Light force devices and non-classical optics on a chip

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Nanophotonic devices allow for realizing complex optical functionality that is otherwise difficult to achieve with free-space optical setups. While such circuits find a multitude of applications in telecommunication and optical signal processing, their tremendous potential for non-classical optics remains largely unexplored. I will present an integrated platform in which key challenges of integrated quantum optics are addressed by combining nanophotonic and superconducting nanowire devices with optomechanical resonators. Superconducting nanowires are particularly promising for recording single photon events in a chip-scale framework. Besides offering near-perfect detection efficiency, they also provide small footprint and scalability as a key step towards integrated quantum optical circuits. In order to enable photon-emission on-chip we use nanoscale carbon-nanotube sources for electroluminescent generation of light. Working with a nonlinear optical substrate material furthermore enables active control of photon interaction. Leveraging additional degrees of freedom provided by free-standing mechanical structures thus yields a rich architecture for studying fundamental physics and emerging applications in chip-based metrology.