

Field Theory for Statistical Mechanics (C004518)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2024-2025

null

Lecturers in academic year 2024-2025

Bultinck, Nick WE05 lecturer-in-charge

Offered in the following programmes in 2024-2025

null

crdts offering

Teaching languages

English

Keywords

Statistical physics, field theory, renormalization

Position of the course

Contents

- 1 **Statistical physics and field theory:** Lightening review of the necessary concepts from statistical physics. Path integrals and quantum field theory. The quantum-classical mapping. Universality of long-distance properties and effective field theories.
- 2 **Renormalization:** The Gaussian 'mean-field' theory and rescaling. Engineering dimensions of operators, and the associated concept of the upper critical dimension. Momentum-shell renormalization and the Wilson-Fisher fixed point. The epsilon expansion.
- 3 **2D XY model:** Villain representation of the partition function. The sine-Gordon continuum field theory description. The Berezinskii-Kosterlitz-Thouless phase transition and the Kosterlitz renormalization group analysis.
- 4 **3D XY model:** Particle-vortex duality and the dual U(1) gauge theory description.
- 5 **O(N) model:** The O(N) model as an effective field theory for (quantum) magnets. Renormalization group analysis of the O(N) model.

Initial competences

Statistical mechanics, quantum mechanics, quantum field theory

Final competences

- 1 The student has an understanding of the universality of statistical physics on large length scales, and how this allows for a continuum field theory description.
- 2 The student can perform calculations in continuum field theory, and is able to use these to derive physical properties.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Study material

Type: Syllabus

Name: Field theory for statistical mechanics

Indicative price: Free or paid by faculty

Optional: no

References

Course content-related study coaching

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Calculation of the examination mark