Nanofiber platform to manipulate photons and phonons

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Brillouin scattering has found extensive applications in advanced photonics functions, including microwave photonics, signal processing, sensing, and lasing. More recently, it has been employed in micro- and nano-photonic waveguides [1]. Tapered optical fibers, due to their small transverse dimensions, exhibit a range of optical and mechanical properties that render them highly attractive for both fundamental physics research and technological applications. In contrast to standard telecom fibers, where Brillouin scattering is characterized by a single Lorentzian resonance centered at 10.86 GHz (@ 1550 nm), tapered silica fibers exhibit multiple Brillouin resonances at various frequencies ranging from 5 GHz to 10 GHz, originating from surface, shear, and compression elastic waves (see Figure 1a) [3]. For a large evanescent optical field surrounding the nanofiber, we observe an efficient Brillouin scattering in gas [4]. We show drastic Brillouin scattering enhancement by increasing the gas pressure with a maximum Brillouin gain which is 79 times larger than in a SMF (fig 1.b) [4].

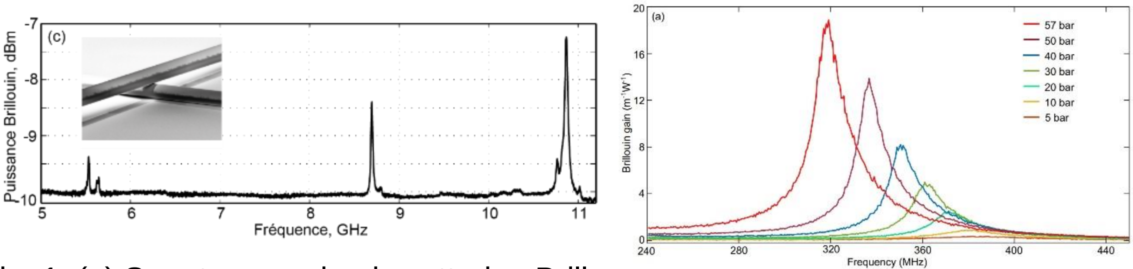

Fig. 1: (a) Spontaneous backscattering Brillouin spectrum in tapered silica optical fiber [2]. (b) Brillouin gain spectra along the 10cm nanofiber gas cell filled with CO_2 at different pressures [3].

References

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