Photonics is now widely recognized as a **major innovation enabling discipline for the 21st century**. It can be defined as the field of science and technology where the fundamental properties of light (=photon) and its interaction with matter are studied and applied.

Since several decades photonics has been penetrating in ever more applications and household appliances, sectors such as tele- and datacom, display and camera industry, biotechnology, solar energy, medical instrumentation, laser material processing, etc.

Ghent University offers a dedicated master of science program in photonics since 2006: the **European Master of Science in Photonics** whereby the main focus is on photonics but also reaches into the fields of electrical engineering and applied physics.

**Tele- & Datacommunicatie**

**Sensing**

**Manufacturing**

**Energy**

**Display Technology**

**Healthcare**
About the program

Ghent University (UGent) and Vrije Universiteit Brussel (VUB) jointly offer a two-year (120 ECTS) **European Master of Science in Photonics**. It leads to a joint UGent-VUB Master of Science degree.

The program provides an in-depth education in photonics, with a focus on both the fundamental science and the engineering of light-based phenomena and systems. Photonics graduates move into PhD positions in top level research groups all around the world or into industry.

The program:

- teaches all the **core photonics courses**
- offers **advanced photonics courses in multiple fields of specialization**
- allows students to broaden their degree to with a secondary engineering specialization
  - in electrical engineering
  - in applied physics
  - In biomedical engineering
- has a strengthened focus on:
  - **Photonic skills**
    (measurement, engineering and research skills)
  - **Employability**
    (internship, entrepreneurship, photonics in industry)
- includes a mandatory **European mobility component**, to be realized by choosing one of the mobility tracks
- includes a **master thesis project** in a research lab
The European Master of Science in Photonics is accessible for both students from an Electrical Engineering background as well as from an Applied Physics or Engineering Physics background. Students must have completed a minimum of 180 ECTS credits (typically a three year bachelor) but is also open to students with a master degree who wants to specialize in the field of photonics.

Each year between 25 and 35 students start this master program which allows them to have a close interaction with their fellow students, the teaching assistants and with the professors.

We also ensure that there is plenty of opportunity to get into contact with the reseachers, people from industry both in a formal and informal setting.

The student population consists of both local UGent students, European students and students from elsewhere in the world.
Overview of the program

Program
- English-taught
- Two-year program, 120 ECTS credits
- Master of Science degree in Photonics
- Started in 2006
- Over 250 graduates

Features
- Basic & Specialised Photonics courses
- Strong focus on hands-on training
- Master thesis in advanced research labs
- Internationale experience

Balanced
- 35 % Theorie
- 10 % Soft Skills
- 30 % Labs
- 25 % Master thesis

Fotonica +
- Broadening in another engineering field:
  - Electronics
  - ICT
  - Applied physics
  - Biotech & Biomedical

Career opportunities
- 65 % works in industry
  - R&D
  - Sales/Business Support
  - Technisch Management
  - Consultancy
- 35 % starts a PhD

Networking
- Light Nights
- Photonics Summer Symposium
- Photonics Event
- Student Chapters
  - Ghent Optics Society
  - IEEE
### Structure

<table>
<thead>
<tr>
<th>Semester 1 – Fundamental Basic Photonic Courses</th>
<th>UGent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 2 – Hands-on Skills &amp; Photonics Applications</td>
<td>UGent</td>
</tr>
<tr>
<td>Semester 3 – Photonics Specialisation &amp; Broadening Engineering</td>
<td>UGent</td>
</tr>
<tr>
<td>Semester 4 – Master Thesis</td>
<td>UGent</td>
</tr>
<tr>
<td>Photonics Summer Symposium</td>
<td></td>
</tr>
<tr>
<td>UGent-VUB Master of Science degree</td>
<td></td>
</tr>
</tbody>
</table>

---

**Joint UGent-VUB**

All **mandatory courses** can be followed either at Ghent University or at Vrije Universiteit Brussel. The courses are taught in parallel on both institutions by a team of professors.

The **electives courses** are taught at one of both institutions. By means of teleclassing students don’t need to commute but can follow VUB-taught electives in the UGent teleclassing room.

For hands-on lab courses, students need to commute to the other partner (easy access by train). The traintickets are reimbursed at the end of the academic year by the program board.

The program leads to one joint degree issued by Ghent University and signed by both UGent and VUB.
International experience is of great importance in present-day society and in the current labor-market. A survey among employers shows that one expects of his co-workers to be capable of collaborating in an international context.

To reply to this demand, all students in master of science programs at Ghent University have the possibility to take courses or do a master thesis project in another university. This is the so-called **Erasmus-exchange**.

In the European Master of Science in Photonics, this kind of exchange is embedded and incorporated in the curriculum.

In academics as well as in industry, international experience, being mobile, learning to adapt to different circumstances/cultures, is a very important asset and in some cases even a must.
International mobility

Within the European Master of Science in Photonics, students must complete part of their program outside Belgium. This length can vary between a short period of a couple of weeks to a longer period (maximum 1 academic year).

Four distinctive mobility tracks were designed to realize this objective.

Students can apply for a Erasmus+ scholarship in order to get a monthly fee to compensate (part of) their costs.

We collaborate with prestigious high-level European partner universities.

The program supports the students in an active manner by selecting, together with the students, the appropriate courses at the partner universities or to define, together with professors or research-labs from the partner universities, a suitable master thesis project.

Choose between 4 ‘Mobility Tracks’

**Mobility Track 1**

Courses (30 ECTS) at a partner university

**Mobility Track 2**

Master thesis * (30 ECTS) project
in collaboration with a partner university

**Mobility Track 3**

Courses (30 ECTS) and master thesis * (30 ECTS) project
at a partner university

**Mobility Track 4**

International internship (10 ECTS)
in a company or research lab

*the master thesis project can be fully (1 semester) or partially done at the partner university
Partner universities

Coordinating universities
- UGent (BEL)
- VUB (BEL)

Preferential partners
- St Andrews (GBR)
- DTU (DNK)
- ICFO (ESP)
- UPV (ESP)
- Lund (SWE)
- ITMO (RUS)
- KIT (DEU)
- EPFL (CHE)
- ECM (FRA)

Other possibilities
- ETH Zurich (CHE)
- NTUA (GRC)
- TUBerlin (DEU)
- ParisTech (FRA)
- KTH (SWE)
- WRUT (POL)
- WUT (POL)
- Polimi (ITA)
## Year 1

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Materials</td>
<td>6</td>
<td>UGent</td>
</tr>
<tr>
<td>Photonics</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Microphotonics</td>
<td>6</td>
<td>UGent</td>
</tr>
<tr>
<td>Lasers</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Mathematics in Photonics</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Introduction to Entrepreneurship</td>
<td>3</td>
<td>UGent</td>
</tr>
<tr>
<td><strong>Semester 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratories in Photonics Research</td>
<td>6</td>
<td>UGent (+ VUB)</td>
</tr>
<tr>
<td>Optical Communication Systems</td>
<td>6</td>
<td>UGent</td>
</tr>
<tr>
<td>Sensors and Microsystem Electronics</td>
<td>6</td>
<td>UGent</td>
</tr>
<tr>
<td>Physics of Semiconductor Technologies and Devices</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Innovation in Photonics</td>
<td>3</td>
<td>UGent</td>
</tr>
<tr>
<td>Photonics Electives</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
Year 2

<table>
<thead>
<tr>
<th>ECTS</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1</td>
<td></td>
</tr>
<tr>
<td>Photonics Specialisation</td>
<td>12 - 20</td>
</tr>
<tr>
<td>Secundary Engineering Specialisation</td>
<td>10 - 18</td>
</tr>
<tr>
<td>‘free to spend’</td>
<td>6 - 8</td>
</tr>
<tr>
<td>Semester 2</td>
<td></td>
</tr>
<tr>
<td>Master thesis project</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
</tr>
</tbody>
</table>

Mobility Tracks
In the second year students to up courses and/or do their master thesis project at UGent or at a partner university, depending on the mobility track selected by the student.

Within each mobility track, the distribution of ECTS credits of ‘Photonics Specialisation’ and ‘Secundary Engineering Specialisation’ is more or less identical.

The ‘free to spend’ ECTS, can be used to either take up more photonics electives or more engineering electives. It also allows the students to choose electives from the entire course offering at Ghent University.
## Lecture schedule Year 1 – Semester 1

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-11:30 Microphotonic</td>
<td>10:00-11:30 Lasers</td>
<td></td>
<td>08:30-11:30 Mathematics in Photonics</td>
<td>10:00-13:00 Optical Materials Lab</td>
</tr>
<tr>
<td>Lab</td>
<td>11:30-13:00 Lasers Lab</td>
<td></td>
<td>11:30-13:00 Optical Materials Lab</td>
<td></td>
</tr>
<tr>
<td>13:00-16:00 Microphotonic</td>
<td>13:00-14:30 Optical Materials</td>
<td><strong>Reserved for electives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab</td>
<td>15:30-18:00 Introduction to entrepreneurship</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Lecture schedule Year 1 – Semester 2

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-13:00 Optical Communication Systems</td>
<td>Laboratories in Photonics Research</td>
<td><strong>Reserved for electives</strong></td>
<td>10:00-13:00 Physics of Semiconductor Technologies and Devices</td>
<td>10:00-11:30 Optical Communication Systems Lab</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00-19:00 Innovation in Photonics</td>
<td></td>
<td></td>
<td>13:00-16:00 Sensors and Microsystem Electronics Lab</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Lectures</strong></td>
<td><strong>Labs</strong></td>
<td></td>
<td><strong>Entrepreneurship</strong></td>
</tr>
</tbody>
</table>
## Photonics Electives

In year 1, **8 credits** (ECTS) are taken up from the list below. In year 2, depending on the chosen mobility track, again **between 12 and 20 credits** (ECTS) are taken up.

<table>
<thead>
<tr>
<th>Course</th>
<th>ECTS</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Spectroscopy of Materials</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Display Technology</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Non-linear Optics</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>High Speed Photonic Components</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Biophotonics</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Photonic Integrated Circuits</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Optical Sensors</td>
<td>4</td>
<td>VUB (^1)</td>
</tr>
<tr>
<td>Design of Refractive and Diffractive Optical Systems</td>
<td>4</td>
<td>VUB (^2)</td>
</tr>
<tr>
<td>Optical Design with Ray-tracing Software: Laboratory</td>
<td>4</td>
<td>VUB (^2)</td>
</tr>
<tr>
<td>Introduction to Quantum Physics for Electrical Engineering</td>
<td>4</td>
<td>VUB (^1)</td>
</tr>
<tr>
<td>Technological Processes for Photonics and Electronics: Laboratory</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Photovoltaic Energy Conversion</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Quantum Optics</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Micro- and Nanophotonic Semiconductor Devices</td>
<td>4</td>
<td>UGent</td>
</tr>
<tr>
<td>Internship in Photonics</td>
<td>4</td>
<td>company</td>
</tr>
</tbody>
</table>

1. Teleclassing is available  
2. Traintickets are reimbursed
Engineering Electives

In Master Year 2, depending on the chosen mobility track, between 10 and 18 credits (ECTS) are selected.

<table>
<thead>
<tr>
<th>Electrical Engineering</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Antennas and Propagation</td>
<td>6</td>
</tr>
<tr>
<td>Design of Analog Circuits and Building Blocks</td>
<td>6</td>
</tr>
<tr>
<td>VLSI Technology and Design</td>
<td>6</td>
</tr>
<tr>
<td>Information Theory</td>
<td>6</td>
</tr>
<tr>
<td>Complex Systems Design Methodology</td>
<td>6</td>
</tr>
<tr>
<td>High-speed Electronics</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Applied Physics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid-state Physics and Semiconductors</td>
<td>6</td>
</tr>
<tr>
<td>Physics of Semiconductor Devices</td>
<td>6</td>
</tr>
<tr>
<td>Micro-analysis &amp; Structure Determination in Materials Science</td>
<td>6</td>
</tr>
<tr>
<td>Plasma Physics</td>
<td>6</td>
</tr>
<tr>
<td>Physical Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Subatomic Physics</td>
<td>6</td>
</tr>
<tr>
<td>Atomic and Molecular Physics</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biomedical Engineering</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelling of Physiological Systems</td>
<td>6</td>
</tr>
<tr>
<td>From Genome to Organism</td>
<td>6</td>
</tr>
<tr>
<td>Quantitative Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biomaterials</td>
<td>6</td>
</tr>
<tr>
<td>Biomechanics</td>
<td>6</td>
</tr>
<tr>
<td>Biomedical Imaging</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations Management</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations Research Models and Methods</td>
<td>6</td>
</tr>
<tr>
<td>Engineering Economy</td>
<td>4</td>
</tr>
<tr>
<td>Information Technology and Data Processing</td>
<td>6</td>
</tr>
<tr>
<td>Heuristics and Search Methods</td>
<td>4</td>
</tr>
<tr>
<td>Supply Chain Engineering</td>
<td>6</td>
</tr>
<tr>
<td>Estimation and Decision Techniques</td>
<td>4</td>
</tr>
</tbody>
</table>
Within the program, there is a strong focus on both employability and on entrepreneurship / entrepreneurial skills.

- **Courses**
  - Introduction to Entrepreneurship
  - Innovation in Photonics

- **Internships**
  - Internship in Photonics - 5 weeks
  - International Internship - 10 to 12 weeks

- **Company visits**
- **Lectures** by people from industry
- **Student-entrepreneur** status possible

Caro (UGent Photonics student on exchange at DTU) participates with her team at the mai Bangkok Business Challenge

Nice work from EMSP-alumnus Francesco (et al.) @infinityPV @eu_photonics
#EMSPalumni@work! Good luck!

Congrats to EMSP alumnus Chiao-Wei Hsu with third place! #swbru
“For the industry, photonics engineers can make the quantum leap. Shaping the photonic industrial revolution starts with the right education.”

- Jan Watté -
group leader R&D Optics
Commscope

“I enjoyed my internship within AMS/CMOSIS very much. A great experience to learn how companies work and how vital precise measurements are in real-life.”

- Cheyenne Goeminne -
student
European MSc. in Photonics
Career possibilities

- **65%** industry
  - R&D
  - project management
  - consultancy
  - sales/business support

- **35%** PhD

* based on 250 graduates since 2006-2007
  based on international students only: 60% PhD, 40% industry
Photonics industry in Belgium
Where do we have alumni in PhD?

**Binnen Europa**
- TU Wien, Austria
- UGent, Belgium
- KUL, Belgium
- VUB, Belgium
- DTU, Denmark
- Paris-Sud, France
- Institut Fresnel, France
- TU Berlin, Germany
- Max Planck, Germany
- Uni Koln, Germany
- GSI, Germany
- NUI Tyndall, Ireland
- NUI Galway, Ireland
- University of Naples, Italy
- Twente, the Netherlands
- TU Eindhoven, the Netherlands
- Trondheim, Norway
- UPM, Spain
- KTH, Sweden
- Uppsala, Sweden
- EPFL, Swizterland
- St Andrews University, UK
- ORC Southampton, UK
- Heriot-Watt, UK
- ...

**Buiten Europa**
- CUDOS, Sydney, Australia
- Swinburne, Australia
- KAUST, Saudi-Arabia
- Masdar Institute, United Arab Emirates
- CREOL, USA
- Stanford, USA
- Yale, USA
- Columbia University, USA
- MIT, USA
- ...

Spin-off @UGent

trinean
Caliopa
LUCEDA Photonics
EYEco eyeCO
indigo

(+ five more in the pipeline)

Research @UGent

nb-photonics
Center for Nano- and Biophotonics
Ghent University

Photonics Research Group

Liquid Crystals and Photonics

Cmst
LumiLab
Alumni Testimonials

Alex Liles
- Master in photonics: 2011 - 2013
  - Internship at CERTH (Greece)
  - Thesis at DTU (Denmark)
- PhD at St Andrews University: 2013 - ...

*The European MSc. in Photonics offers the students exposure to cutting-edge research and top-level infrastructure in leading European academic institutes, providing knowledge and skills necessary for pursuing a career in academia as well as in industry. Most importantly, the mobility tracks of the program sets an excellent ground for professional networking and cultural education which combined can make you stand out from the -competitive- crowd. Intensive, demanding but I would recommend it any time!“*

Pierre Wahl
  - Courses at KTH (Sweden)
- PhD at VUB & Stanford (USA): 2009 - 2014
- Co-founder Luceda Photonics (spin-off): 2014 - ...

*The level of the courses is high. After completing the program I feel prepared to be a researcher and for the job market.*

Tanbir Hasan
- Master in photonics: 2010 - 2012
  - Internship at VTT (Finland)
  - Design Engineer bij AMSL (Netherlands): 2012 - ...

*Rich and diverse course curricula & access to state-of-the-art lab facilities proved quite invaluable later when I joined the R&D department of ASML, a leading provider of optical lithography in the world.*
Maria Anagnosti
- Master in photonics: 2009 - 2011
  - Internship at Xio Photonics (Netherlands)
  - Internship at NTT (Japan)
  - R&D at Alcatel-Lucent / Nokia (France): 2012 - 2015
  - Hardware Development Engineer at Infinera (USA): 2016 - ...

The MSc. in Photonics programme was a life time opportunity for me to study and learn about High Technology Photonic sciences, experience different cultures and meet a lot of interesting people. The courses provided prepare the students for both an academic career and also an industrial position.

Camiel Op de Beeck
  - Vakken + Thesis aan UPV (Spanje)
  - PhD aan de UGent: 2016 - ...
  - in het domein van Terahertz wave generation

After my BSc. in Physics Engineering, I was in doubt about how to proceed. The MSc. in Photonics offered me a very flexible and customizable program that fitted my interests. The photonics courses open up a world of possibilities where all the theory from the bachelor becomes relevant. The international aspect might seem like a hurdle at first, but it really is an invaluable experience for any engineer.

Alvaro Casas Bedoya
  - Courses + Thesis at University of St Andrews (UK)
  - PhD at Sidney University (Australia): 2009 - 2013
  - Postdoctoral Research Associate at CUDOS (Australia): 2013 - ...
  - Cleanroom manager, OSA Ambassador

Surprisingly for me, the researchers, who are writing the science right now, were my professors. This is surely one of the best options for any photonics aspirant...
• **Ghent Optics Society**
  - SPIE Ghent chapter
  - SID Lowlands Branch

• **IEEE Photonics Benelux Student Chapter**

Both chapters/societies consist of researchers, PhD-students and master students. The master students participate actively in both societies.

Each semester a **Light Night** is organized by one of the chapters whereby a guest lecturer is invited (from industry or academics) or a workshop is organized or the students engage in a quiz or game-night.

*Students during a company visit to Philips Museum in Eindhoven (NL)*

*Student chapter activity: Laser Game: Khet 2.0*
During the two-day **Photonics Summer Symposium** the final year students present (and defend) their master thesis topics and some international speakers are invited to give a talk.

During the annual **Photonics Event** companies come to present themselves to the students and researchers. This year imec, luceda photonics, commscope, huawei and trinean organized a hands-on workshop whereby students could interact with the companies.

Students have the opportunity to attend **conferences** or participate in **summer schools** or **workshops**. In 2016 students attended SPIE Photonics Europe (conference) & the IEEE Photonics Benelux Annual Symposium and attended the Silicon Photonics Summer School.
Why choose photonics?

**At the Heart of Technology**
Photonics plays an essential role in a variety of new and innovative technologies such as green energy, biotech, industry 4.0, ICT, multimedia & healthcare.

**Excellent Career Opportunities**
Within 3 months after graduation, over 95% of the students has found a job. Students who wants to starts a PhD have plenty of opportunity at one of UGent’s research groups or in research labs worldwide.

**International Experience**
Due to the mobility tracks, students acquire the indispensable international experience which is required in present-day society and the current job-market.

**Comprehensive Degree**
Students become photonics specialists but as today’s engineers mostly work in a multidisciplinary environment, they can prepare themselves by taking up a number of specialized courses from another engineering discipline.

**Education by World-Class Researchers**
The education is given by professors who not only excel in teaching but also excel in research on a European and even worldwide scale. A fair number of professors have received a prestigious European Research Council Grant.

**Balanced Program**
Besides a firm technical knowledge, there is also a very strong focus on hands-on skills and a focus on employability and entrepreneurship whereby the basic concepts of economy, IP, starting your own business are tackled.
Chair of the Program Board:

Prof. Dries Van Thourhout  
(dries.vanthourhout@ugent.be)

Education & Outreach Officer:
Bert Coryn  
(bert.coryn@ugent.be)