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Developing a two-colour all-fibre balanced optical cross-correlator for sub-femtosecond synchronisation

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In modern accelerator facilities, femtosecond synchronisation between an optical master oscillator (OMO) that provides facility-wide timing pulses and an external experiment laser is needed to achieve the few-fs resolution required for experiments such as pump-probe spectroscopy. This can be achieved with a balanced optical cross-correlator (BOXC), which determines the timing delay between two laser pulses via the generation of sum-frequency radiation in a nonlinear crystal.

In this paper, a design for a two-colour fibre-coupled BOXC using waveguided periodically-poled lithium niobate (PPLN) crystals is presented. An all-fibre two-colour BOXC is highly desirable as it would be more robust against environment fluctuations, easier to implement, and can achieve greater synchronisation performance compared to free-space coupled BOXCs that are currently used in accelerator facilities. This proposed design can theoretically achieve 5 - 10 times greater sensitivity to relative timing changes between laser pulses than current free-space two-colour BOXCs, which can make sub-fs synchronisation between an OMO and an external experiment laser of different wavelength achievable.

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Footnotes

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Yes

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