

Online Stopping Muon Filter

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Gap-Based Stopping Muon Filter Algorithms

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- Tristan Blackburn's gap-based stopping muon filters shown in last week's meeting
- Tristan was very kind to share his code with me
- Examined filters and ran on full MCC 3.0 AntiMuon sample of 10000 events
- Bugs found in counting results, purity and efficiency not as high as hoped
- Simple TPC 5 filter still produces high purity and decent efficiency

Gap-Based Stopping Muon Filter Algorithms

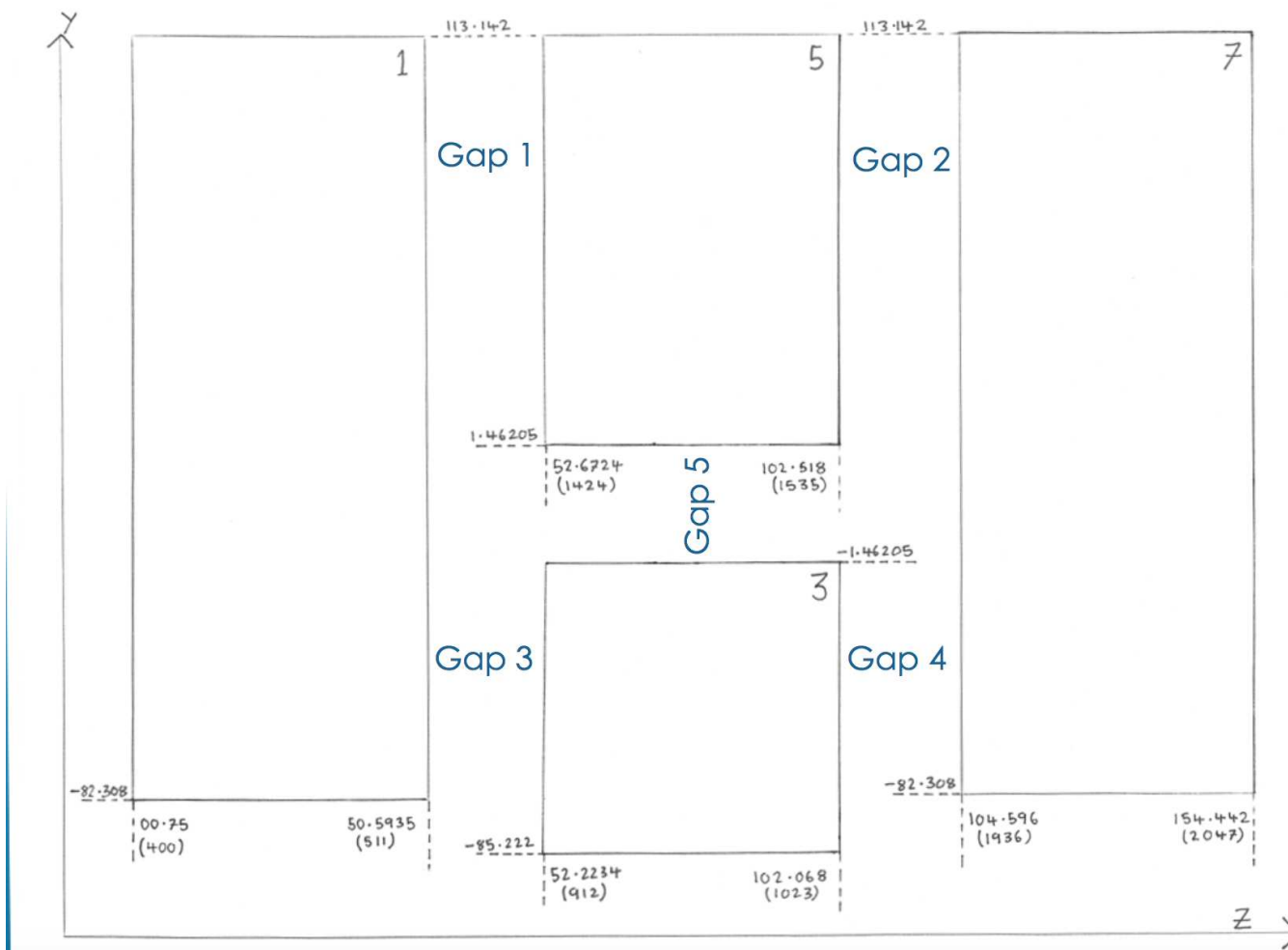


Figure 1: 35t TPCs with gaps shown

Gap-Based Stopping Muon Filter Algorithms

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- All filters exclude all events with hits in short drift volume or with $x > 220$ cm (using MC truth information)
- TPC 5 filter:
 - Only events with hits in TPC 5 allowed
- Gap 1 filter:
 - No hits on channels 400 or 2047
 - No hits in TPC 3
 - Events must cross Gap 1 (between TPCs 1 and 5)
- Gap 2 filter:
 - No hits on channels 400 or 2047
 - No hits in TPC 3
 - Events must cross Gap 2 (between TPCs 5 and 7)
- Constrained stoppers filter:
 - No hits on channels 400 or 2047
 - No hits in TPC 3
 - Events must cross either Gap 1 or Gap 2
 - Events must cross greater than 39 collection plane channels in TPC of entry

Modifications

- Larger event sample of 10000 μ^+ from MCC 3 LSU AntiMuon (DetSim) used
- Comparison of true stopping muon event numbers with events passing filters using 'std::find' resulted in every event passing the filter being counted as a true stopping muon
 - 100% purity for every result, even with more events passing filter than total stopping muons
 - Corrected by using simple nested for loop check to match event lists
- Stopping muons were defined by checking if any backtracked hits were outside detector active volume
 - Changed to check MC truth trajectory of anti-muons to see if they exited
 - Total stoppers found decreased from 2557 to 838

- 838 stopping muons enter active volume:
($-50 < x \leq 250$ cm, $-82 < y \leq 125$ cm, $-1 < z \leq 156$ cm)
- Purity = Number of true stopping muons passing filter / Number of all muons passing filter
- Efficiency = Number of true stopping muons passing filter / Number of all true stopping muons in sample

Table 1: Efficiency and Purity of Muon Filters

Muon Filter	Events Passing	True μ Found	Efficiency	Purity
TPC 5	1127	188	22.4%	83.2%
Gap 1	198	49	5.8%	21.7%
Gap 2	168	48	5.7%	21.2 %
Constrained	226	42	5.0%	18.6 %

Stopping Muon Energy Spectra

Energy of Stopping Muons Passing Cuts

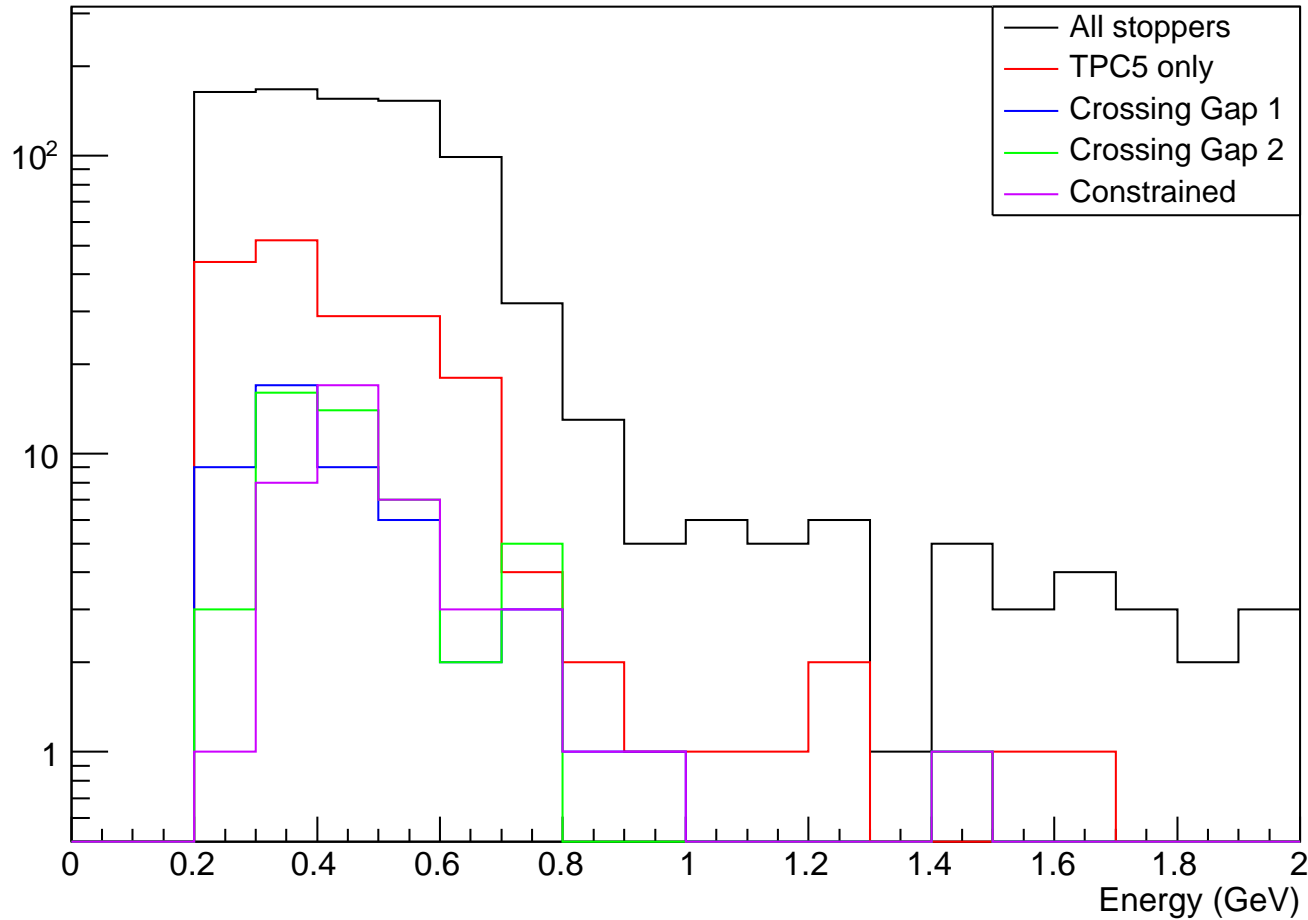


Figure 2: Stopping muon energies passing each algorithm

Next Steps

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- TPC 5 based filter looks promising
- Look further at shaping effects on momentum spectrum, angular distributions
- Replace cheated cut on x position with drift time based cut
- Use RawHitFinder output values instead of cheated values
- Estimate size of expected stopping muon sample
- Look at backgrounds from other particles (protons, pions, etc.)