Introduction to Photonics

Lecture 00: Introduction to the course

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Contents

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What is photonics?

The suffix -ics

Synonym: -logy

Forms nouns referring to fields of knowledge or practice.

Linguistics

Linguist + ics

The scientific study of language.

Electronics

Electron + ics

The study and use of electrical devices that operate by controlling the flow of **electrons** or other electrically charged particles or by converting the flow of charged particles to or from other forms of energy.

Photonics

Photon + ics

The science and technology of generating and controlling **photons**, particularly in the visible and near infrared light spectrum.

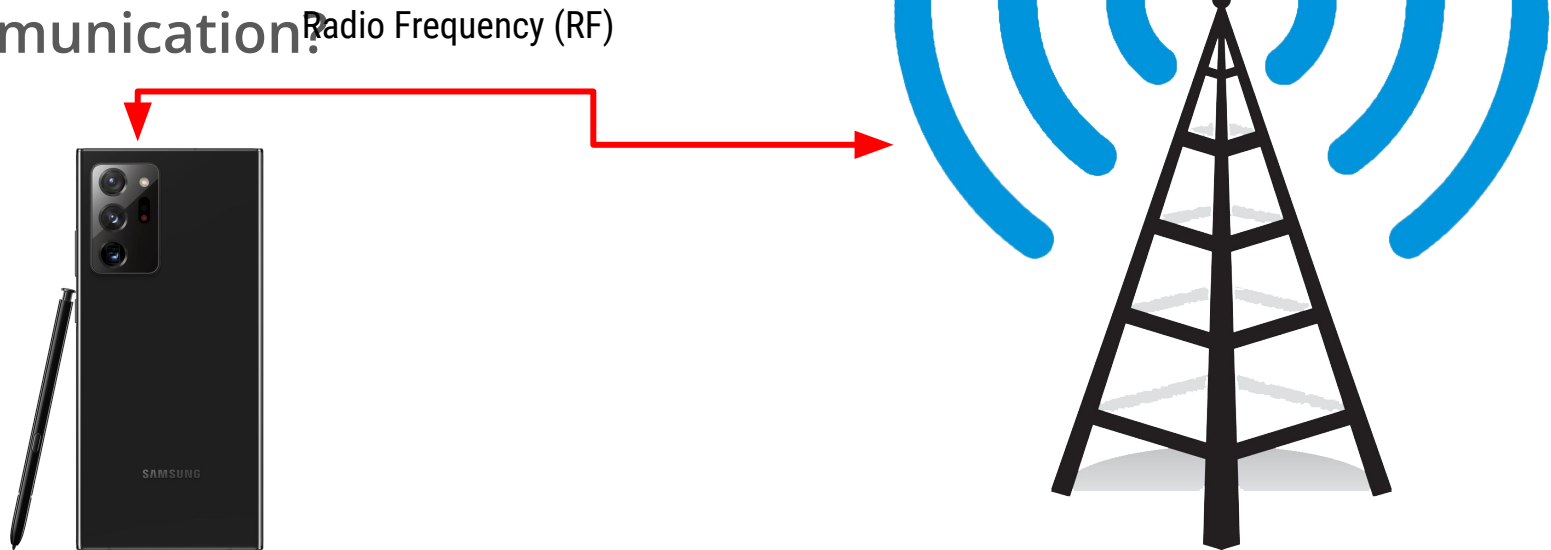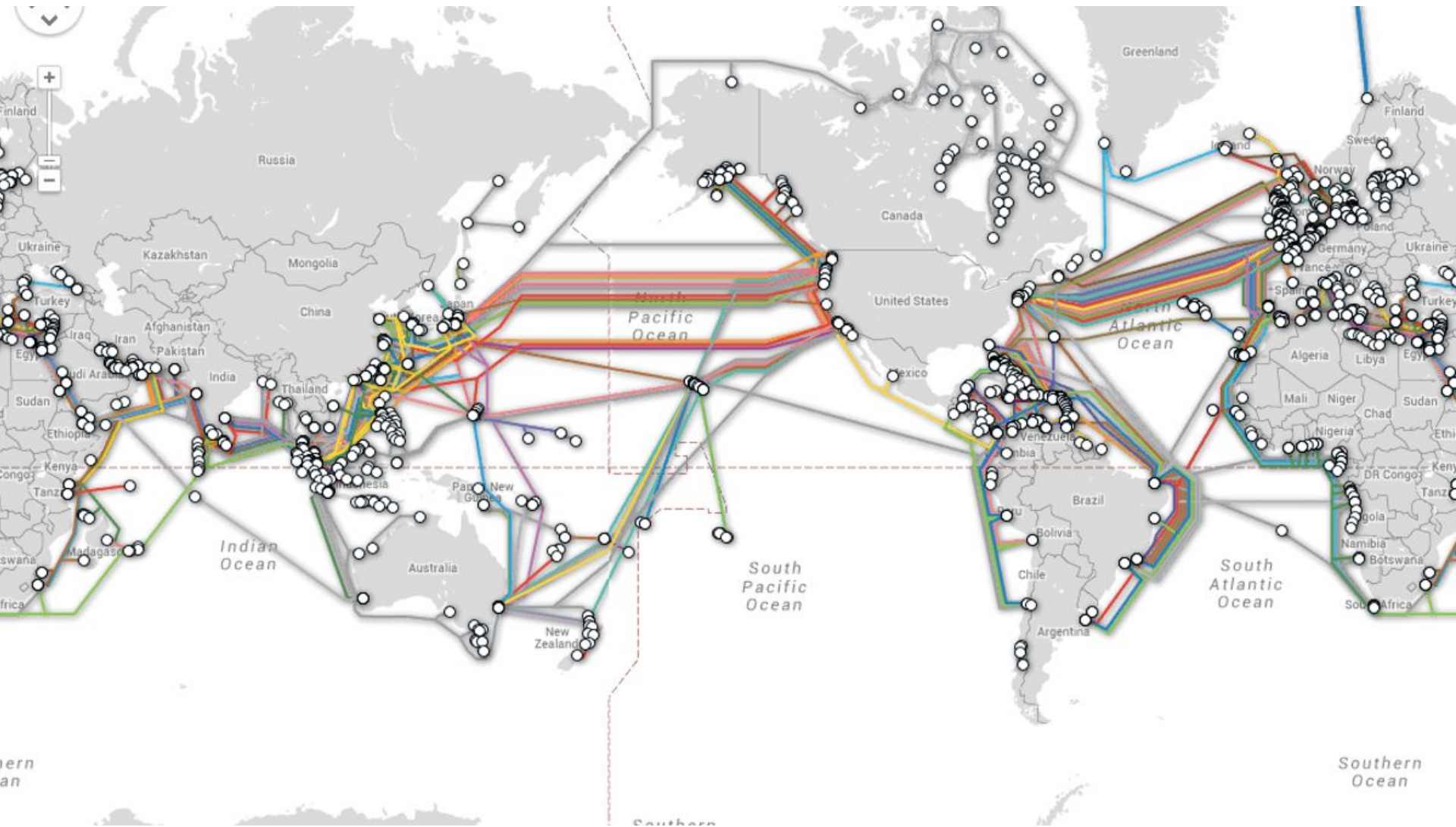**Photonics** is the science of light.

What do we use light for?

Example: Optical communications

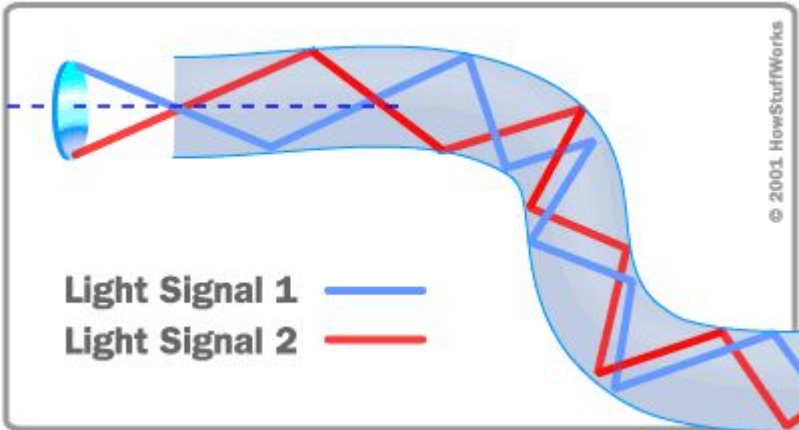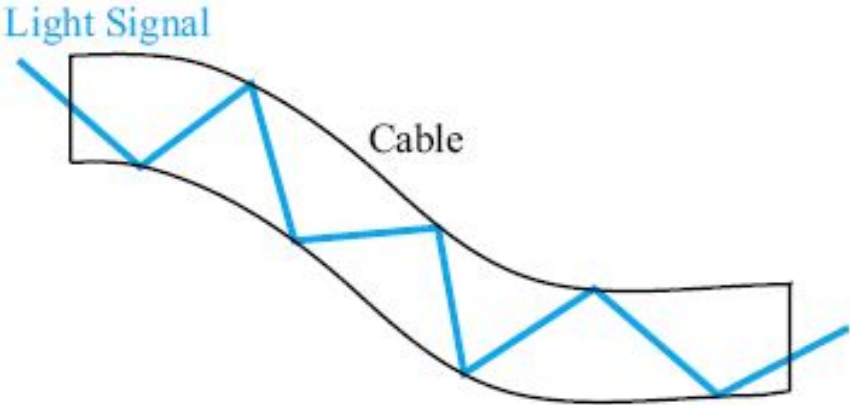What is the most common application using optical communication?

Radio Frequency (RF)

Example: Optical communications

Example: Optical communications

Very good example to say why do we need to study about light!

Light Signal

Cable

Light Signal 1

Light Signal 2

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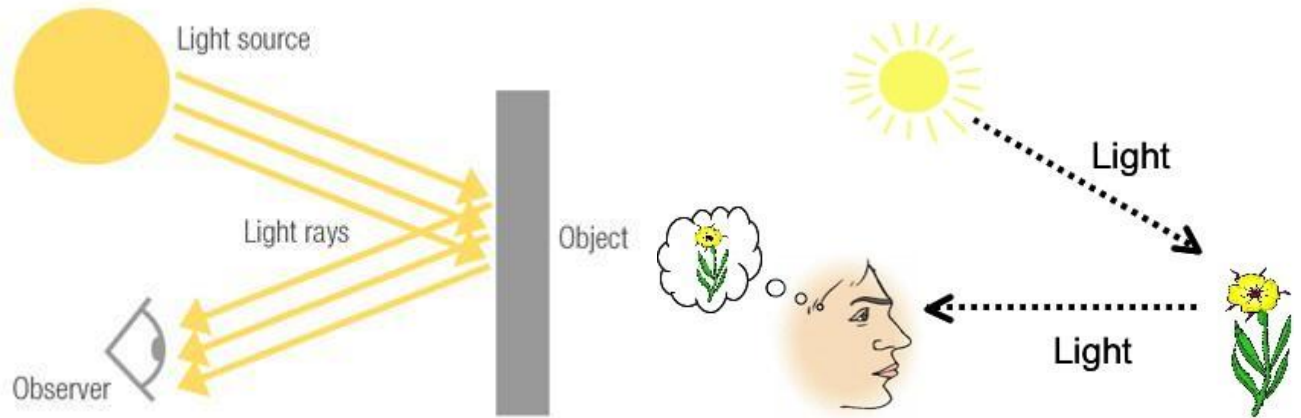
Example: How can you see things?
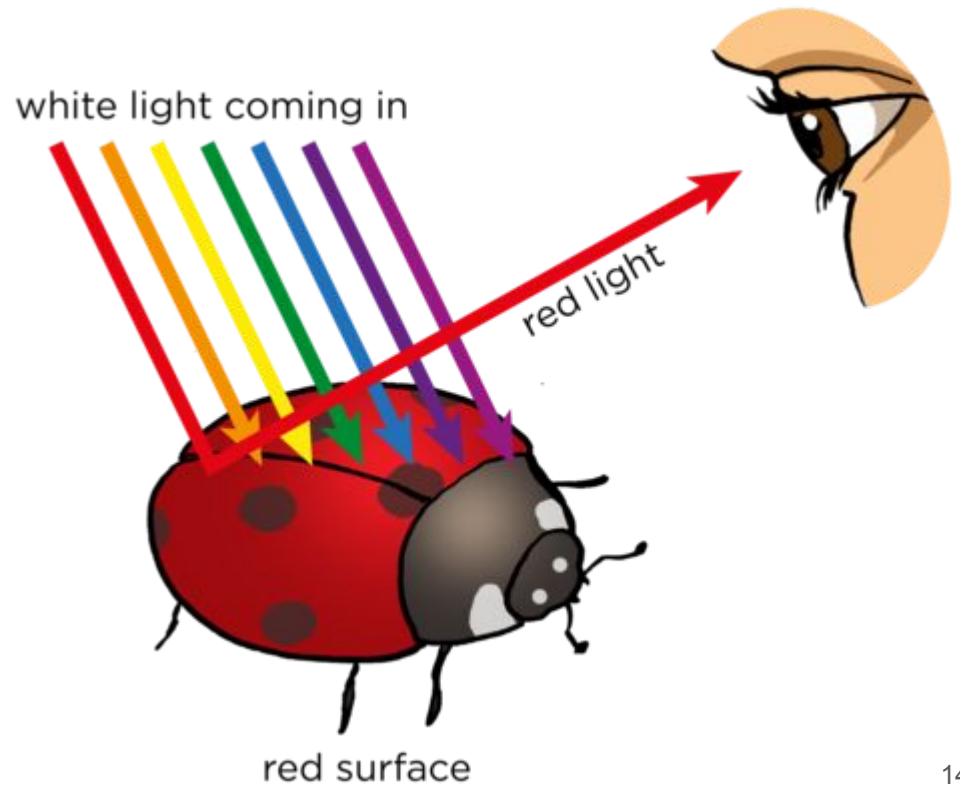
Based on light

Light sources:

- LED lamps
- Fluorescent lamps
- Incandescent light bulbs
- Fire
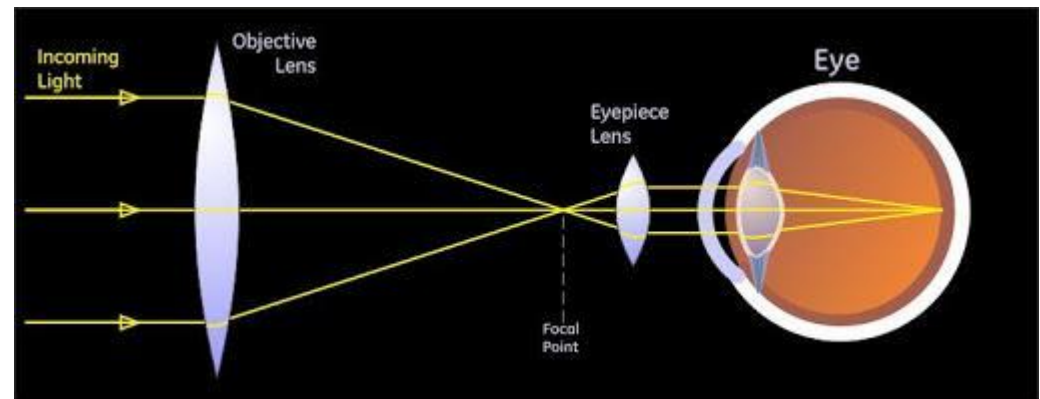- ...

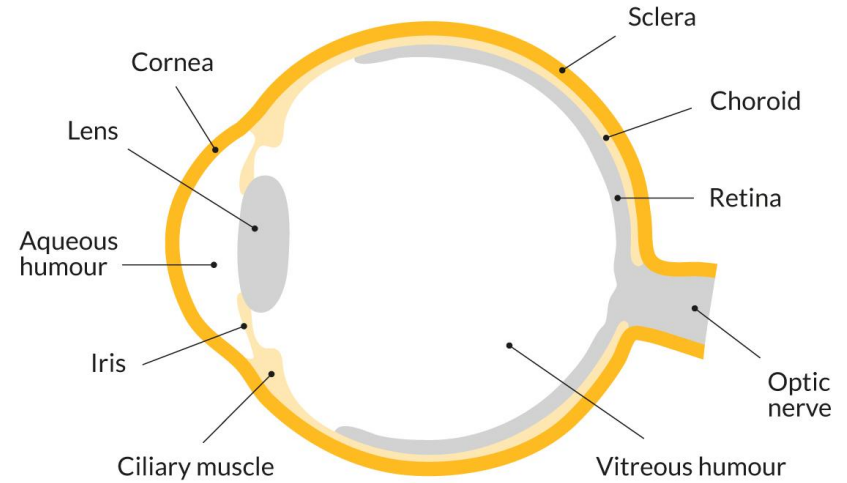# Example: How can you see things?

- Light falls on thing reflect and scatter before coming to human eyes.
- Your eyes are light detectors: See images in the eyes.

The whole process of human vision

- Able to detect light
- Able to use light ⇒ observe

Imaging technologies

All the imaging that is happening… uses light

- Biomedical imaging
- Augmented Reality
- Robotics
- …

Biomedical imaging

- Seeing the internal parts of human body through endoscopy.

Augmented Reality

- mixes 2 different scenarios and it is able to give extra information than what you normally have with your
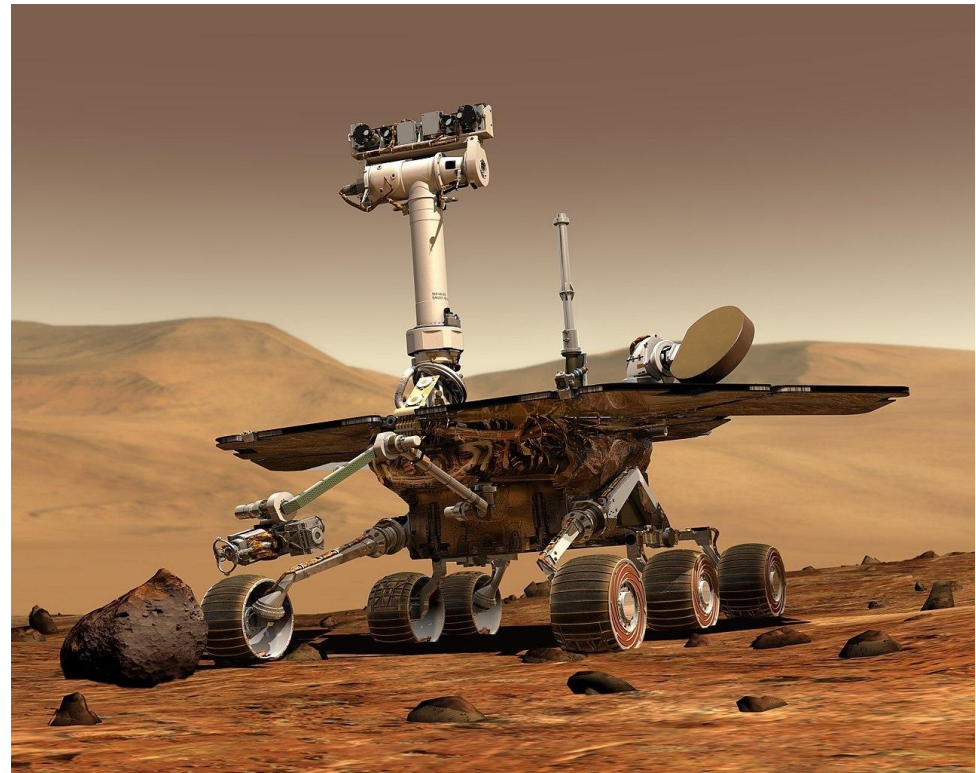
Robotics

- Autonomous Driving
- the whole thing about robotics, it is able to see the situation or things around it and able to take actions.

⇒ **All those require light-base technology**

- Big role in our everyday lives.
- Continue to change the way we see things and get things done.
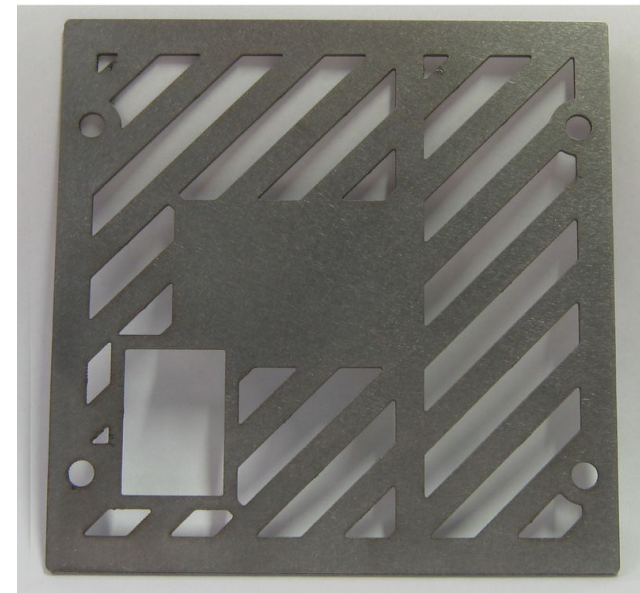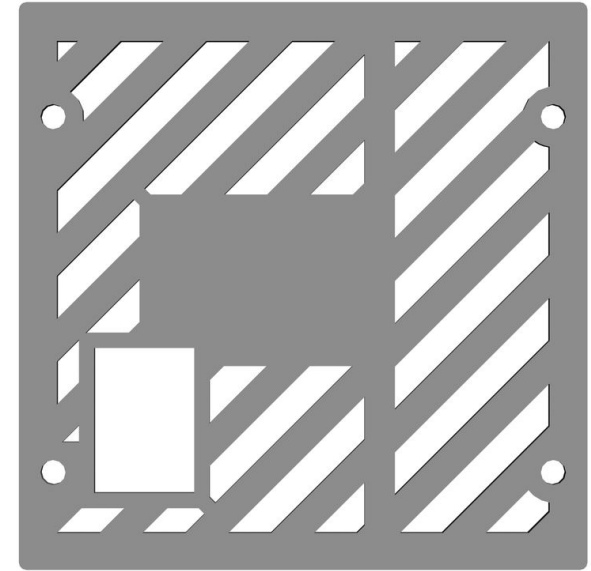
Gesture recognition

interpreting human gestures via mathematical algorit
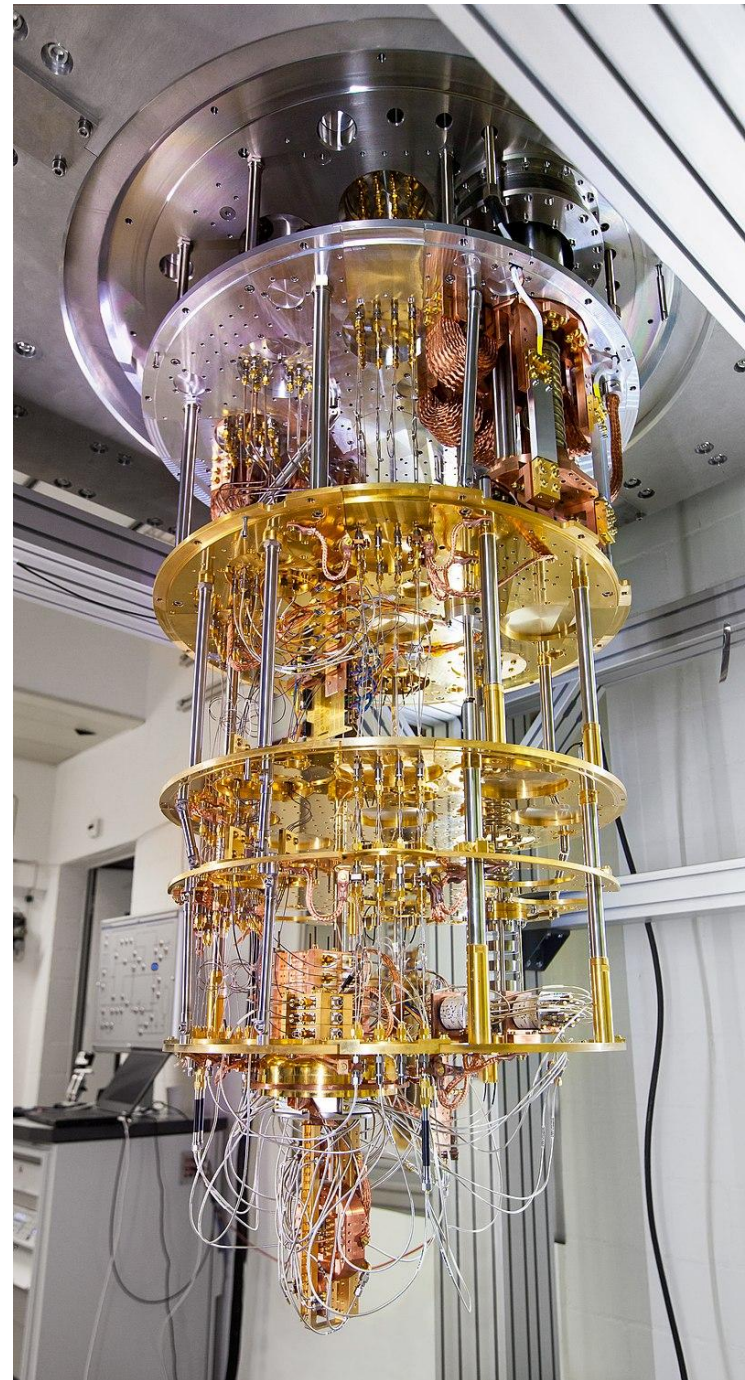
Material processing

Laser cutting: uses a laser
to slice materials.

Quantum computing

Quantum computer based on superconducting qubits developed by IBM Research in Zürich, Switzerland. The qubits in the device shown here will be cooled to under 1 kelvin using a dilution refrigerator.

- Next generation of computer?
- based on things

What do we use light for?

So many applications that are based on things where we manipulate light.

1. Human vision is based on light
2. Imaging: using camera, endoscope... to see things around us
3. Optical communication: using light to carry information
4. Material processing (laser-based cutting)
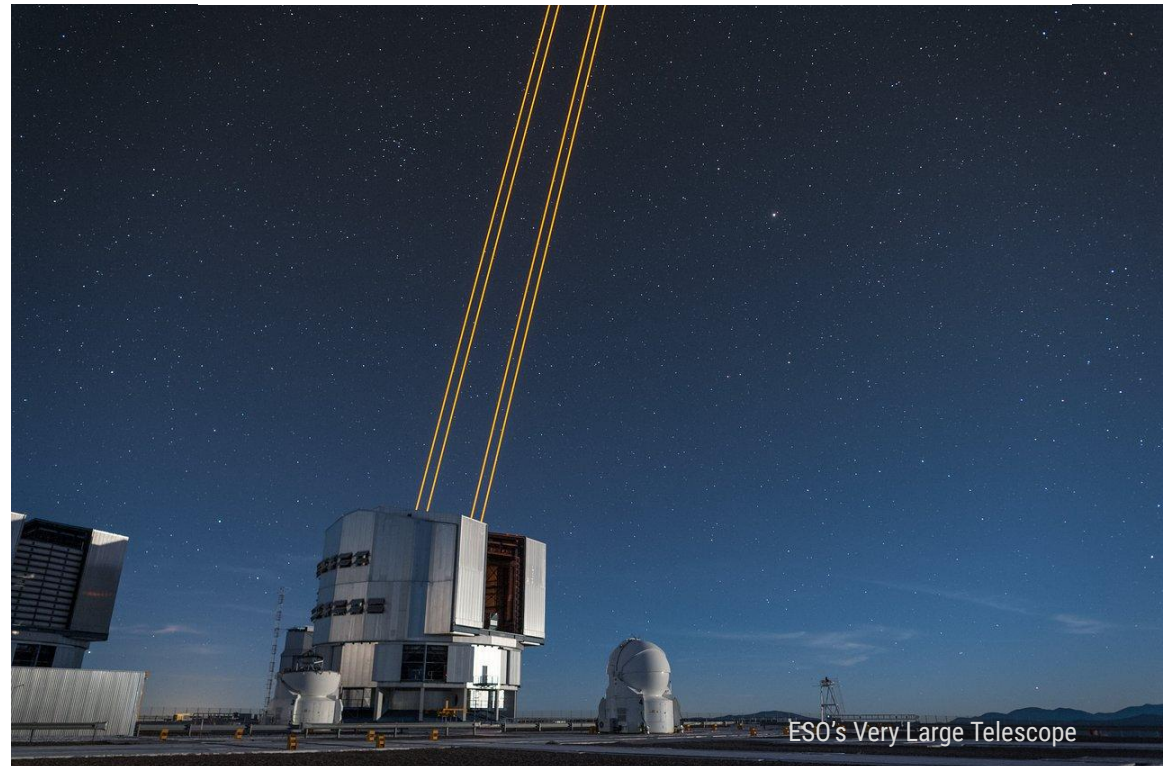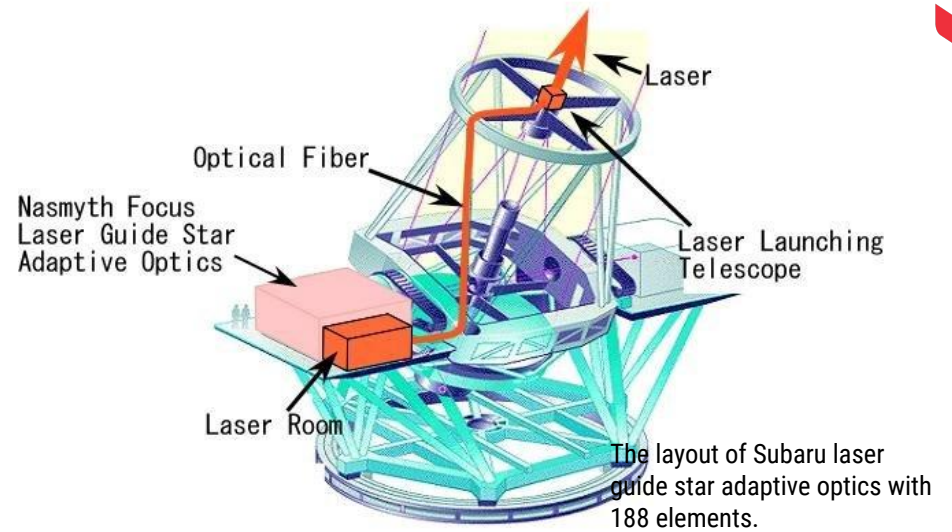5. Augmented Reality - Gesture Recognition
6. Quantum computing

Why photonics?

We are here to understand
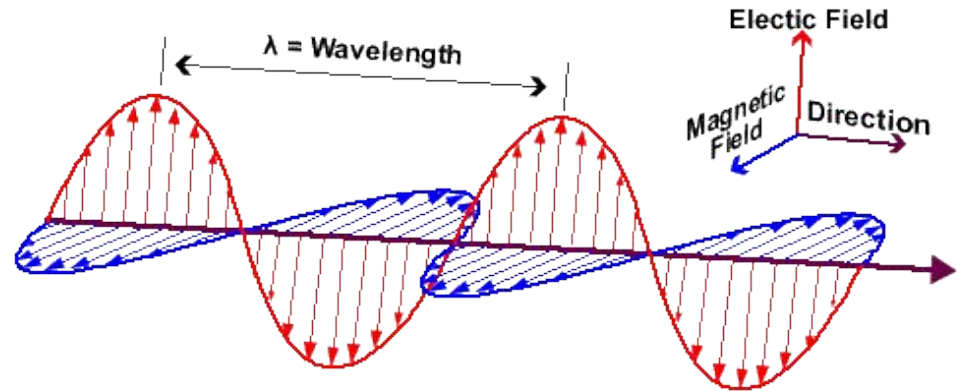
1. What is light?
2. How to generate light?
3. How to manipulate light?
4. How to make light works for us?

The layout of Subaru laser guide star adaptive optics with 188 elements.

ESO's Very Large Telescope

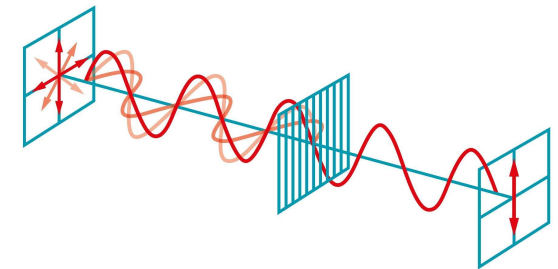# Photonics is the science of light

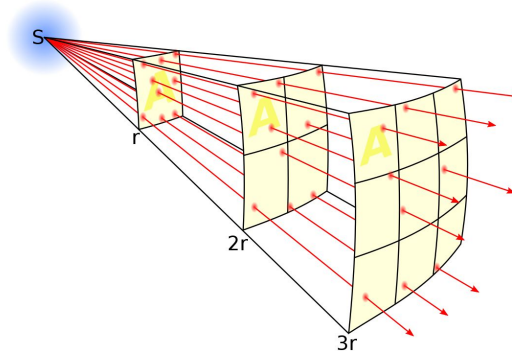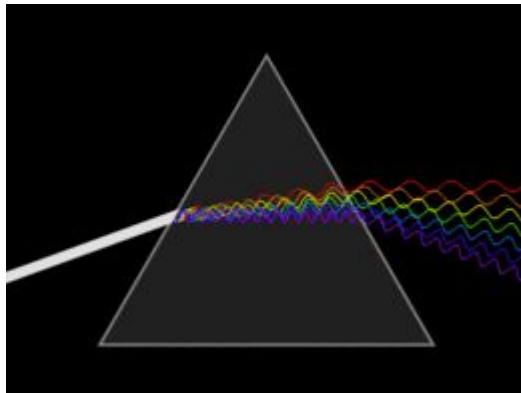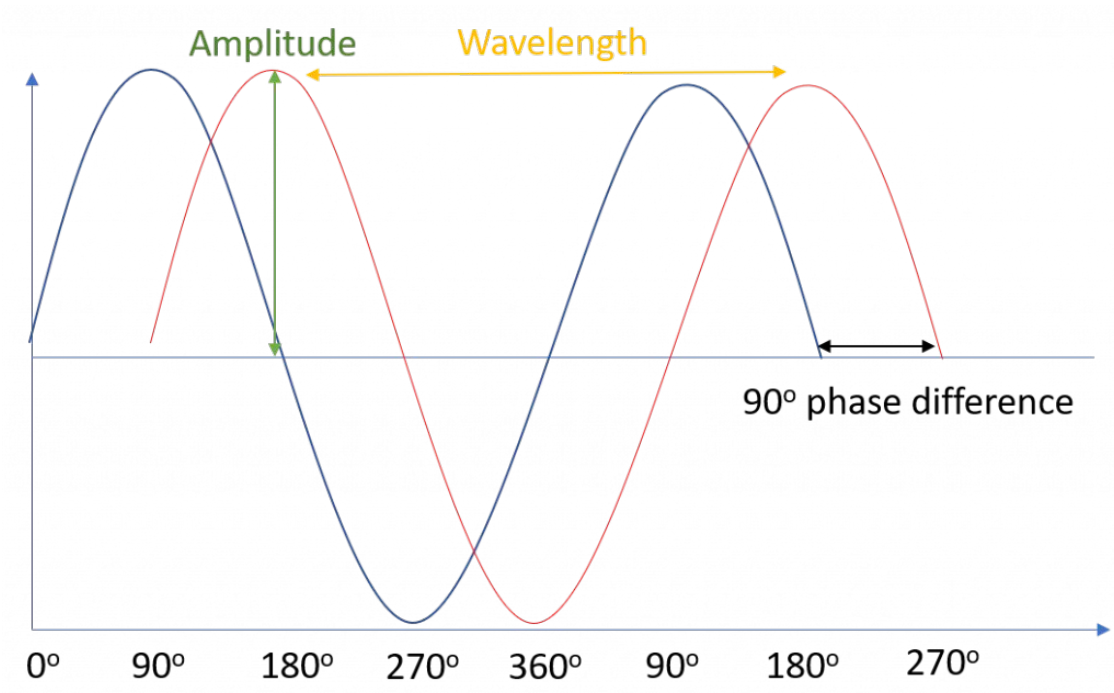Understand the science of light?

1. Properties of light
2. Generation of light
3. Detection of light
4. Manipulation of light
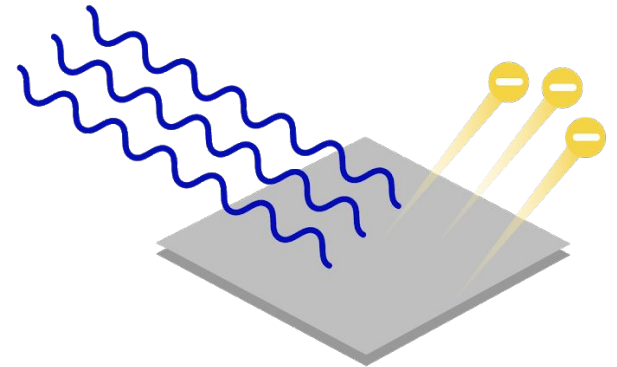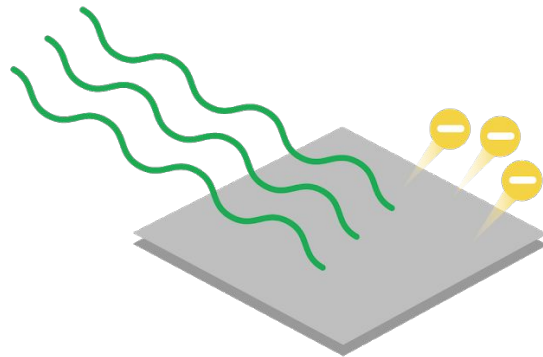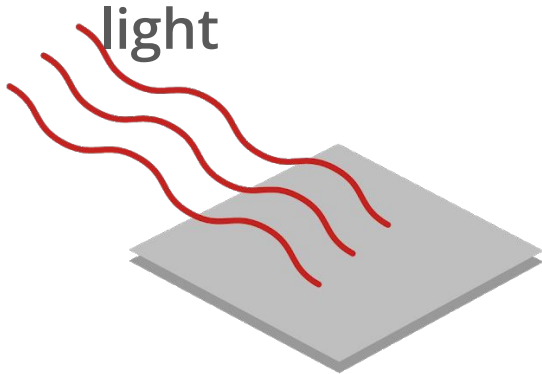
Manipulation of light?

- **Describe light**
  - **Wavelength**
  - **Intensity**
  - **Phase**
  - **Polarization**
- **Change certain properties of light**

Outline of the course

Course syllabus for bachelor program

Subject: **Optics and Photonics in Space Applications**
Academic field: Space and Applications bachelor program
Lecturer: Hien PHAN
Mobile: 0916880111
Email: phan-thanh.hien@usth.edu.vn
Academic year: 2019-2020

Credit point	3	
Level	Bachelor	
Teaching location	University of Science and Technology of Hanoi	
Time Commitment	Lecture	20h
	Tutorial/Exercise/Practical	0h
	Field trip/Lab work	10h
	Total	30h

Course syllabus for bachelor program

Recommended background knowledge	SA 3.12 Optics and Photonics
Subject description	This course will provide the very basic knowledge on Photonics.
Objective & Outcome	After this course, students will able to: ● Describes the fundamental principle of photonics and light - matter interactions; ● Describes and analyses the photonics structures and processes; ● Understand the basic knowledge on manipulating the fundamental properties of light.
Assessment/ Evaluation	Field trip/Lab work — 30% Tutorial/Exercise/Practical/Project — 20% Attendance — 10% Final exam — 40% Total — 100%
Prescribed textbook	1. Kasap, S. (2013). Optoelectronics & Photonics: Principles & Practices: International Edition. Pearson.

COURSE CONTENTS

Optics and Photonics

1. Wave Nature of Light
2. Dielectric Waveguides and Optical Fibers
3. Semiconductor Science and Light-Emitting Diodes
4. Stimulated Emission Devices: Optical Amplifiers and Lasers
5. Photodetectors and Image Sensors
6. Polarization and Modulation of Light