Path Integrals

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Land Acknowledgement

Perimeter Institute is located on the Haldimand Tract, in the traditional territory of the Anishinaabe, Haudenosaunee, and Neutral peoples. After the American Revolution, the tract was granted by the British to the Six Nations of the Grand River and the Mississaugas of the Credit First Nation as compensation for their role in the war and for the loss of their traditional lands in upstate New York. Of the 950,000 acres granted to the Haudenosaunee, less than 5 percent remains Six Nations land. Only 6,100 acres remain Mississaugas of the Credit land.

The policies of expulsion and assimilation that harmed and continue to harm Indigenous peoples directly benefited us in giving us the ability to live and work here. We have the responsibility to learn about and acknowledge these injustices so that we may begin to remedy the damages that have been done and those that are ongoing.

Teaching Assistants

Caroline de Lima Vargas Simoes (`clima@perimeterinstitute.ca`)
José de Jesús Padua Argüelles (`jpaduaarguelles@perimeterinstitute.ca`)

Zoom links

Zoom links are posted in the PSI Start Slack workspace.

Course summary

The goal of this course is to introduce the path integral formulation of quantum mechanics. We will derive the path integral representation of the propagator. Perturbation theory in the path integral formulation will be developed. Path integrals will be used to compute tunneling rates and understand particle statistics.

Learning goals

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

- Prove that the path integral expression for the propagator is equivalent to the bra-ket expression

- Use the semi-classical approximation to perturbatively evaluate path integrals

- Use the instanton method to calculate decay rates

- Explain why anyons exist only in two dimensions

Tentative course schedule

- Day 1: Introduction to path integrals

- Day 2: Path integral expression for the propagator

- Day 3: Classical limit and perturbation theory

- Day 4: Imaginary time and statistical physics

- Day 5: Instantons and tunneling

- Day 6: Path integrals and particle statistics

- Day 7: Path integrals and relativity

Course requirements

Students can receive official recognition of their participation in the course. This requires:

- Attending all sessions of the course on Zoom (excused absence possible with written permission from the instructor)

- Completing one homework assignment which will be available after week 2 of the course; it will be due by the end of the course on Thursday, June 15. The HW will be marked as complete so long as you demonstrate a good-faith effort to solve all the problems.

Resources

Recordings of the lectures will be available to PSI Start participants, so you may re-watch them; these are not a substitute for attending the live course sessions on Zoom.

Lecture notes will also be posted before each course session, but they may not agree perfectly with the actual course content.

Accommodations

Accommodations will be made according to PI's Accommodation Policy. Students can contact Dan or PI's People and Culture department if accommodations are required.

Academic integrity

Students are expected to know, understand, and follow the academic integrity policies detailed on the University of Waterloo Academic Integrity website.