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Ringdown Demonstration of a Low-Loss 14 m Hard X-Ray Cavity

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Cavity-Based X-ray Free-Electron Lasers (CBXFELs) employ an X-ray cavity formed by crystal mirrors such that X-ray pulses receive periodic FEL-amplification and Bragg-monochromatization. CBXFELs enable improved longitudinal coherence and spectral brightness over single-pass self-amplification of spontaneous radiation (SASE) FELs [1,2] for high-repetition rate FELs. Construction and alignment of a stable low-loss cavity of Bragg-reflecting mirrors has been considered a daunting challenge and has not seen previous experimental implementation of large X-ray cavities in the hard X-ray regime. In this work, we demonstrate stable operation of a low loss 14-m-roundtrip rectangular cavity of four Bragg-reflecting diamond (400) mirrors. 9.831 keV X-rays from the Linac Coherent Light Source (LCLS) were in-coupled into the cavity via a thin diamond transmission grating. X-ray ring-down was characterized using fast photodiodes and a nanosecond-gated camera. Intra-cavity focusing was introduced to further stabilize the cavity, enabling observation of X-ray storage at >50 round trips. This experiment demonstrates feasibility of a stable low-loss hard X-ray cavity that will support future CBXFEL tests and operation [3].

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Yes

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