Contribution ID: **25** Type: **not specified**

Quartz Cherenkov Timing Detectors Revisited

In the selective category of timing detectors with few picoseconds precision, quartz (fused silica) Cherenkov radiators associated with fast photodetectors, hold a well-established position.
Such detectors satisfy criteria for timing measurements at picosecond level, such as an instantaneous production of almost isochronous photons, relatively small geometrical dimensions, giving time spread of few picoseconds, and photodetectors with negligible transit time spread (TTS) and high gain.
A time resolution of 5 picoseconds has been obtained for charged particles traversing a quartz radiator block directly attached to the face of a Micro-Channel Plate Photomultiplier (MCP-PMT); different geometries of quartz radiators (bars) can be used, providing results in the range of few picoseconds. Another useful feature of such detectors is a remarkable resistance of quartz to radiation damage, up to few Grads.
Compared to this kind of detectors, other timing techniques reach relatively larger resolutions that can be reduced however by multiple simultaneous measurements; the quartz-radiator+MCP-PMT detector involves a non-negligible material budget that may be incompatible with multiple measurements. The radiator dimensions may condition the time-of-flight measurement precision, introducing correlations preventing a simple statistical treatment of the individual detectors'resolutions. These effects have been studied experimentally with different test beams. A QUARTIC module (with bars in the form of L) has been used for some of the beam tests with hadrons at CERN.
Other tests have been performed with straight bars disposed at different angles with respect to the beam direction. A configuration with 3 quartz counters has been extensively studied with electron beams at DESY, providing permanently calibrated time reference signals with precision below 10 picoseconds, and also giving a test bench for a rigorous treatment of statistical correlations in timing resolution measurements. The experimental results are in satisfactory agreement with GEANT4 simulation studies. The excellent timing response of quartz bars for charged minimum Ionizing particles (MIP) is typical also of quartz optical fiber bundles, which are extensively employed for calorimetry in the forward regions of LHC experiments, due to their high radiation resistance. Therefore high precision timing can be achieved also for particle showers developing in calorimeters.

Primary author: PENZO, Aldo (University of Iowa (US))

Presenter: PENZO, Aldo (University of Iowa (US))