FACOLTÀ DI SCIENZE MATEMATICHE, FISICHE E NATURALI
DIPARTIMENTO DI MATEMATICA E FISICA "NICCOLÒ TARTAGLIA"
INTERNATIONAL DOCTORAL PROGRAM IN SCIENCE

ON THE CLASSICAL AND QUANTUM COHERENCE OF LIGHT

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Abstract
Coherence is defined as the ability of waves to interfere. Intuitively, coherent waves have a well-defined constant phase relationship. However, an exclusive and extensive physical definition of coherence is more nuanced. Coherence functions, as introduced by Roy Glauber and others in the 1960s, capture the mathematics behind the intuition by defining correlation between the electric field components as coherence. These correlations between electric field components can be measured to arbitrary orders, hence leading to the concept of different orders of coherence. The coherence encountered in most optical experiments, including the classic Young's double slit experiment and Mach-Zehnder interferometer, is first order coherence. Robert Hanbury Brown and Richard Q. Twiss performed a correlation experiment in 1956, and brought to light a different kind of correlation between fields, namely the correlation of intensities, which correspond to second order coherence. Higher order coherences become relevant in photon-coincidence counting experiments. Orders of coherence can be measured using classical correlation functions or by using the quantum analogue of those functions, which take quantum mechanical description of electric field (operators) as input. While the quantum coherence functions might yield the same results as the classical functions, the underlying mechanism and description of the physical processes are fundamentally different because quantum interference deals with interference of possible histories while classical interference deals with interference of physical waves.
The scope of these lectures is to highlight two questions:
1- the possibility of transferring quantum states from one physical system to another;
2- to discuss the possibility of using the quantum states in an e.m. to interact and study quantum states in the matter.

PhD Course

Mercoledì 27 marzo 2024
Martedì 16 aprile 2024
Lunedì 22 aprile 2024
Sala Riunioni S4, ore 10.00
via Garzetta 48, Brescia

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