

MASTER'S DEGREE PROGRAMME IN SPACE SCIENCES

Department of Physics

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Web pages: <http://www.helsinki.fi/space/master>

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Studies in Space Sciences at the University of Helsinki

Space Sciences cover a wide range of topics from cosmology to studies of the near-Earth space. The research and teaching at the Department of Physics covers high-energy astrophysics, space astronomy, planetary system research, research of interstellar medium and star formation, cosmology, Solar physics, Solar-planetary relationships, and studies of the atmospheres of the Earth and planets. A part of the studies are conducted in close collaboration with the Finnish Meteorological Institute through the Kumpula Space Centre.

The Master's Degree Programme in Space Sciences was initiated in the autumn term of 2007. The goal of the Programme is to educate students with outstanding skills needed both in post-graduate studies and in many other, often international, careers in space sciences or related fields. Finland is a member of the three most important pan-European space organizations: European Space Agency (ESA), European Southern Observatory (ESO) and European Meteoro-

logical Satellite Organization (EUMETSAT). In addition, Finland participates in several other international organizations for space research such as the Nordic Optical Telescope (NOT) and the European Incoherent Scatter Radar collaboration (EISCAT). Employment in these organizations often requires researcher training. Consequently, the major goals of this Master's Programme are to educate professionals who can successfully compete on, 1) domestic and international post-graduate research school positions, 2) careers in space industry, national and international research organizations, 3) positions in the area of public outreach of science, and 4) teachers at high-schools or polytechnic institutes.

Organization

The Master's Programme in Space Sciences is based on courses held at Department of Physics. The small annual admission of students (at most 10 students) makes it possible to tune highly personalized study plans aiming at completion of the Master's studies within two academic years.

The Master's Programme has close cooperation with the education in space technology at the Aalto University (TKK). The Finnish Meteorological Institute (FMI) participates in the Programme within the framework of the Kumpula Space Centre.

Degrees

After successfully completing the Programme, the student is qualified for the degree of Master of Science in Space Sciences at the University of Helsinki. The scope of the degree is 120 credits, and requires a suitable Bachelor's level degree, or equivalent, as a prerequisite.

The degree consists of a minimum of 80 credits of advanced studies in space sciences, including seminar exercises and Master's thesis, and a minimum of 10 cre-

dits of minor subject studies in mathematics, physics, chemistry, meteorology, geophysics, or computer sciences. It is recommended that the study plan contains 10–20 credits from the space technology courses of the Aalto University. The intended time to complete the degree is two years.

Obtaining the right to study

The right to study is obtained via a successful application. Annually, a maximum of ten (10) students will be admitted to the Master's Degree Programme in Space Sciences. An applicant is qualified for the Programme if he/she has completed an appropriate Bachelor's degree or equivalent qualification in Finland or abroad, and is sufficiently proficient in English. In particular, degrees qualifying for the Programme include Bachelor's degrees in physics, geophysics, meteorology, theoretical physics or astronomy, or Bachelor's degrees or equivalent qualifications with sufficient background in physics and mathematics from polytechnics and universities of technology.

The calls for application for the next academic year will be published in the autumn. Selection protocols, criteria and the schedule will be published on the web pages of the Master's Degree Programme in Space Sciences

Student counselling and the personal study plan

Students are required to make a personal study plan (HOPS) as part of their MSc degree, which is approved by his/her personal teacher tutor. The personal study plan is to be approved by the end of the first period of the first year of study in the Programme. The study plan will be updated when needed as the studies progress. The study plan may emphasize experimental or observational work, methodology of data-analysis, or theoretical studies. The contents of the study plan may be selected from an extensive list, including lectured courses, laboratory exercises, observational work, data-analysis, and exercises of computer simulations, and software development. The student is also encouraged to include

in his/her personal study plan courses in space technology and remote sensing at the Aalto University. While the individual study plans may be different, all students participate in joint seminars, where they report on their own personal topics of studies.

Counselling for students are given by:

Professor Hannu Koskinen, space physics
Professor Karri Muinonen, astronomy
Docent, University Lecturer Rami Vainio, space physics
Docent, University Lecturer Juhani Huovelin, astronomy

More information can be found on the web pages on student counselling:
<http://www.helsinki.fi/spacemaster/>

DEGREE REQUIREMENTS

The requirement for the Master of Science Degree in Space Sciences includes studies summing up to a minimum of 120 cr (ECTS). The structure and contents of one's degree must be accepted in the personal study plan (HOPS) prepared at the beginning of the first semester of studies in this Programme.

MASTER OF SCIENCE DEGREE (120 CREDITS)

1. Major subject studies (minimum 80 credits)

530270 Advanced studies in space sciences

Compulsory common studies for all students include the following elements

Seminar exercises (10 cr)
Master's Thesis (40 cr)
Maturity test

Advanced studies in Space Sciences (30–59 cr) from the following list:

53918 Advanced course on celestial mechanics (7 cr)
53903 Small solar system bodies I (7 cr)
53856 Small solar system bodies II (7 cr)

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53958	Space astronomy (7 cr)
53834	Data analysis and inverse methods in astronomy (7 cr)
53919	Light scattering by small particles I (7 cr)
53806	Light scattering by small particles II (7 cr)
53848	Magnetohydrodynamics (7 cr)
53936	Practical methods in numerical magnetohydrodynamics (7 cr)
53835	Stellar magnetic activity (7cr)
53833	High energy astrophysics (7cr)
53765	Plasma physics (5 cr)
53769	Space applications of plasma physics (5 cr)
53766	Advanced space physics (10 cr)
53743	Solar Physics (5 cr)
53757	Cosmology I (5 cr)
53758	Cosmology II (5 cr)
53736	General relativity (10 cr)
53731	Continuum mechanics (5 cr)
53376	Hydrodynamics (5 cr)
535021	Planetary geophysics (5 cr)
535110	Space geodesy (5 cr)
53023	Instrument and measurement techniques (10 cr)
53261	Radiation detectors I (5 cr)
53263	Radiation detectors II (5 cr)
530184	Semiconductor physics (10 cr)
53032	Laboratory exercises / training (10 cr)
53025	Radiation protection (3 cr)
53369	Scientific computing III (10 cr)
53382	Tools of high-performance computing (5 cr)

2. Minor subject studies (10–38 credits)**530271 Minor subject studies in space sciences**

Depending on the extent of studies in the main subject, a student may choose courses in one or several categories below. These will be agreed upon in the personal study plan (HOPS)

a) Master's level courses in mathematics, physics, astronomy, chemistry, meteorology, geophysics, or computer science.

b) Space technology

It is recommended that the study plan contains 10–20 cr from the space technology courses of the Aalto University (TKK).

3. Other studies (2–20 credits)

Personal study plan (HOPS), 1 cr
Advanced internship or vocational orientation studies, 1–3 cr

The maximum total extent of other studies, not listed above, is 18 cr. These may include studies in topics close to the subject of the degree, and they will be approved as a part of the study plan (HOPS).

GENERAL STUDY INSTRUCTIONS

Studies in space sciences consist of lectures, seminars, practical exercises and homework exercises.

Timing of studies

As the students of the Programme have a very variable background, the personal study plan is essential. Some of the courses are lectured only once in two years and thus the work with Master's thesis during the second year shall be planned so that one or two courses are possible to conduct in parallel. As a model the sequence of studies should be composed as

1. year, autumn

Major subject courses 15–25 cr
Minor subject courses 5–15 cr
Begin HOPS

1. year, spring

Major subject courses 15–25 cr
Minor subject courses 5–15 cr
Update HOPS

Summer internship recommended

2. year, autumn

Major subject course
Optional minor subject course
Start Master's thesis
Seminar exercises
Update HOPS

2. year, spring

Major or minor subject course
 Complete Master's thesis
 Maturity test
 Seminar exercises
 Complete HOPS

Lecture courses

The lecture courses typically contain exercise sessions where solutions to homework problems are discussed. The students are expected to spend at least twice the time they use for lectures and exercises to study the course material and solve problems. Passing a lecture course usually requires completion of a sufficient number of exercises and passing the course exam. The exams are in most cases written, but also oral exams take place.

Laboratory exercises and participation in observational work

Depending on the personal study plan some part of the studies can be study work can involve laboratory exercises or practical work with actual observations in local laboratories, at astronomical observatories, or in a laboratory of a collaborating institute, e.g. FMI. After completing the exercise or observations, the student must deliver a written report of the work. The results can also be used as material for the seminars.

Seminars

The student must participate in the seminar series of the Programme during at least two semesters. Each student is required to give at least one presentation and deliver a written seminar paper and actively participate in the discussions during each semester to obtain the required 10 credits. Grading is based on the oral presentation, participation in discussions and the written paper. Seminars usually meet once a week during the whole semester. Students are required to be present during at least 3/4 of the weekly meetings.

Registration for the courses and examinations

Students register for courses and separate examinations offered by the University of

Helsinki according to the registration practices in the department organizing the course. Usually the registration takes place at the start of a lecture series.

Advanced internship

The degree includes an obligatory advanced internship phase. In practice this means a period of work in a research group or in a company active in space science related field. The aim of the internship is to familiarize the student with real-world space research and researchers. A recommendable procedure to fulfil this requirement is to get a summer trainee position in a space science related laboratory during the summer between the first and second year of studies. This period can also lay the background to the student's Master's thesis during the second year of studies. The internship position is agreed on with the student counsellor as a part of the study plan and the Programme will assist the students to find appropriate positions. Some available positions for the internship will be announced on the Programme's web page.

Grading

All courses are graded either on the six-step scale 0–5 or the two-step scale fail/pass. On the former scale the lowest passing grade is 1/5, for which the student usually needs to get about 45 % of the maximum points. To get the highest grade 5/5, the student usually needs about 85 % of the maximum points. These limits are indicative only.

Teaching language

The teaching language in the Programme is English.

Master's thesis

The Master's thesis is the final thesis done independently by the student for the MSc degree. The extent of the thesis is 40 credits. The thesis is written during the second year of studies.

The topic of the thesis is agreed upon with a professor of the Programme. Usually the topic is related to research conducted at the

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participating departments or at a collaborating space research group either in Finland or abroad.

A more complete list is provided on the web pages of the Programme.

While working on the Master's thesis, the student is expected to participate in the seminar series of the Programme and present the research plan and the progress in the seminar.

Maturity test

The maturity test required for the Master's degree is taken as a separate exam when the Master's thesis has been submitted for evaluation. A new test is required even if the student has given the test at the Bachelor level.

Computer access

The Department of Physics provides classrooms with computers that may be used in studies. All students receive a personal user account and password.

POST-GRADUATE STUDIES

A student who has completed the Master's Programme with good grades (grade 3/5 or better) is qualified for doctoral studies at the Department of Physics. The Department participates in the nationwide Graduate School in Astronomy and Space Physics. It offers a limited number of funded post-graduate student positions, but all doctoral students in astronomy and space physics in Finland are counted as students of the school and they can attend courses and seminars organized by the Graduate School independent of the funding source. Funding can also be provided through various research projects and external foundations. The graduates of the Master's Programme are also encouraged to look for post-graduate student positions elsewhere.

Course descriptions

Course descriptions, lecturing periods and lecturing times will be found on the Programme web pages <http://www.helsinki.fi/spacemaster/> and in WebOodi.