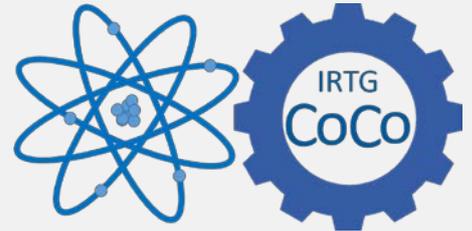




IRTG-Seminar



Dr. András Vukics

Hungarian Academy of Science, Budapest

“From superradiant criticality to solidification – fundamental limitation of ultrastrong coupling between light and atoms”

We present a solution to the long-standing problem whether the superradiant (Dicke) phase-transition critical point can be reached in the original setting of the Dicke model: electric dipoles (atoms) in the electromagnetic field. For this, we have to revisit some fundamentals of the modeling of light-matter interaction. First, by a generalization and modification of the Power–Zineau–Woolley picture, we build such a framework for the quantum electrodynamics of atoms as is free from the A-square and P-square problems, and valid in arbitrary confined geometries [1–2]. Second, by using this framework, we give an upper bound for the achievable coupling strength between light and atoms in the ultrastrong regime [2]. Supported by a scaling argument valid in the presented QED picture, we argue that the superradiant phase transition is an indication of the well-known phase transition of solidification [2]. Finally, we study the effect of the remainder of instantaneous atom-atom (depolarizing) interaction on the phase transition finding a shift of the critical point from the pure Dicke [3].

References

- [1] A. Vukics et al., Phys. Rev. Lett. 112, 073601 (2014)
- [2] A. Vukics et al., Phys. Rev. A 92, 043835 (2015)
- [3] T. Griesser, A. Vukics, and P. Domokos, arXiv:1604.03531 [quant-ph] (2016)