Contribution ID: **850** Type: **Parallel**

Quantum noise reduction in gravitationnal wave detectors

Wednesday 9 July 2025 09:21 (17 minutes)

Quantum noise poses a fundamental limitation to the sensitivity of second-generation terrestrial gravitational wave (GW) detectors,affecting both low and high frequencies through radiation pressure noise and shot noise, respectively. Overcomming this limitation is crucial for the improvement of the detector's sensitivities. For this reason all international collaborations have undertaken an R&D campaign aimed at overcoming the Standard Quantum Limit for GW detectors. The strategy employed is based on the use of squeezed vacuum states injected in to the output port of the interferometers. This technique has been successfully implemented in the LIGO and Virgo interferometers[1][2].

In this talk we will present the principle of the quantum noise reduction technique and its implementation in the GW interferometers and the achieved performance in terms of noise suppression.

[1] D. Ganapathy et al. Broadband Quantum Enhancement of the LIGO Detectors with Frequency-Dependent Squeezing, Phys. Rev. X 13, 041021 (2023)

[2] F. Acernese et al. Frequency-Dependent Squeezed Vacuum Source for the Advanced Virgo Gravitational-Wave Detector, Phys. Rev. Lett. 131, 041403 (2023).

Secondary track

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Session Classification: T15 (Quantum technologies in HEP (special topic 2025))

Track Classification: T15 - Quantum technologies in HEP (special topic 2025)