LHC Physics
GRS PY 898 B8

Lecture #5

[Tulika Bose](#)

Trigger Menus,
Detector Commissioning

Trigger Menus

Need to address the following questions:

- What to save permanently on mass storage ?
  - Which trigger streams should be created ?
  - What is the bandwidth allocated to each stream ?
  - (Usually the bandwidth depends on the status of the experiment and its physics priorities)

- What selection criteria to apply ?
  - Inclusive triggers (to cover major known or unknown physics channels)
  - Exclusive triggers (to extend the physics potential of certain analyses – say b-physics)
  - Prescaled triggers, triggers for calibration & monitoring

General rule :

Trigger tables should be flexible, extensible (to different luminosities for eg.), and allow the discovery of unexpected physics.

Performance is a key factor too…

CMS HLT "Exercise"

- Most extensive study of the High-Level Trigger algorithms, software, rates, efficiencies and technical requirements
  - All algorithms developed, tested and run within the latest software fwk
  - Detector geometry simulated reflecting the most up-to-date understanding of detector layout
  - Reconstruction code based on offline code
  - Assuming half of DAQ available, maximum L1 output: 50 kHz
  - Actual RAW data format expected from the CMS readout simulated
    - Code for data-unpacking deployed, included in all timing studies
  - Deployment of Level-1 trigger emulator
    - Realistic set of events input to HLT

@ $L=10^{32}\ cm^{-2}\ s^{-1}$

CMS HLT "Exercise"

CMS Report (LHCC): "What is the CPU performance of the HLT ?"

CERN-LHCC 2007-021

Focus:

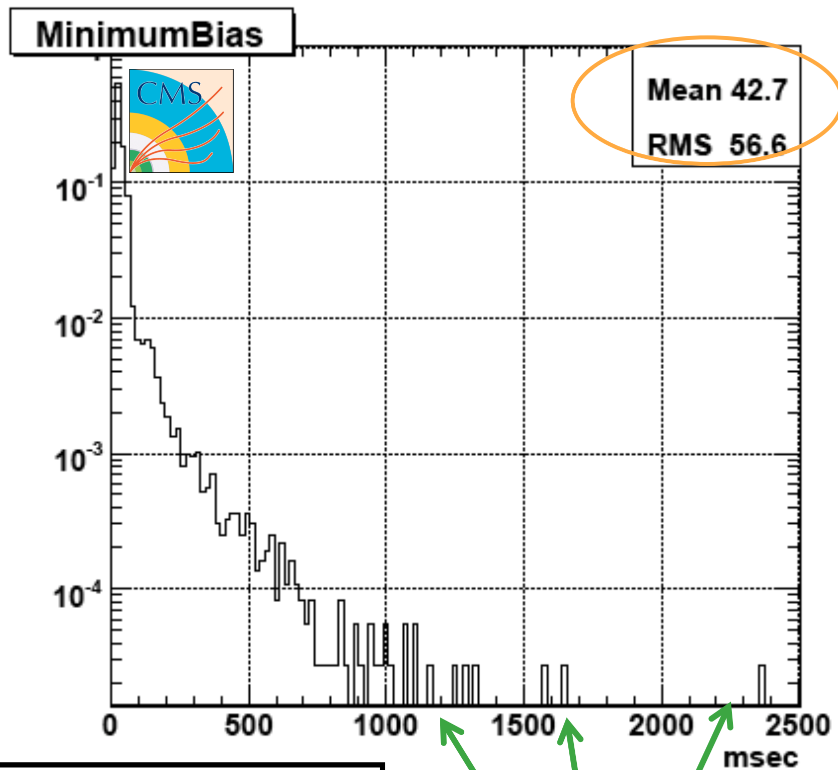
- Compile strawman Trigger Menu that covers CMS needs
- Determine CPU-performance of HLT algorithms
    - Implementation of 2008 physics-run (14 TeV) trigger menu
- (Study motivated by the need to purchase the Filter Farm by end 2007)

HLT cpu time budget ~ 40ms/event †

⇒ Select events that are "interesting enough" and bring down rate as quickly as possible

† DAQ-TDR (Dec 02):
"In 2007, for a L1 accept rate of 50 kHz & 2000 CPUs
we need an average processing time of 2000/50 kHz ~ 40 ms/evt"

CPU Performance



Average time needed to run full Trigger Menu on L1 accepted events: 43 ms/event †

† Core 2 5160 Xeon processor running at 3.0 GHz

- # of MC events used in study: ~40M
- Time to generate MC: 2-3 months
- Equivalent of real-data taking at 1E32: A few secs…

@ $L=10^{32}\ cm^{-2}\ s^{-1}$

"Tails": Will eliminate with time-out mechanism

Auto-accept event if processing time exceeds e.g. 600 ms

This saves significant time in MC (probably much more in real data)

+ will keep events of "unexpected" nature

Do we trust the MC?

We trust some aspects of it; for the rest we take a conservative approach

- Safety factor of 3 in allocation of L1 bandwidth; only 17 kHz allocated to simulated channels – to account for:
  - Uncertainty in maximum DAQ bandwidth (especially at startup)
  - Input cross sections (especially QCD; Tevatron shows factors of ~2)
  - All that we have not simulated:
    - beam conditions, noise spikes, other electronics correlations…
- Safety factor of 2 in HLT accept rate; only 150 Hz allocated to simulated channels – to account for
  - Uncertainties in cross sections (e.g. heavy-flavor cross section)
  - Uncertainties in simulation (e.g. rate for a jet faking an electron: experience from Tevatron experiments shows Monte Carlo reliable to within a factor 2)

Optimization work continues: Additional improvements have been incorporated recently

CMS L1 Trigger Rates

L1 Trigger	Threshold (GeV)	Prescale	Rate (kHz)
A_SingleMu3	3	1000	0.01 ± 0.00
A_SingleMu5	5	1000	0.00 ± 0.00
A_SingleMu7	7	1	1.11 ± 0.04
A_SingleMu10	10	1	0.47 ± 0.03
A_SingleMu14	14	1	0.18 ± 0.02
A_SingleMu20	20	1	0.09 ± 0.01
A_SingleMu25	25	1	0.06 ± 0.01
A_SingleIsoEG5	5	10000	0.00 ± 0.00
A_SingleIsoEG8	8	1000	0.01 ± 0.00
A_SingleIsoEG10	10	100	0.04 ± 0.01
A_SingleIsoEG12	12	1	2.47 ± 0.06
A_SingleIsoEG15	15	1	1.10 ± 0.04
A_SingleIsoEG20	20	1	0.32 ± 0.02
A_SingleIsoEG25	25	1	0.14 ± 0.01
A_SingleEG5	5	10000	0.00 ± 0.00
A_SingleEG8	8	1000	0.01 ± 0.00
A_SingleEG10	10	100	0.04 ± 0.01
A_SingleEG12	12	100	0.03 ± 0.01
A_SingleEG15	15	1	1.51 ± 0.05
A_SingleEG20	20	1	0.52 ± 0.03
A_SingleEG25	25	1	0.25 ± 0.02
A_SingleJet70	70	100	0.02 ± 0.01
A_SingleJet100	100	1	0.43 ± 0.02
A_SingleJet150	150	1	0.07 ± 0.01
A_SingleJet200	200	1	0.02 ± 0.01
A_SingleTauJet40	40	1000	0.02 ± 0.01
A_SingleTauJet80	80	1	0.68 ± 0.03
A_SingleTauJet100	100	1	0.20 ± 0.02
A_HTT250	250	1	2.56 ± 0.06
A_HTT300	300	1	0.65 ± 0.03
A_HTT400	400	1	0.08 ± 0.01

L1 Trigger	Threshold (GeV)	Prescale	Rate (kHz)
A_HTT500	500	1	0.02 ± 0.00
A_ETM20	20	10000	0.00 ± 0.00
A_ETM30	30	1	5.69 ± 0.09
A_ETM40	40	1	0.40 ± 0.02
A_ETM50	50	1	0.05 ± 0.01
A_ETM60	60	1	0.01 ± 0.00
A_DoubleMu3	3	1	0.28 ± 0.02
A_DoubleIsoEG8	8	1	0.28 ± 0.02
A_DoubleIsoEG10	10	1	0.08 ± 0.01
A_DoubleEG5	5	10000	0.00 ± 0.00
A_DoubleEG10	10	1	0.19 ± 0.02
A_DoubleEG15	15	1	0.05 ± 0.01
A_DoubleJet70	70	1	0.58 ± 0.03
A_DoubleJet100	100	1	0.11 ± 0.01
A_DoubleTauJet20	20	1000	0.02 ± 0.01
A_DoubleTauJet30	30	100	0.08 ± 0.01
A_DoubleTauJet40	40	1	2.36 ± 0.06
A_Mu3_IsoEG5	3,5	1	0.95 ± 0.04
A_Mu5_IsoEG10	5,10	1	0.04 ± 0.01
A_Mu3_EG12	3,12	1	0.09 ± 0.01
A_Mu3_Jet15	3,15	20	0.30 ± 0.02
A_IsoEG10_Jet30	10,30	1	1.95 ± 0.05
A_IsoEG10_Jet20	10,20	1	3.04 ± 0.06
A_IsoEG10_Jet70	10,70	1	0.26 ± 0.02
A_IsoEG10_TauJet20	10,20	1	1.95 ± 0.05
A_IsoEG10_TauJet30	10,30	1	1.33 ± 0.04
A_TauJet30_ETM30	30,30	1	1.96 ± 0.05
A_TauJet30_ETM40	30,40	1	0.26 ± 0.02
A_TripleMu3	3	1	0.01 ± 0.00
A_QuadJet30	30	1	0.58 ± 0.03
A_MinBias_HTT10	10	large	0.40
A_ZeroBias	0	large	0.40
Total L1 Trigger Rate (kHz)			16.67 ± 0.15

High Level Trigger Menu

HLT path	L1 condition	Thresholds (GeV)	HLT Rate (Hz)	Total Rate (Hz)
VBF Double-Jet + $\not\!\!E_T$	A_ETM30	(40, 60)	0.2 ± 0.0	89.0
SUSY 2-jet+$\not\!\!E_T$	A_ETM30	(80,20,60)	2.0 ± 0.1	90.4
Acopl. Double-Jet + $\not\!\!E_T$	A_ETM30	(60, 60)	1.0 ± 0.0	90.4
Single Isolated e	A_SingleIsoEG12	15	17.1 ± 2.3	107.5
Single Relaxed e	A_SingleEG15	17	9.6 ± 1.3	109.3
Double Isolated e	A_DoubleIsoEG8	10	0.2 ± 0.1	109.4
Double Relaxed e	A_DoubleEG10	12	0.8 ± 0.1	109.9
Single Isolated γ	A_SingleIsoEG12	30	8.4 ± 0.7	118.1
Single Relaxed γ	A_SingleEG15	40	2.8 ± 0.2	118.5
Double Isolated γ	A_DoubleIsoEG8	(20,20)	0.6 ± 0.4	119.0
Double Relaxed γ	A_DoubleEG10	(20,20)	1.8 ± 0.5	120.1
High E_T e	A_SingleEG15	80	0.5 ± 0.0	120.4
High E_T e	A_SingleEG15	200	0.1 ± 0.0	120.4
Lifetime b-tag 1-jet	$\diamond$	180	1.3 ± 0.0	120.5
Lifetime b-tag 2-jets	$\diamond$	120	2.1 ± 0.0	121.2
Lifetime b-tag 3-jets	$\diamond$	70	1.7 ± 0.0	121.8
Lifetime b-tag 4-jets	$\diamond$	40	1.8 ± 0.0	122.6
Lifetime b-tag H_T	$\diamond$	470	2.5 ± 0.1	123.1
Single τ	A_SingleTauJet80	15	0.2 ± 0.0	123.2
$\tau + \not\!\!E_T$	A_TauJet30_ETIM30	15	1.8 ± 0.2	124.7
Double τ (Calo+Pixel)	A_DoubleTauJet40	15	4.9 ± 0.6	129.4
$e + b$-jet	A_IsoEG10_Jet20	(10, 35)	0.1 ± 0.0	129.4
e + jet	A_IsoEG10_Jet30	(12, 40)	11.6 ± 1.2	135.8
$e + \tau$	A_IsoEG10_TauJet20	(12, 20)	0.2 ± 0.0	135.8
Prescaled e/γ	See Table 3.9		5.0 ± 0.0	140.8
Prescaled μ	See Table 2.4		3.0 ± 0.0	143.8
Min.Bias	A_MinBias_HTT10	—	1.5 ± 0.0	145.3
Pixel Min.Bias	A_ZeroBias	—	1.5 ± 0.0	146.8
Zero Bias	A_ZeroBias	—	1.0 ± 0.0	147.8
Total HLT rate (Hz)				148 ± 4.9

HLT path	L1 condition	Thresholds (GeV)	HLT Rate (Hz)	Total Rate (Hz)
A [illegible]	A_DoubleJet70	[illegible]	[illegible]	[illegible]
Acopl. Single-Jet + $\not\!\!E_T$	A_ETM30	(100, 60)	1.6 ± 0.0	84.2
Single-Jet + $\not\!\!E_T$	A_ETM30	(180, 60)	2.2 ± 0.1	84.4
Double-Jet + $\not\!\!E_T$	A_ETM30	(125, 60)	1.0 ± 0.0	84.4
Triple-Jet + $\not\!\!E_T$	A_ETM30	(60, 60)	0.6 ± 0.0	84.4
Quad-Jet + $\not\!\!E_T$	A_ETM30	(35, 60)	1.2 ± 0.1	84.6
$H_T + \not\!\!E_T$	A_HTT300	(350, 65)	4.4 ± 0.1	86.2
Single Jet Prescale 10	A_SingleJet100	150	3.5 ± 0.0	87.9
Single Jet Prescale 100	A_SingleJet70	110	1.5 ± 0.0	89.1
Single Jet Prescale 1000	A_SingleJet30	60	0.8 ± 0.4	89.9

Continued on next page …

- μ: 50 Hz
- eγ: 30 Hz
- jets/MET/Ht: 30 Hz
- τ: 7 Hz
- b-jets: 10 Hz
- x-channels: 20 Hz
- prescaled: 15 Hz
- Total: 150 Hz

- Leptons: "bread & butter" triggers for many physics analyses
- Prescaled triggers should accompany every physics trigger

@ $L=10^{32}$ cm^{-2} s^{-1}

CMS Trigger Efficiencies

Signal	HLT Single Relaxed muon eff.(%)	HLT Double muon eff.(%)	HLT Single Isolated muon eff.(%)	(Level-1)*HLT acceptance (%)
$Z \to \mu\mu$	98.6	91.2	95.8	98.1
$W \to \mu\nu$	86.9	-	81.4	76.7

Muons

HLT efficiency for benchmark channels

Signal process	Isolated single electron	Relaxed single electron	Isolated double electron	Relaxed double electron
HLT: $Z \to ee$	83.3	85.2	63.8	64.4
HLT: $W \to e\nu$	62.5	61.2	-	-
L1*HLT: $Z \to ee$	80.0	82.6	62.6	63.2
L1*HLT: $W \to e\nu$	52.1	52.4	-	-

Electrons

Signal process	Isolated single photon	Relaxed single photon	Isolated double photon	Relaxed double photon
HLT: $H \to \gamma\gamma (m_H$=120 GeV)	80.5	76.8	75.8	75.7
L1*HLT: $H \to \gamma\gamma (m_H$=120 GeV)	78.8	76.8	75.8	75.7

Photons

Signal process	single high energy EM	Single very high energy EM	Total
$Z' \to ee$ ($M \geq 200$ GeV)	67	7.0	67
$Z' \to ee$ ($M \geq 500$ GeV)	91	69	93
$Z' \to ee$ ($M \geq 1000$ GeV)	94	92	98
$Z' \to ee$ ($M \geq 2000$ GeV)	90	97	98
$G \to \gamma\gamma$ ($M \geq 2000$ GeV)	91	97	98

High-E_T EM candidates
(apply high E_T cuts, loosen-up isolation)

Good *W/Z* efficiencies for muon, egamma HLT

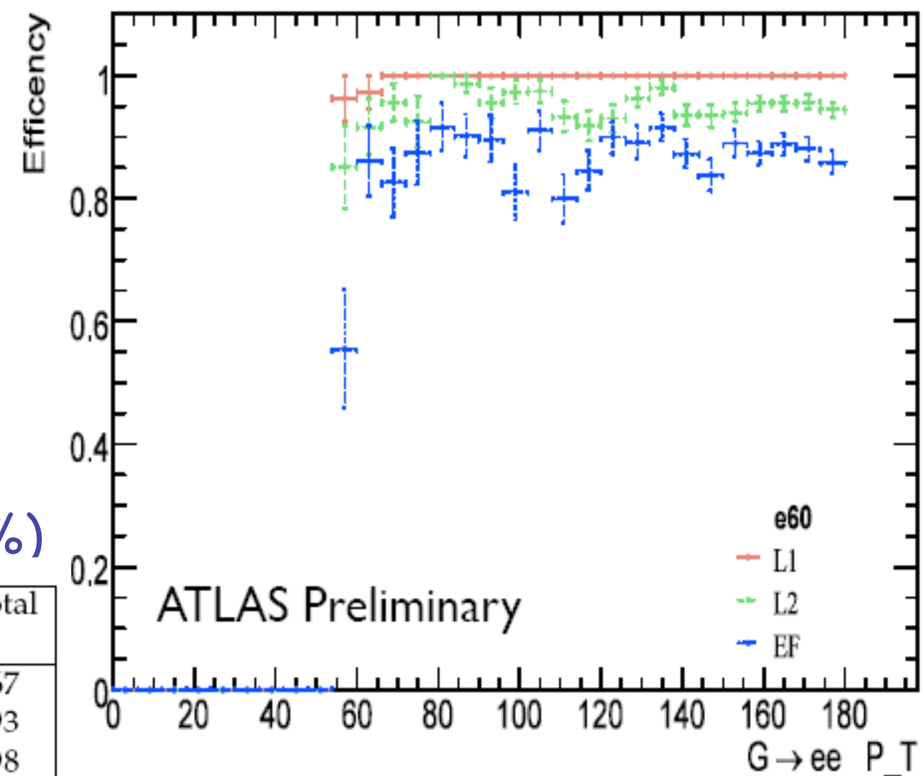
Lepton thresholds/efficiencies

HLT trigger path	E_T threshold (GeV)
Single isolated electron	15
Single relaxed electron	17
Double isolated electron	10
Double relaxed electron	12
Single isolated photon	30
Single relaxed photon	40
Double isolated photon	20
Double relaxed photon	20
Single high energy EM	80
Single very high energy EM	200

Signal Efficiencies : (L1 eff=100%)

Signal process	single high energy EM	Single very high energy EM	Total
$Z' \to ee\ (M \geq 200\ \text{GeV})$	67	7.0	67
$Z' \to ee\ (M \geq 500\ \text{GeV})$	91	69	93
$Z' \to ee\ (M \geq 1000\ \text{GeV})$	94	92	98
$Z' \to ee\ (M \geq 2000\ \text{GeV})$	90	97	98
$G \to \gamma\gamma\ (M \geq 2000\ \text{GeV})$	91	97	98

Efficiency of "e60" trigger Vs electron p_T based on a sample of 500 GeV RS $G \to ee$



@ $L=10^{31}\ cm^{-2}\ s^{-1}$

Trigger Links

- ATLAS Trigger Menu Page: https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerPhysicsMenu
- ATLAS Trigger Naming Scheme: https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerMenuConvention
- CMS Trigger Studies Page: https://twiki.cern.ch/twiki/bin/view/CMS/TriggerStudies
- CMS Scheme: https://twiki.cern.ch/twiki/bin/view/CMS/TriggerNames

ATLAS Trigger Menus

https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerPhysicsMenu

Criteria for startup menus

- Find simplest menus to fill reasonable bandwidth
- Use low pT thresholds + prescaled triggers + prescale for monitoring
- Use high pT thresholds + HLT pass-through (where possible)
- Don't rely on tight shape or isolation criteria

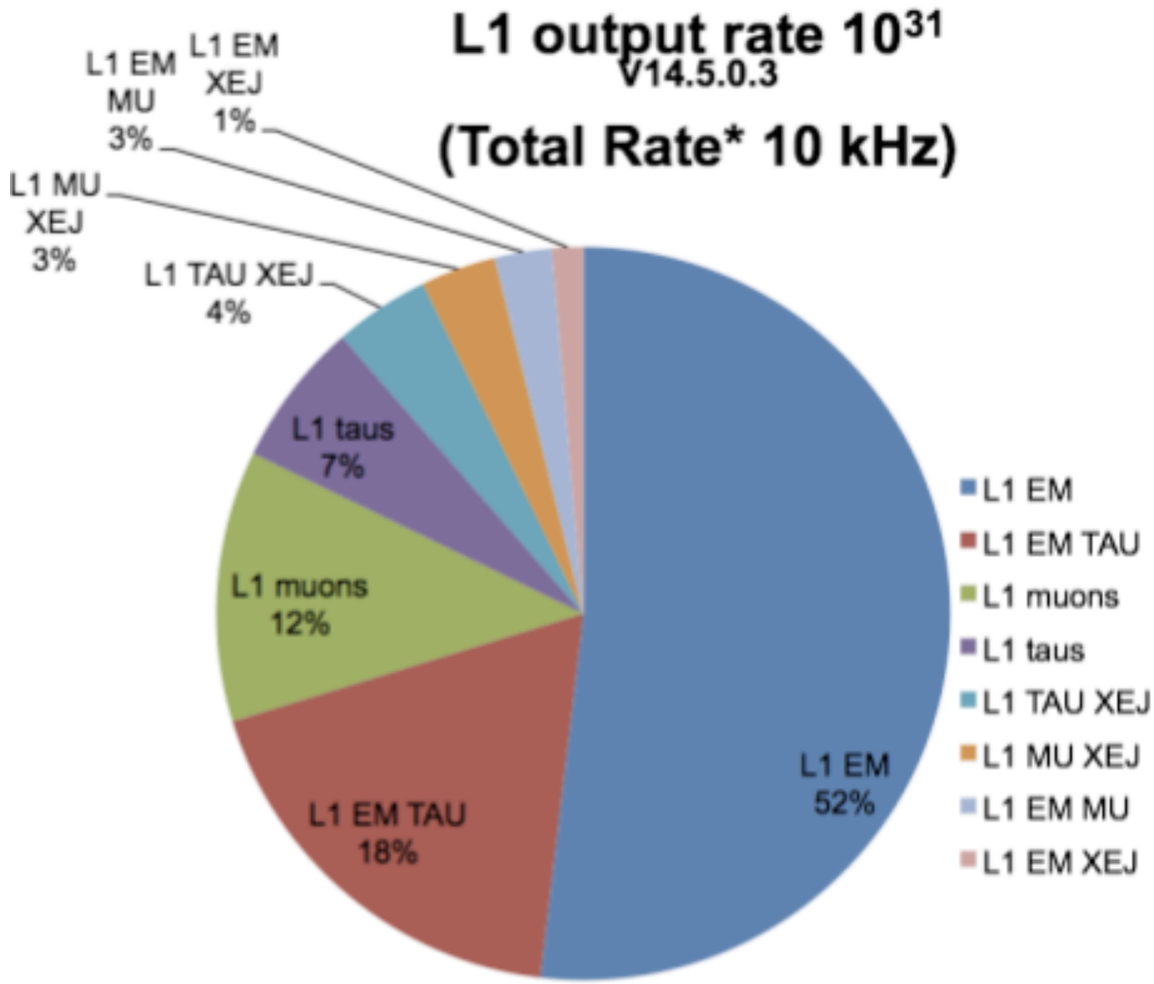
@ $L=10^{31}$ cm^{-2} s^{-1}

http://www-hep.uta.edu/~brandta/ATLAS/Rates/cumul-10TeV-1031-14503.pdf

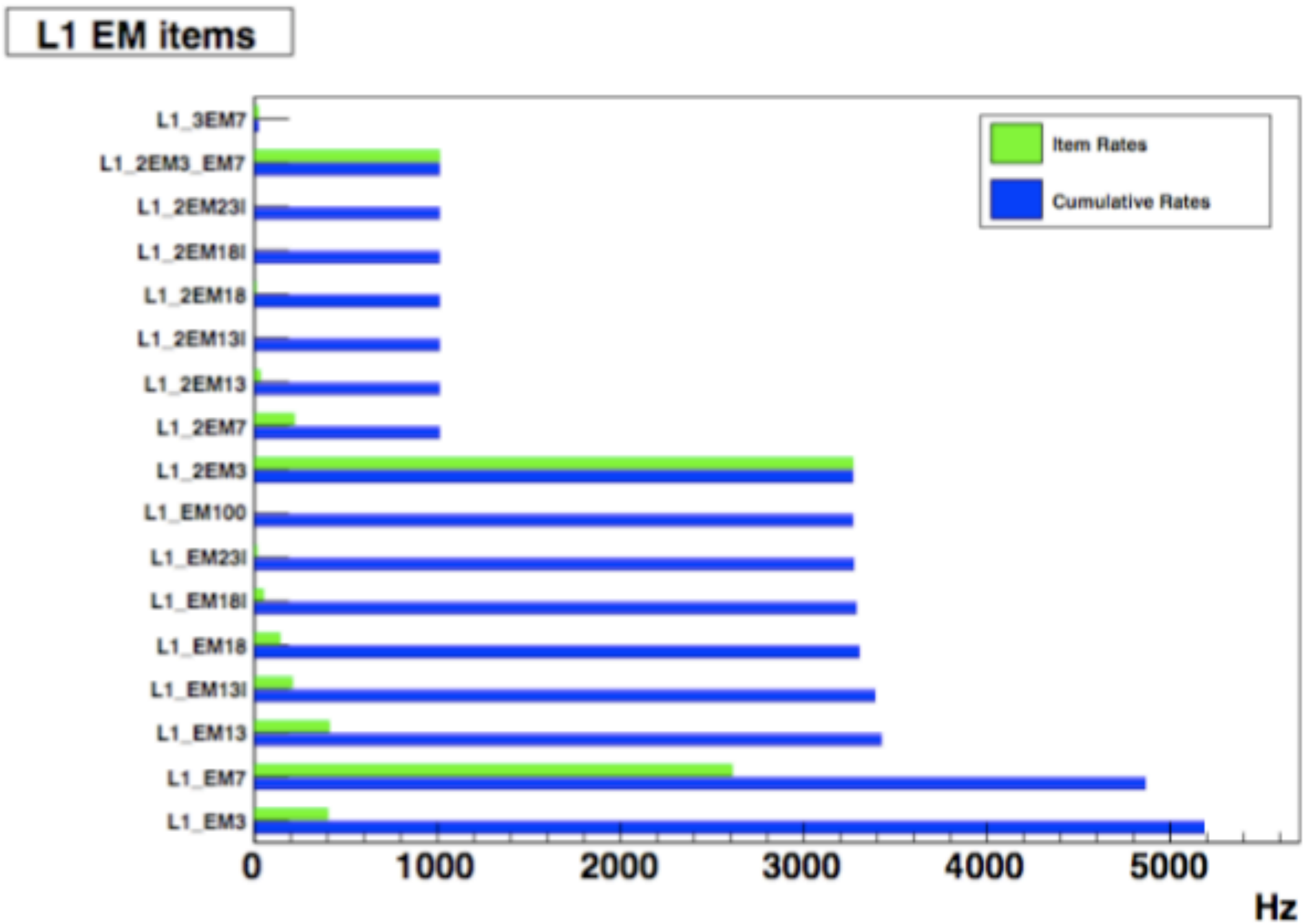
L1 Naming Convention:

- EM : electromagnetic object (electron or photon)
- TAU : tau objects
- XE : missing ET
- MU : muon
- J : jet
- FJ : forward jet (jet in FCAL calorimeter)
- BJT15 : jets to be used by B-physics triggers
- SM : sum Jet trigger
- ET : Et sum trigger

L1 Overview

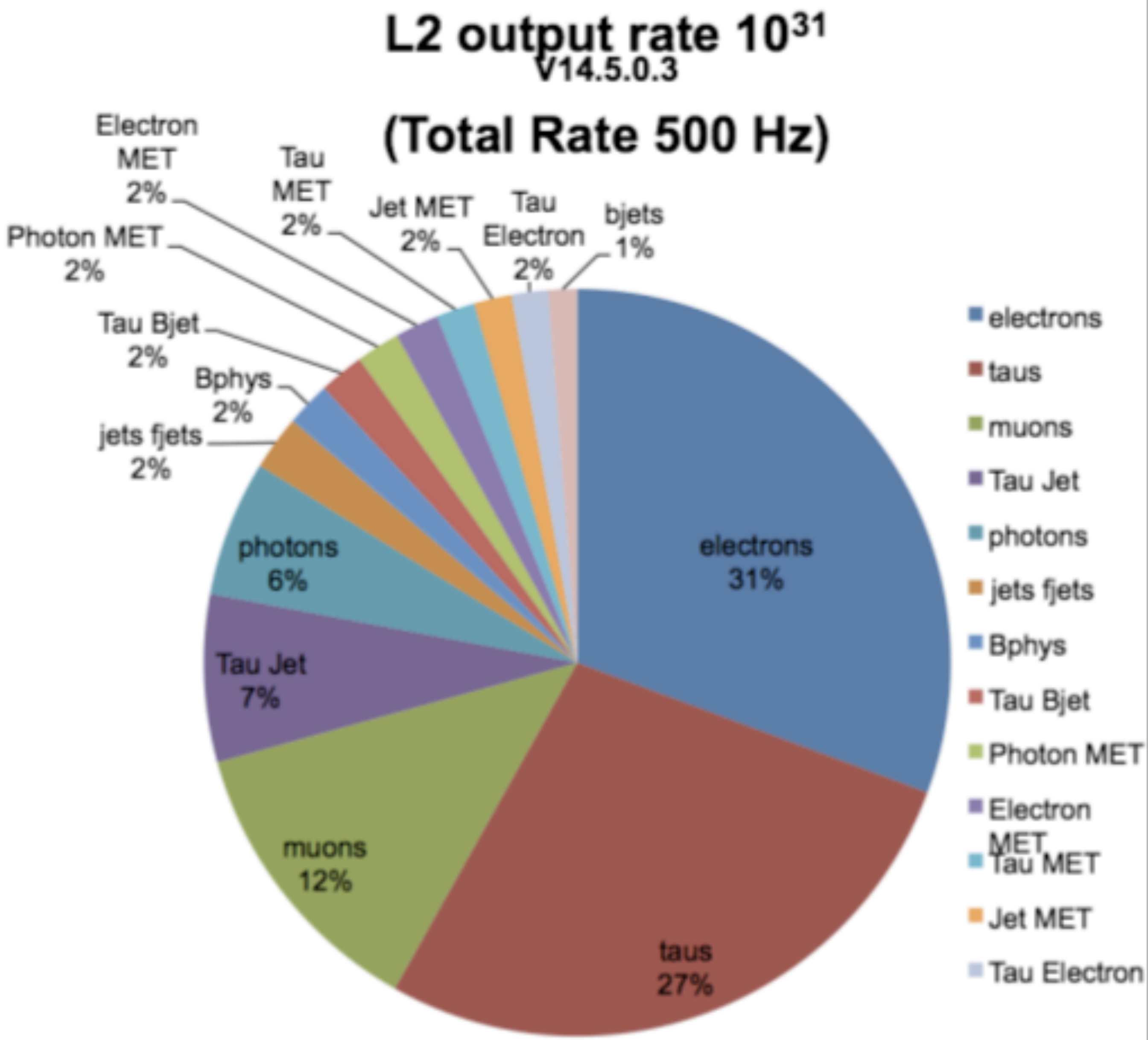


*Sum of each group's rate, including overlaps



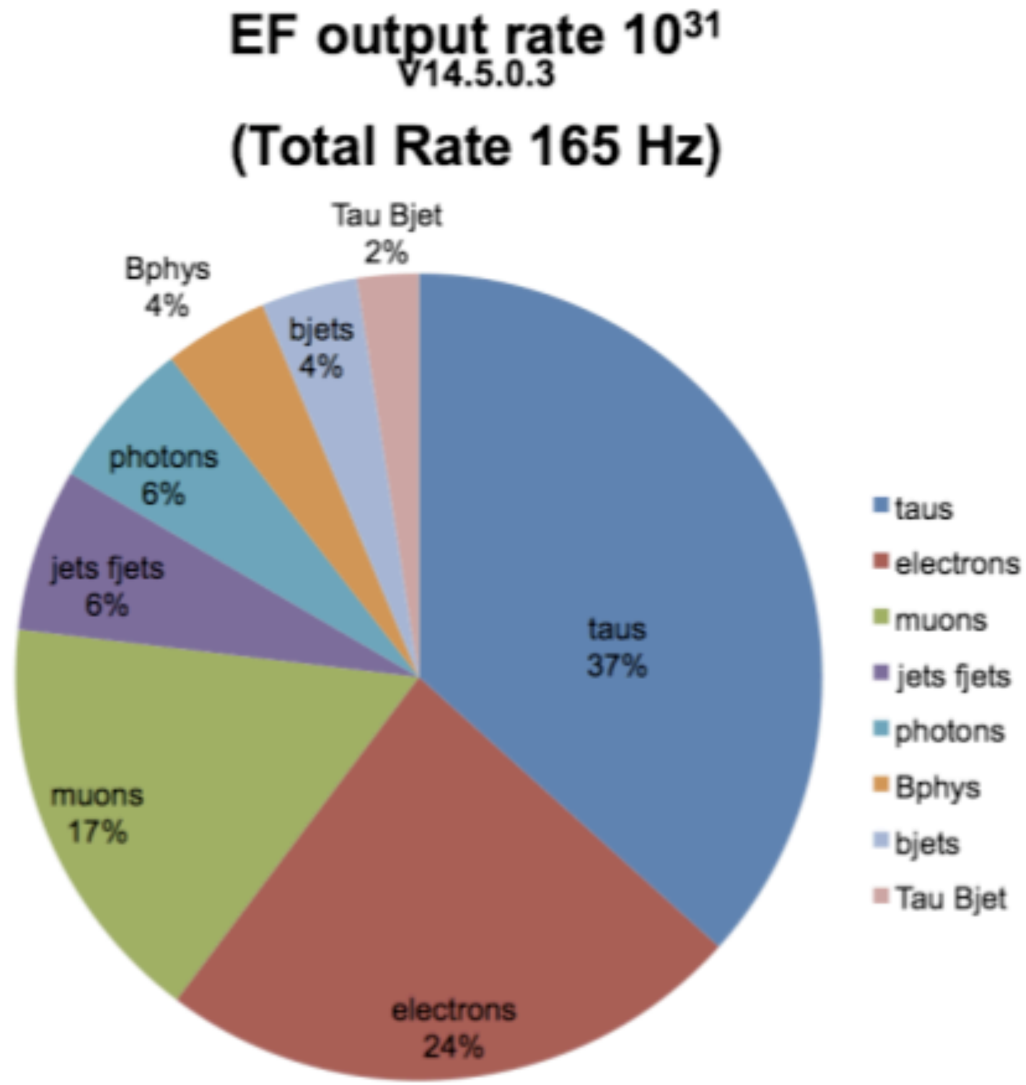
Major users are 2EM3, EM7, 2EM3_EM7

L2 Overview

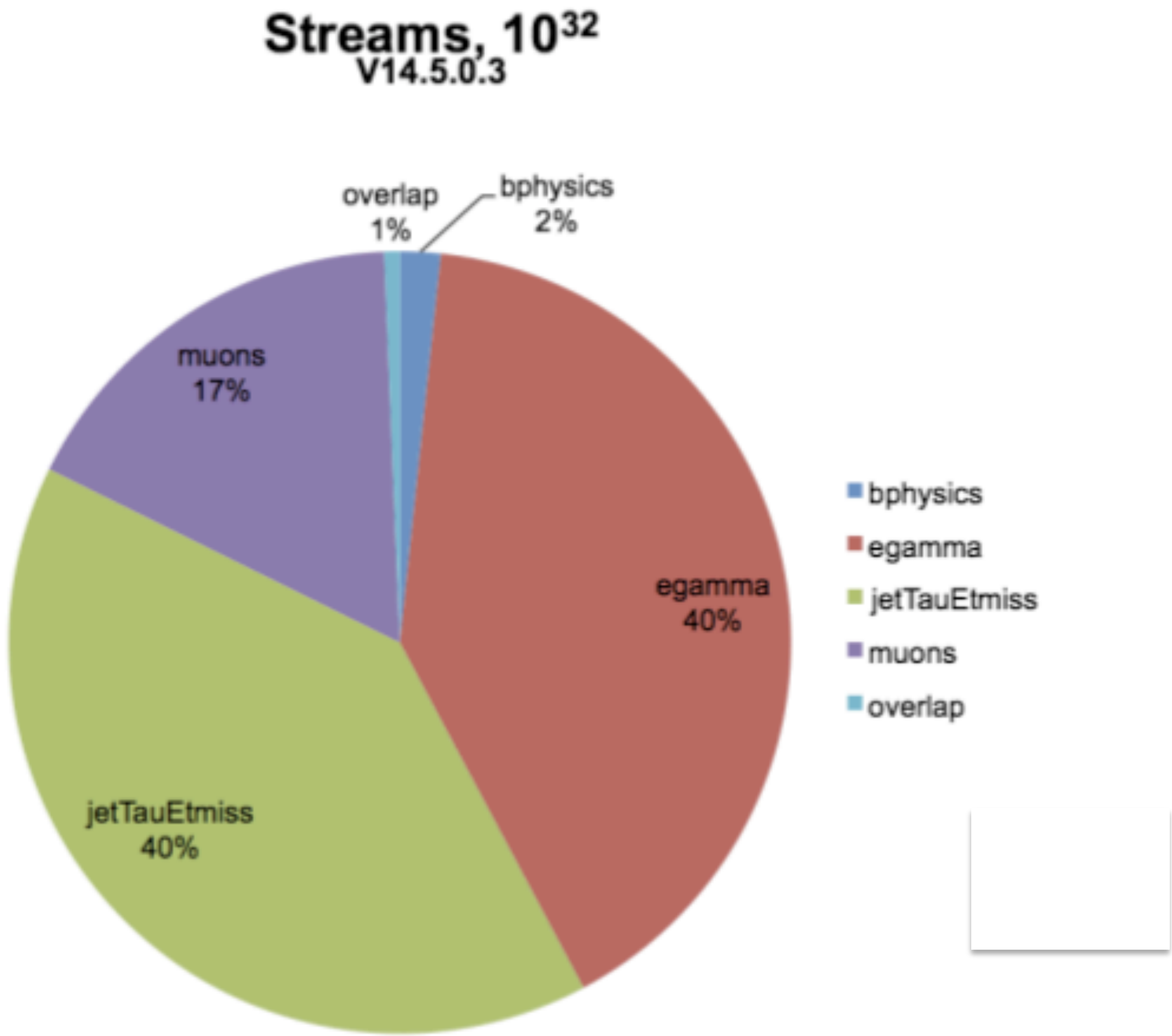


L2 output rate 10^{31}
V14.5.0.3
(Total Rate 500 Hz)
Electron MET 2%
Tau MET 2%
Jet MET 2%
Tau Electron 2%
bjets 1%
Photon MET 2%
Tau Bjet 2%
Bphys 2%
jets fjets 2%
photons 6%
Tau Jet 7%
muons 12%
taus 27%
electrons 31%
electrons
taus
muons
Tau Jet
photons
jets fjets
Bphys
Tau Bjet
Photon MET
Electron MET
Tau MET
Jet MET
Tau Electron

EF Overview


EF output rate 10^{31}
V14.5.0.3
(Total Rate 165 Hz)
Tau Bjet
2%
Bphys
4%
bjets
4%
photons
6%
jets fjets
6%
muons
17%
electrons
24%
taus
37%
taus
electrons
muons
jets fjets
photons
Bphys
bjets
Tau Bjet

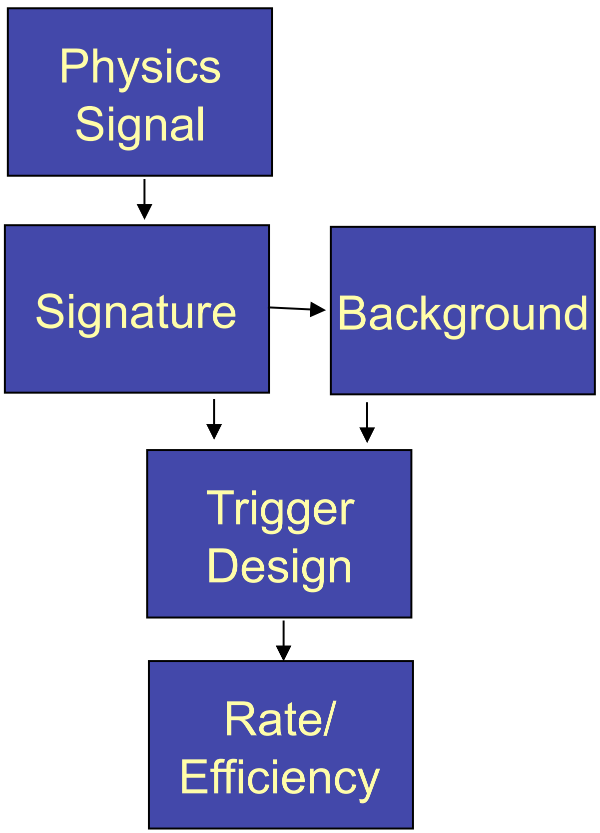
Stream Rates



Triggering on the unexpected

How does one trigger on the unknown ?

General Strategy



Start by looking at various physics signals/signatures…

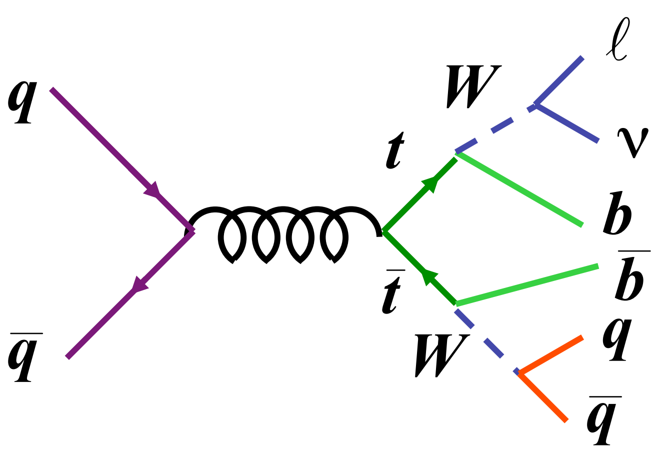
What are the main backgrounds ?

Design a trigger using the above info

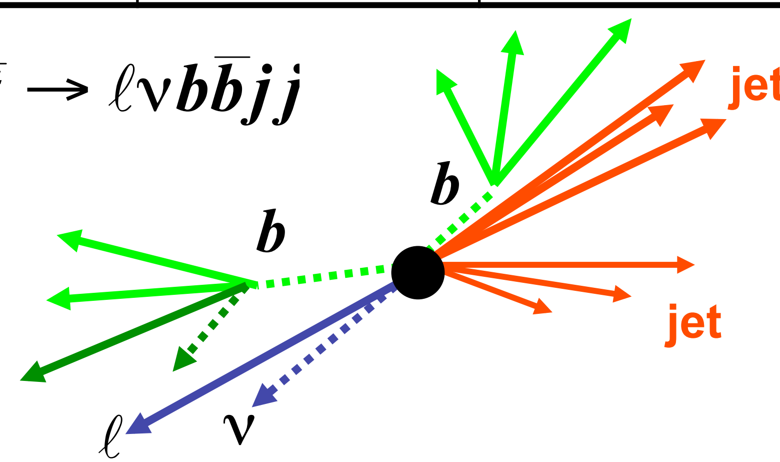
Estimate rates and efficiencies

Recognizing physics

Object	High E_T Leptons	High E_T Jets	Missing E_T	Displ. Vertices
Bgrd QCD	rare	low E	all visible	rare
W/Z	✓	✓	W	—
$p\bar{p} \to b\bar{b}$	low E	—	—	✓
$b \to J/\psi K_s$	$J/\psi \to l^+l^-$	—	—	✓
Top $t \to bW$	✓	✓	✓	✓
Higgs $pp \to hW/Z$ $h \to bb$	✓	✓	✓	✓
W'	✓	✓	✓	✓

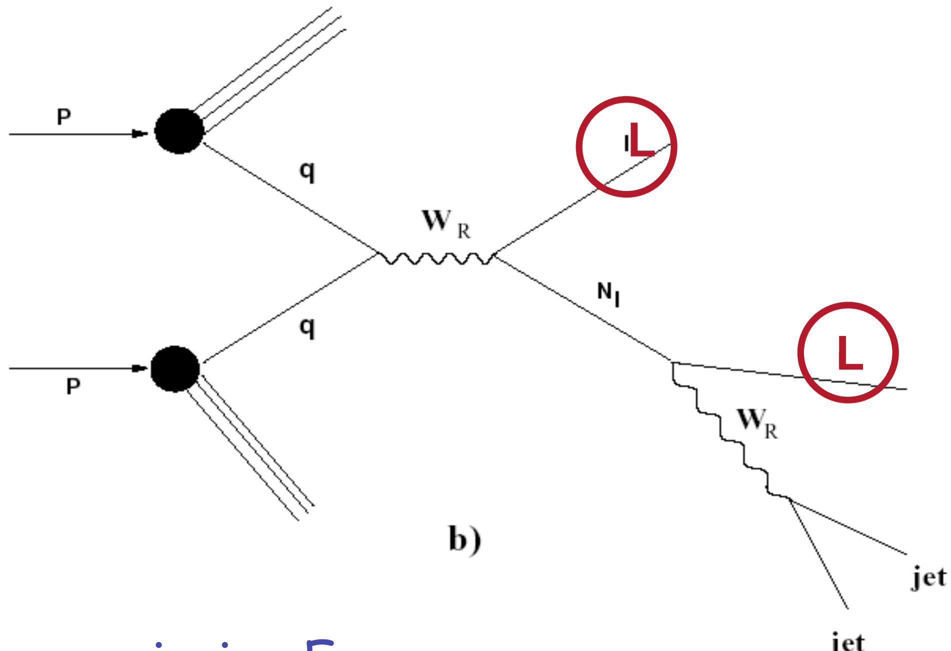


$$p\bar{p} \to t\bar{t} \to \ell \nu b \bar{b} j j$$



"Alternatives" signatures

1) Di-lepton, di-jet, di-photon resonances
   - Z' (leptons, jets),
   - RS Extra dimensions (leptons, photons, jets)
   - Z_{KK} in TeV^{-1}
   - heavy neutrino from right-handed W (di-lepton + di-jets)



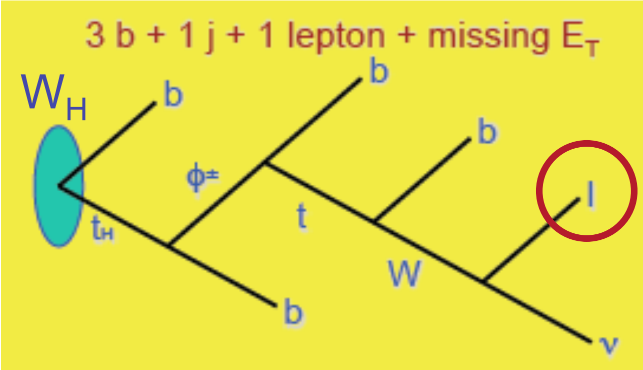
3) Single photon + missing E_T
   - ADD direct graviton emission

"Alternatives" signatures

3) Single lepton + jets/missing ET

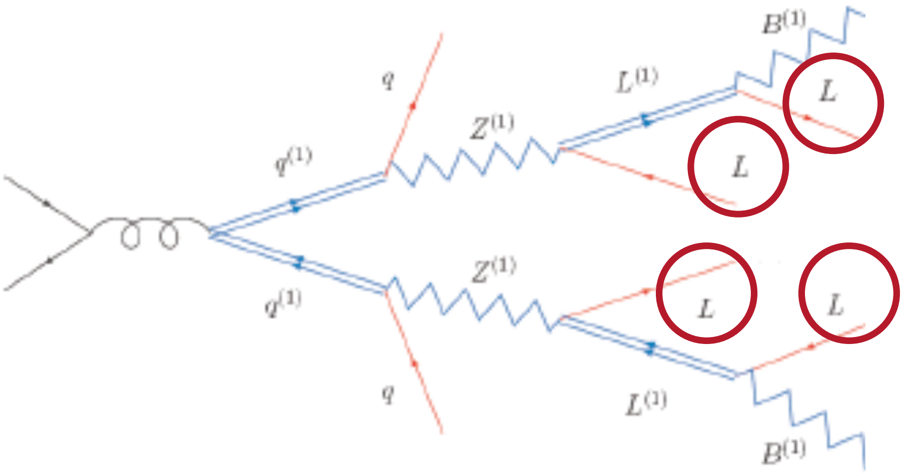
- W' (lepton+ missing ET)
- Twin Higgs (lepton + jets + missing ET)

$W_H \rightarrow t_H\ b$



5) (a) Multi-lepton + multi-jet

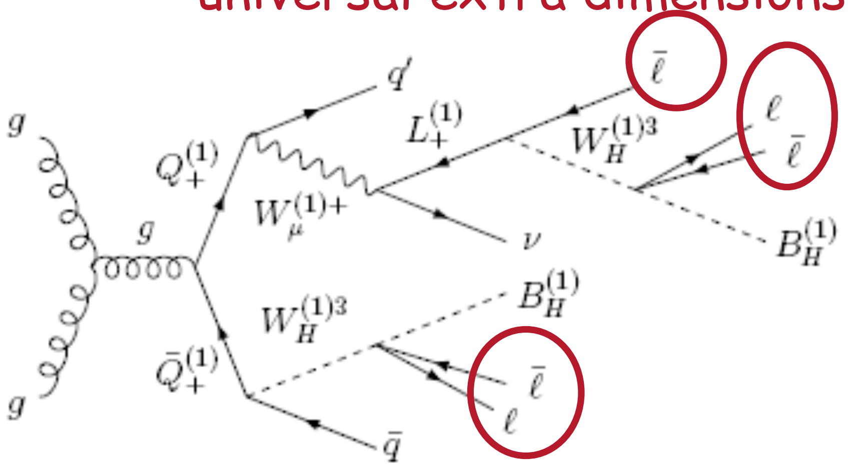
- Technicolor, littlest Higgs, universal extra dimensions

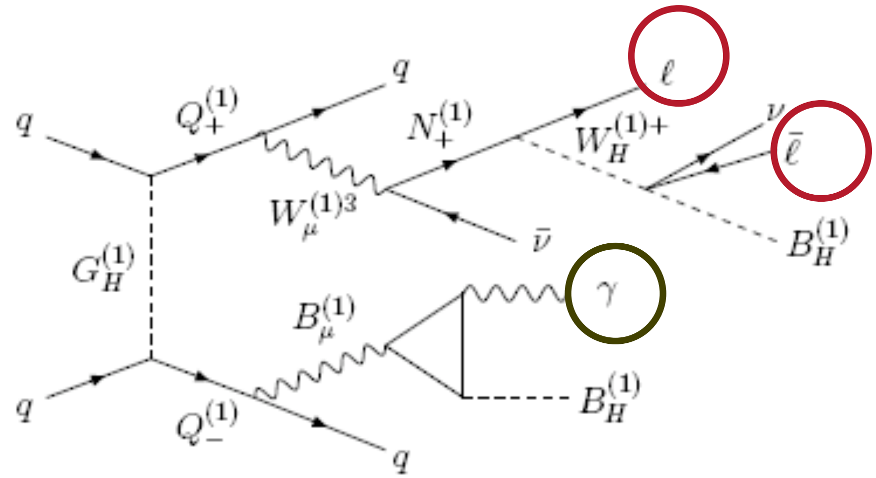


"Alternatives" signatures

4) (b) Multi-leptons + photons

- universal extra dimensions



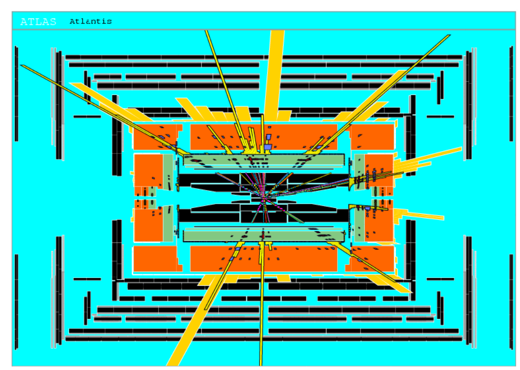


5) Same sign di-leptons

- same-sign top

8) Black Holes

- High multiplicity events, jets/lepton ratio of 5:1

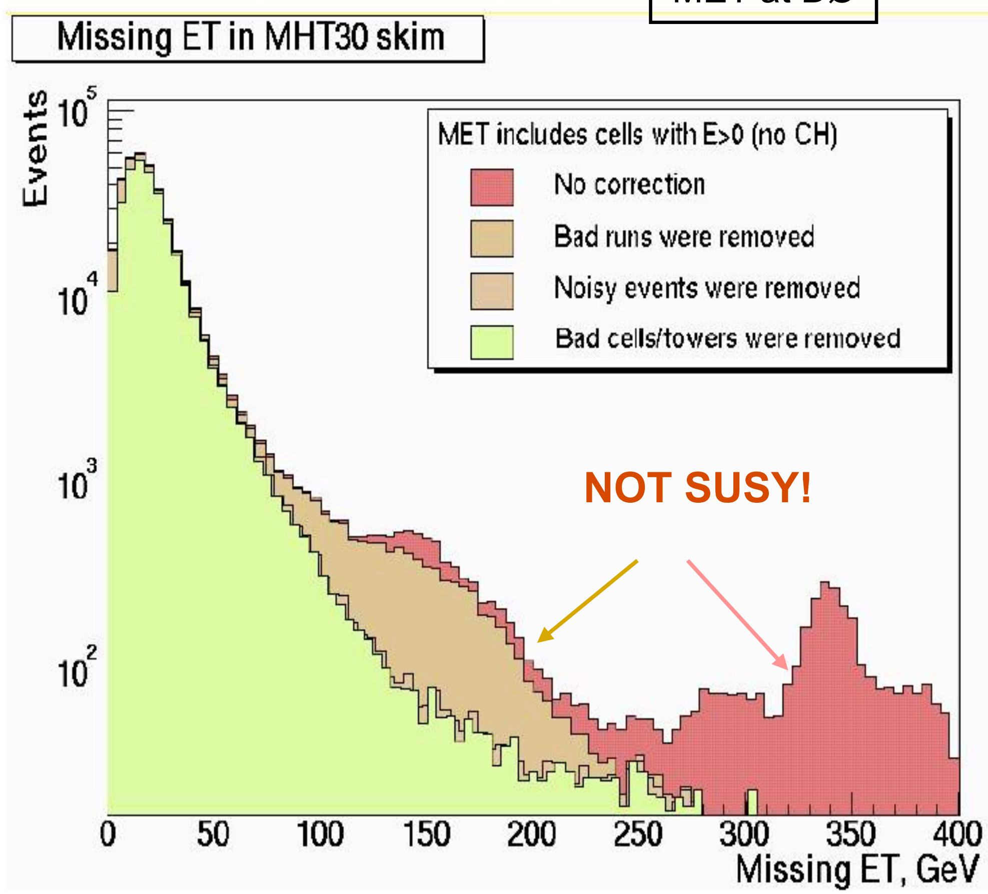


Having robust lepton and jets triggers will be crucial !

(Cross-channel triggers like leptons + jets v. important too.)

(NOTE:
Many BSM signatures involve 3^{rd} generation particles: b's and τ and also MET
Though challenging, triggers for these need to be commissioned at the same time)

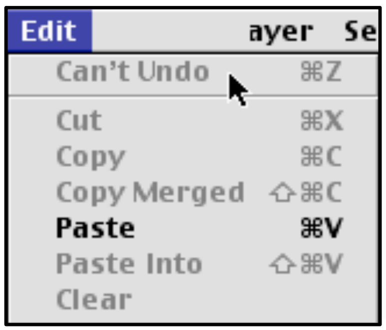
MET at DØ

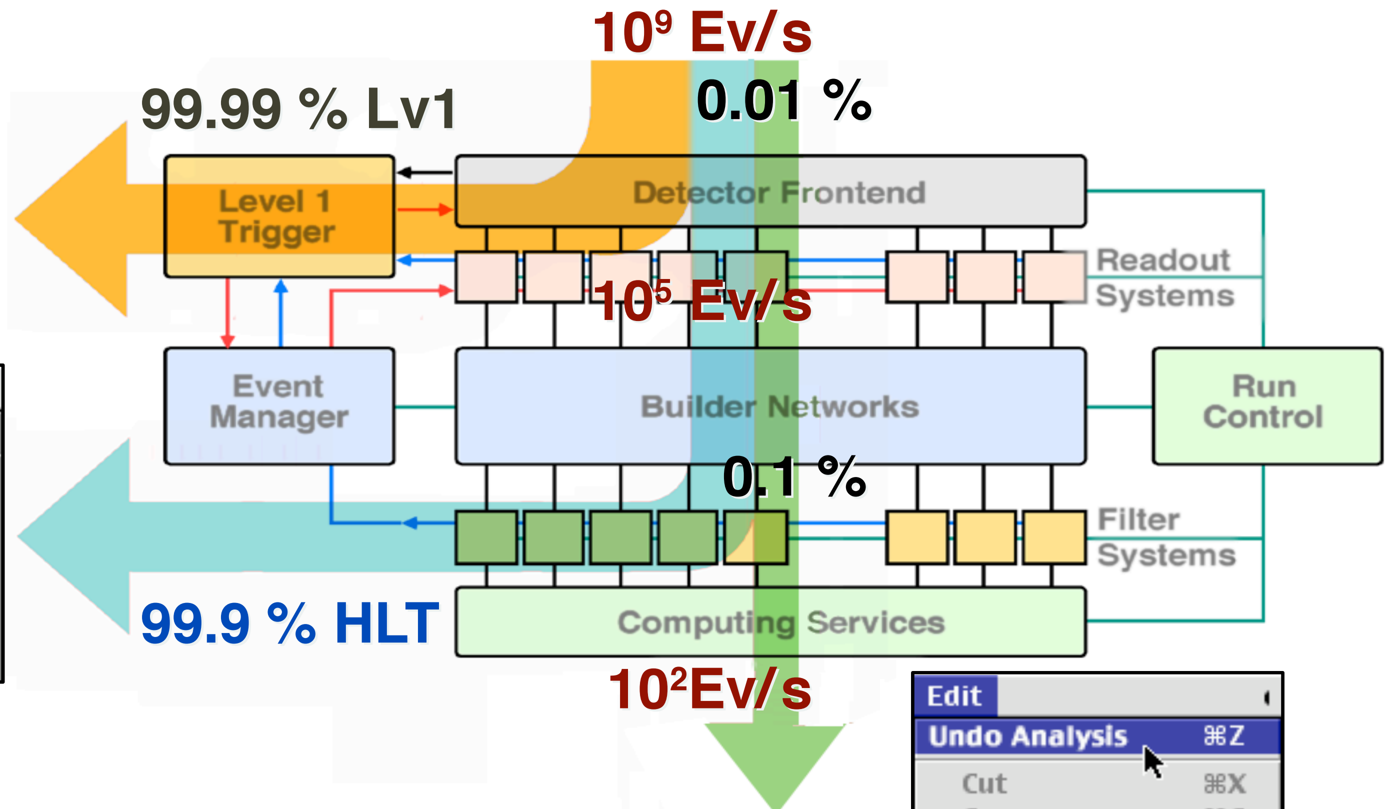


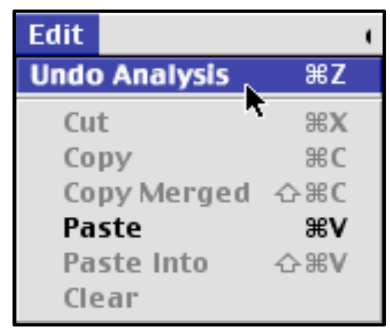
Trigger Summary

- Triggering at the LHC is a real challenge
- Sophisticated multi-tiered trigger systems have been designed by ATLAS and CMS
- Trigger menus for early physics runs are being laid out
  - Tools are in place and strategies are being optimized
- These strategies cover final states predicted by most BSM models
- Perhaps the most important strategy? KEEP AN OPEN MIND!

Trigger: A tricky business







Will your favorite new physics signal be included in the small fraction of selected events?

Last Resort Trigger

- General trigger strategies work, but what if an object fails "standard quality" cuts ?
  - More likely to happen at the HLT, as L1 quality requirements are, in general, fairly loose
- Examples:
  - Electron/photons with large impact parameter resulting in a "funny" cluster profile
  - Events with abnormally high multiplicity of relatively soft objects
  - b-tagged jets with extremely large impact parameter
  - Funny tracking patterns in roads defined by L1 candidates
  - Abnormally large fraction of L1 triggers fired with no HLT triggers to pass
  - Abnormal density of tracks within HLT roads
  - …

Last Resort Trigger

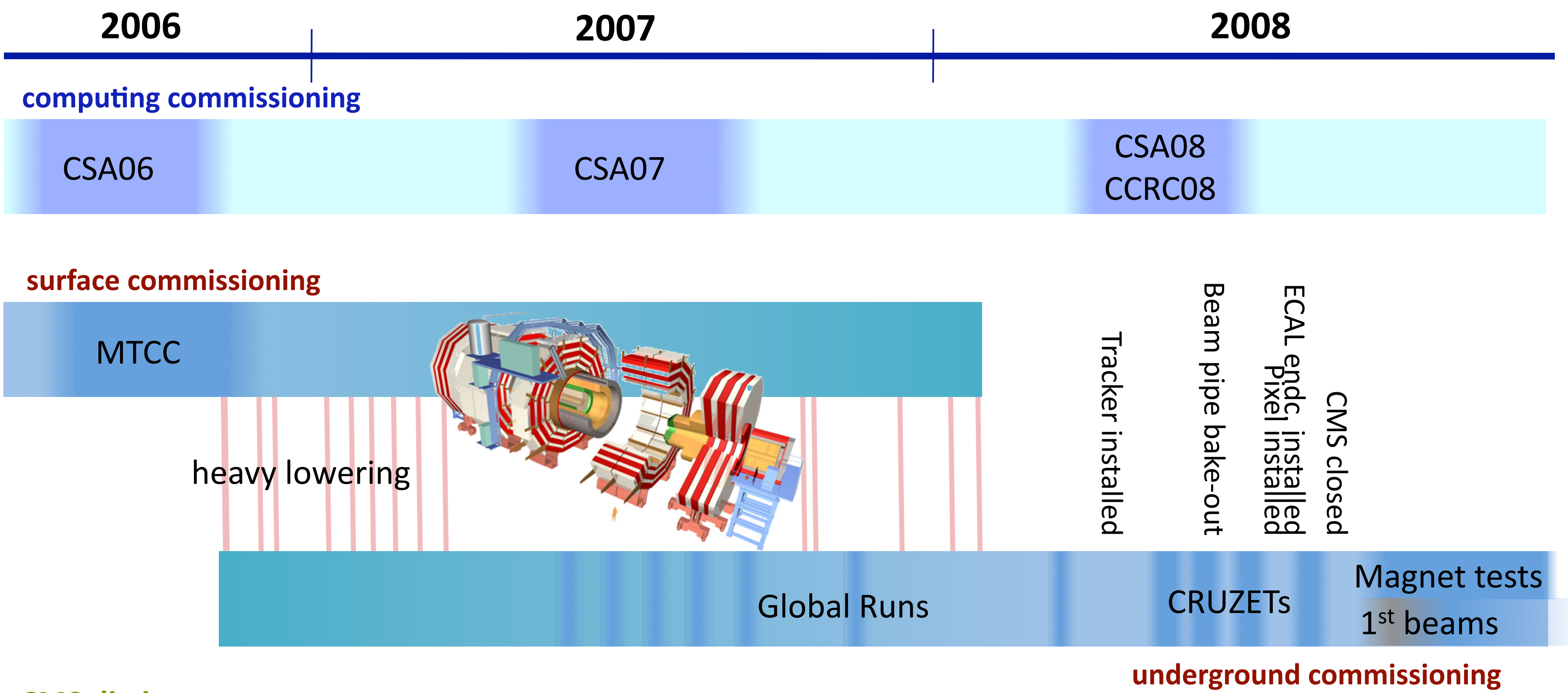
- Proposal:
  - Take advantage of the sequential nature of HLT processing
  - Let individual HLT paths set a “weirdness flag” when the event fails the trigger, but in the process something in the event is found to look fairly strange (e.g., one of the cuts is failed by a very large margin)
- Run the “Last Resort” HLT filter as the last one in the path
  - Try to rescue these weird events by analyzing “weirdness flags” set by individual paths and/or based on global event properties
    - Forcefully accepts the event if several such flags are set
    - Accepts the event if large number of L1 triggers is fired…
  - Cuts designed to keep very low output rate (« 1 Hz)
- The LRT could allow for an early warning system for “weird” events, which may indicate hardware failure or interesting, exotic physics
  - Designated triggers can then be developed for particular exotic signatures found by the LRT without compromising taking these data

Detector Commissioning

Detector Commissioning Exercises

- In Fall 2006 we had the first magnet test and data-taking with a slice of the experiment for about 2 months
- Since May 2007, periodic exercises of 3-10 days have been devoted to global commissioning exercises with installed detectors and electronics <u>underground</u>, ultimately using final power/cooling in the underground experiment cavern and the service cavern
  - Balancing the need to continue installation and local commissioning activities with the need for global system tests
- The incremental goals from one run to the next focus on increased complexity and increased scale.
- Frequency of runs increased as we headed to LHC start-up, where CMS ultimately became a 24/7 running experiment ready for beam

CMS commissioning overview



CMS dictionary:

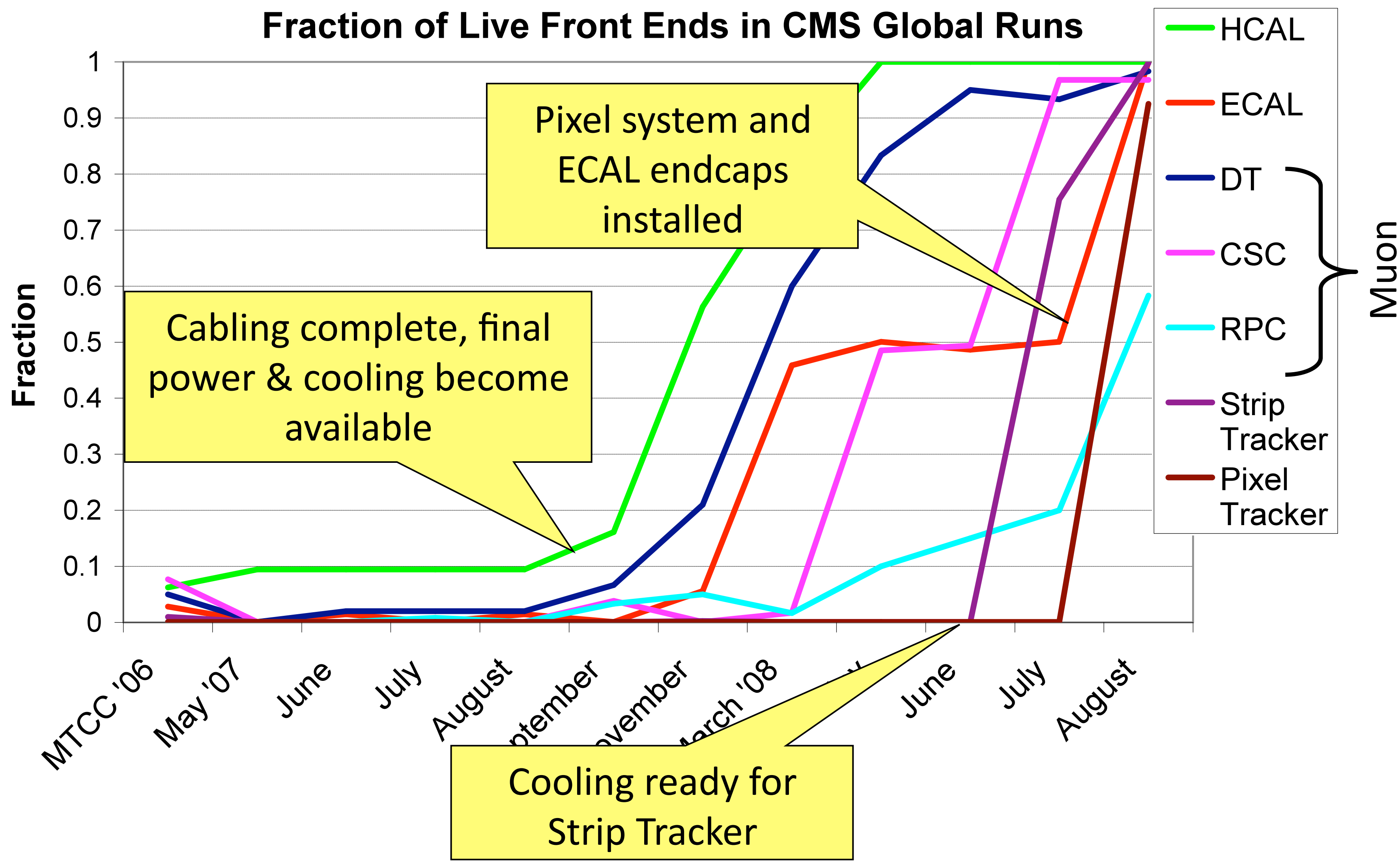
CSA – **C**omputing, **S**oftware and **A**nalysis challenge

CCRC – **C**ommon **C**omputing **R**eadiness **C**hallenges

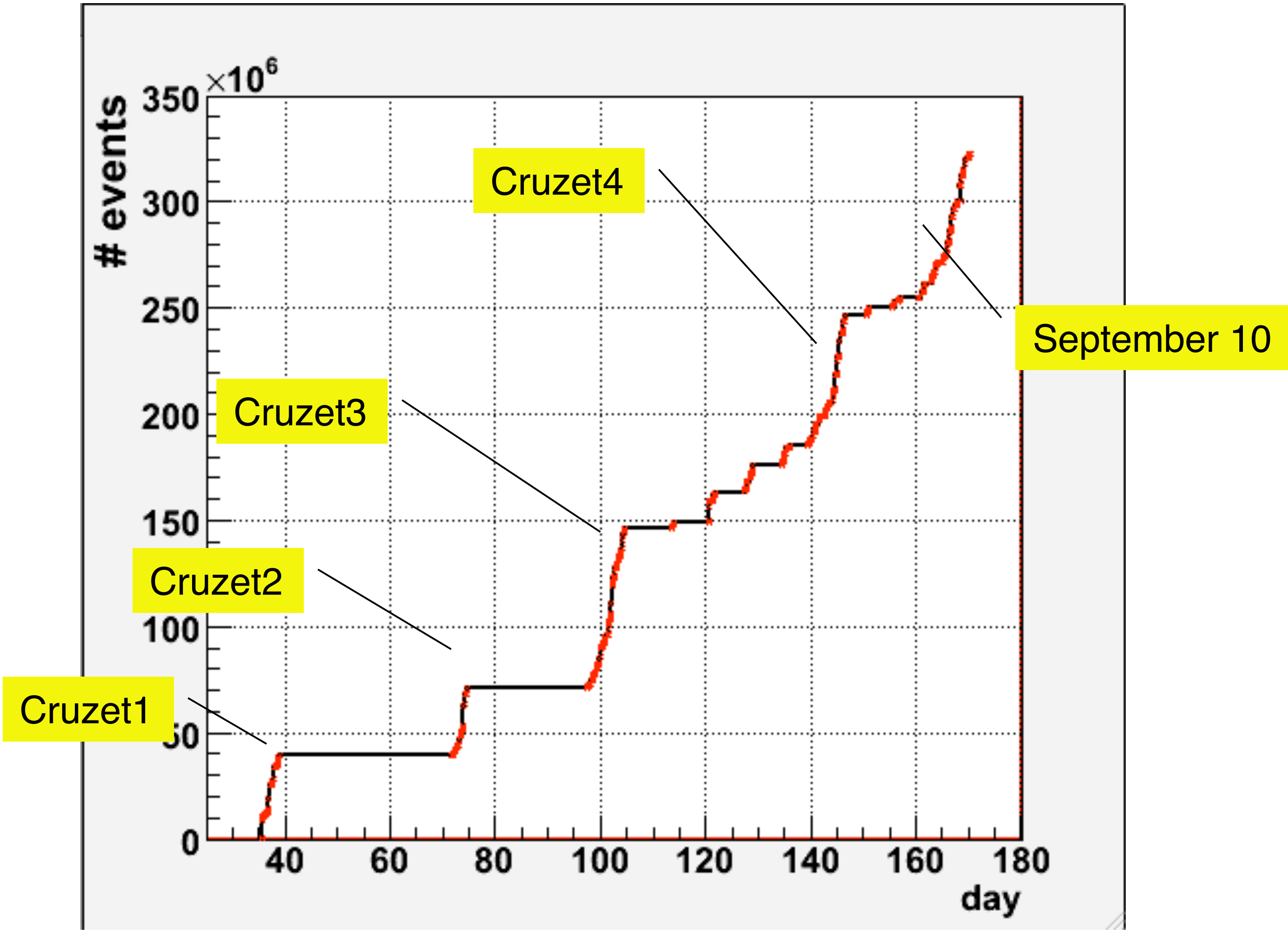
MTCC – **M**agnet **T**est and **C**osmic **C**hallenge

CRUZET – **C**osmic **RU**n at **Ze**ro **T**esla

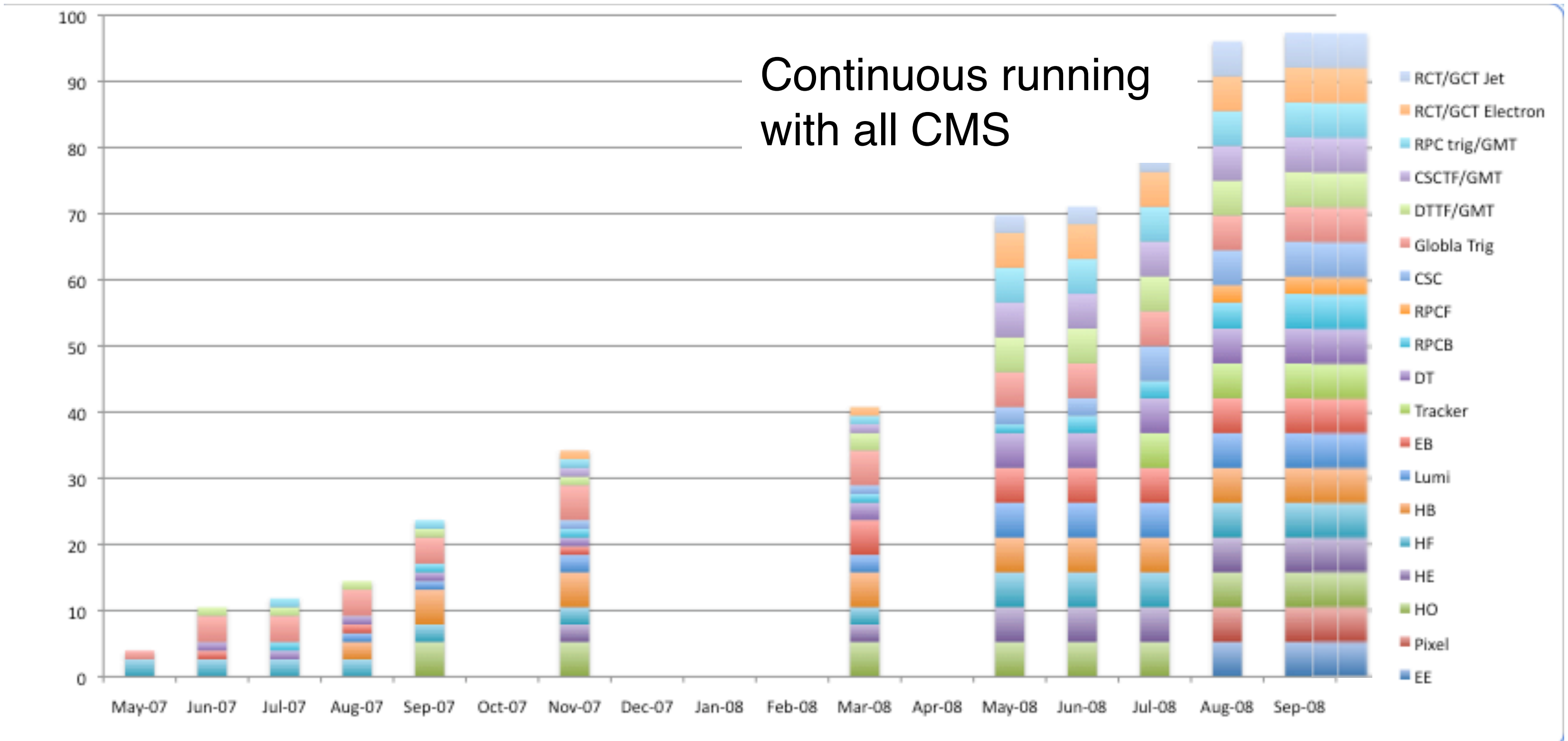
CMS Systems in Global Runs



Significant Datasets (cosmics)



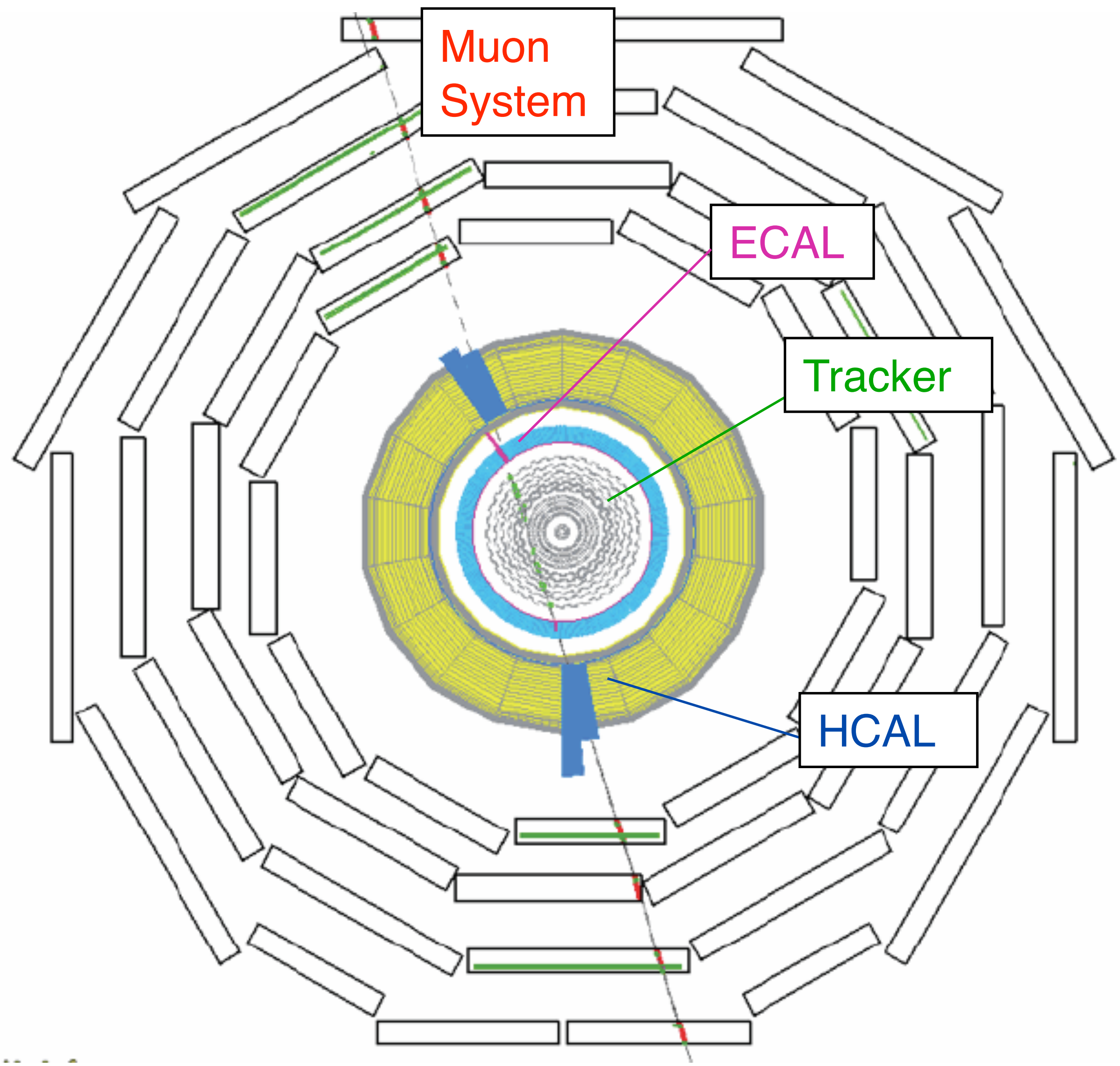
CMS Global Runs



CRUZET4

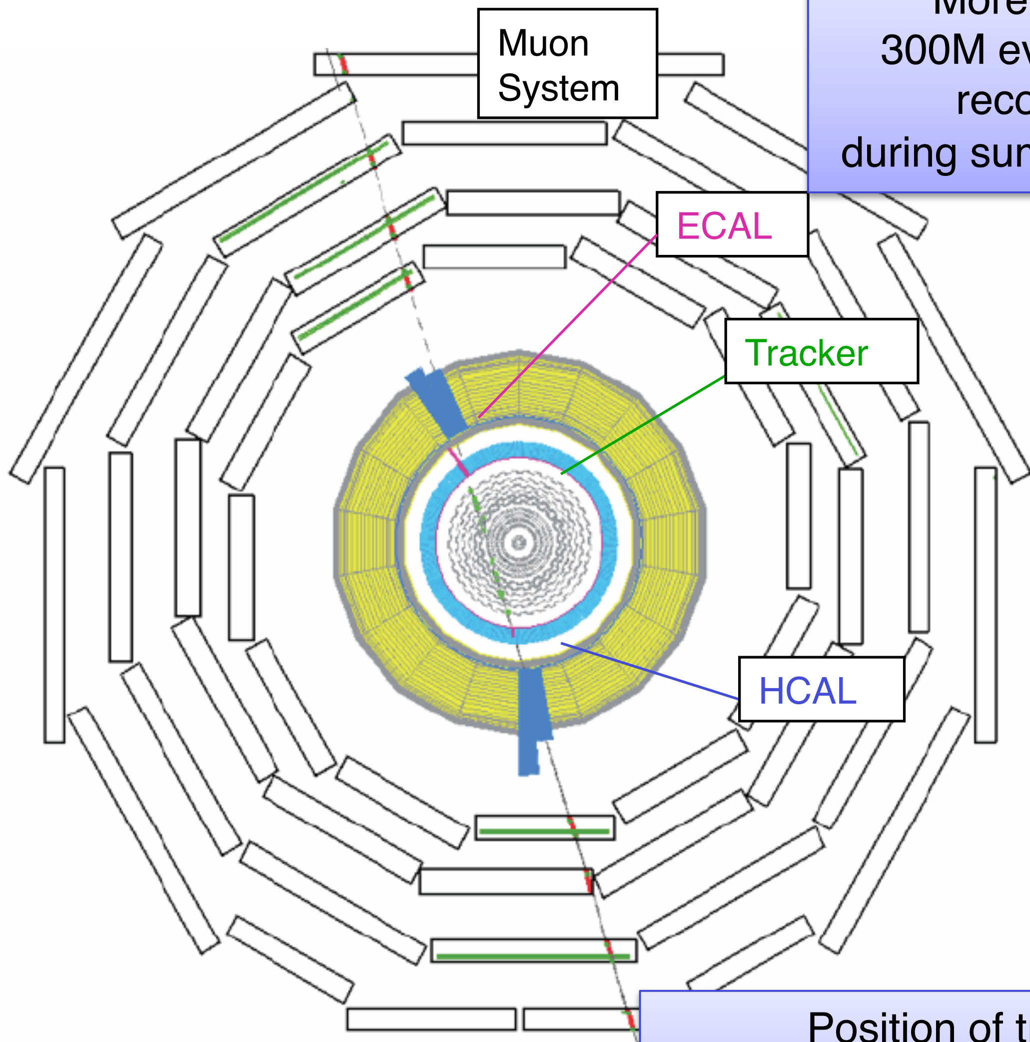
- First Global run with final CMS configuration
- Going from 80% to 100% of CMS was not a trivial step: first 4 days spent in understanding instabilities.
- Last 3 days saw all of CMS (including newcomers like EE and Pixels) accumulating data more stably
- Total of 38 M cosmic triggers logged, being analyzed.

Global Detector Readout

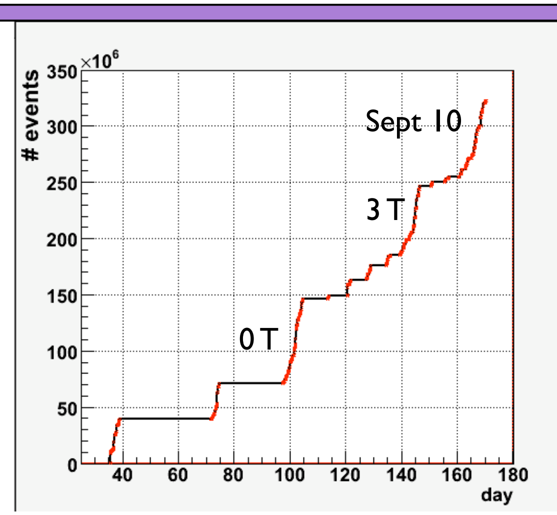


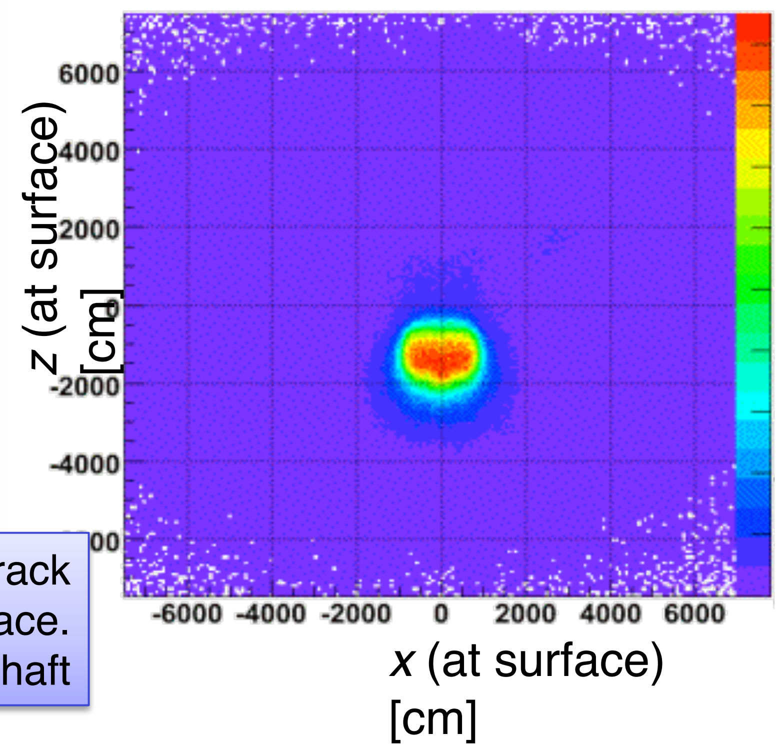
- Muon signals traced through
  - muon system
  - Strip Tracker (and pixels when close to beam pipe)
  - ECAL
  - HCAL
- Requires synchronization of all electronic signals
- Global track fit can be used for alignment and detector performance studies

Commissioning with Cosmics



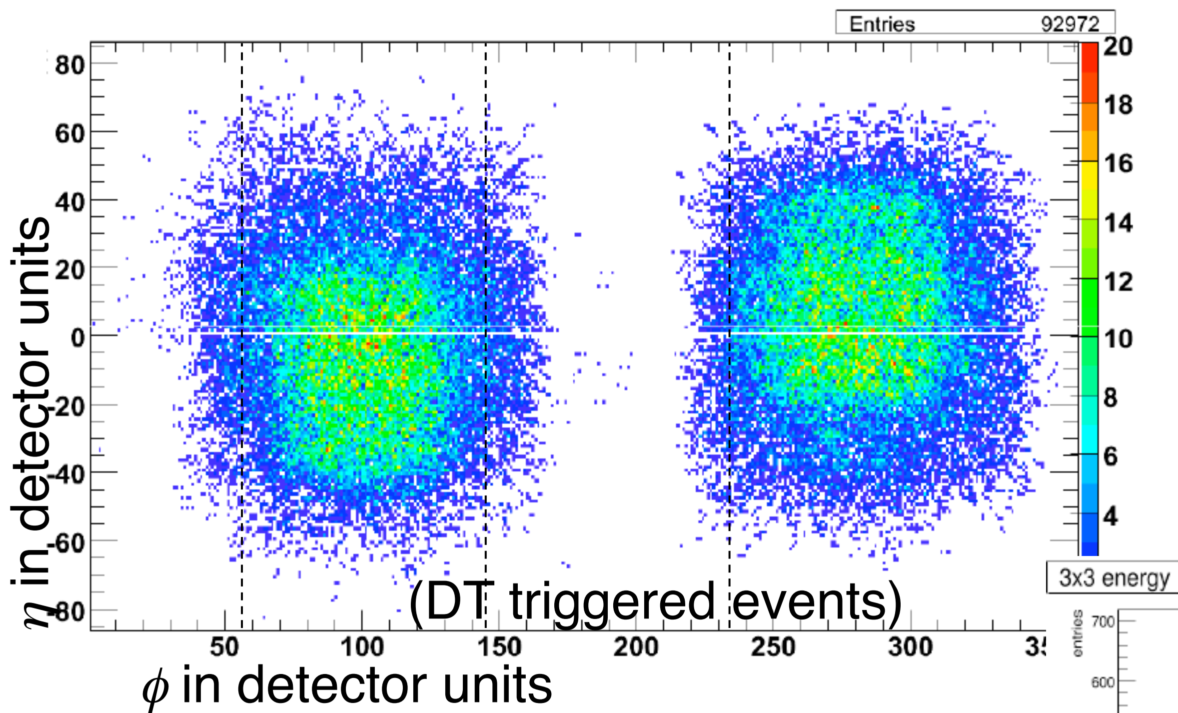
More than 300M events recorded during summer





Position of track extrapolated to surface. Clearly see shaft

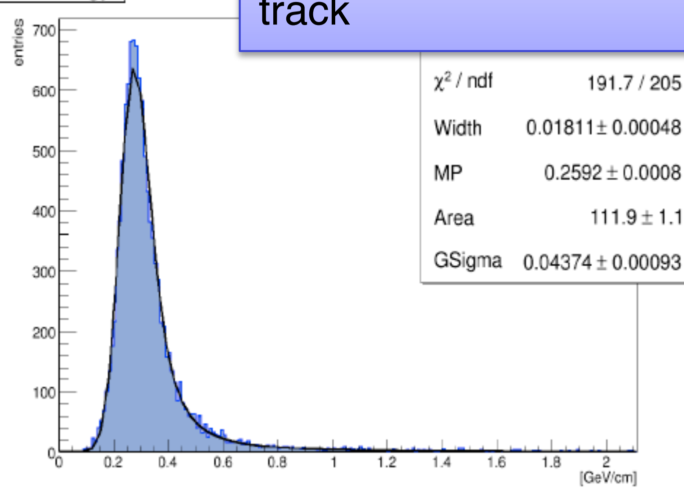
Tracks passing through the ECAL



Reconstructed clusters

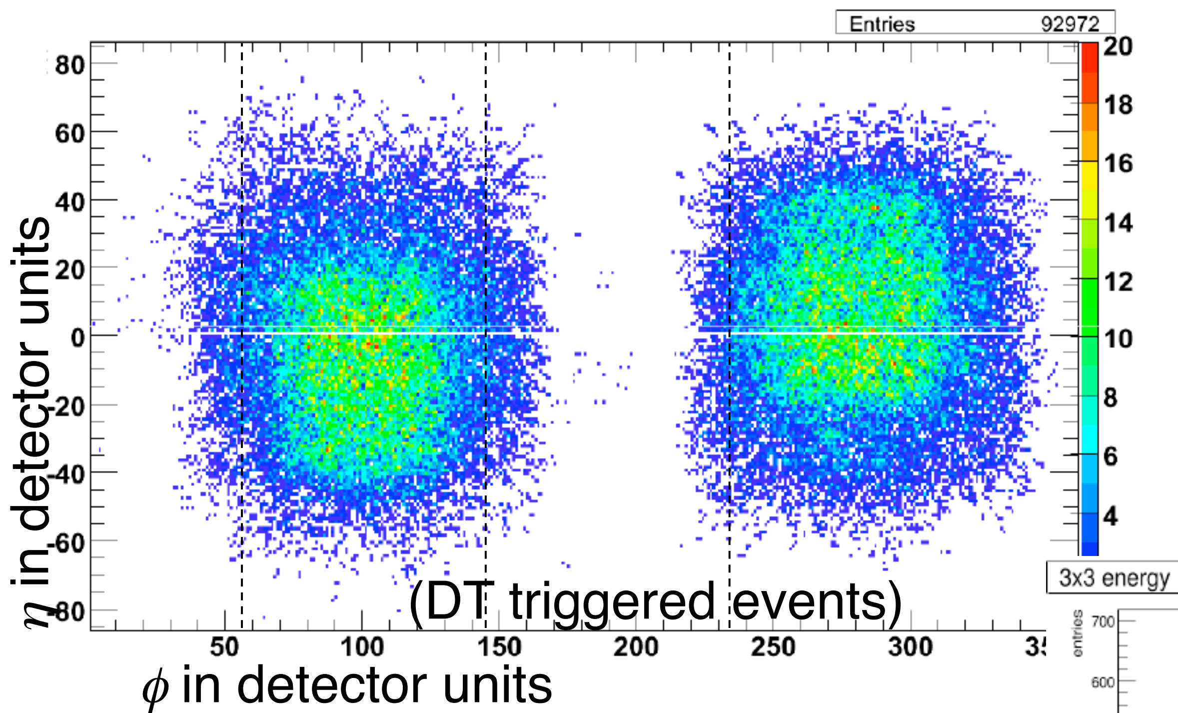
matching muon tracks

Energy deposited in 3x3 ECAL cluster matched to a muon track



- Cosmic running used to test
  - triggers,
  - operation of all detectors
- Example: Trigger using Drift Tubes
  - Validate Calorimeter e-gamma Trigger
- Verify pre-calibration of ECAL

Tracks passing through the ECAL



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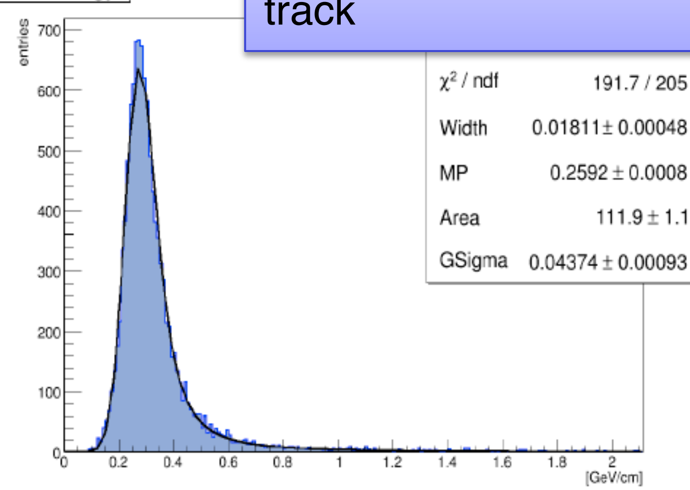

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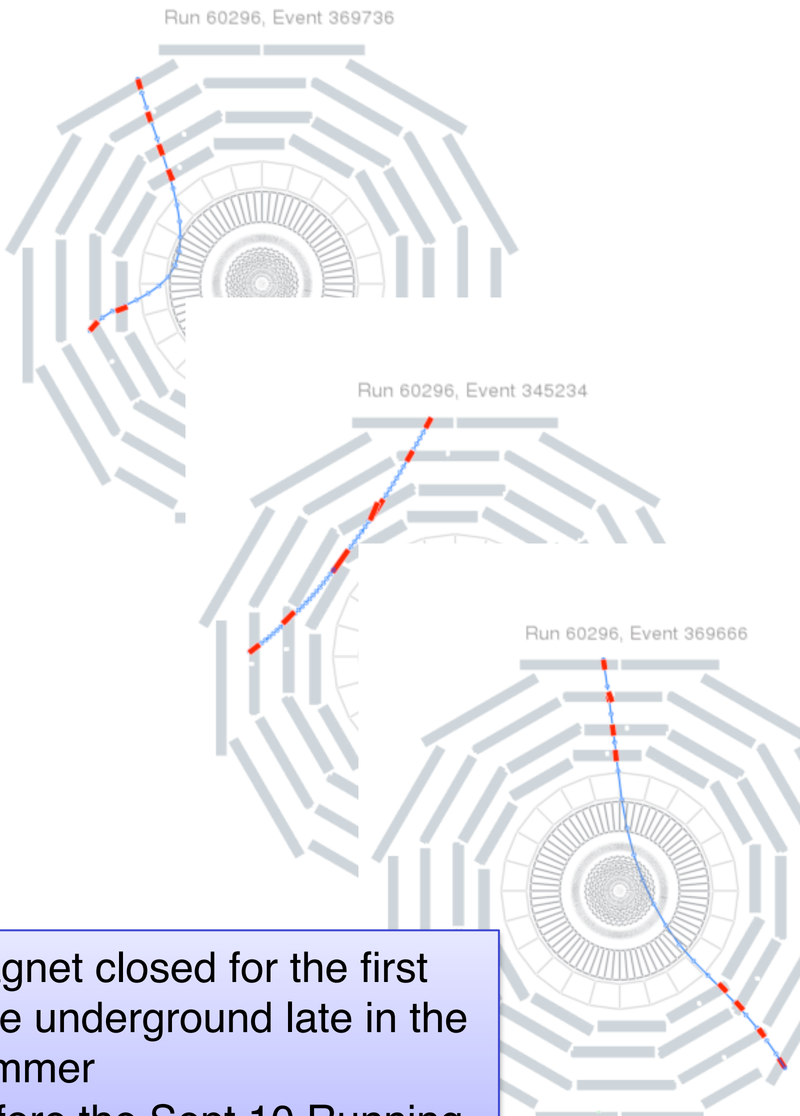
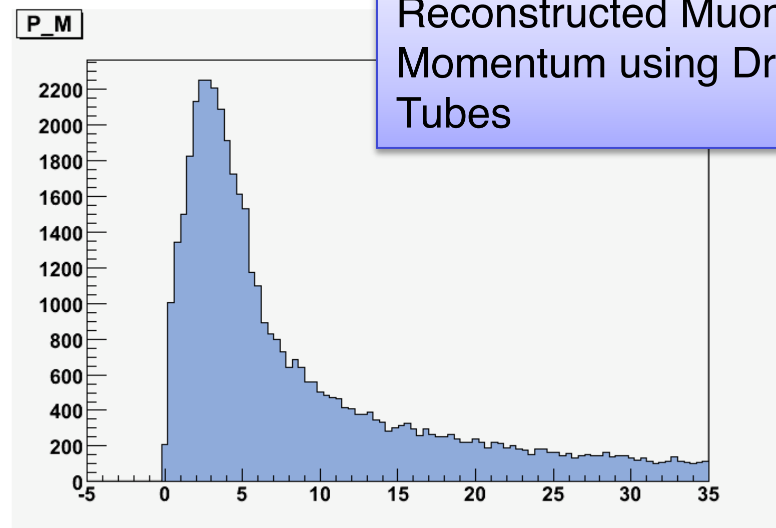
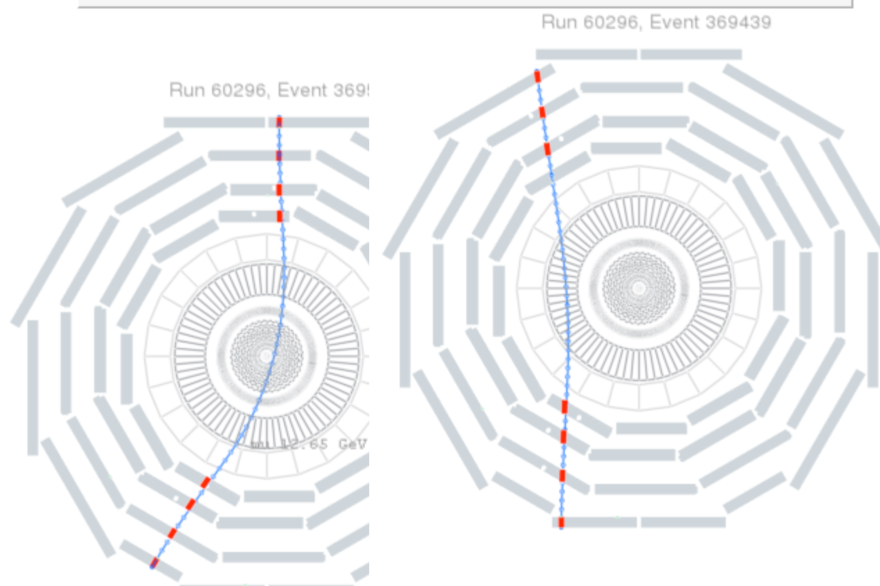
Muon reconstruction at 3T



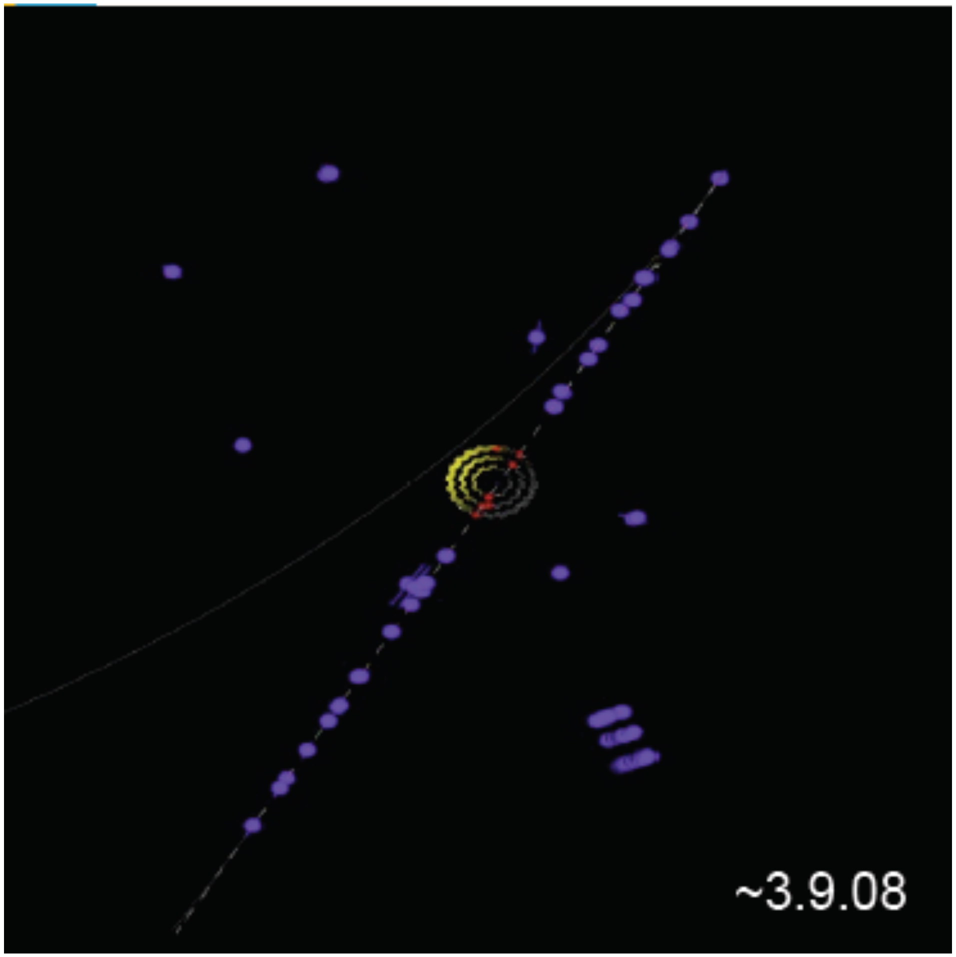


Reconstructed Muon Momentum using Drift Tubes



Magnet closed for the first time underground late in the summer
Before the Sept 10 Running field raised to 3 T

Tracks crossing the pixel tracking system



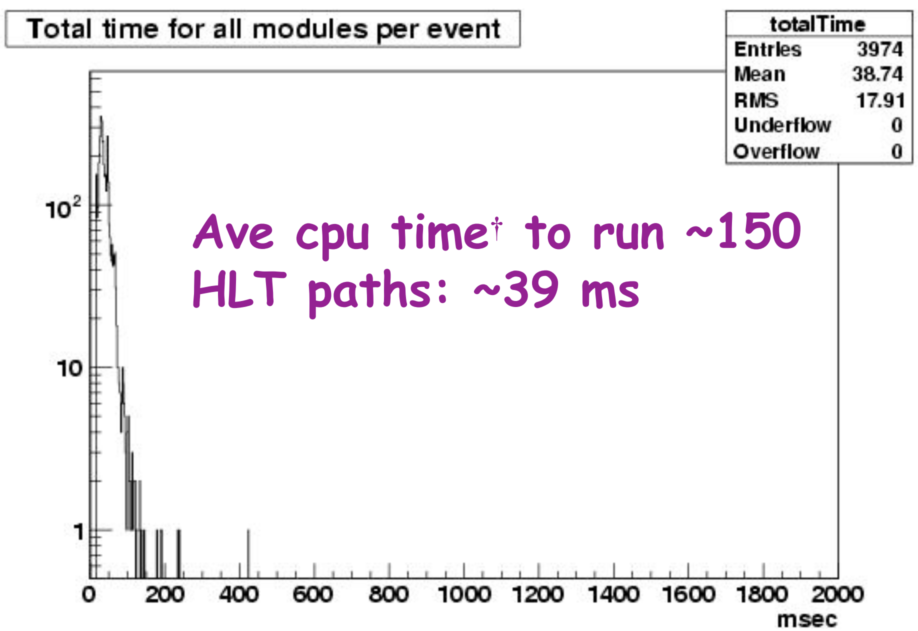
First cosmic tracks with Pixels

- Rate < 0.1 Hz
- Need a lot of data to align sensors
- But tracks going through the small pixel detector resemble those from collisions

Trigger Menu Commissioning

Focus of the last 6-8 months: commissioning using cosmics data
Many invaluable lessons have been learned;
Number of problems have been identified and fixed
Range from:

- memory footprint problems related to multiple output streams
- error messages being printed out when dealing with corrupt data
  - infrequent crashes during unpacking of raw data
  - non-optimal triggers



Trigger Menu Commissioning

Lessons learned:

Should not put all 150 of these present HLT paths online for startup

- Many of these triggers are not relevant for all luminosities: 2E30/2E31/1E32
- Many triggers make assumptions (alignment, calibration, noise, isolation, multiplicities, etc) not yet validated with real data
- Many triggers suitable for 1E32 are known to be very inefficient at startup conditions (and only tuned to MC)
- It is unlikely that analyses based on startup data will be based on multiple triggers…focus on the ones we will use.
- Plan to start with something simple that is robust against startup uncertainties. Then deploy online additional triggers, as needed, after validating them on real data.

Trigger Menu Commissioning

Deployed a modified startup menu late last year:

- Min Bias triggers for calibration
- Single Object Triggers x 2 Thresholds
- Double Object Triggers x 2 Thresholds
- Use prescales to switch between menus for different luminosities

HLT ran without disrupting data-taking

Global runs have lasted > 24 hours!!

Trigger menu commissioning with startup menus is ongoing…