



Contribution ID: 30

Type: talk

Status of the frequency dependent squeezed vacuum source development at TAMA (invited)

Tuesday, 18 May 2021 23:00 (15 minutes)

The second-generation gravitational wave detectors are starting to be limited by quantum noise in the entire detection bandwidth. With the use of frequency independent squeezing, aLIGO and Advanced Virgo achieved a quantum noise reduction at high frequency while increasing it at low frequency. To avoid this issue, we can inject into the interferometer a squeezed state which rotates as a function of frequency to counterbalance the ponderomotive effect present in GW detectors. This state is called frequency dependent squeezing.

In TAMA, we developed a frequency dependent squeezed vacuum source suitable for the quantum noise reduction in advanced gravitational wave detectors. With a frequency rotation centered around 90Hz, up to 1dB squeezing (below rotation frequency) and 3.4dB squeezing (above rotation frequency) were observed.

After the first measurement of frequency dependent squeezing, several degradation mechanisms have been characterized and tackled. An auto-alignment system based on wavefront sensing has been implemented to preserve filter cavity alignment. A new locking scheme to stabilize filter cavity detuning frequency was also proposed and tested successfully. We have also investigated noise contribution which prevents the squeezing level observation at low frequency. By optimizing the current system, we achieved a higher squeezing level and cleaner spectrum for frequency independent squeezing.

Primary authors: ZHAO, Yuhang (ICRR, The University of Tokyo); ARITOMI, Naoki (JAPAN); CAPOCASA, Eleonora (APC); LEONARDI, Matteo (NAOJ); EISENMANN, Marc; GUO, Yuefan; POLINI, Eleonora (Sapienza); TOMURA, Akihiro; ARAI, Koji; ASO, Yoichi; HUANG, Yao-Chin; LEE, Ray-Kuang; LÜCK, Harald; MIYAKAWA, Osamu; PRAT, Pierre; SHODA, Ayaka (NAOJ); TACCA, Matteo (Laboratoire Astroparticule et Cosmologie - CNRS); VAHLBRUCH, Henning (AEI Hannover); TAKAHASHI, Ryutaro (National Astronomical Observatory of Japan); WU, Chien-Ming; VARDARO, Marco (University of Amsterdam - Nikhef); BARSUGLIA, Matteo (APC-CNRS); FLAMINIO, Raffaele (Laboratoire des Matériaux Avancés - CNRS/IN2P3)

Presenter: ZHAO, Yuhang (ICRR, The University of Tokyo)

Session Classification: Quantum noise and optical configurations workshop

Track Classification: Workshops: Quantum noise and optical configurations workshop