



Seminari di Dipartimento

Aula Dottorato, Dipartimento di Fisica
Mercoledì 22 aprile 2026 - ore 14:00

An Introduction to Quantum Contextuality

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Quantum contextuality reveals the failure of a seemingly reasonable intuition: that a measurement reveals a preexisting property of the measured system. This is the physical content of the theorems of Kochen and Specker (1960–1967) and Bell (1963) stating the impossibility of reproducing quantum theory with a class of hidden-variable theories, later called “noncontextual hidden-variable theories”. However, for years, it was thought that, in contrast to Bell’s theorem, the KS-Bell theorem could neither be formulated without “the formal structure of quantum mechanics” nor described “in terms of a collection of black-box gedanken experiments”. This started to change in 1998 and definitively changed in 2008. Since then, quantum contextuality has evolved into a rich field in its own right. Nowadays contextuality is arguably the best conceptual tool guiding our understanding of quantum theory. Moreover, contextuality has been identified as a necessary resource for quantum computational advantage in some models of fault-tolerant quantum computation.

In this seminar, we discuss how to define contextuality in a theory-independent manner, such that it provides a natural generalization of Bell’s nonlocality to compatibility scenarios that cannot be embedded into Bell scenarios. We also present basic examples of quantum contextuality illustrating two striking features—namely, that contextuality can be exhibited by individual qutrits and can be state-independent. Finally, we list several applications of quantum contextuality and explain why it offers crucial insight into nonlocality and, ultimately, into the foundations of quantum theory.

The seminar is in presence up to the maximum occupancy of the lecture hall.