L2-Muon Trigger Performance

Efficiency and Rejection

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April 11, 2002
German DØ Meeting, Munich

✦ What is available in L2?
✦ Rejection
✦ L2-Mu versus Offline Muons
✦ What to expect in near future

An electronic copy of this presentation can be found in
http://www-clued0.fnal.gov/~tim/l2/d0_munich_020411.ps
and
http://www-clued0.fnal.gov/~tim/l2/d0_munich_020411.pdf
What is available in L2?

- L2-Online and L2-Offline for the 1\textsuperscript{st} time out of the box:
  Data taken with p11.XX.00

- L2-Muon workers (Central + forward) reliable, included in most runs

- L2-Muon performance is being thoroughly tested $\rightarrow$ better than pre-scaling

- L2-Global included in most Runs, fine-tuning, testing ...

- Latest tests: L2 rejected for the 1\textsuperscript{st} time with “random-reject” scripts (not only M&P) as well as physics scripts

- $\sim$ 1-2 weeks: run with beam: Physics scripts on L2-Global with real rejection (probably simple $\mu^-$, EM- and jet-scripts)
Run 149852: 9335 events
For L1-triggered events: What did L2-μ find?

The overlaid red histograms show the amount of “L2-rejected” events (bin Ø) with ≥ 1 offline-mouns.
Rejection in L2 II

Run 149852: 9335 events

For L1-triggered events: What did L2-μ find?

L1-Wide: $-1.2 < \eta < 1.2$ (upper plots)
L1-All: $-2 < \eta < 2$ (lower plots)

The overlaid red histograms show the amount of “L2-rejected” events (bin $\emptyset$) with $\geq 1$ offline-mouns.
# Offline Muons vs. # L2 Muons
for events with $\geq 1$ L1-single-$\mu$ trigger
(forw., centr. or all-$\eta$)

Run 149852: 9335 events
Offline reconstruction: p10.15.01 with criteria as defined in the certified Muon-ID note v1.1 (see Muon-ID web page).
# Offline Muons vs. # L2 Muons
for events with $\geq 1$ forward L1-single-$\mu$ trigger

Run 149852: 9335 events
Offline reconstruction: p10.15.01 with criteria as defined in the certified Muon-ID note v1.1 (see Muon-ID web page).
# Offline Muons vs. # L2 Muons
for events with \( \geq 1 \) central L1-single-\( \mu \) trigger

Run 149852: 9335 events
Offline reconstruction: p10.15.01 with criteria as defined in the certified Muon-ID note v1.1 (see Muon-ID web page).
Summary: Efficiency w.r.t. Offline

Fraction of events containing offline-reconstructed muons with $N(L2) > 0$

Large errors associated (not shown in plot)!

149852: 9335 events

Offline reconstruction: p10.15.01 with criteria as defined in the certified Muon-ID note v1.1 (see Muon-ID web page).
All combinations of **Tight Offline** and **L2-ABC Muons** *(medium)*

Run 149852: 9335 events
Where do we find “matching” L2-Muons?

**Efficiency per Muon:** $\eta$

(not per event like before)

“Matching” means: $\Delta \phi < 45^\circ$ and $\Delta \eta < 0.7$

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**Loose Offline Muons**

- No matching L2$_{\mu}$
- Matching loose L2$_{\mu}$
- Matching medium L2$_{\mu}$ (A+BC)

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Run 149222: 2512 events
Efficiency per Muon: $\phi$

Loose Offline Muons
- No matching $L_2^\mu$
- Matching loose $L_2^\mu$
- Matching medium $L_2^\mu$ (A+BC)

Run 149222: 2512 events
Efficiency per Muon: $P_T$

Efficiency per Offline-Muon III

Run 149852: 9335 events
Transverse Momentum of Muons (all combinations): $P_T$

Run 149852: 9335 events
L1 Single-Muon triggers are usually prescaled by $10 - 30$

Using the 

**loosest criteria**

for a muon in L2 (i.e. $\geq 1$ A or BC segment with lowest quality) the 

**rejection** becomes

$$\frac{L1\text{accepts}}{L2\text{accepts}} \sim 1.7 \quad \text{for } -2 < \eta < 2.$$ 

Criterion for L2(-$\mu$) (Trigger Board):

Be better than a random prescale:

$$\varepsilon_{L2\mu} > \frac{1}{\text{Rejection}}$$

With an efficiency (w.r.t. offline muons) of $\varepsilon_{L2\mu} \sim 98\%$, L2-$\mu$ will provide a much purer and richer sample of Muons than simple prescaling:

$$\varepsilon_{L2\mu} \approx 0.98 > 0.59 \approx \frac{1}{\text{Rejection}}$$

L2 throws away $\sim 40\%$ of single-$\mu$ events triggered by L1 while being $> 98\%$ efficient.
Efficiencies and Rejections of L2-μ:

<table>
<thead>
<tr>
<th></th>
<th>Offline Muons</th>
<th>L1 Single Muon Triggers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>loose</td>
<td>medium</td>
</tr>
<tr>
<td>Loose L2μ</td>
<td>98%*</td>
<td>99%*</td>
</tr>
<tr>
<td>Medium L2μ</td>
<td>82%*</td>
<td>84%*</td>
</tr>
<tr>
<td>Tight L2μ</td>
<td>78%*</td>
<td>81%*</td>
</tr>
</tbody>
</table>

* These are only estimates, coming from an OR of all L1-sigle-μ triggers, since: different L1 triggers have different prescales!

A few more ideas...

- Optimize L2 criterion: It is very loose → quality cuts
- Using $P_T$ for higher rejections (yet to be studied)
- ...

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