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STOPGAP - a Time-of-Flight Extension for the Belle II TOP Barrel PID System

The Belle II barrel region is instrumented with the Time of Propagation (TOP) particle identification system comprising sixteen quartz radiator bars arranged around the interaction point. These quartz bars do not overlap, leaving a gap of around 2cm in the azimuthal direction between them and causing a 6% drop in acceptance. An additional 3% of tracks suffer from degraded identification information as they cross the bars close to the edges, leading to an overall inefficiency of around 9%. This affects both the Particle identification capabilitoes and the overall event reconstruction, as TOP provides the best event time resolution within Belle II, which is an important input for the track reconstruction algorithms.
We propose a possible solution to remedy these gaps in the form of a Supplemental TOP GAP instrumentation (STOPGAP) that covers the dead area between adjacent quartz bars with fast, low-granularity silicon detectors, providing a measurement of the time-of-flight of traversing particles. Modern silicon sensors and readouts can offer sufficient time resolution for the task at hand, so that STOPGAP modules could be built compact enough to fit into the limited space available in the area of interest between the Belle II central drift chamber (CDC) and the TOP system.

This talk will present a simulation study demonstrating the feasibility of a silicon time-of-flight system, based on its reconstruction performance in simulated Y(4S) -> BBbar events. It will discuss the performance requirements for possible sensor technologies and demonstrate that such a project could be realised with novel, fast monolithic CMOS sensors that are expected to reach MIP timing resolutions of down to 50ps.

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