

Uses of whispering gallery “supermodes” in a dual sapphire crystal architecture

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Abstract: We present a proof of concept experiment using called whispering gallery “supermodes” in a dual crystal architecture consisting of two cylinders aligned along the z-axis with a small ($\sim 100\mu\text{m}$) gap between their end faces

. As well as a normal whispering gallery mode family existing in each of the two crystals separately, there exists a super mode, which shares the entire volume of the set up, treating the two crystals as one complete cylinder. Mechanical vibration of one crystal would modulate the gap spacing and hence alter the resonant frequency of this super mode. Here we report experiments obtained with sapphire and with SrTiO₃ Single crystal resonators in case of sapphire single crystal Excellent agreement is obtained between simulated and measured data, which demonstrate an order of magnitude improvement of displacement sensitivity ($1.9 \text{ MHz}/\mu\text{m}$) for the super mode when compared to a recently measured single sapphire opto-acoustic system. As such, this new architecture is a good opportunity to further improve macroscopic optomechanical experiments with sapphire crystals. In addition to this, the electromagnetic filling factor in the gap is analysed, demonstrating a potential 40 times improvement on coupling strength to any device under test that one may wish to couple to a whispering gallery mode resonator.

Investigation performed in case of SrTiO₃ Single crystal with a resonant frequency of the fundamental mode at 1.2 GHz is also reported. I will describe advantages of use this architecture at least for quantum applications this resonator with two level systems such as Diamond with NV

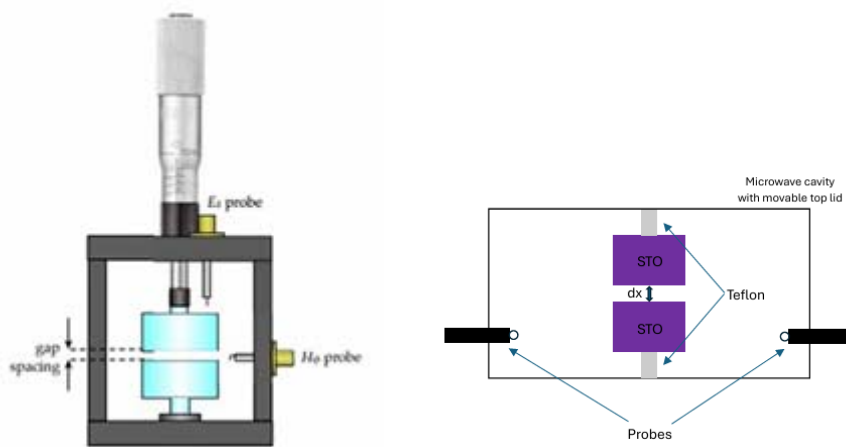


Fig. 1 Proof of concept experimental set up to observe the behavior of “super modes” as gap spacing is varied between two identical whispering gallery modes resonators by considering two different configurations of antennas and crystal of sapphire or SrTiO₃