Picosecond time drift characterization of the Laser MegaJoule Timing System

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The Laser MegaJoule (LMJ) timing system has to synchronize 176 laser beams within 40 ps to compress symmetrically the millimeter-size target in order to ignite the deuterium and tritium filled capsule despite the fact that the quadruplet laser sources are separated within the building by several hundred of meters. This kind of performance is also required for fiducial pulses used to temporally mark laser and plasma diagnostics.

While the LMJ timing system is under development, a major technical challenge is to ensure a time drift of delays measurements (from 5 µs to 100 µs) to less than 2 ps peak-to-peak (pp) over 24 hours, 10 ps pp over 7 days and 30 ps pp over a month for the most precise classes.

In this context, a collaboration between the CEA and the UTINAM Institute was set up in order to develop the methods and means required to reach the measurement of such time drifts.

In this unusual time domain calibration – ps drift for delays of several microseconds watched over periods of several hours or days – the main problem is the control and implementation of the instruments needed to achieve such measurements.

The firsts results obtained in this collaboration provided a measurement method and its associated instruments. This method was certified by an ultra stable frequency reference (MASER supervised over UTC) and very high sampling frequency digitizers (up to 160 Gs/s).

In this paper, the results will be analysed and discussed in terms of stability (jitter) and accuracy (time drift of synchronization delays).

The method used to supervise the facility's time drifts of the LMJ timing system will also be presented.