

OpenQMBP2023: New perspectives in the out-of-equilibrium dynamics of open many-body quantum systems



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Laser-driven superradiant ensembles

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I will present our recent studies on superradiance in dense clouds of ultracold atoms, that are indistinguishably coupled to a mode of the electromagnetic field, akin to cavity or waveguide QED systems, but here in free space. We are in particular interested in the case where the atomic ensemble is continuously driven by a resonant laser that leads to a competition between laser driving and collective spontaneous emission. We observed that this competition induces a transition to a steady-state superradiant phase. Beyond measuring the field intensity, we measure photon-photon correlations. This precious tool of quantum optics allows us to question whether atomic correlations can impart non-trivial photonic correlations. I will show that indeed photonic correlations emerge, and despite the system's simplicity, their description poses a challenge to many-body theories.

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