Electro-Production using Hall D Generator

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Overview

- Electro-Production is implemented using the hall D event generator
  - See previous updates on this
- Wiser, Geant4 QGSP_BERT and hall D generators are compared for proton and deuterium targets
- A Monte-Carlo event generator based on hall D event generator is implemented to the remoll
- Pion background rates at the last GEM for SoLID-PVDIS configuration is compared for Wiser and hall D using deuterium target

Electro-Production Generator Comparison

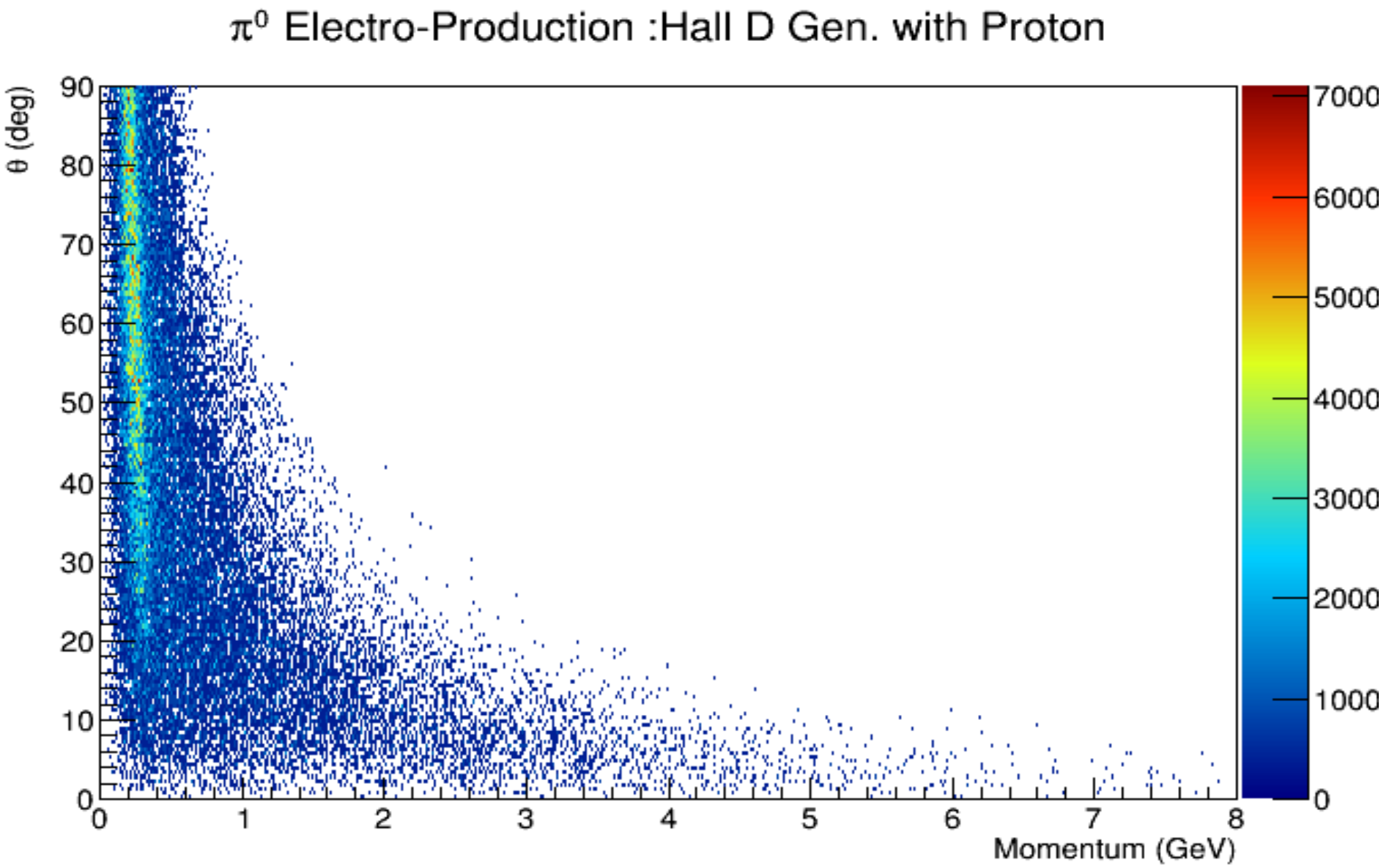
- Using Wiser and Hall D generators, pions are generated for scattering angle < 90 deg for 11 GeV electron beam on proton and deuterium 40 cm targets
- Using Geant4 (QGSP_BERT), 11 GeV electron beam incident on proton and deuterium 40 cm targets
  - Saved pions created in the target

Hall D vs. Geant4 : Proton Target

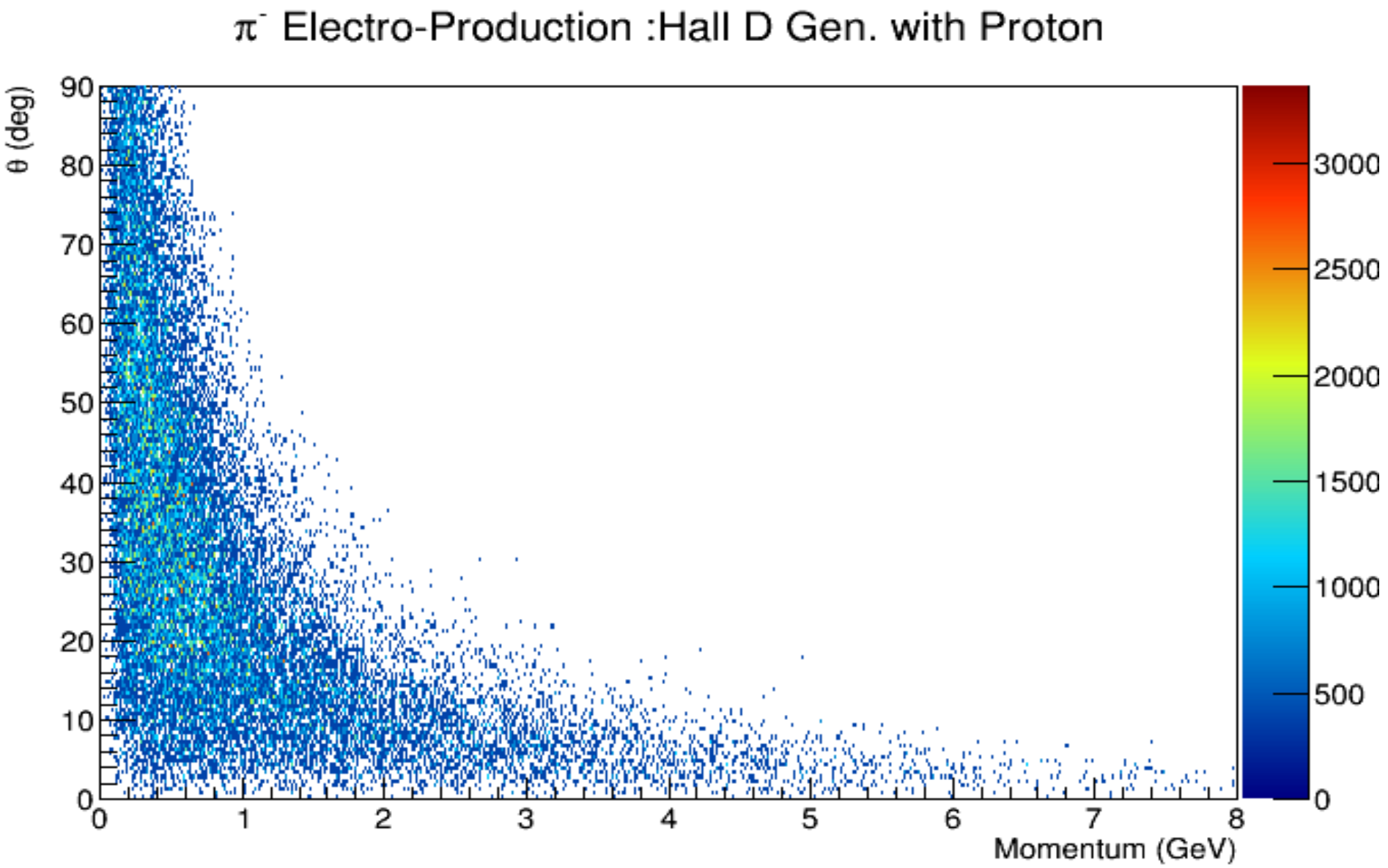
- Using hall D gen, 1 million hadron events were generated
- Using Geant4, 100 million electrons incident on 40 cm proton target

Pion Type	Total Proton xs for theta < 90 deg			Hall D vs. G4 agreement
	Wiser xs	Hall D xs	Geant4 xs	
	(mb)	(mb)	(mb)	(%)
pi0	n/a	31.3	26.8	17
pi-	n/a	20.7	23.5	-12
pi+	n/a	44.4	50.7	-12

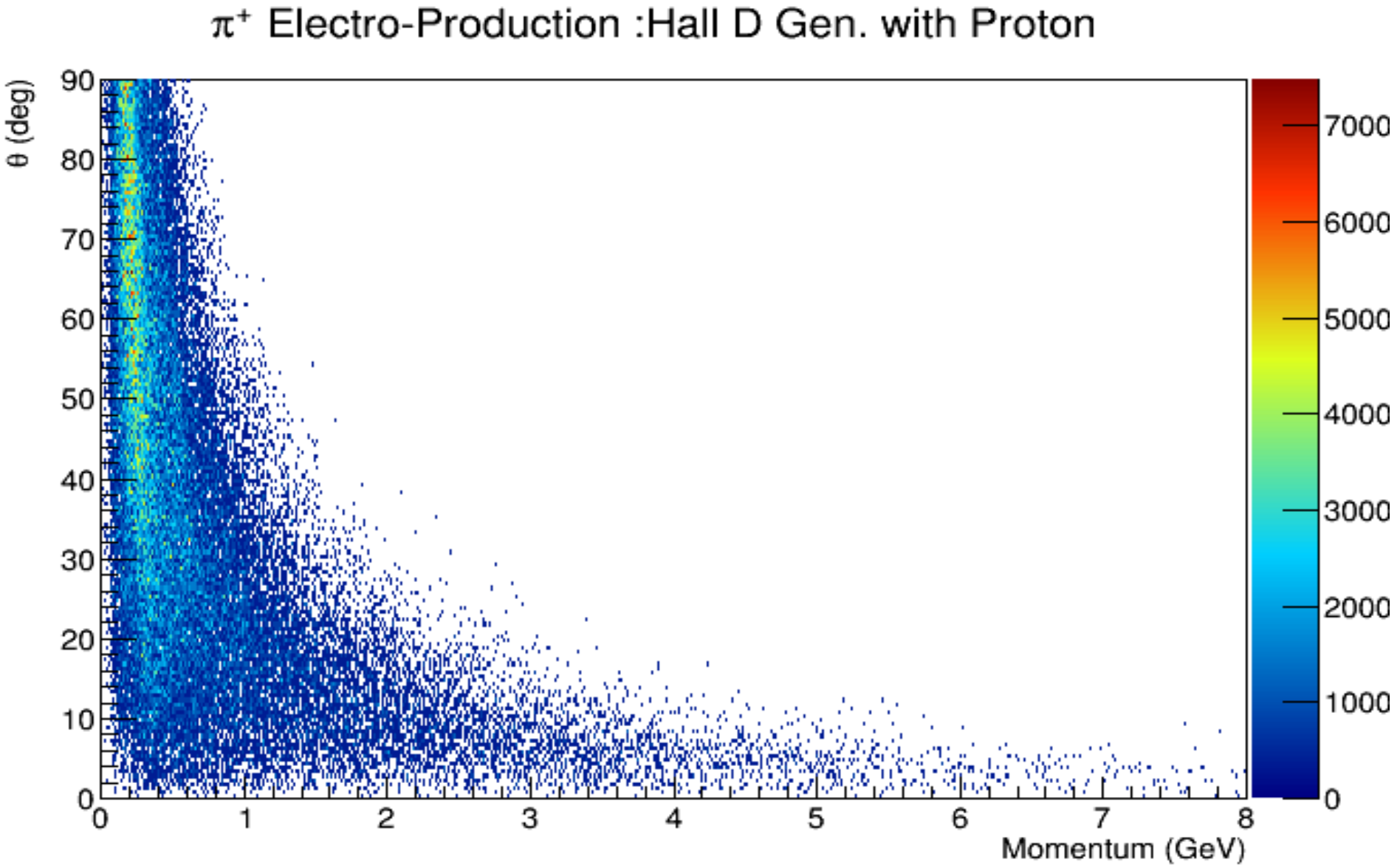
Hall D Generator : Proton Target



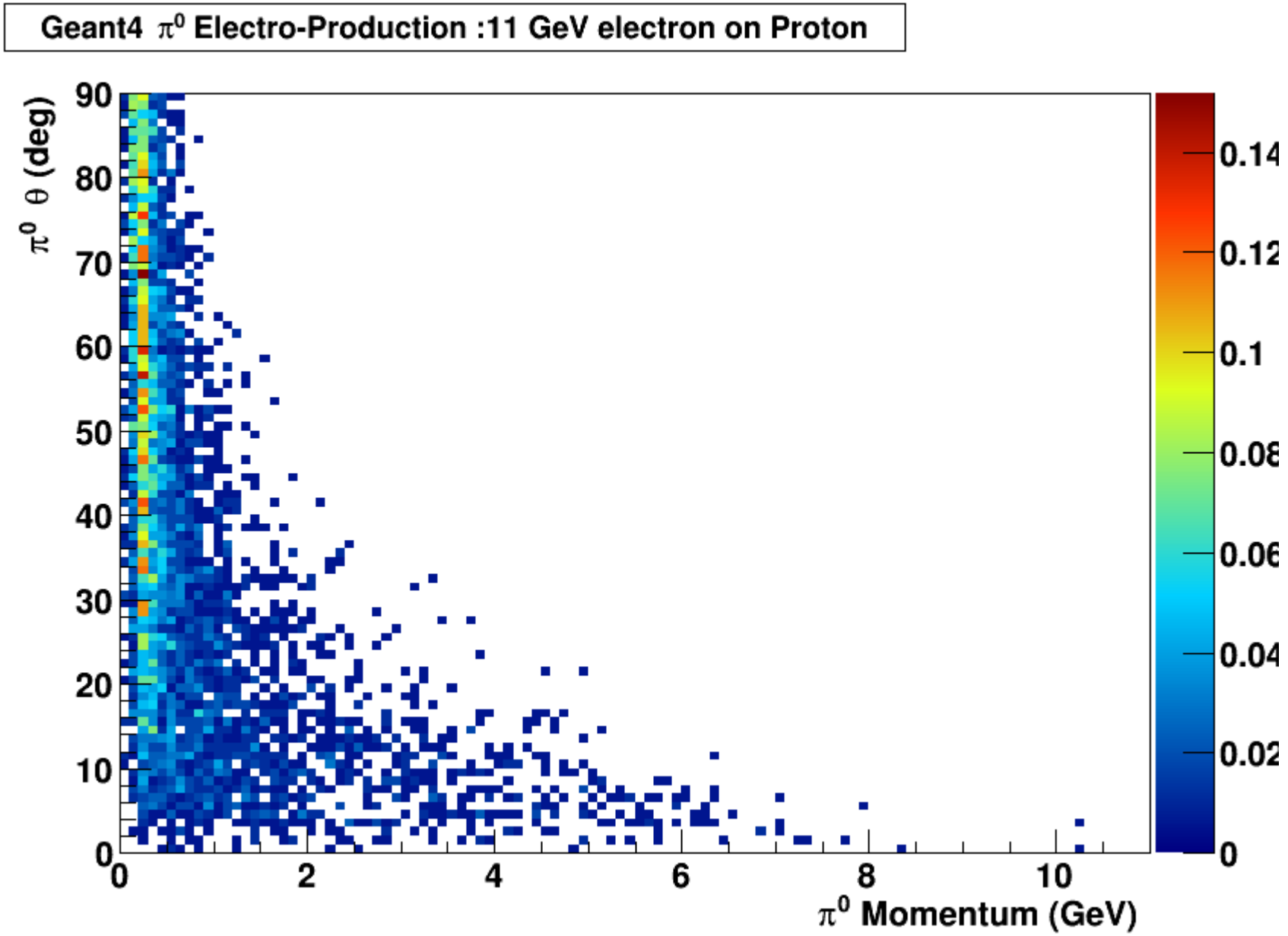
Hall D Generator : Proton Target



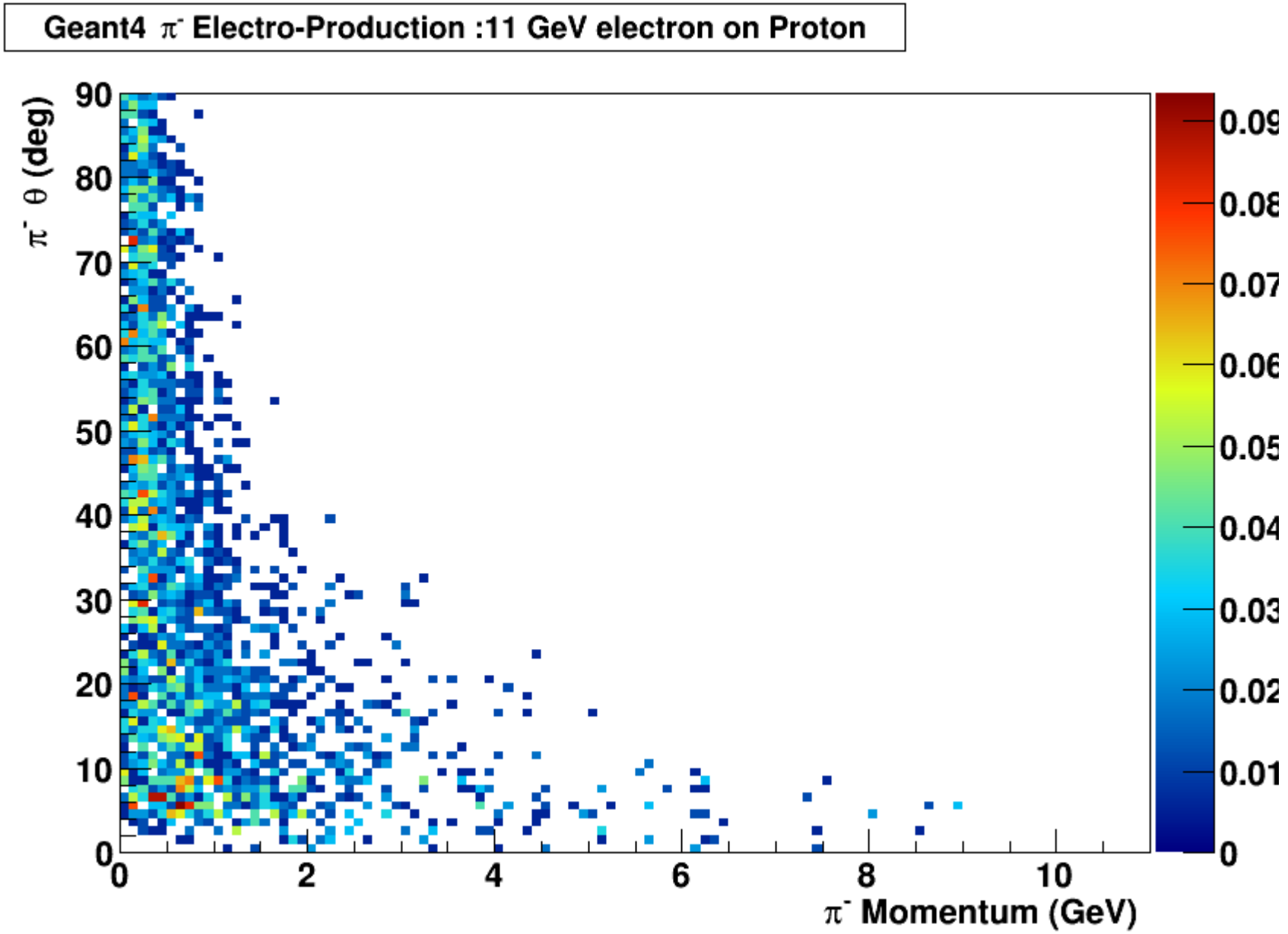
Hall D Generator : Proton Target



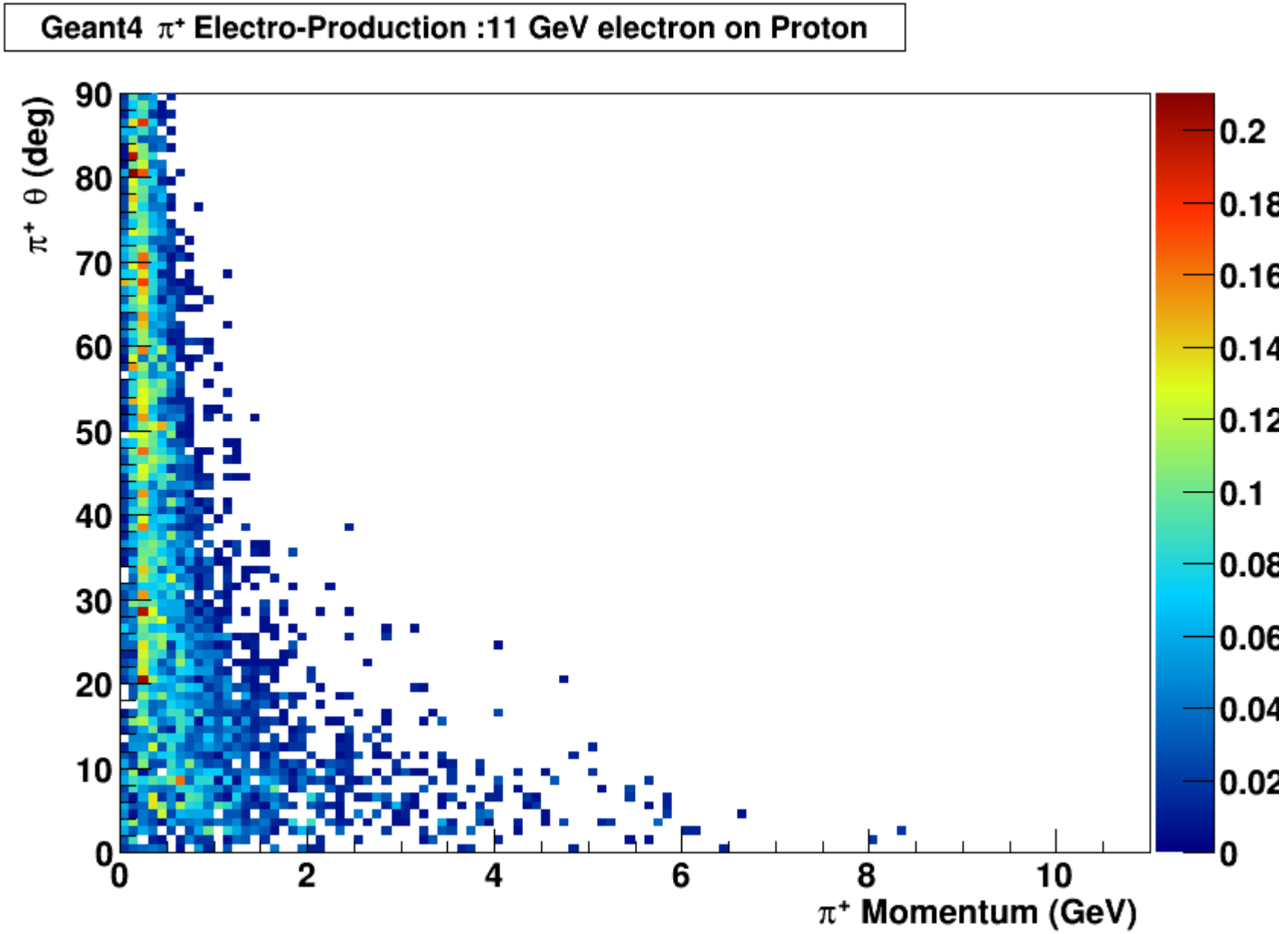
Geant4 : Proton Target



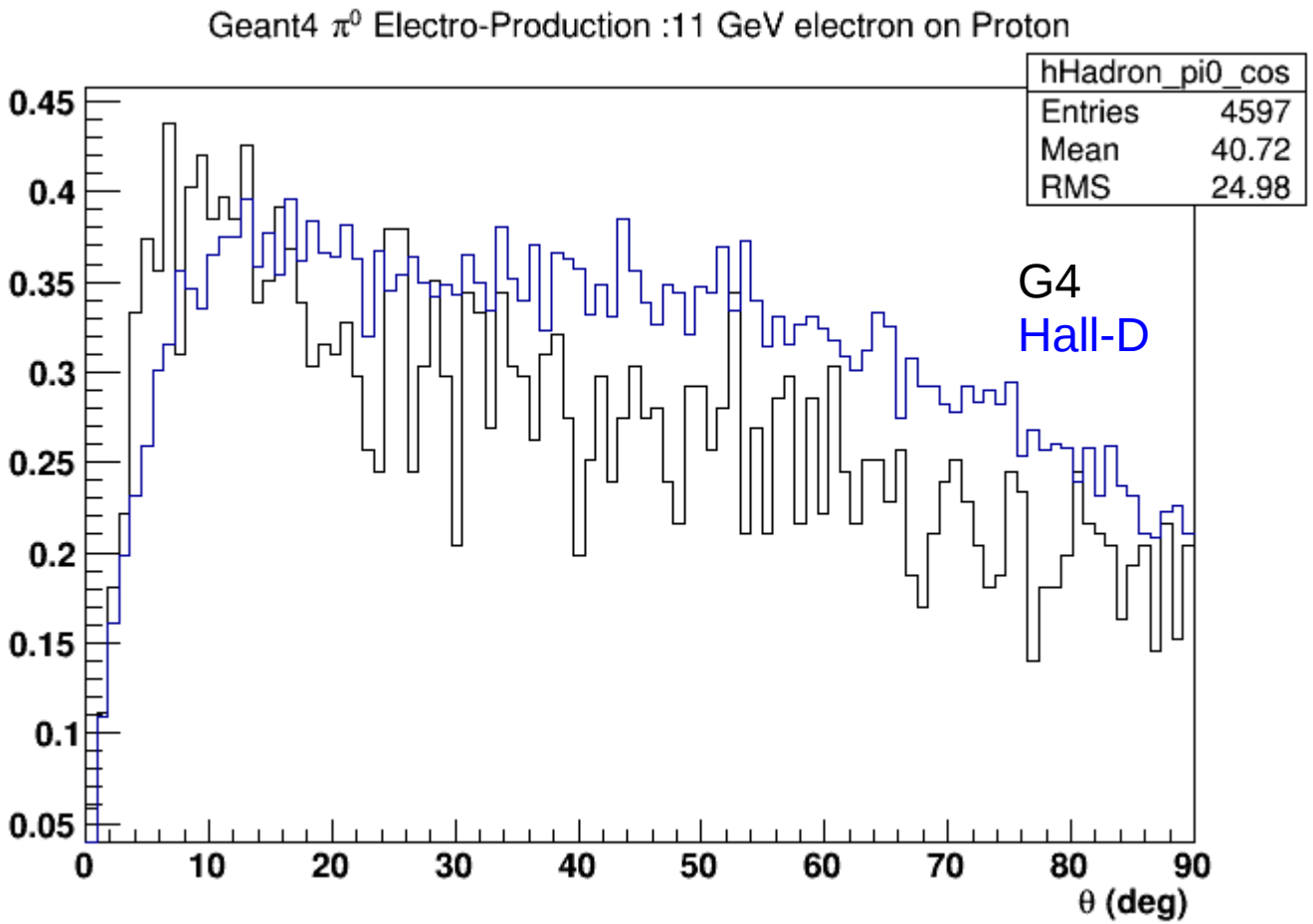
Geant4 : Proton Target



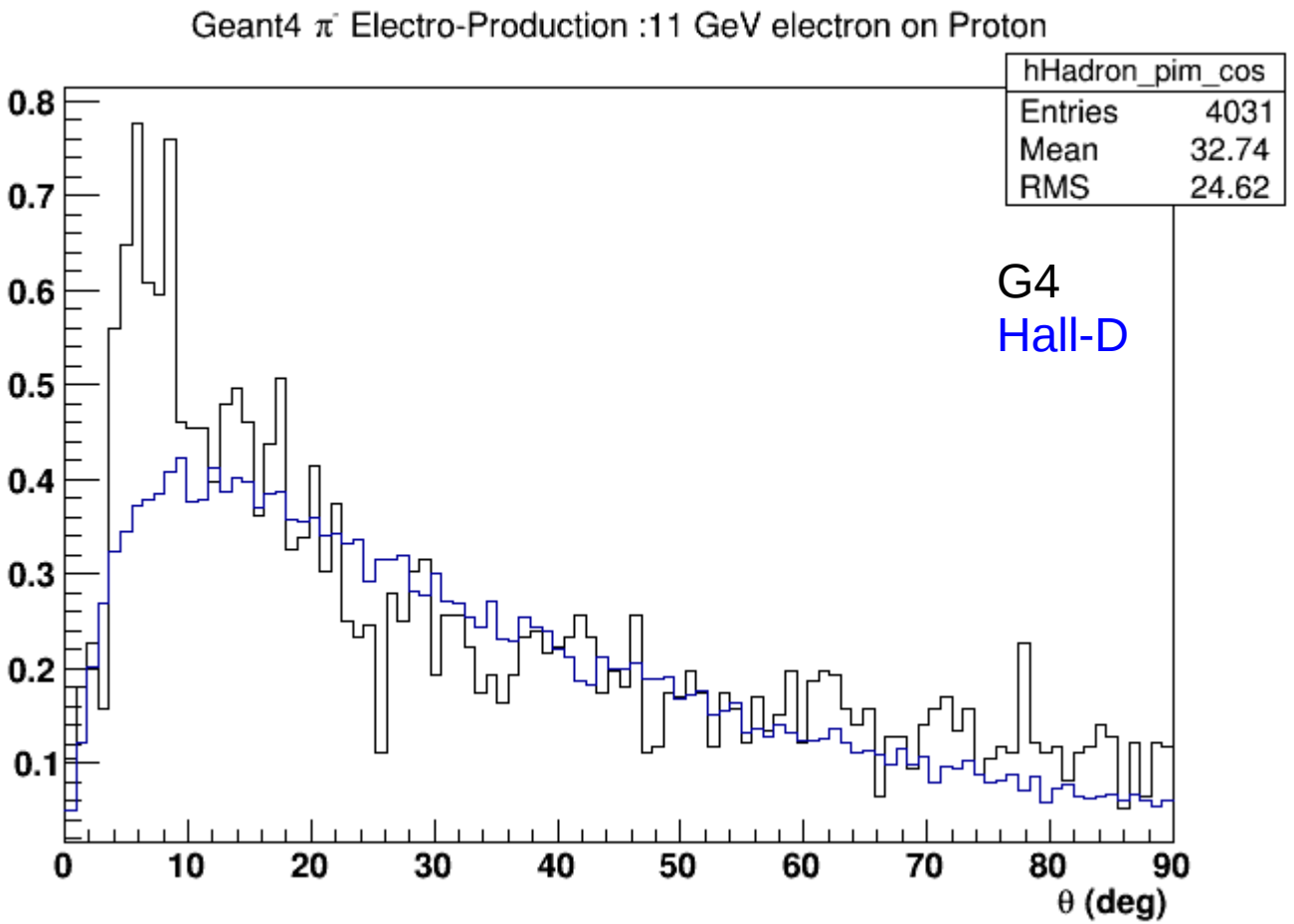
Geant4 : Proton Target



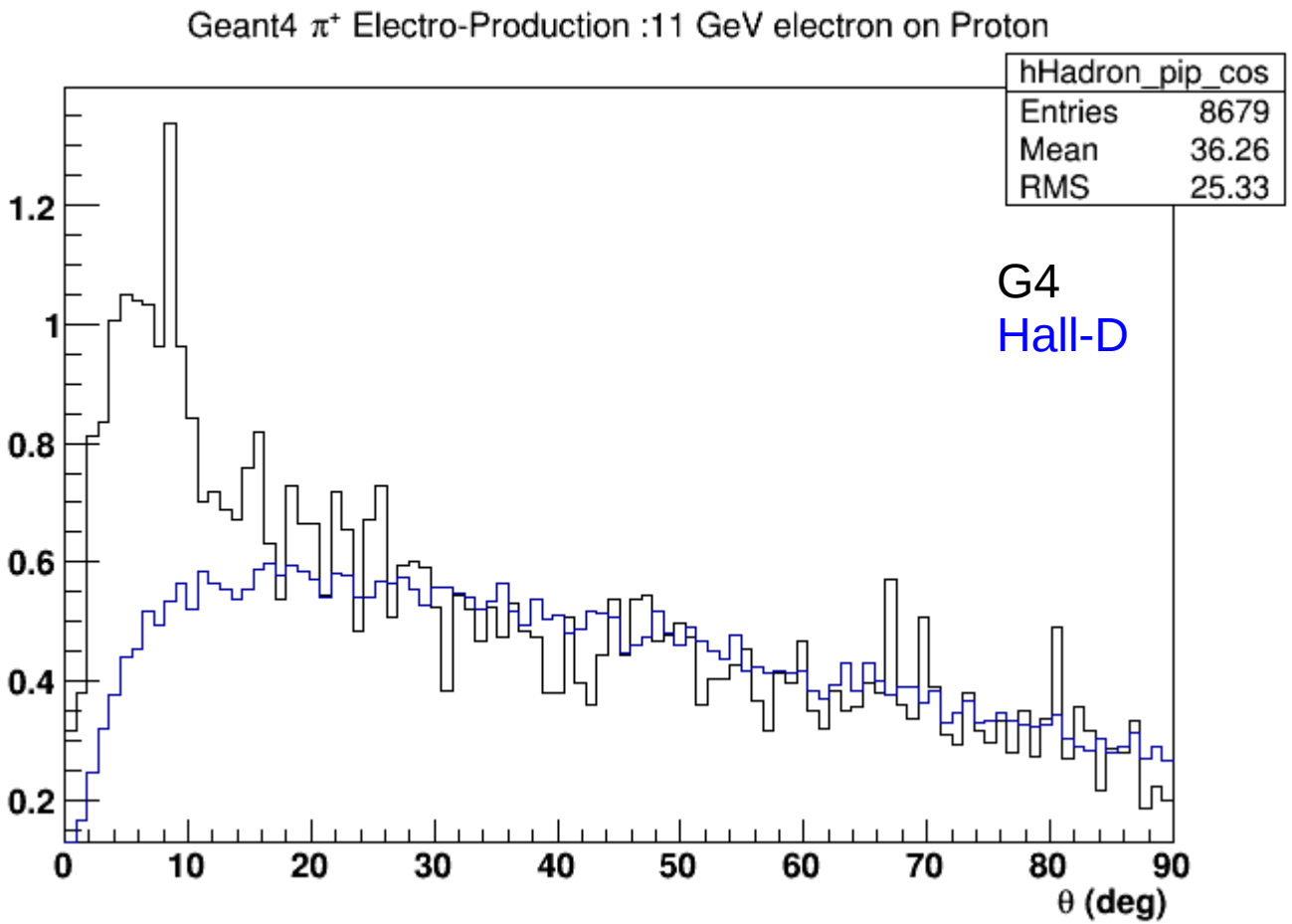
Hall D vs. Geant4 : Proton Target



Hall D vs. Geant4 : Proton Target



Hall D vs. Geant4 : Proton Target



Hall D vs. Geant4 : Deuterium Target

- Assumed isospin symmetry and used proton target events generated by hall D generator
  - Isospin symmetric deuterium cross sections using proton pion cross sections

$$\sigma(A)_{\pi^0} = Z \cdot \sigma_{\pi^0} + N \cdot \sigma_{\pi^0}$$

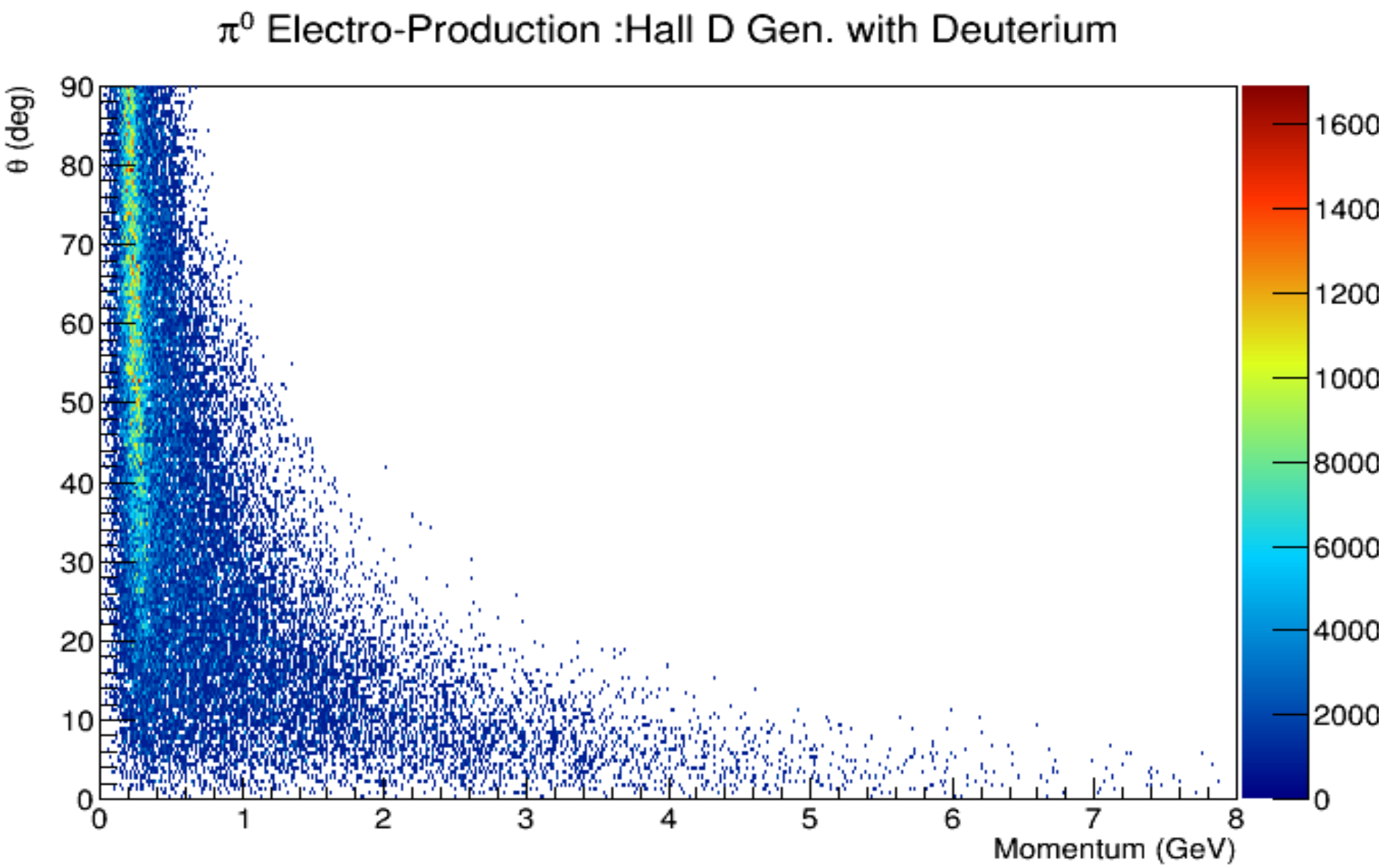
$$\sigma(A)_{\pi^\pm} = Z \cdot \sigma_{\pi^\pm} + N \cdot \sigma_{\pi^\pm}$$

In Wiser generator $\sigma_{\pi^0} = \dfrac{\sigma_{\pi^+} + \sigma_{\pi^-}}{2}$

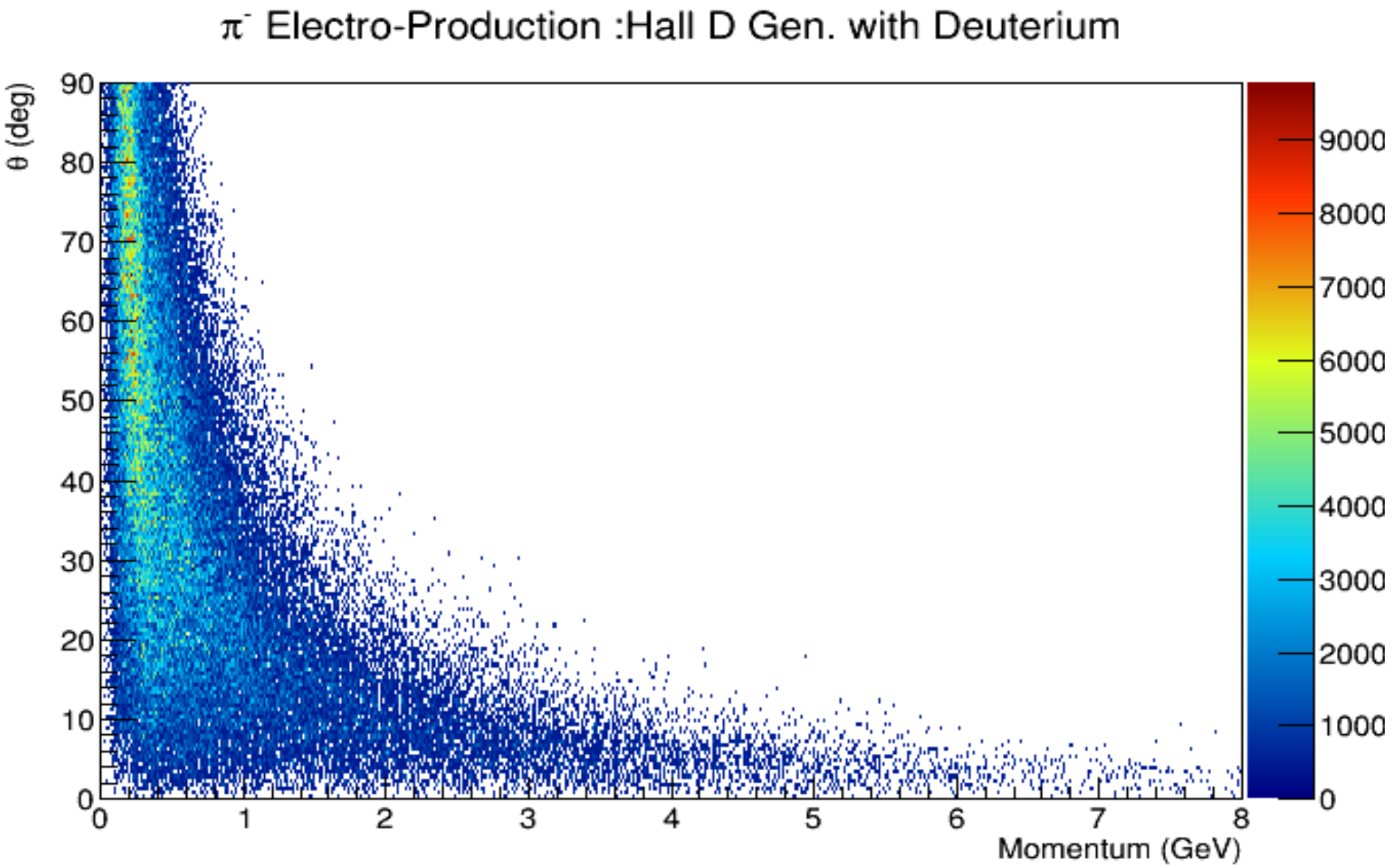
- Using Geant4, 100 million electrons incident on 40 cm deuterium target

Pion Type	Total Deuterium xs for theta < 90 deg			Hall D vs. G4 agreement
	Wiser xs (mb)	Hall D xs (mb)	Geant4 xs (mb)	(%)
pi0	189.7	62.5	84.6	-26
pi-	191.6	65.1	73.2	-11
pi+	192.7	65.1	71.3	-9

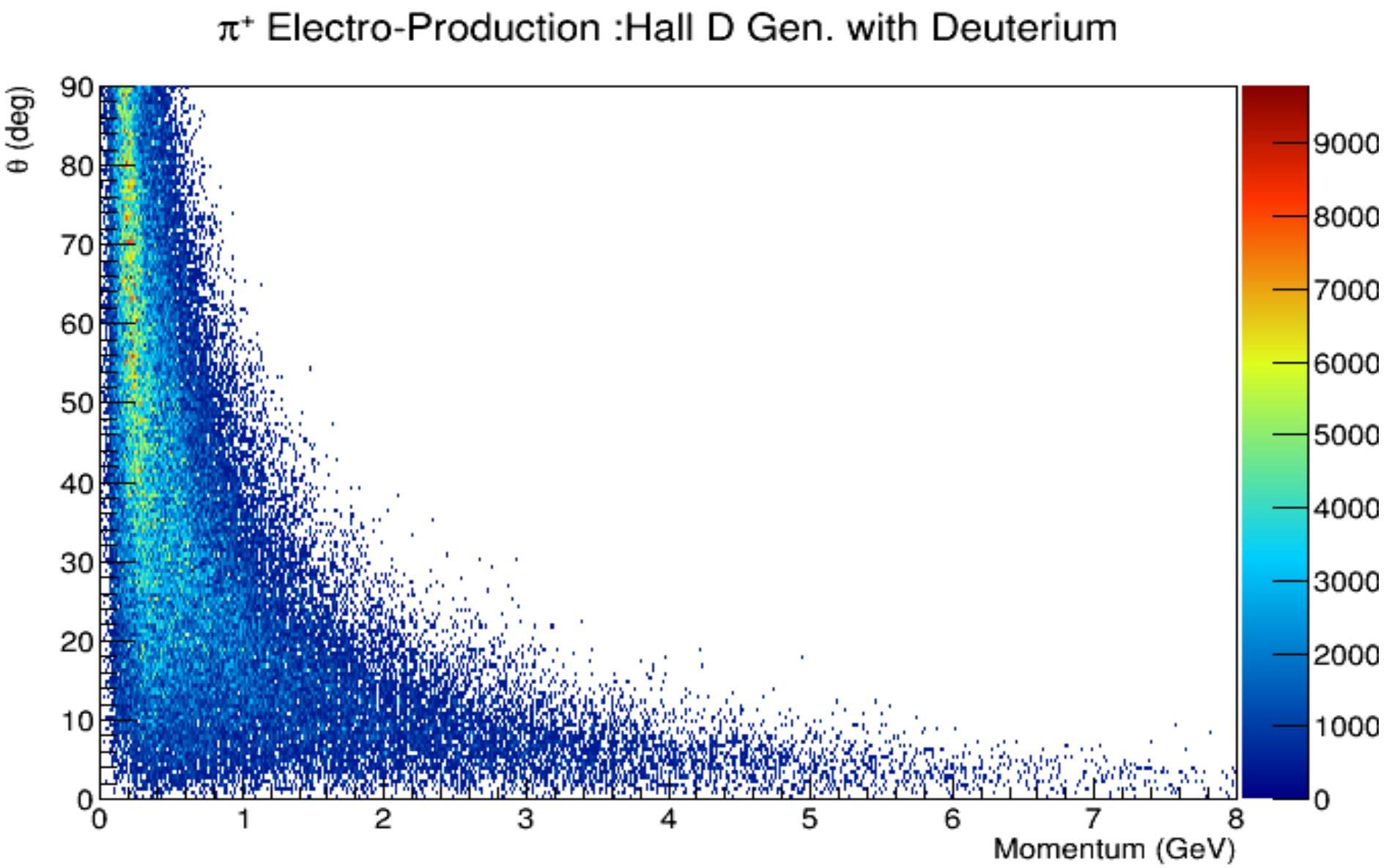
Hall D Generator : Deuterium Target



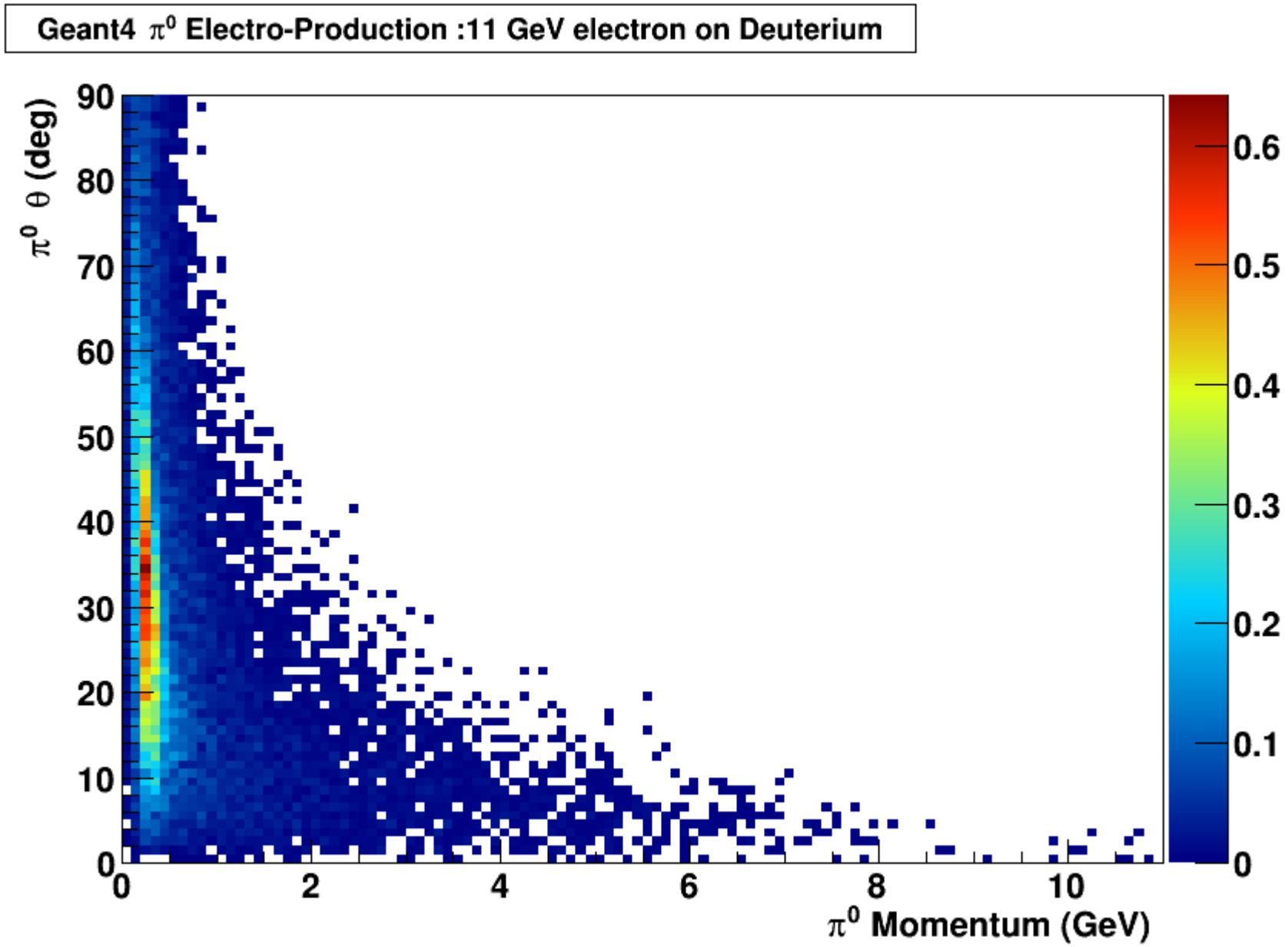
Hall D Generator : Deuterium Target



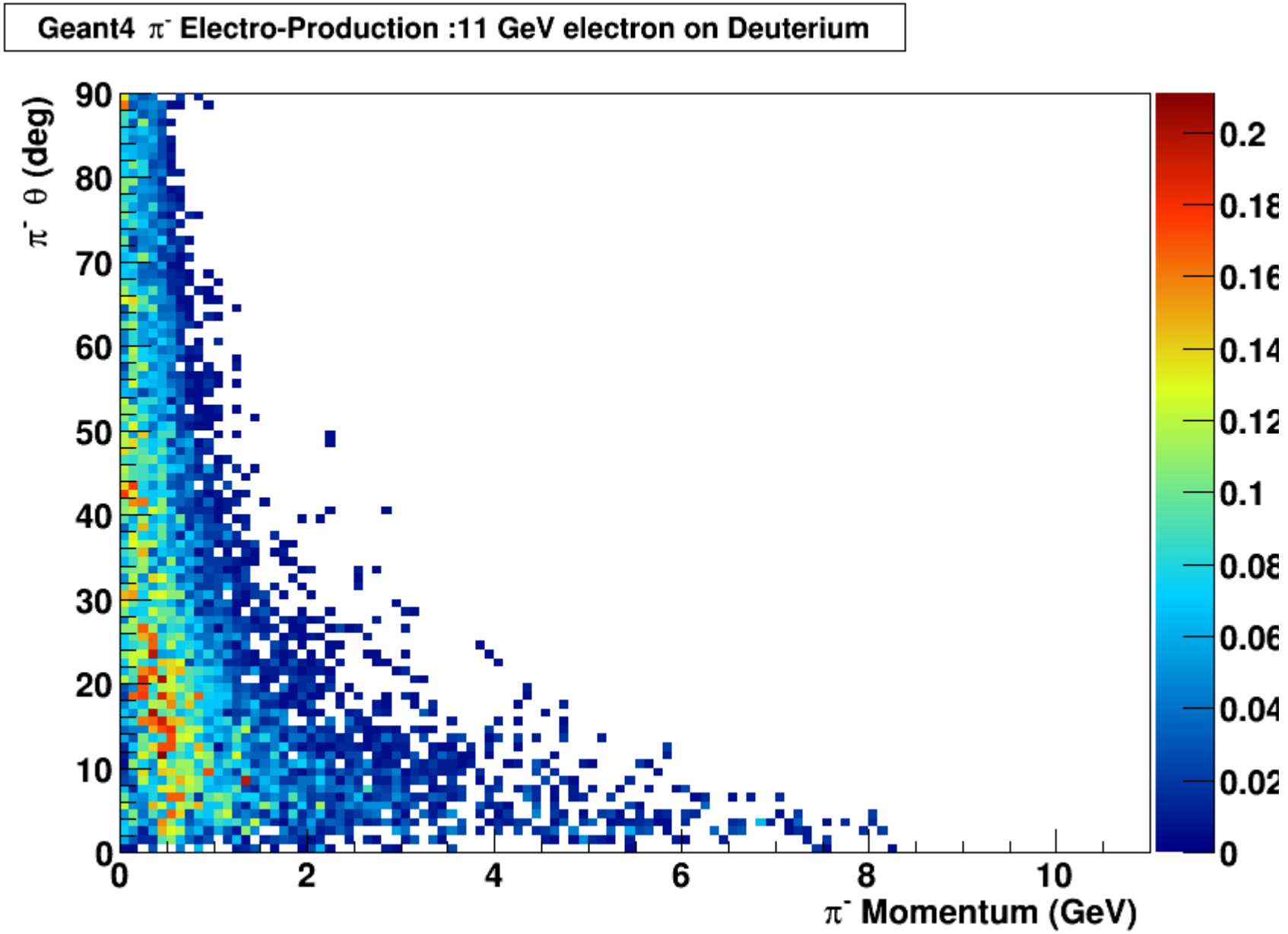
Hall D Generator : Deuterium Target



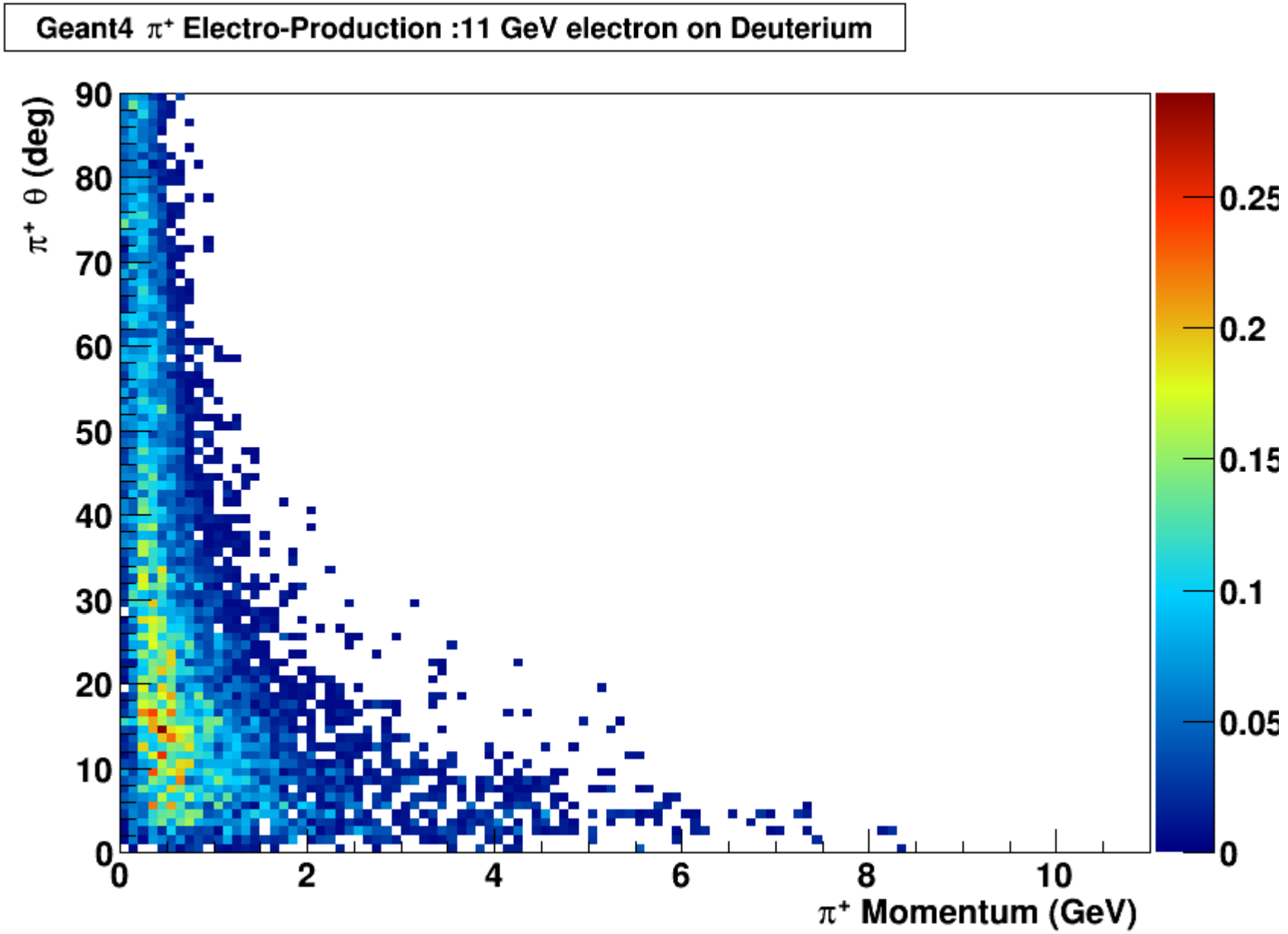
Geant4 : Deuterium Target



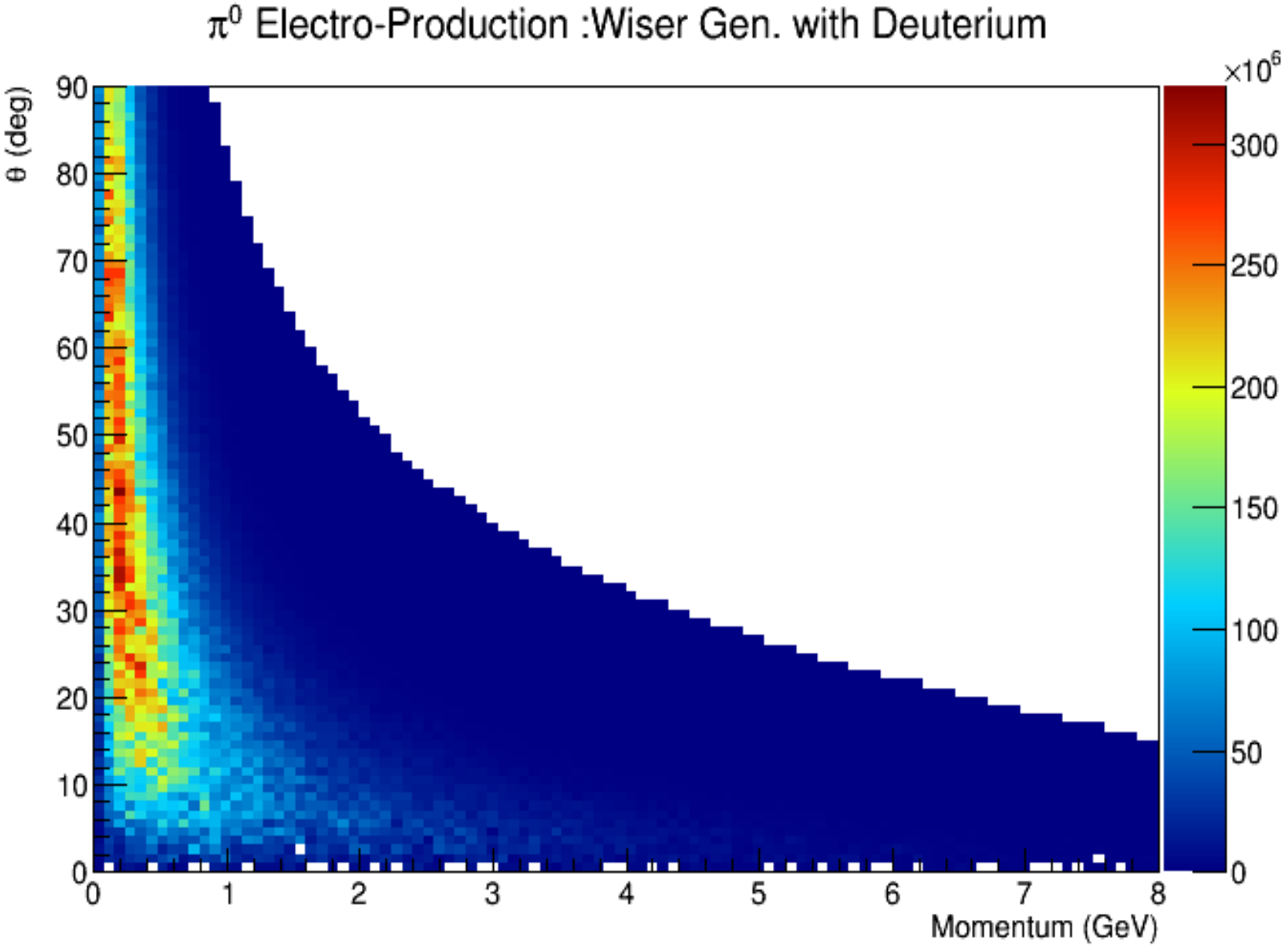
Geant4 : Deuterium Target



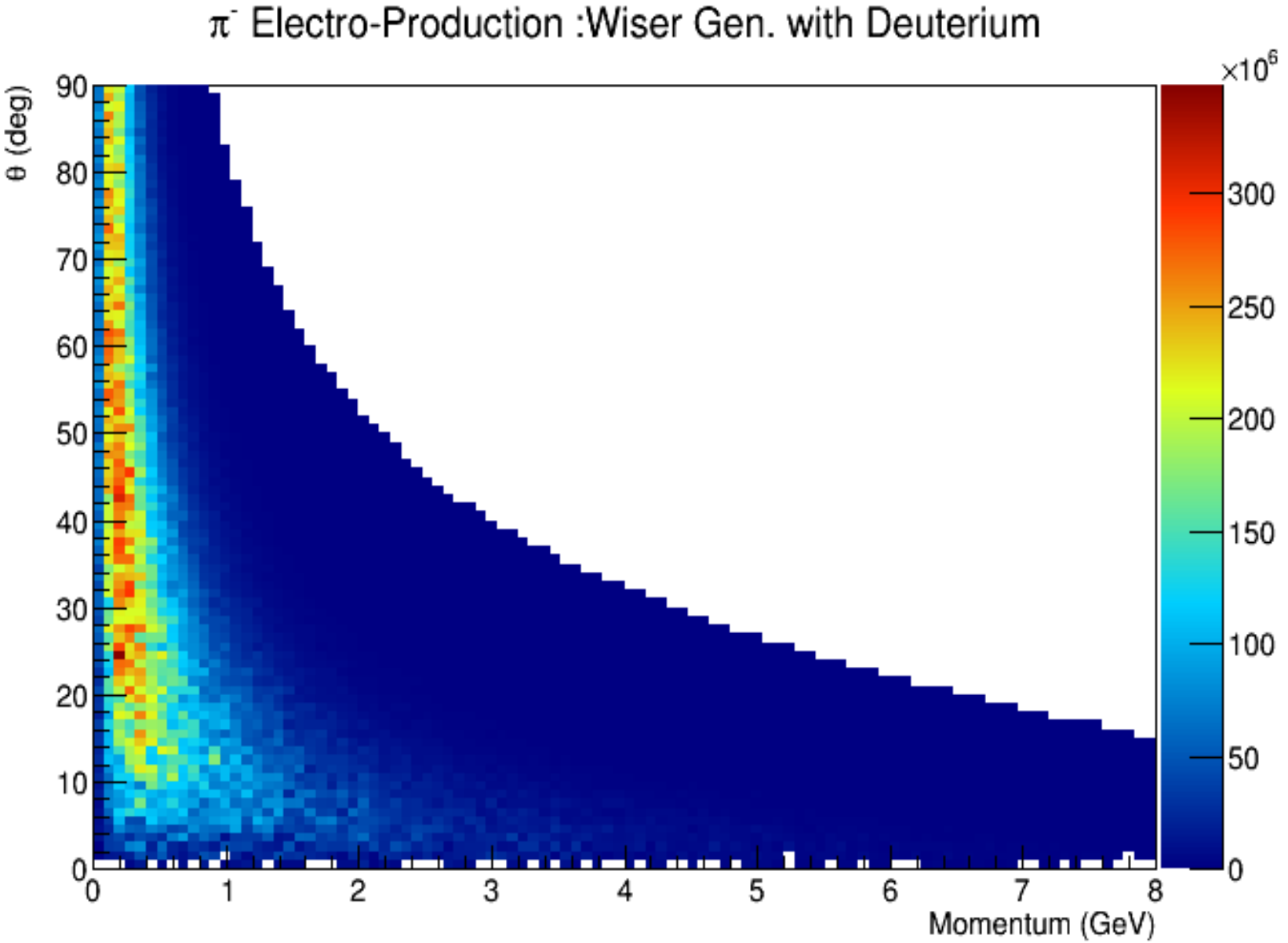
Geant4 : Deuterium Target



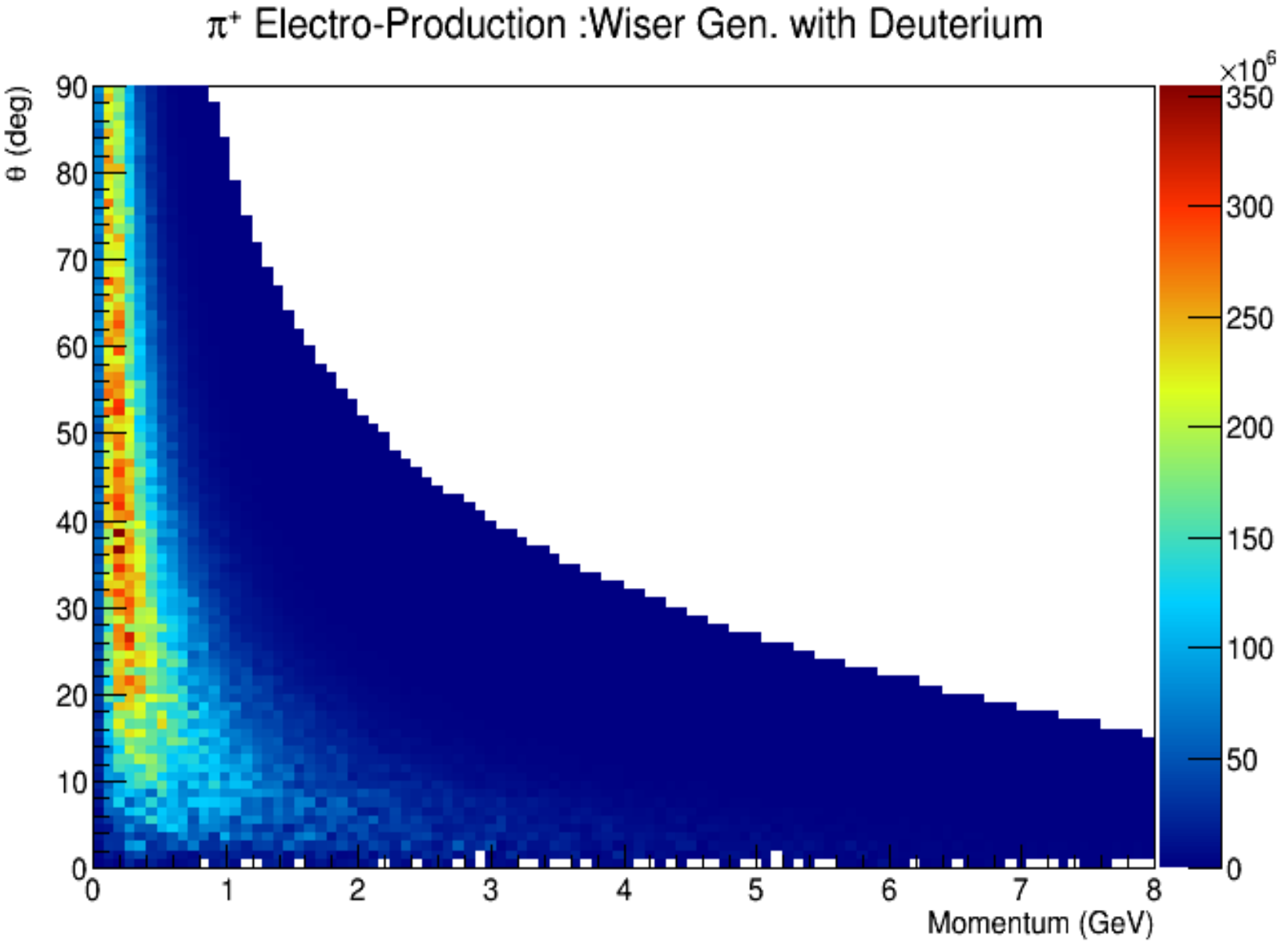
Wiser : Deuterium Target



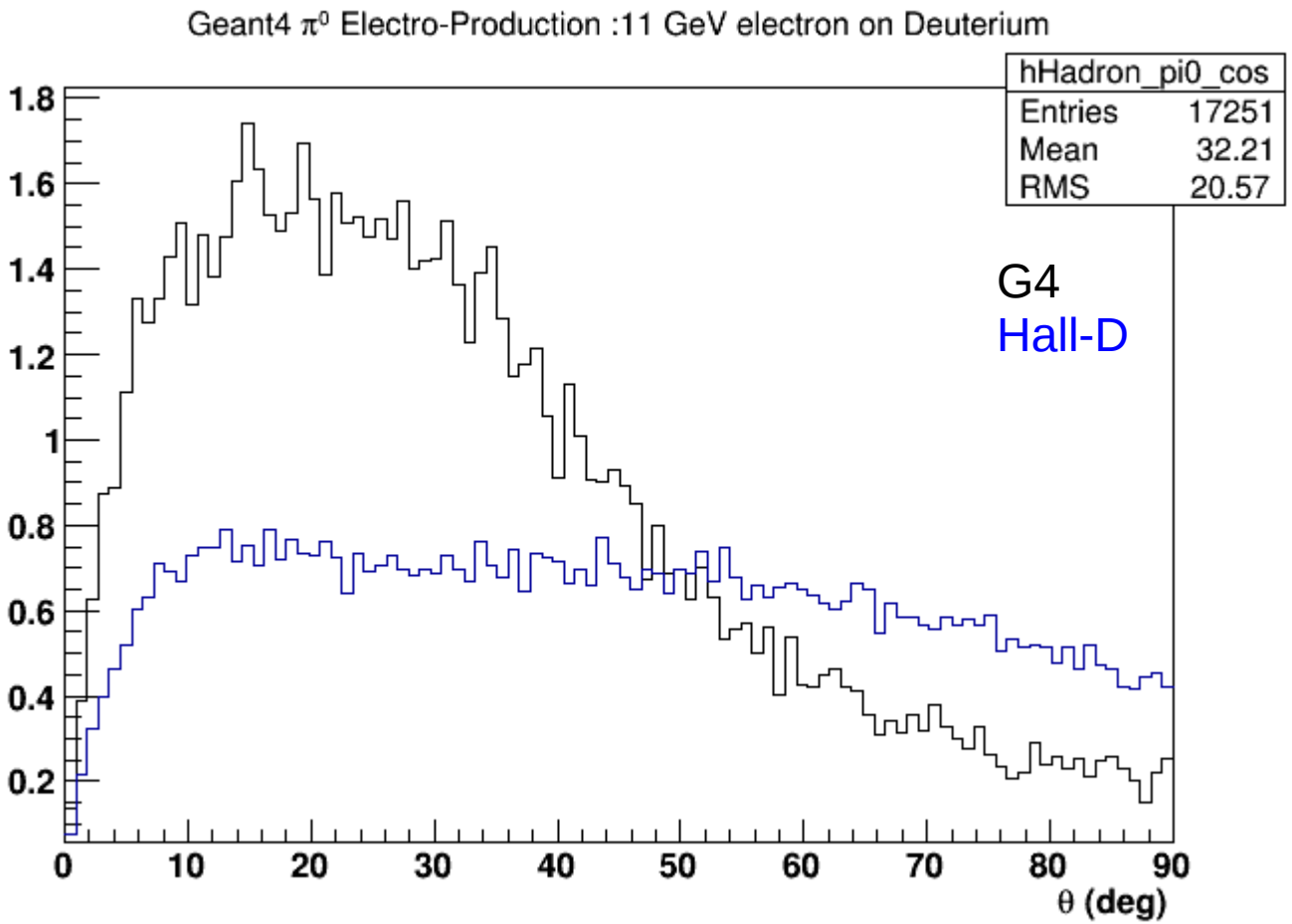
Wiser : Deuterium Target



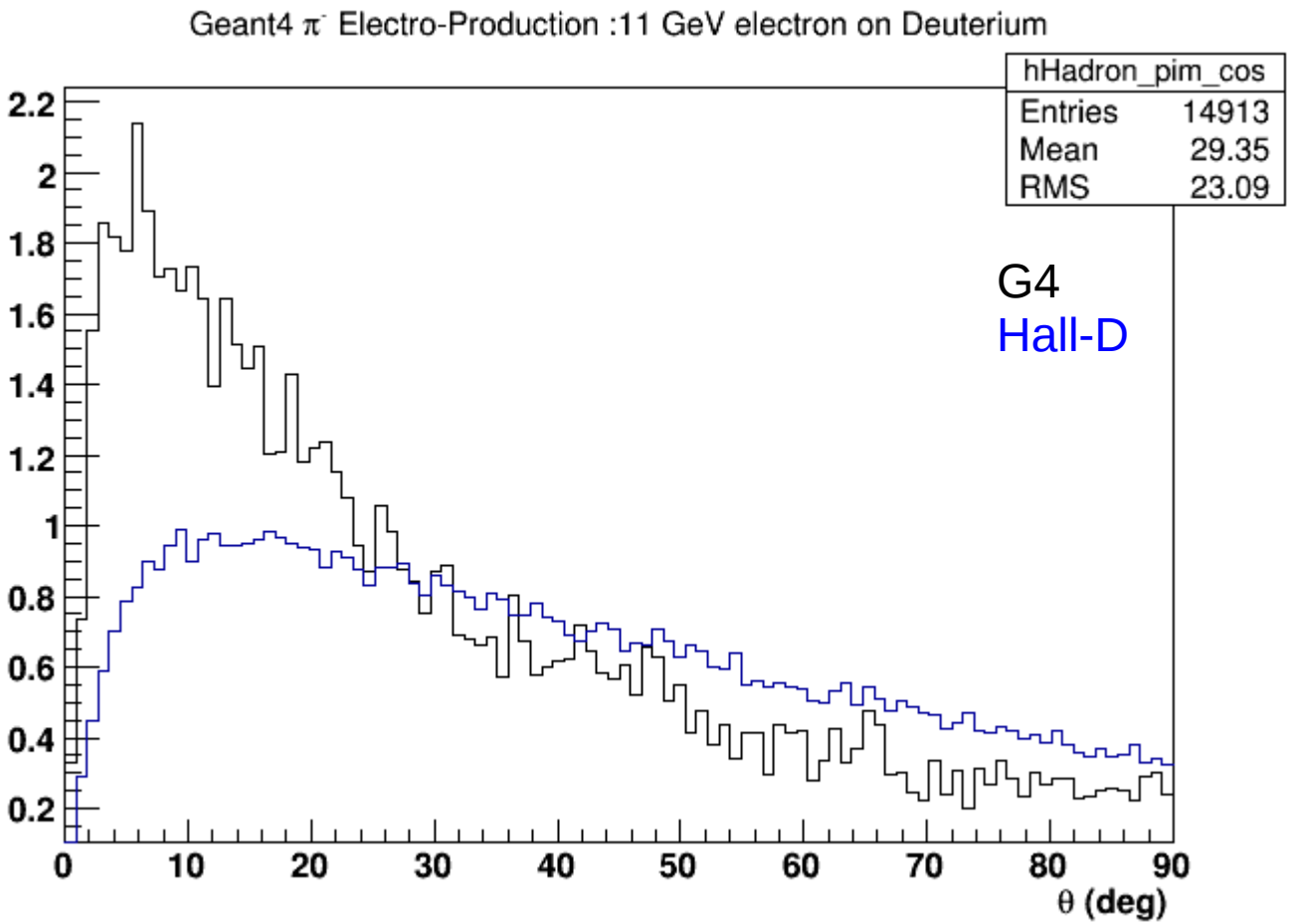
Wiser : Deuterium Target



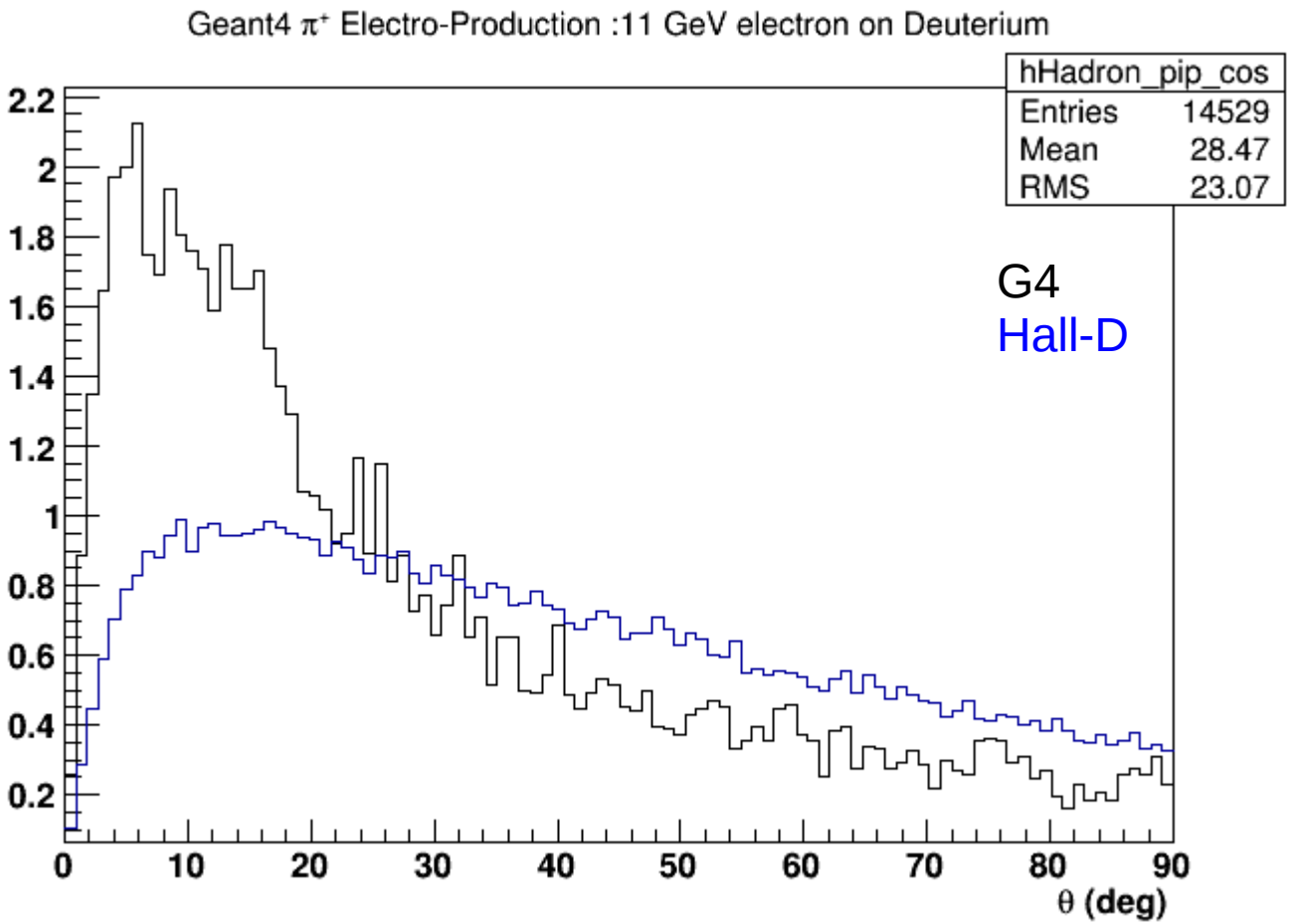
Hall D vs. Geant4 : Deuterium Target



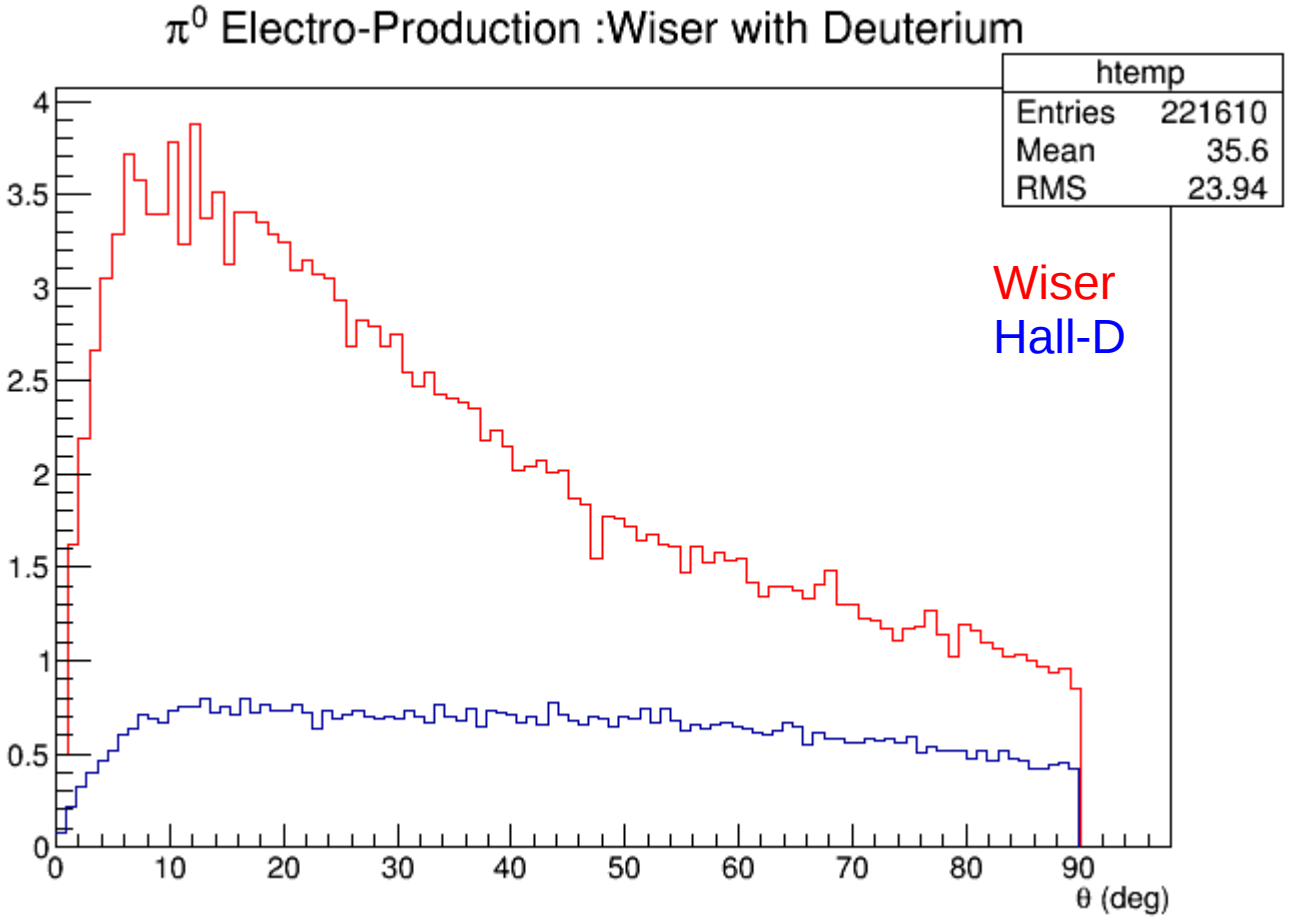
Hall D vs. Geant4 : Deuterium Target



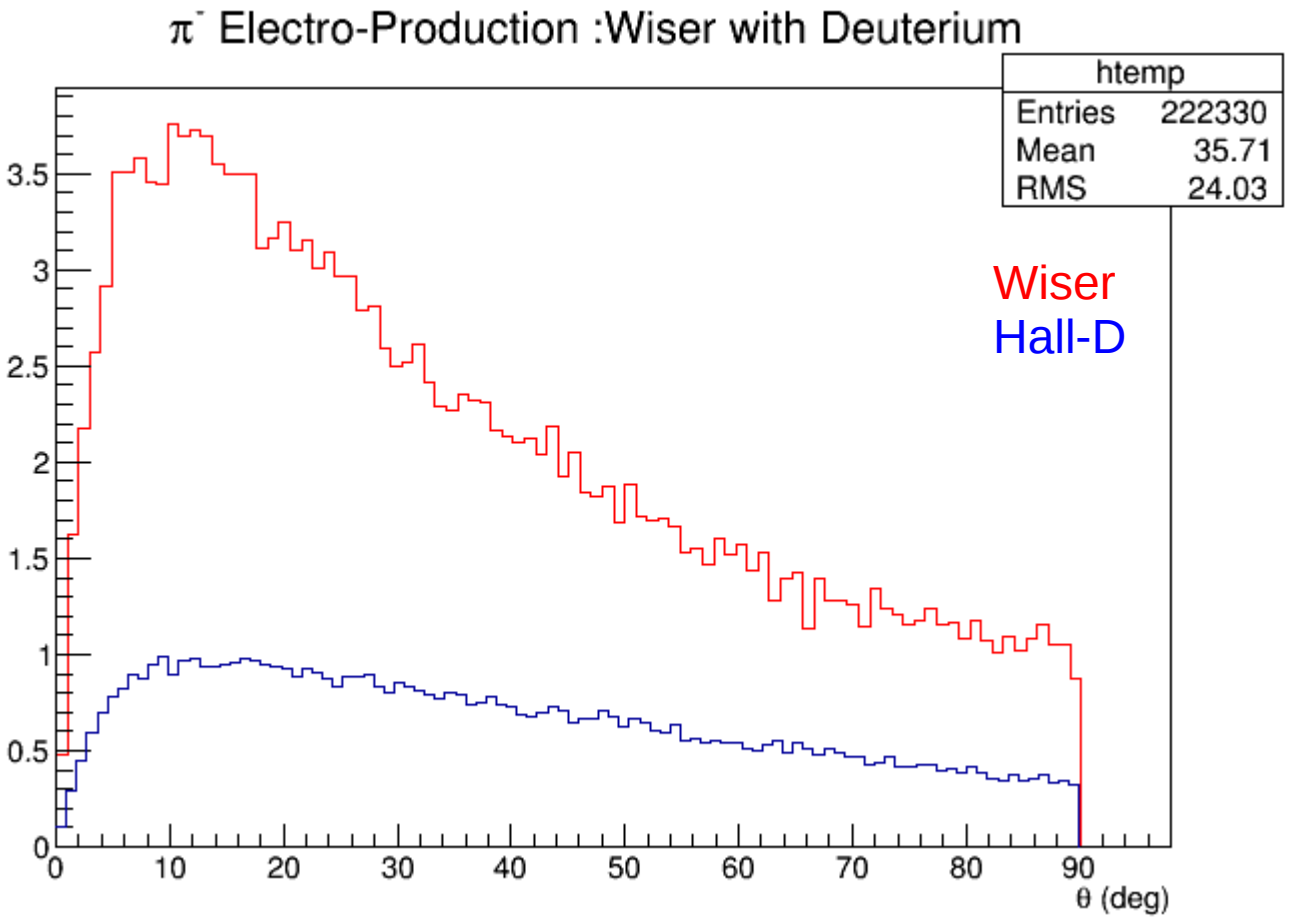
Hall D vs. Geant4 : Deuterium Target



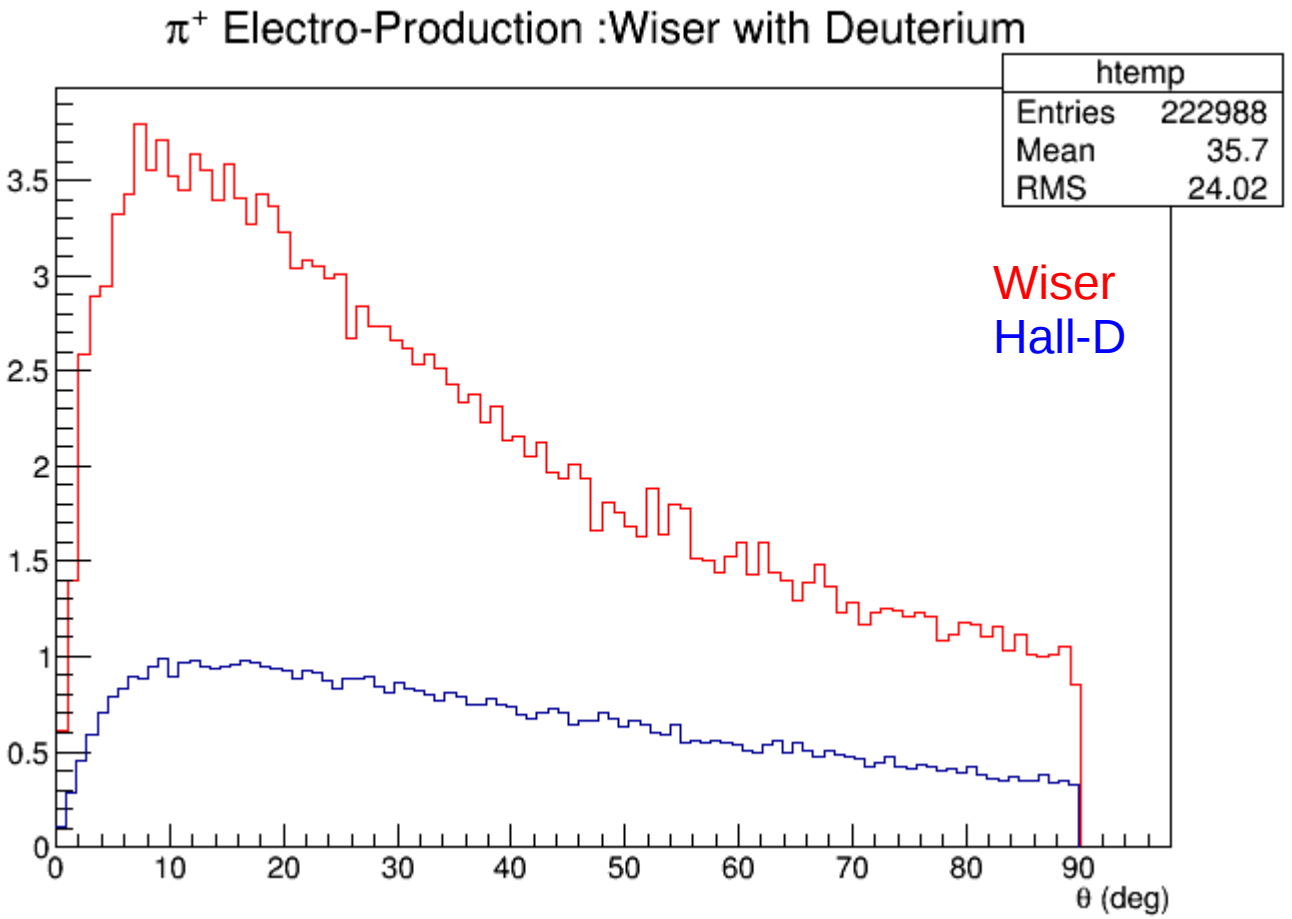
Hall D vs. Wiser : Deuterium Target



Hall D vs. Wiser : Deuterium Target



Hall D vs. Wiser : Deuterium Target



Generator Output Summary

- Geant4 and Hall generators agrees within 10% - 20%
  - I do not distinguish primary and secondary vertex produced pions in G4 while hall D only produce primary vetices → Could explain higher pion xs in G4
- Wiser overestimates pions

Pion Type	Total Proton xs for theta < 90 deg			Hall D vs. G4 agreement
	Wiser xs	Hall D xs	Geant4 xs	
	(mb)	(mb)	(mb)	(%)
pi0	n/a	31.3	26.8	17
pi-	n/a	20.7	23.5	-12
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Pion Type	Total Deuterium xs for theta < 90 deg			Hall D vs. G4 agreement
	Wiser xs	Hall D xs	Geant4 xs	
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pi0	189.7	62.5	84.6	-26
pi-	191.6	65.1	73.2	-11
pi+	192.7	65.1	71.3	-9

Total Deuterium Rates for theta < 90 deg				Hall D vs. G4 agreement
Pion Type	Wiser Total	Hall D Total	Geant4 Tota	
	(MHz)	(MHz)	(MHz)	(%)
pi0	123166.2	40627.8	53831.7	-25
pi-	126437.2	42695.7	46536.0	-8
pi+	125068.8	42695.7	45337.7	-6

Pion background rates for SoLID-PVDIS

- Run remoll with wiser generator to get pion background rates at the last GEM in SoLID-PVDIS setup
- Run remoll with hall D elec-prod events to get pion background rates at the last GEM in SoLID-PVDIS setup

Pion background rates for SoLID-PVDIS

Pion rates in SoLID PVDIS last GEM for LD target and kryptonite baffles								
Pion Type	Wiser				Hall D			
	P <= 1 GeV	P > 1 GeV	P > 3 GeV	Total	P <= 1 GeV	P > 1 GeV	P > 3 GeV	Total
	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
0	1149.4	30.7	0.0	1180.1	291.8	20.3	0.0	312.2
-	23.8	36.5	1.1	60.2	12.8	31.0	0.6	43.8
+	28.9	0.0	0.0	28.9	13.3	0.0	0.0	13.3

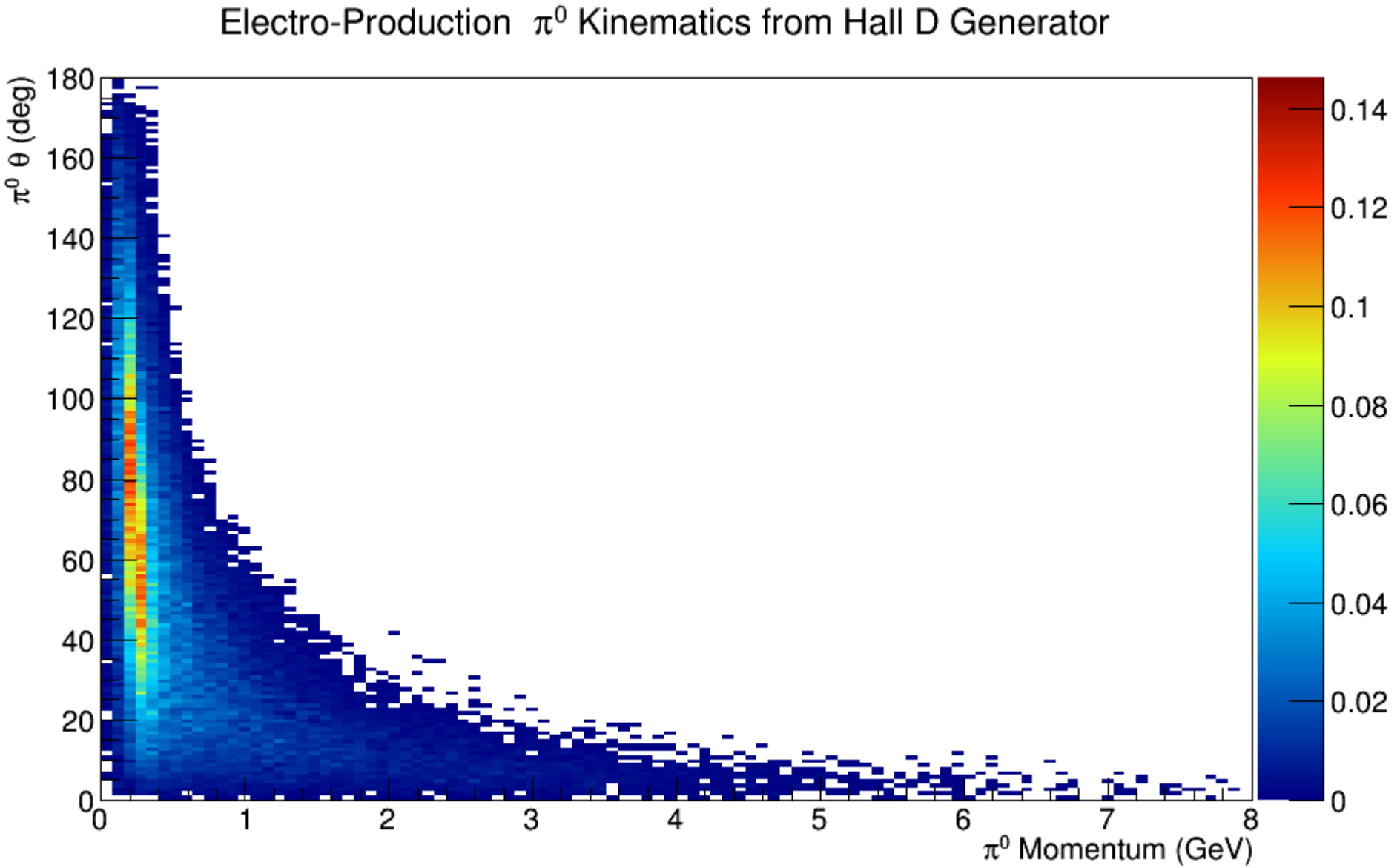
Pion rates in SoLID PVDIS last GEM for LD target and lead baffles								
Pion Type	Wiser				Hall D			
	P <= 1 GeV	P > 1 GeV	P > 3 GeV	Total	P <= 1 GeV	P > 1 GeV	P > 3 GeV	Total
	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
0	68367.7	35.9	0.0	68403.6	25208.8	20.8	0.0	25229.5
-	413.0	126.1	2.2	539.1	240.1	110.6	0.8	350.7
+	294.3	16.4	0.0	310.7	179.8	13.9	0.03	193.7
	Wiser				Hall D			
Pion Type	P <= 10 MeV	1 GeV > P > 10 MeV	P <= 1 GeV		P <= 10 MeV	1 GeV > P > 10 MeV	P <= 1 GeV	
	(MHz)	(MHz)	(MHz)		(MHz)	(MHz)	(MHz)	
0	59275.7	9103.4	68379.1		21767.0	3462.6	25229.6	

Next Steps

- Implement lund format to generate inputs for GEMC
  - Very soon
- Provide trigger rates
  - Currently I can only do ECAL
    - In about 1-2 weeks
  - Need Micheal's assistant for Cerenkov
- Repeat some ECAL studies I have done for understand and optimize ECAL trigger
- Generate ECAL + Cerenkov integrated output
  - To do final trigger rates and other trigger optimizations
  - To do level-3 farm analysis (Alex)

Backups

Hall D Generator : Proton Target



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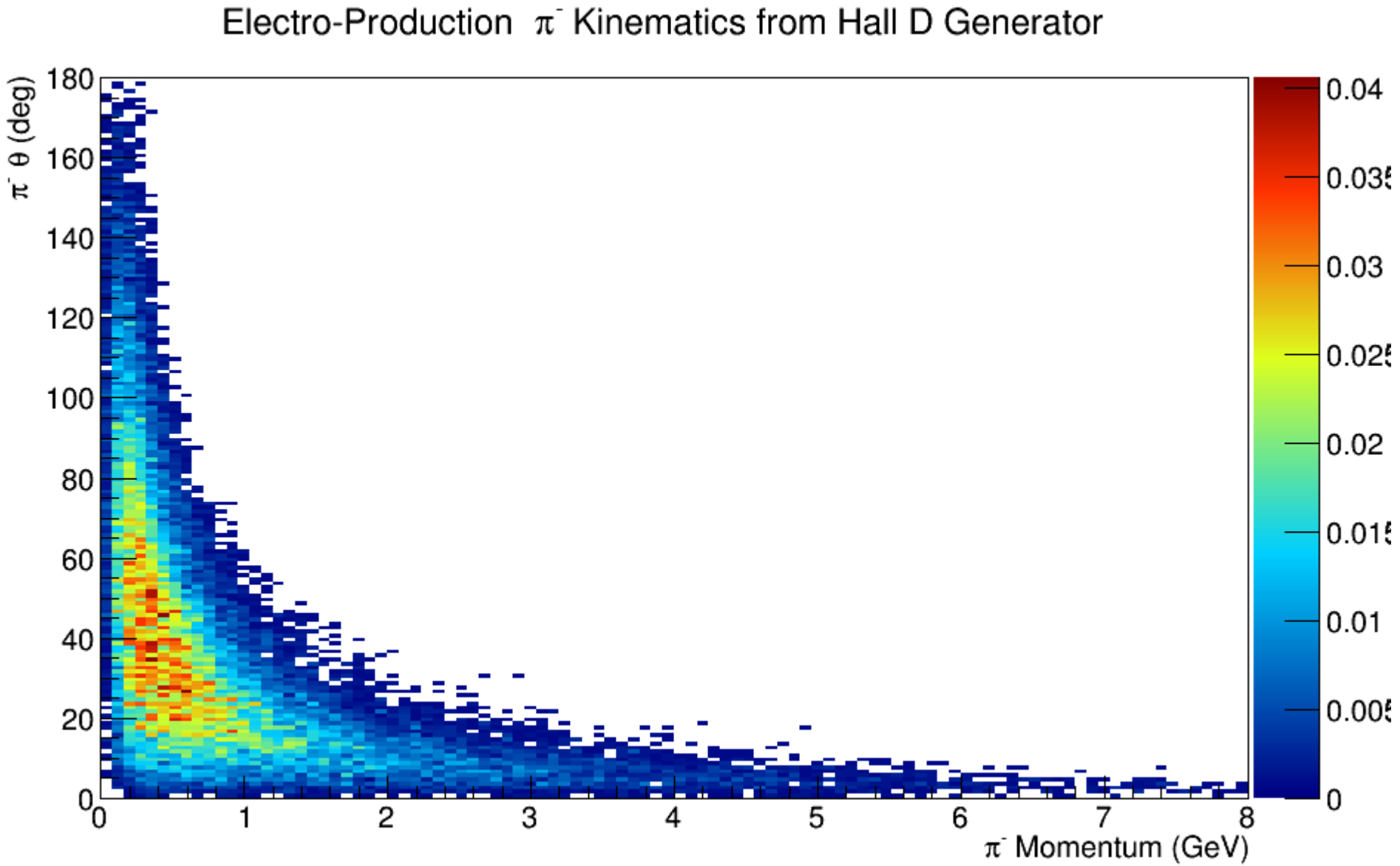

Hall D Generator : Proton Target