

LLRF Topical Workshop - Timing, Synchronization, Measurements and Calibration



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LCLS II precision timing system

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In 2023, LINAC Coherent Light Source II achieved first light, spanning over 5 km from injector to the experiment hall. The goal of achieving 10fs relative jitter between the experiment laser and the x-ray led to the development of new systems. We will present the timing system design, architecture, key commission results and challenges along the way.

The challenge of reference distribution in the harsh environment of the klystron gallery was addressed by using a multi-drop coaxial cable for the superconducting LINAC and stabilized radio frequency over fiber systems for the experimental hall. An in-house laser locker synchronizes the experiment laser to the reference signal, and an S-band beam arrival monitor determines the electron beam's correlation against the reference. A star topology optical timing reference is distributed throughout the soft x-ray experiment hall for synchronization and detection.

Commission results show a laser-to-x-ray jitter of ~60 fs, a significant improvement over the ~200 fs jitter of LCLS. Optical phase synchronization is expected to further enhance jitter performance. As LCLS-II HE progresses, a plan is proposed to enhance the SLAC global timing system to meet the demands of four new hard x-ray instrument hutches.

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