

Linac Coherent Light Source (LCLS) Accelerator System Overview

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Abstract

The Linac Coherent Light Source (LCLS) will be the world's first x-ray free-electron laser (FEL). Pulses of LCLS x-ray FEL will be several orders of magnitude brighter and shorter than most existing sources. These characteristics will enable frontier new science in several areas. To ensure the vitality of FEL lasing, it is critical to preserve the high quality of the electron beam during the acceleration and compression. We will give an overview of the LCLS accelerator system. We will address design essentials and technique challenges to satisfy the FEL requirements. We will report studies on the microbunching instability suppression via a Laser-Heater. The studies clearly prove the necessity of adding the Laser-Heater and show how effectively this Laser-Heater suppresses the instability by enhancing the Landau damping. We will report how to minimize the sensitivity of the final energy spread and the peak current to various system jitters. To minimize this sensitivity, a feedback system is required together with other diagnostics. With all these considerations, full start-to-end simulations show saturation at 1.5 , though the LCLS is expected to be a very challenging machine.

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