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Practical quantum noise estimate of optical-spring quantum locking for space gravitational wave detector DECIGO

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The DECi-hertz Interferometer for Gravitational-wave Observatory(DECIGO) aims mainly at the detection of primordial gravitational waves (PGWs) originating from inflation. Recent observations by the Planck satellite and others have lowered the upper limit of PGWs. Thus, it is necessary to improve the target sensitivity of DECIGO. A newly proposed method to reduce the quantum noise of DECIGO is quantum locking with an optical spring. In this method, a short cavity is added to the main cavity, sharing one mirror of both cavities. The error signal in this auxiliary cavity is obtained properly in a homodyne detection, and fed back to the shared mirror to cancel the radiation pressure noise of the main cavity. In our previous study, the optimal sensitivity assuming ideal homodyne detection without any additional noise was obtained by simulation. In this study, we investigate a more realistic design, taking into account the mixture of the vacuum fluctuations incident to the homodyne detection system. In this poster, we explain the latest results of this investigation

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