Angular filtering for Brillouin spectroscopy in the 20-300 GHz frequency range

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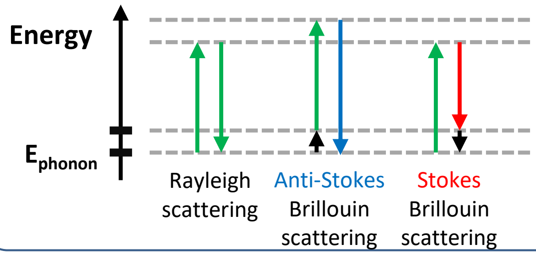
FET ProActive 2019-2024

Motivation

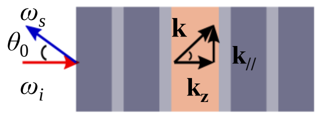
To observe GHz acoustic modes of a tunable optophononic cavity which are not accessible with standard Raman or Brillouin scattering.

✓ Inelastic scattering of light induced by vibrations of a crystal

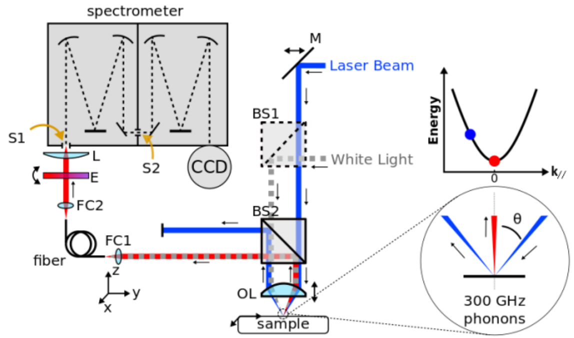


Custom-built Brillouin spectroscopy scheme

Double Optical Resonance



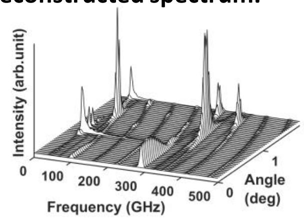
Incident and scattered light are resonant with a cavity at different angles



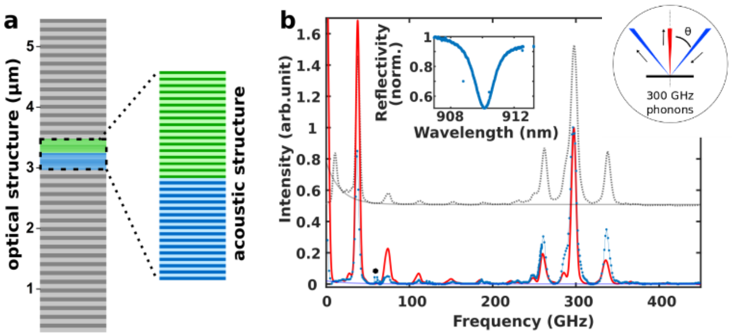
✓ **Spatial filtering** obtained by combining the fiber and the Double Optical Resonance
✓ **Spectral filtering** obtained with the etalon and the intermediate slit

✓ Etalon rotation tunes transmission lines over FSR
✓ Signal acquired as function of rotation angle

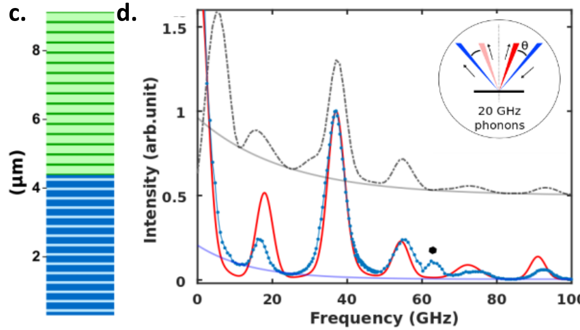
For each angle, integration around one transmission line gives one point in reconstructed spectrum.



Results



a. Quasi-topological structure associated with spectrum in **b.** Mode at **300 GHz** corresponds to an angle **θ=~13 deg**



c. Topological structure associated with spectrum in **d.** Mode **at 18.3 GHz** corresponds to an angle **θ=~2 deg**.

Conclusions

- Sequential **point-by-point reconstruction** of Brillouin spectra
- **Resolution** of 2 GHz
- **Enhancement of Signal to Background Ratio** by a factor: x 4 at 18,3 GHz
  x 7 at 40 GHz

References

- Esmann et al, Optica 6(7), 854 (2019)
- Fainstein et al , PRL 75 3764 (1995)
- Rodriguez et al, Optics Express 29(2), 2637 (2021)