Online Stopping Muon Filter

Jonathan Insler

LSU

July 1, 2015

Stopping Muon Filter Algorithm

- Load wire endpoints and wire-to-channel maps
- Calculate total charge on collection planes in each TPC
- Cut 0: Only muons that enter the active volume are considered:
  ($0 < x \leq 200$ cm, -85.25 $< y \leq 125$ cm, $0 < z \leq 153.516$ cm)
- Cut 1: reject events with significant (> 1000) charge deposition in TPCs on short drift side
- Cut 2: reject events without greater (< 1000) charge in TPCs on long drift side
- Find first and last collection plane wires with hits - one of these should be exit point
- Scan over all hits
  - Loop over all hits on first and last collection plane wire to be hit
  - For each of those hits, check times and positions against hits on induction planes
  - Vary allowed offsets in y, z, and time:
    - Offset in y is maximum allowed difference between wire ends of hit candidates from top or bottom of TPC; this cut is not applied if collection plane hit is on first 5 channels in TPC 1 or last 5 channels in TPC 7
    - If a triplet of hits on each of the three wire planes occurs within the allowed y, z, and time differences, then an entrance/exit point is found
- Cut 3: reject events with more or less than exactly one entrance/exit point

Event Sample and Definitions

- 10000 μ^+ from MCC 3 LSU AntiMuon sample (DetSim)
- 4883 throughgoing muons and 546 stopping muons enter active volume (Cut 0)
- Purity = Number of true stopping muons passing all cuts / Number of all muons passing all cuts
- Efficiency = Number of true stopping muons passing all cuts / Number of all stopping muons in sample
- Purity and efficiency have been plotted for allowed offset in y vs. allowed time difference, for allowed offsets in z of 1 to 10

Purities and Efficiencies

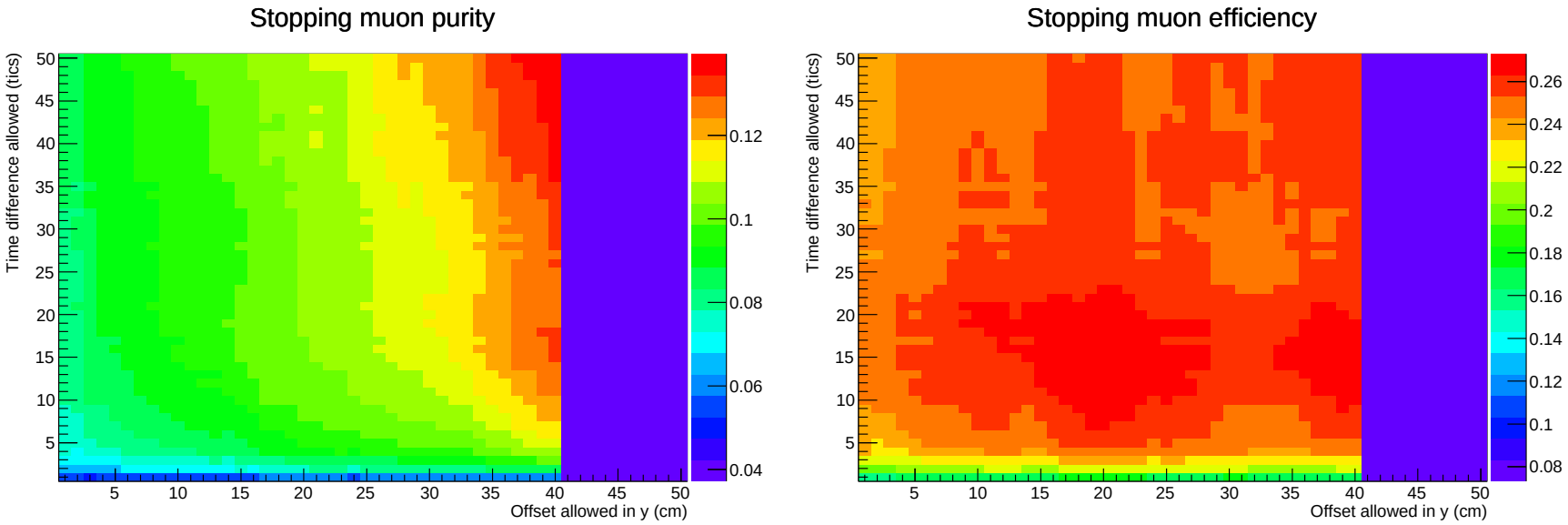

Figure 1: Purities and efficiencies for maximum offset in z = 1

Maximum purity = 0.139489 at offset in y = 40, time difference = 50
Maximum efficiency = 0.272894 at offset in y = 39, time difference = 14

Purities and Efficiencies

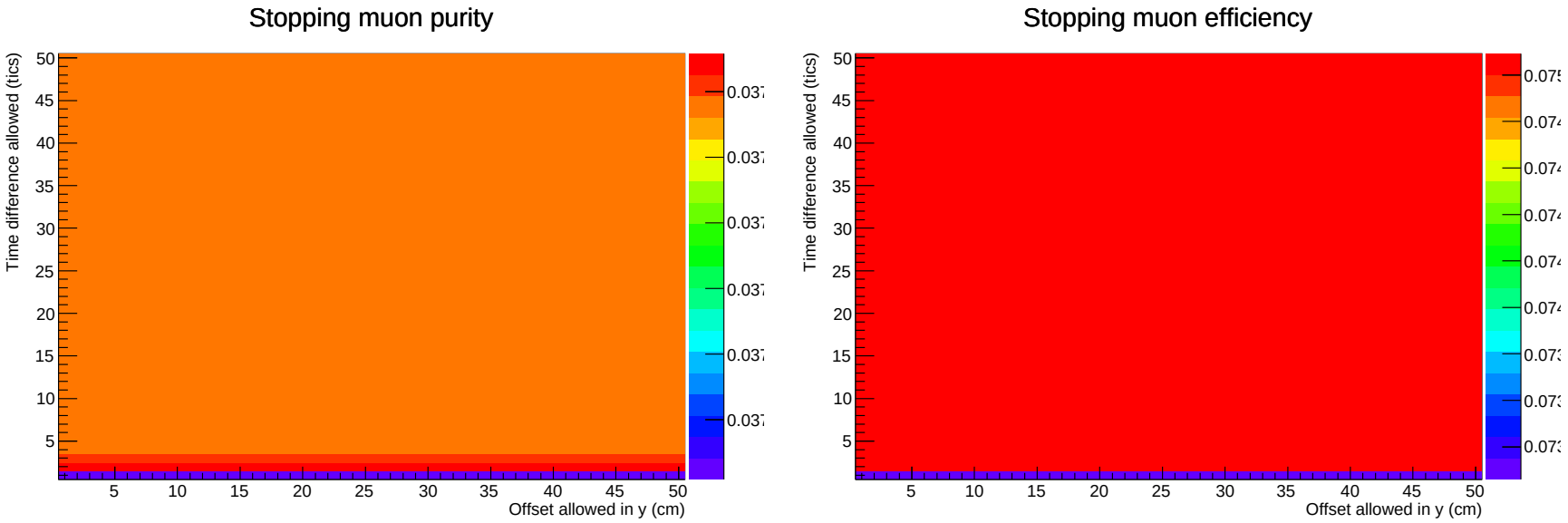

Figure 2: Purities and efficiencies for maximum offset in z = 2

Maximum purity = 0.0378578 at offset in y = 1, time difference = 2
Maximum efficiency = 0.0750916 at offset in y = 1, time difference = 2

Purities and Efficiencies

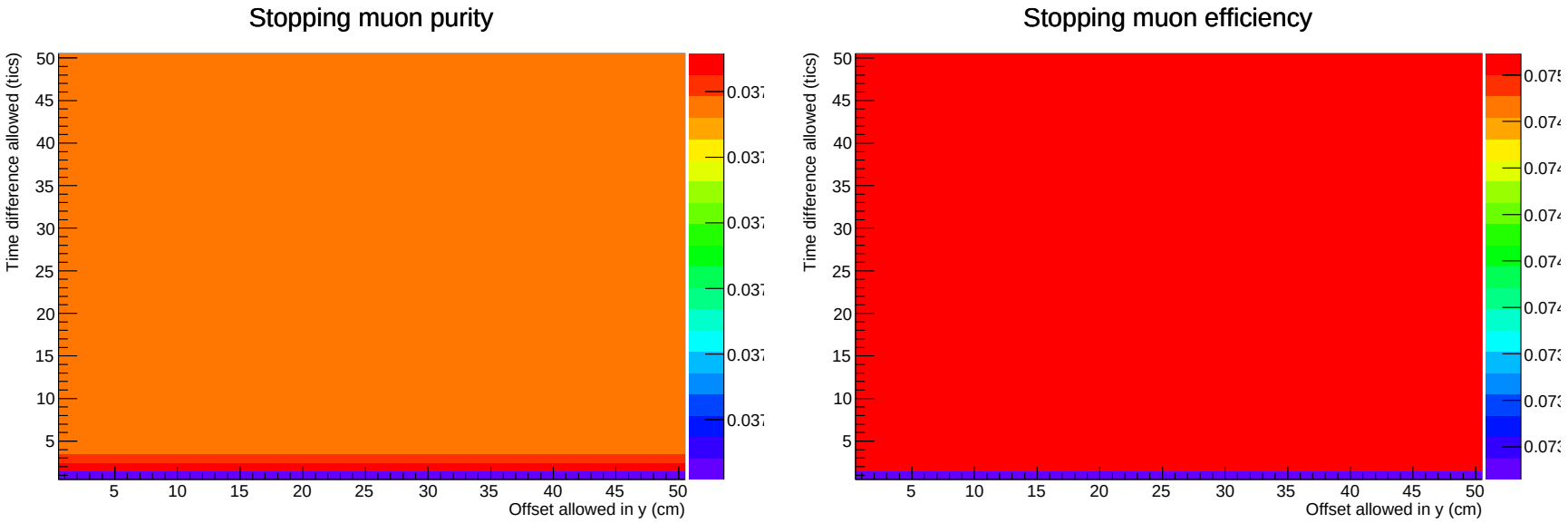

Figure 3: Purities and efficiencies for maximum offset in z = 3

Maximum purity = 0.0378578 at offset in y = 1, time difference = 2
Maximum efficiency = 0.0750916 at offset in y = 1, time difference = 2

Purities and Efficiencies

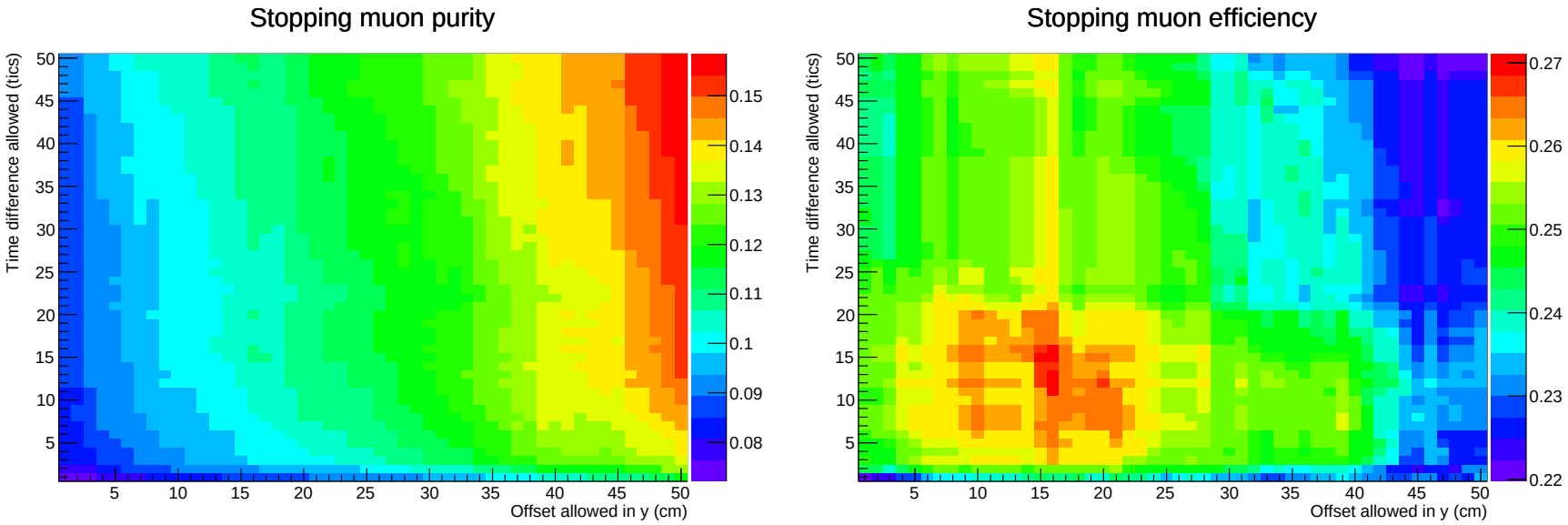

Figure 4: Purities and efficiencies for maximum offset in z = 4

Maximum purity = 0.158505 at offset in y = 50, time difference = 47
Maximum efficiency = 0.271062 at offset in y = 16, time difference = 12

Purities and Efficiencies

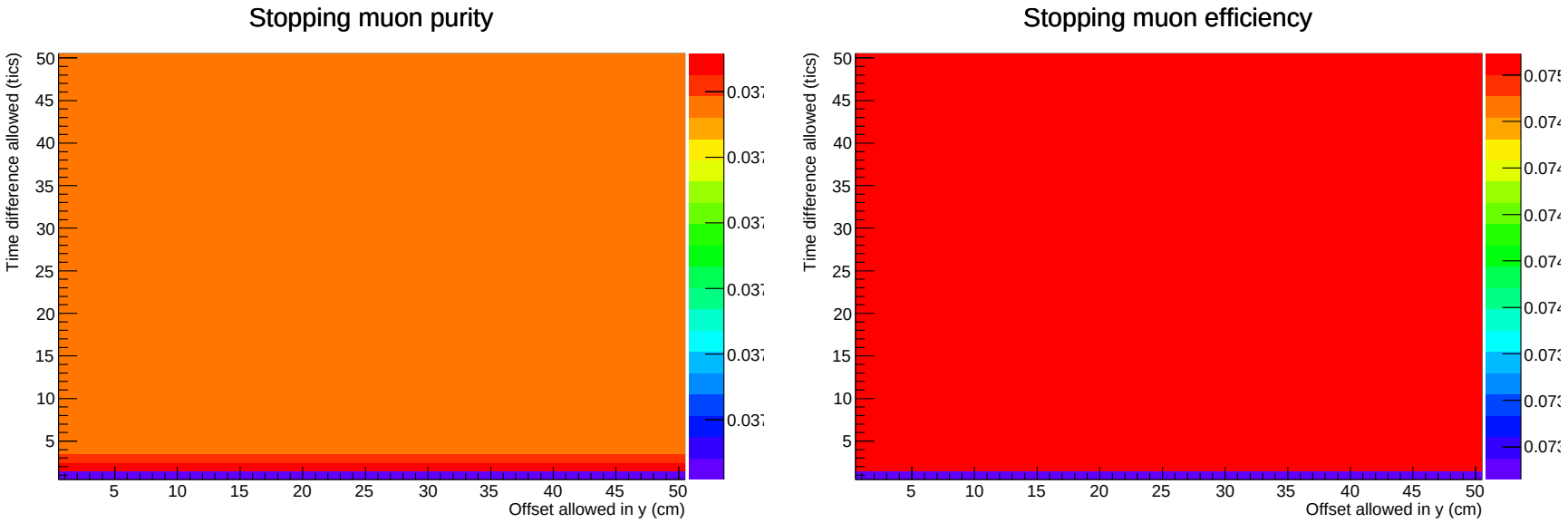

Figure 5: Purities and efficiencies for maximum offset in z = 5

Maximum purity = 0.0378578 at offset in y = 1, time difference = 2
Maximum efficiency = 0.0750916 at offset in y = 1, time difference = 2

Purities and Efficiencies

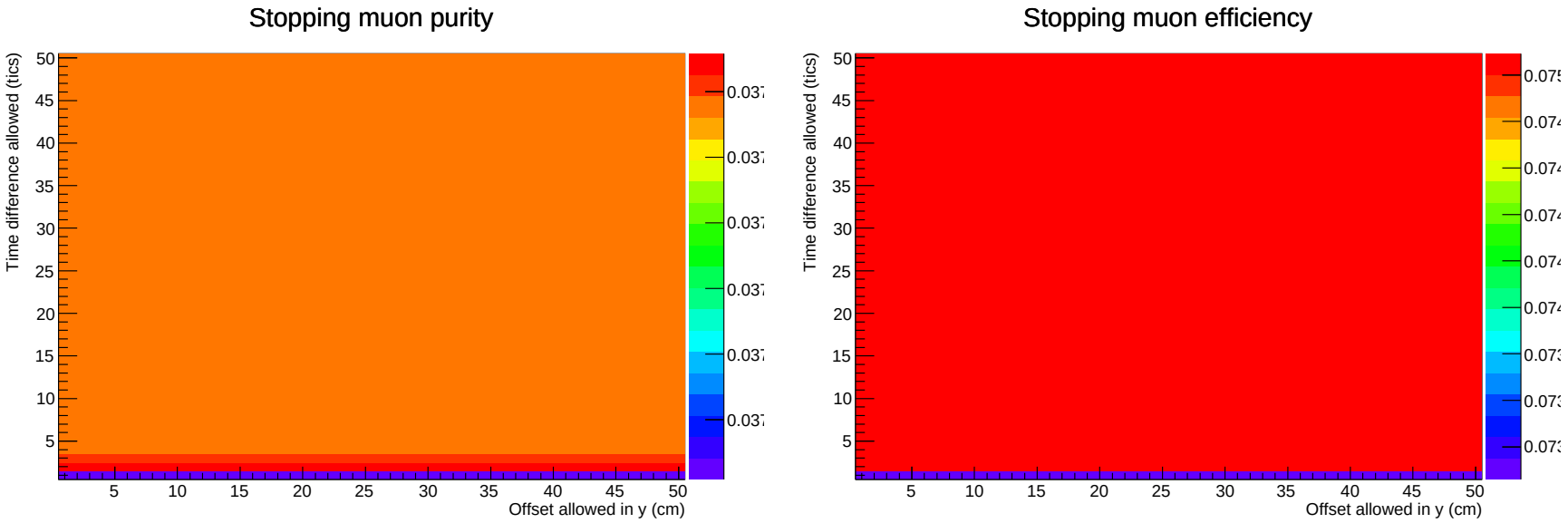

Figure 6: Purities and efficiencies for maximum offset in z = 6

Maximum purity = 0.0378578 at offset in y = 1, time difference = 2
Maximum efficiency = 0.0750916 at offset in y = 1, time difference = 2

Purities and Efficiencies

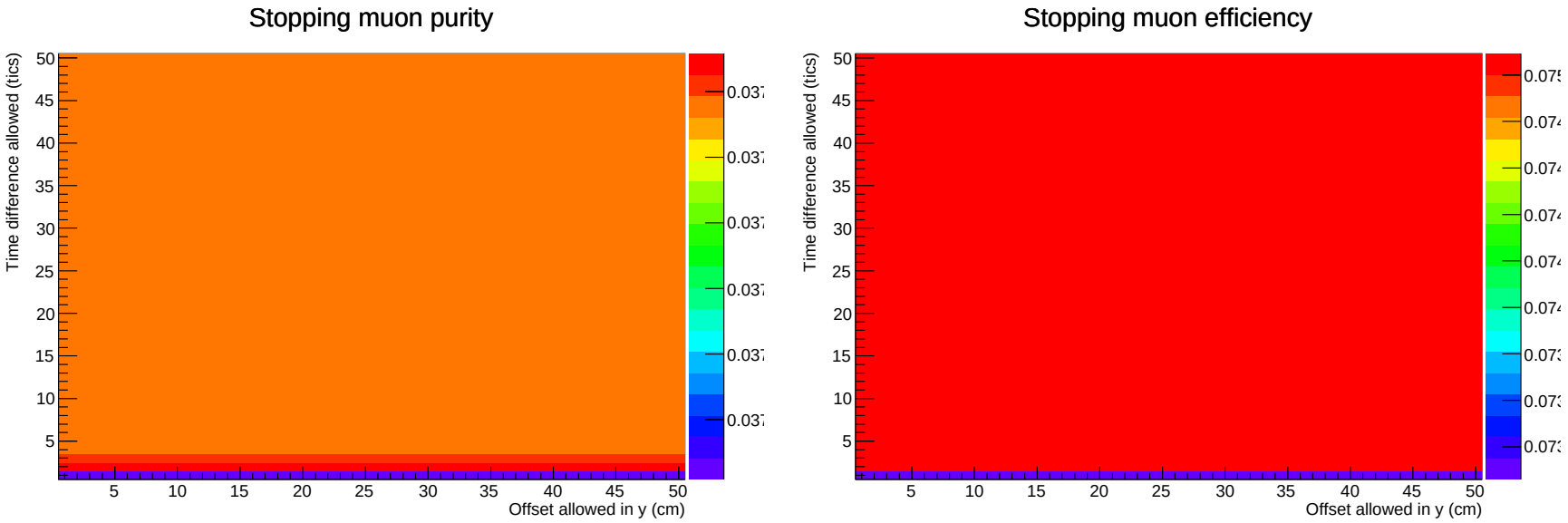

Figure 7: Purities and efficiencies for maximum offset in z = 7

Maximum purity = 0.0378578 at offset in y = 1, time difference = 2
Maximum efficiency = 0.0750916 at offset in y = 1, time difference = 2

Purities and Efficiencies

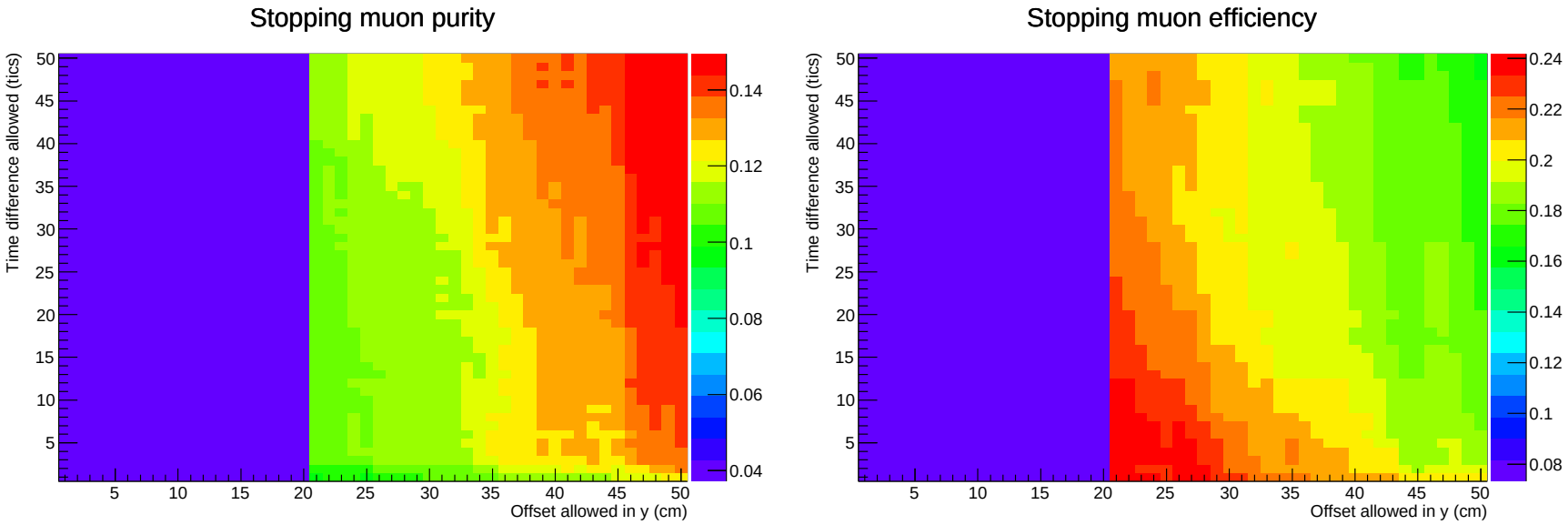

Figure 8: Purities and efficiencies for maximum offset in z = 8

Maximum purity = 0.149444 at offset in y = 50, time difference = 41
Maximum efficiency = 0.241758 at offset in y = 21, time difference = 1

Purities and Efficiencies

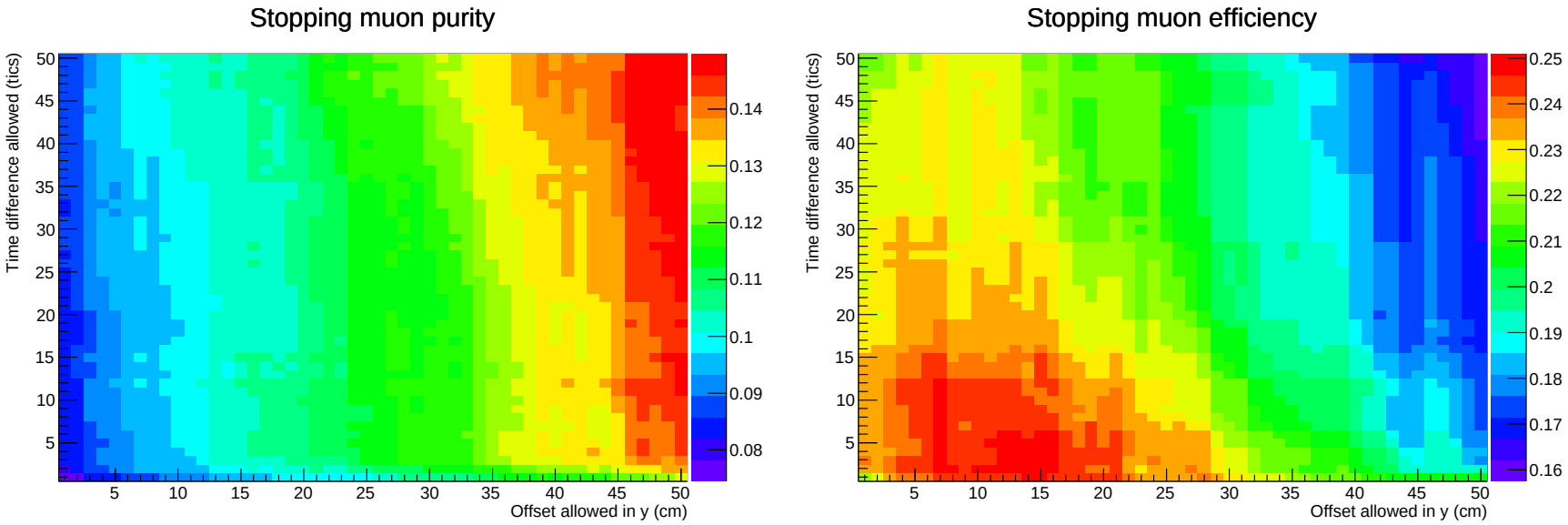

Figure 9: Purities and efficiencies for maximum offset in z = 9

Maximum purity = 0.149671 at offset in y = 50, time difference = 37
Maximum efficiency = 0.250916 at offset in y = 7, time difference = 2

Purities and Efficiencies

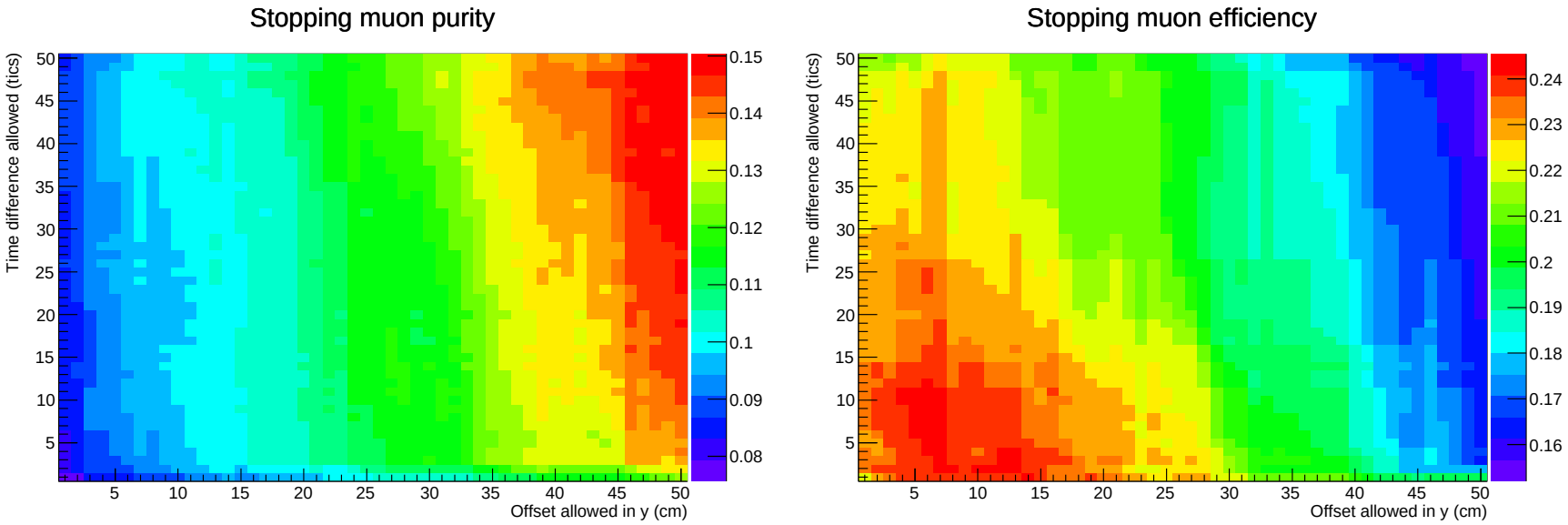

Figure 10: Purities and efficiencies for maximum offset in z = 10

Maximum purity = 0.15035 at offset in y = 49, time difference = 48
Maximum efficiency = 0.245421 at offset in y = 6, time difference = 7

Results

- Maximum purity of 15.9% is found at offset in z = 4 cm, offset in y = 50 cm, offset in time = 47 tics
- Maximum efficiency of 27.3%is found at offset in z = 1 cm, offset in y = 39 cm, offset in time = 14 tics
- Results appear to be unstable for many values in offsets of z
- Purity is too low

Next Steps

- Refine checking of hits on first and last collection plane wires
- Look at properties of throughgoing muons that successfully pass cuts
- Aim to raise purity