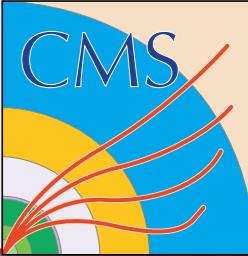


L1 Trigger Upgrade Simulation

Jim Brooke

Overview

- ▶ Upgrades are planned to almost all L1 Trigger subsystems
 - ▶ RCT, GCT
 - ▶ DTTF, CSCTF, GMT
 - ▶ GT
- ▶ These upgrades will be staged during period up until end of LS2
- ▶ Trigger objects have been the focus of most work so far
 - ▶ Although not all algorithms are in the software
 - ▶ Trigger object simulation is factorising from detector upgrades
 - ▶ In general, algorithms available now work with current detector
 - ▶ Detector upgrades will need to be integrated, eg. increased granularity in ME1/1, HF, ...
- ▶ I will also present what I know about simulation of related detector upgrades
- ▶ All this is evolving rapidly, as we work towards L1 Upgrade TDR



L1 Upgrade Algorithms

▶ E/gamma

- ▶ 2x2 tower sliding window (0.5 tower eta/phi resolution)
- ▶ H/E
- ▶ Isolation from 8x8 towers

▶ Tau

- ▶ 2x2 tower sliding window (0.5 tower eta/phi resolution)
- ▶ Isolation from 8x8 towers

▶ Jet

- ▶ Circular/square sliding windows of different sizes
- ▶ PU subtraction
- ▶ Only available up to $\eta < 3$ right now

▶ Muon (CSCTF)

- ▶ Studies underway to improve p_T resolution

▶ Muon (DTTF)

- ▶ Some ideas have been discussed

Software available

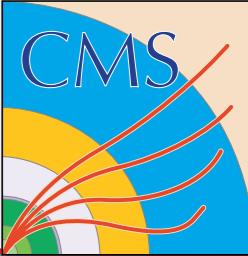
Input = ECAL/HCAL TPs

Output = L1Extra

NB - many parameters, not yet
well tuned

No software

So we are told... although I see stuff under
SLHCUpgradeSimulations/L1*Trigger



Calorimeter Software Recipe

- ▶ Recipe for running full upgrade algorithms
 - ▶ https://twiki.cern.ch/twiki/bin/view/CMS/L1TUpgradeMenuDevelopment#Ntuple_Production

```
cvs co UserCode/L1TriggerDPG  
cvs co UserCode/L1TriggerUpgrade  
cvs co SimDataFormats/SLHC  
cvs co SLHCUpgradeSimulations/Configuration  
cvs co SLHCUpgradeSimulations/L1CaloTrigger  
cvs co -d JetSLHC/CalibTowerJetProducerUserCode/rucas/SLHCjetSimulations/JetSLHC/CalibTowerJetProducer  
scram b
```

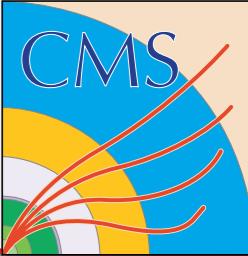
- ▶ This recipe includes an ntupliser

```
cmsRunUserCode/L1TriggerUpgrade/test/l1UpgradeNtupleFromRAW.py  
cmsRunUserCode/L1TriggerUpgrade/test/l1UpgradeNtupleFromDIGI.py
```

- ▶ Upgrade trigger objects are all stored in EDM L1Extra format
 - ▶ Inherits from Candidate (hence 4-vector), same class used for current trigger objects

vector< l1extra::L1EmParticle >	"SLHCL1ExtraParticles"	"EGamma"	"PROCESS"
vector< l1extra::L1EmParticle >	"SLHCL1ExtraParticles"	"IsoEGamma"	"PROCESS"
vector< l1extra::L1JetParticle >	"SLHCL1ExtraParticles"	"IsoTaus"	"PROCESS"
vector< l1extra::L1JetParticle >	"SLHCL1ExtraParticles"	"Taus"	"PROCESS"
vector< l1extra::L1JetParticle >	"calibJetProducer"	"Tower"	"PROCESS" (these are the jets!)

- ▶ Further documentation on EG and tau algorithms :
 - ▶ <https://twiki.cern.ch/twiki/bin/view/CMS/SLHCCaloTriggerTools>



Muon / Calorimeter Detector Simulation

- ▶ Various pieces of detector simulation needed for post-LS1 and post-LS2 detectors
 - ▶ Geometry/digitisation/**trigger primitives** for ME4/2, RE4, and ME1/1 unganging
 - ▶ Geometry/digitisation/**trigger primitives** for HB/HE/HF upgrades
- ▶ CMSSW_6_0_1 is the target for GEN-SIM of post-LS1 detector
 - ▶ ME4/2, RE4, ME1/1
 - ▶ HF geometry changes (PMT windows)
- ▶ Digitisation/trigger primitives for post-LS1 will follow this
- ▶ Post-LS2 detector updates are further away
 - ▶ Coupled with updates to pixel detector....
- ▶ Status here :
 - ▶ <https://twiki.cern.ch/twiki/bin/view/CMS/SLHCFall2012Updates>

Status of Studies

- ▶ First estimate of rates from current trigger at 14 TeV 2E34
 - ▶ Studies using data (8 TeV 45/66 PU) and MC (14 TeV 50PU)
 - ▶ Lisbon talk : <https://indico.cern.ch/getFile.py/access?contribId=4&sessionId=0&resId=0&materialId=slides&confId=204705>
 - ▶ Demonstrated the need for an upgrade between LS1 and LS2
- ▶ Currently looking at rates of upgrade trigger algorithms
 - ▶ <https://indico.cern.ch/getFile.py/access?contribId=2&resId=0&materialId=slides&confId=211851>
- ▶ Large MC request for TDR studies
 - ▶ <https://indico.cern.ch/getFile.py/access?contribId=15&sessionId=4&resId=0&materialId=slides&confId=212479>
- ▶ Ongoing studies comparing rates in 8 TeV MC vs data (inc. high PU)
 - ▶ Long standing discrepancy in hadronic trigger rates
 - ▶ Hope to resolve this soon (ie. within weeks) before large MC production starts
- ▶ Parallel ongoing work on
 - ▶ Interim calorimeter trigger upgrade
 - ▶ <https://twiki.cern.ch/twiki/bin/view/CMS/UCT2015>
 - ▶ CSCTF algorithm studies - may produce some code?
 - ▶ <https://indico.cern.ch/getFile.py/access?resId=3&materialId=slides&contribId=3&sessionId=0&subContId=0&confId=208762>