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Small scale suspended interferometer for ponderomotive squeezing as test bench for EPR squeezer integration in Advanced Virgo

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In 2015, after many years of R&D efforts of the LIGO-Virgo collaboration for the upgrade to the second generation of ground based gravitational wave detectors, for the first time it has been possible a direct observation of a gravitational wave event (GW). In the following years, many other GW events have been detected by both LIGO and Virgo. Nevertheless, in the very near future the present generation of detectors will face the limit in sensitivity due to the quantum nature of light: the so-called Standard Quantum Limit (SQL). Therefore, any future upgrade aiming at increasing the sensitivity implies quantum noise reduction techniques. LIGO and Virgo already adopt frequency independent squeezers, which reduce the quantum noise in the high frequency range where shot noise is dominant (above 200Hz). In the very near future, the detectors will be also limited by quantum noise in the low frequency range (below 100Hz), where radiation pressure noise is dominant. Therefore, it is crucial to develop table-top experiments aiming at testing broadband quantum noise reduction (10Hz-1kHz): frequency dependent squeezers. We are developing a small-scale interferometer with monolithic suspension of test masses (SIPS) that will be sensitive to the radiation pressure noise in the audio frequency band of GW detectors. In order to be able to produce frequency dependent squeezing (FDS) in the audio frequency band, seismic noise at low frequency must be suppressed. This can be possible by suspending the whole interferometer to a chain of mechanical filters like a superattenuator of Virgo. In the same time, we are developing a table-top experiment for the FDS generation through the Einstein Rosen Podolsky (EPR) principle. These two experiments are growing up in parallel. EPR technique, before the injection in Virgo for the quantum noise reduction, needs to be tested in an optical cavity achieving the radiation pressure noise limit. Therefore, the small-scale interferometer SIPS turns out to be a suitable test bench for the EPR technique before the integration in Virgo. In this talk the status of the art of the SIPS experiment and the design for the integration with the EPR experiment will be presented.

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