

Pico-Second Timing Systems

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- Particle Identification
- Time of Flight
- Detector Set-up
- Research Plan

Pico-Second Timing Systems

Particle Identification

Experimentalists need to be able to distinguish particles produced in colliders

Charged hadrons, esp. π/K , difficult to tell apart

- Have very similar interaction characteristics

- Masses differ by about 4

$$\pi^\pm \quad 140 \text{ MeV}$$

$$K^\pm \quad 494 \text{ MeV}$$

- Can find mass from momentum and velocity

$$p = \gamma \beta m = \sqrt{\gamma^2 - 1} m \quad \left(\begin{array}{l} \gamma^2 = \frac{1}{1 - \beta^2} \\ \beta = \frac{v}{c} \end{array} \right)$$

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Time of Flight

A straight-forward way to measure particle velocities: measure time to cross a known distance

Needs to have good time resolution (low jitter)

p (MeV/c)	$t_{\pi} - t_K$ (ps)	(Difference in time to cover 1.5m)
400	2600	
1000	530	
3000	61	
10000	5.6	

For $p \gg m_{\pi}, m_K$, $t_{\pi} - t_K \propto \frac{1}{p^2}$

Current state-of-the-art: 60-80ps

Can we reach 10ps? 1ps?

-What is the limiting physics?