Contribution ID: **9**

Type: **not specified**

Frequency dependent squeezing experiment at TAMA

Thursday, 24 October 2019 13:25 (25 minutes)

Gravitational wave (GW) detectors are the most sensitive displacement sensors on earth. So sensitive that they made possible the first GW detection in September 2015. After the first one, many other GW detections followed, and that was possible mainly due to the several upgrades that were implemented. Among the many noises that limit the GW detector sensitivity, one of the most fundamental is the quantum noise. This noise can be understood as the sum of two different contributors: the shot noise coming from the photon counting noise at the photodiode and the radiation pressure noise, due to the momentum exchange between photon and mirrors. The shot noise is currently the main limiting noise in the high frequency region of the GW detectors' sensitivity. It is expected that soon the radiation pressure noise, will be the main limiting source in the low frequency region, having therefore the quantum noise to limit the entire sensitivity band of GW detectors. The impact of the quantum noise on the total GW sensitivity is even more severe in the case of KAGRA.
KAGRA is an underground GW detector operating at cryogenic temperature, currently under commissioning in Japan. Thanks to these two features, the associated noises (namely the seismic noise and the coating thermal noise) are reduced, having the quantum noise to dominate entirely the detection bandwidth. The most promising technique to achieve a broadband reduction of the quantum noise is the injection of a frequency-dependent squeezed vacuum state from the output port of the GW detector, with the squeeze angle rotated by the reflection off a Fabry-Perot filter cavity, known as filter cavity.
A 300m filter cavity prototype is being developed at the National Astronomical Observatory of Japan, using the vacuum system and the seismic isolation system originally built for the TAMA interferometer. The goal of the experiment is to demonstrate frequency-dependent squeezing, with a rotation angle below 100 Hz, in the region where the rotation is needed for Virgo, LIGO, and KAGRA. The experiment is in its final stages: the frequency independent squeezed light source construction is finished and the commissioning is ongoing (6.1dB of squeezing achieved so far starting from about 10Hz), the filter cavity has been completely characterized and the injection of squeezing into the filter cavity has been started.

Primary author: Dr LEONARDI, Matteo (NAOJ)

Presenter: Dr LEONARDI, Matteo (NAOJ)

Session Classification: New strategies for quantum noise reduction