

Muon Related Studies

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- Muon tagging and efficiency calculation study (Jiajie)
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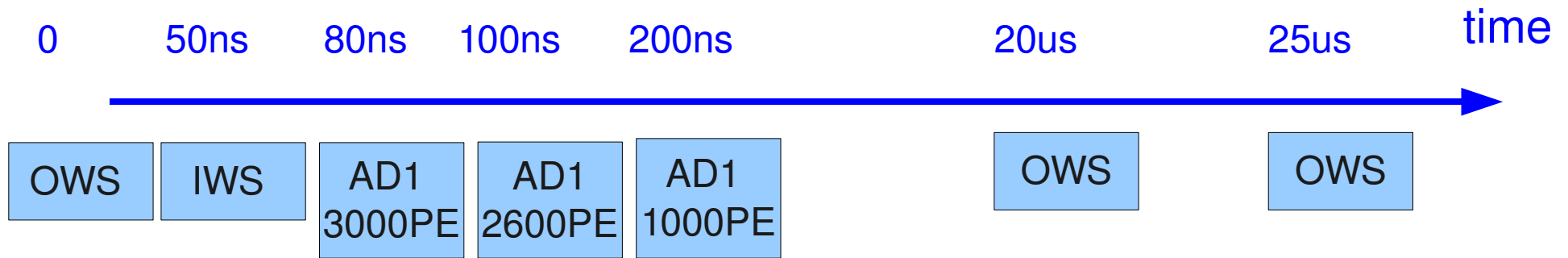
Muon Tagging Types

- Dan has implemented a few types of muon tags.
 - Sub-detector muon tagging (MuonAny)
 - OWS, IWS, AD muon triggers
 - Coincidence muon tagging (MuonPrompt)
 - Different sub-detectors have muon triggers within 300ns window
 - First Trigger in each coincidence Triggers (FirstMuonTrigger)
 - Retrigger tagging (Retrigger)
 - Retrigger effect (ringing) after the first main trigger in each sub-detector ($< 10 \text{ us}$)

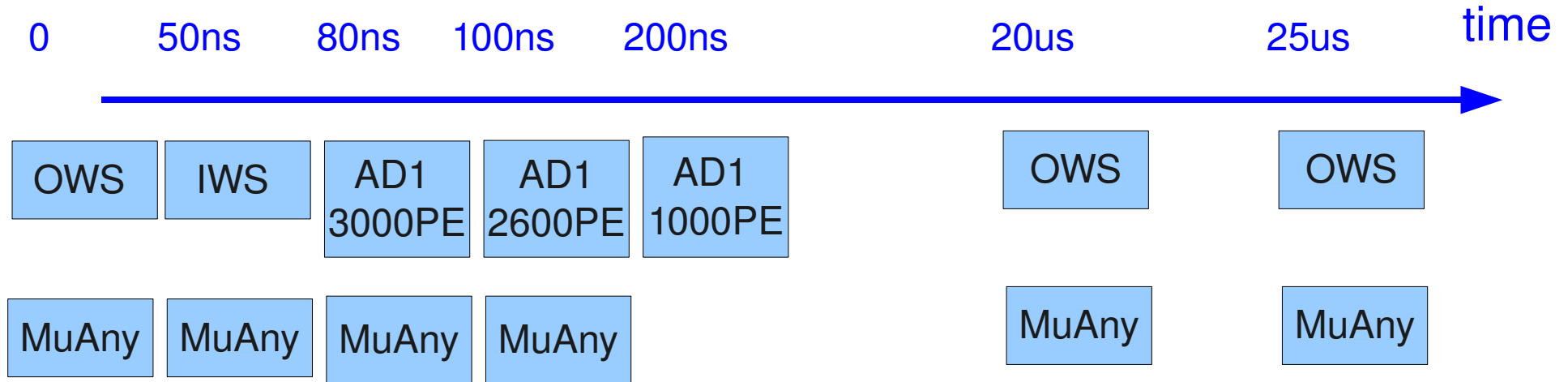
Simple Sub-Detector Muon tagging

- Water Pool
 - Nhit trigger (IWP: 10 OWP: 12)
- AD
 - Energy > 2500 PE (~ 20 MeV)
- Coincidence Time Window
 - 300 ns
- Retrigger Time Window
 - 10 μ s

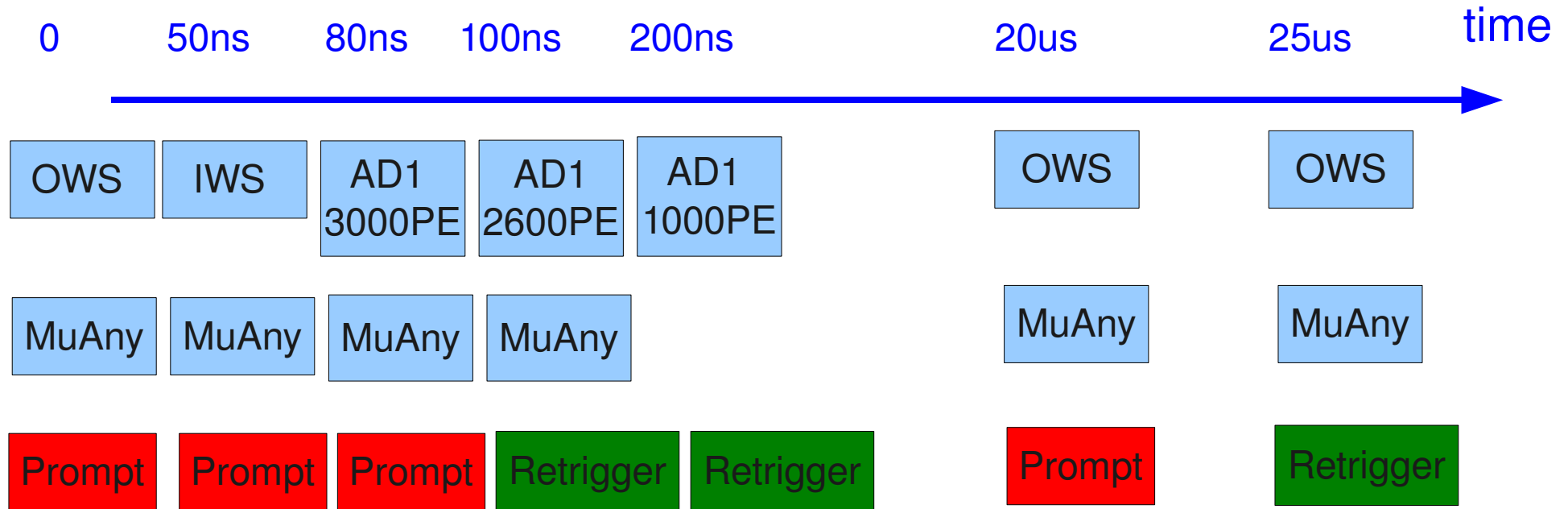
Muon Triggers



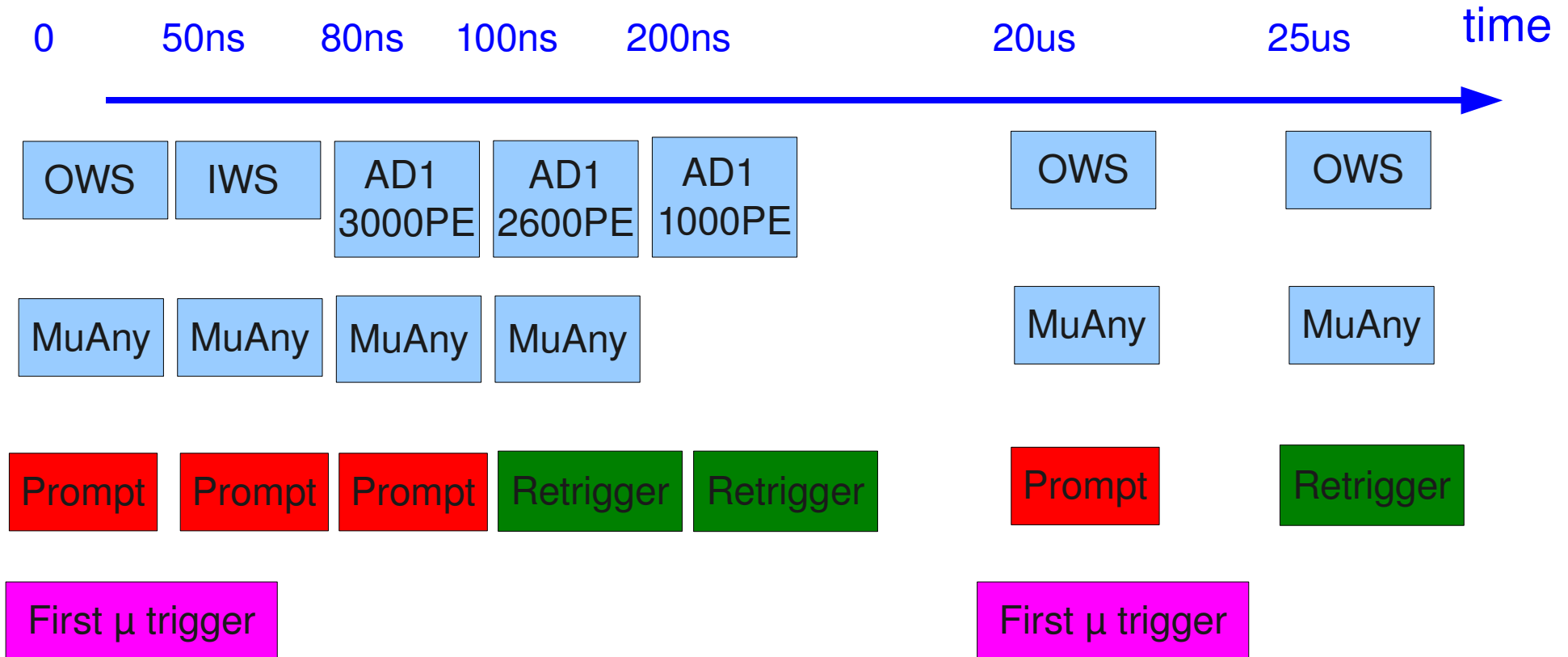
Muon Tagging (MuAny)



Muon Tagging (Prompt & Retrigger)



Muon Tagging (FirstMuon)



Event Counting

- Muon Triggers: $3.13315e+06$
- MuonAny Triggers: $2.70544e+06$
- MuonPrompt Triggers: $2.65865e+06$
- FirstMuonTriggers: $1.38778e+06$
- Retrigger: 401950

Efficiency Calculation

- Efficiency
 - Total muon Efficiency = Trigger Efficiency * tagging efficiency
 - Trigger Efficiency:
 - No of true muons causing the trigger / No. of all the muons passing the detector
 - Tagging Efficiency:
 - No of true muons being tagged / No. of true muons causing the trigger

Efficiency Calculation

- Trigger Efficiency
 - Efficiency = true muons being triggered / total muons passing the detector
 - Total muons passing the detector:
 - Registration sequence -> SimHeader
 - Counting the No. of muons passing the detector
 - True muons being triggered:
 - Flag the total true muon map being triggered
 - Counting the No. of true muons being flagged

Efficiency Calculation

- Tagging Efficiency
 - Tagging Efficiency = true muons being tagged / true muons being triggered
 - True muons being tagged:
 - Flag the total true muon map if tagged
 - Counting the No. of true muons being flagged
 - True muons being triggered:
 - Flag the total true muon map being triggered
 - Counting the No. of true muons being flagged

Purity Calculation

- Purity
 - $\text{Purity} = \text{truly tagged muon triggers} / \text{all tagged triggers}$
 - Truly tagged muon triggers
 - Triggers contain the muon information
 - Counting the No. of triggers are from muons
 - All tagged triggers:
 - Counting the No. of triggers being tagged

Efficiency Numbers

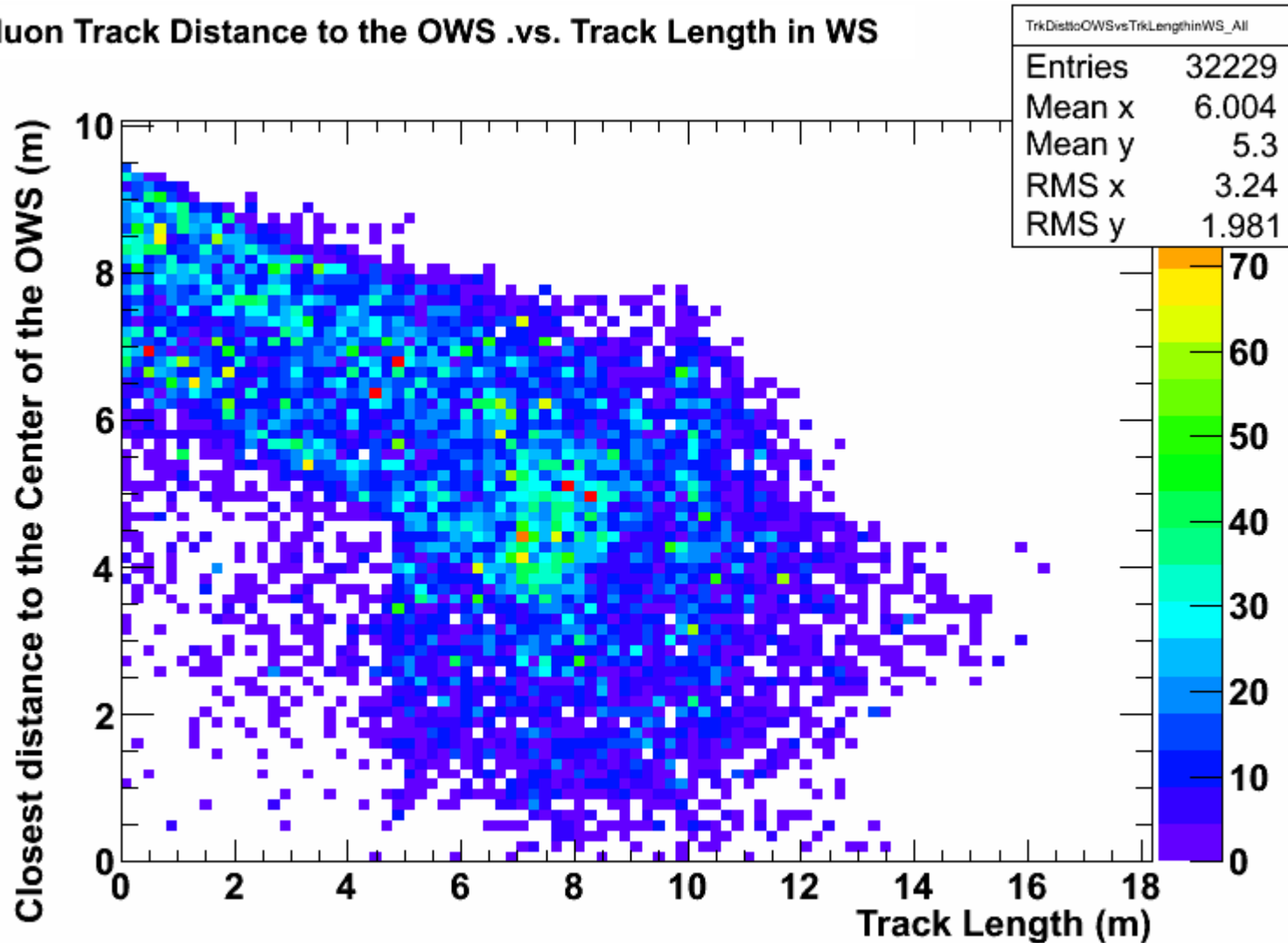
- All Generated Muons passing the detector: 32229
- All Generated Muons causing the trigger: 31139
- All Generated Muons being tagged as MuonAny: 31128
- All Generated Muons being tagged as MuonPrompt: 31128
- Trigger Efficiency: $31139/32229 = 0.96618$
- MuonAny tagging Efficiency: $31128/31139 = 0.999647$
- MuonPrompt tagging Efficiency: $31128/31139=0.999647$

Purity Numbers

- MuonAny Triggers: 2.70544e+06
- MuonPrompt Triggers: 2.65865e+06
- FirstMuonTriggers: 1.38778e+06
- True MuonAny Triggers: 2.69776e+06
- True MuonPrompt Triggers: 2.65098e+06
- True FirstMuonTriggers: 2.65098e+06
- MuonAny Purity: $2.69776e+06 / 2.70544e+06 = 0.997165$
- MuonPrompt Purity: $2.65098e+06 / 2.65865e+06 = 0.997115$
- FirstMuon Purity: $1.38011e+06 / 1.38778e+06 = 0.994474$

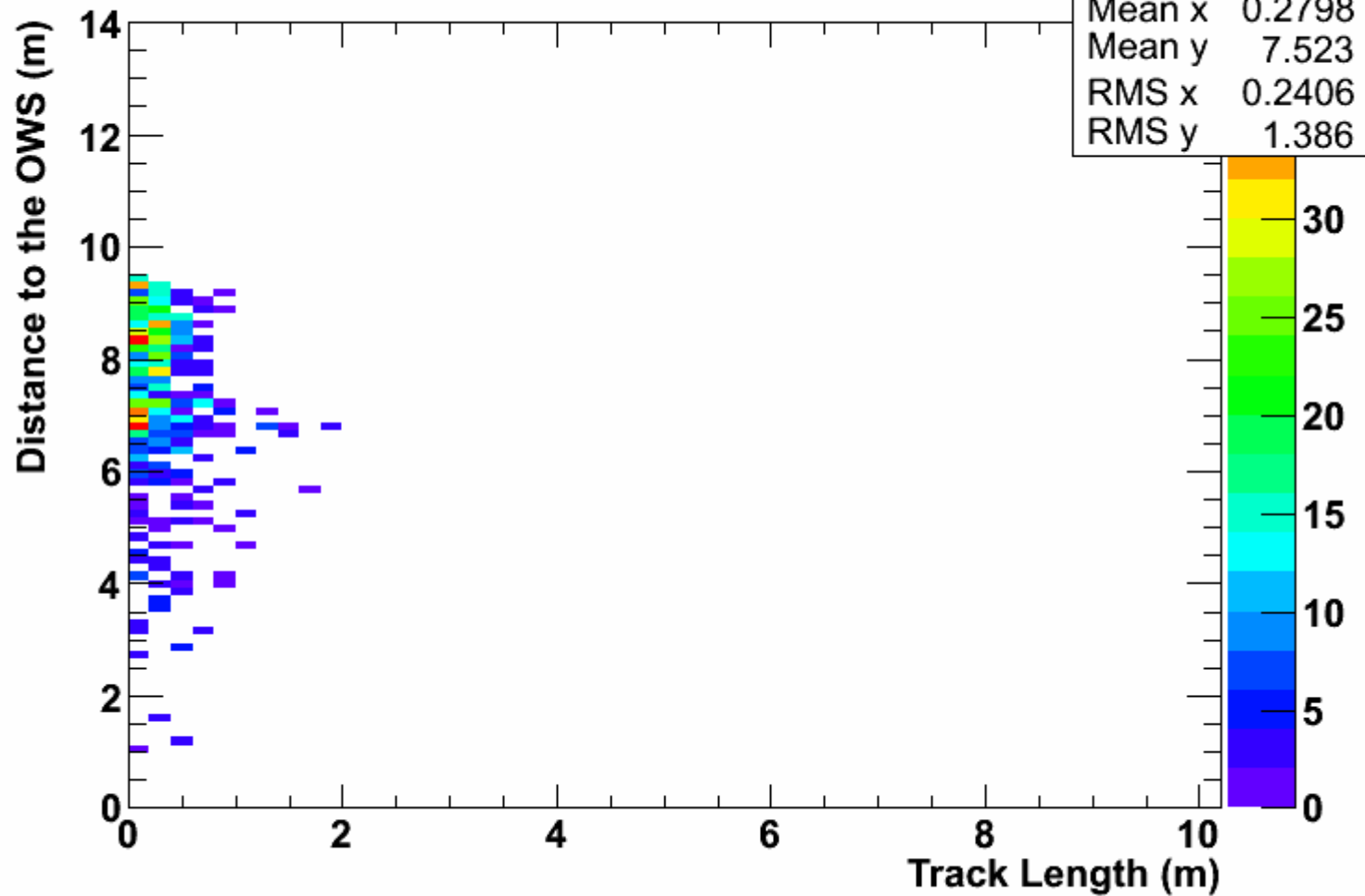
All the Generated Muons

Muon Track Distance to the OWS .vs. Track Length in WS



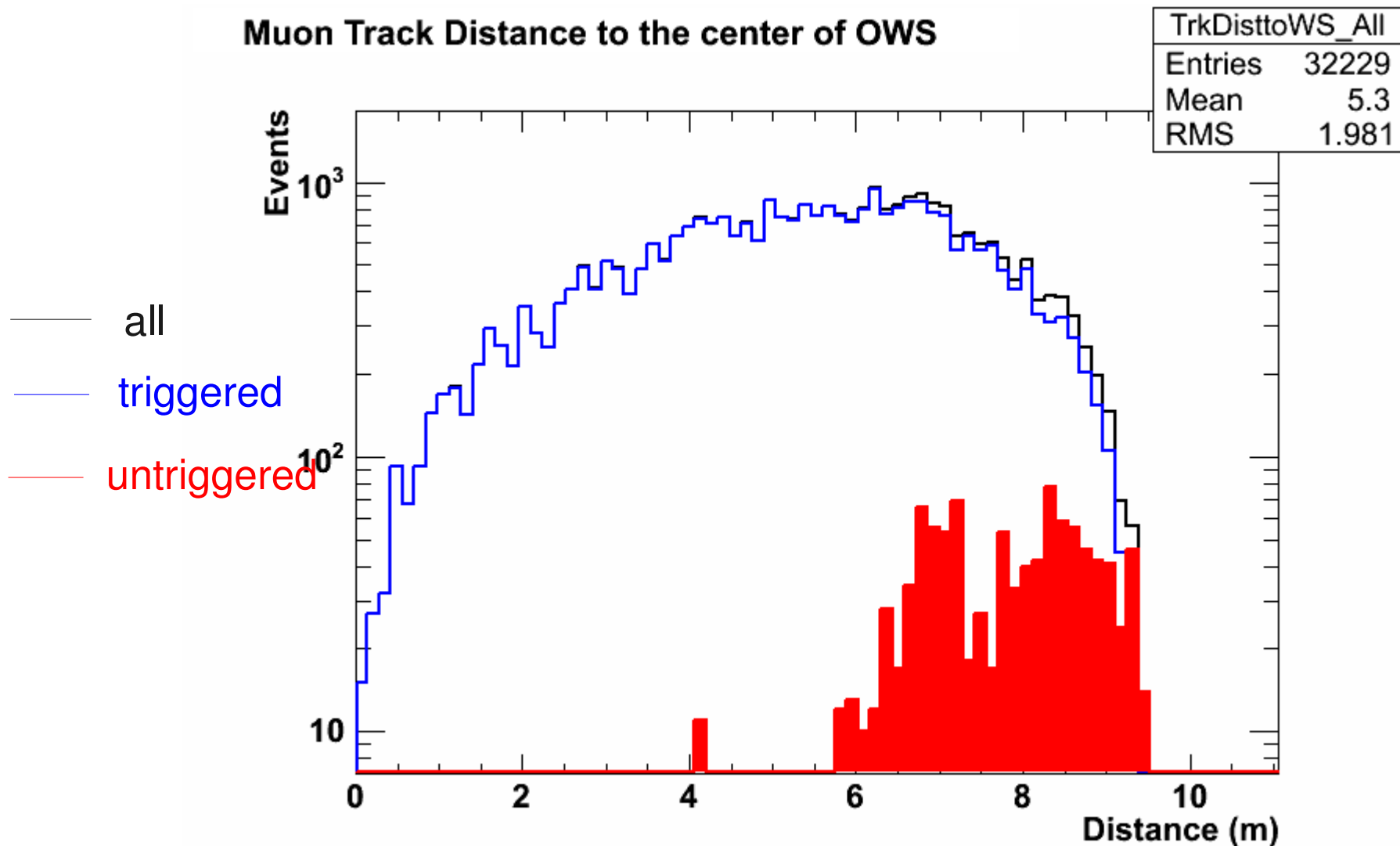
Untriggered Muons

Muon Track Distance to the OWS .vs. Track Length in WS, UnTriggered



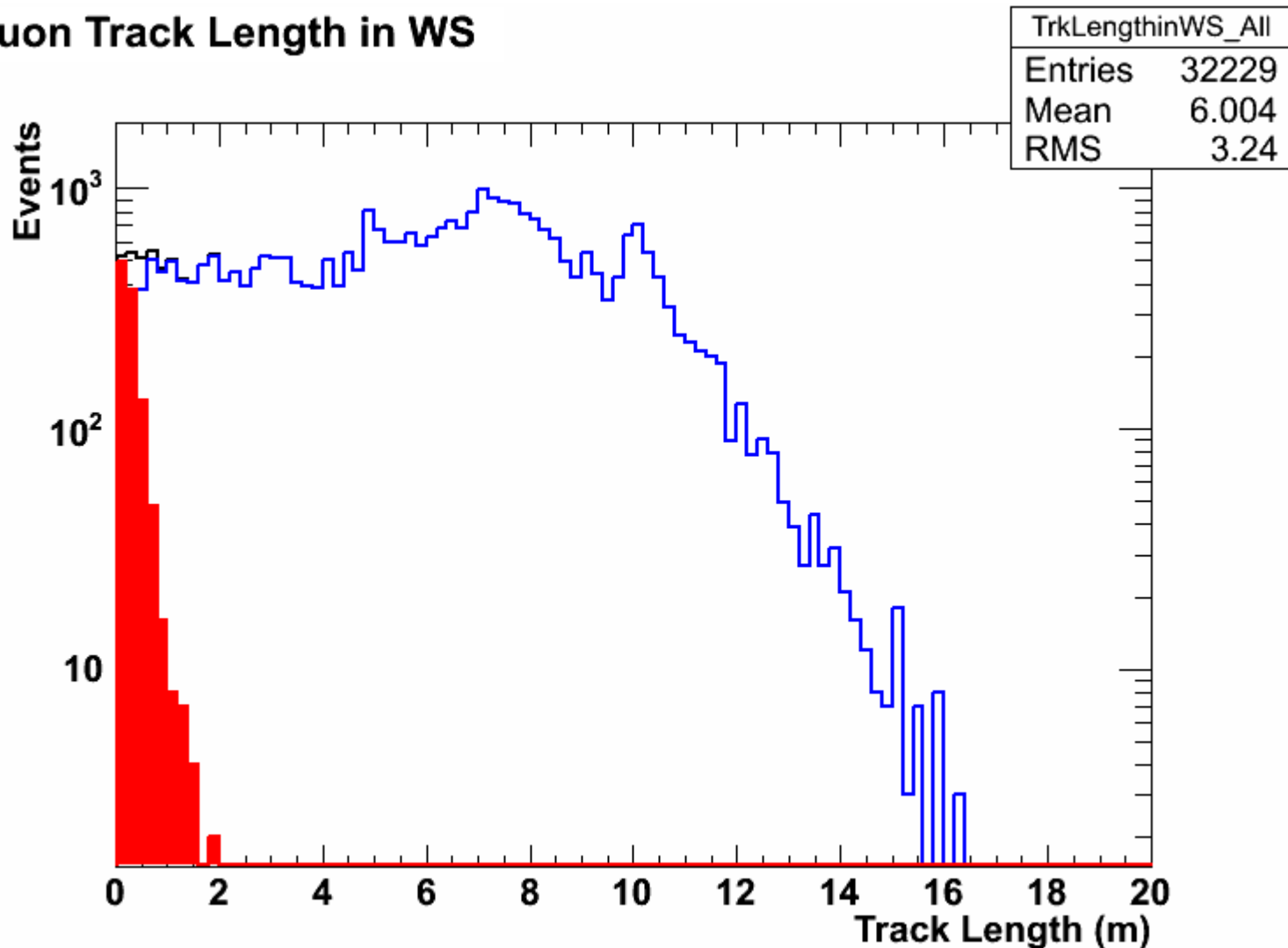
Distance of Muon Track to the Center of OWS

Muon Track Distance to the center of OWS



Track length in the Water

Muon Track Length in WS



Codes in SVN

- Muon Tagging code:
 - *<http://dayabay.ihep.ac.cn/svn/dybsvn/dybgaudi/trunk/Tagging/Tagger/python/Tagger/MuonTagger/MuonTag.py>*
- Efficiency calculation codes:
 - *<http://dayabay.ihep.ac.cn/svn/dybsvn/people/jjling/analysis/MuonTag>*

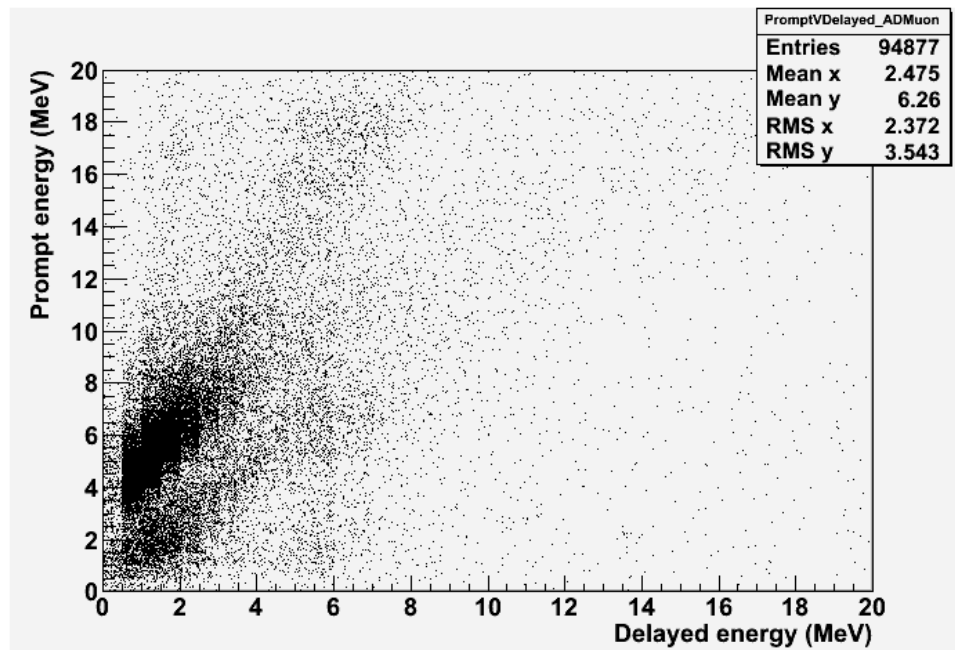
Muon Reconstruction (Qing)

- Tool package committed in:
Reconstruction/PoolMuonRec
- Has tested a few events on FMCP11a MC: it is running and write out the rec header correctly, has not checked the quality of the fit yet.
- A simpler package (PoolMuonSimple) which doesn't require minuit minimization will be ready soon.

Double Neutron background Study (Lisa)

Double neutron background in FMCP11a (see DocDB-5939 for more on double neutrons)

Muon passes through AD, produces two or more neutrons, capture on H gives prompt signal, capture on Gd gives delayed signal



Used FMCP11a coincidence files
Reco energy of AD coincidences (<20 MeV), requiring time since last muon in the AD < 200 μ s

Don't seem to see any Gd captures for the delayed signal... ?