PHYS-638 **Some aspects of topology in condensed matter physics**

Mudry Christopher Marc

Cursus	Sem.	Type
Physics		Opt.

Language of teaching	English
Credits	4
Session	
Exam	Term paper
Workload	120h
Hours	**56**
Courses	56
Number of positions	

Frequency

Every 2 years

Remark

Next time: Fall 2021

Summary

Some topics covered in this class are: The Index theorem, solitons, topological band insulators/superconductors, bulk-edge correpondence, quantum anomalies, quantum pumping, symmetry protected topological phases and symmetry enriched topological order if time allows.

Content

In this class, I will give examples of phenomena in condensed matter physics that have a topological origin.
I will use the Su-Schrieffer-Heeger model for polyacetylene as the simplest fermionic Hamiltonian that ties concepts such as the index theorem, solitons, topological band insulator, the bulk-edge correspondence, quantum anomalies, and quantum pumping.
I will use the frustrated quantun spin-1/2 antiferromagnetic XYZ chain as the simplest Hamiltonian hosting continuous phase transitions that evade the Landau paradigm for phase transitions.
Other quantum spin Hamiltonians on a chain will be used to introduce the concept of symmetry protected topological phases.
If times allow, I will present the quantum spin-1/2 Kitaev Hamiltonian on a honeycomb and variant thereof to construct quantum spin liquids supporting topological order.

Learning Prerequisites

Recommended courses

The class will be self-contained and presumes no more than a solid grasp of quantum mechanics, say at the level of the textbook of Gordon Baym.

Resources

Bibliography

E. Fradkin, Field Theories of Condensed Matter Physics, 2nd edition (Cambridge University Press).
A. Tsvelik, Quantum Field Theory in Condensed Matter Physics, 2nd edition (Oxford University Press).
B. A. Bernevig with T. L. Hughes, Topological Insulators and Topological Superconductors (Princeton University Press).