

Path Integrals

Perimeter Institute Summer School 2020

Instructor information

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Course description

The goal of this course is to introduce the path integral formulation of quantum mechanics and a few of its applications. We will begin by motivating the path integral formulation and explaining its connections to other formulations of quantum mechanics and its relation to classical mechanics. We will then explore some applications of path integrals.

Each 90-minute session will include roughly equal amounts of lecture time and activities. The activities are designed to enhance your learning experience and allow you to assess your own level of understanding.

Learning outcomes

By the end of this course students should be able to:

- Explain the connection between quantum mechanics and statistical physics
- Use the saddle-point approximation to evaluate path integrals
- Determine tunneling rates using the instanton method
- Explain the connection between particle statistics and spacetime dimension

Resources

For a part of each class you will collaboratively work on problems in groups of 3 or 4 in Zoom breakout rooms. Before the course begins you should determine a method to share mathematical expressions over Zoom. You will be provided with a document that gives several suggestions.

Tentative course schedule

Lecture 1	Introduction to path integrals and the semi-classical limit
Lecture 2	Propagator in real and imaginary time
Lecture 3	Perturbation theory
Lecture 4	Non-perturbative physics and quantum tunneling
Lecture 5	Topology and path integrals