

Status of Full Simulation for Muon Trigger at SLHC

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Goal

- A big goal: to provide full simulation framework that realistically describes performance of the future CMS detector and muon trigger at SLHC luminosities
- Why full simulation?
 - (at least for CSC) studies of trigger primitives depend on realistic simulation of rather subtle effects in incredibly busy environment
 - Simplifications in fast simulation make detailed muon trigger simulations unreliable
 - Understanding occupancy and BX related effects and backgrounds make Full Geant simulation the only viable option

Muon Simulation Infrastructure Status

High PU simulation framework:	Priority	Readiness
High PU machinery (short term working solution exists)	3	70%
Backgrounds: Neutrons (work in progress)	1	60%
Beam halo and forward detectors	3	0%
Samples:		
Signal and BG (some small samples available, will need larger ones)	2	50%
Trigger Emulation:		
Addition of station ME4/2	1	100%
CSC Low level trigger: Data Formats (keep old ones)	1	100%
Emulator code (big task, work in progress)	1	80%
CSC Track Finder: Improving efficiency, adding ME1/a, etc.	2	10%
CSC Mu+Track Matching: New Data Formats	1	75% (?)
Emulation (new algorithms, code etc.)	2	40% (?)
DT Mu+Track Matching: New Data Formats	1	75% (?)
Emulation (new algorithms, code etc.)	2	33% (?)

(?) = "I'm not sure", feel free to suggest better estimates

High PU FullSim Machinery

- Custom SLHC FullSim framework by TAMU:
 - Needed in order to cope with memory hungry high PU FullSim
 - FullSim in fraction of detector, drop unnecessary data
 - Stable & reliable for efficiencies & single object rates estimates
 - Can simulate muon systems+long barrel tracker with PU400 in full DT and half of CSC
 - Twiki: [SLHCFullSim](#)
- It is still a short term fix
 - Can't study rates of global trigger or physics processes
- Plans:
 - Move current solution to CMSSW_3_4_X (or 3_5_X ?)
 - Find out how much advantage will bring
 - Improved memory management in 3_X core framework
 - Optimized for memory use CrossingFrame and mixing workflow
 - Future migration to 64-bit CMSSW and computer hardware
 - Long term goal:
 - Full simulation of physics processes in whole detector with high PU

Neutron Backgrounds

- Rick Wilkinson's Machinery for SIM samples of MB+neutrons is practically ready
 - Will be included in CMSSW_3_4_0
- Will need to produce high statistics neutron sample
 - Neutrons simulation takes ~30x longer /event than for regular MB
 - Will need help with production
- Tools for utilizing samples of neutrons are not ready yet
 - Waiting on MixingModule developers for a special "neutron" input
 - Just got email from Emilia that "it could be done quickly"
- When the sample will be ready and tools will be useable:
 - SimHit and Trigger Primitives occupancy and rate studies for
 - Neutron pileup
 - Neutron pileup + minbias pileup
 - Neutron pileup + minbias pileup + signal muons

Effects Still Missing in Simulation

- Scattering from forward detectors and beam halo
 - Might become a key problem for ME4
- Ability to switch from BX time 25ns to 50ns
 - One of SLHC scenarios is PU400 at 50ns BX time
 - So far we do simulations for it as PU400 at 25ns,
 - Too many things in simulation depend on 25ns BX time
 - Predictions might be slightly pessimistic?
 - But might compensate for lack of neutron BG
 - In view of complexity of the problem, and not enough motivation for 50ns, we put it on very low priority

Samples

- Have samples for Phase I emulator studies
 - PU hits digitized only for muon systems
 - 10K samples for quick turnaround
 - Can be quickly created privately
 - I am so far the only user
 - Bigger samples would be necessary for rates estimation
- Samples for Phase II (with new tracker)
 - PU (if present) is digitized in tracker and muon systems
 - No-PU samples for Florida's track-muon matching studies:
 - Small test samples are available
 - Can be quickly created privately
 - PU samples:
 - It's possible to do simulate muon systems+long barrel tracker with PU400 in full DT or in half of CSC
 - Would require substantial amount of computing resources
 - Working framework exists: whoever needs it is welcome to use it
 - I haven't heard from Dave Newbold in awhile about his progress on centralized production of samples

Trigger Emulation

- In order to have a complete simulation framework, it should include simulation of proposed hardware and algorithms changes
 - E.g., in order to start work on CSC Track Finder improvement for high PU, we need to have CSC trigger primitives code optimized for high PU available for use

Trigger Emulation Status

- CSC low level trigger
 - My talk in previous session describes the status
 - Initial version of code is in CVS
 - Will commit new version after finishing timing resolution studies
- CSC Track Finder:
 - Will wait for an updated low level code
 - Manpower is lacking
- CSC TF + Tracker and DT + Tracker matching:
 - Lots of work on algorithms (see talks in this session)
 - Initial versions of code in CVS