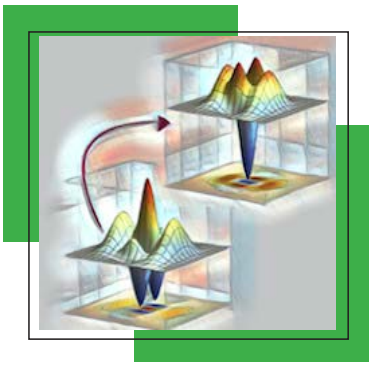
institute for pure & applied mathematics

Non-commutative Optimal Transport

March 10 - June 13, 2025



Scientific Overview

In the last decades, optimal transportation (OT) has emerged as a fertile field of inquiry, and an effective tool for the diverse exploration of applications within and beyond mathematics, including economics, meteorology, geometry, statistics, fluid mechanics, engineering, and design problems.

More recently, motivated by fundamental problems in Artificial Intelligence, Quantum Physics, and Electronic Structure Theory, the theory of OT has been broadening to a different class of state spaces such as the spaces of density matrices, operators, or more generally C* and von Neumann algebras, all of which are non-commutative. Although these non-commutative OT variants share a common mathematical feature, a unified geometrical perspective for them is still lacking. Additionally, many crucial analytical, computational, and statistical challenges remain unsolved, impeding the development of practical applications.

The program brings together and fosters collaborations among researchers from complementing mathematical communities that have been or are keen on working on the topic. More specifically, the program will focus on:

- Evolution equations for density operators
- Quantum optimal transport
- Wasserstein distances for density operators
- Semidefinite relaxation of non-commutative transport
- Statistical and probabilistic aspects of non-commutative transport
- Matrix and Operator Functional inequalities
- Computational algorithms solving non-commutative optimal transport

Long Program Schedule

- Opening Day: March 10, 2025
- Non-commutative Optimal Transport Tutorials: March 11-14, 2025
- Workshop I: Optimal Transport for Density Operators: Theory and Numerics: March 31 - April 4, 2025
- Workshop II: Dynamics of Density Operators: April 28 - May 2, 2025
- Workshop III: Statistical and Numerical Methods for Non-commutative Optimal Transport: May 19-23, 2025
- Non-commutative Optimal Transport Culminating Workshop at Lake Arrowhead : June 9-13, 2025

Organizers

Tryphon Georgiou (University of California, Irvine (UCI))
Augusto Gerolin (University of Ottawa)
Farnaz Heidar-Zadeh (Queen's University)
Katarzyna Pernal (Politechnika Lodzka)
Alessandro Rudi (Ecole Normale Supérieure)
Dario Trevisan (Università di Pisa)
Oliver Tse (Eindhoven University of Technology)

Participation

This long program will involve senior and junior researchers from several communities relevant to this program. You may apply for financial support to participate in the entire fourteen-week program, or a portion of it. We prefer participants who stay for the entire program. Applications will be accepted through **October 10, 2024**, but offers may be made up to one year before the start date. We urge you to apply early. Mathematicians and scientists at all levels who are interested in this area of research are encouraged to apply for funding. Supporting the careers of women and minority researchers is an important component of IPAM's mission and we welcome their applications. More information and an application is available online.

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For more information, visit the program webpage:
www.ipam.ucla.edu/not2025