UNIVERSITY OF TARTU

Doctoral/master study programmes requirements in University of Tartu (Estonia)

Laur Järv
senior research fellow in theoretical physics
assistant director, Institute of Physics
University of Tartu

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Current structure of the PhD curriculum

4 years, 240 ECTS

- Research (3 papers indexed by Web of Science + thesis) 180 ECTS
- Other 60 ECTS including
  - Presentations at conferences and seminars 18 ECTS
  - Doctoral course (3 book exams) 18 ECTS
  - University-wide courses („Communicating science“, „Entrepreneurship“, „Learning, teaching, and supervision“, „Management“, „Philosophical disagreements“, „Practical teaching in university“, „Research integrity“, „Statistical data science) 12 ECTS
  - Optional courses (anything) 12 ECTS

Current structure of the Physics MSc curriculum

2 years, 120 ECTS

- Compulsory subjects (statistical physics, quantum mechnics, spectroscopy, data processing and scientific computing) 24 ECTS
- Specialization module courses (e.g. „Theory of particles and fields“: classical field theory, quantum field theory, general relativity, modern fundamental physics) 24 ECTS
- Practice (in a company or e.g. As a CERN summer student) 12 ECTS
- Strategies of professional success (effective planning, communicating, project writing, …) 6 ECTS
- Seminars 6 ECTS
- Elective courses (in physics or sciences) 12 ECTS
- Optional courses (anything) 6 ECTS
- Thesis 30 ECTS

Planned structure of the Materials Science and Technology MSc curriculum (in English)

2 years, 120 ECTS

Starts in September 2019

- Materials science (theoretical principles, testing and investigating, development, seminar) 30 ECTS
- Entrepreneurship (technology entrepreneurship basic course, seminars) 15 ECTS
- Elective courses (materials science, physics, chemistry related) 24 ECTS
- Practice (in a company) 15 ECTS
- Optional courses (anything) 6 ECTS
- Thesis 30 ECTS

Requirements for the joint study programme

- All participating universities must have the right to teach at this level, and in this field.
- Current law: All diploma granting institutions must award at least 20% of the ECTS
- New law (operative from 1 September 2019): No 20% requirement

Examples

- **MSc Materials and processes in sustainable energetics**
  - 1st and 3rd semester in TalTech, 2nd semester in University of Tartu, 4th writing the thesis
  - ~32 students/year from Asia, Africa, Estonia, ex-Soviet countries

- **MSc Excellence in analytical chemistry (Erasmus Mundus programme)**
  - 1st year in University of Tartu, 2nd year in either Uppsala, Lyon 1, or Åbo Akademi
  - Master's thesis (30 ECTS) is evaluated jointly by the first and second year universities
  - ~18 students/year, occasionally also from Europe

Advice from the University of Tartu, Office of Academic Affairs

- There is not much point in a joint PhD programme. Just a lot of bureaucracy, but rather few students. If necessary, a *cotutelle* agreement can be signed on an individual basis.
- A joint MSc programme can be opened. But too many partner institutions can be a bureaucratic hassle for everybody involved.
- Also, asking the students to relocate too much will not work! Even coming from Tallinn to Tartu for a semester can be a problem.
- Must think though the questions:
  - Is there a demand, a need? Are there similar competing study programmes nearby?
  - What added value is gained by making it a joint study programme?
  - Who will come to study? From where? Will they pay?
  - Will it pay off for the University? Does running the programme need extra funding?

Some considerations from University of Tartu, Institute of Physics

- To be active in CERN, and to keep up research in particle physics and related fields, we need to teach students in the subject at all levels. However the Estonian student numbers are very small (1-2 per year).
- Teaching particle physics at MSc level will have much more juice, if besides 2 Estonians, also 3 Latvians-Lithuanians, plus some students from 3rd countries, would participate in a class.
- Especially good, if the 3rd country students could also pay!

- For accelerator technologies there is some demand from the hospitals, but not much specialized study is offerend in Estonia.
- There are three reserch groups in University of Tartu who are involved in the development of particle detectors or detector materials. Their interest in the study programme is at the moment vague, more inclined to materials science.

MSc courses in Particle Physics, University of Tartu

Course	Language	ECTS	Lecturers	Year (Fall, Spring semester)
Classical Field Theory (from group theory to the SM)	Estonian	6	Järv	2010f, 2012f, 2014f, 2017f, 2018f
Quantum Field Theory	Estonian or English	6	Groote, (Veermäe)	2010s, 2011s, 2012f, 2015f, 2016f, 2017f (eng), 2018s
Gauge Theory	Estonian or English	6	Groote	2009s, 2010f,2013s, 2016s, 2017s, 2018s (eng)
Renormalization Methods in Field Theory	Estonian or English	6	Groote	2011s, 2013f, 2016f, 2018f
Group Theory	Estonian	6	Saar	2012f, 2013f, 2015f, 2017s
Modern Fundamental Physics (SM and beyond, cosmology, astroparticle)	Estoninan/ English	6	Raidal, Hektor, Kannike, Marzola	2014/15, 2015/16, 2018/19
Experimental Particle Physics	Estonian	3	Raidal, Kadastik, Tiko, Rebane	2013s, 2014s
Differential Geometry for Physicists	English	3	Hohmann	2015s, 2018f
Introduction to String Theory	Estonian	3	Järv	2010s
General Relativity	Estonian	6	Saal	2011s, 2013s, 2015s, 2017s, 2018s

Potential supervisors on topics related to particle physics

- Experimental particle physics : Mario Kadastik, Andrea Giammanco, Liis Rebane, Andres Tiko, Joosep Pata, … (NICBP)
- Particle physics phenomenology / astroparticle physics : Martti Raidal, Kristjan Kannike, Andi Hektor, Luca Marzola, Antonio Racioppi, … (NICBP)
- Quantum field theory : Stefan Groote (UT IP)
- Gravity theory, cosmology : Laur Järv, Manuel Hohmann, Margus Saal, … (UT IP)
- Relativistic quantum mechanics : Veiko Palge (UT IP)
- Galaxies (dark matter, astroparticle) : Gert Hütsi, Elmo Tempel, Jukka Nevalainen, … (UT TO)

Materials science collaboration projects with CERN

- **Crystal Clear Collaboration** (CCC), from 2012:
  - development of novel scintillator materials for novel ionizing radiation detectors aimed at applications in high-energy physics, medical imaging and industry;
  - Marco Kirm, Vitali Nagirnyi and Sergei Omelkov from UT Institute of Physics.

- **CTF-3 experiment,** since 2013;
  - intended to design the Compact Linear Collider (CLIC) accelerator,
  - research to solve the electrical breakdown problems in CLIC accelerating structures by focusing copper in extreme environments;
  - large scale computer simulations using tools like DFT, MD, FEA;
  - Alvo Aabloo and Vahur Zadin from UT Institute of Technology.