Centre
DE Nanosciences
& DE Nanotechnologies

Seminar

Friday April 22th - 11h00

Amphithéâtre du C2N

"Non-Gaussian states and their role in reaching a quantum computational advantage"

Mattia Walschaers

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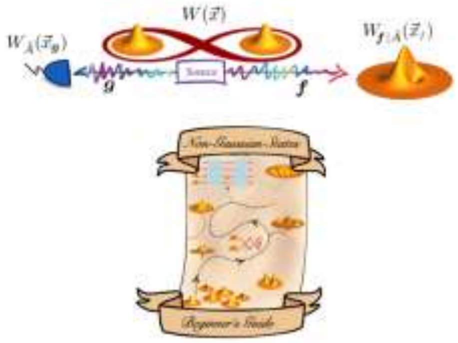
Gaussian states appear naturally in quantum optics under the guise of coherent, squeezed, or thermal states. In particular squeezing is an important resource for the deterministic generation of large entangled states useful for quantum computation. Yet, Gaussian states have an important limitation: all Gaussian measurements on Gaussian states can be efficiently simulated i.e nothing specifically quantum is happening. In many quantum technologies, we thus require non-Gaussian states.A common route to create non-Gaussian states in quantum optics is by performing non-Gaussian measurements (often photon counting) on parts of a Gaussian state. I will therefore present a general way to describe such conditionally generated states. The resulting set of non-Gaussian states is vast compared to the well-characterized corpus of Gaussian states and it is thus interesting to quantify this non-Gaussianity. I will argue in favour of negativity of the Wigner function as a figure of merit, based on its important role in sampling problems. I will then circle back to the conditional preparation scheme to show how Wigner negativity is fundamentally intertwined with quantum correlations.



Mattia Walschaers got his PhD from the universities of Freiburg (Germany) and Leuven (Belgium) for a cotutelle project, supervised by *Andreas Buchleitner* and *Mark Fannes*. His work initially focused on the role of **quantum effects in photosynthesis**, where he developed analytically solvable toy models to better understand the role of disorder in coherent transport of photosynthetic excitons. Later on, his interest shifted to many-particle systems and **many-particle interference** a phenomenon which induced by indistinguishability of quantum particles. This ultimately led to the development of an experimentally implementable **statistical benchmark for** boson sampling**.** The resulting dissertation was published as a book in the *Springer Theses* series, and it was also one of the four nominees for the *SAMOP dissertation prize* of the German Physical Society. Between 2016 and 2019 , Mattia was a post-doctoral researcher in multimode quantum optics group of the *Laboratoire Kastler Brossel*, where his research interests shifted to **continuous-variable quantum optics and quantum information** where he studied **experimentally feasible non-Gaussian states** and developed a general framework to study **multimode photon addition and subtraction**. Mattia has been a CNRS researcher at the LKB since 2019 where he is studying **multimode non-Gaussian quantum states, quantum correlations in CV systems, quantum batteries, complex quantum networks, and applications of machine learning in quantum experiments**.