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A real time sub-picosecond phase correction system.

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The use of precision timing to measure time-of-flight or to distinguish events from the same bunch crossing in collider detectors has become a common feature of many modern experiments. Currently achieving a precision of 30 picoseconds is seen as an attainable goal. To move to a precision close to one picosecond will require further advances in our time measurement technology. One central component of any time measurement is a precisely aligned reference clock distributed to all of the detector elements. When the required precision of the measurement is of the order of a picosecond, environmental changes need to be tracked and corrected for to maintain the the precision of the reference clock. In this talk we will present the design and testing of a system capable of measuring the drift in the clock phase (wander) and correcting for it in real time with sub-picosecond precision. For this we have developed an ASIC, using the TSMC 65nm process, that is capable of adjusting with sub-picosecond precision the phase delay of a digital clock signal, and a simple digital dual mixer time difference (DDMTD) circuit that can be used for measuring wander with sub-picosecond precision. Using this system, we will demonstrate the feasibility of distributing reference clocks, detecting and correcting for changes in the phase delay to a precision of ˜200fs.

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