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Low-jitter conversion from optical references to electrical radio frequency signals

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Ultra-fast science at free electron laser (FEL) facilities is pushing accelerator and FEL technology towards shorter laser pump and FEL probe pulses to resolve fast dynamics.

Ideally, the short pulses should be backed by a synchronization system that provide a pump-probe jitter that is similar to the pulse duration. This is challenging, and the achieved timing jitter is typically one order of magnitude larger than the pulse duration.

Recent developments at MAX IV are focused on the use of a low-noise optical main oscillator (OMO) as the common reference for the accelerator. The OMO optical signal is converted to electrical RF with a photo detector. The conversion does not add jitter by amplitude-to-phase coupling that can be present in photo-detector conversion. We have also enhanced the available electrical RF power from the detector by repetition rate multiplication, which shifts power in the spectral plane to the frequency of the RF system.

The combination of an OMO and direct conversion gives on the order of 1 fs relative jitter between the reference laser and the generated RF.

Footnotes

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