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# Science with Arctic Attitude

University of Oulu 28 January 2022





New scientific information and future pioneers to build a more sustainable, intelligent and humane world

SUSTAINABLE MATERIALS AND SYSTEMS

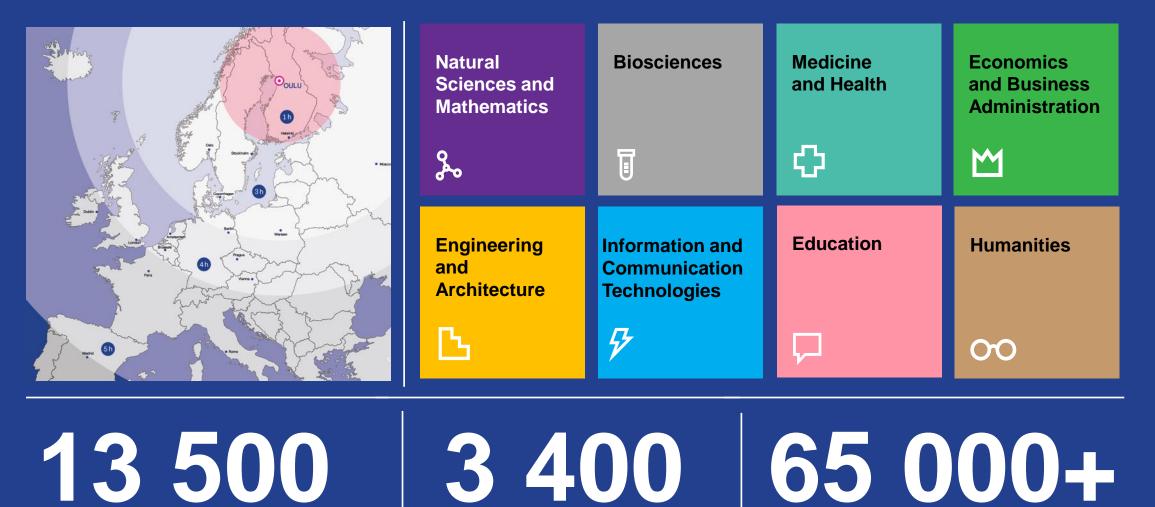
Strate and the state

CHANGING CLIMATE AND NORTHERN ENVIRONMENT DIGITALIZATION AND SMART SOCIETY

LIFELONG HEALTH UNDERSTANDING HUMANS IN CHANGE

# The University of Oulu in brief

**Students** 



Staff

University of Oulu

Alumni

The university community's values Creating Taking Succeeding responsibility together new





# Focus areas and scientific profile



# Sustainable materials and systems

# Achievements

### Solutions to manage

1/

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- water resources
- emission load and its mitigation
- industrial residues
- material structure analysis

World's strongest steels and advanced concrete

# Goals

New knowledge and technologies for

- sustainable resource management
- carbon-neutral steel and concrete industries
- promotion of intelligent circular economy
- development of new materials

Supporting the change towards zero-waste steel plants and the most advanced steel applications



# Changing climate and northern environment

# Achievements

- Eco-friendly solutions for industry and land use, especially in the Arctic
- Novel tools to assess the environment and ecosystems in the north
- New leads for drug discovery from Arctic nature
- State-of-the art methods to study near-Earth space and upper atmosphere
- Cosmic particles found to destroy ozone

# Goals

New knowledge, technologies and solutions for

- biodiversity conservation and production of new biomaterials
- the Arctic ecosystems' future
- understanding and advancing human-nature interactions in the north
- prediction of space weather effects relative to the Arctic upper atmosphere and space
- understanding the sources of the Arctic geo-environment variability



# Lifelong health

# Achievements

### Our inventions

- fight obesity
- provide treatment options for fibrotic and heart diseases
- offer novel therapeutic and diagnostic tools for osteoarthritis

We discovered a new commercially viable natural and calorie-free **sugar substitute**. The first **renal anaemia drug** and **artificial cornea** were based on our research.

# Goals

We aim to understand the interplay of **obesity**, **hypoxia** and **fibrosis** in disease development.

We study the effects of **digitalisation** in teaching, healthcare, health research and society.

We harness our **cohort resources** in big data and multiomic science to understand disease processes in a systems medicine approach.



# Digitalization and smart society

# **Achievements**

Home of 6th generation wireless networks.

Several generations of mobile phone technology have been created in Oulu.

We have developed core technologies for machine vision.

Our research has generated large number of start-ups.

# Goals

We develop

- the fundamental technology needed to enable 6G and support industry in finalisation of 5G
- novel virtual reality solutions for society
- innovative health technologies
- infrastructures and autonomous measurements.



# Understanding humans in change

# **Achievements**

Our research contributes to the

- creation of a more sustainable and inclusive world
- empowerment of individuals, communities and economies
- building of a human-centric digital future.

Resilient individuals, organisations and societies.

# Goals

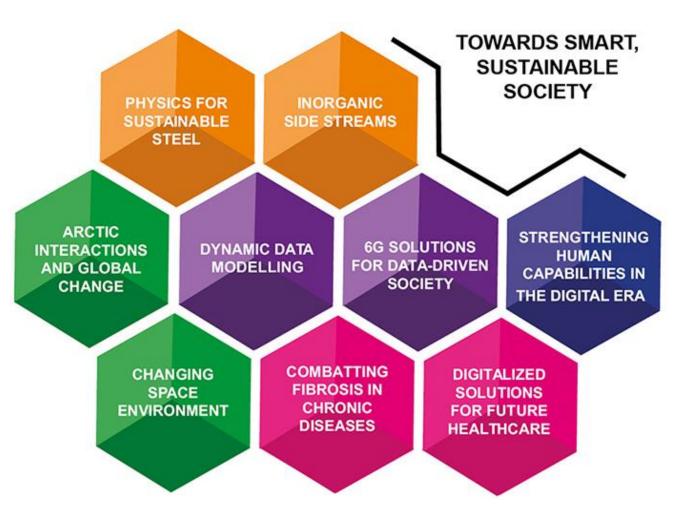
We strive to understand attitudes towards climate refugees and the role of talk and interaction in conflict management.

We study education, childhood, language and how to communicate in a culturally sensitive way.



# We are at the international top in our profile fields

Our scientific profile is built on a university with a wide range of specialisations.



# **High-level impactful research**

Our focus areas, profile fields and strategic development programmes will steer the University's development in the coming years.

# GOALS

- RISING TO THE INTERNATIONAL TOP IN OUR PROFILE FIELDS
- 2 STRENGTHENING RESEARCH IN EMERGING FIELDS AND MULTIDISCIPLINARY ACTIVITIES
- **3** SYSTEMATICALLY MONITORING AND DEVELOPING THE QUALITY OF RESEARCH
- 4

DEVELOPING HIGH-QUALITY RESEARCH INFRASTRUCTURES



PROMOTING RESPONSIBLE RESEARCH AND THE UTILISATION OF OPEN INFORMATION

# Scientific publications 20202 728Doctoral degrees 2020143Scientific publications companies since 200071



On 9 February 2021, the University of Oulu adopted a declaration of responsibility and transparency in all its research activities.

# **Open and responsible research**

Research produced with public funds and related to published research results is, as a rule, collaborative and transparent.

– Publishing

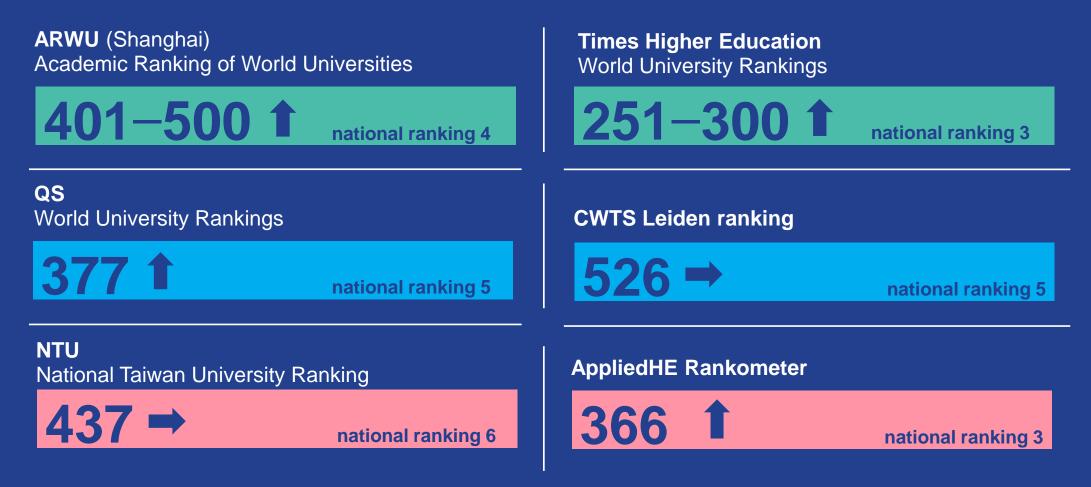
• The university encourages researchers to publish in open publishing channels.

- Research data

• Research data is made and kept findable, accessible, interoperable and reusable.

- Open research infrastructures
- Open source
- Open education
- Broadening access to learning by lowering barriers and increasing accessibility.

# Performance in the major university rankings – within global top 3% \*



\* There are around 17,000 to 23,000 universities in the world depending on the method of calculation.



# Faculties





# Faculty of Biochemistry and Molecular Medicine

# **Education**

Medical biochemistry and molecular biology

- Protein science and biotechnology as well as cell and molecular biology
- Focus areas include cellular interactions with the extracellular matrix, structure and function of proteins and enzymes, cellular and tissue regulatory networks and cell metabolism, and related diseases





# **Faculty of Humanities**

# Education

- History, Culture and Communications
- Languages and Literature
- Logopedics

- Cultural change, interaction and human agency
- Learning, language development and difficulties
- Man, well-being and environment





# **Faculty of Education**

# **Education**

 Majors in special education, education, psychology, educational psychology, music education and early childhood education

- Main theme of research: education in a changing world
- Seeks solutions for how a person can exert an active influence on changes instead of just reacting to them





# **Oulu Business School**

### **Education**

 Accounting, marketing, international business management, finance, economics and business analytics.

- Role of managerial traits in insider trading, tax noncompliance and other corporate decision-making
- Business dynamics, ecosystems and models in development environments
- The role of renewable energy in the electricity market
- Knowledge-intensive digital products and services and responsible business
- Business relations, services and brands
- International entrepreneurship and open innovation





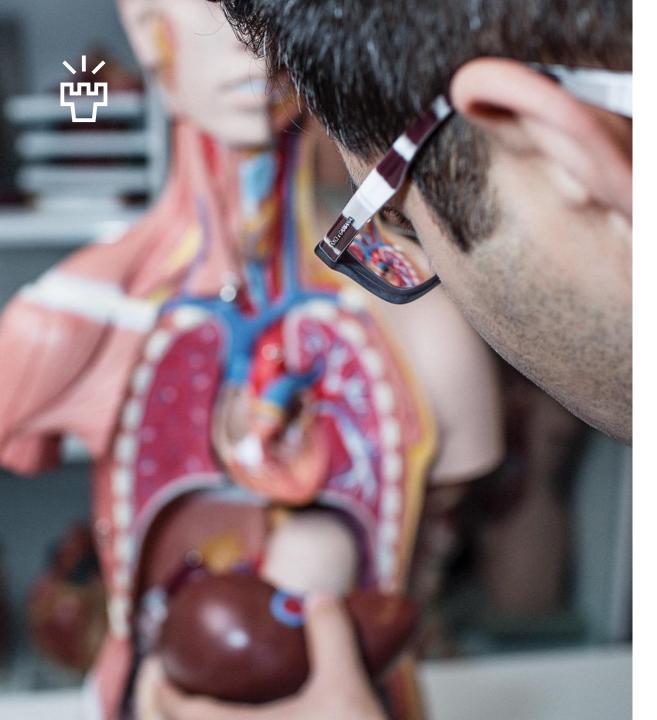
# **Faculty of Science**

### Education

- Biology, physics, geography and mathematics

- Regional change and people in a changing environment
- The Sun and the Earth's near-space system, space weather and climate change
- Bayesian data analysis and mathematical analysis
- Ecology and genetics
- Galaxies and high-energy astrophysics
- Quantum and molecular phenomena, computational and AI-based process modelling





# **Faculty of Medicine**

## Education

- Medicine, dentistry and health sciences
- Medical bioengineering

- Strong research areas include birth cohort and environmental health research, as well as research on cardiovascular diseases and paediatric diseases.
- Emerging research areas include translational research, imaging and medical physics research, as well as individual-centred health care and innovation-driven research enabled by ICT.





# **Faculty of Technology**

### Education

 Fields of education: architecture, geosciences, mining and refining technology, chemistry, mechanical engineering, process engineering, civil engineering, industrial engineering and management, environmental engineering

- Sustainable use of natural resources
- Biomass, mineral and steel processing and knowledge about the application of materials
- Production chains, minimising environmental effects and economic perspectives





# Faculty of Information Technology and Electrical Engineering

### **Education**

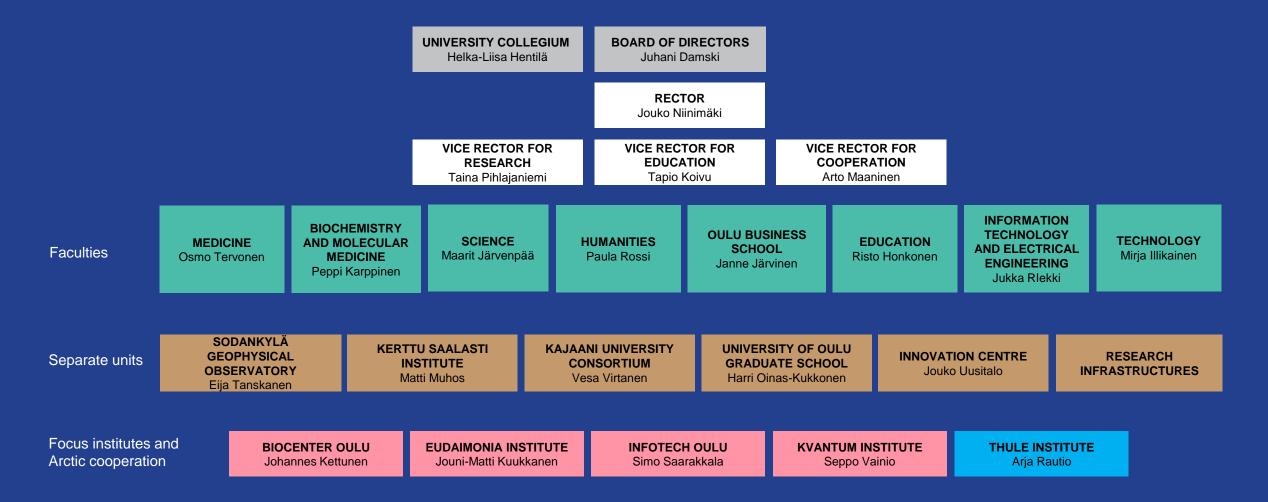
- Electronics and telecommunications
- Computer science
- ICT
- Business analytics
- Biomedical engineering

### Research

 Measuring, electronics and materials, 5G and 6G wireless communications, artificial intelligence, systems, software and experiences.









# Education





# Quality education for different parts of life

Biosciences	Humanities	Education
1	00	$\Box$
Economics and Business Administration	Natural Sciences and Mathematics	Medicine and Health
Engineering and Architecture	Information and Communication Technologies	

### **Degree education:**

Bachelor's and Master's degree programmes (22 international programmes) / Licentiate of Medicine

Doctoral training in doctoral programmes

### **Continuous learning offering:**

Open University Open-path studies and studies for upper secondary schools Continuing education

Solutions for companies and organizations

**13 500** students

**1 060** international students

**450** exchange students

# Our students learn how to solve global challenges

We train skilled and adaptable professionals who are able to apply the latest scientific knowledge and technology to practical challenges.



# Climate change and sustainable development

Adequacy of clean water, renewable energy and sustainable use of natural resources are important themes in mitigating climate change.



### Health and wellbeing

The importance of health and wellbeing is emphasised as people's life expectancy increases. At the University of Oulu, lifelong health is promoted through strong research information.



### Man and the changing world

The changes that are shaking society affect all of our lives. Identifying the effects of the changes will help predict their impact.



Artificial intelligence and digitalisation

The effects of artificial intelligence and digitalisation are everywhere. The aim of new technology is to make people's lives easier.

# **International** cooperation

Participating in international science networks is the foundation for the University's renewal and development.

International Master's Programmes

Different nationalities in the university community

23

agreements with universities

**Bilateral cooperation** 

Erasmus network: No. of agreements

Erasmus network: Partner Universities

327



**Students** 

1 060

**International students** 

450

Exchange students



# Alumni



### 65 000+ alumni – including സ്വ



### Leena Peltonen-Palotie

- 2010 2009 Finnish Science Academician Helped to found the UCLA **Department of Human Genetics** 



# Jussi Pesonen

President and Chief Executive Officer, UPM

### Kaisa Hietala

Partner, Gaia Consulting Oy Chairman of the Board of Directors, Tracegrow Oy Non-executive director, Kemira Oyj Has worked as: EVP for Renewable Products at Neste

### Antti Nousjoki

Founding partner ALA Architects Architect of the Helsinki Central Library Oodi Winner of the World's Best Public Library Award 2019









### Martti Ahtisaari

Peace mediator United Nations diplomat Nobel Peace Prize laureate 2008 President of Finland 1994–2000

### Paula Vanninen

Director of Verifin, Finnish Institute for Verification of the Chemical Weapons Convention

Member of the Scientific Advisory Board of the UN Organisation OPCW 2010-2016

### Jarkko Oikarinen (WiZ)

**Technical Lead Manager** Inventor of the first Internet chat network, Internet Relay Chat (IRC)

### Leena Bruckner-Tuderman

Full Professor and Chair, Department of Dermatology, Medical Center -University of Freiburg, Germany Member of the German National Academy Leopoldina Member of Berlin-Brandenburg Academy of Sciences and Humanities

### Tytti Tuppurainen

Minister for European Affairs and Ownership Steering at **Finnish Government** Member of the Parliament of Finland

### Sakari Orava

Sports medicine surgeon, physician, orthopedist and professor Client list includes Real Madrid.

FC Barcelona, Chelsea FC and Juventus

Erja Sankari Chief Operating Officer at iLOQ





# Cooperation

# Cooperation and Innovation



# 一个 Research results and expertise for broad use

The University of Oulu's special strength is bringing science and the different actors of society closer together. We want our research results and expertise to be in active use.

Strong competence, innovation and inclusion in international pioneer networks will enable Finland to succeed in the future.

Many innovations that have changed the world have their roots in the University of Oulu.

### GOALS

- **1** AN INTERNATIONALLY VALUED INNOVATION PARTNER
- 2 ACTIVE AND EXPANDING COOPERATION
- **3** COMMERCIALISING RESEARCH RESULTS AND EXPERTISE

# ACTIVITIES

- Research cooperation
- Patenting inventions and managing the patent portfolio
- Licensing and technology transfer agreements
- Research and laboratory services
- Preparation and financing of commercialisation projects
- Launching a research-based business
- Student theses or case courses



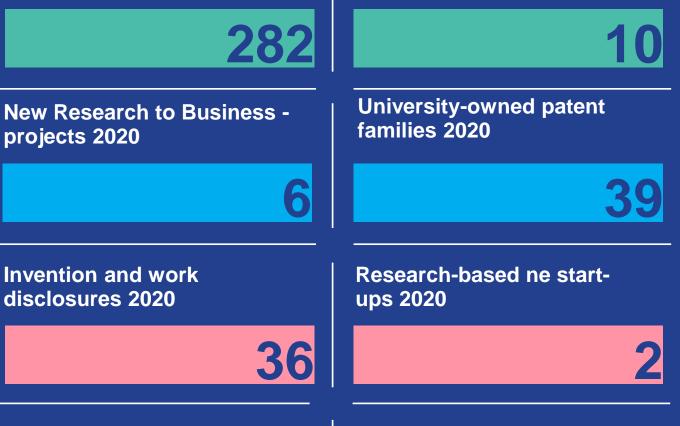
# Cooperation and innovations in numbers

**Company and stakeholder** clients 2020

University business

2020





9 7 5 3 0 0 0 € 6 4 6 9 0 0 0 € 5 0 3 0 0 0 €

**Business Finland grants** 2020

Share of foreign companies 2020



# ICT

# 6G Flagship

- 5G commercialisation, new application areas
- Development of 6G technology, new frequencies and the solutions they require

# TimeGate

- Pulsed picosecond laser Raman spectroscopy  $\rightarrow$  Fluorescence-free Raman spectrum

# Visidon

- Photo and video image enhancement technology
- Computer vision and facial recognition methods



# Well-being technology

- The development of the world's first wireless heart rate monitor. Seppo Säynäjäkangas, Professor of Electrical Engineering, founded a company in 1977 to manufacture personal pulse monitors.
- The Oura wellness ring for sleep, activity and recovery tracking
- The Onnikka weight management system aims to influence the thoughts and attitudes of the dieter



### **Biomedical research**

- Discovery and commercialisation of new treatments and diagnostic practices, e.g. assessment of knee joint condition in osteoarthritis
- Pharmaceutical development for the treatment of fibrotic diseases, among others, together with Nasdaq-listed FibroGen Inc., which the University of Oulu was involved in establishing
- Development of a commercially viable method for production of a natural, caloriefree sweetener that tastes like sugar

# **Oulu Innovation Alliance**

The strategic consortium of eight contractual partners focuses its research, development and innovation in Oulu on three strategic areas and one common, cross-cutting theme:

- 1. Digitalisation in the changing urban environment
- 2. The OuluHealth ecosystem
- 3. Sustainable circular economy and clean solutions

Startup entrepreneurship, competence and continuous learning, as well as the enterprise ecosystems and support thereof





#### Versatile research equipment and environments

- ICT testing and development services
- Manufacturing and prototyping services
- Research services for metal and mining industries
- Process industry research services
- Construction research services
- Medical research services
- Research services in biochemistry and biomedicine
- Research services in the field of natural resources
- Educational and cultural services



# Campuses





## **University of Oulu**

Linnanmaa campus, Oulu Kontinkangas campus, Oulu Sodankylä Geophysical Observatory Kajaani University Consortium Kokkola University Consortium Kerttu Saalasti Institute, Nivala Oulanka Research Station, Kuusamo



### Linnanmaa Campus

Humanities

Natural Sciences and Mathematics

Education

Engineering and Architecture

Information and Communication Technologies **Botanical Gardens** 

Economics

and Business

Administration

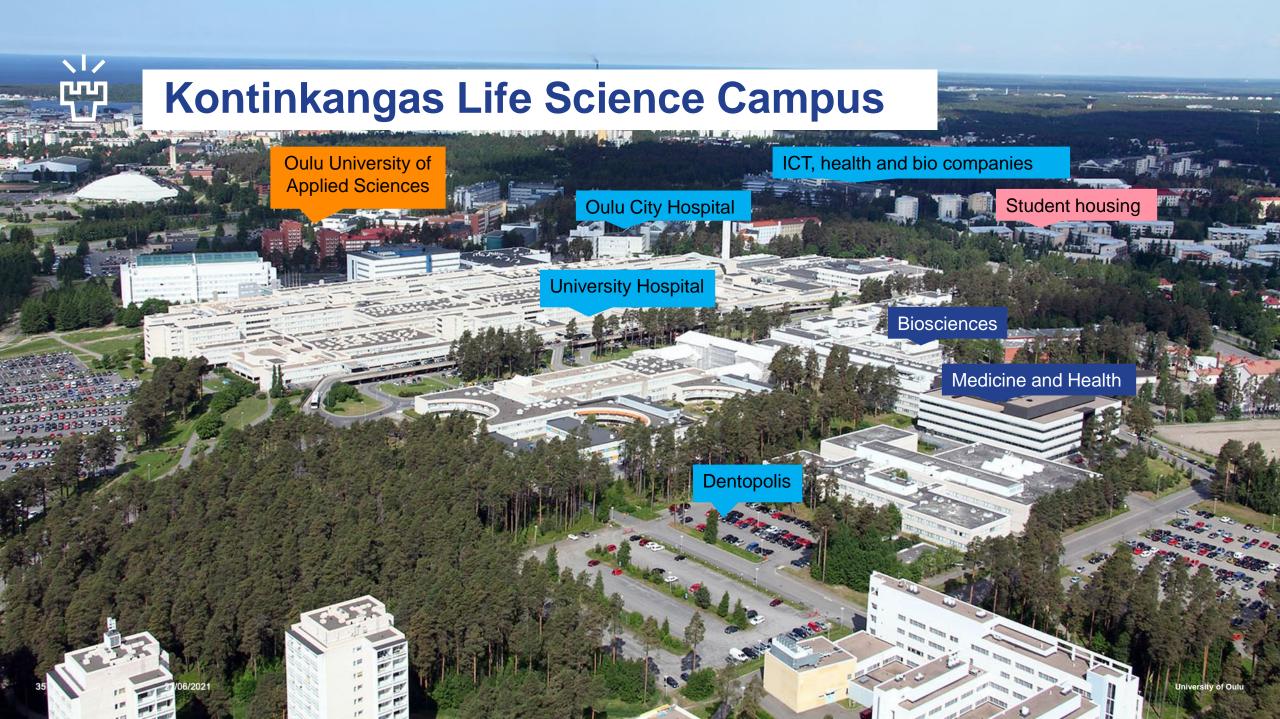
Oulu University of Applied Sciences

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Student housing

CONSTRUCTION OF

Student housing

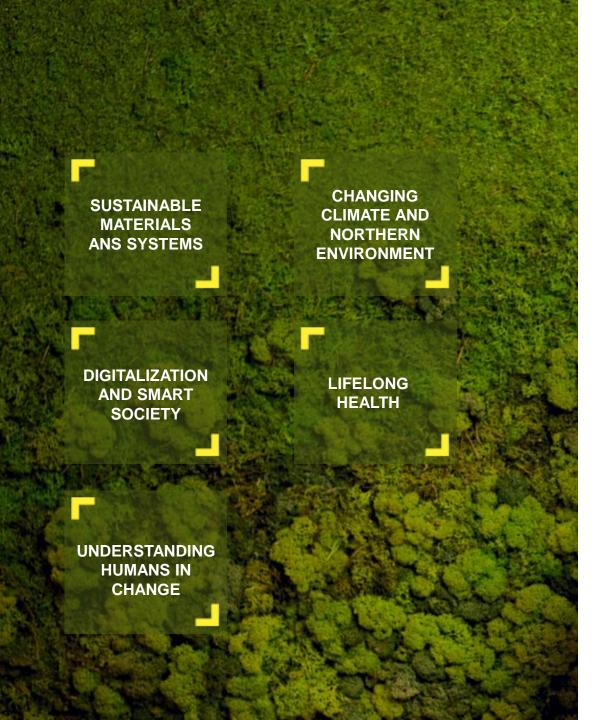


## Oulu City Campus

Station Centre







# Focus institutes promote multidisciplinarity

- Promoting multidisciplinary and internationally significant research in the five focus areas in accordance with the university strategy
- Promoting cross-faculty research cooperation, researcher interaction and community spirit
- Supporting multidisciplinary spearhead projects based on international evaluation
- Engaging in foresight work and initiating new research projects
- Supporting and developing doctoral education in each focus area
- Strengthening international networking
- Promoting the popularisation of science and participating in business and other stakeholder cooperation



## **Kvantum Institute**

#### **Research topics**

- Natural and anthropogenic drivers of climate change
- Processes and interactions of the ionosphere, atmosphere and cryosphere
- The response of ecosystems to global changes
- Developing more sustainable materials with a lower environmental impact for industry
- Reducing environmental impacts with intelligent control and production systems



## Eudaimonia

#### **Research topics**

- What phenomena, processes and practices are involved in changes?
- How do changes affect individuals, communities and cultures?
- How do people face change?
- How can human competence and ability be supported as part of the global change?

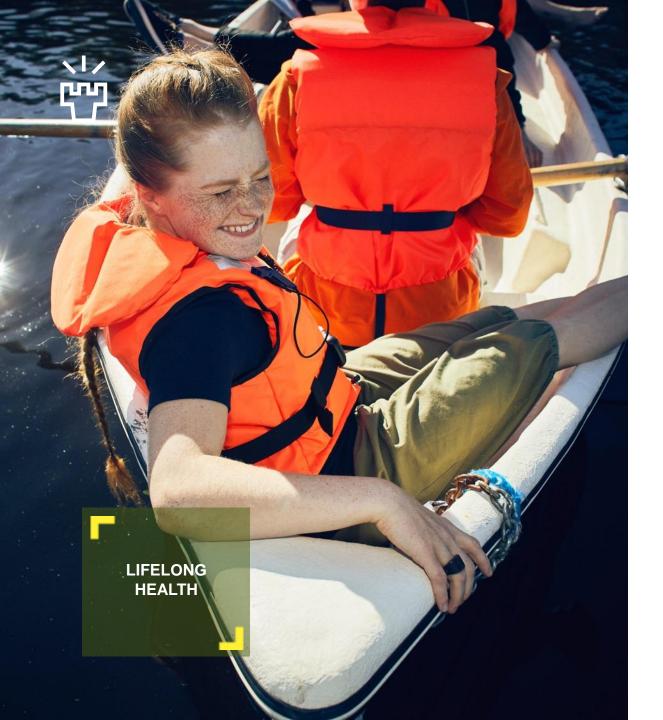
Aristotle and the Greek language: εὐδαιμονία – good and prosperous life, spiritual prosperity, true happiness and good spirits



## **Infotech Oulu**

#### **Research topics**

- Various aspects of modern information technology, including digital technologies, wireless sensors and networks, artificial intelligence, computer vision and electronics
- The development of new methods to strengthen the digitalisation of society
- Ways in which people, communities and societies absorb digital technologies



## **Biocenter Oulu**

#### **Research topics**

- Human life at molecular and physiological level, as well as effects of environmental, social and psychosocial factors
- Combining medical and ICT expertise to create digital health innovations

Development of research infrastructures in national and international networks



## **University of the Arctic**

University of the Arctic is a cooperative, multidisciplinary network of over 200 universities, research institutes and other organizations concerned with education and research related to the Arctic.

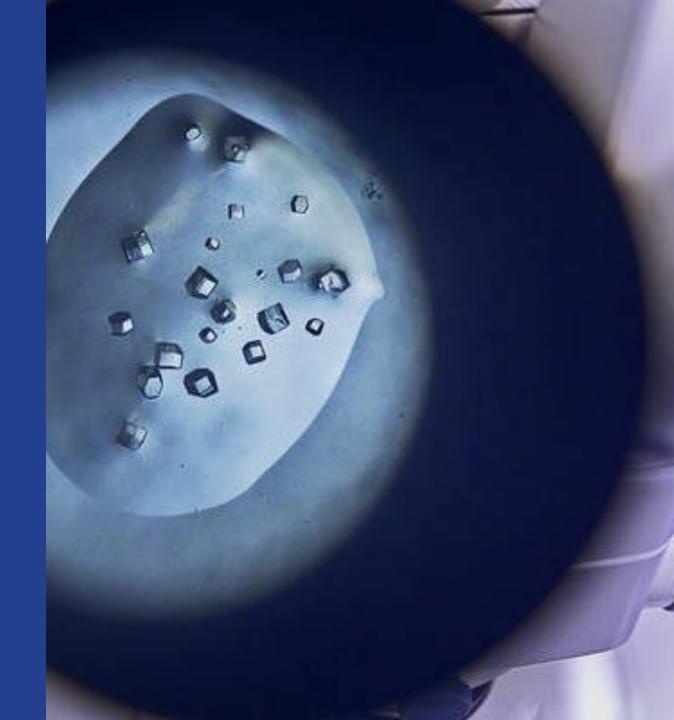
#### Arctic Agenda

Research and innovation regarding e.g. sustainable utilization of natural resources, near-Earth space environment, logistics, technology, and cultures in the Arctic.

#### Joint arctic agenda in collaboration with

Luleå University of Technology, Sweden Umeå University, Sweden UIT The Arctic University of Norway University of Lapland, Finland

# Infrastructure





### **University-level infrastructures**

#### **BCO CORE**

Biocenter Oulu infrastructure centre

#### **Biodiversity Unit**

Zoological Museum, Botanical Museum and Botanical Gardens

#### **OULAC**

**Oulu Laboratory Animal Centre** 

#### LeaF infrastructure

Learning environment

#### 

Centre for Material Analysis

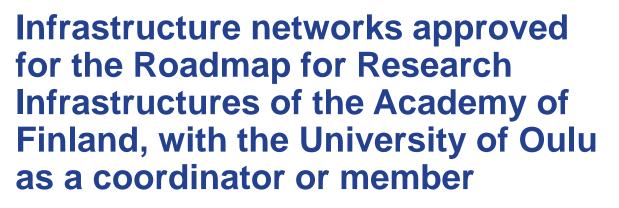
**Oulanka Research Station** 

Regional unit in Kuusamo.



#### International infrastructures whose national coordination is carried out at the University of Oulu

- INFRAFRONTIER, European research infrastructure for the analysis, conservation and distribution of genetically modified mice
- EISCAT and EISCAT\_3D, Scattering radars measure the connection of the geospace environment to the Earth's atmosphere in the Auroral Zone and on the edge of the Polar Vortex
- MAX IV, Next-generation synchrotron radiation source

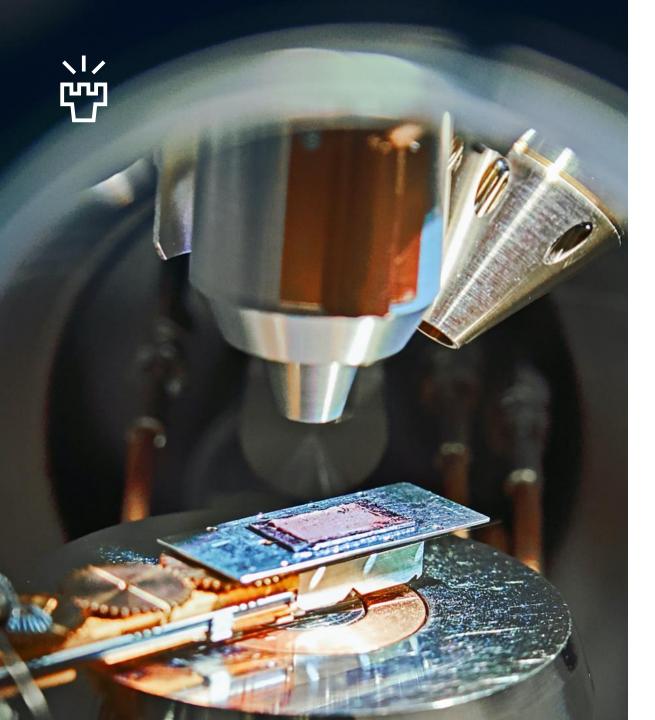


#### **National coordination**

- PII, Printed Intelligence Infrastructure
- FUWIRI, Research Infrastructure for Future Wireless Communications
- E2S, Earth-space research ecosystem

#### Participant in eight Roadmap infrastructures

- Biocenter Finland, bioscience and medical infrastructures
- BBMRI, Biobanking and BioMolecular Resources Research Infrastructure
- EuBI, European Research Infrastructure for Biomedical Imaging
- FinStruct, Structural Biology Finland
- FIRI-PBS, Finnish Research Infrastructure for Population Based Surveys
- FINN-EPOS, European Plate Observing System
- FCCI, Finnish Computing Competence Infrastructure
- FinBIF, Finnish Biodiversity Information Facility



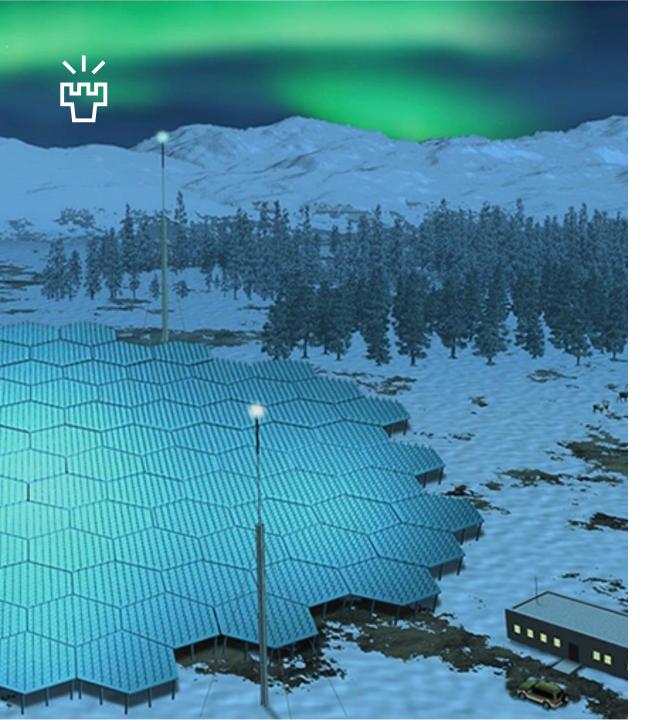
### **Other major infrastructures**

- Biobank Borealis of Northern Finland consortium (University of Oulu, hospital districts of Northern Finland and Nordlab laboratory)
- Northern Finland Birth Cohorts 1966 and 1986
- OBI, Oulu BioImaging (University of Oulu and Oulu University Hospital OYS)
- Minipilot mining laboratory
- Virtual Oulu, open interactive 3D city model
- Virtual Campus, open innovation platform for 3D applications



# Regional units





## Sodankylä Space Campus

Areas of responsibility and research of the University of Oulu

- Monitoring of the Arctic environment
- Monitoring and research of natural hazards
  - Magnetic storms, solar storms, natural radio interference, pulsations, seismics, cosmic particles
- Northern Lights research and forecasts
- Space safety 24/7



Photo: Esa Turunen EISCAT\_3D radar for measuring atmospheric profile



## Kajaani University Consortium

The Kajaani University Consortium consists of four networked universities (Eastern Finland, Lapland, Jyväskylä and Oulu).

Areas of responsibility and research of the University of Oulu

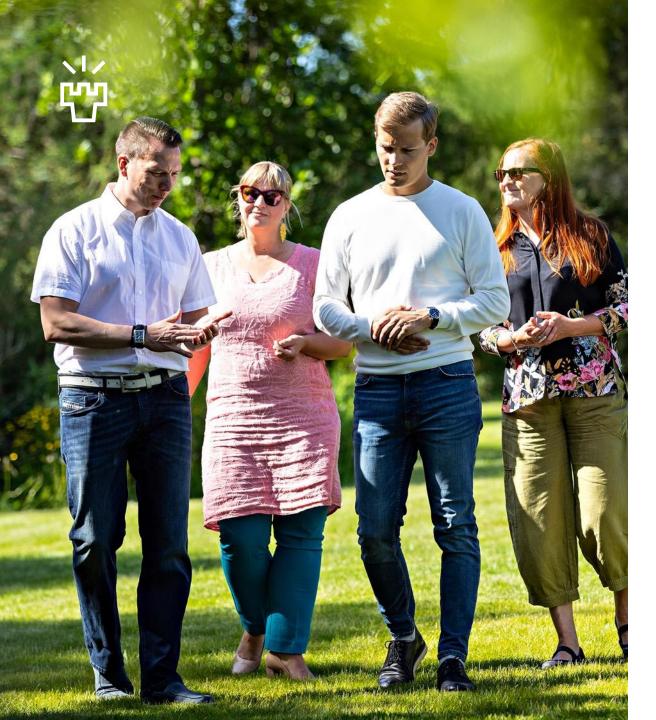
Coordination of the activities of the university centre

- Electrical and information technology, biotechnology, computer science, medicine and adult education

Research focuses on measurement technology – Measurement Technology Research Unit

- Two application areas: cleantech and health & well-being, in which there is sensor development and online analytics
- Main focus is on the bioeconomy





## Kerttu Saalasti Institute

The University of Oulu's Kerttu Saalasti Institute focuses on research and education related to on micro-enterprises and their operating conditions.

The main office of the Institute is in Nivala, and the core region of operation southern part of Northern

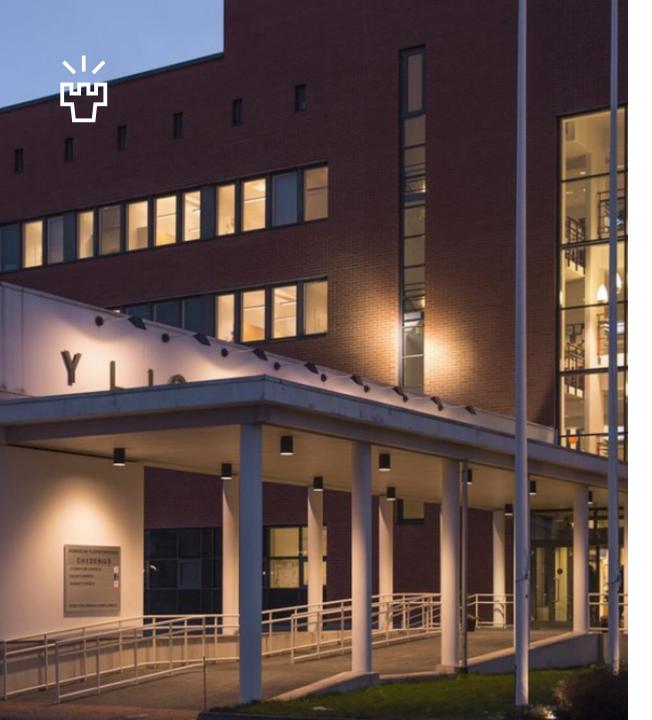
#### 3 research groups

- Micro-entrepreneurship Center of Excellence MicroENTRE<sup>®</sup>
- Future Manufacturing Technologies (FMT)
- Regional Excellence (REx)

#### Micro-entrepreneurship online training

- Continuing education
- Open University education
- Coming: EMBA in micro-entrepreneurship and specialisation training in entrepreneurship education





### Kokkola University Consortium Chydenius

Kokkola University Consortium Chydenius is a multidisciplinary university consortium formed by the universities of Jyväskylä, Oulu and Vaasa. Its activities are coordinated by the University of Jyväskylä.

The Applied Chemistry Research Group is part of the Research Unit of Sustainable Chemistry at the University of Oulu.

Focus areas of research of the University of Oulu in Kokkola

- Energy storage of new inorganic materials in Li-ion batteries
- Inorganic catalytic materials and processes for biomass processing
- Chemical precipitation and coagulation, inorganic adsorbents in (waste) water and process water treatment
- Solubilisation, solution purification and precipitation in an inorganic industrial circular economy





## Education of the University of Oulu at the Kokkola University Consortium Chydenius

The education of the University of Oulu in Kokkola is fully integrated into the Degree Programme in Chemistry

- M.Sc. Degree in Chemistry of Sustainable Processes and Materials (inorganic chemistry + process technology)
- Open University education
- Postgraduate studies in science (Ph.D. in chemistry, D.Sc. in chemical technology)
- Cooperation with Centria in the field of higher education in chemistry and chemical technology





# OULU

NORTHERN, HUMANE AND SMART OULU

HOME OF 208,000 PEOPLE

AVERAGE AGE OF RESIDENTS 39

**EASILY REACHABLE NORTHERN GROWTH CENTRE** 





University of Oulu

## **Quality of life**

### COMFORTABLE LIVING

VERSATILE POSSIBILITIES FOR LEISURE ACTIVITIES SERVICES THAT WORK SMOOTHLY

#### **EVERYWHERE IN 20 MINUTES**

Nearly 80% of Oulu residents estimate their quality of life is good. (Organisations & governance surveys and studies 2020, FCG)

Overall satisfaction with services in Oulu is at a good level (3,75/5) and has increased in recent years. (Organisations & governance surveys and studies 2020, FCG)



## Jobs, innovations and trade

CITY OF TECHNOLOGY – MOST R&D INVESTMENTS IN FINLAND PROPORTIONATE TO THE NUMBER OF INHABITANTS

STRONG BASIC INDUSTRY – WOOD, CHEMISTRY, STEEL, AND RELATED INNOVATIONS

TRADE, CONSTRUCTION, ARCHITECTURE AND DESIGN

TOURISM AND SERVICES AS GROWING INDUSTRIES



## Leisure

#### **CYCLING CAPITAL OF FINLAND**

### CITY CLOSE TO NATURE, SEA AND RIVERS

#### ENJOY SPORTS AND EXERCISE OUTDOORS AND INDOORS

- There is more than **900 km** of purpose-built roads for pedestrian and bicycle traffic in the Oulu region.
- Cycling is especially common among schoolchildren (more than 50% of school trips by bike).
- Oulu has been ranked as the best winter biking city in the world.
- Finland's most comprehensive bicycle route guidance has been implemented in the Oulu region (2019).



THE REAL PROPERTY AND

ACTIVATION OF A PROPERTY AND

DENER STREET

# OULU EUROPEAN CAPITAL OF CULTURE 2026



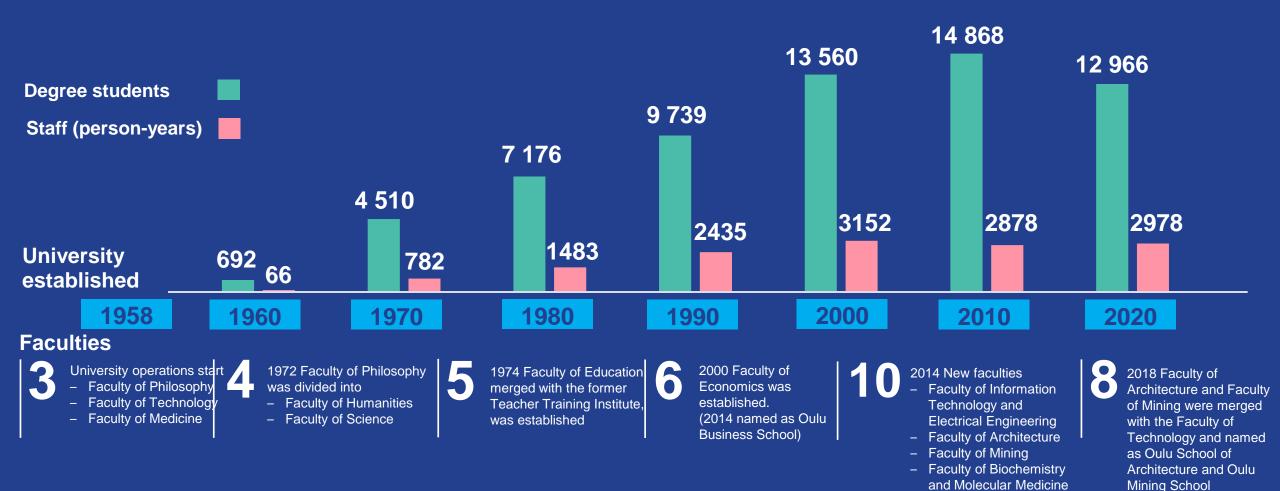
# University of Oulu history



Minister of Education Kerttu Saalasti had a strong influence to the establishment of the University of Oulu. President Urho Kekkonen signs the law proposal of establishment of the University of Oulu on 25 October 1957.

15

# The first 60 years of the University of Oulu



University of Oulu



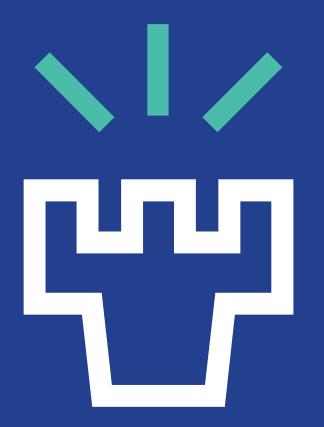
## #arcticattitude

We are situated close to the Arctic region, humanity's new frontier. The demanding conditions of the far north have always forced people to be inventive and resourceful, and many innovations that have changed the world have their roots here.

At the University of Oulu, we call this Science with Arctic attitude.

# Thank you!





## UNIVERSITY OF OULU



# Key figures

