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# SEE
# THE LIGHT!

Power of Photonics from Finland

# Photonics is Everywhere

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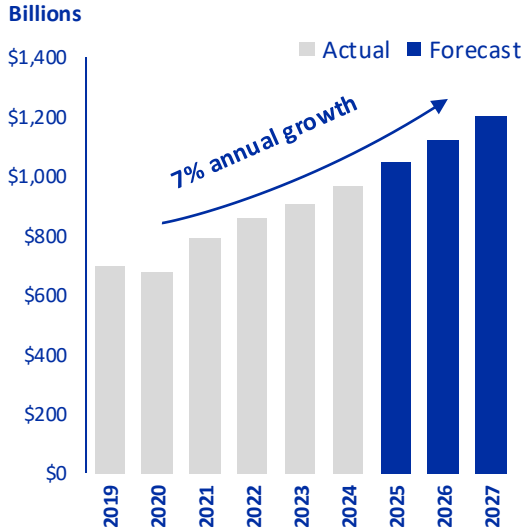
- The science and technology of light manipulation
- The generation, control, and detection of photons (light particles)
- A key enabling technology for other technologies in multiple industries
- Everywhere in everyday life
- Example: photonics accounts for over 50% of the value in smart phones: display, camera, flash, sensors, backlighting – and more
- Offers solutions to prevalent global challenges

# Steadily Growing Global Market – Forecasted Value of $1,200 Billion

SUOMI FINLAND

- The market growth reflects the rising importance of photonics:
  - Market valued at $865 billion (€820 billion) in 2022. Expected to reach the $1200 billion mark by 2027 (Photonics21, Market Research Study Photonics 2024)
  - Global annual revenue from production of optics and photonics core components reached $368 billion in 2022 (SPIE, Global Industry Report 2024)
- Europe and North America lead in innovation, Japan and China in manufacturing

PHOTONICS WORLDWIDE MARKET SIZE




**KEY GROWTH SECTORS**

- Optical communications
- Displays
- Biomedical devices
- Advanced manufacturing



Source: Photonics21 Market Research Study Photonics 2024

# Finland – Thriving Hub for Photonics

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Globally, Finland is a central nucleus in photonics research, innovation, education, and commercial applications.

**2,5+ billion EUR**
Estimated total turnover of the photonics industry in Finland

**7,500+**
People directly employed in the photonics business

**340+**
Tightly networked photonics companies

**12%** ↑ 7%
Annual growth rate 2x the global average of 7%

**FINLAND EXCELS IN**

- Optical sensing and imaging
- Micro- and nanophotonics
- XR/AR
- Lasers and fiber optics
- Silicon-based photonics
- Medical sensors



Source: Photonics Industry in Finland 2023 survey

# A Unique Ecosystem Benefiting Everyone: Dynamic, Collaborative, Well-Organized

SUOMI FINLAND

## INDUSTRY

- Photonics Finland: a technology cluster driving the industry and research
- Connects companies, universities, and research organizations to promote cooperation
- 300+ member organizations
- Functions as a single point of contact for Finnish photonics
- Supports companies, startups, and research geared for growth

Photonics Finland


## RESEARCH

- PREIN: the flagship for photonics research and innovation, funded by the Research Council of Finland, gathers key universities and research organizations
- 700+ photonics researchers in almost 70 research groups
- Annual research budget over €80M
- PREIN partners: Aalto University, Tampere University, University of Eastern Finland, and VTT Technical Research Centre of Finland

PREIN

## EDUCATION

- Bachelor's, Master's, and Doctorate degrees with photonics specialization
- I-DEEP: a doctoral education ecosystem for photonics network funded by the Research Council of Finland

I-DEEP

# Advanced R&D Infrastructure Open for Collaboration


- Finnish R&D infrastructure for photonics is utilized by universities and research organizations in collaboration with companies
- State-of-the-art labs, testing facilities, and research centers specializing in photonics
- Facilitating rapid R&D and reducing costs
- **FinnLight.fi:** Finnish Research Infrastructure on Light-Based Technologies
  - A comprehensive combination of technologies covering all classes of photonics materials
  - Full-scale process lines for device fabrication and assembly

FinnLight

# Highly International Companies, Research, and Education

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FINLAND

- Globally networked companies, universities, and research organizations with international partnerships and research programs
- Global companies such as Microsoft, Nextrom, and Amazon Ring have a photonics branch in Finland
- Foreign acquisitions of Finnish companies, such as Specim by Konica Minolta, Tutcore by Coherent, Primoceler by Schott, and Nanocomp by Radiant Opto-Electronics
- Employees in the Finnish photonics ecosystem represent dozens of nationalities
- Actively recruiting experts globally
- Easy for expatriate families to settle in Finland

# World Leading Education in Photonics


- 50+ university professors in photonics
- 700+ staff in research communities
- I-DEEP: National doctoral program in photonics
- MSc in Technology and MSc in Engineering programs in seven universities
  - Various photonics specializations
  - Double-degree programs with abroad universities
  - Erasmus Mundus joint degree programs
- Multi-disciplinary educational programs collaborating with the industry
- Photonics student chapters affiliated with international associations

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# FOUR PHOTONICS HUBS

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# ESPOO
# New Optical Materials and XR/AR

- International research at Aalto University and VTT conducted with partners worldwide in various programs
- Focus on silicon-based integrated photonics, spectroscopy, metamaterials, and quantum applications
- R&D infrastructure: VTT's Micronova facilities and Kvanttinova with a shared pilot line for semiconductor development
- Several photonics start-ups born from the Otaniemi start-up ecosystem


Aalto University VTT

**MAJOR STRENGTH**

High concentration of international research talent and R&D infrastructure; a vibrant start-up ecosystem.

# JOENSUU
# A Productive Photonics Community

- One of Europe's leading regional photonics ecosystems, a pioneer in modern optics
- Focus on micro- and nanophotonics and hyperspectral imaging
- Long history in 3D printed optics
- R&D: top-notch shared facilities and corporate equipment
- 50+ years of cutting-edge research by the Center for Photonics Sciences at the University of Eastern Finland (UEF)
- UEF is the largest Finnish photonics educator with 25+ professors with MSc in photonics specialization

UNIVERSITY OF EASTERN FINLAND

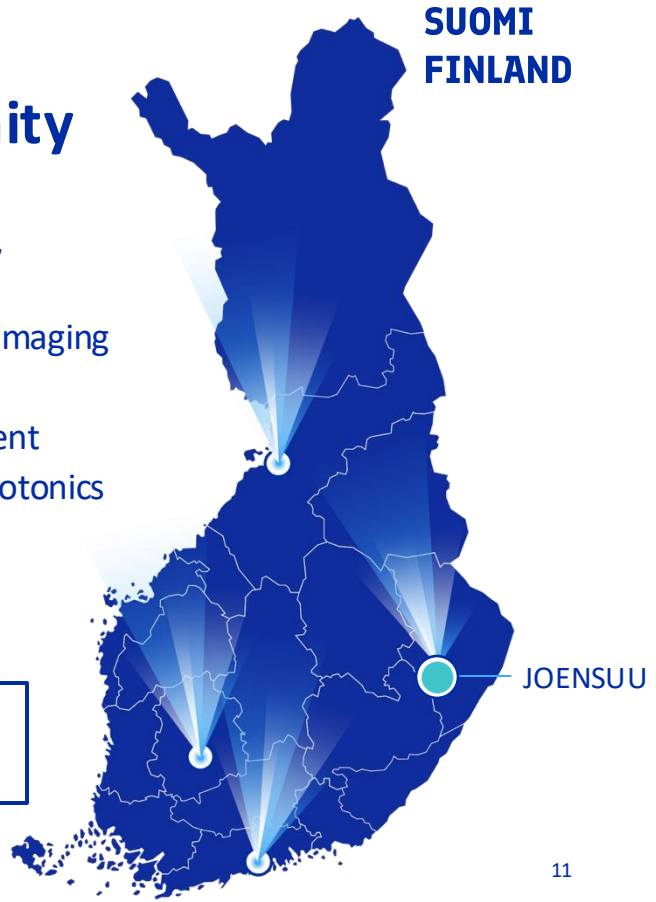
CENTER FOR PHOTONICS SCIENCES

PHOTONICS CENTER

Photonics Joensuu

**MAJOR STRENGTH**

An established research and business community generating industry applications.

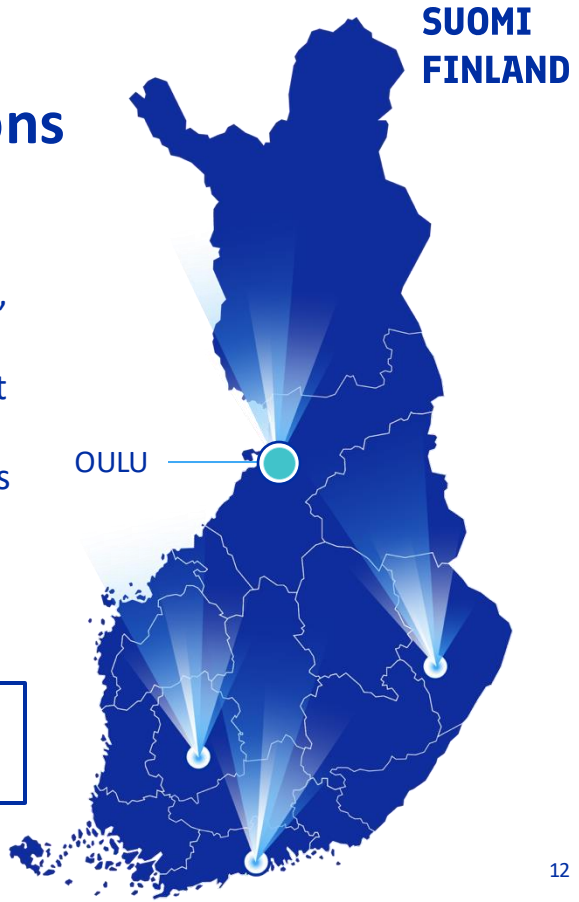


# OULU
# Forerunner in Medical Applications

- Global TOP-30 among digital health tech cities
- Focus on optoelectronics, measurement technologies, LIDARs, printed intelligence, and biomedical sensors
- R&D: University of Oulu and VTT offer state-of-the-art infrastructure for the development, manufacturing, testing, and characterization of optoelectronic devices
- A pilot line with PrintoCent and MedPhab association
- A cluster of companies in health, dual-use, and transmission technologies, and manufacturing

**MAJOR STRENGTH**

Biomedical photonics combined with wireless technologies.

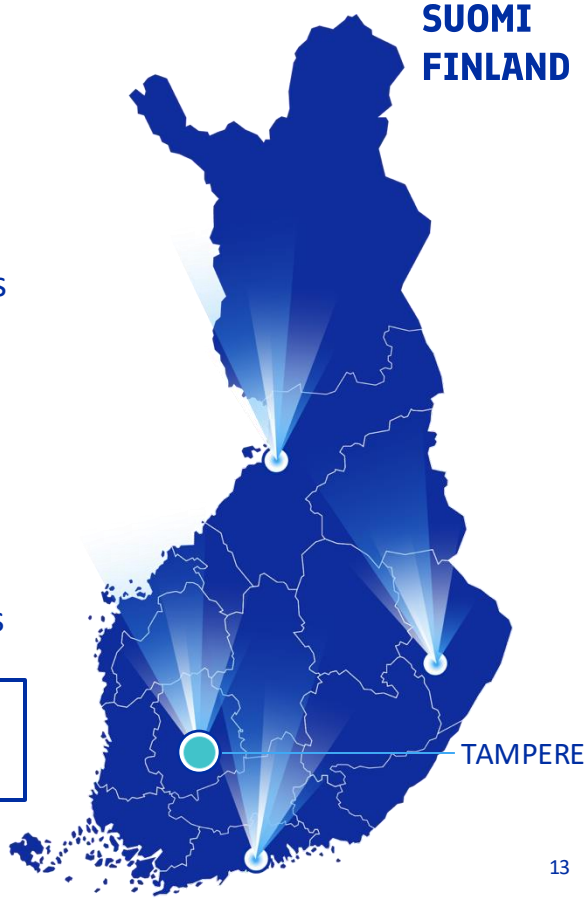


# TAMPERE
# Research Hub and Coordinator

- Photonics is a strategic focus area at the University of Tampere (TAU) with an international MSc in photonics
- TAU coordinates national initiatives such as PREIN, I-DEEP and FinnLight
- Focus on optoelectronics, laser technology, imaging, and defense applications
- R&D: FinnLight infrastructure, SiPFAB pilot line, and Optoelectronics Research Center at TAU
- Among the world's TOP-5 imaging technology clusters

**MAJOR STRENGTH**

Photonics is highly prioritised and pushed towards integrated applications and commercialization.



# SUCCESS STORIES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# Global Leader in Environmental Measurements

VAISALA

**Vaisala is a global leader in measurement instruments and intelligence for climate action.**

- Vaisala equips customers with devices and data to improve resource efficiency, drive energy transition, and care for the safety and well-being of people and societies worldwide
- International airports rely heavily on their devices
- Vaisala has developed optical and photonics instruments for decades utilizing technology such as LiDAR, infrared absorption spectroscopy, and MEMS sensors
- NASA's Curiosity and Perseverance rovers are using Vaisala's measurement technology on Mars

# Mission Critical VR/XR

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FINLAND

**Varjo provides the world's most immersive virtual and mixed reality products for safety-critical work.**

- Solutions used to train civilian and military pilots, astronauts, and nuclear power plant operators, and conduct research
- Over 25% of Fortune 100 companies are using Varjo for high-stakes work
- Transforming workflows across industries through true-to-life immersion and secure solutions
- Customers in aerospace, defense, automotive, maritime, steel, and many more industries

# Transparent Waveguide Displays for AR

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FINLAND

dispelix

**Dispelix develops and supplies transparent waveguides used as see-through displays for AR devices.**

- Enables seamless fusion of real and virtual worlds
- Serves world's leading enterprise and consumer technology companies developing custom waveguide displays
- Near-eye displays for AR eyewear and headsets
- Head-up displays for aerospace and defense applications, aviation, and cars
- Extensive IP portfolio with 200+ patents
- Long-term supply contract with Collins Aerospace, a globally leading defense and aerospace supplier

# Kill Cancer with Tailored Laser Solutions

modulight

**Modulight specializes in personalized medicine and high-value add applications.**

- Laser therapies for oncology and opthalmology
- Breakthroughs in quantum applications, microscopy, spectroscopy, and flow cytometry
- Exclusive supplier to 10+ pharmas, other Fortune 500 companies, and leading cancer centers
- The only vertically integrated medical laser manufacturer in the world, with own semiconductor and laser fab
- 25 years of expertise in lasers and optics

# Bioprocess Monitoring to See the Unseen

timegate

**Timegate develops and provides process analytics for the biopharmaceutical industry.**

- Cutting-edge patented time-resolved Raman technology with effective fluorescence interference suppression
- Broadens the scope of real-time chemical analysis to areas that were previously unattainable
- Customers across various fields of industry and research, including medical development, battery chemistry evolution, and environmental science
- Collaborating with leading global brands

# Enlightening Darkness for Top Performance and Safety

SENOP

**Senop develops and manufactures advanced electro-optical systems and high-tech night vision systems.**

- Customers both in defense and industrial markets
- MIL compliant system platforms, optronics, and integration services for safety-critical applications
- Customized optics and imaging solutions for industrial applications and R&D
- Advanced sights and control systems ensuring outstanding performance even at night
- Leading turnkey partner of Nordic defense companies

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# World's First Wearable Designed for Personal Health

ŌURA

**Oura Health is a health technology company known globally for the Oura Ring.**

- Oura's unique ring is the first wearable created to paint a holistic picture of personal health
- The Oura Ring tracks sleep data, heart rate, body temperature, respiratory rate, and activity
- The operation is based on infrared, red and green LEDs projected through the skin
- Captures highly accurate biometric data with Smart Sensing technology

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# Forerunner in micro- and nanophotonics

NANOCOMP

**Nanocomp offers one-stop solutions from design to mass production for display illumination for portable devices.**

- The key product is applied to reflective displays, like EPD and LCD
- It is unique in terms of optical performance enabling superior contrast and wider color gamut
- Products are applied into a wide range of applications across several industries, such as interior decor in automobiles, smart surfaces, displays of any kind and biometric identification
- Core competences include the design and tooling of micro- and nanophotonics and roll-to-roll technology


# Critical quality control for pulp, paper, and nonwovens industries

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**Valmet Automation Systems business line provides automated on-line quality measurement solutions for pulp, paper, energy, and process industries, and more.**

- Over 50% of solutions use photonics-based technologies
- Near-infrared measurement of specialty coatings
- Near-infrared and mid-infrared technologies for moisture, basis weight, and coating measurement
- Camera-based solutions for smoothness, surface topography, and fiber orientation
- Web inspection and runnability monitoring with advanced camera technology
- Accurate color and brightness measurement

Photo: Marcelo Quinan on Unsplash

# Welcome to Finland!

SUOMI
FINLAND

- World-leading photonics know-how
- Collaborative photonics network
- Advanced R&D infrastructure for photonics
- Top-level education in photonics
- Strategic support and funding for photonics
- Strong research basis in photonics

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