ICFO

SEMINAR: Qualitative equivalence between incompatibility and Bell nonlocality

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11:00 to 12:00
Seminar Room

Measurements in quantum theory can fail to be jointly measurable. Like entanglement, this incompatibility of measurements is necessary but not sufficient for violating Bell inequalities. The structure of (in)compatibility relations among a set of measurements can be represented by a joint measurability structure, i.e., a hypergraph with its vertices denoting measurements and its hyperedges denoting all and only compatible sets of measurements. Since incompatibility is necessary for a Bell violation, we also have that the joint measurability structure on each wing of the Bell experiment must necessarily be non-trivial, i.e., it must admit a subset of incompatible vertices. We show that for any non-trivial joint measurability structure with a finite set of vertices, there exists a quantum realization with a set of measurements that enables a Bell violation, i.e., given that Alice has access to this incompatible set of measurements, there exists a set of measurements for Bob and an entangled state shared between them such that they can jointly violate a Bell inequality. We thus establish a qualitative equivalence between incompatibility and Bell nonlocality: a non-trivial joint measurability structure is not only necessary for a Bell violation, but also sufficient. We also provide a characterization of some qubit measurements that are useful for Bell inequality violations in the simplest joint measurability structure of interest, i.e., Specker's scenario, which consists of three pairwise compatible but triplewise incompatible measurements.
(Joint work with S.A. Yadavalli and N. Andrejic.)

Hosted by: Prof. Dr. Antonio Acin