

# L1 Trigger Upgrade Simulation

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- ▶ 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

## Software available

Input = ECAL/HCAL TPs  
Output = L1Extra

NB - many parameters, not yet well tuned

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- ▶ **Muon (CSCTF)**
    - ▶ Studies underway to improve  $p_T$  resolution
  - ▶ **Muon (DTTF)**
    - ▶ Some ideas have been discussed

## 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](https://twiki.cern.ch/twiki/bin/view/CMS/L1TUpgradeMenuDevelopment#Ntuple_Production)

```
cv s co UserCode/L1TriggerDPG
cv s co UserCode/L1TriggerUpgrade
cv s co SimDataFormats/SLHC
cv s co SLHCUpgradeSimulations/Configuration
cv s co SLHCUpgradeSimulations/L1CaloTrigger
cv s co -d JetSLHC/CalibTowerJetProducer UserCode/rlucas/SLHCjetSimulations/JetSLHC/CalibTowerJetProducer
scram b
```

- ▶ This recipe includes an ntupliser

```
cmsRun UserCode/L1TriggerUpgrade/test/l1UpgradeNtupleFromRAW.py
cmsRun UserCode/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>

Expected this week?

# 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>