**Squeezed phonon laser with trapped ions**

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In this talk, I will present a tunable phonon laser and its squeezed variant using a large array of trapped ions. Optical tweezers are employed to isolate a subset of ions, forming an acoustic cavity resonator where phonon lasing occurs. By adjusting the tweezer strength and the number of pinned ions, we dynamically control cavity loss, providing flexible tuning of system parameters. The phonon laser operates via a blue-sideband transition, facilitating coherent energy exchange between the internal states of the ions and their vibrational motion, similar to a Raman laser.

To generate a squeezed phonon laser, we employ both blue- and red-sideband transitions, leading to quadrature noise reduction. The squeezing is characterized using the Wigner function, highlighting nonclassical phonon states. We analyze key properties such as squeezing strength, coherence, and linewidth narrowing, demonstrating potential applications in quantum sensing and precision metrology.