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Laboratory tests for Diode-Laser based Calibration Systems for Fast Time-of-Flight Systems

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Time-of-flight systems, based on scintillators, may reach good intrinsic time resolution, by using fast scintillators and photomultipliers. Examples are the large time-of-flight system constructed for the HARP experiment at CERN PS (~150 ps detector resolution) or the most demanding time-of-flight system of the MICE experiment at RAL (~50-60 ps detector resolution).
This level of intrinsic timing resolutions puts demanding requirements on the laser based calibration system for day by day time monitoring.
Such as system may be realized by splitting a fast laser beam (FWHM~ 30 ps) to a fast photodiode, giving the START for the TDC system, and injecting the laser light into a system of fibers that transmit the pulse to the individual counters to be calibrated, giving the STOP signal.
Due to the limited power of diode-laser systems (up to 1 W) extreme care must be put to minimize power losses. The choice of the type of optical fiber to be used (multimode vs single-mode)is another critical issue. Step-index multimode fibers has been chosen giving the best trade-off between input power loss minimization and timing properties of the system. Timing characterization were done with a sampling HP54750A scope with a 20 GHz bandwidth. Additional tests to study the temperature dependence of the system components were done with a precision LAUDA PR845 cooling thermostat.
A system based on optical switches, fused fiber splitters and an ultrafast diode-laser will be described, together with the laboratory tests needed to optimize the choice of components and characterize completely the timing performances.

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