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The Level-3 Trigger System at STAR

STAR Collaboration
STAR Level 3 Trigger

• Online event reconstruction at an input rate up to 100 Hz for Au+Au or p+p collisions.

• Trigger for Au+Au or p+p collisions with special topological or physics characteristics.

Trigger Applications:

already applied:

• event vertex in beam direction
  - trigger on events which are centred in the STAR detector.

• $^0\rho$ produced in peripheral collisions
  - trigger on $\pi^+\pi^-$ candidates from $^0\rho$.

planed:

• rare particles
  
  $J/\psi \rightarrow e^+ e^-$

• heavy fragments
  - antideuterons
STAR Experiment

Solenoidal Tracker At RHIC

June: Au+Au at $\sqrt{s_{NN}} = 70$ GeV
July - Sept: Au+Au at $\sqrt{s_{NN}} = 130$ GeV

2000: Level-3 Trigger based on TPC data only
Level 3 Trigger Architecture

- **cluster finding**
- **track finding**
- **trigger decision**
- **display events**

**TPC Sectors**

**TPC**

**SL3** Alpha DS10

**GL3** Alpha DS10

**Eventbuilder**

**Tape**

- 20ms
- 25ms
- 150ms
- 165ms
- 200ms

**time**
Trigger on Event Vertex

rejected

$|V_z| > 75\text{cm}$

triggered

$|V_z| < 75\text{cm}$
Trigger on $\pi^+ \pi^-$ from $\rho^0$ in peripheral Collisions

rejected
beam gas event

triggered
pair points to beam position
Particle Identification

\begin{figure}
\centering
\includegraphics[width=\textwidth]{dEdx.png}
\caption{\textbf{dE/dx offline analysis}}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{dEdx_online.png}
\caption{\textbf{dE/dx online analysis}}
\end{figure}

\textbf{dE/dx offline analysis}

\textbf{dE/dx online analysis}

\begin{itemize}
\item Pid in 200 ms with L3 online analysis
\end{itemize}
Event Vertex

vertex x pos. [cm]

vertex y pos. [cm]

vertex z pos. offline [cm]

vertex z pos. L3 online [cm]

vertex z pos. L3 online vs. offline analysis

vertex z pos. L3 online-offline

entries [n]

vertex z pos. offline - online [cm]
Clusterfinding

Slight differences between online and offline analysis.

- spots: rawdata
- cycle: cluster found offline
- error bars: cluster width offline
- crosses: cluster found by L3 online
Online vs. Offline Analysis

Online momentum distribution (200ms) shows the same shape as offline reconstructed events (10min). A certain systematical difference is observed.
Summary

• L3 Trigger was applied on Au+Au collisions to trigger on:
  - event vertex
  - $\rho^0$ in peripheral collisions

• Online tracking / clusterfinding are less accurate than offline. Reconstruction efficiency is already good enough to trigger on simple event characteristics.

• To trigger on more complicated signals, the reconstruction efficiency has to be improved:
  - rare particles, $J/\psi \rightarrow e^+e^-$
  - heavy fragments, antideuterons

• Other subdetectors will be included in the L3 Trigger.