Reference Timing for FP420

Stating the obvious, but

\[ z_0 = \left( \frac{c}{2} \right) \times \left( \frac{1}{t_1 - t_0} + \frac{1}{t_2 - t_0} \right) \]

if \( z_1 = z_2 \)

The reference time, given by a local (to FP420) “clock” must
(a) have no **differential jitter** (at few ps level) between L and R stations
(b) be calibrate-able

fix \( z_0 = 0 \) and \( \frac{dz_0}{d - TDC} \)
A possible scheme:

Tell where $p$ is w.r.t. bunch centroid. (few mm/70mm)
Fine correction on $p_{\text{incident}}$. Compare with sum time from $t_E + t_W$
Learn from space physics?

TIME TRANSFER BY LASER LINK T2L2

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The T2L2 experiment allows the synchronisation of remote clocks on Earth, and the monitoring of a satellite clock, with a time stability of the order of 1 ps over 1000s and a time accuracy better than 100 ps. The principle is based on the propagation of light pulses between the clocks to synchronise. The ground segment is a satellite laser ranging station with a special instrumentation able to time light pulses accurately as compared to the ground clock to synchronise. The satellite payload comprises an optical package, and a time tagging unit connected to the space clock.

elements:
A detection unit based on an avalanche photo-diode working in a Geiger mode.
A time tagging unit able to time the photo-diode output in the satellite clock time scale with a precision better than 3 ps.
A high index corner cube (100mm diameter) having a large field of view.
Assuming jitter problem solved,
Calibrate with real DPE events.

Want low-ish Lum, enough single interactions  \( L \leq 5 \times 10^{32} \, cm^{-2} s^{-1} \)
(maybe want a special low-L bunch crossing later)

Trigger on two forward rap gaps - needs better coverage  \( 6.5 < |\eta| < 9.5 \)
plus central state (could be dijets, or just \( \sum E_T \))

“Know” central vertex and \( z_0 \)

Ambiguities give much background if do not select single interactions.
Could require (e.g.):
\[
\xi_1 \xi_2 > \left( \frac{M^2_{\text{jj}}}{\sqrt{s}} \right)
\]
→ We must have a good reference signal free of jitter between E and W stations. This is as important as the detectors themselves. Temperature control? Return path control?

→ To use 220m stations together with 420m, these need timing too.

→ Position of interaction in bunch: tight (?) correlation with position in time of p wrt bunch center at 420, because no RF cavities intervene.

→ Need to discuss with LHC RF/clock experts.