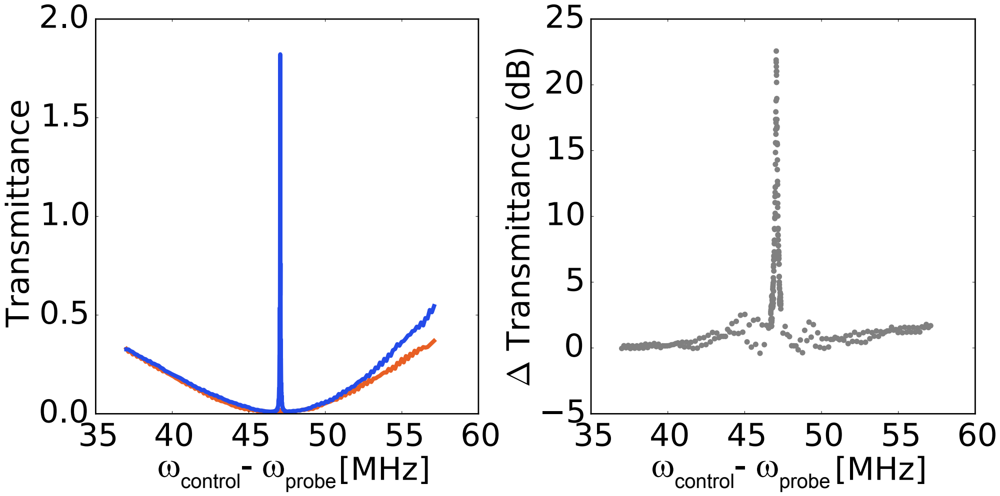
Experimental realization and characterization of an optomechanical isolator

F. Ruesink[1], M.A. Miri[2], A. Alu[2] & E. Verhagen[1]

[1] *FOM Institute AMOLF, Amsterdam, The Netherlands*

[2] *The University of Texas at Austin, Austin, United States*

Lorentz reciprocity is one of the fundamental principles in optics and photonics, governing the behaviour of the vast majority of photonic systems. Breaking it is a prerequisite for effective optical isolation, as well as the creation of photonic topological insulators. Current implementations achieve such non-reciprocity using bulky Faraday-rotators, correspondingly limiting their use in small scale devices. Here we present experimental results that show how the toolbox of cavity optomechanics[1] can be used to achieve optomechanically induced non-reciprocity[2]. We study optomechanically induced non-reciprocity of a probe laser that passes through a minimal system based on a whispering gallery resonator, where the strength and nature of the non-reciprocal light transmission can be adjusted via the detuning and optical power of an optical control beam. Our results show the successful experimental implementation and full-characterization of a non-reciprocal optical device, which, by precise adjustement of the detuning of the control beam allows for optical isolation as well as non-reciprocal amplification of light.



Left : Optical power transmission when a (blue-detuned) control and probe beam co-propagate (blue) or counter-propagate (orange). It is clearly visible that co-propagating control and probe beams yield amplification of the probe power, while in the counter propagating situation amplification is absent. Right : Quantifying the resulting non-reciprocal optical power transmission, showing an asymmetry in transmission which exceeds 20 dB.

---

1. Weis, S. et al. *Optomechanically induced transparency*, Science 330, 1520-1523
2. Hafezi, M. Rabl, P. *Optomechanically induced non-reciprocity in microring resonators*, Opt. Express 20, 7672-7684