Routing thermal noise through quantum networks

Shabir Barzanjeh [1], Matteo Aquilina [2], André Xuereb * [3]

[1] Institute of Science and Technology Austria – Austria
[2] National Aerospace Centre – Malta
[3] Department of Physics, University of Malta – Malta

There has been significant interest recently in using complex quantum systems to create effective non-reciprocal dynamics. Proposals have been put forward for the realisation of artificial magnetic fields for photons and phonons; experimental progress is fast making these proposals a reality. Much work has concentrated on the use of such systems for controlling the flow of signals, e.g., to create isolators or directional amplifiers for optical signals. In this talk, we build on this work but move in a different direction. We develop the theory [1,2]of and discuss a potential realization for the controllable flow of thermal noise in quantum systems. We demonstrate theoretically that the unidirectional flow of thermal noise is possible within quantum cascaded systems. Viewing an optomechanical platform as a cascaded system we show here that one can ultimately control the direction of the flow of thermal noise. By appropriately engineering the mechanical resonator, which acts as an artificial reservoir, the flow of thermal noise can be constrained to a desired direction, yielding a thermal rectifier. The proposed quantum thermal noise rectifier could potentially be used to develop devices such as a thermal modulator, a thermal router, and a thermal amplifier for nanoelectronic devices and superconducting circuits.

References

[1]S. Barzanjeh, M. Aquilina, and A. Xuereb, Phys. Rev. Lett., **120**, 060601 (2018).
[2]A. Xuereb, M. Aquilina, and S. Barzanjeh, Proc. SPIE **10672**, 10672N (2018).

*Speaker