Matter and light, collective emission

[1] C. Cohen-Tannoudji, J. Dupont-Roc, and G. Grynberg, *Photons and Atoms* (Wiley-VCH Verlag GmbH, Weinheim, Germany, 1997), ISBN 9783527618422, DOI: 10.1002/9783527618422.

[2] R. H. Dicke, *Coherence in Spontaneous Radiation Processes*, Phys. Rev. **93**, 99 (1954), DOI: 10.1103/PhysRev.93.99.

[3] M. Gross and S. Haroche, *Superradiance: An essay on the theory of collective spontaneous emission*, Phys. Rep. **93**, 301 (1982), DOI: 10.1016/0370-1573(82)90102-8.

Dicke model, Dicke phase transition, No Go theorem

[1] K. Hepp and E. H. Lieb, *On the Superradiant Phase Transition for Molecules in a Quantized Radiation Field: the Dicke Maser Model*, Ann. Phys **76**, 360 (1973), DOI: 10.1016/0003-4916(73)90039-0.

[2] Y. K. Wang and F. T. Hioe, *Phase Transition in the Dicke Model of Superradiance*, Phys. Rev. A **7**, 831 (1973), DOI: 10.1103/PhysRevA.7.831.

[3] K. Hepp and E. Lieb, *Equilibrium statistical mechanics of matter interacting with the quantized radiation field*, Phys. Rev. A **8**, 2517 (1973), DOI: 10.1103/PhysRevA.8.2517.

[4] K. Rzazewski, K. Wódkiewicz, and W. Zakowicz, *Phase Transitions, Two-Level Atoms, and the A2 Term*, Phys. Rev. Lett. **35**, 432 (1975), DOI: 10.1103/PhysRevLett.35.432.

[5] P. Nataf and C. Ciuti, *No-go theorem for superradiant quantum phase transitions in cavity QED and counter-example in circuit QED.*, Nat. Commun. **1**, 72 (2010), DOI: 10.1038/ncomms1069.

Chemical potential, Rotating frame

[1] P. R. Eastham and P. B. Littlewood, *Bose condensation of cavity polaritons beyond the linear regime: The thermal equilibrium of a model microcavity*, Phys. Rev. B **64**, 235101 (2001), DOI: 10.1103/PhysRevB.64.235101.

[2] S. Schmidt, G. Blatter, and J. Keeling, *From the Jaynes-Cummings-Hubbard to the Dicke model*, J. Phys. B At. Mol. **46**, 224020 (2013), DOI: 10.1088/0953-4075/46/22/224020.

[3] W. L. Yang, Y. P. Zhong, T. Liu, J. Twamley, H. Wang, and M. Feng, *Simulating the quantum critical behaviour in a driven Tavis-Cummings circuit*, p. 10 (2014), 1406.1436.

Atomic realisation, dynamics

[1] F. Dimer, B. Estienne, A. S. Parkins, and H. J. Carmichael, *Proposed realization of the Dicke-model quantum phase transition in an optical cavity QED system*, Phys. Rev. A **75**, 013804 (2007), DOI: 10.1103/PhysRevA.75.013804.

[2] D. Nagy, G. Kónya, G. Szirmai, and P. Domokos, *Dicke-Model Phase Transition in the Quantum Motion of a Bose-Einstein Condensate in an Optical Cavity*, Phys. Rev. Lett. **104**, 1 (2010), DOI: 10.1103/PhysRevLett.104.130401.

[3] M. J. Bhaseen, J. Mayoh, B. D. Simons, and J. Keeling, *Dynamics of Non-Equilibrium Dicke Models,*, Phys. Rev. A **85**, 013817 (2012), DOI: 10.1103/PhysRevA.85.013817.

Self Organisation of atoms

Boltzmann

[1] P. Domokos and H. Ritsch, *Collective Cooling and Self-Organization of Atoms in a Cavity*, Phys. Rev. Lett. **89**, 253003 (2002), DOI: 10.1103/PhysRevLett.89.253003.

[2] A. T. Black, H. W. Chan, and V. Vuletić, *Observation of Collective Friction Forces due to Spatial Self-Organization of Atoms: From Rayleigh to Bragg Scattering*, Phys. Rev. Lett. **91**, 203001 (2003), DOI: 10.1103/PhysRevLett.91.203001.

[3] J. Asbóth, P. Domokos, H. Ritsch, and A. Vukics, *Self-organization of atoms in a cavity field: Threshold, bistability, and scaling laws*, Phys. Rev. A **72**, 053417 (2005), DOI: 10.1103/PhysRevA.72.053417.

[4] H. Ritsch, P. Domokos, F. Brennecke, and T. Esslinger, *Cold atoms in cavity-generated dynamical optical potentials*, Rev. Mod. Phys. **85**, 553 (2013), 1210.0013, DOI: 10.1103/RevModPhys.85.553.

Bosons

[1] K. Baumann, C. Guerlin, F. Brennecke, and T. Esslinger, *Dicke quantum phase transition with a superfluid gas in an optical cavity*, Nature **464**, 1301 (2010), DOI: 10.1038/nature09009.

[2] E. G. Dalla Torre, S. Diehl, M. D. Lukin, S. Sachdev, and P. Strack, *Keldysh approach for nonequilibrium phase transitions in quantum optics: Beyond the Dicke model in optical cavities*, Phys. Rev. A **87**, 023831 (2013), DOI: 10.1103/PhysRevA.87.023831.

[3] F. Piazza, P. Strack, and W. Zwerger, *Bose-Einstein condensation versus Dicke-Hepp-Lieb transition in an optical cavity*, Ann. Phys. (N. Y). **339**, 135 (2013), 1305.2928, DOI: 10.1016/j.aop.2013.08.015.

Fermions

[1] J. Keeling, M. J. Bhaseen, and B. D. Simons, *Fermionic Superradiance in a Transversely Pumped Optical Cavity*, Phys. Rev. Lett. **112**, 143002 (2014), 1309.2464, DOI: 10.1103/PhysRevLett.112.143002.

[2] F. Piazza and P. Strack, *Umklapp Superradiance with a Collisionless Quantum Degenerate Fermi Gas*, Phys. Rev. Lett. **112**, 143003 (2014), 1309.2714, DOI: 10.1103/PhysRevLett.112.143003.

[3] Y. Chen, Z. Yu, and H. Zhai, *Superradiance of Degenerate Fermi Gases in a Cavity*, Phys. Rev. Lett. **112**, 143004 (2014), 1309.3784, DOI: 10.1103/PhysRevLett.112.143004.

Multimode physics

[1] S. Gopalakrishnan, B. L. Lev, and P. M. Goldbart, *Emergent Crystallinity and Frustration with Bose–Einstein Condensates in Multimode Cavities*, Nat. Phys. **5**, 845 (2009), DOI: 10.1038/nphys1403.

[2] S. Gopalakrishnan, B. Lev, and P. Goldbart, *Atom-light crystallization of Bose-Einstein condensates in multimode cavities: Nonequilibrium classical and quantum phase transitions, emergent lattices, supersolidity, and frustration*, Phys. Rev. A **82**, 043612 (2010), DOI: 10.1103/PhysRevA.82.043612.

Spin glass

[1] S. Gopalakrishnan, B. L. Lev, and P. M. Goldbart, *Frustration and Glassiness in Spin Models with Cavity-Mediated Interactions*, **107**, 277201 (2011), DOI: 10.1103/PhysRevLett.107.277201.

[2] P. Strack and S. Sachdev, *Dicke Quantum Spin Glass of Atoms and Photons*, Phys. Rev. Lett. **107**, 277202 (2011), DOI: 10.1103/PhysRevLett.107.277202.

[3] M. Müller, P. Strack, and S. Sachdev, *Quantum charge glasses of itinerant fermions with cavity-mediated long-range interactions*, Phys. Rev. A **86**, 023604 (2012), DOI: 10.1103/PhysRevA.86.023604.

[4] M. Buchhold, P. Strack, S. Sachdev, and S. Diehl, *Dicke-model quantum spin and photon glass in optical cavities: Nonequilibrium theory and experimental signatures*, Phys. Rev. A **87**, 063622 (2013), DOI: 10.1103/PhysRevA.87.063622.