Fast Timing Counters

Counters with ~ 10 ps timing resolution behind tracking

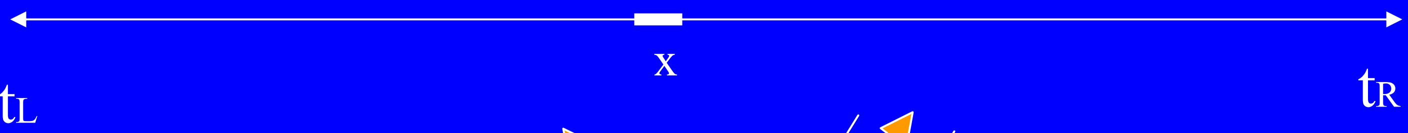
10 ps = 3 mm

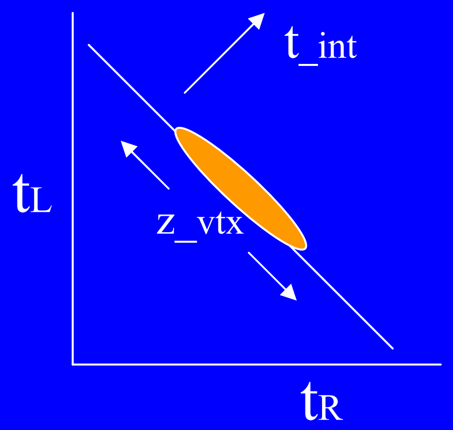
1) Check both p's from same collision (reduce background)
2) Get z(vertex) to match with central track vertex
3) Tell what part of bunches interacting protons were (F-M-B)

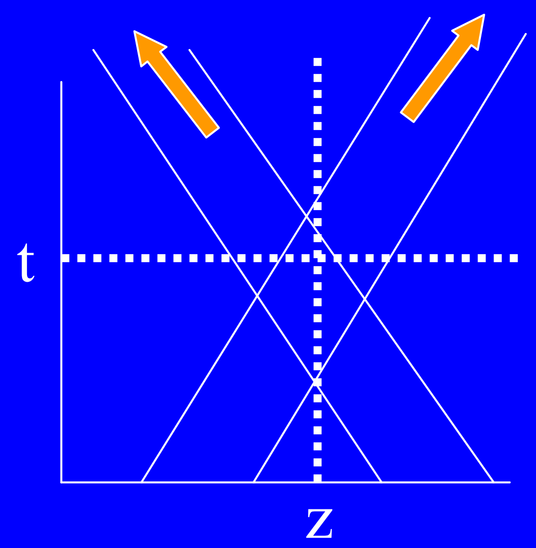
Likely solution:
Solid Cerenkov block or fibers (quartz?)
MCP-PMT (Micro-Channel Plate PMT)

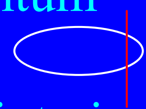
Put at back of 420m (220m?) tracking high precision timing counters.
Suggested in Tevatron LOI: Quartz Cerenkov + ~ Microchannel PMT
Then said 30 ps(?). Now tested (Japanese Gp) → **10 ps**

Check that p's came from same interaction vertex (& as central tracks)







Know position in each bunch of interacting p's. Position-momentum correlation → 
Reduce uncertainty in incoming momenta.

Potentially valuable e.g. MSSM triplet (Higher cross section & close states)

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MCP-PMT timing property for single photons

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Abstract

We have measured the performance, especially the timing properties, of micro-channel plate photo-multiplier tubes (MCP-PMTs) by irradiating with single photons with/without a magnetic field. A time resolution of $\sigma = 30$–35 ps was obtained for single photons under 1.5 T. With an MCP-PMT, a small time-of-flight counter, by means of Cherenkov light radiation instead of scintillation light has been prepared, and a time resolution $\sigma \sim 10$ ps was attained for a high-energy π-beam by multiple photons.

It's been done!
Perhaps the challenge is the geometry?

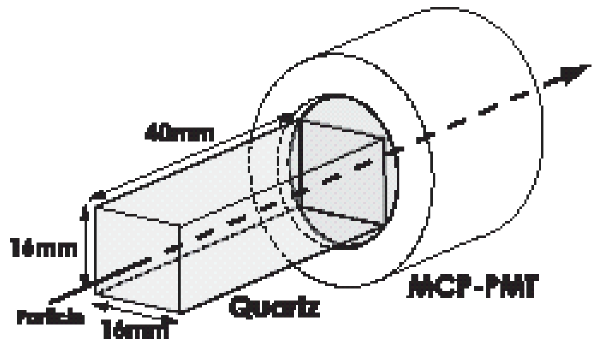


Fig. 12. Schematic drawing of the test TOF counter. HPK10 is used as the MCP-PMT.

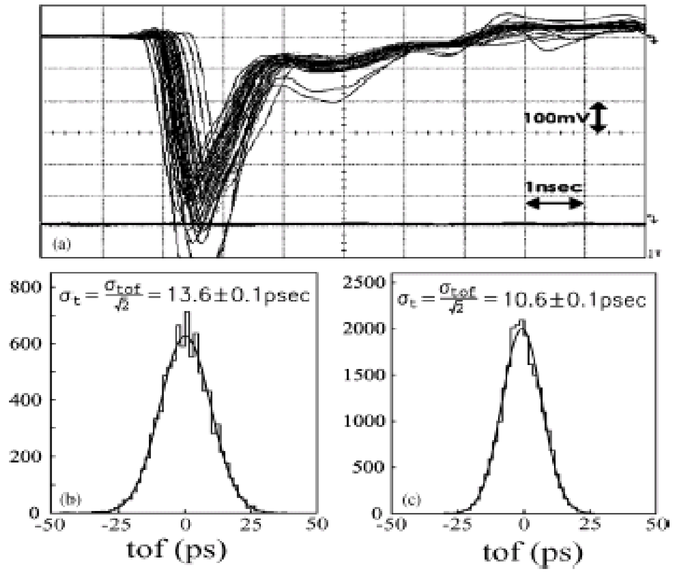
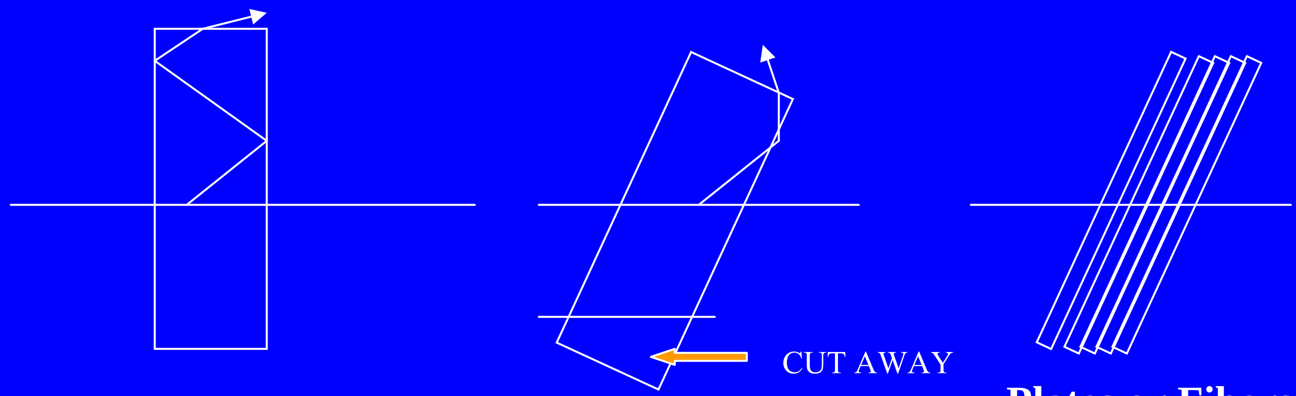


Fig. 13. (a) shows HPK10s output signal for 3 GeV/c pion beam; (b) and (c) are the distributions of the time difference between two test counters without and with a quartz radiator, respectively. Their resulting time resolutions of the single counter are obtained as $\sigma_t = \sigma_{tof}/\sqrt{2} = 13.6 \pm 0.1$ ps and 10.6 ± 0.1 ps.

Geometry?



Rectangular Block **Tilted** **Plates or Fibers**

For quartz $n(\lambda) \sim 1.54$

$$\cos(\theta_{Cerenk}) = \frac{1}{\beta n} = \frac{1}{n} = 0.65; \theta_{Cerenk} = 49.5^{o}$$

$$\text{For TIR } \sin(\theta_i) = \frac{1}{n} = 0.65; \theta_i = 40.5^{o}$$

Challenging, needs study: (1) <u>3D</u> ray tracing program, <u>with times</u>
Design a practical compact detector. Beam test.
… great project for interested-in-instrumentation student/postdoc