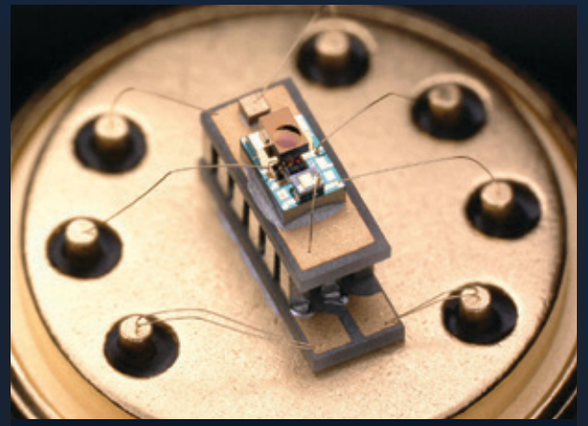

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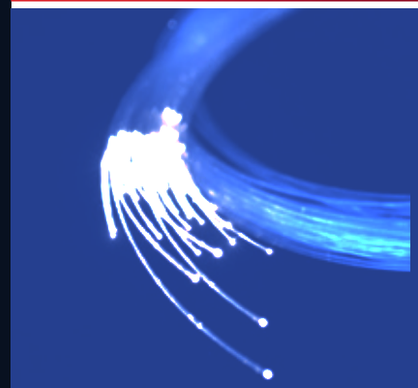

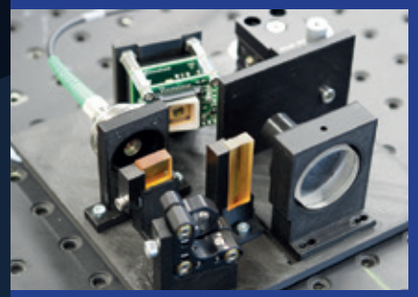

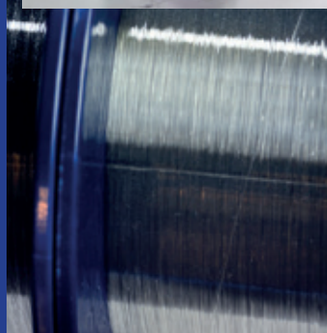

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SUOMEN FOTONIIKAN SEURA RY

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Companies are most welcome to advertise their products and services in FOTONI Corporate and societal members can have one half-page black and white advertisement per year free of charge. Remember to utilize this possibility to ensure visibility among Photonics Finland members. Full page advertisements and more frequent or color ads cost extra. Prices in EUR can found in the price list shown below. Job advertisements (text-only) can be sent to members via email to photonics-list@fos.fi. Only members are able to post and only from the email address they have provided to the list.

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full page	500 e (+VAT 24 %)	200 (+VAT 24 %)
color rear cover	700 e (+VAT 24 %)	400 (+VAT 24 %)

Suomen fotoniikan seura ry, jäsenyys ja jäsenmaksut

Seuran jäseneksi voi hakea täyttämällä lomakkeen osoitteessa www.photonics.fi/members/ join ja maksamalla jäsenmaksu taloudenhoitajan ilmoittamalla viitenumerolla yhdistyksen tilille IBAN: FI44 1309 3000 2042 48, BIC: NDEAFIHH. Seuran hallitus käsittelee seuraavassa kokouksessaan hakemukset ja merkitsee pöytäkirjaan uudet jäsenet. Viimeisimmät yhdistyksen kokouksen vahvistamat jäsenmaksut ovat: henkilöjäsenet 45 e, opiskelijajäsenet 20 e, yhteisösivujäsenet 45 e, yrityssivujäsenet 45 e
ja yhteisöjäsenet 450 e.

Yritysjäsenmaksut: 0 – 3 henkilöä / 165 euroa, 4 – 10 henkilöä / 375 euroa, 11 – 50 henkilöä / 450 euroa, 51 – 250 henkilöä / 575 euroa ja yli 251 / 700 euroa.

Fotoni

Suomen fotoniikan seura ry:n julkaisu