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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.

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. At MAX IV, our achromat bunch compressors enables cancellation of the energy and timing jitter caused by modulator high voltage (HV) ripple. The cancellation works at a specific off-crest acceleration phase, the so-called magic angle.

Combining acceleration at or around the magic angle with a high-precision synchronization system we aim at a timing jitter on the order of 1 fs at the end of the MAX IV linear accelerator.

### Footnotes

### Funding Agency

### I have read and accept the Privacy Policy Statement

Yes

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