Synchronization of a photo-injector and a high power laser with independent clocks

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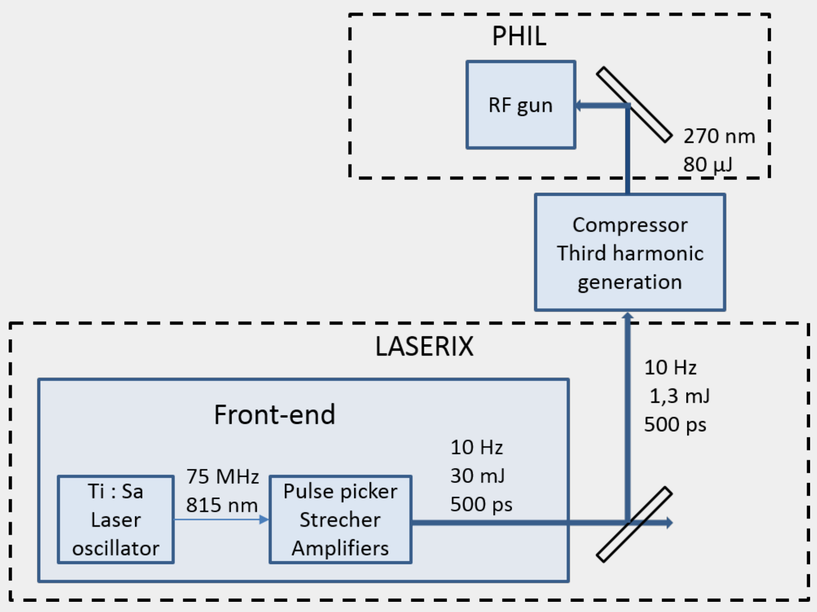
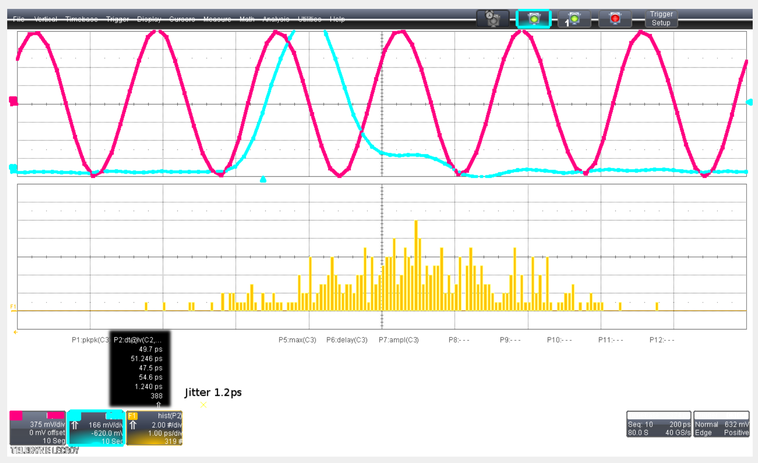
Introduction



The plasma acceleration project ESCULAP (*ElectronS CoUrts pour L'Accélération Plasma*) aims at studying electrons injection into a laser plasma accelerator. This requires the injection of short electron bunches generated by the photo injector PHIL (Photo injector at LAL) into a plasma wave by the high power femtosecond Laser LASERIX. As a first step we have studied how to synchronize PHIL and LASERIX. As these two machines had not been initially designed to work together, simple synchronization solutions were not available. We detail here the synchronisation scheme that we have tested and the experimental results obtained.

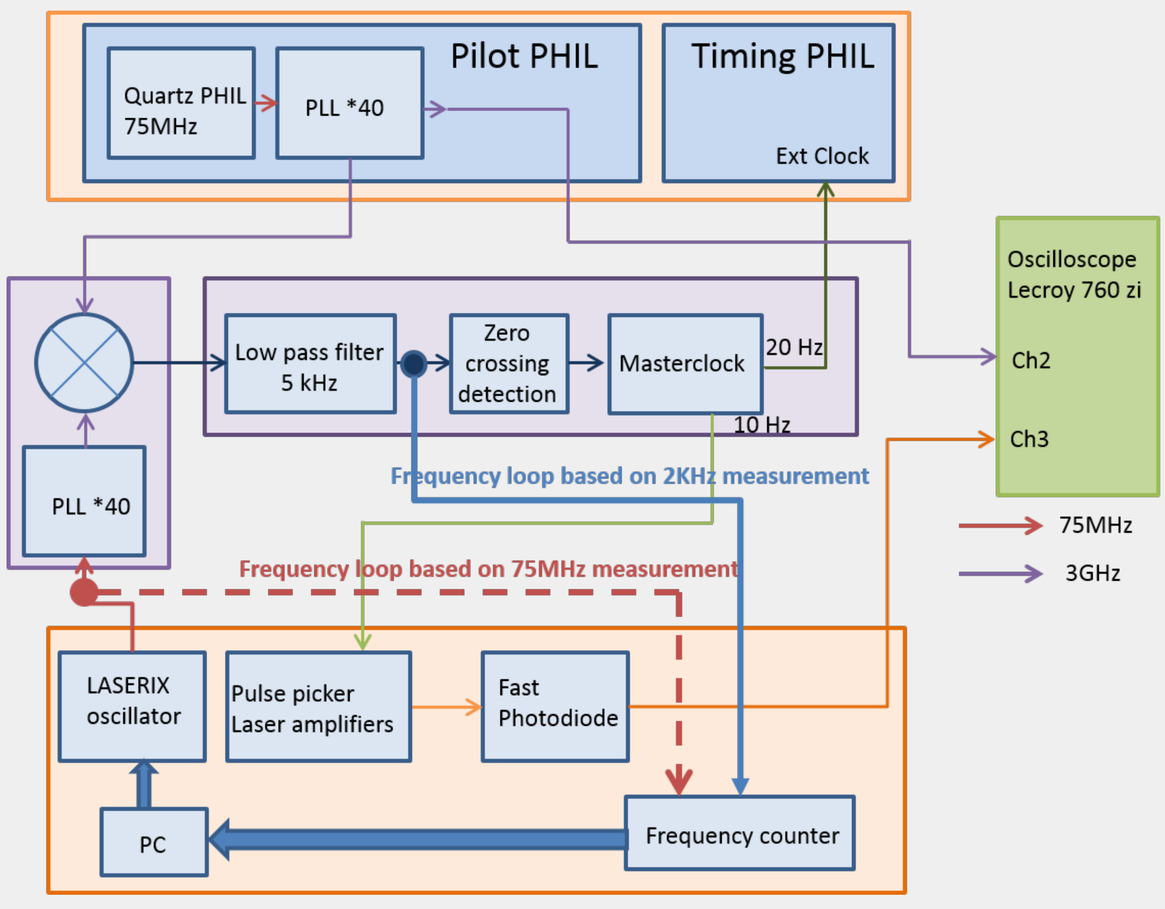
Method

Jitter is calculated using a 30GSample/s scope and a fast photodiode by measuring the time delay between the RF signal crossing a threshold and the signal from a laser pulse crossing another threshold.



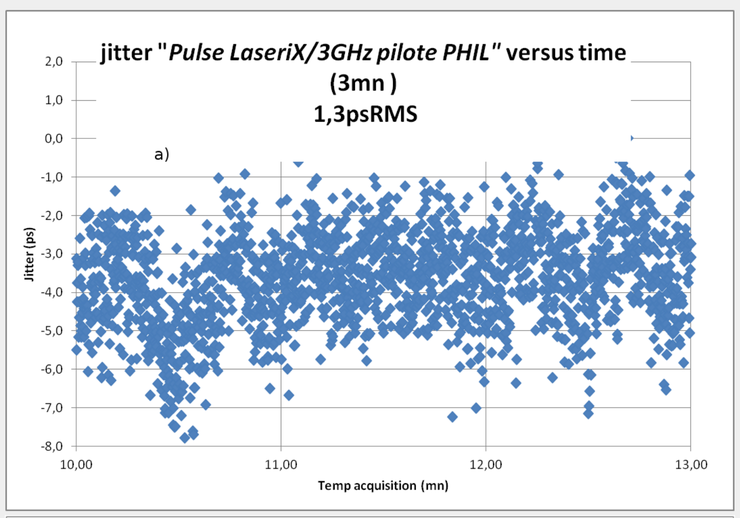
Jitter measurement between the ps laser pulse and the 3 GHz *RF of PHIL.*

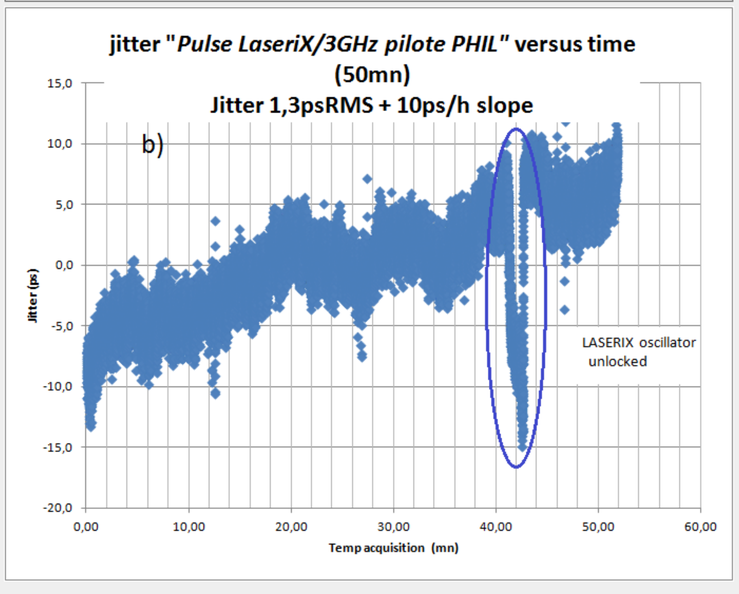
Heterodyne synchronisation scheme



As the two machine clocks are independent, the trigger must operate in such way as to find a fixed phase relation between the two clocks. This is done by using a RF mixer and low-pass filtering the output to keep only the heterodyne frequency. By using a comparator to always detect the same phase (for example positive zero crossing) of this heterodyne frequency one can generate a trigger signal that has a fixed phase relation with the two RF clocks.

Results





The measured jitter with heterodyne synchronisation is of the order of 1 ps.