



Contribution ID: 87

Type: **Oral presentation**

Status of Quantum Noise Reduction system in AdV+

Thursday, 15 September 2022 12:45 (15 minutes)

One of the fundamental noise in gravitational waves detectors is the so called Quantum Noise, that is related to the intrinsic quantum nature of the laser used to interrogate the GW interferometers, i.e. to the uncertainty on amplitude and phase of the coherent state of light that couples with the vacuum fluctuations. Due to the frequency dependent opto-mechanical response of the GW detectors, the amplitude and phase fluctuations is weighted in different way in the detectors frequency band, leading to the so called Radiation Pressure Noise (RPN) at low frequency and to the so called Shot Noise (SN) at high frequency, respectively. By injecting frequency independent squeezed (FIS) vacuum light into the dark port of the GW interferometer a significant reduction of the SN can be and has been observed during the last observations runs, both for Advance Virgo and the two LIGO detectors. Nevertheless the big effort done to reduce in parallel one of the most sensitivity limiting noise in the low frequency region, the technical noise, has revealed the main drawback of the FIS injection: the increasing of the RPN at low frequency.

Moreover, even without FIS injection, the improvement of the low frequency sensitivity for the new upgraded detectors, in any case leads to the need of the quantum noise mitigation in the whole detectors band. For this reason FIS injection must be replaced with frequency dependent squeezed vacuum (FDS). For the next observation runs, both Virgo and LIGO collaboration planned FDS injection. The technique to produce it is based on the phase sensitive response of a filter cavity that allows the squeezing ellipse rotation in the detectors frequency band.

Here we will present the commissioning status of the Quantum Noise Reduction system for the FDS injection into AdV+.

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Session Classification: Multimessenger and Gravitational Waves