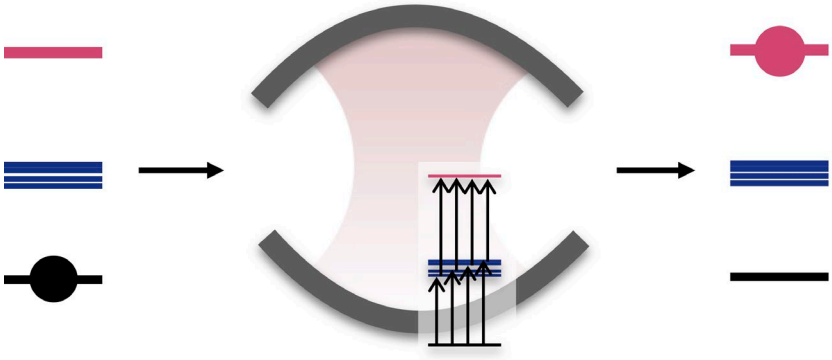
Physikalisches Institut
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

PHYSIKALISCHES KOLLOQUIUM

AM 29. JANUAR 2024 UM 17 UHR C.T.
IM GROßEN HÖRSAAL



HYBRIDIZE: HOW TO USE PHOTONS TO CONTROL YOUR FAVOURITE QUANTUM SYSTEM

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Many applications of quantum mechanics require the ability to prepare a system in an initial state and subsequently control its evolution into a desired final state. Classical light fields have proven a versatile tool for such a targeted manipulation of complex systems. What has remained so far largely unexplored is the quantum nature of the control field. In this case, the state space of the field degree of freedom accommodates a large variety of states which are very different from quasi-classical coherent states, as is well-established in quantum optics and cavity quantum electrodynamics.
In this talk, I will discuss how to find quantum states of light to optimally excite a target transition in a multilevel quantum system. To this end, we can exploit the quantum correlations in entangled photon pairs to populate the target state more efficiently, along optimal excitation pathways and by minimizing the amplitudes of undesired nearby states. An alternative strategy is to couple the target system to the quantized field of an electromagnetic cavity, and to tailor the latter's quantum statistics. Here we see that experimentally accessible states of the field, like coherent or squeezed states, achieve good and fast control of the multilevel target system, notably also at coupling strengths far beyond perturbative approximations of various flavours.

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