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# Quantum performances of resonant cavities schemes for frequency-dependent squeezing in future generation gravitational-wave detectors

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Gravitational-wave detectors use frequency-dependent quantum squeezing to reduce the impact of quantum noise on the detector bandwidth. While a single filter cavity (FC) is enough to achieve the frequency dependence for current detectors, future generations such as Einstein Telescope Low-Frequency (ETLF) will be operated with a detuned signal recycling cavity. This will require a complex rotation of the squeezing ellipse to achieve optimal quantum noise reduction. For this complex rotation a single filter cavity is not sufficient, two filter cavities (2FC) or one 3-mirrored coupled filter cavity (CFC) have to be implemented. In this work, after having derived the equations of quantum degradation for systems composed of more than one cavity, we compare the feasibility and performances of these two systems (2FC and CFC) with respect to various kinds of squeezing degradation sources: loss, mismatch and phase noise. A special focus is also given to the impact of the middle mirror in the coupled cavity configuration. This work extends previous analysis about 2FC and CFC in terms of squeezing degradation and uses new tools to derive and compare quantum noise degradations using optimal readout schemes that generalize homodyne detection.

**Author:** DING, Jacques (Université Paris Cité)

**Co-auteurs:** CAPOCASA, Eleonora; AHREND, Isander-Louis; BARSUGLIA, Matteo; M. ZHAO, Yuhang (APC, Université Paris Cité)

**Orateur:** AHREND, Isander-Louis

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