Poster # C02

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Double Balanced Homodyne Detection and Fabry-Perot gravitational-wave detector

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This research is on a readout scheme of gravitational-wave detectors.

In interferometric gravitational-wave detectors, gravitational-wave signals are included in the output photon quadratures as $\hat{b}_{\theta}(\Omega) = \cos\theta\hat{b}_1(\Omega) + \sin\theta\hat{b}_2(\Omega) = R(\Omega)\left(\hat{h}_n(\Omega) + h(\Omega)\right)$.

- $\hat{b}_1(\Omega)$: amplitude quadrature (in two-photon formulation); $\hat{b}_2(\Omega)$: phase quadrature (in two-photon formulation);
- θ : homodyne angle; $R(\Omega)$: response function of the detector (complex function);
- $h(\Omega)$: gravitational-wave signal (classical function); $\hat{h}_n(\Omega)$: noise operator (signal referred).

In the previous KAGRA f2f meeting, we showed that the expectation value of the operator $\hat{b}_{\theta}(\Omega)$ can be measured through the “double balanced homodyne detection.”

In this poster, we discuss an application of this readout scheme to a Fabry-Perot GW detectors as an example.

Although the advantage of the frequency-dependent homodyne detection is lost in our double balanced homodyne detection, this example indicates that ***we should discuss the signal-noise trade-off relation through the total quantum measurement process including its readout scheme***, since the quantum measurement process of GW detectors is completed by the inclusion of its readout scheme.

See you at Poster C02 !!