USC Dornsife
College of Letters, Arts and Sciences
Department of Physics and Astronomy

Joint Seminar Series

USC Viterbi
School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

From Tomography of CV Systems to a New Measure of Non-Gaussianity: *The Symplectic Rank*

Francesco Anna Mele

Physics at the Scuola Normale Superiore
Pisa, Italy

Friday, June 20, 2025
1:30-3:00pm

In-person: EEB 132

via Zoom:
https://usc.zoom.us/j/91779790215?pwd=ZlygfD3dO1htFllfQ0n8HyIaLNnYjL.1
Meeting ID: 917 7979 0215 | Passcode: 078849

Abstract:
Quantum state tomography, aimed at deriving a classical description of an unknown state from measurement data, is a fundamental task in quantum physics. In parallel, non-Gaussianity serves as a crucial resource for quantum information processing in continuous-variable (CV) systems. In this work, we investigate the fundamental limits of quantum state tomography for CV systems, revealing a deep connection between the efficiency in tomography and the degree of non-Gaussianity. Specifically:

- We first show that tomography of general non-Gaussian states is extremely inefficient;
- In contrast, we demonstrate that tomography of Gaussian states is efficient. To accomplish this, we introduce new tools of independent interest: tight bounds on the trace distance between CV states in terms of the norm distance between their first moments and covariance matrices.
- We then explore the intermediate regime, establishing that tomography becomes progressively harder as the level of non-Gaussianity increases.

The latter result naturally leads to the concept of symplectic rank: a novel non-Gaussianity monotone that satisfies remarkable operational and resource-theoretic properties. Mathematically, the symplectic rank of a pure state is the number of symplectic eigenvalues of the covariance matrix that are strictly larger than the ones of the vacuum. Importantly, the symplectic rank is non-increasing under post-selected Gaussian operations, leading to strictly stronger no-go theorems for Gaussian conversion than those previously known.
The talk will be based on: https://arxiv.org/pdf/2405.01431, https://arxiv.org/pdf/2411.02368, and https://arxiv.org/pdf/2504.19319 .

Bio:
Francesco Anna Mele was born in Italy in 1997. He received the B.Sc. and M.Sc. degrees in physics from the University of Pisa, Italy, in 2021, and the Diploma degree in physics from Scuola Normale Superiore of Pisa, Italy, in 2021. He is currently pursuing a Ph.D. in Physics at the Scuola Normale Superiore of Pisa, Italy, under the supervision of Vittorio Giovannetti and Ludovico Lami. He is currently visiting the California Institute of Technology (Caltech) until August 15. His research interests include all aspects of quantum information and computation.

Hosted by:
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