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Quantum optics, cavity QED, and quantum optomechanics[1]

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Quantum optomechanics provides a universal tool to achieve the quantum control of mechanical motion. It does that in devices spanning a vast range of parameters, with mechanical frequencies from a few Hertz to GHz, and with masses from 10^{-20} g to several kilos. Its underlying ideas can be traced back to the study of gravitational wave antennas, quantum optics, cavity QED and laser cooling which, when combined with the recent availability of advanced micromechanical and nanomechanical devices, opens a path to the realization of macroscopic mechanical systems that operate deep in the quantum regime. At the fundamental level this development paves the way to experiments that will lead to a more profound understanding of quantum mechanics; and from the point of view of applications, quantum optomechanical techniques will provide motion and force sensing near the fundamental limit imposed by quantum mechanics (quantum metrology) and significantly expand the toolbox of quantum information science. After a brief summary of key historical developments, the talk will give a broad overview of the current state of the art of quantum optomechanics, and comment on future prospects both in applied and in fundamental science.

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