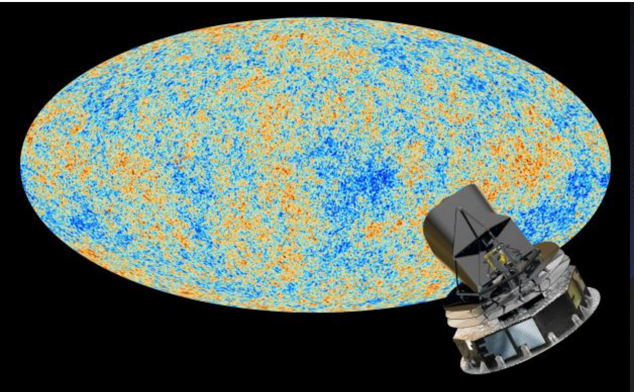
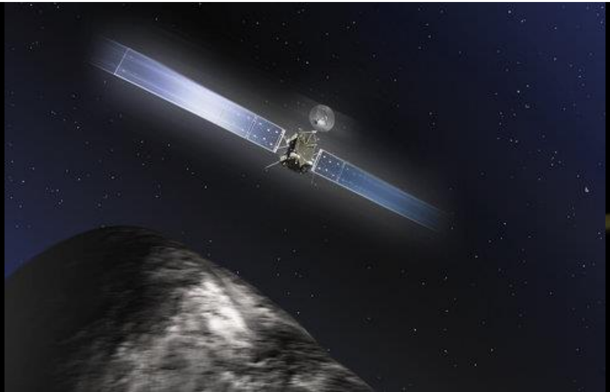
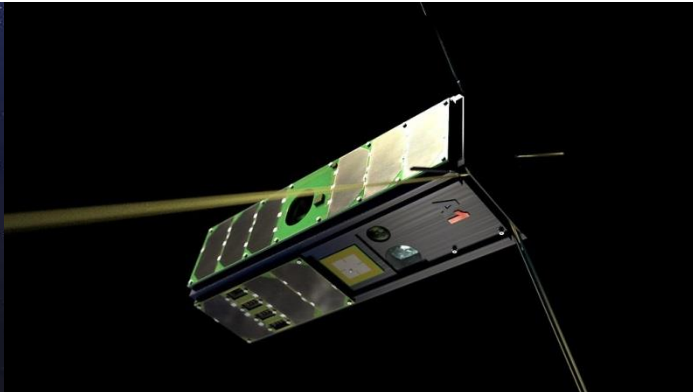
Space Instrumentation

ELEC-E4220 (5 cr)

Today

- Course introduction and practicalities (AL)
- Why go to space?
  - Astronomy: AL
  - Solar system & Space physics: EK

ESA

Teachers @aalto.fi

Anne Lähteenmäki

- Radio astronomy

Esa Kallio

- Space physics

+ Guests

Course chat for students

- Join Telegram group at

  https://t.me/joinchat/D5UP9eJneXoyM2Q0

- No teachers, this is for students only! Questions to teachers should go via email or general discussion in MyCourses.

Space science and technology courses

- ELEC-E4210 Introduction to space
- ELEC-E4220 Space instrumentation
- ELEC-E4230 Microwave Earth Observation instrumentation
- ELEC-E4240 Satellite systems
- ELEC-E4520 Space physics
- ELEC-E4530 Radio astronomy
- ELEC-E4540 Space climate
- ELEC-E4920 Space technology project (5 – 10 cr)
- ELEC-E4930 Special assignments (5 – 10 cr)

Course content

- Observational techniques in astronomy and space physics.
- Scientific payloads of satellites and probes.
- Effect of space environment on instrumentation.
- Life cycle of a space mission: researcher's view.
- Examples of science missions.
- Design your own mission.

Learning outcomes

- After this course the student knows why and how information about astronomical and solar system phenomena is collected.
- She/he can describe the physical principles on which the scientific instruments onboard satellites and probes are based.
- The student is able to differentiate between various types of instruments and observing techniques and what they are used for, and evaluate which kind of systems are suitable for measuring certain astronomical and solar system phenomena.
- She/he identifies what kinds of effects space environment has on instrumentation and observations.
- The student is able to review the state-of-the-art space instrumentation and its immediate possibilities and challenges.
- She/he can explain the life cycle of a space mission from a researcher's point of view (from long-term planning, such as ESA's Cosmic Vision, to implementation and operation of a space mission, all the way to analysis of the scientific data), and give examples of scientific space missions.

Workload

Contact hours 48h (2x2h) + Independent work 87h = 135h = 5 cr

Course structure

In MyCourses

Follow the teaching session listings in section Course schedule in MyCourses. All you need to know is in MyCourses.

We will have:

- Live teaching sessions via Zoom.
- Possible pre-recorded materials and other self-study materials.
- Assignments, quizzes…

Course structure

- Contact sessions on Tuesdays 14-16 and Thursdays 12-14 via Zoom.
- Two parts: solar system & astronomical space instrumentation
- Lectures, assignments, project work & report
  - No exam
- All you need to know is in MyCourses.

In MyCourses

How to participate in live teaching sessions

- Zoom room for the course can be found in MyCourses in the Course schedule section.
- Always use this link on this course, for all teaching sessions.
- We start quarter pass the hour, that is 12.15 or 14.15.
- It is difficult for the teacher to follow chat during lectures so please be patient with possible questions.

Course schedule, Part 1

Date	**Topic**
Tue 14.9.	Course introduction. Zoom lecture
Thu 16.9.	**No Teaching**
Tue 21.9.	Solar system instruments: Langmuir probe, RPA, radars 1 and ionosonde. Zoom lecture
Thu 23.9.	Introduction to this week's assignment. Zoom lecture
Tue 28.9.	Ground based instruments: radars 2, radio wave and plasma wave instruments. Zoom lecture
Thu 30.9.	Introduction to this week's assignment. Zoom lecture
Tue 5.10.	Remote sensing instruments. Zoom lecture
Thu 7.10.	Introduction to this week's assignment. Zoom lecture
Tue 12.10.	Magnetic field measurements. Zoom lecture
Thu 14.10.	Introduction to this week's assignment. Zoom lecture
Tue 19.10.	High energy particle instruments, miniaturized cubesat instruments. Zoom lecture
Thu 21.10.	Introduction to the final assignment of Part I. Zoom lecture
Tue 26.10.	**No teaching** (exam week).

Course schedule, Part 2

Tentative

Tue 2.11. Astronomical space missions: an overview. Teaching methods TBC for Period II

Thu 4.11. A look into the future: astronomical space missions in the next few decades.

Tue 9.11. Project work kick-off.

Thu 11.11. Project work help & discussion (TBC)

Tue 16.11. Lifecycle of a space mission. Case study: the Planck satellite.

Thu 18.11. Project work help & discussion. (TBC)

Tue 23.11. High-energy space missions I. X-rays, XMM-Newton satellite, Chandra etc.

Thu 25.11. Project work help & discussion. (TBC)

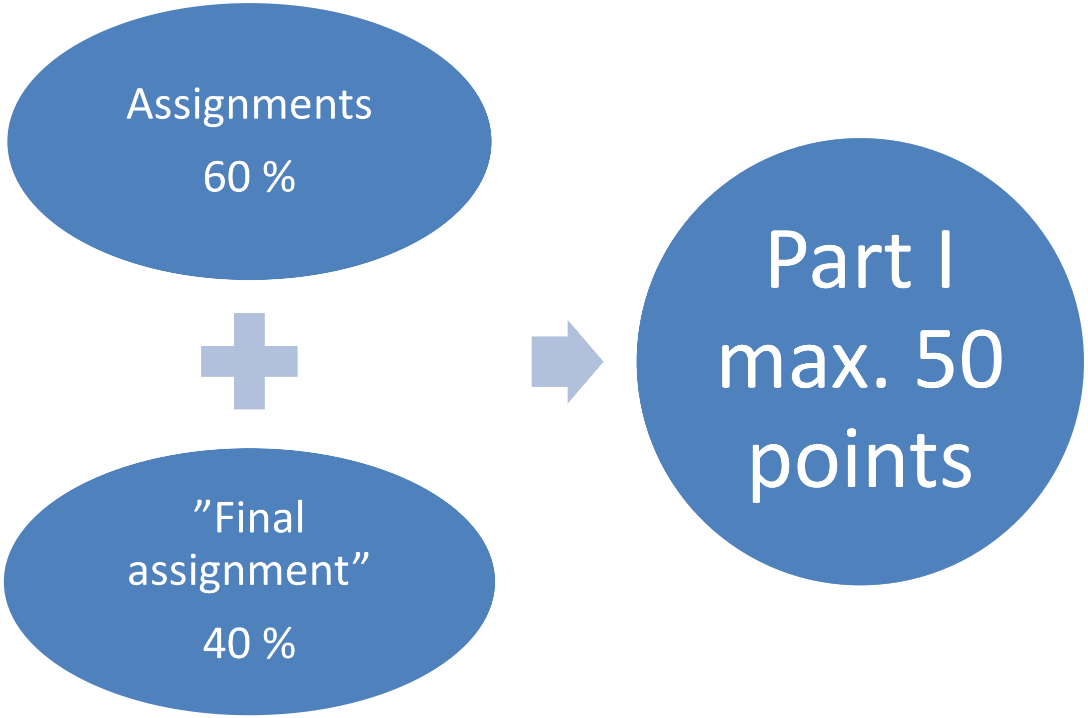
Tue 30.11. High-energy space missions II. Gamma-rays, Fermi satellite.

Thu 2.12. Project work help & discussion (TBC)

Tue 7.12. Peer-assessment: what does it mean. A (very) short introduction to UV astronomy. How do I get observing time with a satellite?

Thu 9.12. Possible project presentations (TBC)

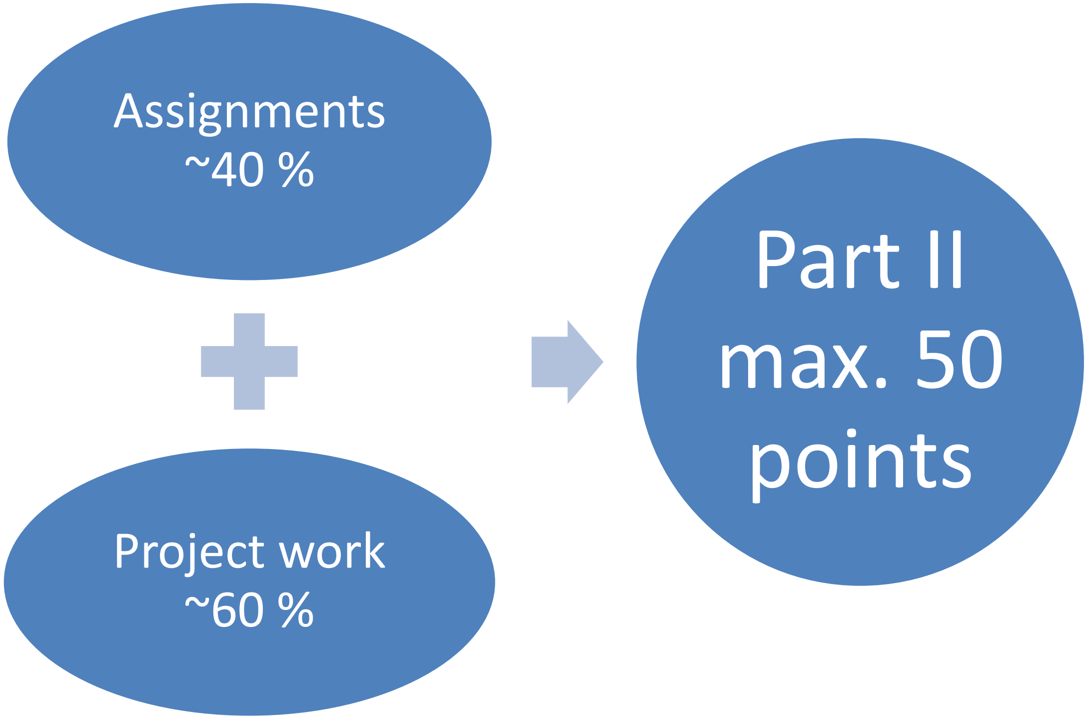
Evaluation and grading: Part I



Part I requirements

- The maximum number of points is 50:
  - Assignments: 5 x 6 points = 30 points in total.
  - Final assignment: 20 points.
- Approx. 50% are required for passing the course.
- Details posted in MyCourses (”Evaluation and grading”).

Evaluation and grading: Part II



Part II requirements

Student contribution	Points	Comments
Assignments	3 x 5 = 15 in total	3 assignments, maximum of 5 points each.
Project plan	10	
Project report	20	
Peer-assessment	5	Points are given for the quality of the assessment.

- The maximum number of points is 50. Approx. 50% are required for passing the course.
- Will be clarified when Part II starts.
- In the meantime, details posted in MyCourses (”Evaluation and grading”).

To pass the course you need to do …

- Part I:
  - Assignments
  - Final assignment
- Part II:
  - Assignments
  - Project work (plan and report)
  - Peer-assessment

The final course grade is based on the total number of points in Parts I and II: 100 points.

We need your feedback!

- During and after the course:
  - E-mail
  - MyCourses
  - Talk to us
  - Take the course survey
- Your chance to make this a good course!

Next lecture on Tuesday 21.9.!