Classical and Quantum particle systems, 7.5 hp

Course period:
January 19-May 15, 2017

Last day for application:
January 10, 2017

Course leader / Address for applications:
Jakob Björnberg / jakob.bjornberg@gmail.com

Course description (Advertisement for Ph.D. students):
The aim of this course is to give an introduction to probabilistic models for phase transitions, including percolation, the classical Ising model, and the quantum Heisenberg model. The subject is at the intersection of probability theory and statistical physics.

We will meet once a week for 14 weeks. There will be some homeworks and an oral exam at the end of the course. The exact schedule will be determined before the course start.

Responsible department and other participation departments/organisations:
Mathematics Department

Teachers:
Jakob Björnberg (Course leader and main contact).

Examiner:
Jakob Björnberg

Classical and Quantum particle systems, 7.5 hp

1. Confirmation
The syllabus was confirmed by the Head of the Department of Mathematical Sciences 2016-01-22.

Disciplinary domain: Science
Department in charge: Department of Mathematical Sciences
Main field of study: Mathematics and Mathematical statistics

2. Position in the educational system
Elective course; third-cycle education

3. Entry requirements
The student should have a reasonably good background in probability theory.

4. Course content
The aim of this course is to give an introduction to probabilistic models for phase transitions. The subject is at the intersection of probability theory and statistical physics. Models discussed will include percolation, classical models for magnetic phase transitions such as Ising and Potts, and quantum theoretical models such as the ferromagnetic and antiferromagnetic Heisenberg models. Topics covered will include existence and basic properties of phase transitions, stochastic domination and correlation inequalities, and probabilistic representations of quantum spin systems. No background in physics will be assumed.

5. Outcomes

After completion of the course the Ph.D. student is expected to be able to:

- Understand the central parts of percolative phase transitions in a classical and quantum setting.

6. Required reading
The main source will be the book *Probability on Graphs* by Geoffrey Grimmett. A version of the book is available on his homepage.

7. Assessment
Passing grade requires a passing grade on the homework and the final oral exam.

A Ph.D. student who has failed a test twice has the right to change examiners, if it is possible. A written application should be sent to the Department.

In cases where a course has been discontinued or major changes have been made a Ph.D. should be guaranteed at least three examination occasions (including the ordinary examination occasion) during a time of at least one year from the last time the course was given.

8. Grading scale
The grading scale comprises Fail, (U), Pass (G)

9. Course Evaluation
The course evaluation is carried out together with the Ph.D. students at the end of the course, and is followed by an individual, anonymous survey. The results and possible changes in the course will be shared with the students who participated in the evaluation and to those who are beginning the course.

10. Language of instruction
The language of instruction is English.