

Design of an optical reference cavity with low thermal noise and flexible thermal expansion properties

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An ultrastable optical reference cavity with re-entrant fused silica mirrors and a ULE spacer structure is designed through finite element analysis. The designed cavity has a low thermal noise limit of 1×10^{-16} and a flexible zero crossing temperature of the effective coefficient of thermal expansion (CTE). The CTE zero crossing temperature difference between a composite cavity and a pure ULE cavity can be tuned from $-10 \text{ }^\circ\text{C}$ to $23 \text{ }^\circ\text{C}$, which enables operation of the designed reference cavity near room temperature without worrying about the CTE zero crossing temperature of the ULE spacer. The design can be applied to cavities with different lengths. Vibration immunity of the cavity is also achieved through structure optimization.

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