Anatomy of a Global Trigger List

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High Level Trigger Jamboree
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Trigger Fundamentals

• **Effect of the ‘Trigger’ system**
  – given over a million opportunities for collisions (‘events’ per second)
  – choose <50 to record for later analysis

• **Selecting events:**
  – Some fraction of these events are not ‘rare’ (but still useful):
    • Low energy jet production via QCD …
    • Measure luminosity …
    • Detector monitoring …
  – The study of rare processes and the discovery of unknown phenomena require maximal ‘exposure’ to the beam
    • Need well designed triggers that can remain unprescaled at the highest luminosity

• **The trigger system is designed to**
  – Record the wide variety of processes that D0 physicists are interested in looking at
  – It does this using a ‘trigger menu’ (or Trigger List) which is complex by necessity
Trigger System Design

• Fast, complex, high rate,…, multi-level

  – Level 1 - electronics and firmware
    • reduce 1 MHz to 10 kHz by looking for interesting signatures (high Pt tracks, high Et energy deposition)

  – Level 2 - firmware and software
    • 10 kHz to 1kHz by refining L1 objects, match objects found by different detectors

  – Level 3 - software
    • 1kHz to 50 Hz - execute streamlined versions of offline reconstruction programs to select events.

• Programmable!

  – through the ‘trigger configuration’ generated from Trigger Lists stored in the Trigger Database
  – and online resource allocation by COOR
Trigger Database Purpose

• **Generate:**
  – precise programming for trigger configuration
    • ONLINE
    • SIMULATION
  – The configuration format: ‘xml’
    • Extensible Markup Language (XML) universal format for structured docs and data on the web
    • The trigger ‘xml’ does not contain all the information stored in the trigger database, specifically wrt versioning, how one trigger list relates to another triggerlist, or descriptions.

• **Store**
  – all global Trigger Lists used online in Run 2
  – Bench march Trigger Lists for simulation

• **Report**
  – trigger configuration settings
    • for use by offline analysis programs
      – Et thresholds, eta ranges ...
    • to the collaboration (web), with some documentation features
      – not intended as a substitute for trigger subsystem documentation!
Trigger Database Implementation

• **Design:**
  – Three levels of decision making
    • Level 1 - hardware, firmware
    • Level 2 - firmware, software
    • Level 3 - software
  – complexity is a reflection of the complexity of the trigger
  – symmetry/commonality is taken advantage of wherever possible
  – seemingly cryptic nomenclature reflective of trigger programming.

• **Implementation:**
  – IN USE for all global trigger configurations since December 2001

• **Documentation:**
  – Specifications from
    • COOR document (Scott Snyder)
    • D0 Trigger/Online Groups
  – Trigger Database
    • see Entry Interface ‘help’ button
A Trigger is a Logical Condition

- identified by a **trigger name**
- with a set of criteria called a Script at Level 1, Level 2, and Level 3
  > each of which is satisfied if all of its logical conditions or **TERMS** is satisfied
- satisfied (true) for an event if all 3 Level Scripts are true for that event

<table>
<thead>
<tr>
<th>Trigger Name</th>
<th>Script</th>
<th>Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2EM_HI_Z</td>
<td>L1</td>
<td>CEM(2,10)</td>
</tr>
<tr>
<td></td>
<td>L2</td>
<td>TTK(2,pt3)</td>
</tr>
<tr>
<td></td>
<td>L3</td>
<td>Afastz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2EM(.9,10,.trk)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ele(2,.95,glob,..)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>InvMass(ele1,ele2,75,100....)</td>
</tr>
</tbody>
</table>
A Trigger List

- identified by Triggerlist Name/Version
- contains one or more triggers
- like a tree with Triggers as branches
  - if any trigger is satisfied, the event is recorded and the trigger bit for that trigger name is set to TRUE in the event record

Example:

```
EM_MAX
  L1Script
  L2Script
  L3Script

2EM_HI

3JET_HT
  logical TERMS (yes/no)

MU_JET_HI
```
NAME/VERSION scheme is repeated throughout the design. The name is intended to reflect the conditions in that definition.
**Trigger Nomenclature – L1**

- **NEOTYPE** – an L1 detector class
  - Group NEOTERMS which shares common download mechanisms
    - Examples: ctt, fpd, fps, muo, emcount, jetcount … specterm

- **NEOTERM** – the “And/Or terms”
  - For any event: result is TRUE or FALSE
  - Map into the L1 And/Or Framework
  - Combine one/more to form a Level 1 Script decision
    - Examples: TTK(1,1.5), Afastz …

- **L1 Script decision**
  - Logical AND of one/more NEOTERMS
**Level 1 Trigger Systems**

C -- Calorimeter -- based on Calorimeter “trigger towers”
- emcount / CEM(n,Et[,Hv]) – Cal EM TTower
- jetcount / CJT(n,Et) – Cal Jet (tot) TTower
- misspt / CME(MEt) – near future

M -- MUON – based on Muon system scintillator, PDT, MDT and CFT
- muo / MUO(n,Pt,eta,scint,wire,option)

T -- CFT/CPS
- ctt / TTK(n,p) – CFT track
- ctt / TIS(n,p) -- Isolated track
- ctt / TIQ(n,p,q) -- Isolated tracks in a quadrant
- ctt / TIL - Isolated track(s) with low home-sector occupancy.

A -- Special (L1 Framework terms)
- constructed from signals from: the Accelerator, Luminosity Monitor, Trigger Timing and Control
  - Afastz, ALiveBX, ASkip0 …
**DØ: Calorimetry**

**Features**
- **Projective geometry**
- **Cell size:** 0.1 x 0.1 in eta x phi

**L1 Cal Trigger exploits features**
- Fast summing of Cal cell energies in towers (called Trigger Towers or TT)
  - 0.2 x 0.2 in eta x phi
  - CEM TT sums EM section (optional veto on HAD)
  - CJT TT (TOT) sums projective tower exclude CH
## L1 Muon Trigger

**Description:** Muon global track combining CFT and/or Central Muon (PDT's and Scintillator) and/or Forward Muon (MDT's and Pixels).

See Level 1 Muon Terms Description

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1     | Mult   | int  | Muon track multiplicity. Possible values:  
  - 0 = no tracks,  
  - 1 = one track,  
  - 2 = two tracks,  
  - 3 = three tracks (generally not implemented but could be). |
| 2     | Pt     | string | Pt (transverse momentum) threshold. Possible values:  
  - ptx = no momentum selection (L1CFT not used),  
  - pt1 = p1 of the L1CFT,  
  - pt2 = p2 of the L1CFT,  
  - pt3 = p3 of the L1CFT,  
  - pt4 = p4 of the L1CFT. |
| 3     | Eta    | string | Eta (pseudorapidity) range. Possible values:  
  - C = Central: |eta|≤1.0 (central muon system only),  
  - W = Wide: |eta|≤1.5 (CFT system coverage),  
  - A = All muon: |eta|≤2.0 (muon system coverage),  
  - N = North: |eta| between -1.0 and -1.5,  
  - O = North: |eta| between -1.5 and -2.0,  
  - P = North: |eta| between -2.0 and -1.0,  
  - S = South: |eta| between +1.0 and +1.5,  
  - T = South: |eta| between +1.5 and +2.0,  
  - U = South: |eta| between +1.0 and +2.0,  
  - B = Between: -2.0<|eta|<2.0 but not -1.0<|eta|<1.0. (forward muon system only) |
| 4     | Scint  | string | L1CFT and scintillator quality (MTC05). Possible Values:  
  - L = Loose,  
  - T = Tight,  
  - X = no requirement  
  - E = Experimental |
| 5     | Wire   | string | Wire and scintillator quality (MTC10). Possible Values:  
  - L = Loose,  
  - T = Tight,  
  - X = no requirement  
  - E = Experimental. |
L1 CTT Trigger

**REPORT: Neotypes and Neoterms**

Level 1 detector: CFT/CPS, NEOTYPE/Version= **ctt/2.00**, Use_Status= **used**, Current_Status= **current**, created by toole on 09/13/2002 00:00:00

Description: CFT/CPS terms: These terms are as described in D0 Track and Preshower Trigger Level Trigger Terms and Data Transfer Protocols, v07-00.

- **pt thresholds** = 1.5, 3, 5, 10 GeV
- **n**: number of tracks
- **p**: **pt** threshold = 1.5, 3, 5, or 10 GeV.
- **q**: quadrant number = 1, 2, 3, or 4
- **occ**: Average fractional occupancy in a a CFT trigger sector.
- **nsep**: Separation in terms of CFT trigger sectors.

- **TTK**(n,p) CFT track.
- **TEL**(n,p) CFT track with preshower.
- **TPQ**(n,p,q) Low pt CFT track(s) with preshower deposition in a quadrant
- **TNQ**(n,q) Preshower cluster in a quadrant.
- **TDL**(n,p,s) Pair(s) of track/preshower with same (ss), opposite (os), or don't care (ns) charge signs.
- **TIS**(n,p) Isolated tracks.
- **TDS**(n,p,s) Two isolated CFT tracks with same (ss) or opposite(os) charge sign.
- **THT**(occ) Fraction of total CFT doublet hits.
- **TAC**(nsep) Track Accoplanarity. The number of sectors between two highest pt octants
- **TIQ**(n,p,q) Isolated tracks in a quadrant
- **TOC**(n,p) Octants with sum pt above threshold.
- **TTA1** Number of tau candidates >=1
- **TTA2** Number of tau candidates >=2
- **TIL** Isolated track(s) with low home-sector occupancy.
Audience Participation @ L1!

• Decode L1 neoterm name: CEM(1,5)
  • Starts with a “C” -- Calorimeter
  • CEM (Sum Electromagnetic Trigger Towers)
    – CEM(n,Et[,Hv])
  • N = 1 – Requires ONE EM TT with
    • Et > 5 GeV and
    • No Hv – NO Hadronic veto

• Decode L1 neoterm name: mu2pt3wtlx
  • Starts with a “m” – Muon / (maybe CTT)
    – MUO(n,Pt,eta,scint,wire,option)
  • N = 2 – DIMUON
  • Pt3 – requires pt > 3rd CTT threshold
  • Region = ‘w’ – WIDE region (CFT coverage)
  • Scint = ‘t’ – TIGHT req. on muon scintillator
  • Wire = ‘l’ – LOOSE req. on muon PDT/MDT’s
  • Option = ‘x’ – no additional options

• Decode L1 Script Name (seen in DAQmonitor)
  TTK(2,3.)TTK(1,5.)_CEM(2,3)CEM(1,6)_ncu
L1: Whaaaaaat’s that?

• ‘_ncu’ – started appearing in L1 Script names for global_CMT-11.00
  – Cal_unsuppressed / 1
    • New trigger in it’s own exposure group
    • Read out all Calorimeter cells unsuppressed
  – All other triggers were changed to veto on that L1 condition

• Other ‘short names’ used in L1 Scripts:
  – ‘_fz’ – requires Afastz
  – ‘_nfz’ – veto on Afastz
Trigger Nomenclature – L2, L3

• **OBJECT**
  – Has a distinct name
    • At Level 2: EM, JET … or at Level 3: L3TEle
  – Has a distinct set of parameter definitions
    • Name, type, default, min, max, description
  – Has a distinct type
    • TOOL or FILTER
    • Basis for all TOOL and FILTER TERMS (below)
  – Associated with one/more L2/L3 ‘releases’

• **TOOL TERM**
  – An instance of a TOOL type OBJECT giving values to each parameter
    • Aside: At L2, TOOLS depend on getting input from the L2 preprocessors in the Run
  – Can depend on other tools
    • Example: Jet finding TOOL uses clusters from a Cal Cell Clustering TOOL which uses Cell Energies unpacked by a Cal Unpacking TOOL
  – **Finds candidates** for other tools, filters

• **FILTER TERM**
  – An instance of a FILTER type OBJECT giving values to each parameter
  – Can depend on other filters
  – May find candidates for higher level filters
  – **Makes cuts on candidates**
  – For any event: result is TRUE or FALSE

• **L2,L3 Script decision**
  – **Logical AND of one/more FILTER TERMS**
A ‘Term’ is a tool or filter with a distinct set of parameter = value pairs

August 4, 2003

ElizabethGallas / TriggerListAnatomy

‘Release Version’
P15.02.00 or pseudoversion
Trigg er Database Interfaces

http://www-d0.fnal.gov/trigger_meister/trigdb/

**Trigger Database Interfaces**

- **Entry/Report Interface:**
  Uses a CORBA based Database Server to enter, modify, report and delete trigger list elements. Includes some documentation on the trigger database.

- **Reporting Interface:**
  Read only. More flexible queries to get relationship between trigger elements.

- **MISWEB Interface:**
  displays all records in particular tables. May not be useful to casual user.

Send email comments to the Trigger Meisters: Levan Babakhad ia and Elizabeth Gallas
Last modified: Sun Apr 21 14:43:46 CDT 2002
Trigger Database Entry Interface

- **Entry Interface:**
  - Used by experts to enter data.
  - Used by anyone (on DØ) to read data.
  - Currently the only interface with NEOTERM information (Level 1 And/Or Terms)
  - Help button points to existing documentation.
  - Has URL links into the Reporting Interface
## Trigger Database Report Interface

### Trigger Database Element Query

**Report Format (all options may not be available for all elements)**

Select the Status Category for your query.

<table>
<thead>
<tr>
<th>Choose TDB elements with STATUS:</th>
<th>all</th>
<th>current</th>
<th>future</th>
<th>local</th>
<th>nameold</th>
<th>obsolete</th>
<th>oldname</th>
<th>scrap</th>
</tr>
</thead>
</table>

### Trigger Lists and Trigger Names

- **Trigger List**: TRIGGER List
  - Version: 12.20
- **Trigger Name**: TRIGGER Name
  - Version:

### Level Dependent TDB Elements:

- **Choose the trigger level/type for the current entry/report**
- **SCRIPT Name**:
  - Version:
- **TERM Name**: Version:

### Level 1 Trigger Programming

- **OBJECT Name**
  - CVS Package (ignored at LI)
  - Version:

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**August 4, 2003**

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Trigger List Report

Trigger List Name input [ inname , inversion ] = [ GLOBAL_CMT , 12.20 ]
TRIGGER LIST Name/Version= global_CMT / 12.2 , Use_Status= permanent , Current_Status= current
Implementation in primary DAQ system , Configuration Type = physics , autopause= yes , combina_rectype= data , L3_type= regular , num_node= 0 ,
Trigger_count= 220 , Link to RunsDB using this TriggerList:
Created (Modified) by Stevenj on 15-Jul-2003 , 11:04 ( 16-Jul-2003_08:03 )
Description:

Global trigger list requested by the Trigger Board to place corrections in.

Changes from global_CMT-12.10:

Have separated the l1-specific bits for the following paired triggers:
MT3_L2M0_2TK3_MM and MT3_L2M0_MM3_IP
MU_JT15_L3M0 and MU_JT20_L3M0

Have adjusted the L3-IP tool to correct previous version.

Adjusted the pass fractions for the following triggers:-
JT_65TT (75 to 300)
JT_95TT (180 to 400)
JT_125TT (50 to 100)
MUW_L2M3_TRK10 (1000 to 2000)
MU_JT15_L3M0 (150 to 500)
MU_JT20_L3M0 (150 to 500)
MU_JT25_L3M0 (150 to 500)

Group 1 allocates /1 regular 0

L1 Cal Trigger Tower Programming ( L1Dialog )

<table>
<thead>
<tr>
<th>em11</th>
<th>em13</th>
<th>em6</th>
<th>em9</th>
<th>it3</th>
<th>it5</th>
<th>it7</th>
<th>null</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFD/CPS</td>
<td>Calorimeter</td>
<td>Calorimeter</td>
<td>Calorimeter</td>
<td>Muon</td>
<td>Muon</td>
<td>Muon</td>
<td>specterm/1.00</td>
</tr>
<tr>
<td>ctr2.00</td>
<td>emcount/1.00</td>
<td>emcount/1.00</td>
<td>jetcount/1.00</td>
<td>muon2.00</td>
<td>Special (Named) And/Or</td>
<td>specterm/1.00</td>
<td></td>
</tr>
</tbody>
</table>
## Report: global_CalMuon-12.20 (2)

### L1 Cal Trigger Tower Programming

```
| Filters | none | ETA | EM | ETA | EM | ETA | EM | JET | HT | JET | RANDOMPASS | JET | MJT | MUON | JET | MJT | JET | MUON | JET | PHISEP | JET | MUON |
```

### L2 tools:

```
EM(0,3.3,5.1,5.0,0.0)/1
EM(0,3.3,5.5,0.0)/1
JET(0.7)/1
JET(0.5)/1
COMMISSION/1
MJT(0.10)/1
MUON(0.0,5.0)/1
```

### L3 filters:

<table>
<thead>
<tr>
<th>PassFraction</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ele</th>
<th>Ht</th>
<th>Jet</th>
<th>Jet</th>
<th>Met</th>
<th>Jet</th>
<th>Jet</th>
<th>Met</th>
<th>mp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ele</td>
<td>Ele</td>
<td>Ele</td>
<td>Ele</td>
<td>Ele</td>
<td>Ele</td>
<td>Met</td>
<td>Track</td>
<td>Track</td>
<td>Ele</td>
<td>Ele</td>
<td>Ele</td>
<td>Ht</td>
<td>Jet</td>
<td>Jet</td>
<td>Met</td>
<td>Jet</td>
<td>Jet</td>
<td>Met</td>
<td>Jet</td>
<td>Jet</td>
</tr>
</tbody>
</table>

### L3 tools:

```
GlobalTracker/4
PrVTX3/1
PrVTX3/1
Cal CLUS4 PV3 NLC ON/1
NONE/1
ELE NLV/1
ELE NLV SH T1/1
PhTrk3/1
ELE NLV T1/1
PhTrk6/1
ELE NLV SH T5/2
Cal CLUS PV3 NLC ON/1
SC5JET9 PV3/1
CalMex3 PV3 NLC N/1
ELE Road T3/1
CAL LUS7 NLC NAD
ELE Road VL T3/1
ELE Road VL T5/1
VTXNULL/2
CAL CLUS7 NLC NAD
PrVTX Z TRK3
CAL CLUS PV1 NLC ON/1
SC5JET9 PV3/1
Prvtc1 phys/1
PhTrk10 8/1
MUO LOCAL/3
Muon2
MUO CENTRAL MATCH/1
MUON CM/1
PhTrk1/1
SC7JET8 PV3 NLC/1
TAU LOOSE TRACK/6
PrVTX0/5/1
XYVtx5 beam/1
IPTag JT10.3
```
### Trigger List Report - Netscape

<table>
<thead>
<tr>
<th>Index</th>
<th>Trigger Name</th>
<th>Level 1</th>
<th>Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>STRTOOLS ONLINE / 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1(1)</td>
<td>min bias NCU / 2</td>
<td>Require beam crossing and NS luminosity monitors above threshold in coincidences and NOT unsuppressed Calorimeter readout</td>
<td></td>
</tr>
<tr>
<td>2(2)</td>
<td>zero bias NCU / 2</td>
<td>Require beam crossing (an accelerator condition) and NOT unsuppressed Calorimeter readout</td>
<td></td>
</tr>
<tr>
<td>3(3)</td>
<td>LIMIT Download / 5</td>
<td>Not a real trigger. For downloaded purposes only.</td>
<td></td>
</tr>
<tr>
<td>4(4)</td>
<td>LIMIT Download / 6</td>
<td>Not a real trigger. For downloaded purposes only.</td>
<td></td>
</tr>
<tr>
<td>5(5)</td>
<td>E48 / E2 ELE MP / 1</td>
<td>L1: Require one calorimeter EM object with E_T&gt;3 GeV. Veto on Calorimeter unsuppressed readout condition.</td>
<td>L3: Require an electron satisfying loose requirements.</td>
</tr>
<tr>
<td>6(6)</td>
<td>E486 ELE MP / 1</td>
<td>L1: Require one calorimeter EM object with E_T&gt;6 GeV. Veto on Calorimeter unsuppressed readout condition.</td>
<td>L3: Run each L3 trigger filter. Pass one event in C300 and</td>
</tr>
<tr>
<td>7</td>
<td>E66 / 62</td>
<td>A Level 1 Calorimeter EM object with E_T&gt;6 GeV. Veto on cal_unsuppressed condition.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>E49 / 1</td>
<td>L1: Require one calorimeter EM object with E_T&gt;6 GeV. Veto on Calorimeter unsuppressed readout condition.</td>
<td>L3: Require an electron satisfying loose requirements</td>
</tr>
<tr>
<td>9(9)</td>
<td>E43 / 1</td>
<td>L1: Require one calorimeter EM object with E_T&gt;11 GeV. Veto on Calorimeter unsuppressed readout condition.</td>
<td>L3: Require an electron satisfying loose requirements</td>
</tr>
<tr>
<td>10(10)</td>
<td>E41 / 1</td>
<td>L1: Require one calorimeter EM object with E_T&gt;9 GeV. Veto on Calorimeter unsuppressed readout condition.</td>
<td>L3: Require an electron satisfying loose requirements</td>
</tr>
<tr>
<td>11(11)</td>
<td>E58 ELE MP / 1</td>
<td>L1: Two calorimeter EM trigger towers with E_T&gt;5 GeV. Also, the event must have two tracks with pt&gt;3 GeV and NOT Calorimeter unsuppressed readout.</td>
<td>L3: Run the</td>
</tr>
<tr>
<td>12</td>
<td>E63 / 2</td>
<td>L1: Two calorimeter EM trigger towers with E_T&gt;5 GeV. Also, the event must have two tracks with pt&gt;3 GeV and NOT Calorimeter unsuppressed readout.</td>
<td></td>
</tr>
</tbody>
</table>
Two Triggers in every physics Trigger List

• zero_bias
  – Level 1 only trigger
    • Requiring NEOTERM ALiveBX
    • An accelerator based trigger
      – true on each of the 36 beam crossings of a single turn of the accelerator
      – About 1.7 M times per second
    • Used to cross check the luminosity measurement and trigger system functionality
    • Really is unbiased

• min_bias (‘minimum biased’)
  – Level 1 only trigger
    • requiring NEOTERM ‘Afastz’
      – (and ALiveBX and ASkip0) – every trigger
    • Based on Luminosity monitor:
      – North, South scintillator array on beamline
    • Requires N and S pulse heights above threshold in timing coincidence
    • Gives a quick measure of the z vertex
  – Necessary to measure luminosity
  – Is undoubtedly biased physics-wise
Example:

Trigger MWTL_M3_IMM_2T / 2

Trigger Name(s) Report

Trigger Name input: [ intname , intversion ] = [ MWTL_M3_IMM_2T , 2 ]

TRIGGER Name/Version= MWTL_M3_IMM_2T / 2 . Use_Status= used , Current_Status= current , created by toole on 19-May-2003

Description: L1: NOT Cal unsuppressed readout and 'w' region (CFT) muon with tight scintillator and loose wire requirements. L2: Medium quality muon candidate with pt>3 GeV. L3: Require a track matched muon isolated from jets plus one additional track.

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>SCRIPT Name/Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mu1ptxwtlx_ncu / 1</td>
<td>A region-w (wide muon region) single muon trigger with tight scintillator and loose wire requirements and NOT Calorimeter unsuppressed readout.</td>
</tr>
<tr>
<td>2</td>
<td>MUON(0.3,2.0,0,0)MUON(0,0,0,5) / 1</td>
<td>pass events with at least one muon found with pT&gt;3 GeV meeting MEDIUM quality (~2) requirements (no region requirement).</td>
</tr>
<tr>
<td>3</td>
<td>L3FTrack(PhTrk5.2,5.1,10.0) L3FdR(MUON CM 5,SCJET 8, 7) / 1</td>
<td>Requires two tracks with pt&gt;5 GeV. Also require a central match muon isolated from jets.</td>
</tr>
</tbody>
</table>
Example:
Trigger MWTL_M3_IMM_2T / 2

Trigger Script(s) Report

Trigger Level: [ slevel ] = [ 13 ]
Script input: [ insname, insversion ] = [ L3FTRACK(PhTRK5,2,5,1,10,0)_L3FDR(MUON_CM_5,SCJET_8,7), 1 ]

SCRIPT_NAME= L3FTrack(PhTrk5,2,5,1,10,0)_L3Fdr(MUON_CM_5,SCJET_8,7)/1, Version= 1, Use_Status= used, Current_Status= current, created by tool on 19-May-2003
Description: Requires two tracks with pt>5GeV. Also require a central match muon isolated from jets.

<table>
<thead>
<tr>
<th>ORDER</th>
<th>Includes Level 3 Filter TERM(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Term Name: L3FTrack(PhTrk5,2,5,1,10,0)/1</td>
</tr>
<tr>
<td>2</td>
<td>Term Name: L3Fdr(MUON_CM_5,SCJET_8,7)/2</td>
</tr>
</tbody>
</table>

Trigger Level 3 Term Report

Term Name/Version= L3Fdr(MUON_CM_5,SCJET_8,7)/2, Use_Status= used, Current_Status= current, created by tool on 19-May-2003 10:04
Description: require a muon with a central track match to be isolated by dR>.7 from all jet candidates with Et>8 GeV.
is based on a Level 3 OBJECT name= L3Fdr, CVS_package= 13filters, Version= p15

<table>
<thead>
<tr>
<th>Order</th>
<th>Parameter</th>
<th>Type</th>
<th>Value</th>
<th>PVTVersion</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>key1</td>
<td>filter</td>
<td>L3FMuon(MUON_CM,1,0,0,2,5,0,5,LOOSE)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>key2</td>
<td>filter</td>
<td>L3FJet(SCJET8_PV3_NLC,0,8,0,3)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>DR</td>
<td>float</td>
<td>.7</td>
<td>-</td>
<td>.7</td>
</tr>
</tbody>
</table>
List Current L2 TOOLS/FILTERS

• In Entry OR Report Interface:
  – Select ‘current’ status
  – Select ‘L2 tools’ or L2 filters
  – Click on ‘OBJECT’ button
  – Get a Report of all objects with descriptions and parameters…

• L2 Tools:
  – COMMISSION, EM, JET, MET, MJT, MUON

• L2 Filters:
  – EM, ETA, ETAPHISEP, HT, JET, MJT, MUON, PHISEP, RANDOMPASS, TIMEDELAY
## Current L2 TOOLS/FILTERS from Trigger Database

### Trigger Object Report

Trigger Level input: [tlevel] = [12f] with object type FILTER.

**FILTER Object Name** = EM, **CVS_package** = l2gb1generic, **Version** = 1, **Use Status** = used, **Current Status** = current. Created by Gallas on 20-Mar-2002 18:00

**Description**: EM Cluster Filter

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MINOR_VERSION</td>
<td>int</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>EMFRAC</td>
<td>float</td>
<td>0.9</td>
<td>ElectroMagnetic F</td>
</tr>
<tr>
<td>3</td>
<td>ISOFRAC</td>
<td>float</td>
<td>1.</td>
<td>Isolation Fration</td>
</tr>
<tr>
<td>4</td>
<td>MINET</td>
<td>float</td>
<td>-</td>
<td>Minimum E_T</td>
</tr>
<tr>
<td>5</td>
<td>TOOL</td>
<td>tool</td>
<td>-</td>
<td>EM Tool TERM</td>
</tr>
</tbody>
</table>

**FILTER Object Name** = ETA, **CVS_package** = l2gb1generic, **Version** = 1, **Use Status** = used, **Current Status** = current. Created by Gallas on 20-Mar-2002 18:00

**Description**: ETA region Filter

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MINOR_VERSION</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ETAMIN</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>minimum eta value</td>
</tr>
<tr>
<td>3</td>
<td>ETAMAX</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>maximum eta value</td>
</tr>
<tr>
<td>4</td>
<td>FILTER</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**FILTER Object Name** = ITAPHISEP, **CVS_package** = l2gb1generic, **Version** = 1, **Use Status** = used, **Current Status** = current. Created by Gallas on 15-Jul-2002 18:00

**Description**: Filter requiring eta or phi separation between elements among NFILTERS sets of elements to be greater than IETAMINSEP or IPHIMINSEP.

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MINOR_VERSION</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NFILTERS</td>
<td>int</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>number of input filters</td>
</tr>
<tr>
<td>3</td>
<td>IETAMINSEP</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>minimum eta separation value</td>
</tr>
<tr>
<td>4</td>
<td>IPHIMINSEP</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>minimum phi separation value</td>
</tr>
<tr>
<td>5</td>
<td>FILTER0</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>FILTER1</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>FILTER2</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>FILTER3</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**FILTER Object Name** = HT, **CVS_package** = l2gb1generic, **Version** = 1, **Use Status** = used, **Current Status** = current. Created by Gallas on 15-Jul-2002 18:00

Document: Done (1.823 secs)
List Current L3 TOOLS/FILTERS

• In Entry OR Report Interface:
  – Select ‘current’ status
  – Select ‘L3 tools’ or L3 filters
  – Click on ‘OBJECT’ button
  – Get a Report of all objects with descriptions and parameters…

• L3 Tools:
  – L3T…BTagIP, _CFTUnpack, CFTVertex, CalCluster, CalMEt, CalUnp, Ele, GlobalTracker, Jet, MuoCentralMatch, MuoLocal, MuoUnpack, Muon, NullVertex, CFTVertex, PhysTracker, SmtUnpack, XYVertex, TauHadronic

• L3 Filters:
  – L3F…BID, CFTVertex, Ele, Ht, FIP, Jacop, Jet, Met, MHT, MarkAndPass, Muon, PassFraction, PreScale, Tau, Track, dR
# Current L3 FILTERS from Trigger Database

## FILTER: Current L3 FILTERS from Trigger Database

### Current L3 FILTERS from Trigger Database

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>filter1</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>input filter processing candidates which contribute to the event total scalar Ht</td>
</tr>
<tr>
<td>2</td>
<td>filter2</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>optional additional filter (if an additional filter is not required, set equal to filter1 and double the Ht thresholds)</td>
</tr>
<tr>
<td>3</td>
<td>MinHt</td>
<td>float</td>
<td>5</td>
<td>0</td>
<td>500</td>
<td>minimum scalar Ht satisfying this filter (double if filter1 = filter2)</td>
</tr>
<tr>
<td>4</td>
<td>MaxHt</td>
<td>float</td>
<td>500</td>
<td>10</td>
<td>2000</td>
<td>maximum scalar Ht satisfying this filter</td>
</tr>
</tbody>
</table>

### Description: Cuts on the number of tracks above a specified impact parameter significance.

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>filter1</td>
<td>tool</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>impact parameter tool</td>
</tr>
<tr>
<td>2</td>
<td>number</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>number of tracks</td>
</tr>
<tr>
<td>3</td>
<td>IP</td>
<td>float</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>impact parameter significance</td>
</tr>
<tr>
<td>4</td>
<td>MinPt</td>
<td>float</td>
<td>0.4</td>
<td>0</td>
<td>100</td>
<td>min pt of the tracks used.</td>
</tr>
<tr>
<td>5</td>
<td>MinXYHits</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>min number of xy hits per track</td>
</tr>
<tr>
<td>6</td>
<td>MinZHits</td>
<td>int</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>min number of z hits per track</td>
</tr>
</tbody>
</table>

### Description: L3FJAcop calculates and cuts on the angle between the two leading jets. The accepted events are those with MinAngle lt angle lt MaxAngle.

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>jets</td>
<td>filter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>jet list</td>
</tr>
<tr>
<td>2</td>
<td>MinAngle</td>
<td>float</td>
<td>0</td>
<td>0</td>
<td>360</td>
<td>min angle of 2 leading jets</td>
</tr>
<tr>
<td>3</td>
<td>MaxAngle</td>
<td>float</td>
<td>0</td>
<td>0</td>
<td>360</td>
<td>max angle of 2 leading jets</td>
</tr>
</tbody>
</table>

### Description: filter object for selecting one/more jets with E_T and eta criteria.

<table>
<thead>
<tr>
<th>order</th>
<th>name</th>
<th>type</th>
<th>defaultValue</th>
<th>min</th>
<th>max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
L3: Whaaaaat’s that?

• **Mark and Pass (special filter)**
  – A Level 3 Filter designed to create samples for L3 trigger analysis (not for physics analysis)
  – Has one argument: pass\_1\_of\_n
  – Action: puts 1 of every n events passing through it into the inclusive ‘monitor’ stream
  – Events written to the monitor stream are not intended for physics analysis
    • No luminosity accounting for monitor stream
    • Events recorded exclusively to the monitor stream events
      – do not get registered in the SAM event catalog
      – Cannot use ‘pick events’ utility to get them
  – Level 3 scripts using this filter have mp* in their name, where pass\_1\_of\_n = *

• **Other shortnames:**
  – ‘ps*’ -- for L3FPrescale, prescale = *
  – ‘pf*’ -- for L3FPassFraction, fraction = *
TriggerList in ‘xml’
You can generate TriggerList ‘xml’

- Get trigger list name / version
- On domino (clued0?):
  - setup d0cvs
  - cvs co trigdb_xmlclient
  - cd trigdb_xmlclient
  - gmake
  - source bin/xmlclient_setup

- Run the program with desired options
  - For help:
    - xmlgen.py (no arguments for help)
  - global_CMT-12.20 for ONLINE:
    - xmlgen.py -tlname global_CMT -tlversion 12.20 -file -OneStream all
  - global_CMT-12.20 for Simulation:
    - xmlgen.py -tlname global_CMT -tlversion 12.20 -file -Sim

- xmlgen.py in ‘development’.
  - To get latest version.
    - gmake clean
    - gmake

we hope to have a link on the web someday...
xmlgen.py -h

MANDATORY INPUT (wildcard %):
xmlgen.py --tlis-list-name listname --tlis-list-version version

OPTIONAL SETTINGS (the first 2 are most often used for online lists):

--OneStream all (to write all events to one stream like 'all')
--file (writes the xml to file named listname-version.xml)
--debug 0 (0 for debug mode (all levels), 1 for L1, 2 for L2, 3 for L3) (put this argument first if you want other input arguments reported)

--Sim

Choses set of options typical in offline simulation: including

--OneStream all
--GetCrates

--SRDirective useL1=no uses L3 tools script SRtools_sim/1 for L3 instantiation of the L3 error handling tool to write a logfile (port 0) called testfile1 with typical simulation use file and stats thresholds does not include &smt_monitoring; (inserted for all online xml)

--UniqueL1L2 (generate unique L1/L2 names for all triggers, even if they share L1/L2 conditions)
--PrescaleFile (writes a default prescale file named listname-version-default.prescales)
--realNames (SR parser cannot handle realNames so use this option for testing only)
--NumNodes (number of L3 nodes to be used, overriding value in database (usually 0))

--SRDirective useL1=yes,monitorinfo=10,sendmoninfo=yes (is the current default)(enter a comma separated list of directives needed at top of the <triglist>)

--GetCrates (will generate real cratelists rather than use allcrates_readout.xml)

--Database (default is 'd0ofprd1')

-help (the help)
xmlgen.py --tlist-name global_CalMuon
--tlist-version 5.01 --file --Sim

Use -OneStream all

Don’t start a SDAQ process for smt monitoring

Changes to ScriptRunner Directives:
• useL1=no
• do not initiate L3 monitor info

L3 ErrorHandling Tool
• make a log file called test1
• don’t send the log file to d0olc
  on port 52245

Inserts a cratelist
• GUI Crater used online to make cratelists called allcrates_readout.xml and allcrate_novbd.xml

Removes the noVBD cratelists from all exposure groups

August 4, 2003

ElizabethGallas /
TriggerListAnatomy
**Trigger List Rules ...**

Examples of rules for valid Triggers, Lists...

- all Trigger Names must
  - be unique (in that Trigger List)
  - len(TriggerName) ≤ 16 (thumbnail)
  - cannot contain special characters

- cannot use more than 4 Level1 Calorimeter EM or JET thresholds

- cannot use more than 32 L1 muon terms from the set of 256 valid terms

- cannot use more than 128 unique L1L2 bits

- L3 filters and tools mustn’t use different versions of tools of the same name

- L3 filters and tools may call other tools, but tools may not call filters (not true at L2)

- L3 tool names must conform to SR parsing rules

—...—

Many rules checked upon db entry, but the ‘xml’ generator checks many features as well ...
What is the Trigger Db NOT?

• The Trigger Database is not designed to know about:
  – Runs
  – Stores
  – Magnet settings
  – alignment
  – calibration
  – release version installed in L2 or L3
    (but may know about release compatibility)
  – time

• Why not?
  – These other aspects of a Run are recorded in other databases or using other methods
  – The trigger database is an offline database
  – including ‘real time’ information would be an expansion in scope of the project
Trigger Database - Conclusion

• My usual apologies for any features not yet implemented or ‘perfected’:
  – reminder ...this is working system but is in many ways work in progress ...
    • ‘Option not Implemented’ messages
  – Documentation is in development…

• Elements of trigger configuration programming in many Trigger Lists are available via Trigger Db web interfaces.
  – ALL Global Lists since December 2001
  – MOST Special Run physics Lists
  – An increasing number of
    • Commissioning
    • Calibration
    • …
Trigger Database - FAQs

• Why are there 3 interfaces?
  – there are different ways to access the database. Each interface has a specific function and/or takes advantage of the features available in that access mode

• Why is the TriggerDb in offline?
  – needed in offline simulator and online
  – online security/access
  – design requires one repository because of the use of name/version convention at many levels
  – limited manpower

• Can I enter my own triggerlist?
  – Not without TM help.
  – The TM are ready to help you enter lists and generate/modify ‘xml’.
Trigger FAQs

• Why <50?
  – Keep the online system stable
    • Minimize dead time reduces complexity in luminosity measurement/accounting
      – L1 FEB (front end busy)
      – L2 Busy
      – L3 Disable
    • Absence of backlog/backpressure
    • able to handle subsystem variations without crashing
  – 50 is A LOT
    • finite time to reconstruct/re-reconstruct
    • Offline ‘skim’ uses only 30% of the data – why not throw away that 70% online?
    • Trigger Board needs to be smarter