



More Top Quark Physics and the Trigger Program

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07 November 2006



L1CTK Trigger

- ◆ Designed to reduce the L1 trigger rate for electrons and taus at high luminosity by exploiting the L1CAL and L1CTT Run IIb trigger upgrades
- ◆ L1CTK trigger algorithms match ϕ position of EM/jet objects from L1CAL with ϕ position of tracks from L1CTT
 - Matching in E_T/P_T is also used
 - Isolation and CPS/FPS information is also used
- ◆ Based on the successful L1MU trigger architecture developed by Arizona for Run II



L1CTK Trigger

- ◆ Arizona holds sole responsibility for the L1CTK trigger hardware and software
 - **Hardware**
 - ◆ Day-to-day operations, monitoring, and maintenance
 - ◆ Trouble-shooting
 - ◆ Documentation for shifters
 - **Software**
 - ◆ Online control and monitoring (“Examine” and REGMON GUI’s)
 - ◆ Offline “reconstruction” of L1CTK data
 - ◆ L1CTK trigger simulator and certification
 - ◆ Data analysis (e.g. efficiency, purity, optimization)
- ◆ These tasks are fundamentally important ones for DØ and require a substantial time and intellectual commitment
- ◆ Obviously we draw heavily on L1MU hardware and software accomplishments



L1CTK Trigger

◆ Hardware status

- All trigger hardware installed and integrated by early 2006
 - ◆ 16 trigger cards, 16 flavor boards, 6 crate managers, 12 splitter cards
- Tested with upgraded L1CAL and L1CTT triggers during 2006 shutdown
- ***Still*** waiting for latency shift to occur at DØ
 - ◆ In the meantime we are focusing on software and offline analysis



L1CTK Trigger

◆ L1CTK trigger crate



◆ L1CTK manager crate





L1CTK Trigger

◆ Software status

■ Previously

- ◆ Developed suite of online GUI's
- ◆ Developed class structure for evaluating L1CTK trigger algorithms

■ More recently

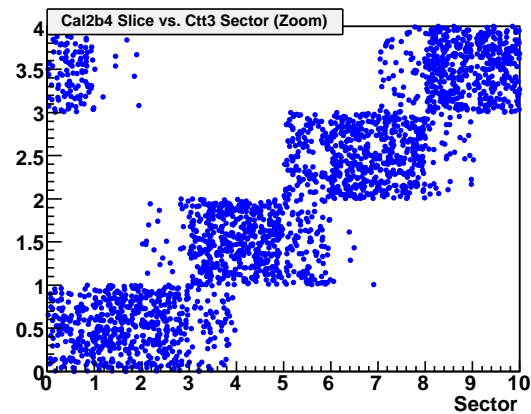
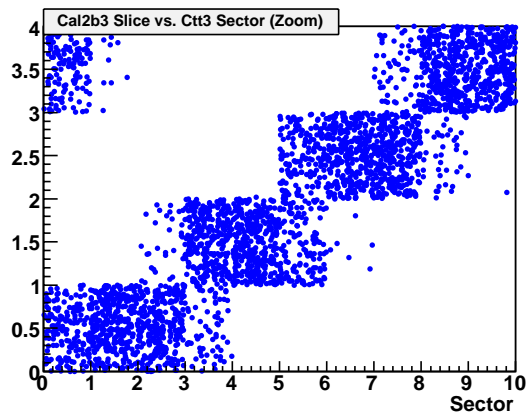
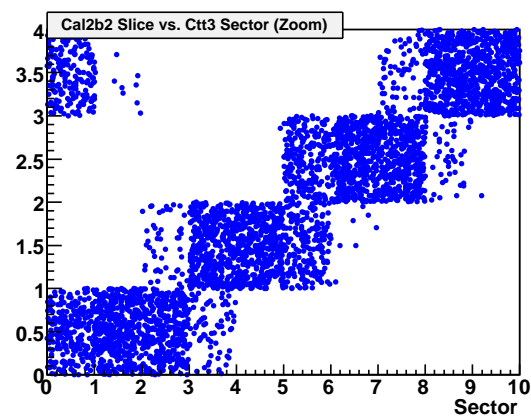
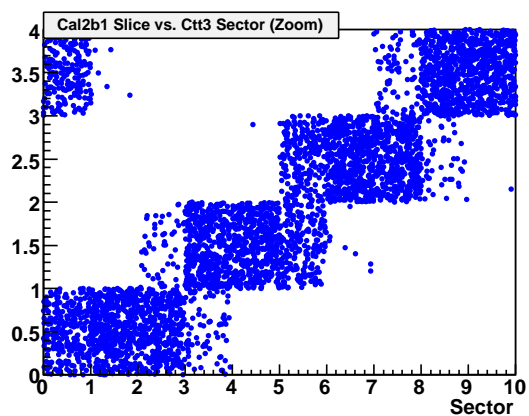
- ◆ Completed offline analysis package (unpacking, etc.)
- ◆ Developed L1CTK trigger simulator (can be run inside or outside DØ framework)
- ◆ Completed L1CTK monitoring in "Examine"



L1CTK Trigger

◆ ϕ matching algorithms

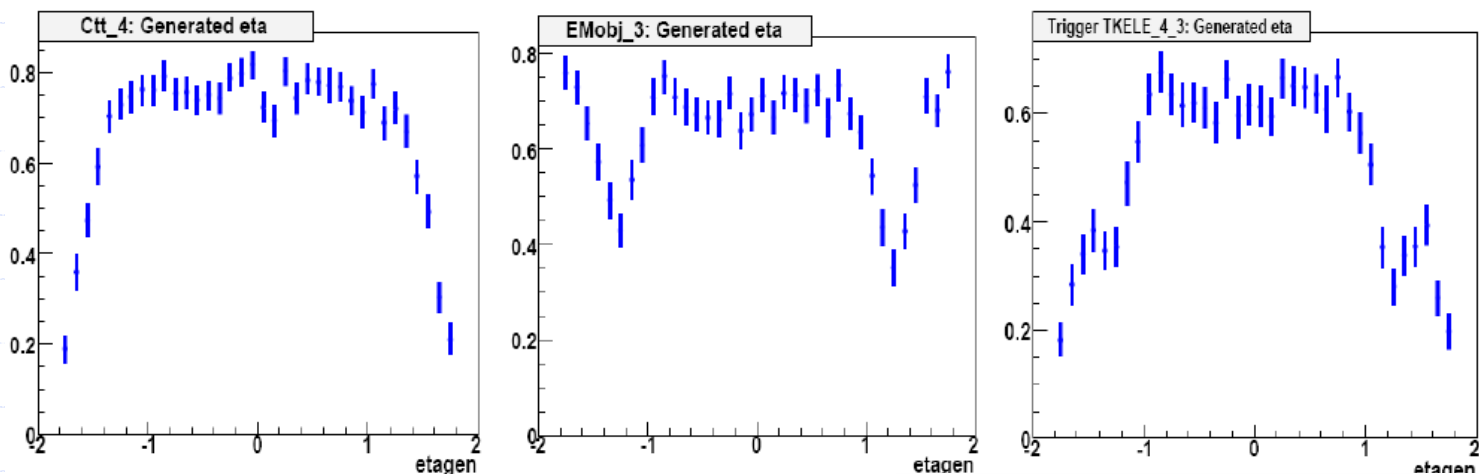
sliceVsector_Z_pt3



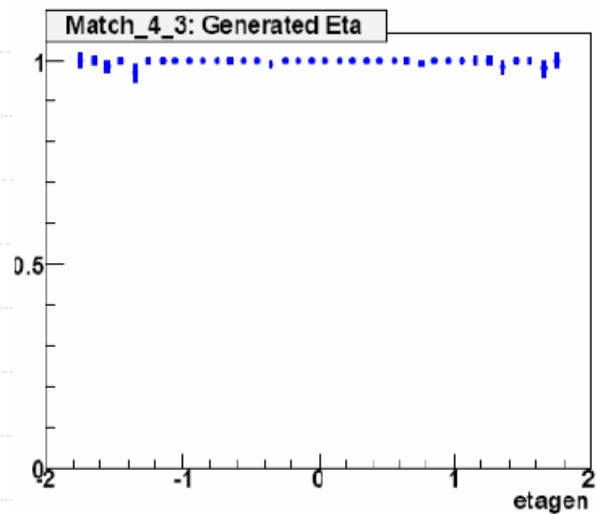


L1CTK Trigger

Electron efficiency (10 GeV track and 13 GeV EM)



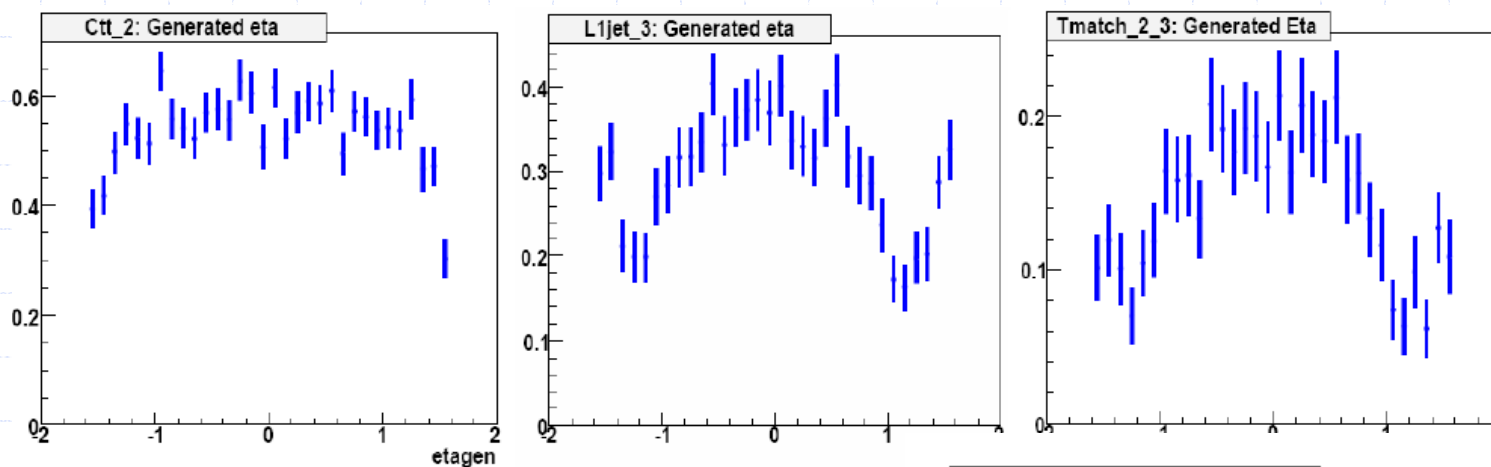
~100% matching efficiency



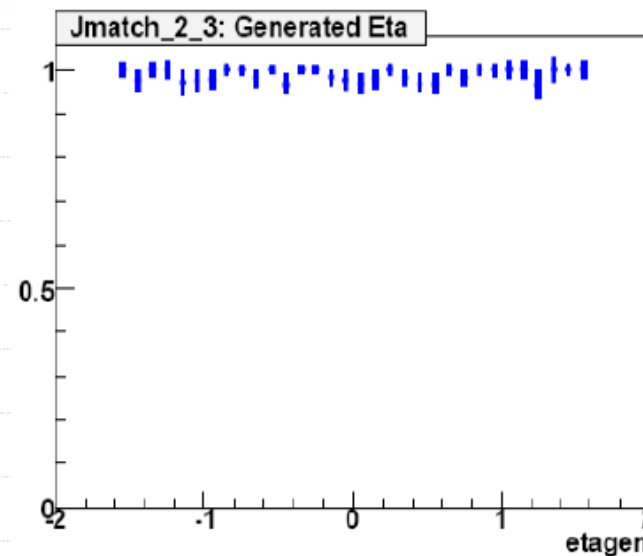


L1CTK Trigger

◆ Tau efficiency (5 GeV track and 12 GeV jet)



◆ ~100% matching efficiency





L1CTK Trigger

◆ L1CTK power supply control and monitoring

File View Help									
CTKT	CTKM	L1CTK Supply							
Device	U0 (+5V) Voltage Current	U1 (+12V) Voltage Current	U2 (-12V) Voltage Current	U3 (+3.3V) Voltage Current	U4 (+5V) Voltage Current	U5 (+12V) Voltage Current	U6 (-12V) Voltage Current	U7 (+3.3V) Voltage Current	SUPPLY STATUS
L1CTK Supply Located in MCH1 Rack 119									
L1CTK Voltage (V)	4.98	12.00	11.96	3.31	4.97	11.91	11.84	3.31	Normal <input type="button" value="On"/> <input type="button" value="Off"/> <input type="button" value="Reset"/>
L1CTK Current (A)	24.01	5.41	0.48	56.68	8.54	0.91	0.48	7.97	
Status: <input type="text"/>									
<input type="button" value="Reconnect"/>		<input type="button" value="Clear Parity"/>						<input type="button" value="Exit"/>	



L1CTK Trigger

L1CTK online control

File Mode Help

GENERAL TOOLS | EXPERT TOOLS | PDT DEBUG INPUTS

MAIN | CTT | CAL | FPS | CTKM

Double-click to show/hide help information:

CFT - L1CalTrack Input Sectors

octant 0	0	1	2	3	4	5	6	7	8	9
octant 1	10	11	12	13	14	15	16	17	18	19
octant 2	20	21	22	23	24	25	26	27	28	29
octant 3	30	31	32	33	34	35	36	37	38	39
octant 4	40	41	42	43	44	45	46	47	48	49
octant 5	50	51	52	53	54	55	56	57	58	59
octant 6	60	61	62	63	64	65	66	67	68	69
octant 7	70	71	72	73	74	75	76	77	78	79

disable all CFT inputs enable all CFT inputs

Write params.dat files

QUIT

Restore CTKT Restore CTKM

Welcome to the L1 CalTrack input mask GUI, sanderso!
You have expert-level access to this program!

File Mode Help

GENERAL TOOLS | EXPERT TOOLS | PDT DEBUG INPUTS

Expert - CTKM Trigs | Expert - CTKM MTCM | Expert - CTKT Trigs | Expert - CTKT MTCM

Double-click to show/hide help information:

CTKM Trigger Terms

Trigger Term	Trig Name	Trig #	Trigger Term	Trig Name	Trig #
0	clk(b,1,xxxx,M)	255	16	ctt_only_oct0	209
1	clk(b,1,xxxx,x)	253	17	ctt_only_oct1	210
2	clk(b,2,xxxx,x)	254	18	ctt_only_oct2	211
3	clk(b,1,xxxx,0)	245	19	ctt_only_oct3	212
4	clk(b,1,xxxx,1)	246	20	ctt_only_oct4	213
5	clk(b,1,xxxx,2)	247	21	ctt_only_oct5	214
6	clk(b,1,xxxx,3)	248	22	ctt_only_oct6	215
7	clk(b,1,xxxx,4)	249	23	ctt_only_oct7	216
8	clk(b,1,xxxx,5)	250	24	ctt_only	217
9	clk(b,1,xxxx,6)	251	25	f1ctt_test	093
10	clk(b,1,xxxx,7)	252	26	f1ctt_test	093
11	clk(e,1,5,7,w,c,x)	009	27	045	045
12	clk(e,1,6,7,7,w,c,x)	010	28	clk(e,1,10,13,w,x,x)	005
13	clk(e,1,6,7,10,w,c,x)	011	29	clk(e,2,6,7,7,w,c,l)	122
14	clk(e,1,8,10,w,c,x)	012	30	clk(e,2,6,7,10,w,x,l)	117
15	clk(e,1,3,3,w,x,l)	013	31	clk(j,1,8,15,w,x,l)	037

Check All Triggers Show All Trigger Names

Write params.dat files

QUIT

Restore CTKT Restore CTKM

Welcome to the L1 CalTrack input mask GUI, sanderso!
You have expert-level access to this program!



L1CTK Trigger

◆ REGMON monitoring

- Error registers are also monitored by alarm system

CTKT	CTKM	Device	MaskA	MaskB	LockA	LockB	FF FullA	FF FullB	ParityA	ParityB	D-AvailA	D-AvailB	
L1 Cal Track Trigger Crate													
CTKT-S1		CTKT-S1	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S3		CTKT-S3	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S5		CTKT-S5	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S7		CTKT-S7	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S9		CTKT-S9	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S11		CTKT-S11	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S13		CTKT-S13	0x1c00	0xf	0xc00	0x0	0xffff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity
CTKT-S15		CTKT-S15	0x1c00	0xf	0xc00	0x0	0xfcff	0x0	0x0	0x0	0xf3ff	0xf3ff	Clear Parity

Status:

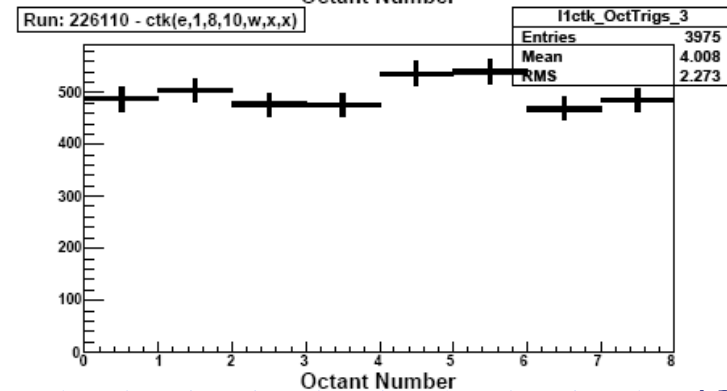
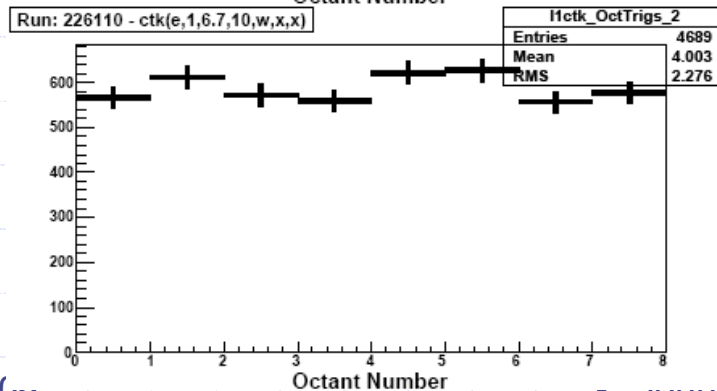
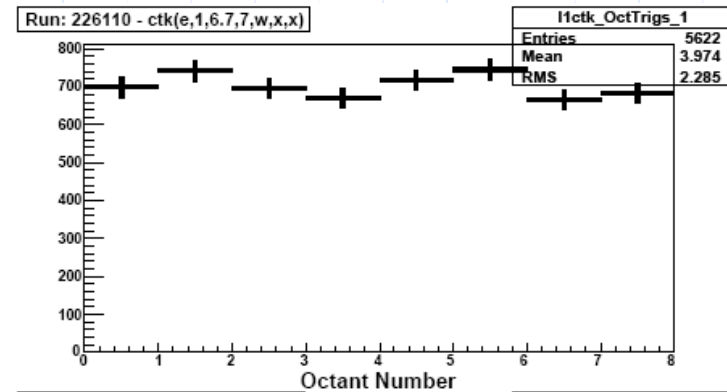
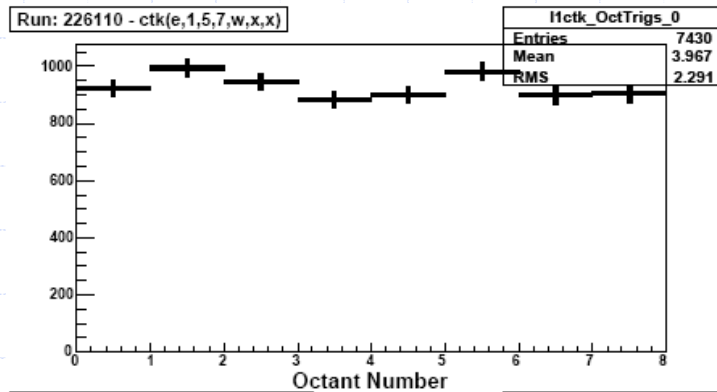
Reconnect Clear Parity Exit



L1CTK Trigger

◆ Online “Examine” plots

- Φ distribution of electron triggers for different (P_T, E_T) thresholds

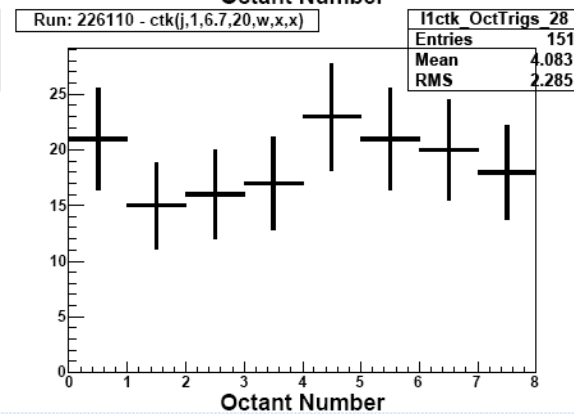
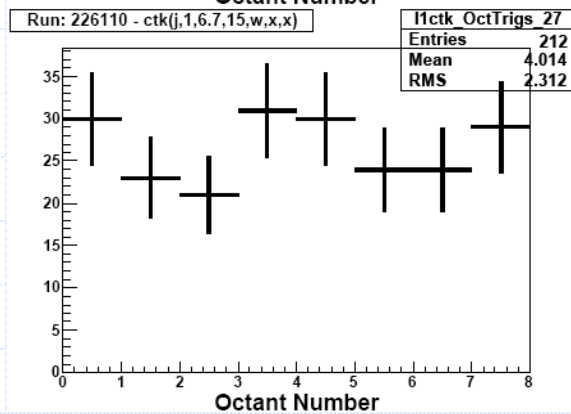
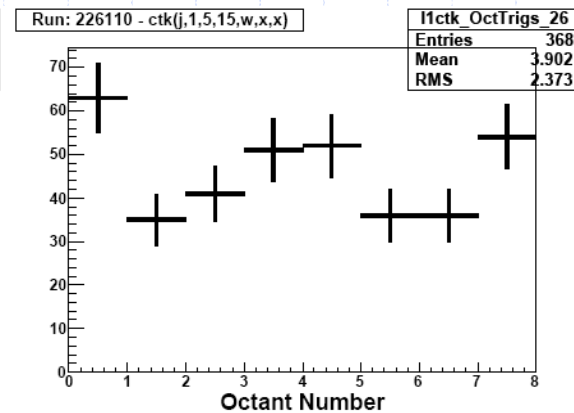
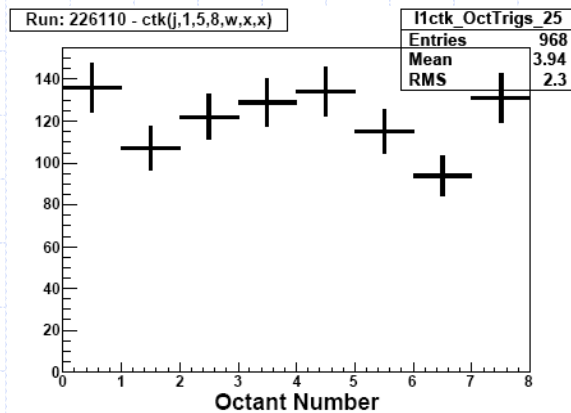




L1CTK Trigger

◆ Online “Examine” plots

- Φ distribution of tau triggers for different (P_T, E_T) thresholds

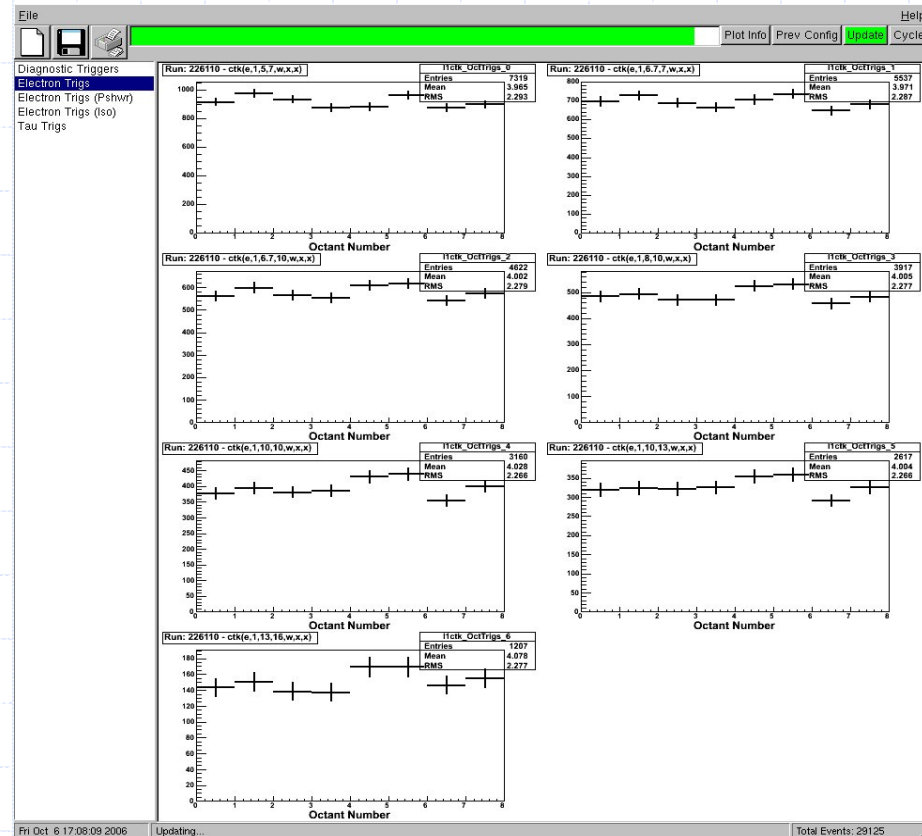




Software: Trigger Examine

Modified to

- Get hardware counters from L1L2Chunk
- Put information into TrigSimCert root tree
- Generate plots of diagnostic and physics trigger terms



Running on d0ol76

11/6/2006 ■ Stable for last 4

K. Johns

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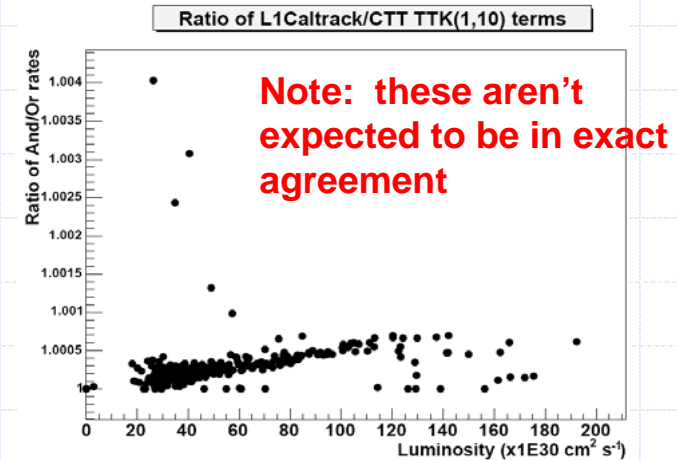
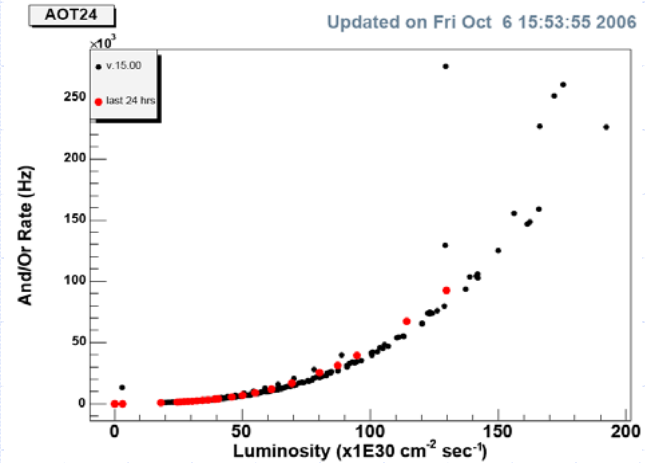


Software: Rate Monitoring

TTK(1,10) - L1Caltrack Copy

◆ Scripts modified from l1muon job

- Extracts And/Or rates from archiver
- Plots term rates vs. luminosity
 - ◆ Without latency shift, rates not sensible
- Ultimately, trends fitted
 - ◆ Function used to check rates online





L1CTK Trigger

- ◆ Arizona (Anderson, Burke, Johns, Steinberg, and Temple) is solely responsible for all aspects of the L1CTK trigger
- ◆ This (2006) is the last year Arizona will likely be able to provide substantial hardware and software support services to DØ



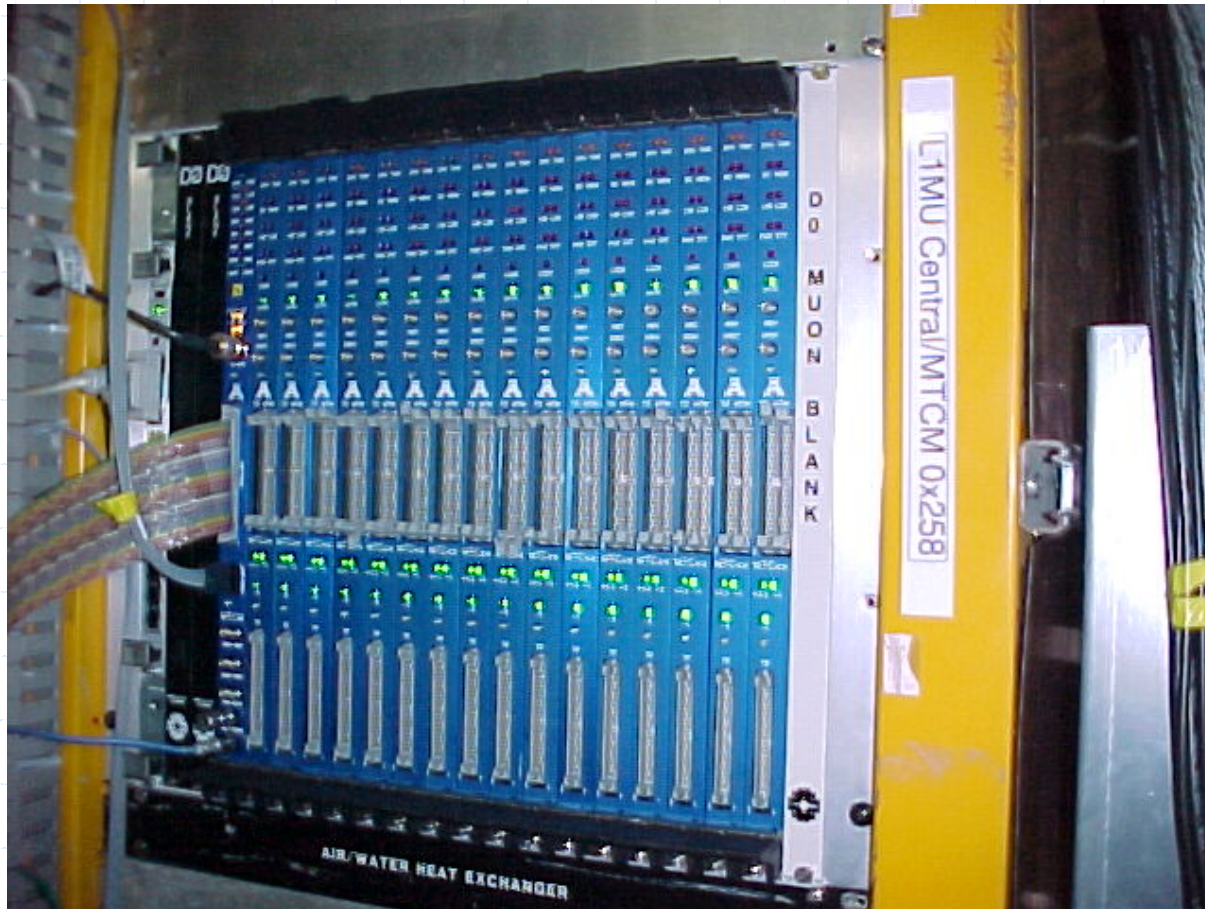
L1MU Trigger

- ◆ Arizona continues to hold primary responsibility for the L1MU trigger hardware and software
 - **Hardware**
 - ◆ Day-to-day operations, monitoring, and maintenance
 - ◆ Trouble-shooting (sometimes the entire muon system)
 - ◆ Instructions for shifters
 - ◆ Support for L1CTT and FPD trigger managers
 - **Software**
 - ◆ Online control and monitoring (“Examine” and REGMON GUI’s)
 - ◆ Offline “reconstruction” of L1MU data
 - ◆ L1MU trigger simulator and certification
 - ◆ Data analysis (e.g. efficiency, purity, optimization)
- ◆ These tasks are fundamentally important ones for DØ and require a substantial time and intellectual commitment



L1MU Trigger

◆ In the collision hall





L1MU Trigger

- ◆ We continue to enhance and enlarge the L1MU monitoring tools used by experts and shifters
- ◆ Real-time monitoring
 - Power supplies, BOT and trigger rates, geographical distributions, status and error registers, “one button” startup
- ◆ Long-term monitoring
 - Variety of cron jobs that record and update information (> 100 plots) hourly
 - Includes trigger rates, trigger hardware-trigger simulator comparisons, trigger efficiencies and purities



L1MU Trigger

Level 1 Muon Page


<http://www-d0online.fnal.gov/groups/l1muon/>



L1 Muon Home Page




[Click here to see which inputs to L1 Muon should currently be enabled!!](#)

 [OVERVIEW OF THE L1 MUON SYSTEM FOR NEW CALMUO SHIFTERS](#)

 [ADVANCED TRAINING FOR CALMUO SHIFTERS](#)

[And/Or Rates vs. Luminosity for Run IIB](#)
(updated hourly at 41 minutes past the hour)
(.ps)

 [How to check Level 1 Muon And/Or Rates vs. Luminosity](#)

General L1 Muon Info

- [How to mask off an input to Level 1 Muon System](#)
- [How to check/power cycle the L1 Muon power supplies](#)
- [How to cold start the L1 Muon crates](#)
- [LVPS archiver](#)
(Directory is /projects/archive/muo/l1muo)
- [L1 Muon Wiki](#)
- [How to find/record L1 Muon And/Or terms for the Muon Checklist](#)
- [Explanation of L1 Muon Global Monitor Plots](#)
- [Location of L1Muon Electronics/Readout System](#)

L1 Muon Problem-Solving List

- [L1 Muon Call List](#)

[CLICK HERE FOR STEP-BY-STEP HELP ON COMMON L1 MUON PROBLEMS](#)

- [CLICK HERE FOR THE OLD HELP PAGE](#)

11/6/2006

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L1MU Trigger

Tabs for individual crates

Expand to see individual errors

The screenshot shows the L1MU Trigger software interface. At the top, there are tabs for 'L1MU Supplies', 'MTCC', 'MTCN', 'MTCS', and 'MTM'. The 'MTCC' tab is selected. Below the tabs is a table with columns: Device, Mask, Lock, FF Full, Parity, Latch Error, and two columns for actions: 'Clear Parity' and 'Clear Latch Error'. The table lists various MTCC devices (MTCC_XX0 to MTCC_XXF) and their status. A dropdown menu is open for the 'PDT246 BAD!' entry, showing a list of error codes and their status (e.g., PDT016 Good, PDT026 Good, PDT036 Good, PDT106 Good, PDT116 Good, PDT136 Good, PDT146 Good, Bphi Oct6 #0 Good, PDT206 Good, PDT216 Good, PDT236 Good, PDT246 BAD!, No Connect, Aphi Oct6 Good, Bphi Oct6 #1 Good, CMSC Oct6 (Conc) Good). At the bottom, there are buttons for 'Reconnect', 'Clear Parity', 'Clear LError', and 'Exit'. The status bar at the bottom left says 'Status: Clear latched error finished'.

Device	Mask	Lock	FF Full	Parity	Latch Error	Clear Parity	Clear Latch Error
L1 Muon Central Trigger Crate							
MTCC_XX0	0x4000	0x4000	0x0	0x4000	0x0	Clear Parity	Clear Latch Error
MTCC_XX1	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX2	0x4000	0x4000	0x0	0x4000	0x0	Clear Parity	Clear Latch Error
MTCC_XX3	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX4	0x4000	0x4000	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX5	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX6	0x4000	0x4000	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX7	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XX8	0x4000	0x4000	0x0	0x4000	0x0	Clear Parity	Clear Latch Error
MTCC_XX9	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XXA	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XXB	0x1000	0x1000	0x0	0x1000	0x0	Clear Parity	Clear Latch Error
MTCC_XXC	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XXD	0x1000	0x1000	0x0	0x80	0x0	Clear Parity	Clear Latch Error
MTCC_XXE	0x4000	0x4000	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCC_XXF	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error

Dropdown menu for PDT246 BAD!:

- PDT016 Good
- PDT026 Good
- PDT036 Good
- PDT106 Good
- PDT116 Good
- PDT136 Good
- PDT146 Good
- Bphi Oct6 #0 Good
- PDT206 Good
- PDT216 Good
- PDT236 Good
- PDT246 BAD!
- No Connect
- Aphi Oct6 Good
- Bphi Oct6 #1 Good
- CMSC Oct6 (Conc) Good



L1MU Trigger

L1MU REGMON GUI

The screenshot shows a software window titled "L1 Muon PS Monitor and Error Register Display /". The window has a menu bar with "File", "View", and "Help". Below the menu bar is a tabbed interface with tabs for "L1MU Supplies", "MTCC", "MTCN", "MTCS" (selected), "MTM", "LICTTTest", and "LIPDTest". The main display area is a table with columns: "Device", "Mask", "Lock", "FF Full", "Parity", "Latch Error", "Clear Parity", and "Clear Latch Error". The table is titled "L1 Muon South Trigger Crate" and lists 20 devices from MTCS_XX0 to MTCS_XXF. The "Clear Parity" and "Clear Latch Error" columns contain buttons. At the bottom, there is a status bar with the text "Status: Clear latched error finished" and four buttons: "Reconnect", "Clear Parity", "Clear LError", "Clear Parity & LError", and an "Exit" button.

Device	Mask	Lock	FF Full	Parity	Latch Error	Clear Parity	Clear Latch Error
L1 Muon South Trigger Crate							
MTCS_XX0	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX1	0xc00	0xf00	0x0	0x800	0x0	Clear Parity	Clear Latch Error
MTCS_XX2	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX3	0xc00	0xf00	0x0	0x800	0x0	Clear Parity	Clear Latch Error
MTCS_XX4	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX5	0xc00	0xf00	0x0	0x4	0x0	Clear Parity	Clear Latch Error
MTCS_XX6	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX7	0xc00	0xf00	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX8	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XX9	0xc00	0xb00	0x400	0x400	0x0	Clear Parity	Clear Latch Error
MTCS_XXA	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XXB	0xc00	0xf00	0x0	0x800	0x0	Clear Parity	Clear Latch Error
MTCS_XXC	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XXD	0xc00	0xf00	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XXE	0x0	0x0	0x0	0x0	0x0	Clear Parity	Clear Latch Error
MTCS_XXF	0xc00	0xf00	0x0	0x0	0x0	Clear Parity	Clear Latch Error

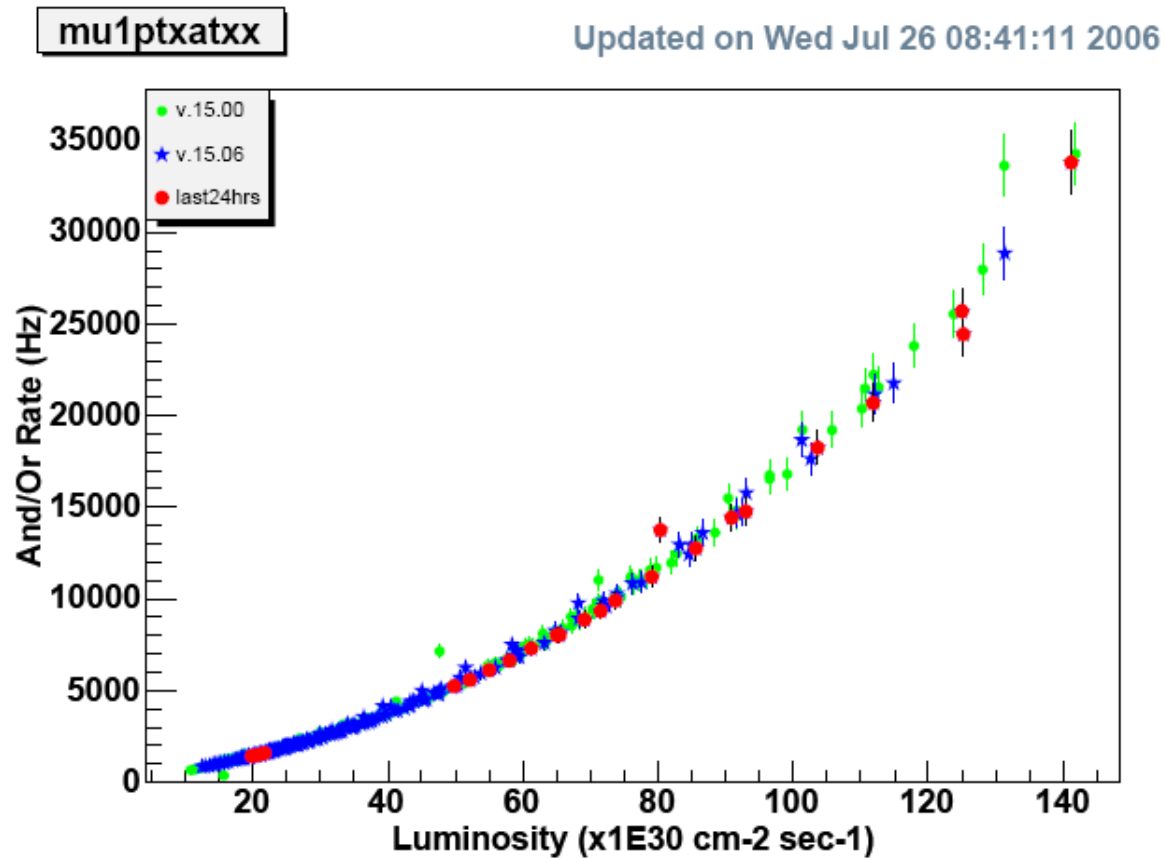
Status: Clear latched error finished

Buttons: Reconnect, Clear Parity, Clear LError, Clear Parity & LError, Exit



L1MU Trigger

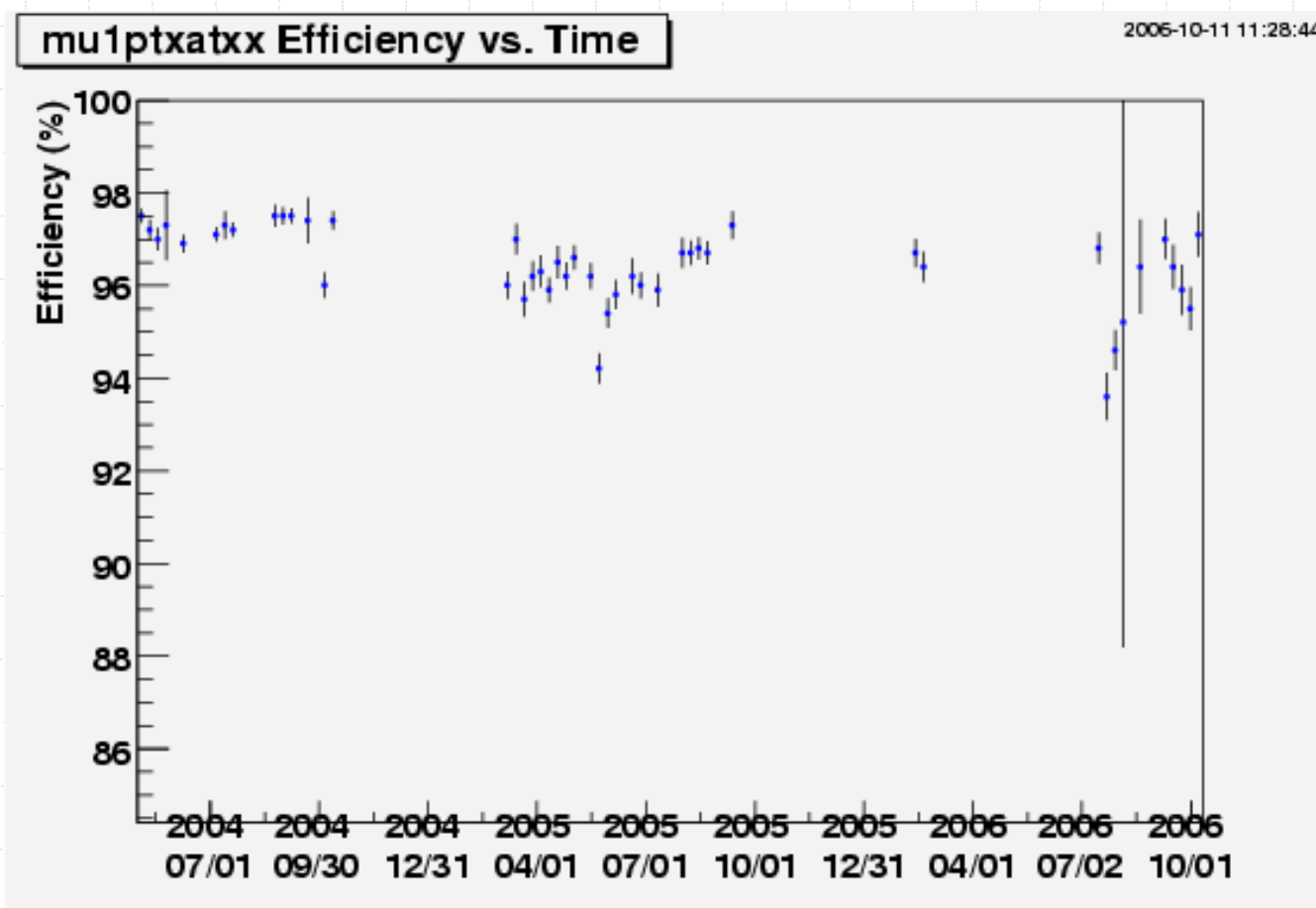
◆ Trigger rate as a function of luminosity





L1MU Trigger

◆ Trigger efficiency as a function of time



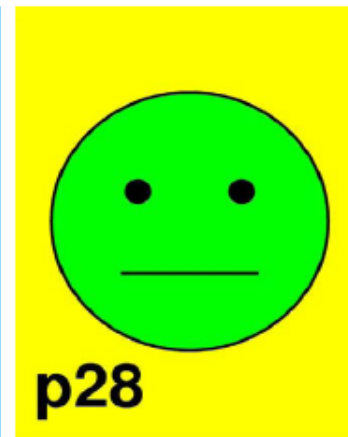


L1MU Trigger

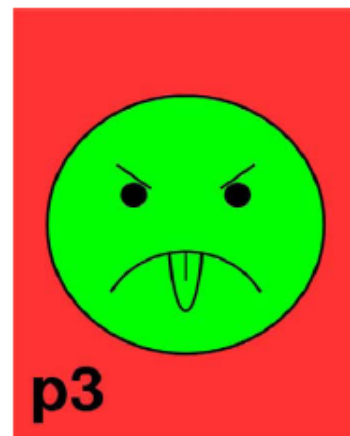
◆ Results when cursor placed over plot



(a)



(b)



(c)



(d)

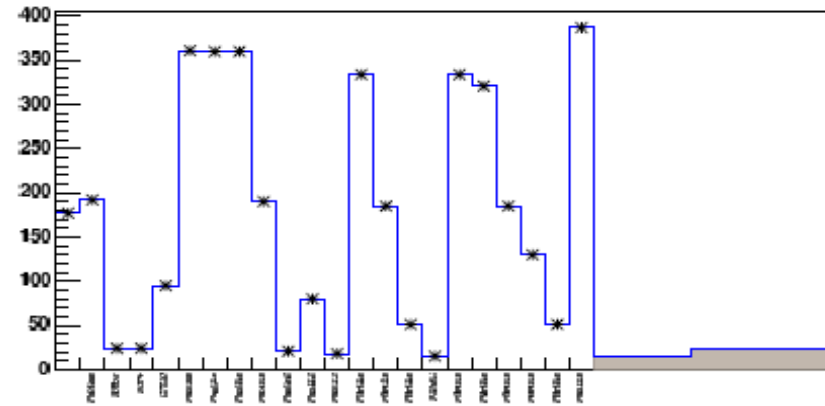


L1MU Trigger

Hardware trigger – simulator trigger comparison

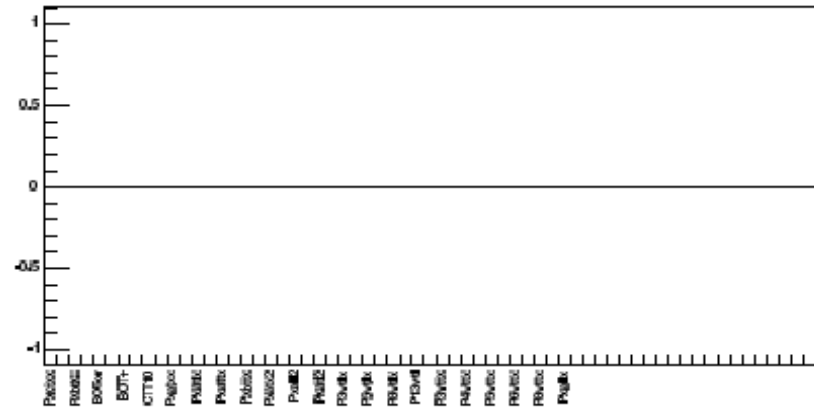
MTM Hardware Trigs - Sim Trigs Marked With *

Entries 4099



MTM Hardware-Sim Fractional Differences

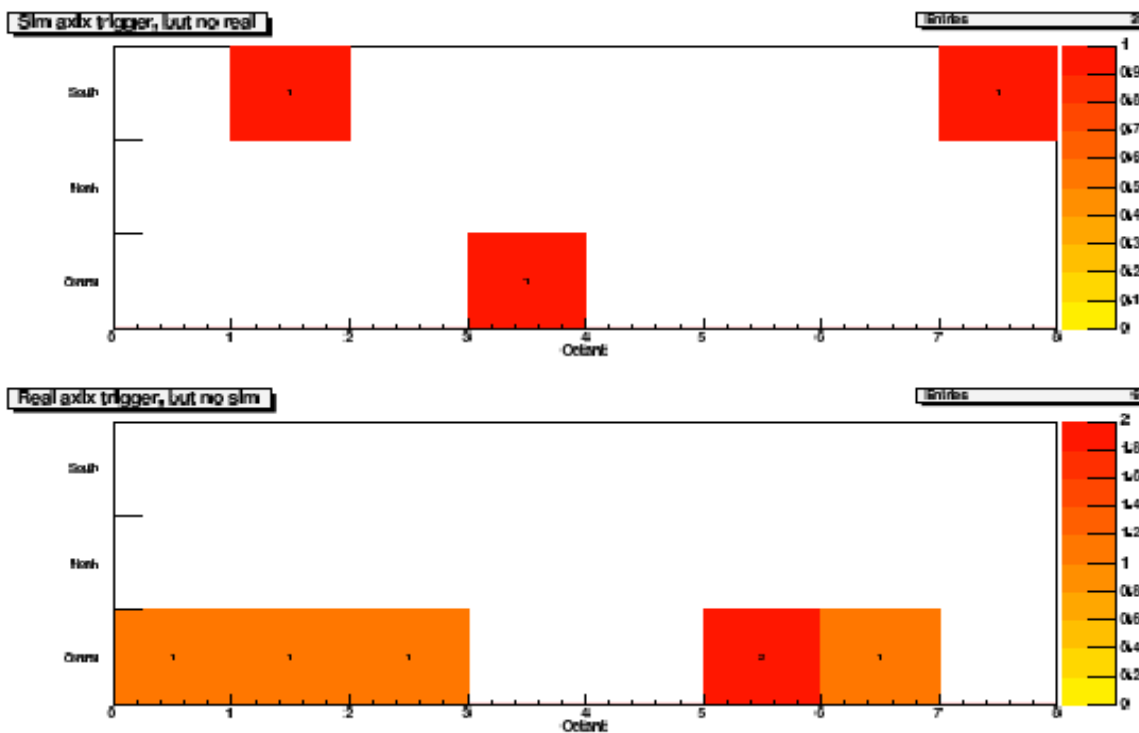
Entries 3896





L1MU Trigger

- ◆ Hardware trigger – simulator trigger comparison



Excess in Simulator – Could indicate loose flavor board!



L1MU Trigger

- ◆ The stellar performance of the L1MU trigger is due to the personal responsibility assumed by Anderson, Burke, Johns, Steinberg, and Temple
 - *Aside, it was the only L1 trigger system that did not need to be upgraded for higher luminosity running*
- ◆ This (2006) is the last year Arizona will likely be able to provide critical operation services to DØ