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Broadband quantum noise reduction in Advanced Virgo Plus

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Quantum noise is limiting the sensitivity of ground based gravitational wave detectors both at high and low frequency. Carlton Caves in 1980s proposed to introduce particular quantum states of lights, called vacuum squeezed states, from the output port of the detector to reduce this noise. In O3, the injection of frequency independent squeezing improved Virgo and LIGO sensitivities at high frequency, slightly worsening the performance at low frequency. A broadband quantum noise reduction can be achieved using frequency dependent squeezing, i. e. rotating the vacuum squeezed ellipse below 100 Hz by reflecting the squeezed vacuum off a Fabry–Perot cavity. Once the frequency dependent squeezing is produced, it has to be injected in Virgo with a non trivial interface of additional benches and a 285 meters cavity. The installation and pre-commissioning of infrastructure and optics have been completed. The commissioning is ongoing and we will soon have this new technique working.

Primary author: POLINI, Eleonora (LAPP)

Presenter: POLINI, Eleonora (LAPP)

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