

# Beyond the Dicke Model: Universality and Geometry in Many-Body Superradiance

## 1) Collective Scattering in Cavities

- [1] R. H. Dicke. “Coherence in Spontaneous Radiation Processes”. In: *Physical Review* 93.1 (1954), pp. 99–110. DOI: [10.1103/PhysRev.93.99](https://doi.org/10.1103/PhysRev.93.99).
- [2] Nicholas E. Rehler and Joseph H. Eberly. “Superradiance”. In: *Physical Review A* 3.5 (1971), pp. 1735–1751. DOI: [10.1103/PhysRevA.3.1735](https://doi.org/10.1103/PhysRevA.3.1735).
- [3] H. J. Carmichael. “Analytical and numerical results for the steady state in cooperative resonance fluorescence”. In: *Journal of Physics B: Atomic and Molecular Physics* 13.18 (1980), pp. 3551–3575. DOI: [10.1088/0022-3700/13/18/009](https://doi.org/10.1088/0022-3700/13/18/009).
- [4] M. Gross and S. Haroche. “Superradiance: An essay on the theory of collective spontaneous emission”. In: *Physics Reports* 93.5 (1982), pp. 301–396. DOI: [10.1016/0370-1573\(82\)90102-8](https://doi.org/10.1016/0370-1573(82)90102-8).
- [5] Nikita Leppen and Ephraim Shahmoon. “Quantum correlated steady states under competing collective and individual decay”. In: *arXiv preprint arXiv:2404.02134* (2024). DOI: [10.48550/arXiv.2404.02134](https://doi.org/10.48550/arXiv.2404.02134). arXiv: [2404.02134](https://arxiv.org/abs/2404.02134) [quant-ph].

## 2) Collective Scattering Beyond Cavities

- [1] R. H. Lehmberg. “Radiation from an  $N$ -Atom System. I. General Formalism”. In: *Physical Review A* 2.3 (1970), pp. 883–888. DOI: [10.1103/PhysRevA.2.883](https://doi.org/10.1103/PhysRevA.2.883).
- [2] R. H. Lehmberg. “Radiation from an  $N$ -Atom System. II. Spontaneous Emission from Two Two-Level Atoms”. In: *Physical Review A* 2.3 (1970), pp. 889–896. DOI: [10.1103/PhysRevA.2.889](https://doi.org/10.1103/PhysRevA.2.889).
- [3] A. Asenjo-Garcia et al. “Exponential Improvement in Photon Storage Fidelities Using Subradiance and “Selective Radiance” in Atomic Arrays”. In: *Physical Review X* 7.3 (2017), p. 031024. DOI: [10.1103/PhysRevX.7.031024](https://doi.org/10.1103/PhysRevX.7.031024). arXiv: [1703.03382](https://arxiv.org/abs/1703.03382) [quant-ph].
- [4] A. Asenjo-Garcia et al. “Atom-light interactions in quasi-one-dimensional nanostructures: A Green’s-function perspective”. In: *Physical Review A* 95.3 (2017), p. 033818. DOI: [10.1103/PhysRevA.95.033818](https://doi.org/10.1103/PhysRevA.95.033818). arXiv: [1701.04948](https://arxiv.org/abs/1701.04948) [quant-ph].
- [5] Robert J. Bettles, Simon A. Gardiner, and Charles S. Adams. “Enhanced Optical Cross Section via Collective Coupling of Atomic Dipoles in a 2D Array”. In: *Physical Review Letters* 116.10 (2016), p. 103602. DOI: [10.1103/PhysRevLett.116.103602](https://doi.org/10.1103/PhysRevLett.116.103602). arXiv: [1510.07855v3](https://arxiv.org/abs/1510.07855v3) [quant-ph].
- [6] Stuart J. Masson et al. “Many-body signatures of collective decay in atomic chains”. In: *Physical Review Letters* 125.26 (2020), p. 263601. DOI: [10.1103/PhysRevLett.125.263601](https://doi.org/10.1103/PhysRevLett.125.263601). arXiv: [2008.08139v2](https://arxiv.org/abs/2008.08139v2) [quant-ph].

- [7] Stuart J. Masson and Ana Asenjo-Garcia. “Universality of Dicke superradiance in arrays of quantum emitters”. In: *Nature Communications* 13.1 (2022), p. 2285. DOI: [10.1038/s41467-022-29805-4](https://doi.org/10.1038/s41467-022-29805-4). arXiv: [2106.02042](https://arxiv.org/abs/2106.02042) [quant-ph].
- [8] F. Robicheaux. “Theoretical study of early-time superradiance for atom clouds and arrays”. In: *Physical Review A* 104.6 (2021), p. 063706. DOI: [10.1103/PhysRevA.104.063706](https://doi.org/10.1103/PhysRevA.104.063706).
- [9] L. Rubies-Bigorda, L. Ostermann, and S. F. Yelin. “Characterizing superradiant dynamics in atomic arrays via a cumulant expansion approach”. In: *Physical Review Research* 5.1 (2023), p. 013093. DOI: <https://doi.org/10.1103/PhysRevResearch.5.013091>. arXiv: [2207.13709](https://arxiv.org/abs/2207.13709) [quant-ph].
- [10] A. Douglas et al. “Many-body super- and subradiance in ordered atomic arrays”. In: *arXiv preprint arXiv:2311.13000* (2024). DOI: <https://doi.org/10.48550/arXiv.2604.11795>. arXiv: [2604.11795v2](https://arxiv.org/abs/2604.11795v2) [quant-ph].

### 3) Scaling Laws for the Correlated Decay Rate of Many-Body Quantum Systems

- [1] Wai-Keong Mok et al. “Dicke Superradiance Requires Interactions Beyond Nearest Neighbors”. In: *Physical Review Letters* 130.21 (2023), p. 213605. DOI: [10.1103/PhysRevLett.130.213605](https://doi.org/10.1103/PhysRevLett.130.213605). arXiv: [2211.00668](https://arxiv.org/abs/2211.00668) [quant-ph].
- [2] Wai-Keong Mok et al. “Universal scaling laws for correlated decay of many-body quantum systems”. In: *arXiv preprint arXiv:2406.00722* (2024). DOI: [10.48550/arXiv.2406.00722](https://doi.org/10.48550/arXiv.2406.00722). arXiv: [2406.00722](https://arxiv.org/abs/2406.00722) [quant-ph].
- [3] Cosimo C. Rusconi et al. “Optical depth dictates universal bounds on many-body decay in atomic ensembles”. In: *arXiv preprint arXiv:2604.24680* (2026). DOI: [10.48550/arXiv.2604.24680](https://doi.org/10.48550/arXiv.2604.24680). arXiv: [2604.24680](https://arxiv.org/abs/2604.24680) [quant-ph].

### 4) Experimental Implications of Collective Decay in Arrays

- [1] Giovanni Ferioli et al. “A non-equilibrium superradiant phase transition in free space”. In: *Nature Physics* 19.9 (2023), pp. 1317–1321. DOI: [10.1038/s41567-023-02064-7](https://doi.org/10.1038/s41567-023-02064-7). arXiv: [2207.10361](https://arxiv.org/abs/2207.10361) [quant-ph].
- [2] Stefan Ostermann et al. “Breakdown of steady-state superradiance in extended driven atomic arrays”. In: *Physical Review Research* 6.2 (2024), p. 023206. DOI: [10.1103/PhysRevResearch.6.023206](https://doi.org/10.1103/PhysRevResearch.6.023206). arXiv: [2311.10824](https://arxiv.org/abs/2311.10824) [quant-ph].
- [3] S. Agarwal et al. “Directional superradiance in a driven ultracold atomic gas in free space”. In: *arXiv preprint arXiv:2403.15556* (2024). DOI: [10.48550/arXiv.2403.15556](https://doi.org/10.48550/arXiv.2403.15556). arXiv: [2403.15556](https://arxiv.org/abs/2403.15556) [quant-ph].
- [4] D. Gonçalves-Romeu, L. Bigué, and D. E. Chang. “Driven-Dissipative Phase Separation in Free-Space Atomic Ensembles”. In: *PRX Quantum* 6.2 (2025), p. 020303. DOI: [10.1103/PRXQuantum.6.020303](https://doi.org/10.1103/PRXQuantum.6.020303). arXiv: [2403.15237v1](https://arxiv.org/abs/2403.15237v1) [quant-ph].
- [5] Janne Roustekoski. “Superradiant phase transition in a large interacting driven atomic ensemble in free space”. In: *arXiv preprint arXiv:2404.12939* (2024). DOI: [10.48550/arXiv.2404.12939](https://doi.org/10.48550/arXiv.2404.12939). arXiv: [2404.12939](https://arxiv.org/abs/2404.12939) [quant-ph].