Miniaturized self-sustained coherent phonon sources, also known as “phonon lasers”, are interesting for applications such as mass-force sensing, intra-chip metrology and intra-chip time-keeping among others. We will review several mechanisms and techniques that can drive a mechanical mode into the lasing regime by exploiting the radiation pressure force in optomechanical cavities. We will specifically focus on a novel and efficient strategy for achieving the “phonon lasing” regime in optomechanical (OM) crystals [1] using the radiation pressure as the driving force of the motion. The mechanism is based on a self-pulsing limit cycle, which is a spontaneous process triggered within the optical cavity that modulate the intracavity radiation pressure force in resonance with a mechanical mode [2]. Self-sustained mechanical oscillations of modes up to 0.2 GHz are achieved if one of the low harmonics of the modulated force is resonant with a mechanical eigenstate (see Figure 1). We will discuss how it will be possible to further speeding up of the self-pulsing dynamics to reach the GHz regime, where the lack of good quality and miniaturized sources is a severe issue.

References
