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**Multimode Optomechanics with Cold Atoms**[1]

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Recent years have brought much progress in the motional control of cold atomic samples. So much so, that in many respects this motion can be now considered a controllable quantum resource. I will review some recent results in this domain, ranging from experimentally realized coupling of atomic motion mediated by the field of an optical resonator to the theoretical study of exploiting forces between atoms dressed with external laser fields. In the latter case, the strong van-der-Waals interactions between atoms in Rydberg states are inherited via dressing with off-resonant laser fields. The tunability of the interactions between any two trapped atoms allows intricate engineering of the quantum mechanical state of motion of a many-body system consisting of a large number of atoms trapped in an optical lattice or a tweezer array.

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