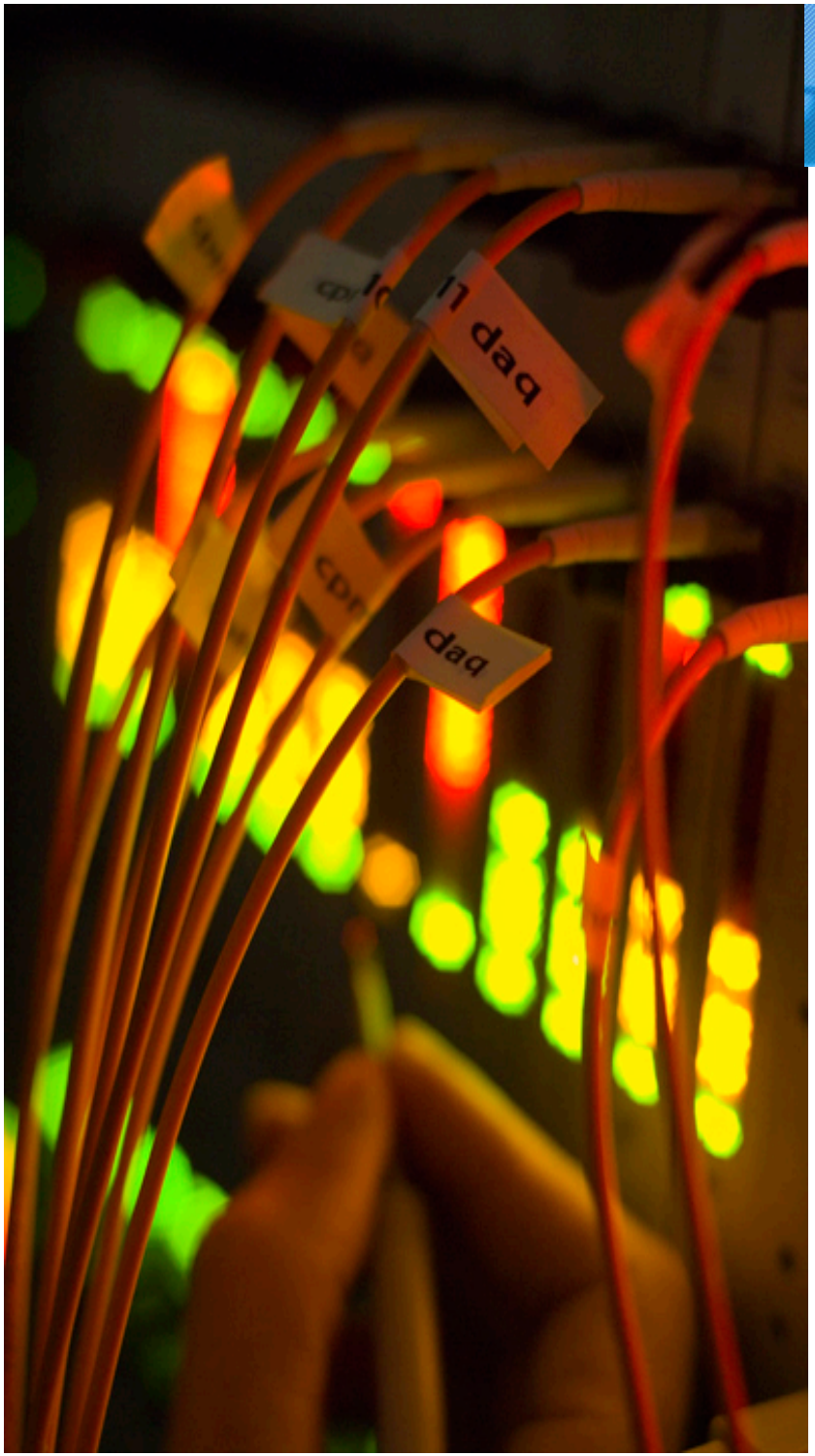


JOINT INSTITUTE FOR NUCLEAR RESEARCH

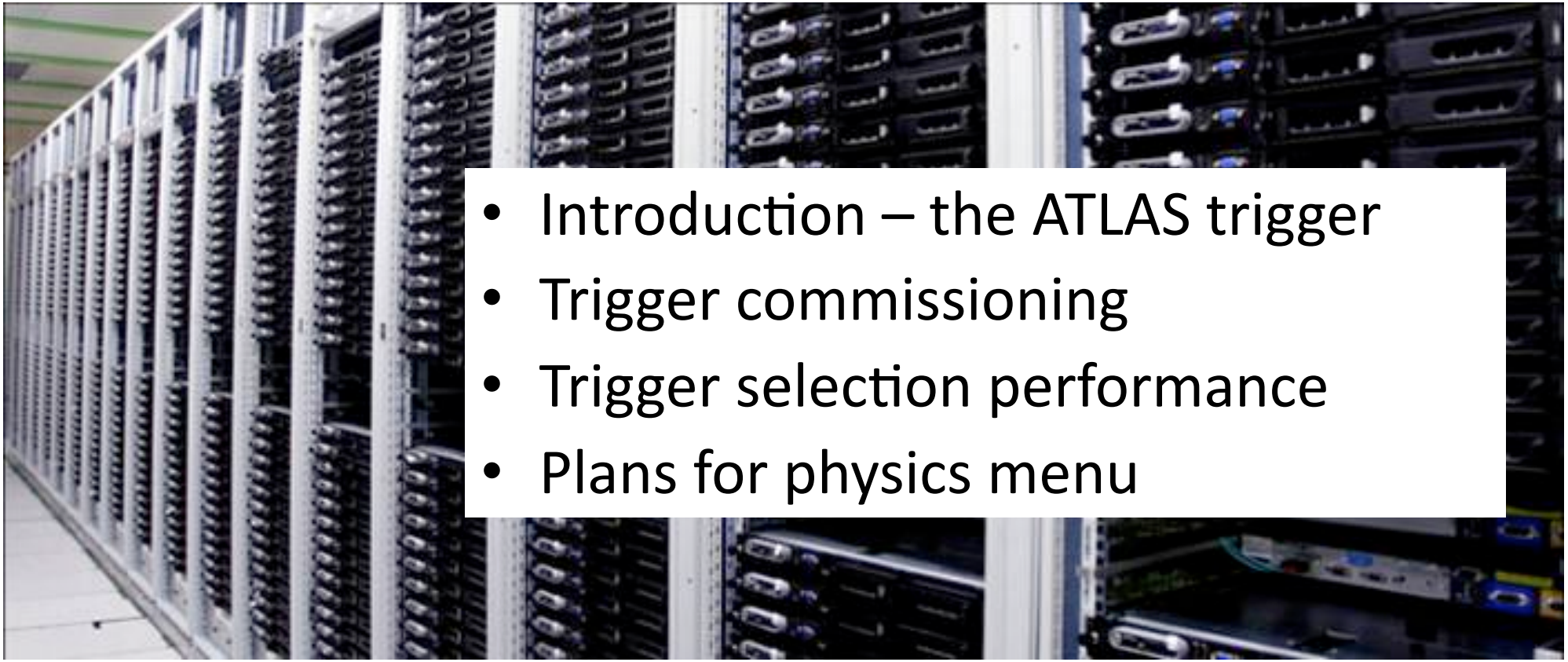
Royal Holloway University of London

TRIGGER PERFORMANCE

HSG5 Meeting at JINR
Dubna – 29 April 2010

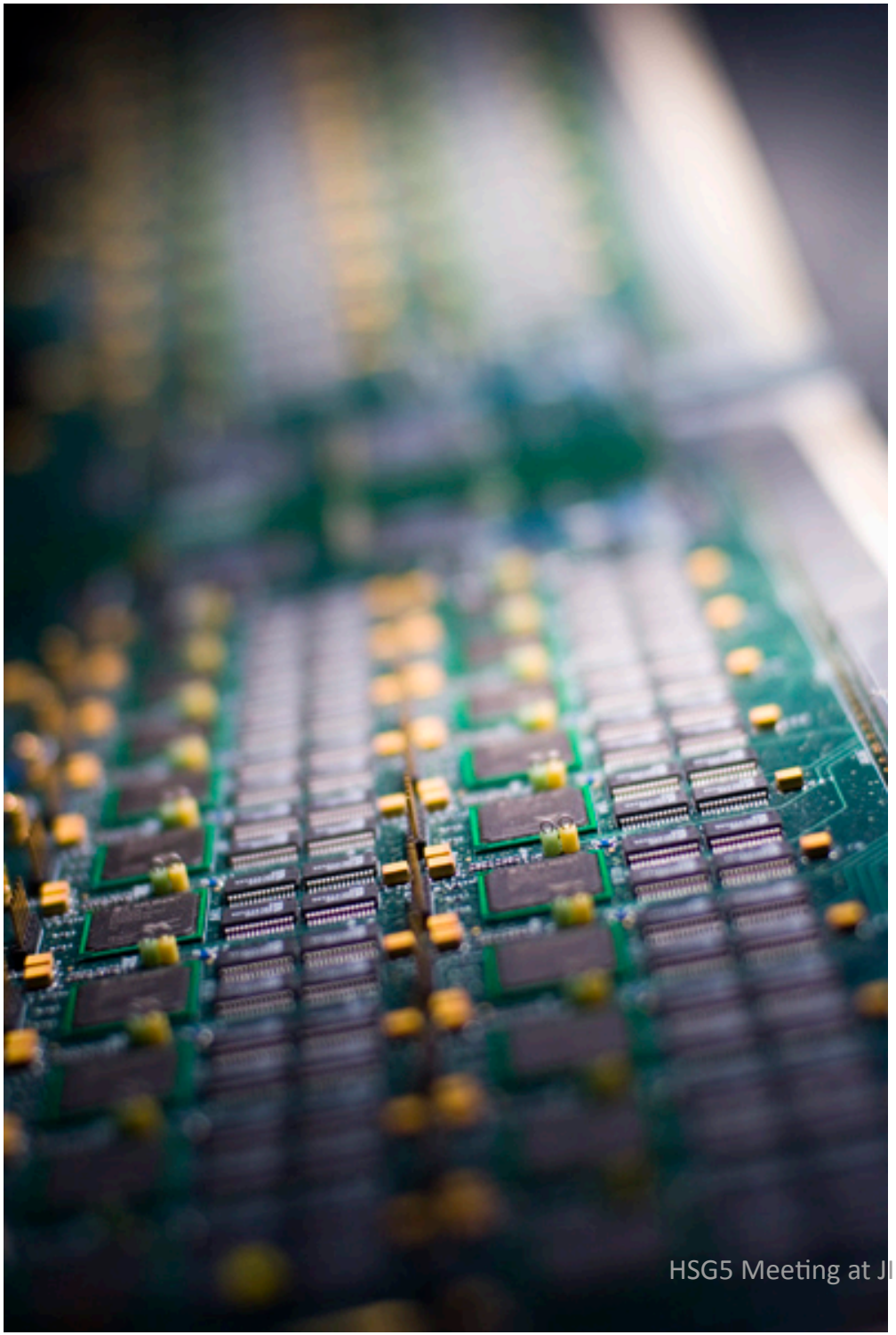
Ricardo Gonçalo
Royal Holoway University of London

OUTLOOK



- Introduction – the ATLAS trigger
- Trigger commissioning
- Trigger selection performance
- Plans for physics menu

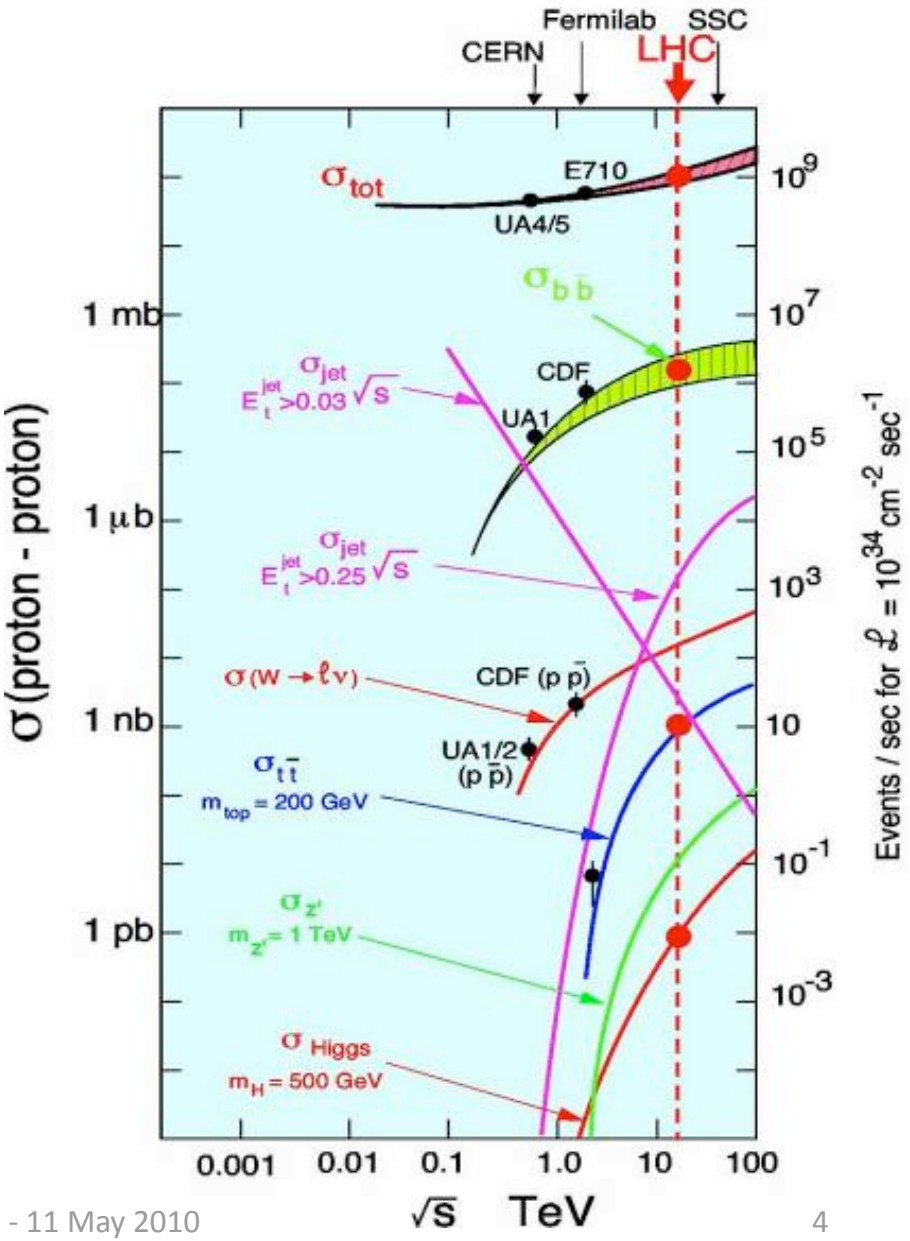
The Trigger is a large system – Inevitably, I am reporting on the work of too many people to mention by name – many thanks to them!



THE ATLAS TRIGGER

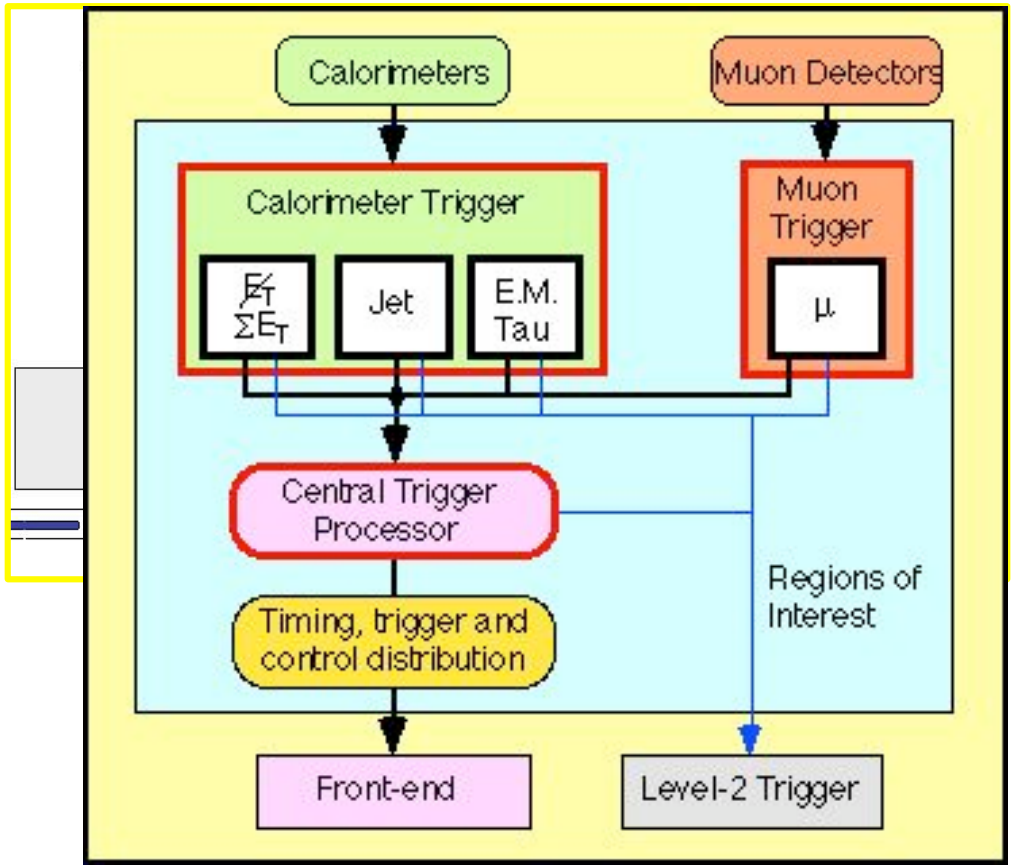
What is the ATLAS trigger for?

- Much of LHC physics will mean cross sections at least ~10^6 times smaller than total cross section
- 25ns bunch crossing interval (40 MHz)
- Offline storing/processing: ~200 Hz
  - ~5 events per million crossings!
- In one second at design luminosity:
  - 40 000 000 bunch crossings
  - ~2000 W events
  - ~500 Z events
  - ~10 top events
  - ~0.1 Higgs events?
  - **200 events written out**
- The right 200 events should be written out!



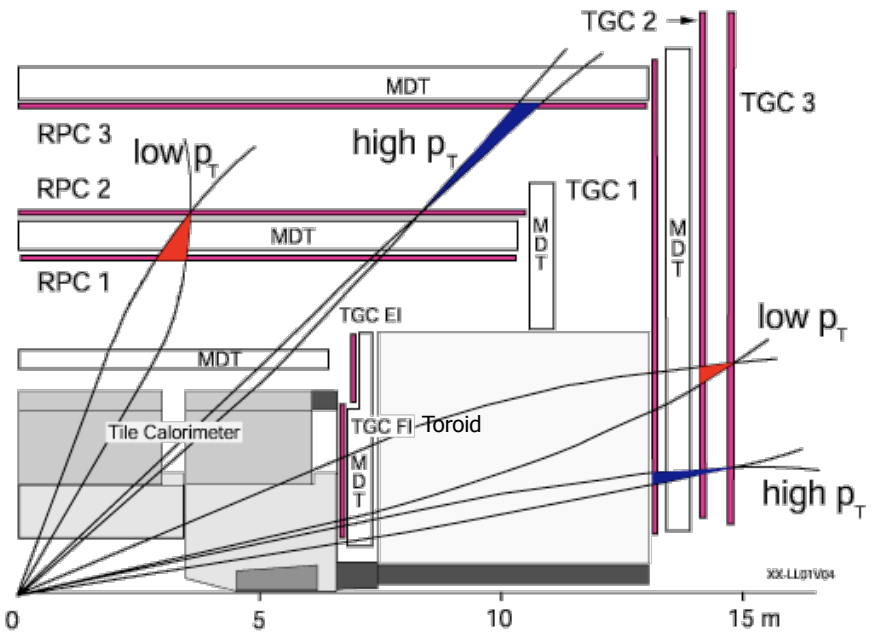
Level 1 architecture

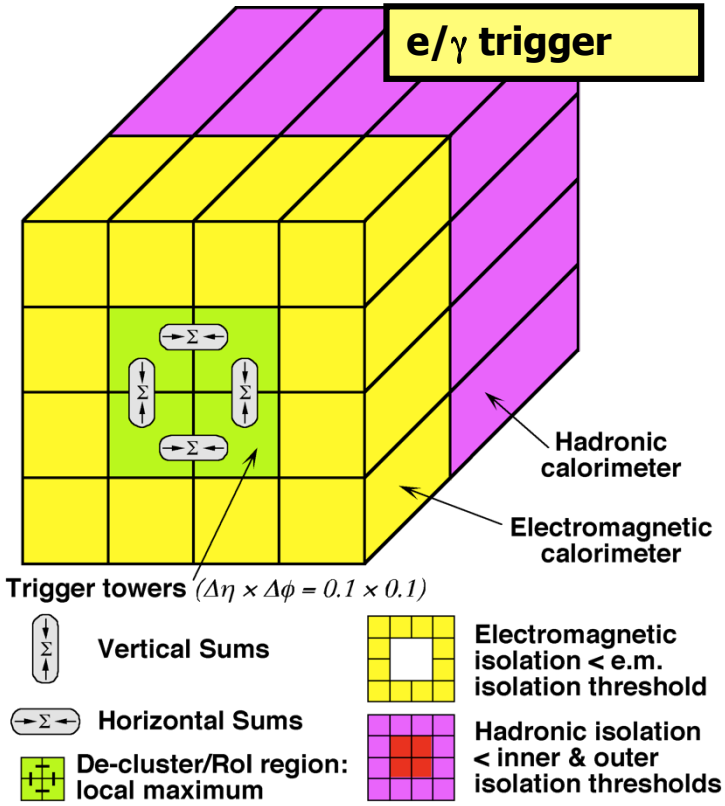
- Level 1 uses calorimeter and muon systems only
- Muon spectrometer:
  - Dedicated trigger chambers
    - Thin Gap Chambers (endcap) – TGC
    - Resistive Plate Chambers (barrel) – CSC
- Calorimeter:
  - Trigger towers group calorimeter cells in coarse granularity: $\Delta\eta\times\Delta\varphi = 0.1\times0.1$ (EM/Tau); $\Delta\eta\times\Delta\varphi = 0.2\times0.2$ (Jets)
- Identify regions of interest (RoI) and classify them as MU, EM/Tau, Jet
- Information passed to level 2:
  - RoI type
  - E_T threshold passed
  - Multiplicity
  - Location



The response of the level 1 hardware is emulated in Athena.

L1 - Muons & Calorimetry



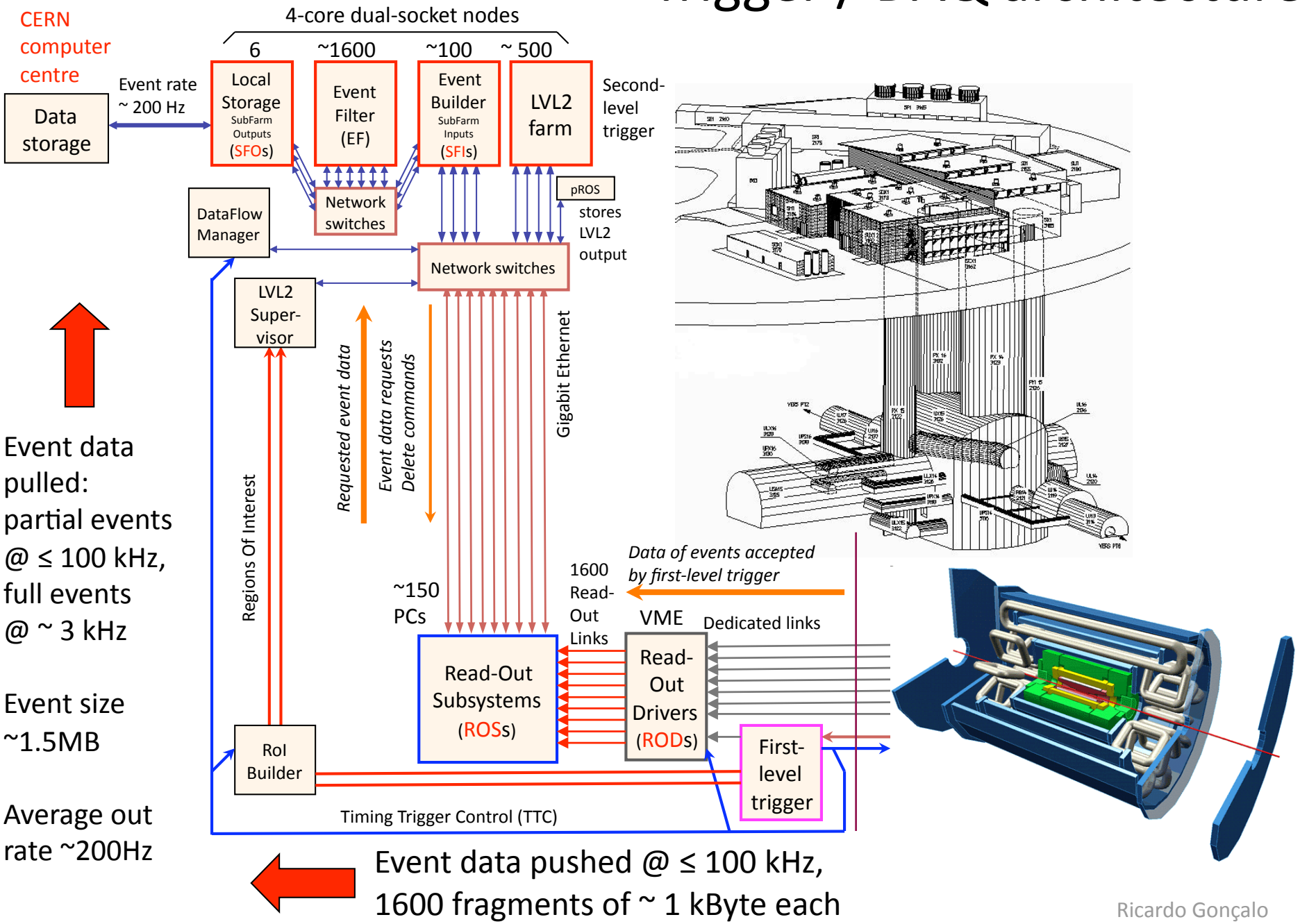


Muon Trigger looking for coincidences in muon trigger chambers – e.g.:
3 out of 4 (low-p_T; >6 GeV) and
3 out of 4 + 1/2 (Barrel) or 2/3 (Endcap) - high-p_T; >20 GeV

Calorimetry Trigger looking for e/γ, τ,/isolated hadron, jets

- **Various combinations of cluster sums and isolation criteria**
- **$\Sigma E_T^{em,had}$, E_T^{miss}**

Trigger / DAQ architecture



Event data pulled:
partial events
@ ≤ 100 kHz,
full events
@ ~ 3 kHz

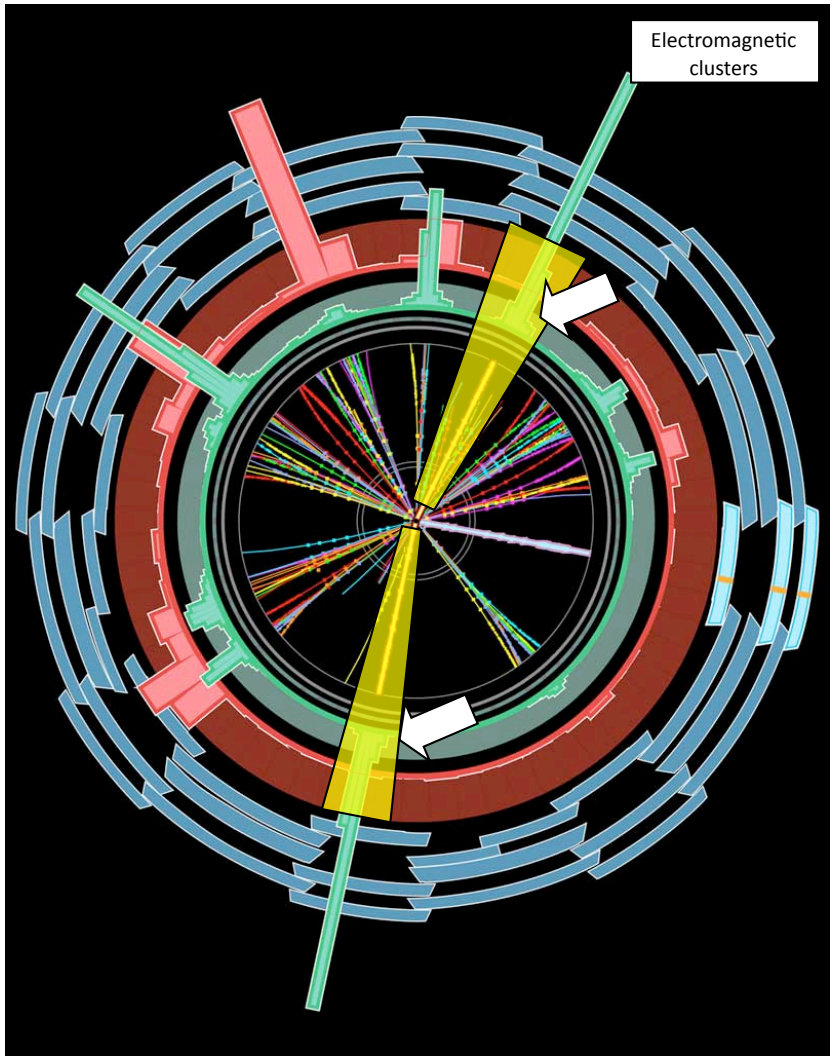
Event size
~1.5MB

Average out rate ~200Hz

High Level Trigger

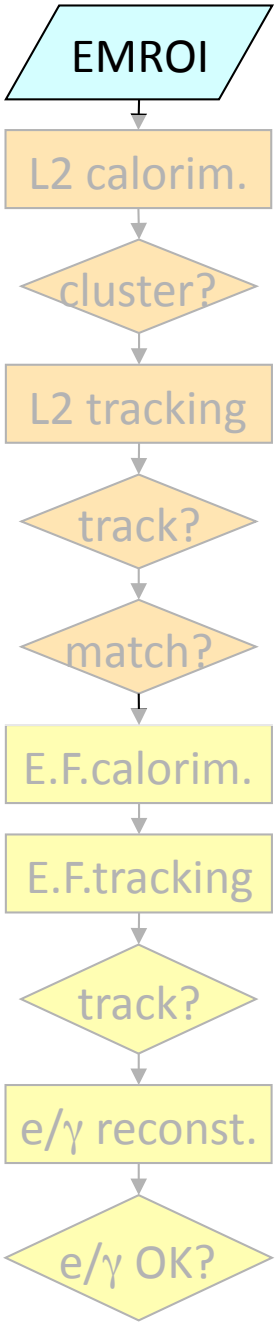
Level1 Region of Interest is found and position is passed to Level 2

Event rejection possible at each step



Level 2 seeded by Level 1
Fast reconstruction algorithms
Reconstruction within RoI

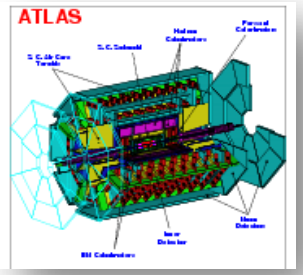
Ev.Filter seeded by Level 2
Offline reconstruction algorithms
Refined alignment and calibration



Trigger Configuration + Data

Preparation

Data taking



Configures

TriggerDB
All configuration data

Stores decoded Trigger Menu

Online Conditions Database COOL

Encoded trigger result from all 3 levels

Decoded trigger menu

Reconstruction

Trigger Result

- passed?, passed through?, prescaled?, last successful step in trigger execution?

Trigger EDM

- Trigger objects for trigger selection studies

Trigger Configuration

- Trigger names, prescales, pass throughs

access through TrigDecisionTool

Trigger aware analysis

ESD

AOD

DPD

TAG

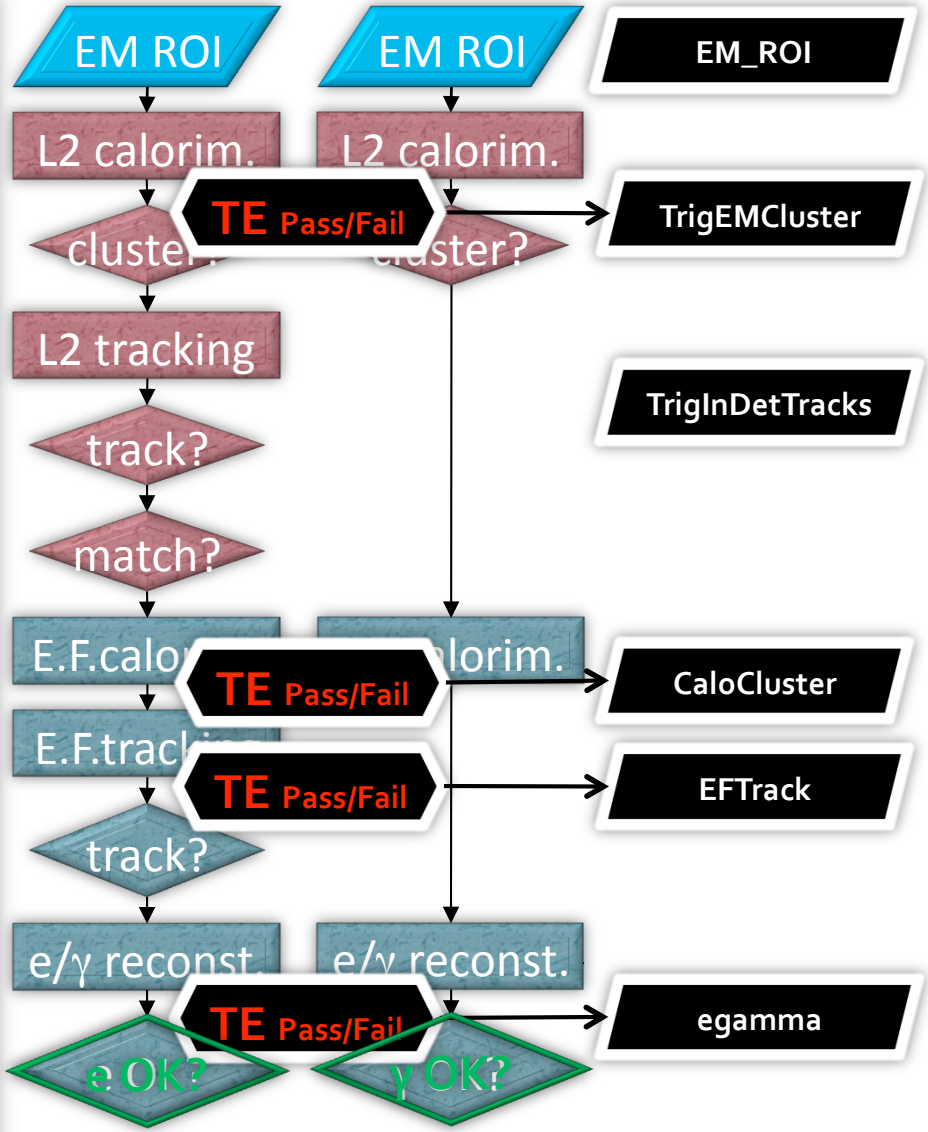
With decreasing amount of detail

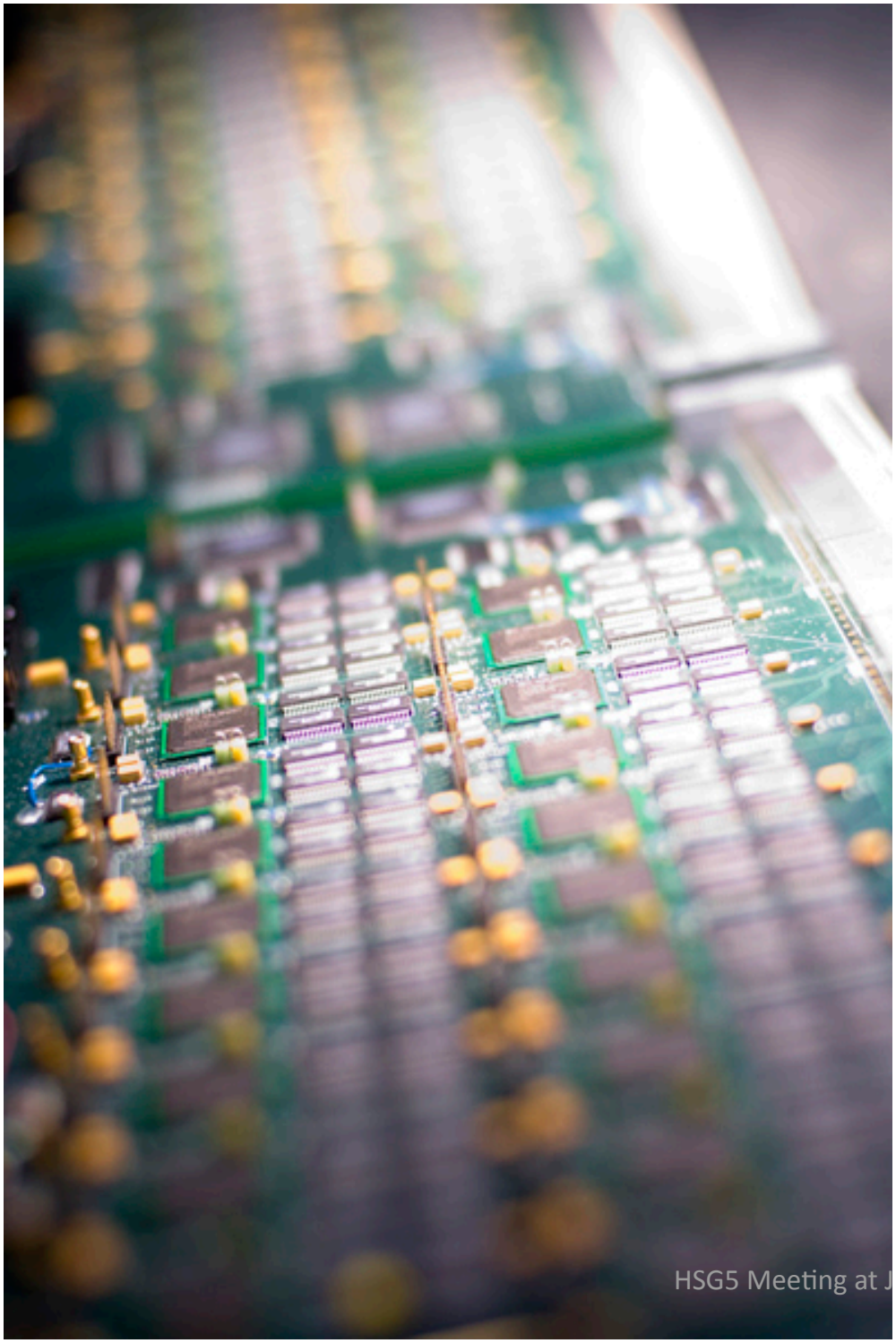
Trigger Algorithms and Trigger Data

FEX
Feature
HYPO

FEX algo's are executed to create features on which selection in HYPO algo's is based

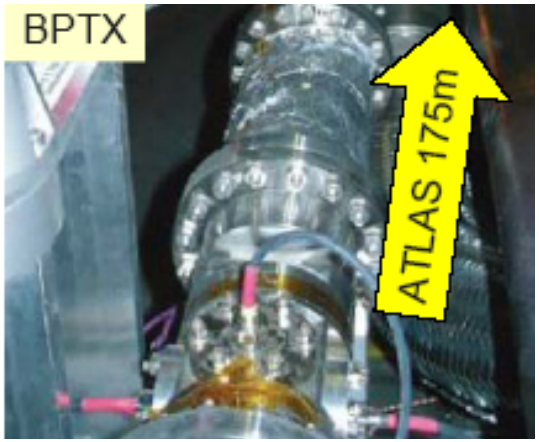
- Chain:
  - Started, if seed has fired and chain is not **PRESCALED**
  - Stopped **AT STEP**, if a HYPO is not passed
  - Last HYPO passed → **CHAIN PASSED**
- Event:
  - Passed, if at least one EF chain is passed
  - Put into all streams that are associated with the passed EF chains
- Trigger objects associated with triggers through Navigation TriggerElements
- Trigger information in ESD AOD DPD TAG
  - **TRIGGER DECISION** + Configuration + Navigation + Feature



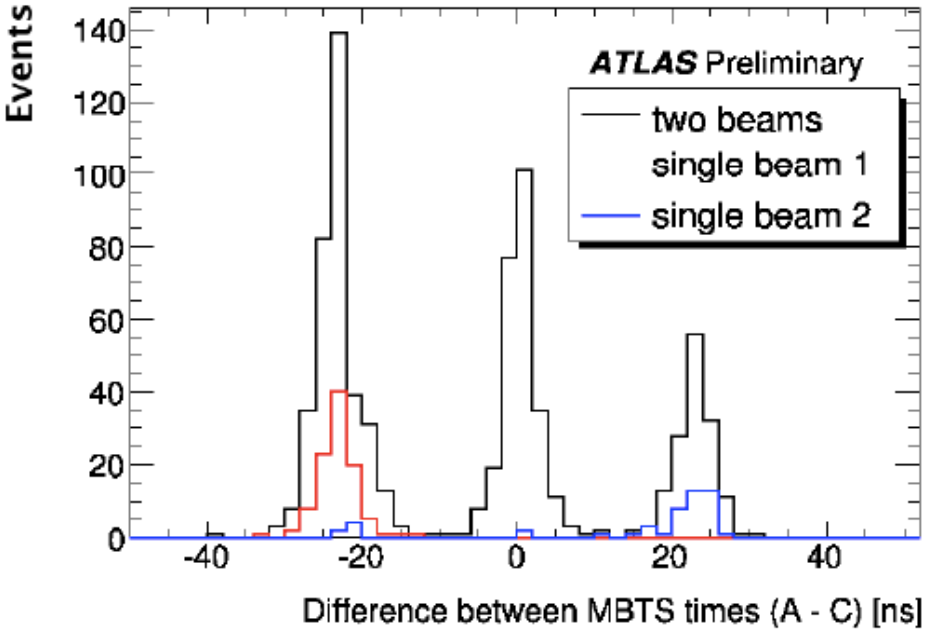


TRIGGER COMMISSIONING

- Long period of commissioning with cosmics
  - Good side was we got used to infrastructure
- Finally followed by 900GeV running last December
- Beam pickups (BPTX) and MBTS give workhorse L1 triggers
- Skeleton HLT only: no algorithms



Beam Pickup: ±175m from ATLAS

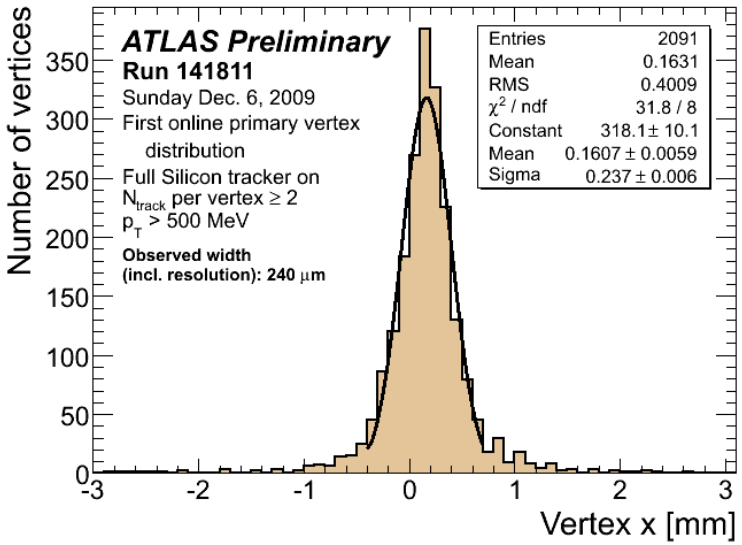


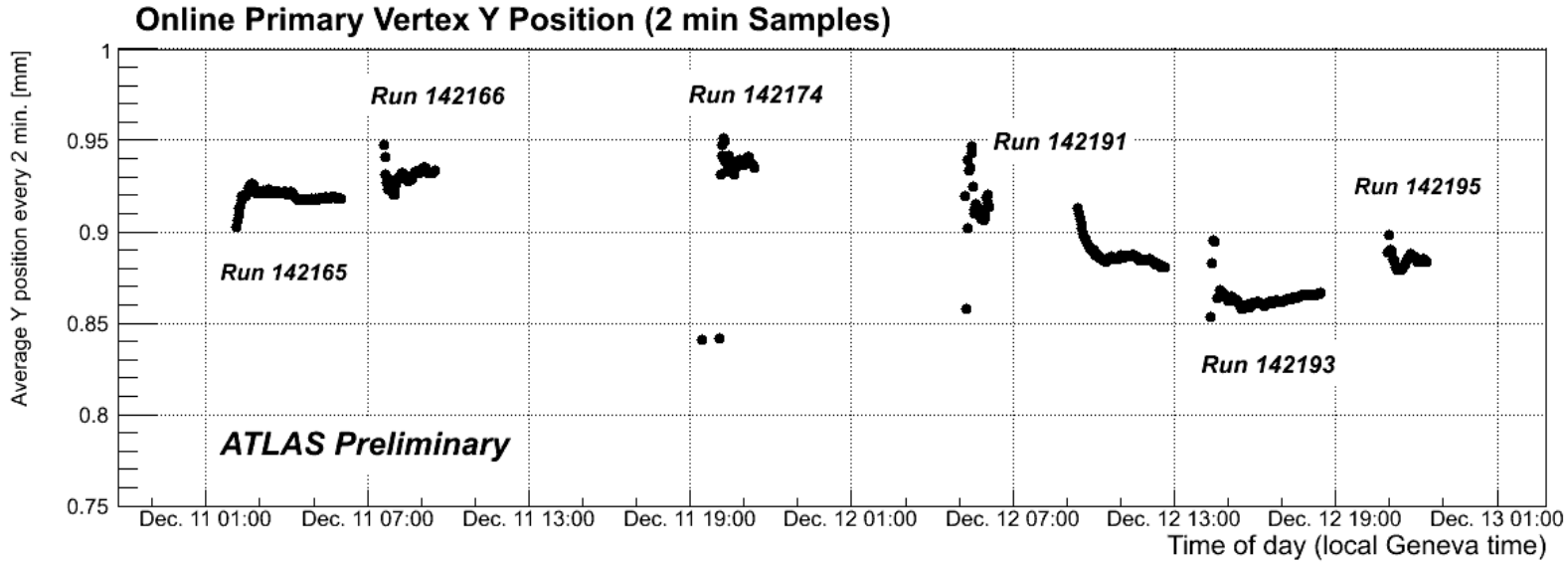
- HLT algorithms introduced a few days after first 900GeV run
  - E.g. L2 beamspot algorithm sends immediate info to LHC

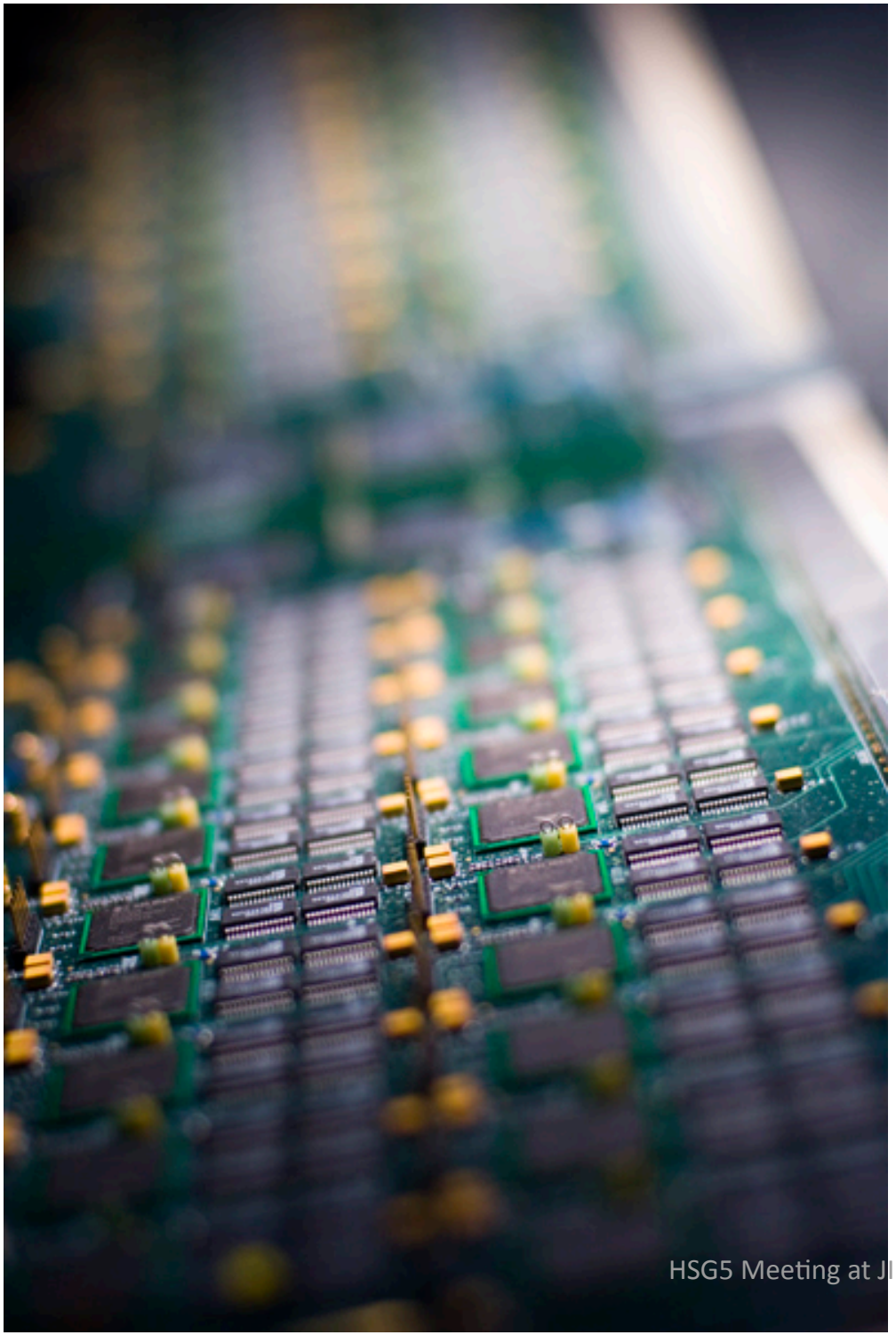
- Running HLT online important to debug and commission algorithms and monitoring

- Started prescaling loosest MBTS triggers only when we reached $4x10^{27}cm^{-2}s^{-1}$

- Start rejecting events in HLT for MinBias triggers only (using InDet chains at L2)



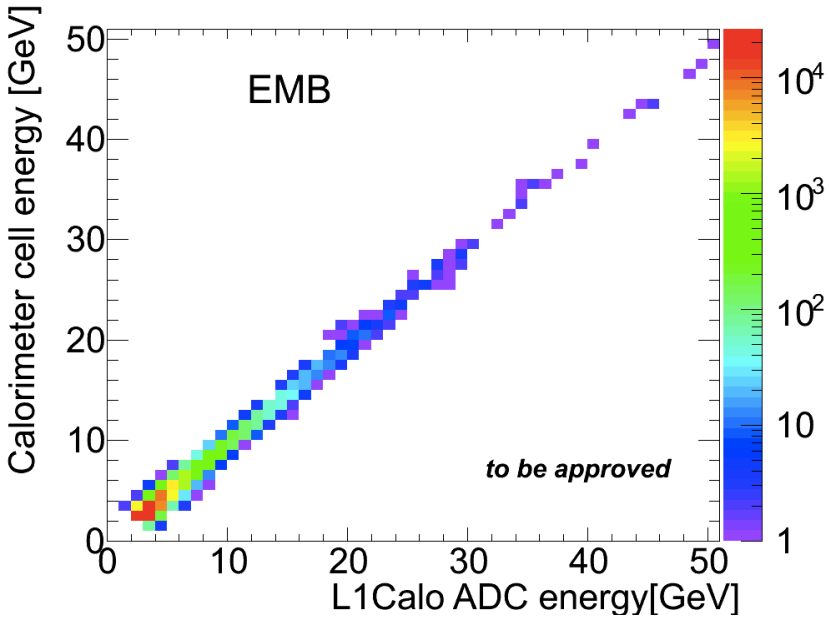


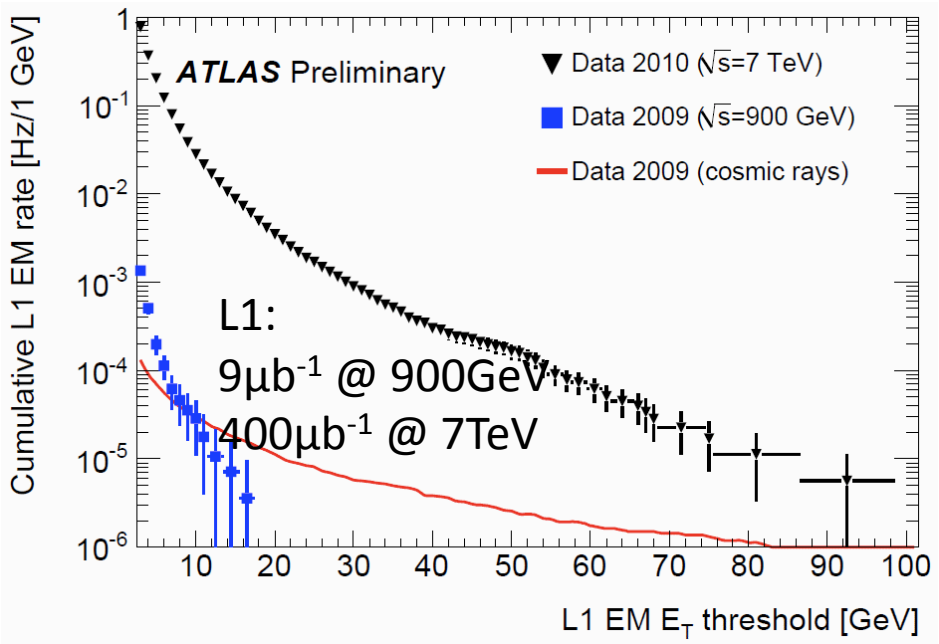


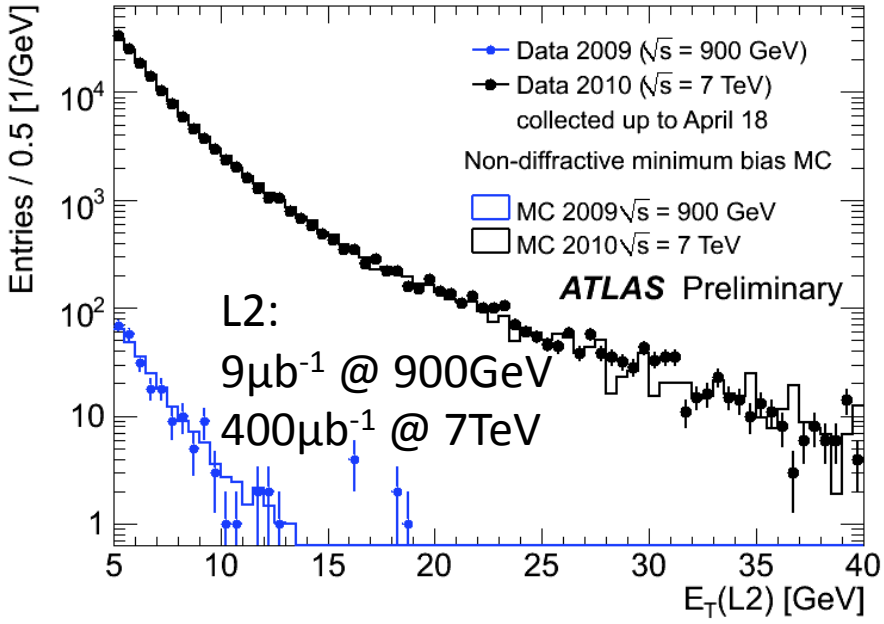
TRIGGER PERFORMANCE

Calorimeter

- L1 Calo has different energy scale and readout than HLT – coarser granularity
  - Summing cells and comparing to trigger tower
- Recent improvement in timing of signals
- HLT relies on DSP-decoded quantities for each cell - cannot re-fit samplings as for offline reconstruction
- Developments in parallel with detector

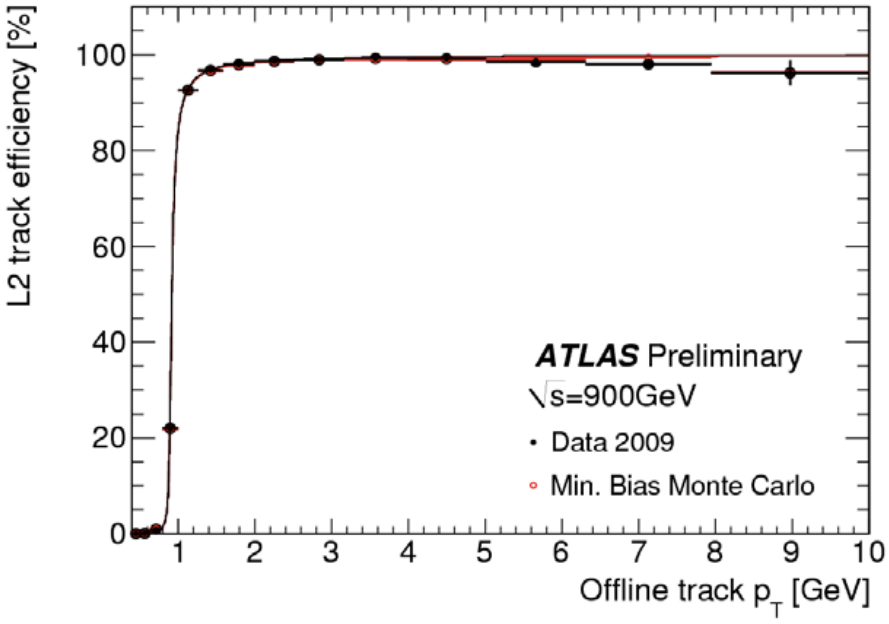


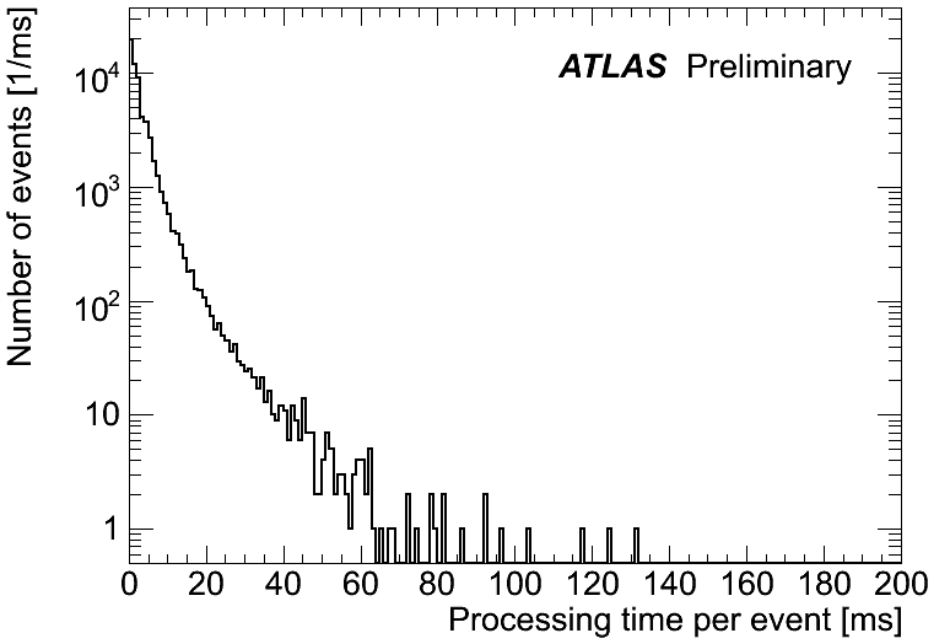


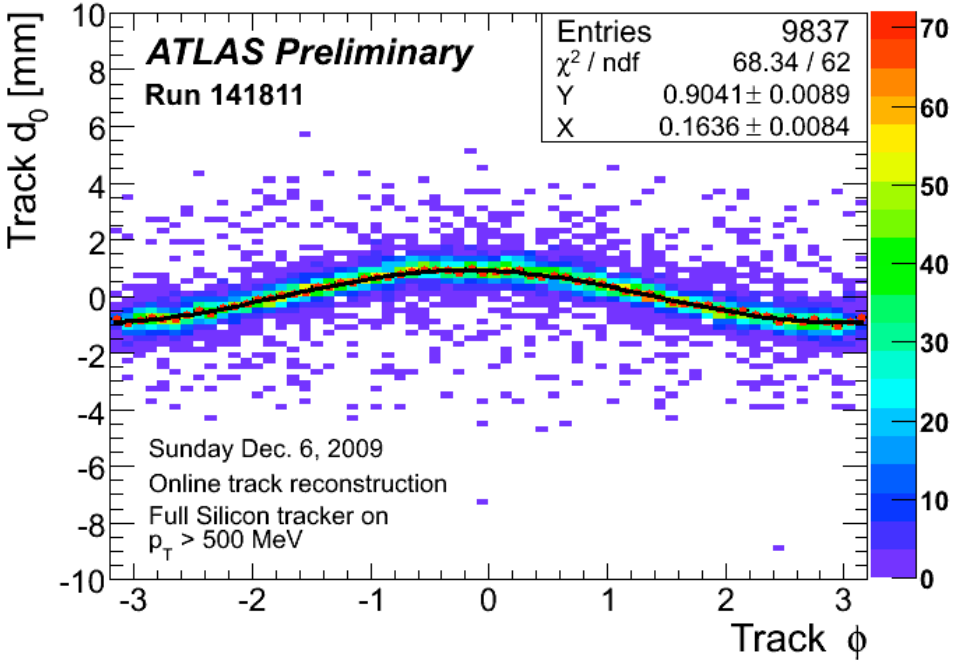


HLT Tracking

- Efficiency for L2 tracks close to 100%; compares well to MC
- L2 tracking used online for beamspot calculation and feedback to LHC
- L2 tracking algorithm processing time per event – average 40ms/event for whole L2

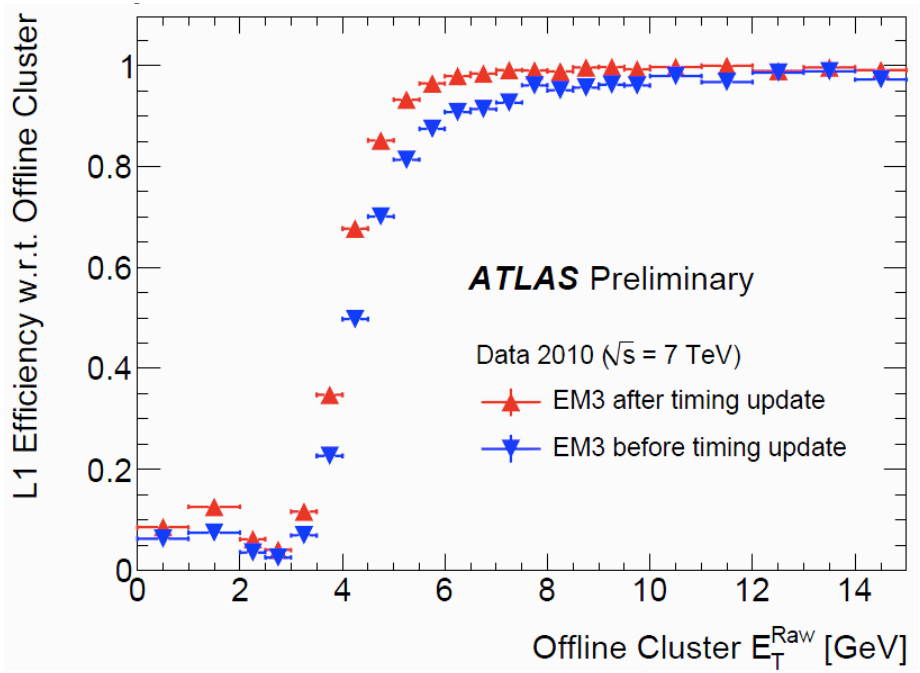


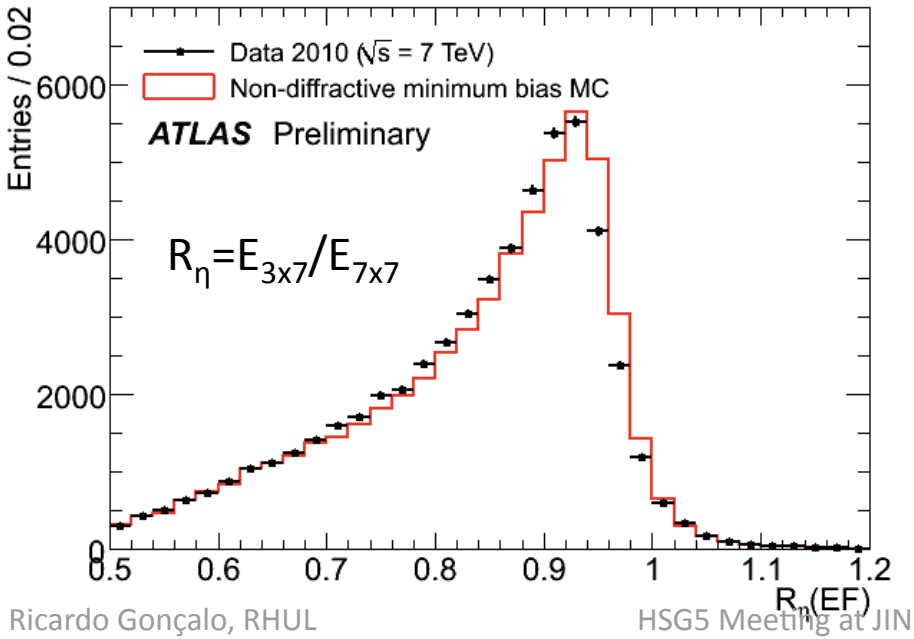




e/gamma Trigger

- Improvements from L1Calo timing
- HLT some disagreement in shower shapes between data and MC – likely cross talk, or dead material map in MC not correct
- Rates show EM2 will need to be prescaled or HLT rejection @ 10^{29}
- L2 track cluster matching well described by MC



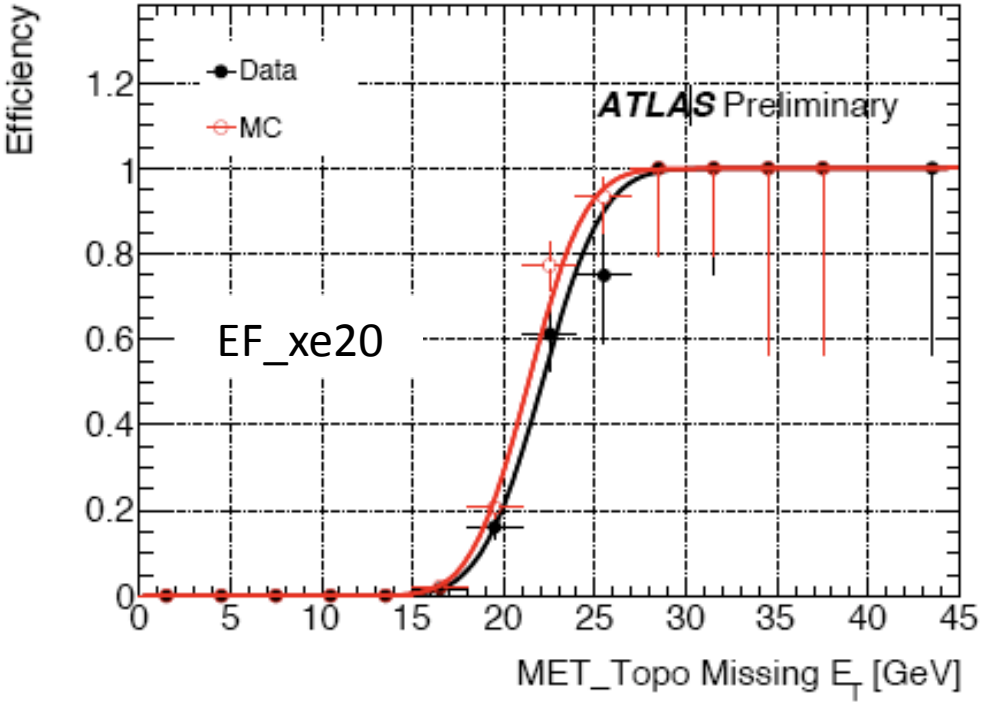


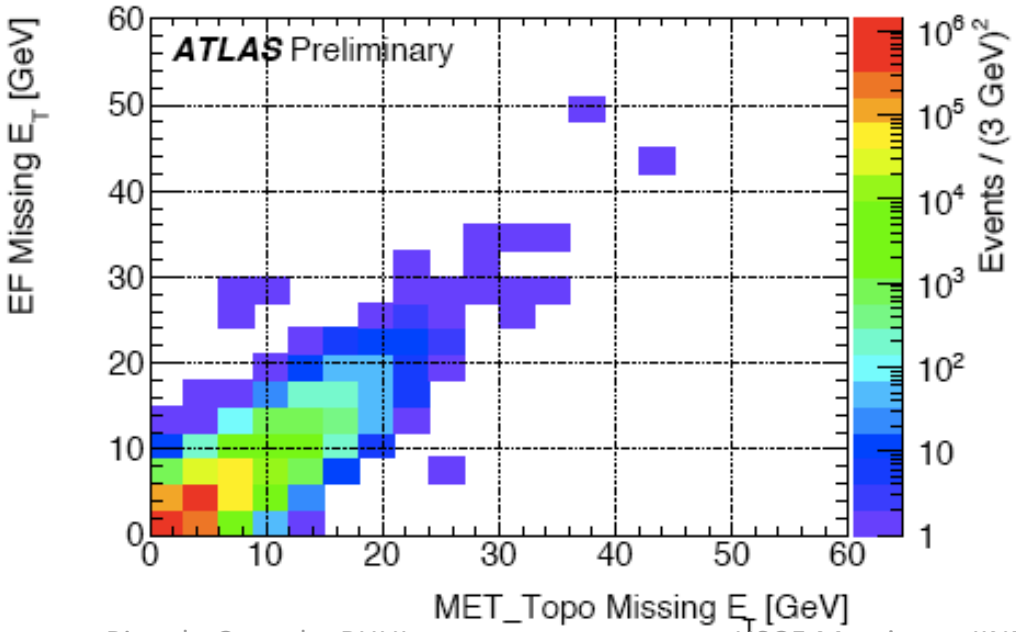
L1 rates measured for 10^{27} cm^{-2}s^{-1} – stat. errors only (luminosity error ≈20%)

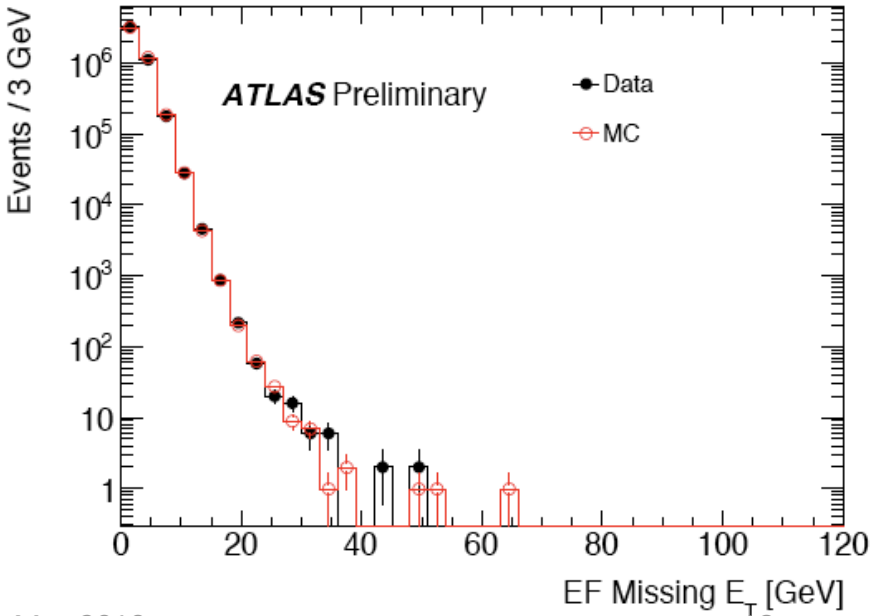
Trigger	Rate (Hz)
EM2	1.282 ± 0.005
EM3	0.515 ± 0.003
EM4	0.252 ± 0.002
EM5	0.142 ± 0.002
EM10	0.021 ± 0.001
EM14	0.008 ± 0.001

Missing E_T

- Turn-on curve for EF_xe20 with 7TeV data compared to MC
- Data-MC comparison of E_T^{miss} at the Event Filter after jet-cleaning cuts (stat. errors only)
- Correlation between online and offline at E_t^{miss} 7 TeV

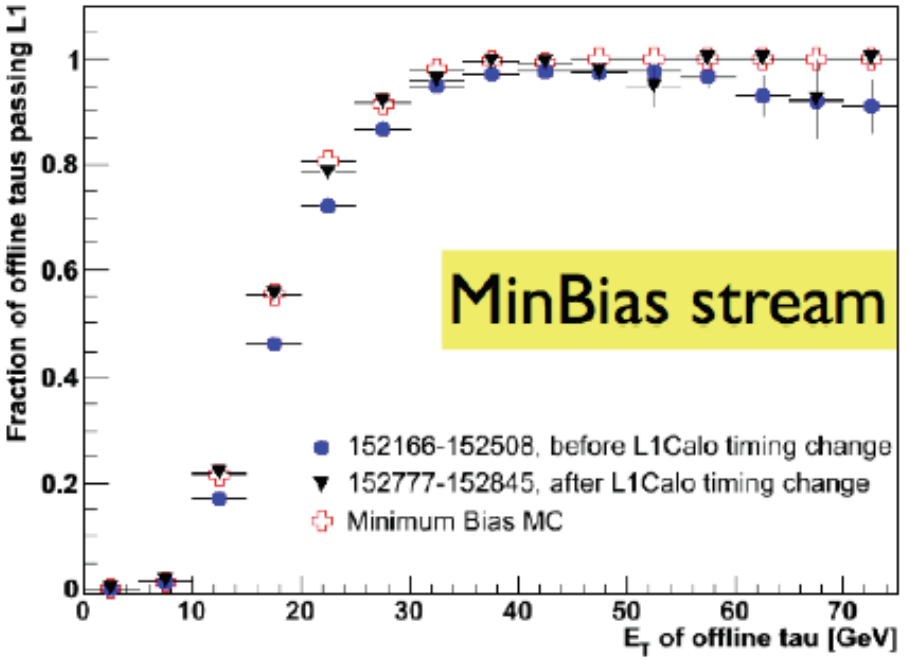


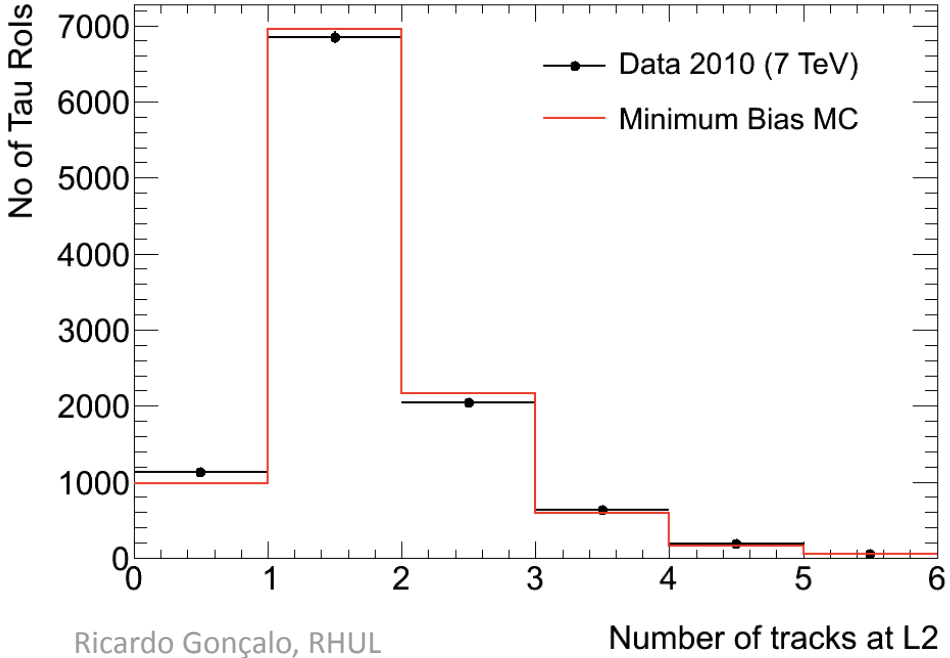


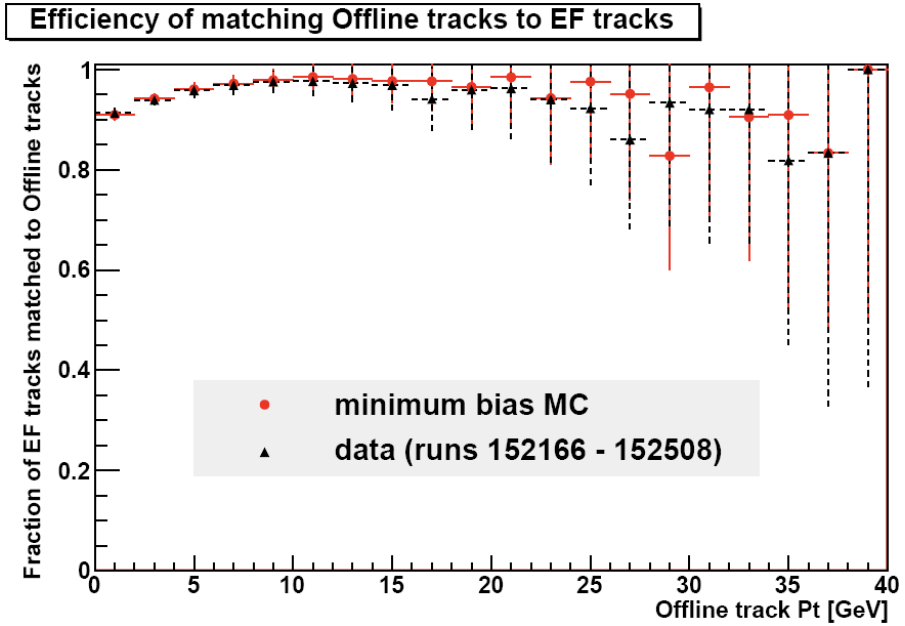


Tau

- Improvement of the L1 tau efficency after L1Calo timing change
- EF tracking efficiency for tau candidates:
- Offline: Pt>1GeV, nPIXhits >=1 , nSCThits >=6
- EF tracks: Pt > 0.5 GeV, nPixhits >=1, nSCThits >=6
- #tracks in tau candidates: MinBias MC compared to 7TeV

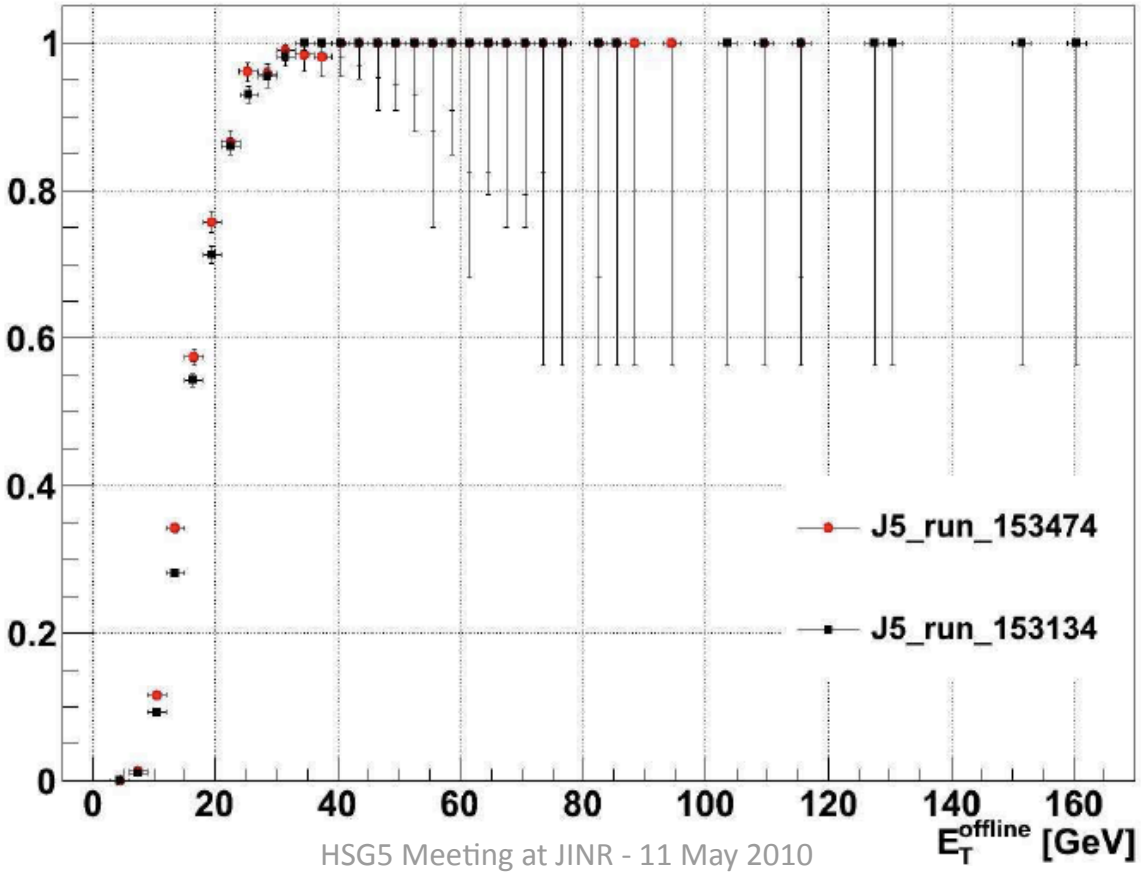






Jets

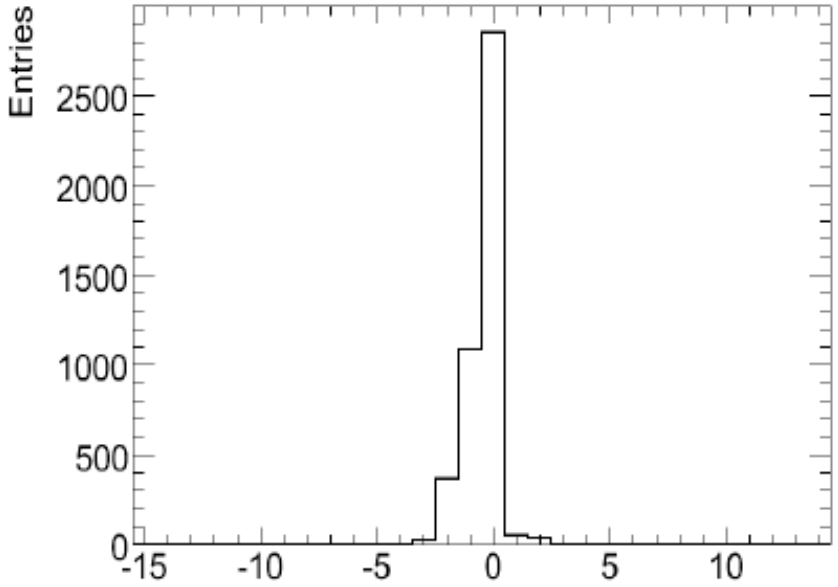
- Improvements from L1Calo timing in – better agreement with MC
- Investigated changing L1Calo noise threshold from 4 to 3 ADC counts – no significant change
- Moving trigger jet energy scale to EM scale
- Planning to introduce jet-cleaning cuts online

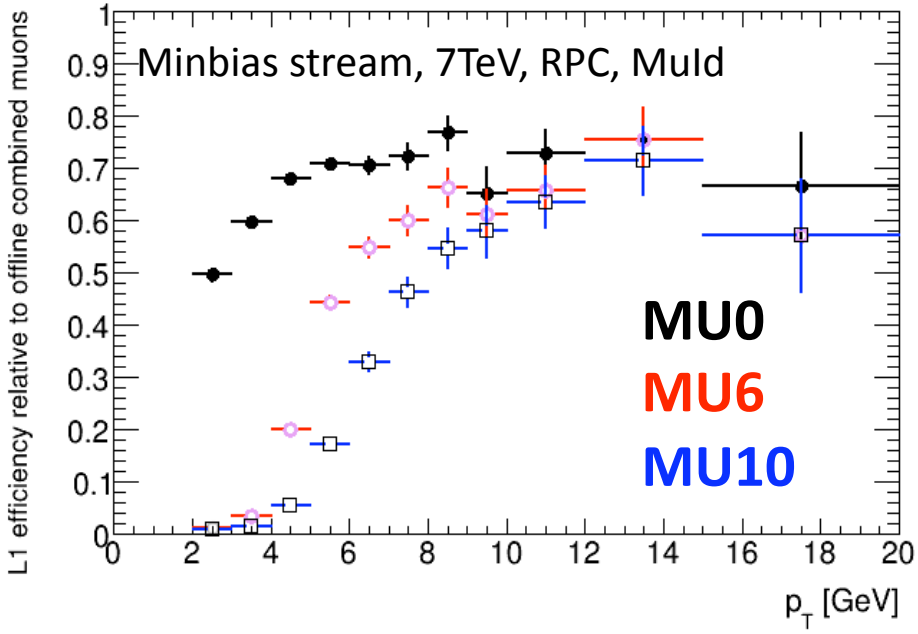


L1 Muon – RPC

- Currently fighting problems with timing-in RPC
  - Need more non-cosmic muons

- Problem : MU6 is expected to be as efficient as MU0 for p_T>6 GeV – under investigation
  - Problem possibly from non-prompt muons plus chamber inefficiency



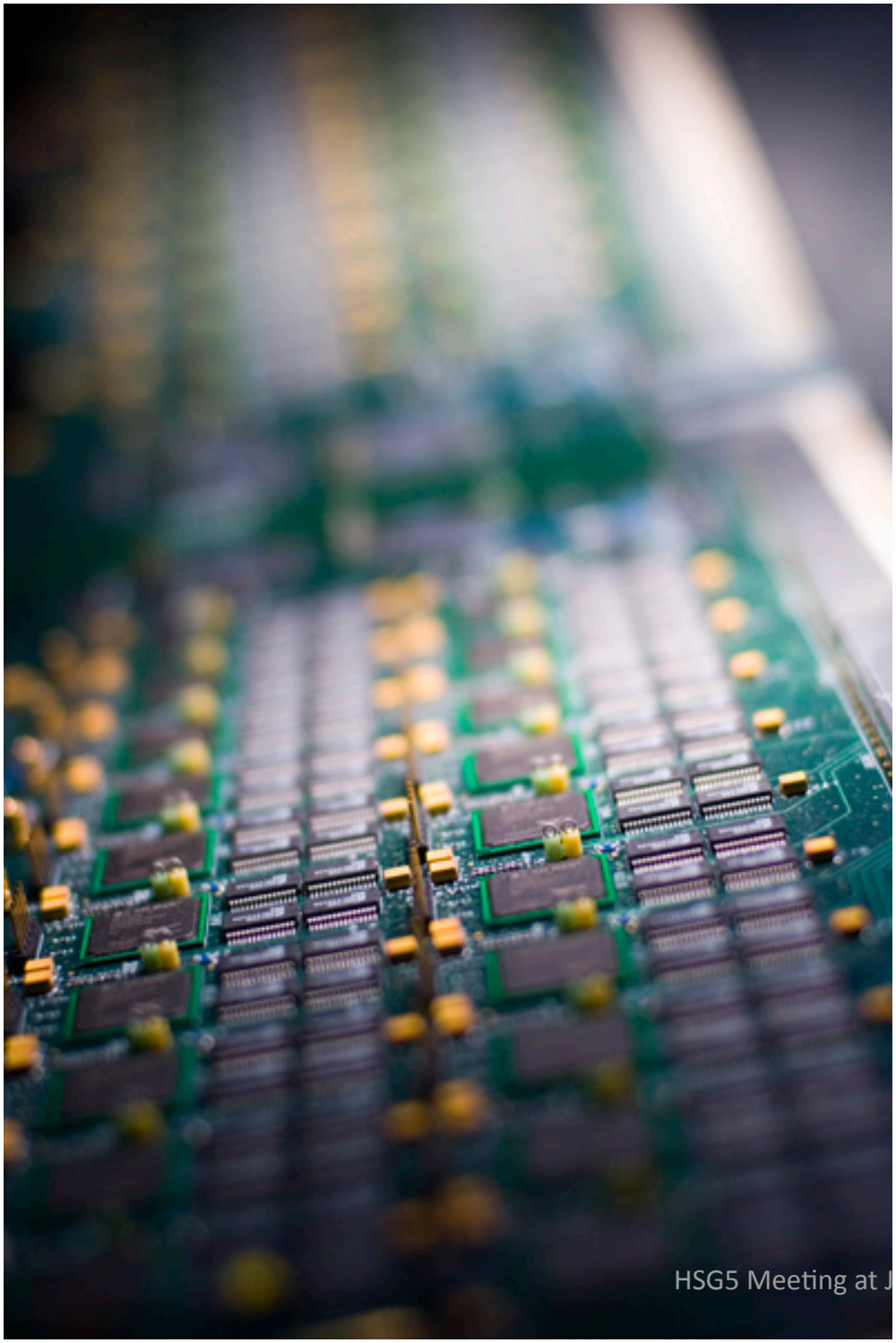


Rate predictions

7 TeV data rates

All rates in mHz MC uses InitialBeam_v1, data uses InitialBeam_v2

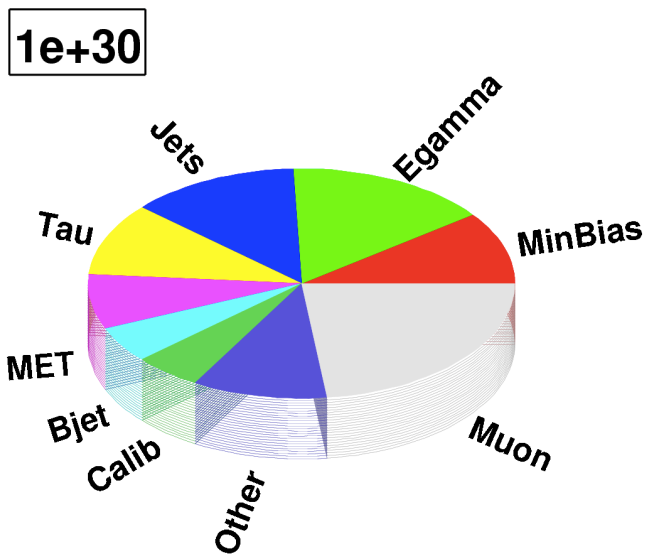
Trigger	No cuts	DQ cut	MBTS_1_1	Timing	mc09	mc09/data	error
MBTS_1_1	32918	56763	56763	54310	–	–	–
TE10	946.1	1628.6	1628.3	1627.5	–	–	–
EM2	686.2	1184.2	1182.2	1178.2	–	–	–
EM3	276.80	478.20	477.60	476.20	971.00	2.039	0.016
EM5	74.53	128.00	127.90	127.50	295.10	2.315	0.035
EM10	10.83	18.82	18.82	18.75	44.73	2.386	0.092
J5	159.10	273.60	273.20	272.70	646.10	2.369	0.024
J10	33.70	58.20	58.10	58.00	140.40	2.421	0.054
J15	12.530	21.890	21.840	21.750	48.36	2.223	0.080
FJ18	0.489	0.820	0.820	0.820	10.80	13.171	2.284
TAU5	100.90	173.30	173.00	172.70	372.40	2.156	0.027
TAU6	63.35	108.90	108.80	108.50	238.80	2.201	0.035
TAU8	29.57	51.00	50.90	50.80	114.10	2.246	0.053
MU0	35.14	61.40	58.10	57.50	122.50	2.130	0.048
MU6	5.69	9.91	9.25	9.09	47.15	5.187	0.278
MU20	0.193	0.362	0.362	0.338	0.497	1.470	0.442
XE10	20.160	34.840	34.820	34.700	196.800	5.671	0.156
XE15	5.600	9.810	9.790	9.710	36.690	3.779	0.197
XE20	2.230	3.770	3.750	3.700	9.770	2.641	0.230

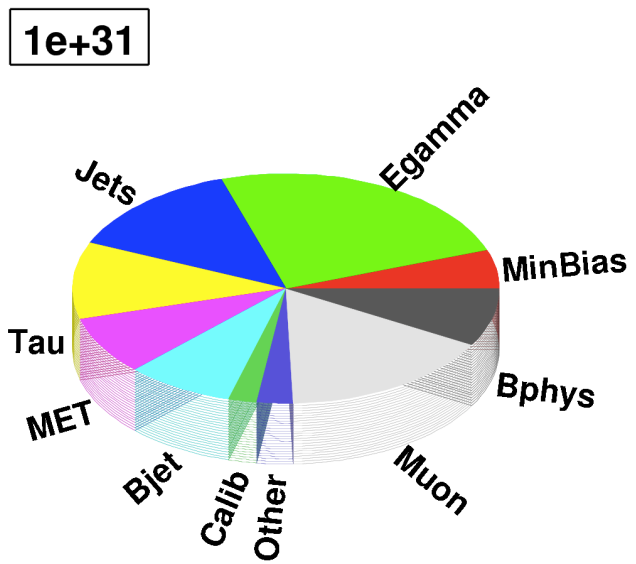


THE PHYSICS MENU

Menu Coordination News

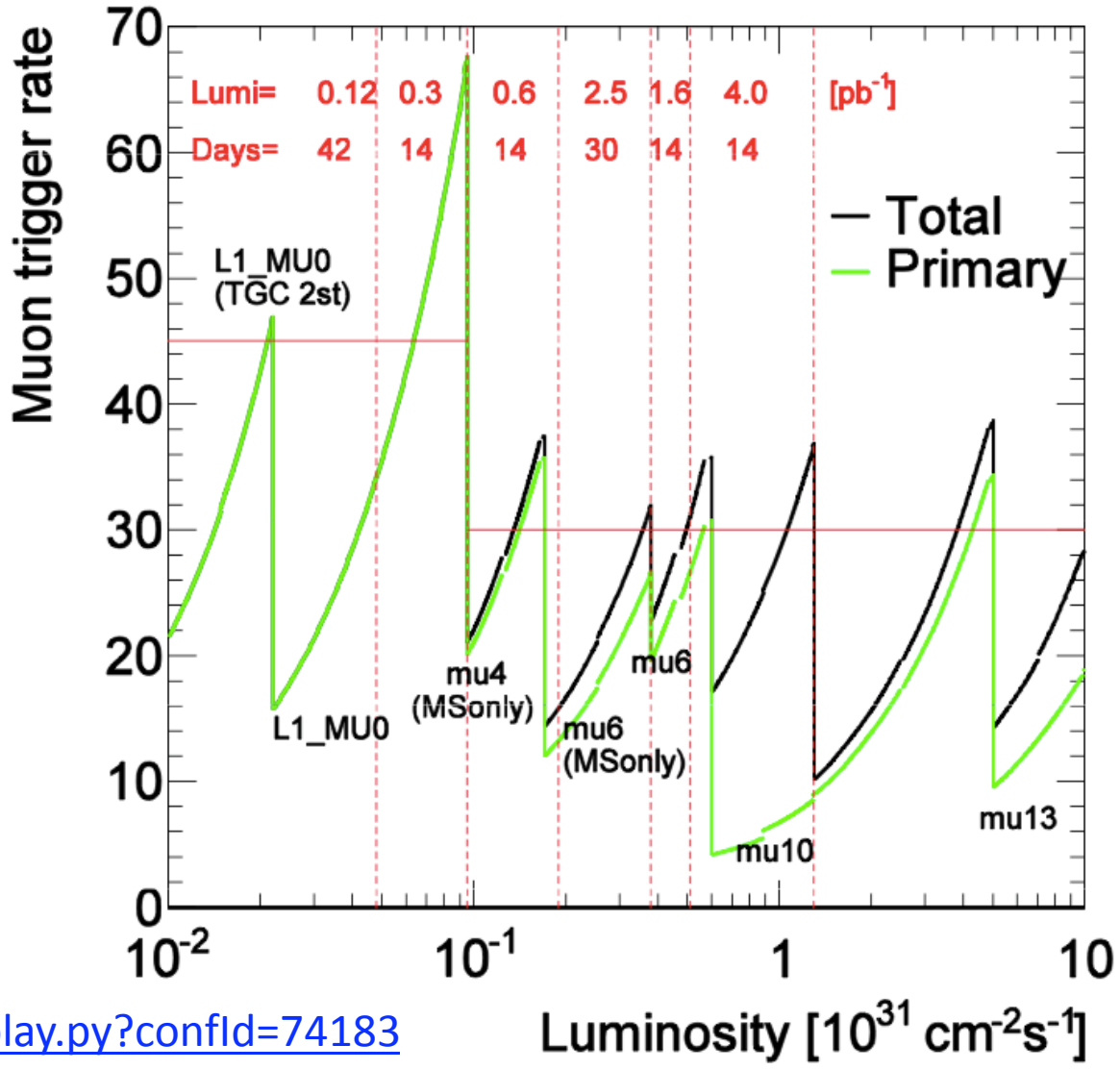
- Physics menu to be used when we reach $10^{30}cm^{-2}s^{-1}$
  - Menu currently being designed
  - Will be available until the end of this year (from 10^{31} to $10^{32}cm^{-2}s^{-1}$)
    - To improve uniformity and ease operations
  - A preliminary version will be made available soon for input from physics and CP groups
- Final approval at the end of May for deployment anytime afterwards





Muons

- Primary Physics Triggers as a function of luminosity
- Primary trigger **mu10** up to $4x10^{31}$
- Then move to **mu13** up to 10^{32}



Details in
http://indico.cern.ch/conferenceDisplay.py?confId=74183

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

Note: zero pileup assumed

- Not yet enough stat from data plus not all triggers in initial beam menu, use rates from 15.5.5 and divide by 2.5 (safe estimate comparing data/MC)

2e3_loose	4 Hz (est.)
2e3_medium	2 Hz
2e5_medium	0.6 Hz
2g10_loose	few Hz (est.)
e3_loose (presc)	few Hz
g10_loose (presc)	1 Hz
e10_loose	20 Hz (est.)
e10_medium	11.4 Hz
e20_loose	1.5 Hz
g20_loose	6.2 Hz
em105_passHLT	<1 Hz

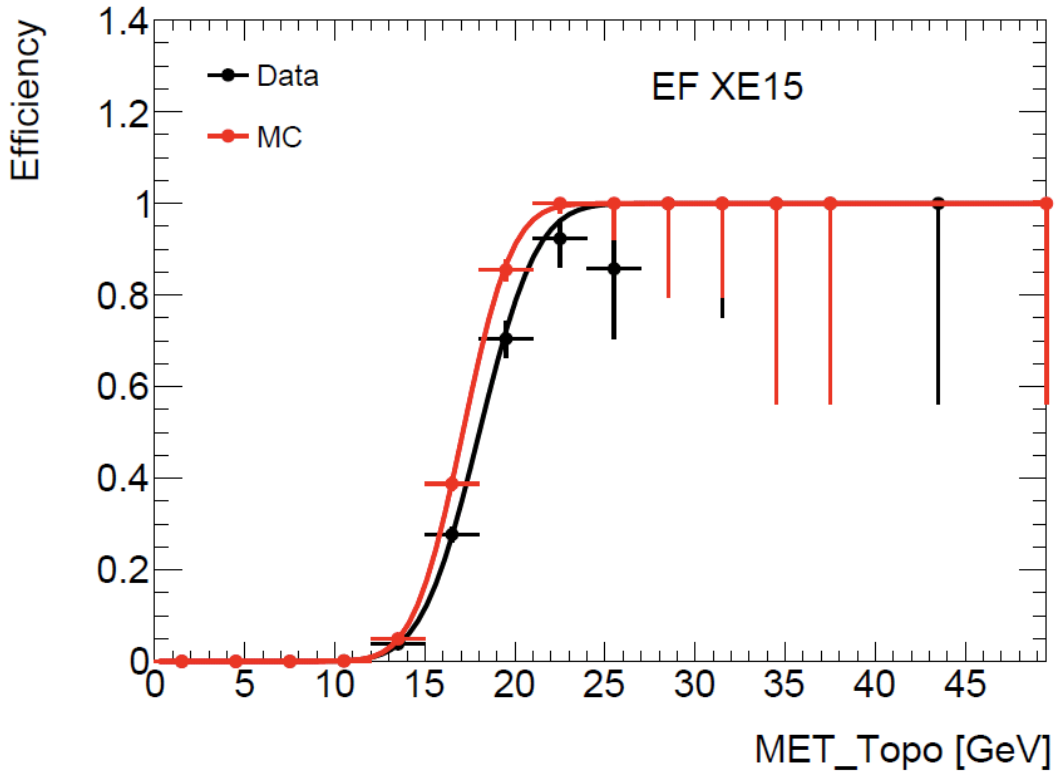
- Plus ~5Hz of monitoring triggers
- Total: ~45Hz
- Comments
  - As rates lower than expected run with EM2 in physics menu and use 2e3_loose instead of 2e5_medium
  - Use e10_loose instead of e10_medium
  - Add 2g10 trigger (recent request)
  - As not all rates are yet known, so add some backup, e.g. 2e3 seeded from EM3

Up to Lumi= few times $10^{31}cm^{-2}s^{-1}$

- Note: by this time we will upload new optimisations which should bring the rates down a bit
- However, now we also have to consider pile-up which increases rates
- Evolution:
  - e10_loose (~$1 \cdot 10^{31}$) → e10_medium, e15_loose (~$2 \cdot 10^{31}$) → e10_tight, e15_medium (~$4 \cdot 10^{31}$) → e15_tight
  - 2e3_loose (~$1 \cdot 10^{31}$) → 2e3_medium (~$3 \cdot 10^{31}$) → 2e3_tight, 2e5_medium or 2e3_medium prescaled
  - g20_loose (~$2 \cdot 10^{31}$) → g20_tight
  - Above depends as well on how fast we ramp up. We don't want to change menu every 2 weeks…

Missing ET

- The hope is to have xe30 unprescaled up to a luminosity of 10^{31}
- An inclusive bandwidth of 20Hz was requested so that xe30 can remain unprescaled up to 10^{32}
- Current bandwidth allows running XE15 unprescaled up to 10^{30} (around 15Hz)



D.Casadei

tau50_loose + higher	6.3 Hz
2tau20_loose	2 Hz
tauNoCut_trk9_xe25	5.1 Hz
tau12_loose_xe20	5.1 Hz
tau16_loose_e10_loose	3.8 Hz
tau16_loose_mu10	1.4 Hz
tau16_loose_3j40	1 Hz
Monitoring various	2 Hz

MC

1.3 10^31

Large overlap of
2 tau+met items and
Large overlap with MET
and egamma
=> It is <~ 15 Hz

When looking at rates in data for run 153565 (see rustem online rates)

tau50_loose + higher	3 Hz
2tau20_loose	<1 Hz
tauNoCut_hasTrk9_xe25	<1 Hz
tau12_loose_xe20	1 Hz
tau16_loose_e10_loose	1 Hz
tau16_loose_mu10	< 1 Hz
tau16_loose_3j40	0 Hz
Monitoring various	2 /hz

DATA
(extrapolated)

Monitoring : tau12_loose/ tau12_loose_PT and maybe some L1 (HLT in PT) chain for high pT

Stefania Xella

Work in progress

1 10^32 **no pileup**

(*)
All missing in 10^31 menu

tau84_medium	6 Hz
tau125_loose	<1 Hz
2tau29_medium	3 Hz
tau16i_medium_xe25	10 Hz
tau16i_medium_e15i	7 Hz
tau16i_medium_mu15	7 Hz
tau16_medium_3j40	3 Hz
Monitor. various	2 Hz

MC

Use of medium and isolated for tau triggers in view of scenario with only short time at 10^31 and long at 10^32

When looking at rates in data for run 153565 (see rustem online rates)

+ additionally tau16i_medium -> tau29_loose combinations for tau+X as support (possibly e15i -> e15, request from tau WG). Rate for these is largely overlapping with above.

tau84_loose + higher	6 Hz
2tau29_loose	3 Hz
Tau16_loose_xe25	10 Hz
Tau16_loose_e15	7 Hz
Tau16_loose_mu15	7 Hz
Tau16_loose_3j40	3 Hz
Monitor. various	2 Hz

DATA
(extrapolated)

b-jet input to physics menu

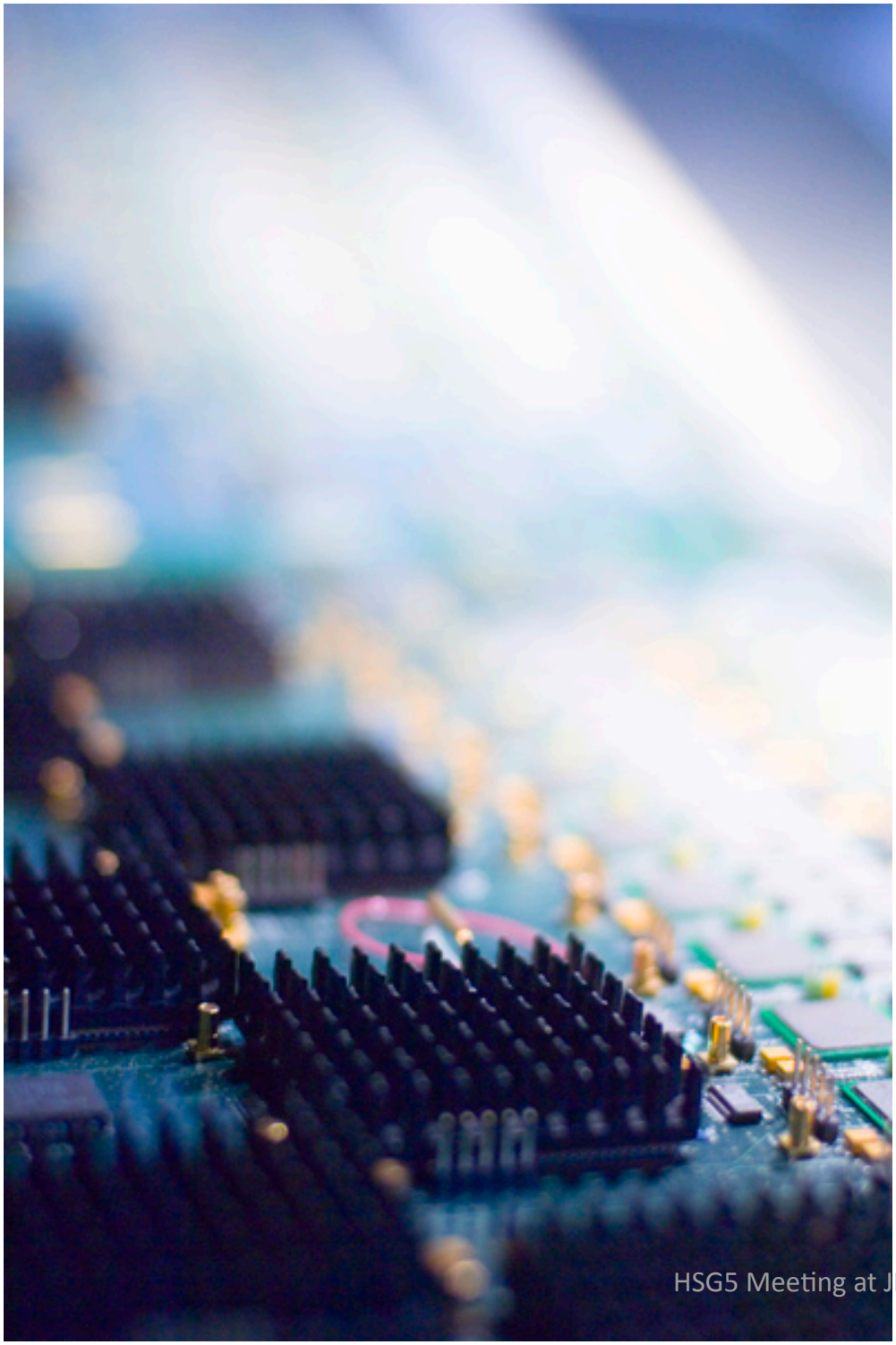
Input is not, unfortunately, based on data experience.
Joint beamspot+*b*-jet CAF reprocessing is going to start and will allow us to evaluate performance of the *b*-jet slice taking into account the beam spot parameters evaluated online (so far online beam spot parameters are not uploaded in the condition folder).

- `-- What are the primary physics triggers for the Luminosity range of 1030 to 1032 for each lumi step (if prescaled then to which rate)`

  2b20_3L1J20, 3b20_4L1J20, 1b40_2b20_3L1J10, 1b40_2b20_3L1J20, 2b40_3L1J20, 3b20_4L1J10.
  All unprescaled: at present they only account for 0.07 *Hz* at 10^{31} *Hz*.

  One can say that is a quite conservative approach..
  Indeed we would like to relax a bit the selection or decrease the thresholds but beforehand we need to understand out performance on data (beamspot dependence, performance of different taggers).

  - Proposal: add few, lower thresholds, signatures (ready to prescale them is the rate becomes too high).



CONCLUSIONS

- An enormous amount of activity is taking place in the trigger
- The increasing LHC luminosity means the HLT will soon need to actively reject events
- Trigger performance needs to be understood before activating the HLT in rejection mode
- Moving from commissioning menu to physics menu

BACKUP SLIDES

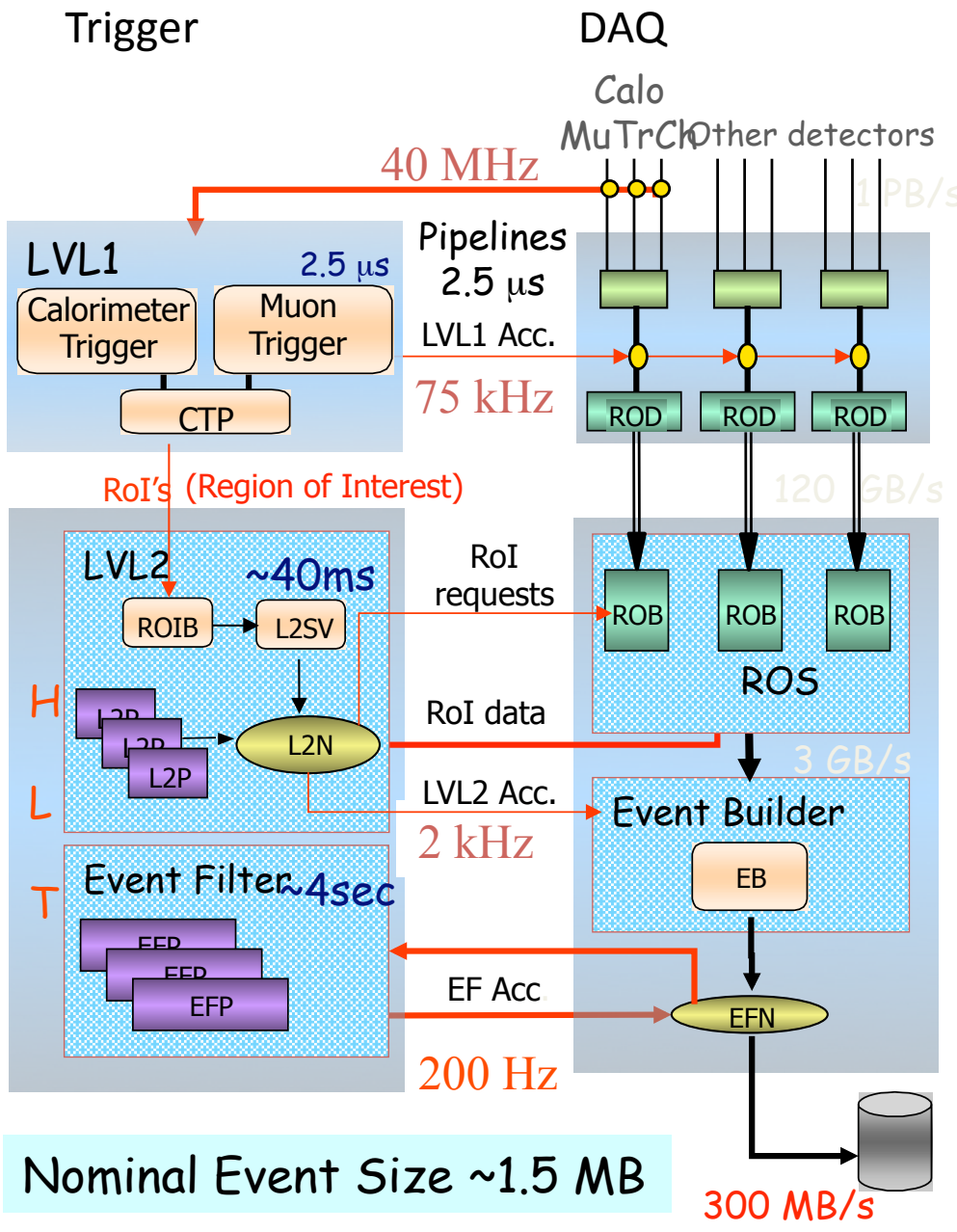
- Three trigger levels:
- Level 1:
  - Hardware based
  - Calorimeter and muons only
  - Latency 2.5 μs
  - Output rate ~75 kHz

- Level 2: ~500 farm nodes(*)
  - Only detector **"Regions of Interest" (RoI) processed - Seeded by level 1**
  - Fast reconstruction
  - Average execution time ~40 ms(*)
  - Output rate up to ~2 kHz

- Event Builder: ~100 farm nodes(*)

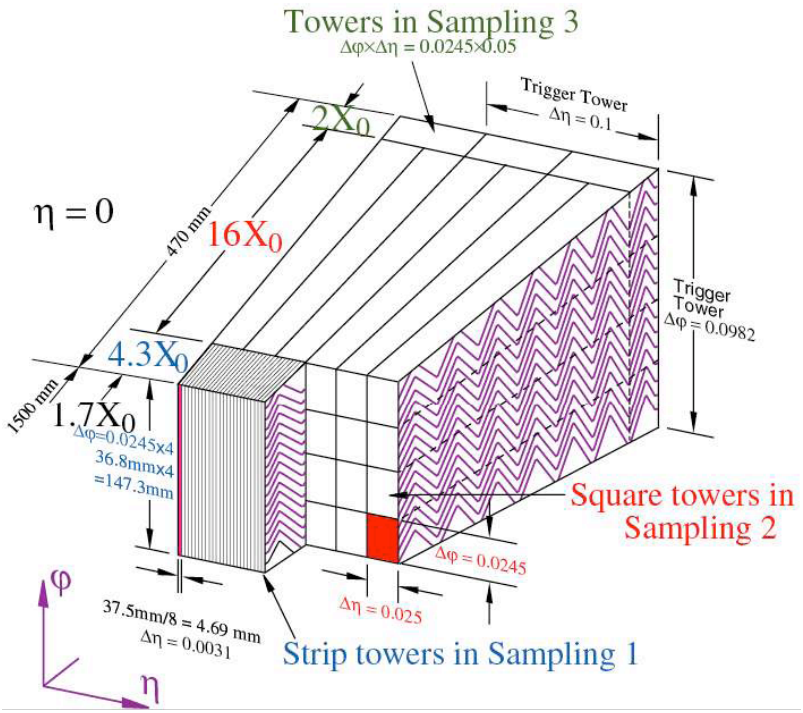
- Event Filter (EF):~1600 farm nodes(*)
  - Seeded by level 2
  - Potential full event access
  - Offline algorithms
  - Average execution time ~4 s(*)
  - Output rate up to ~200 Hz

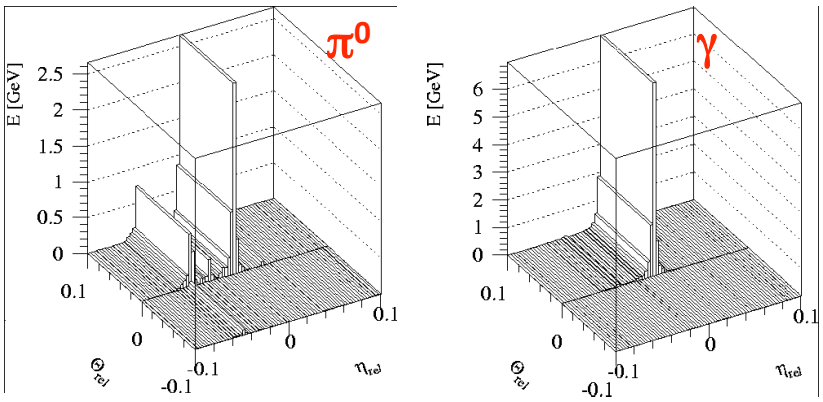
(*) 8CPU (four-core dual-socket farm nodes at ~2GHz



Example: level 2 e/γ calorimeter reconstruction

- Full granularity but short time and only rough calibration
- Reconstruction steps:
  1. LAr sample 2; cluster position and size (E in 3x3 cells/E in 7x7 cells)
  2. LAr sample 1; look for second maxima in strip couples (most likely from $\pi^0 \rightarrow \gamma\gamma$, etc)
  3. Total cluster energy measured in all samplings; include calibration
  4. Longitudinal isolation (leakage into hadronic calorimeter)
- Produce a level 2 EM cluster object (note EDM different from offline)

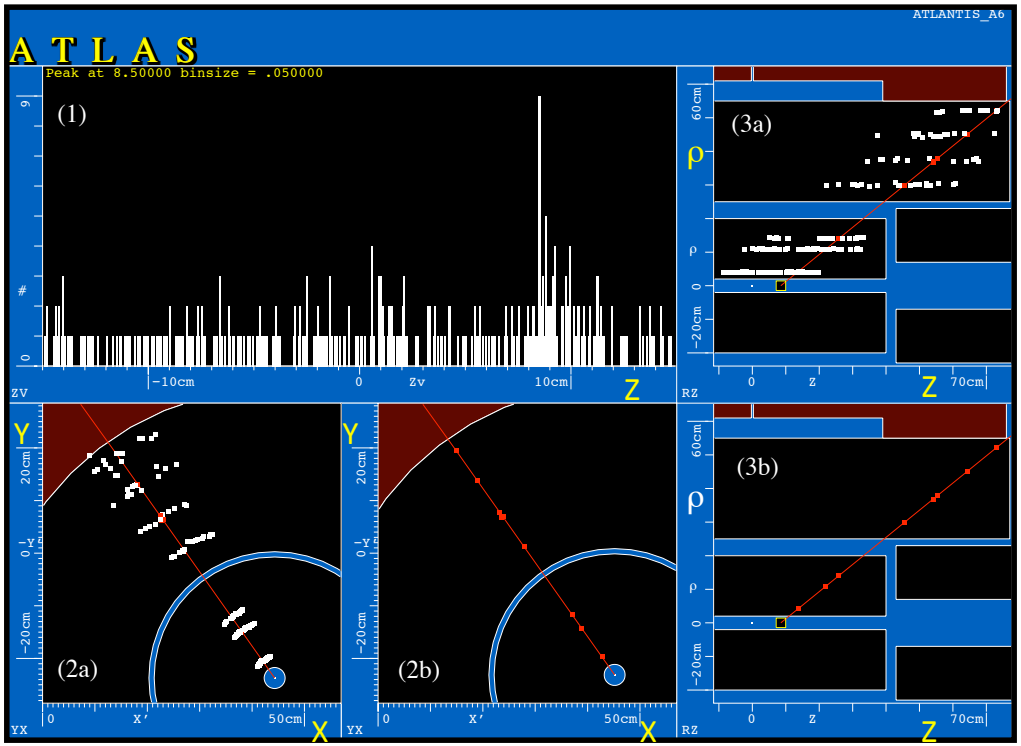




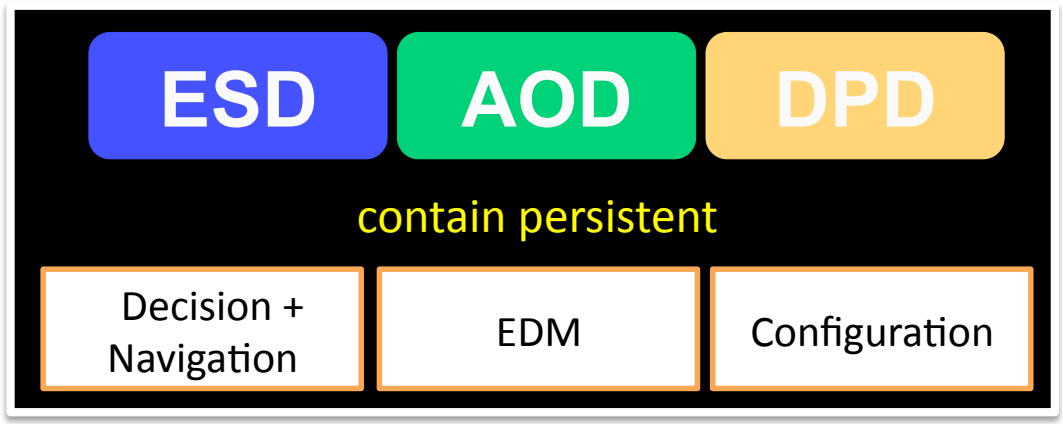
Example: level 2 tracking algorithm

1. Form pairs of hits in Pixel and SCT in thin ϕ slices;
   - extrapolate inwards to find Z_{vtx} from a 1D histogram
2. Using Z_{vtx}, make 2D histogram of hits in η-ϕ plane;
   - remove bins with hits in too few layers
3. Do 2D histogram using space point triplets in $1/p_T$-ϕ plane;
   - Form tracks from bins with hits in >4 layers
4. Use Kalman technique on the space points obtained in previous steps
   - Start from already estimated parameters: Z_{vtx}, $1/p_T$, η, ϕ

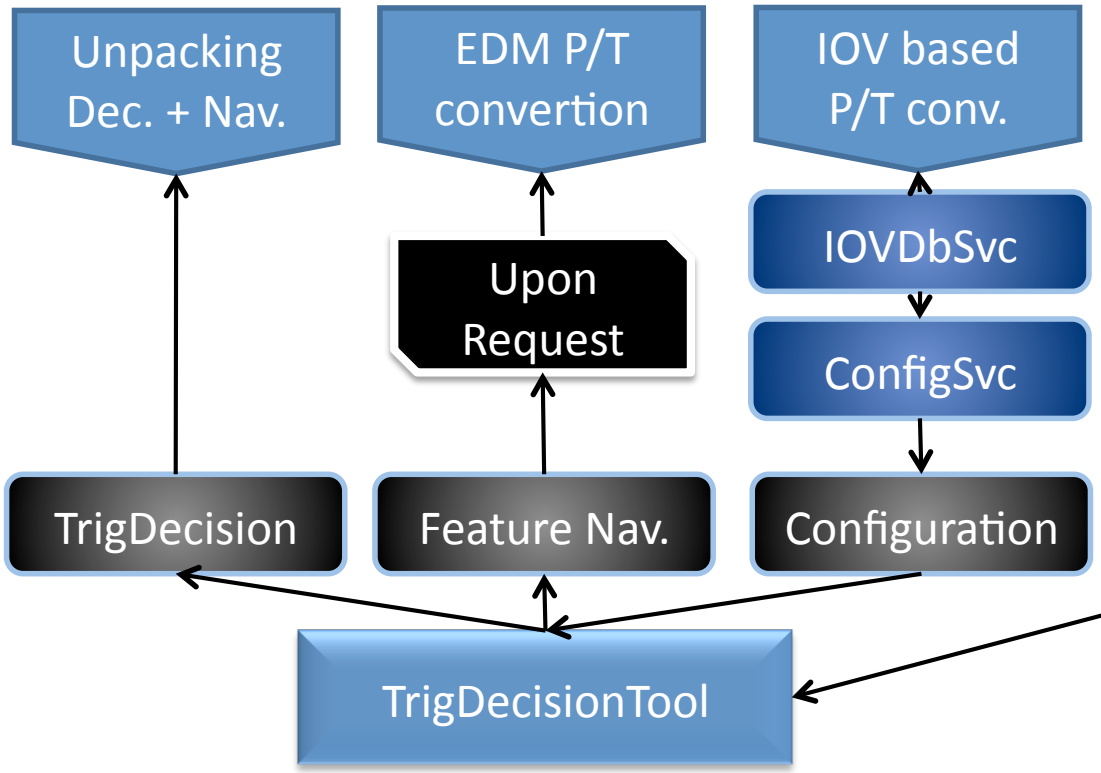
- Full granularity but short time
- Algorithms optimised for execution speed, including data access time
- Produce level 2 tracks



Bringing it Together – TrigDecisionTool



Transient:



Configuration can change between runs

BUT:

Prescales can change between lumiblocks (trigger on/off)

Tool Usage

1. Alg.h: define ToolHandle to a TrigDecisionTool

2. Alg.cxx – Alg::Alg(): declare ToolHandle as public tool

3. Alg.cxx – Alg::initialize(): retrieve tool
   - Has to be in initialize()!

4. Alg.cxx – Alg::execute(): use tool

```
private:
    ToolHandle<Trig::TrigDecisionTool>  tdt;
```

```
MyAlgo::MyAlgo(const std::string &name, …)
tdt("Trig::TrigDecisionTool/TrigDecisionTool")
{…}
```

```
StatusCode sc = tdt.retrieve();
```

```
if (tdt->isPassed ("L2_e15i"))  {
    log << MSG::INFO << "I'm happy!" << endreq;
}
```

TWIKI: https://twiki.cern.ch/twiki/bin/view/Atlas/TrigDecisionTool15
Doxygen: http://atlas-computing.web.cern.ch/.../TrigDecisionTool/html/

Working with ChainGroups

1. Alg.h: define ChainGroup pointer

```
const Trig::ChainGroup* mMyTrigger;
```

2. Alg.cxx – Alg::initialize(): declare ChainGroup
   - Note: the ChainGroup automatically updates with each run (chain content) and lumiblock (prescales)
   - Use regular expressions, e.g. "EF_e.*"

```
mMyTrigger =

tdt.createChainGroup("EF_e10_loose","EF_mu10",...);
```

3. Alg.cxx – Alg::execute():
   - Access to trigger configuration

```
bool useLB = ! mMyTrigger->getListOfTriggers().empty();
```

   - Access to trigger decision

```
bool myEvent = mMyTrigger.isPassed();
```

   - Access to trigger objects

```
const Trig::FeatureContainer fc = mMyTrigger.features();
const std::vector< Trig::Feature< TrigTau > > taus =
      fc.get();
```

Anonymous ChainGroups:
- Note that one can work without steps 1 and 2. In Alg::execute() define the triggers on the fly:
- Equally fast (TDT keeps ChainGroups)

```
string  tr ("EF_e10_loose");
bool useLB = ! tdt->getListOfTriggers().empty(tr);
bool myEvent = tdt->isPassed(tr);
const Trig::FeatureContainer fc = tdt.features(tr);
```

Athena Example for using Features

FeatureContainer for 'EF_tau16i_loose_2j23'

Access the feature

You need to know the type of the Feature: 'JetCollection' in EF

Access the object (implicit conversion)

Access information of object

Find corresponding L2 jet using TDT::ancestor<T>

```
FeatureContainer f = tdt->features("EF_tau16i_loose_2j23");  // creating the feature container
std::vector< Feature<JetCollection> > jetColls = f.get<JetCollection>();
mLog << MSG::INFO << "Number of JetCollections: " << jetColls.size() << endreq;
if(jetColls.size()>0) {
   const Feature<JetCollection>& jcf = jetColls[0]; // get the first Feature
   mLog << MSG::INFO << "Label: " << jcf.label() << endreq;
   const JetCollection* jc = jcf;    // implicit Feature -> object conversion
   mLog << MSG::INFO << "Number of Jets: " << jc->size() << endreq;
   JetCollection::const_iterator jIt = jc->begin();
   for (; jIt != jc->end(); ++jIt ) {
      Jet* jet = *jIt;
      mLog << MSG::INFO << "Jet e : " << jet->e() << endreq;
   }
   // find the corresponding jets in LvI2 through the inheritance tree (navigation does that all)
   Feature<TrigT2Jet> l2jetF = tdt->ancestor<TrigT2Jet>(jcf);
   mLog << MSG::INFO<<"Found "<< (l2jetF.empty()?"no ":"")<< "corresponding L2 Jet."<<endreq;
   if ( !l2jetF.empty() ) {
      const TrigT2Jet* t2jet = l2jetF.cptr(); // explicit Feature -> object conversion
      mLog << MSG::INFO << " e : " << t2jet->e() << endreq;
   }
}
```

Output:

```
Number of JetCollections: 1
TE Label: TrigJetRec
Number of Jets: 1
Jet e : 82827.9
Found corresponding L2 Jet.
e : 83197.4
```

Tools to Investige the Trigger Setup

- http://atlas-trigconf.cern.ch:
  - Main web portal to trigger configuration by run number, MC menu name, configuration keys
  - Uses TriggerTool and AtlCoolTrigger.py underneath

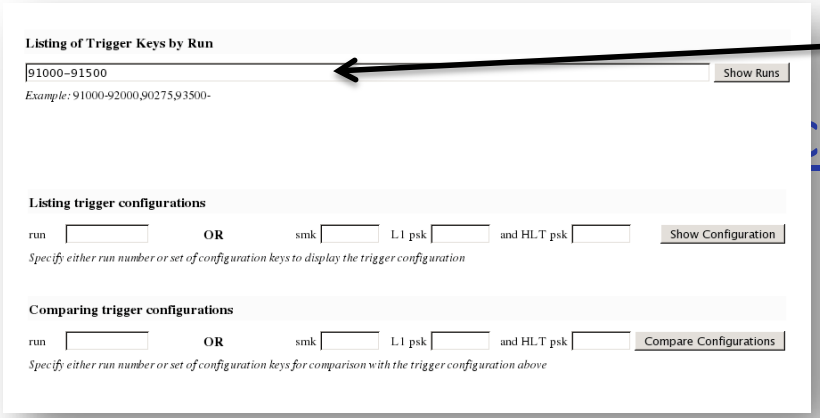
- TriggerTool:
  - Java based GUI to browse the TriggerDB (replica) for all information
  - Also used at point 1 for preparation of trigger

- AtlCoolTrigger.py:
  - Command line tool to show release, configuration keys, menu information, streams for data

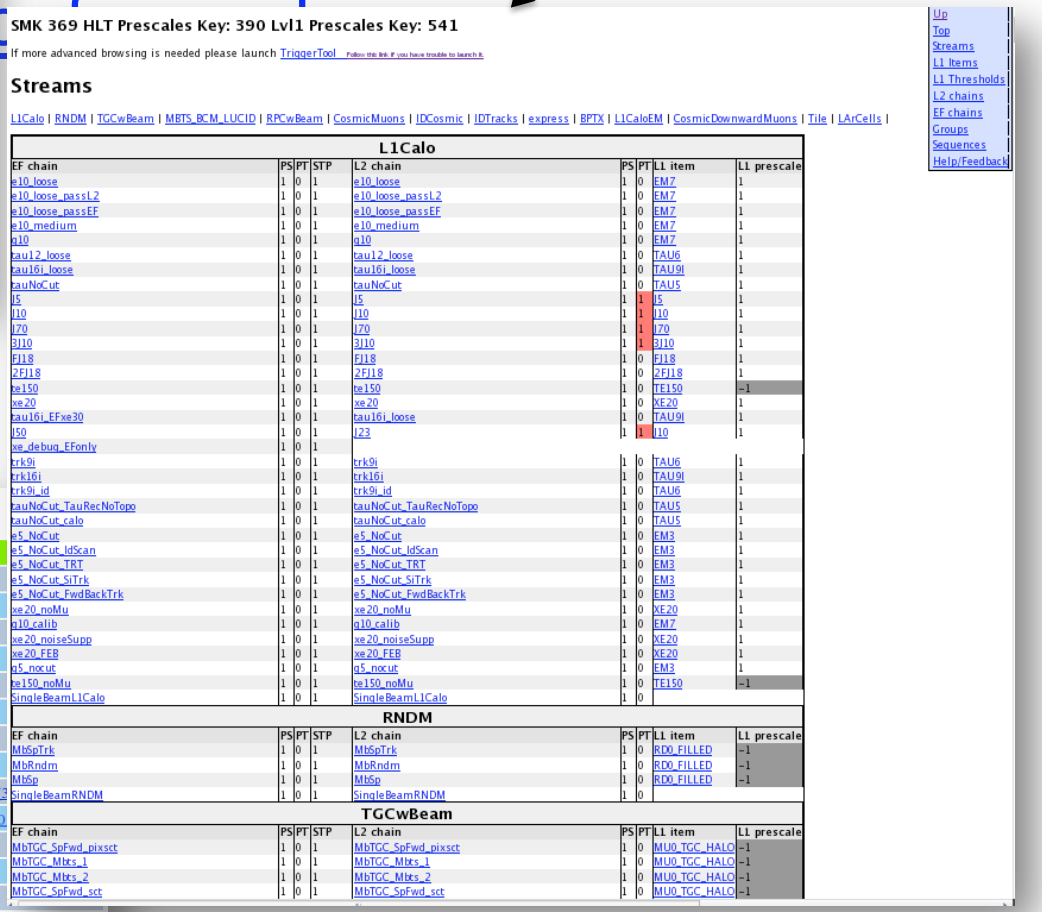
- http://atlas-runquery.cern.ch/
  - Query page for trigger chains, prescales, trigger release for data

Example for the Configuration Portal

3. Browse the trigger configuration (definition, algorithms, selection cuts)

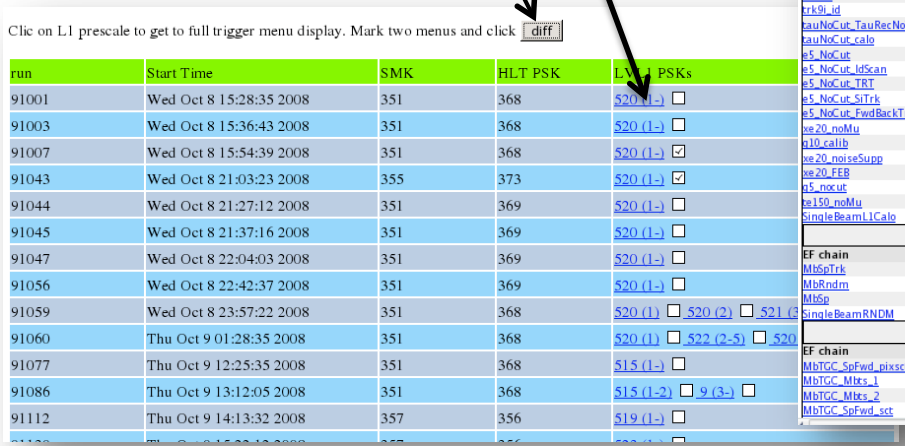


1. Enter run-range



2. Click on link in resulting run list

Also with simple comparison functionality

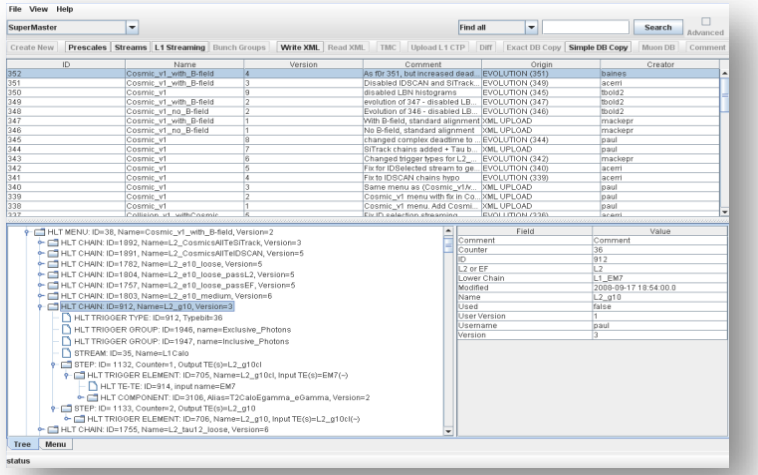


Trigger Menu Listing

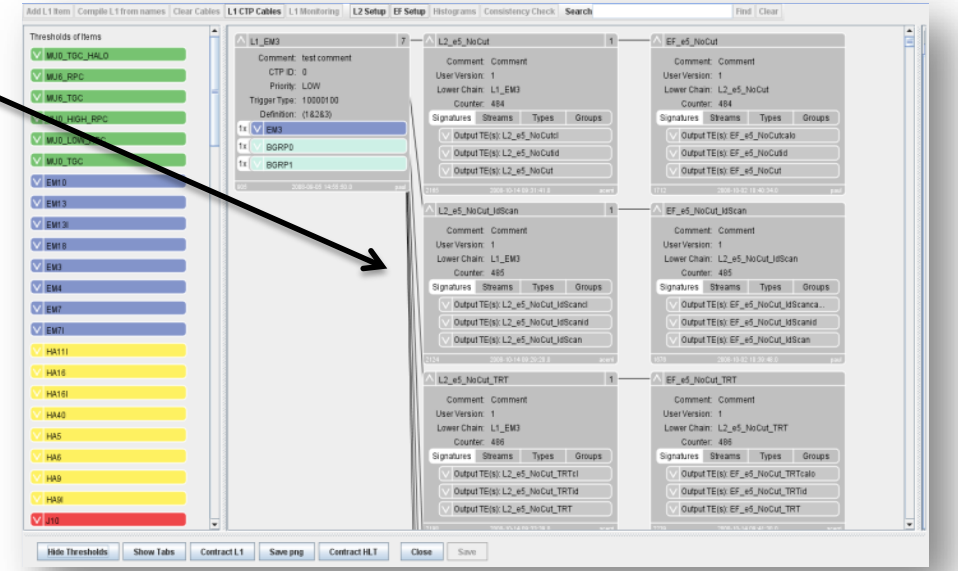
- Trigger Menu and L1 rates stored in COOL, HLT rates coming. Quick access via
  - AtlCoolTrigger.py (command line tool)
    - AtlCoolTrigger.py –r 91000-99000 (many run summary)
    - AtlCoolTrigger –v –m –r 90272 (single run menu)
      - Prints keys, trigger menus, streams, allows diff-ing of menus in different runs, creates menu in xml format
  - Run summary pages (WEB based): **http://atlas-service-db-runlist.web.cern.ch/atlas-service-db-runlist/query.html**
    - Trigger names, rates for single run

TriggerTool

- Java based front end to TriggerDB, launch from the web (Java web-start): http://www.cern.ch/triggertool
  - Overview of all trigger configurations (data taking and MC)
  - Detailed and convenient investigation of trigger menus
    - Trigger definition L1->L2->EF: prescales, threshold algorithms, selection criteria, streaming information, etc.



- Possibility to compare different trigger configurations



- Used at point 1 for trigger operation
- TDAQ training tutorial for the TT

Scripts to Check Pool File Content

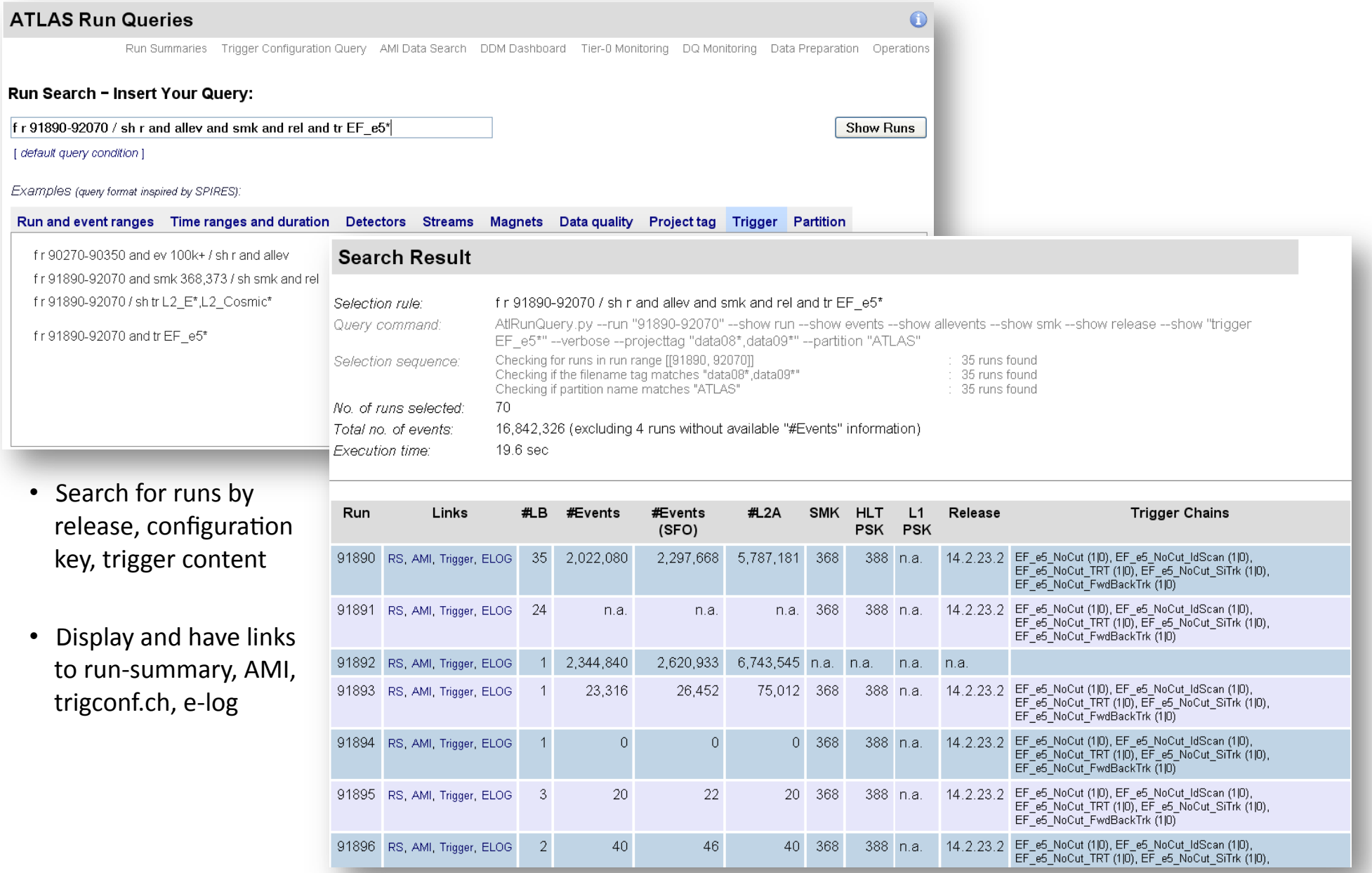
- checkTrigger.py AOD.pool.root
  - Runs over ESD/AOD/DPD and presents detailed (chain-wise) counts of the trigger decision

```
File:AOD.pool.root
Size:    55955.492 kb
Nbr Events: 250

Trigger configuration summary:
SMK: 0, HLTpsk: 0, L1psk: 0
Config source: TriggerMenuXML/LVL1config_MC_lumi1E31_no_prescale_15.1.0.xml and
TriggerMenuXML/HLTconfig_MC_lumi1E31_no_prescale_15.1.0.xml
L1 Items   : 146
HLT Chains : 556

================================================================================
  ID level    Trigger name    Passed events:   raw, after PS, after PT/Veto
================================================================================
     LVL1   Global LVL1                 250
     LVL2   Global LVL2                 250
       EF   Global EF (LVL3)            250
--------------------------------------------------------------------------------
  13  LVL1   L1_2EM13                   71      71         71
  14  LVL1   L1_2EM13I                  34      34         34
 163  LVL1   L1_2EM13_MU6                8       8          8
....
--------------------------------------------------------------------------------
...
  77  LVL2   L2_2g10                   118     118        118
 246  LVL2   L2_2g10_mu6                12      12         12
....
--------------------------------------------------------------------------------
...
 477   EF   EF_2e6_medium               8       8          8
 478   EF   EF_2e6_medium1              7       7          7
  79   EF   EF_2g20                    39      39         39
 248   EF   EF_2j42_xe30                3       3          3
....
================================================================================
```

- checkTriggerConfig.py -d AOD.pool.root
  - Runs on ESD/AOD/DPD and presents detailed trigger configuration(s)
  - Shows multiple configurations (merged DPD)

```
> checkTriggerConfig.py –d data09_cos.00121733.physics_L1Calo.recon.ESD.r733_tid073522/ESD.073522._000001.pool.root.1
…
EF: EF_mu0_tgc_halo_IDSCAN (1.00), L2: L2_mu0_tgc_halo_IDSCAN (1.00), L1: L1_MU0_TGC_HALO (1) [streams: TGCwBeam]
…
```

Trigger Content of Atlas-Runquery



Run	Links	#LB	#Events	#Events (SFO)	#L2A	SMK	HLT PSK	L1 PSK	Release	Trigger Chains
91890	RS, AMI, Trigger, ELOG	35	2,022,080	2,297,668	5,787,181	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0), EF_e5_NoCut_FwdBackTrk (1|0)
91891	RS, AMI, Trigger, ELOG	24	n.a.	n.a.	n.a.	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0), EF_e5_NoCut_FwdBackTrk (1|0)
91892	RS, AMI, Trigger, ELOG	1	2,344,840	2,620,933	6,743,545	n.a.	n.a.	n.a.	n.a.	
91893	RS, AMI, Trigger, ELOG	1	23,316	26,452	75,012	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0), EF_e5_NoCut_FwdBackTrk (1|0)
91894	RS, AMI, Trigger, ELOG	1	0	0	0	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0), EF_e5_NoCut_FwdBackTrk (1|0)
91895	RS, AMI, Trigger, ELOG	3	20	22	20	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0), EF_e5_NoCut_FwdBackTrk (1|0)
91896	RS, AMI, Trigger, ELOG	2	40	46	40	368	388	n.a.	14.2.23.2	EF_e5_NoCut (1|0), EF_e5_NoCut_IdScan (1|0), EF_e5_NoCut_TRT (1|0), EF_e5_NoCut_SiTrk (1|0),

- Search for runs by release, configuration key, trigger content
- Display and have links to run-summary, AMI, trigconf.ch, e-log

Additional Information

Trigger user info:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerUserPages
Tutorials:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerSoftwareTutorialPage
TDT Twiki:	https://twiki.cern.ch/twiki/bin/view/Atlas/TrigDecisionTool
TDT Doxygen:	http://atlas-computing.web.cern.ch/atlas-computing/links/nightlyDevDirectory/AtlasOffline/latest_doxygen/InstallArea/doc//TrigDecisionTool/html/index.html
Trigger obj matching:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerObjectsMatching
TrigAnalysisExample:	http://atlas-computing.web.cern.ch/atlas-computing/links/nightlyDevDirectory/AtlasOffline/latest_doxygen/InstallArea/doc/TrigAnalysisExamples/html/index.html
UserAnalysis example:	https://twiki.cern.ch/twiki/bin/view/AtlasProtected/UserAnalysis
Trigger Configuration:	http://trigconf.cern.ch
TriggerTool:	http://www.cern.ch/triggertool
Run query:	http://atlas-runquery.cern.ch/
Trigger EDM:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerEDM, http://alxr.usatlas.bnl.gov/lxr/source/atlas/Trigger/TrigEvent/TrigEventARA/TrigEventARA/selection.xml
TriggerMenu group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerPhysicsMenu
TriggerSW group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TAPMCoreSW
TriggerConfig group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerConfiguration
Help on e-groups:	hn-atlas-TriggerHelp at cern.ch

Trigger Contacts in Analyses

Higgs Group	Channel	Contact Person
HSG1	H->γγ	Li Yuan
HSG2	H->4l	Diego Rodriguez
	H->2l2tau, H->2l2nu and H->2l2b	Paul Thompson
	HZ (H->invisible)	Sylvie Brunet
HSG3	H->WW (gg, VBF, WH, ttH, inv.)	Gemma Wooden
HSG4	H->ττ leptonic and lep-had final states	Matthew Beckingham and Henrik Nilssen
	H->ττ hadronic final states	Stefania Xella
HSG5	ttH (H->bb) semileptonic	Catrin Bernius
	ttH (H->bb) hadronic	Michael Nash
	H+ (light, hadronic tau)	Martin Flechl
	H+ (light, leptonic tau)	Arnaud Ferrari
	H+ (heavy)	Martin zur Nedden

Project for TDAQ farm of tomorrow