Quantum Information Seminar

Using and reusing coherence to realize quantum processes

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Abstract:

Using and reusing coherence to realize quantum processes Coherent superposition is a key feature of quantum mechanics that underlies the advantage of quantum technologies over their classical counterparts. Recently, coherence has been recast as a resource theory in an attempt to identify and quantify it in an operationally well-defined manner. Here we study how the coherence present in a state can be used to implement a quantum channel via incoherent operations and, in turn, to assess its degree of coherence. We introduce the robustness of coherence of a quantum channel-which reduces to the homonymous measure for states when computed on constant-output channels-and prove that: i) it quantifies the minimal rank of a maximally coherent state required to implement the channel; ii) its logarithm quantifies the amortized cost of implementing the channel provided some coherence is recovered at the output; iii) its logarithm also quantifies the zero-error asymptotic cost of implementation of many independent copies of a channel. We also consider the generalized problem of imperfect implementation with arbitrary resource states. Using the robustness of coherence, we find that in general a quantum channel can be implemented without employing a maximally coherent resource state. In fact, we prove that every pure coherent state in dimension larger than 2, however weakly so, turns out to be a valuable resource to implement some coherent unitary channel. We illustrate our findings for the case of single-qubit unitary channels.

About the Speaker:

Matteo Rosati did his BSc and MSc studies in Physics (2009-2014) at Università La Sapienza, Rome, studying the modelling of disordered and complex systems under the supervision of Prof. Giorgio Parisi. He took his PhD in Theoretical Physics (2017) at Scuola Normale Superiore, Pisa with Prof. Vittorio Giovannetti, with a thesis aimed at devising efficient and implementable decoders for classical communication on quantum guassian channels. Since then, he has been a postdoctoral fellow at the Universitat Autonoma de Barcelona, working with Profs. Andreas Winter and John Calsamiglia on resource theories and quantum learning. In 2019 he has been awarded a Marie Skłodowska-Curie Fellowship from the EU, starting in January 2020.

All are welcome!
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