PHENIX

Performance of High Resolution Time-of-Flight detector for Study of Identified Hadron Production at RHIC-PHENIX experiment

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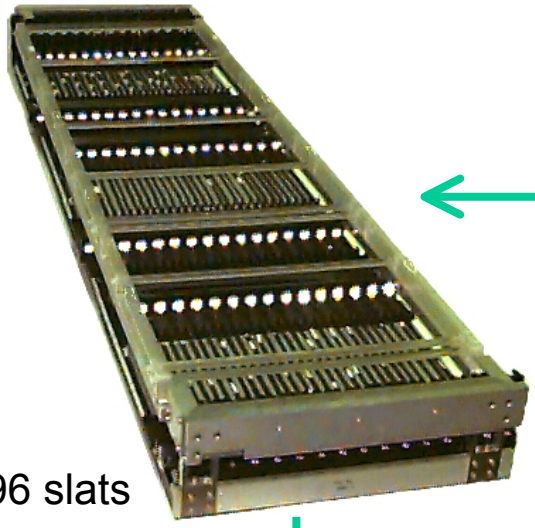
JPS meeting @Niigata University

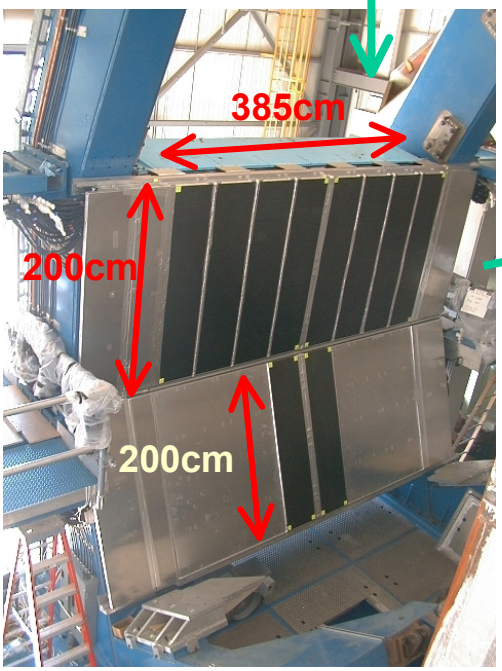
- PHENIX-TOF
- Basic Design
- Construction/Operation
- Performance
- Summary

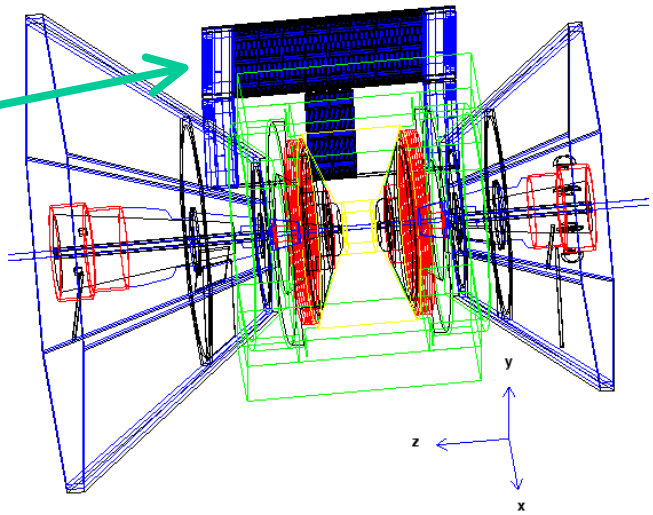
PHENIX-TOF



Panel: 96 slats

Slat: Plastic scintillator w. 2 PMT's





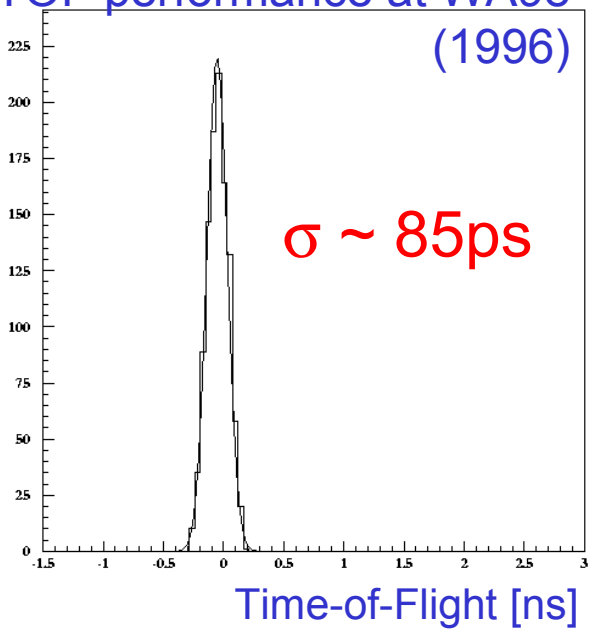
- 960 plastic scintillators with 1920 PMT's
- locate at 5m from the vertex
- Acceptance : driven by HBT and f meson

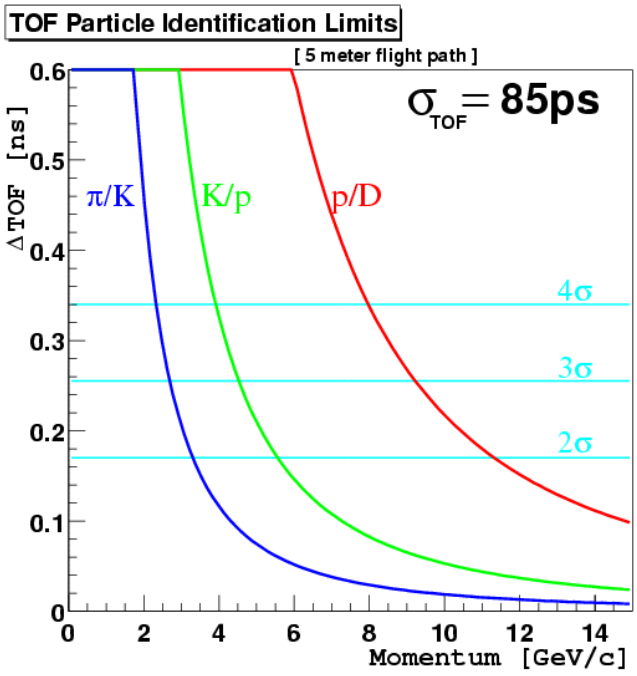
  $\Delta\theta = 40^{o}$, $\Delta\varphi = 45^{o}$, Ω ~1/3 Sr

Particle Identification using TOF

TOF
- Time Resolution: σ ~ 80 ps
- π / K separation to 2.4 GeV/c
- K / p, $\bar{p}$ separation to 4.0 GeV/c

TOF performance at WA98 (1996)





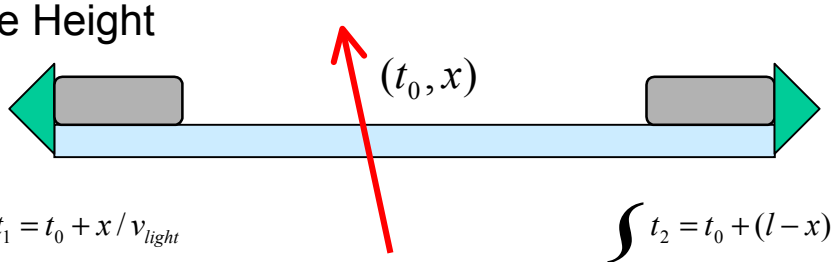
Used high momentum π
TOF resolution for all 500 slats

- WA98 used 5 panels of PHENIX TOF system.

Basic Design

PMT:R3478
Scinti.:BC404

Timing
Pulse Height



$$\begin{cases} t_1 = t_0 + x / v_{light} \\ a_1 = a_0 \exp(-\frac{x}{\lambda}) \end{cases} \qquad \begin{cases} t_2 = t_0 + (l - x) / v_{light} \\ a_2 = a_0 \exp(-\frac{l-x}{\lambda}) \end{cases}$$

$$\therefore \begin{cases} t_0 = \frac{t_1 + t_2}{2} - l / v_{light} \\ x = \frac{t_1 - t_2}{2} v_{light} \end{cases}$$

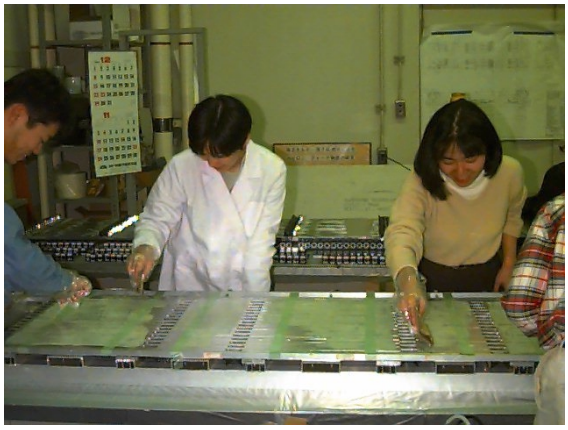
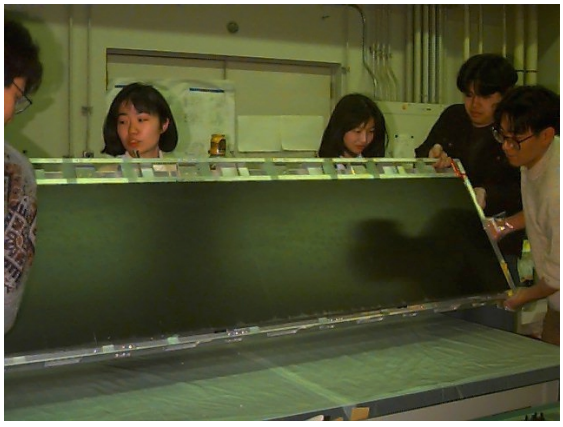
$$\delta t_0 = \sqrt{(\frac{\delta t_1}{2})^2 + (\frac{\delta t_2}{2})^2} \cong \frac{\delta t_1}{\sqrt{2}} \rightarrow \textbf{80 ps}$$

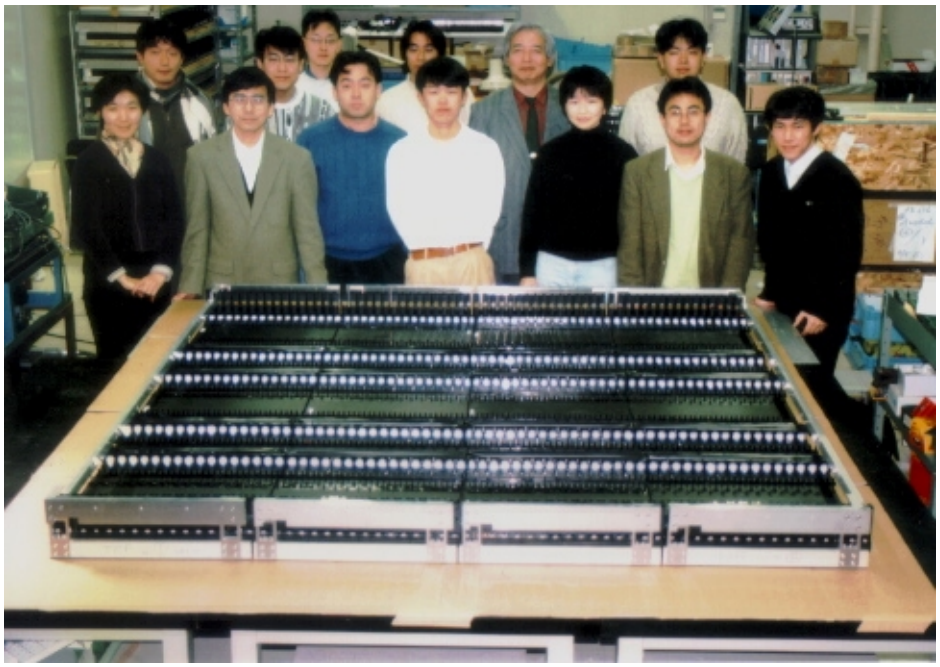
$$\delta x = v_{light} \sqrt{(\frac{\delta t_1}{2})^2 + (\frac{\delta t_2}{2})^2} \cong \frac{v_{light} \delta t_1}{\sqrt{2}} \rightarrow \textbf{1.3 cm}$$

- Precise TOF & Hit position
- Typical resolution
  - Electronic pulse at Discr. : < 25 ps
  - Laser Pulse on PMT: 50 ~ 100 ps
- Double hit
  - Lose timing information

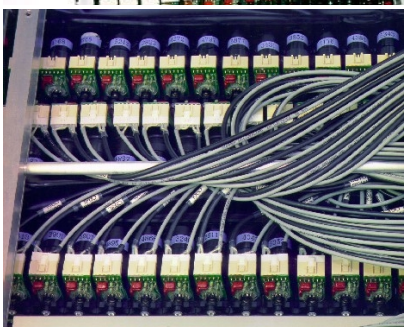
FEE

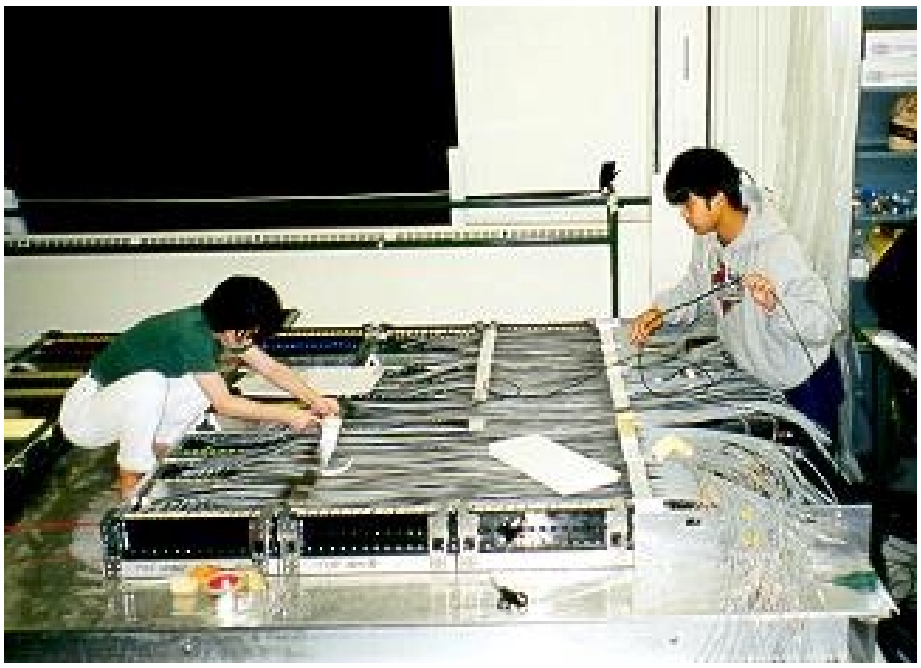
Construction at Tsukuba (1996-1998)



Construction at BNL (1998-1999)

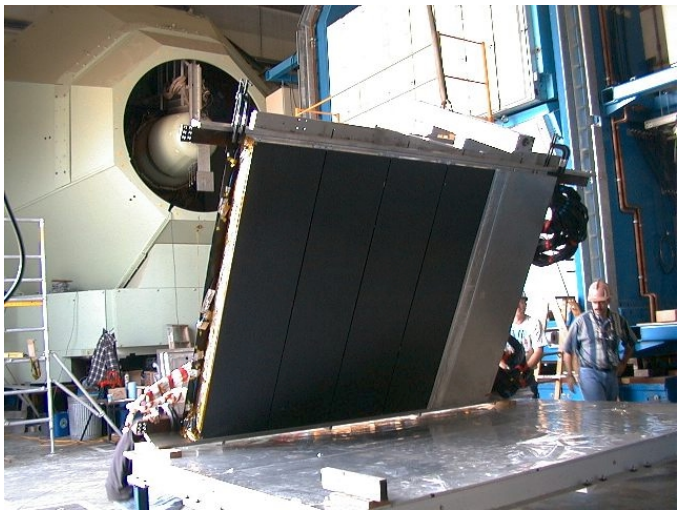




- PMT installation
- Cable Assemble
- Signal Check

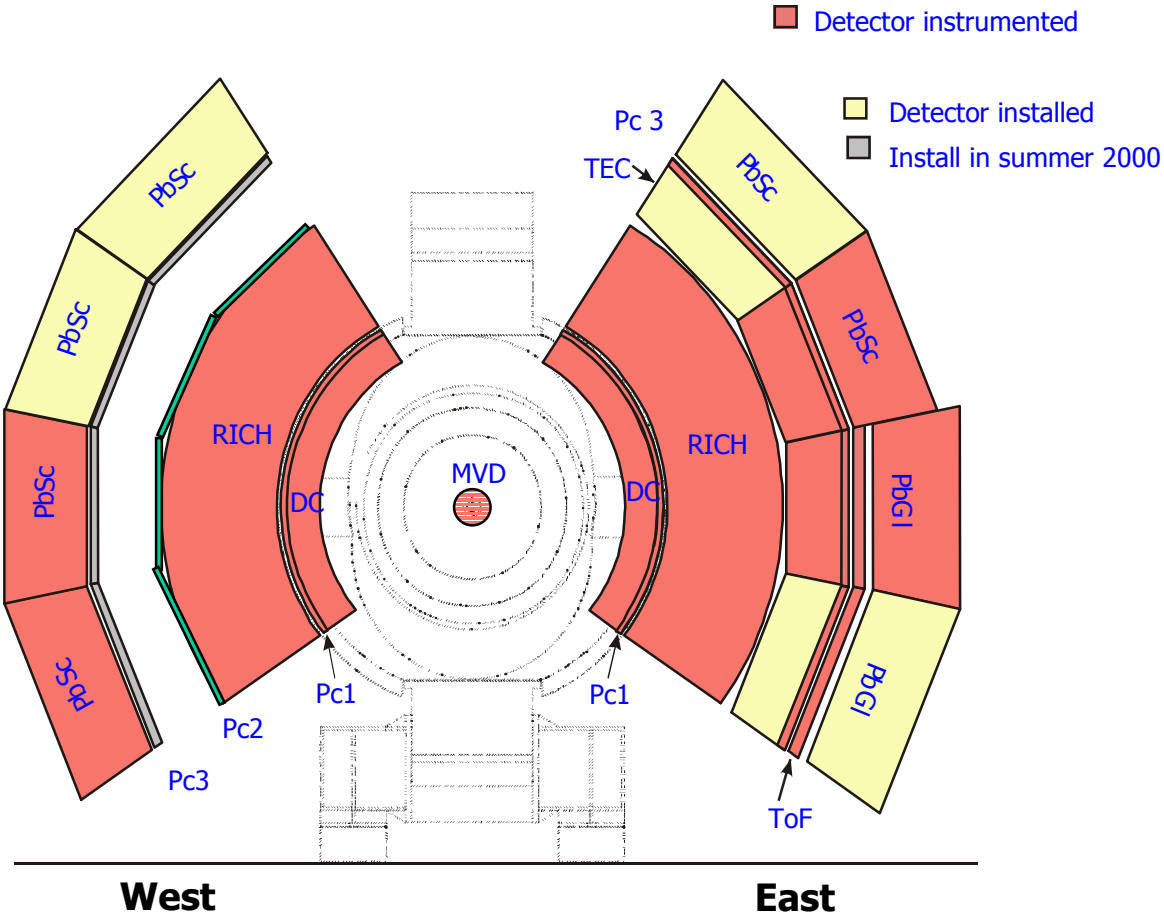
Instoration in PHENIX

(August 1999)

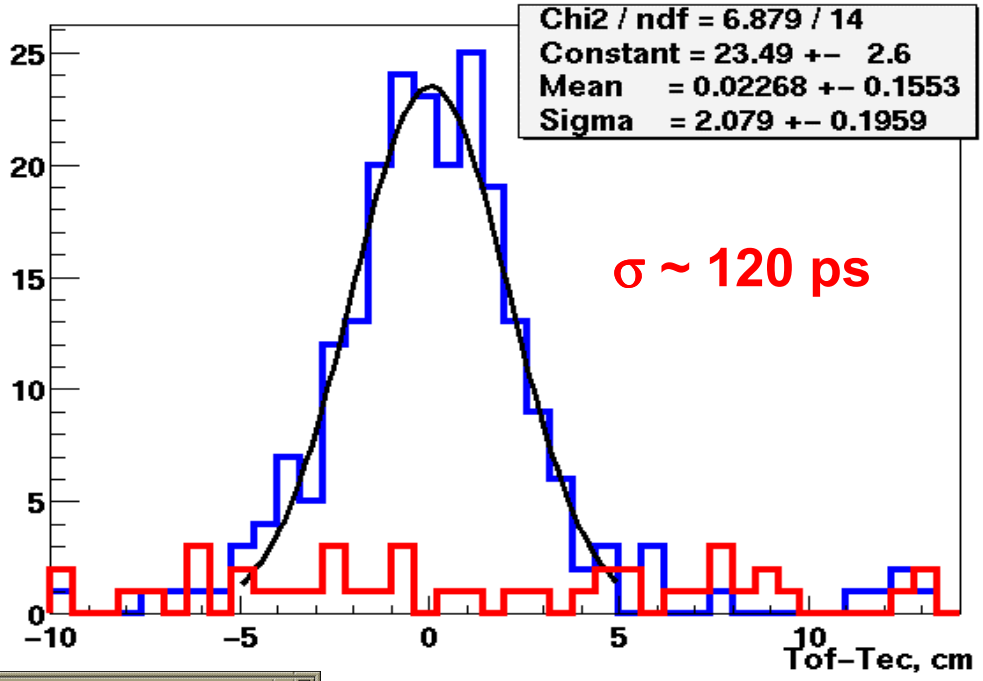


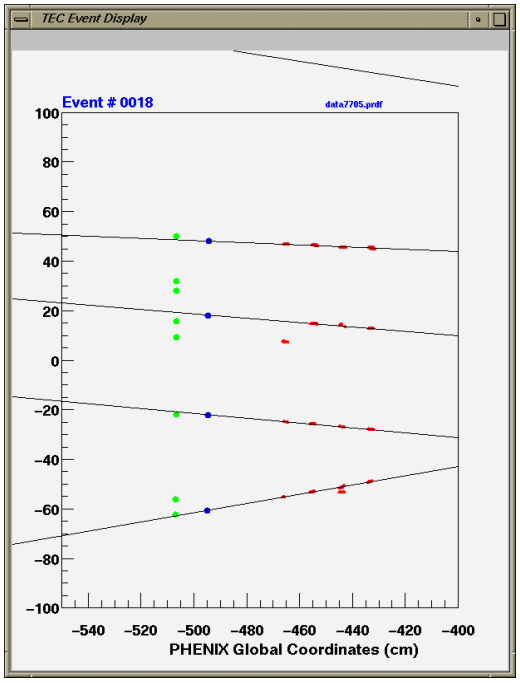
- All 10 panels were installed.

Operation at PHENIX year1



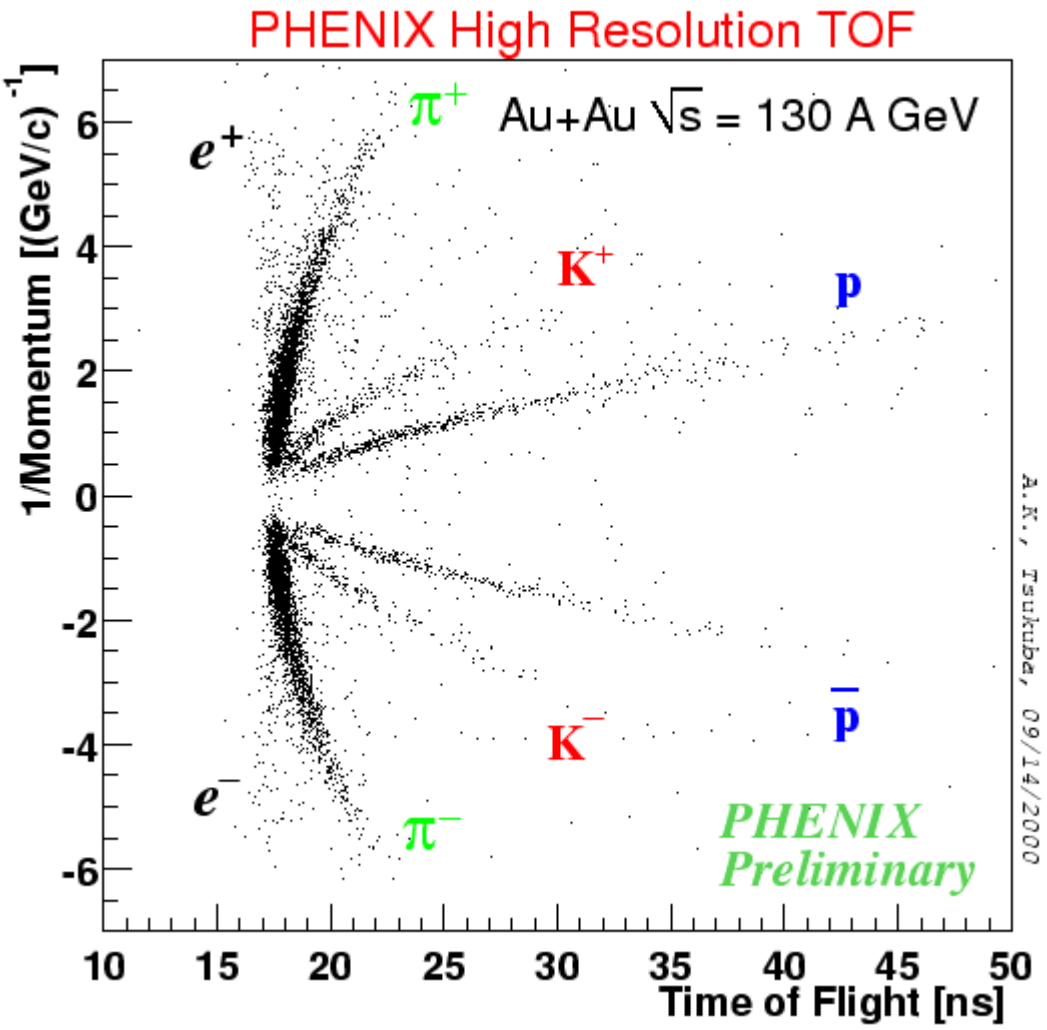
Track matching and TOF intrinsic timing resolution





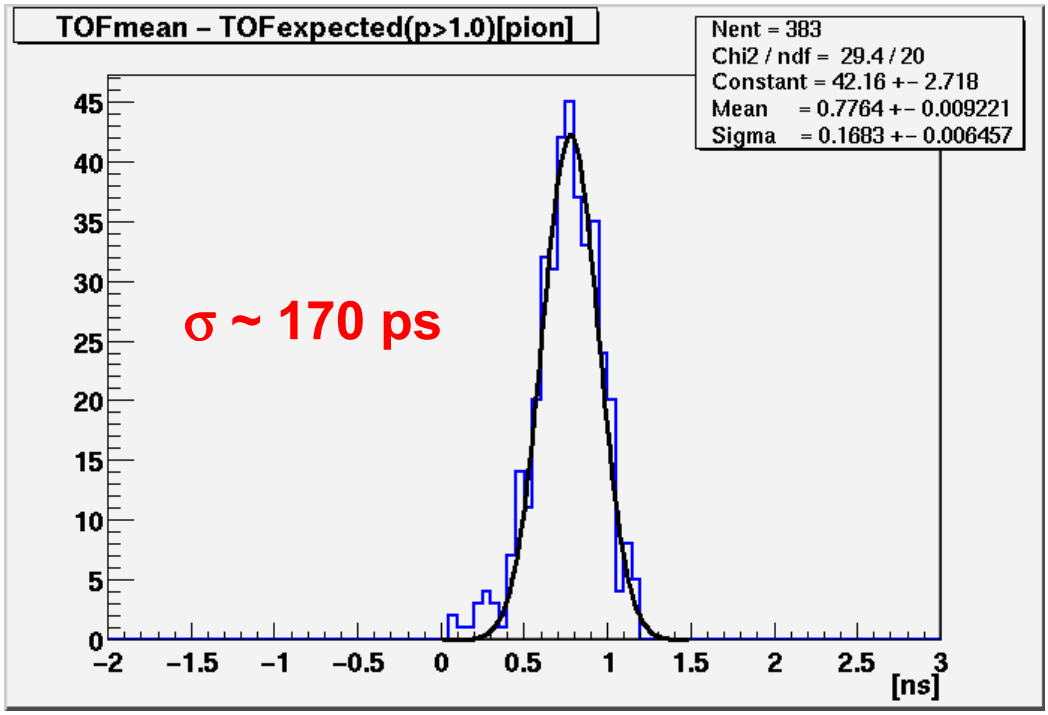
- $\sigma_{TOF\text{-}TEC}$ = 2cm:
  - Corresponding timing resolution is 120 ps.
  - 120 ps is consistent with TOF intrinsic timing resolution for NO slewing correction.

Particle Identification



- We can see clear π,K,p separation
- No Slewing correction

TOF resolution



- Select High-momentum pion.
- Current Time of Flight resolution is ~170ps.
  - BBC, TOF, Tracking Chamber
- aaa
- bbb

Summary

- TOF intrinsic timing resolution is 120 ps from TEC/TOF matching without slewing correction.
- Time-of-Flight resolution is 170 ps