

PHYS-638

Some aspects of topology in condensed matter physics

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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 2025

Summary

Some topics covered in this class are: The Index theorem, solitons, topological band insulators/superconductors, bulk-edge correspondence, 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 quantum 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**

Christopher Mudry and Claudio Chamon

Fractionalization of Particles in Physics: Invertible Topological Phases of Matter (Cambridge University Press, 2025).

Ressources en bibliothèque

- [Fractionalization of Particles in Physics: Invertible Topological Phases of Matter / Mudry](#)