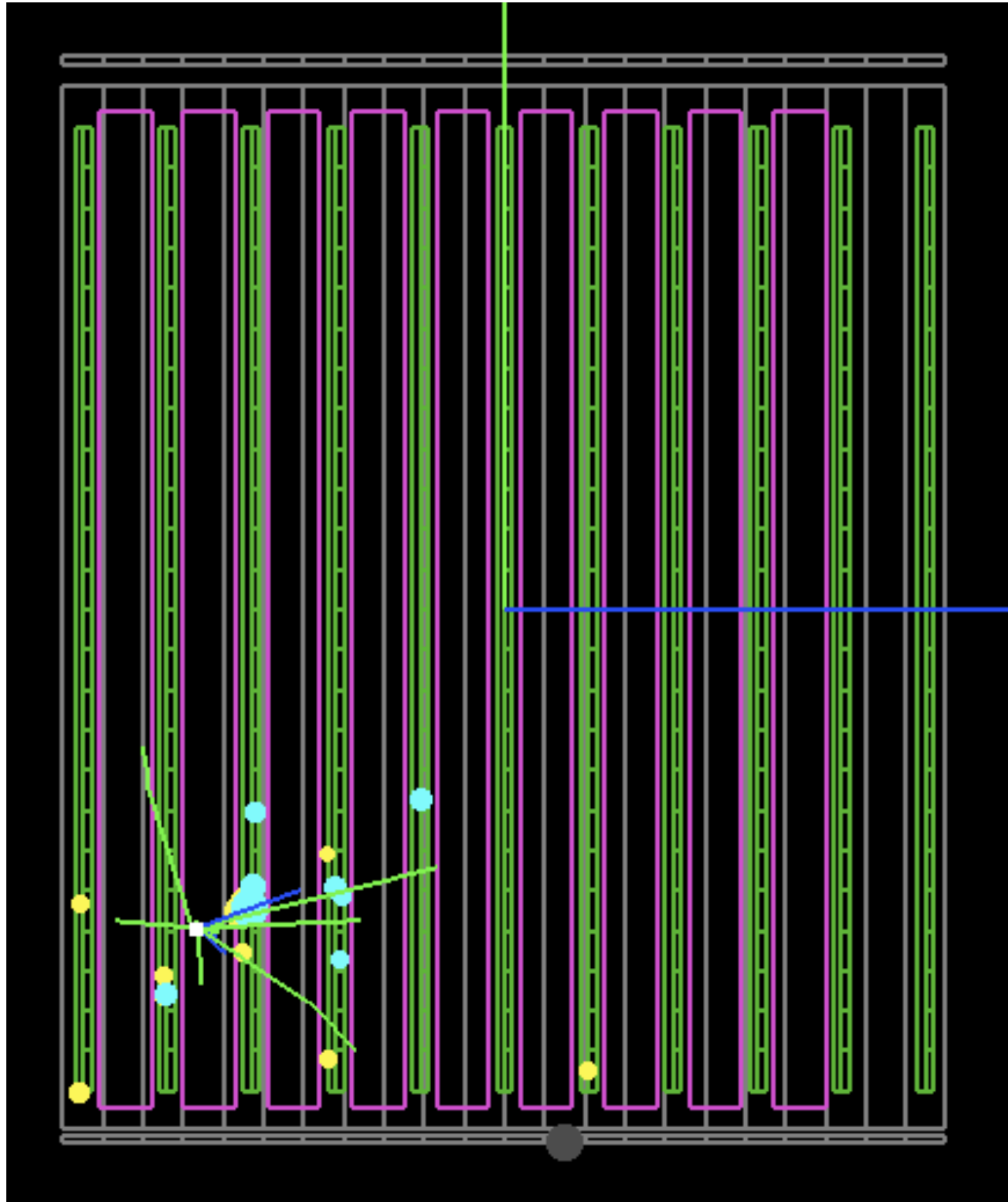


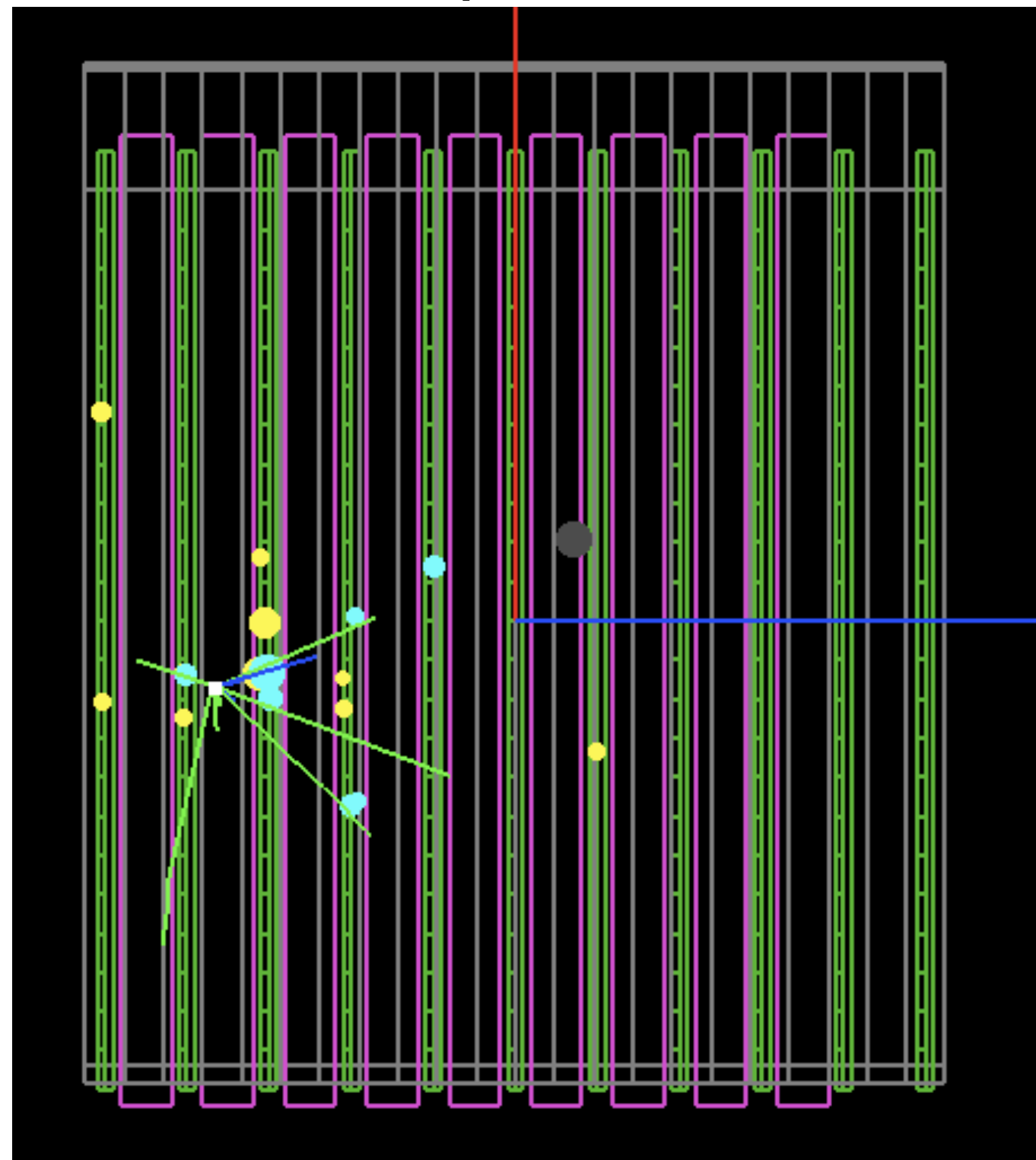
NC Event sample

neut + N/P $\rightarrow$ neut + N/P + Mesons

side view



top view



用いたニュートリノの情報

=== Neutrino Information from Jnubeam ===

ParentID: 8 Neut Production Mode: 11 Neut interaction Mode: 46

Energy: 8.291 GeV Direction: {-0.000622,-0.06493,0.9979}

Vertex (cm): {-8.487, -39.68, -38.23} Module: 3

=== Shoted Particle information ===

Particle: 111 Index: 6 Parent Index: 1
Tracking Flag: 1 Interaction Code: 0
Momentum:219.2 472.7 501.6
Kinetic Energy: 600.8

Particle: -211 Index: 9 Parent Index: 4
Tracking Flag: 1 Interaction Code: 0
Momentum:-33.43 44.42 75.69
Kinetic Energy: 28.65

Particle: 2212 Index: 12 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:311.2 383.3 945
Kinetic Energy: 482

Particle: 2112 Index: 13 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-182.7 83.4 -180.5
Kinetic Energy: 38.03

Particle: 2112 Index: 14 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:294.1 504.1 218.4
Kinetic Energy: 187.9

Particle: 2212 Index: 15 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:202.6 -55.81 -219.2
Kinetic Energy: 47.93

Particle: 2212 Index: 16 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-186.1 -340 59.81
Kinetic Energy: 78.66

Particle: 2212 Index: 17 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:93.4 -36.04 342.5
Kinetic Energy: 65.55

Particle: 2212 Index: 18 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-348.1 179.5 -129.2
Kinetic Energy: 86.64

Particle: 2112 Index: 19 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-219.1 -43.93 238.2
Kinetic Energy: 55.13

Particle: 2112 Index: 20 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-335.3 84.88 -14.05
Kinetic Energy: 61.72

Particle: 2112 Index: 21 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-163.5 -115.9 172.3
Kinetic Energy: 36.47

Particle: 2112 Index: 22 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:126.7 13.36 291.5
Kinetic Energy: 52.38

Particle: 2212 Index: 23 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-305.6 -165.3 444.2
Kinetic Energy: 156.4

Particle: 2212 Index: 24 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-1.458 -275.3 -156.4
Kinetic Energy: 51.98

Particle: 2112 Index: 25 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-190.5 -386.5 41.23
Kinetic Energy: 94.94

Particle: 2212 Index: 26 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-130.1 1.702 -276.6
Kinetic Energy: 48.55

Particle: 2112 Index: 27 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:80.34 20.91 -238.7
Kinetic Energy: 33.4

Particle: 2112 Index: 28 Parent Index: 3
Tracking Flag: 1 Interaction Code: 0
Momentum:-128.2 85.13 337
Kinetic Energy: 70.41

Particle: 2212 Index: 29 Parent Index: 7
Tracking Flag: 1 Interaction Code: 0
Momentum:143.9 -412.2 473
Kinetic Energy: 199.6

Particle: 2112 Index: 30 Parent Index: 7
Tracking Flag: 1 Interaction Code: 0
Momentum:-92.98 -260 19.54
Kinetic Energy: 39.92

=== hits in XLayer (yellow) ===

Mod:3 Plane:3 Ch:9 Edep:778 keV PID:2212 Track:35 pos(mm):{-110, -559.7, -218.5}
Mod:3 Plane:0 Ch:9 Edep:1.009 MeV PID:11 Track:52 pos(mm):{-102, -365.6, -528.2}
Mod:3 Plane:1 Ch:9 Edep:896.9 keV PID:2212 Track:71 pos(mm):{-123.5, -454.6, -423.5}
Mod:3 Plane:2 Ch:10 Edep:7.757 MeV PID:2212 Track:3 pos(mm):{-66.52, -375.4, -325}
Mod:3 Plane:6 Ch:8 Edep:855.2 keV PID:2212 Track:246 pos(mm):{-166, -572.9, 104.9}
Mod:3 Plane:0 Ch:17 Edep:1.54 MeV PID:2212 Track:510 pos(mm):{267.9, -599.4, -529.8}
Mod:3 Plane:2 Ch:13 Edep:1.19 MeV PID:1000060120 Track:517 pos(mm):{80.74, -425.4, -324.1}
Mod:3 Plane:1 Ch:10 Edep:897.3 keV PID:11 Track:524 pos(mm):{-65.29, -480.5, -423.7}
Mod:3 Plane:2 Ch:11 Edep:6.562 MeV PID:11 Track:785 pos(mm):{-1.906, -363.7, -319.6}
Mod:3 Plane:3 Ch:10 Edep:336.6 keV PID:11 Track:1896 pos(mm):{-73.42, -303.1, -220}

=== hits in YLayer (cyan) ===

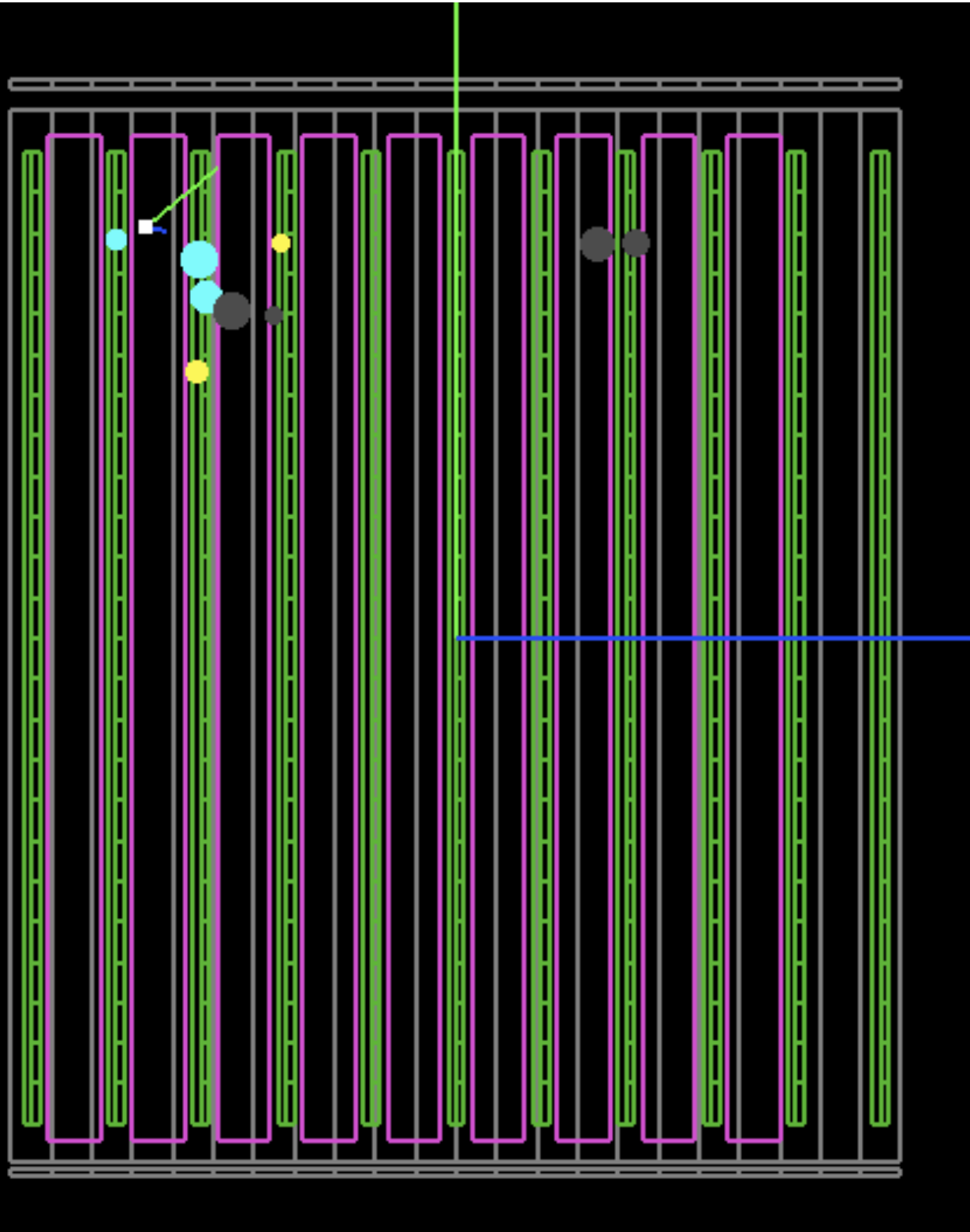
Mod:3 Pln:3 Ch:3 Edep:758.3 keV PID:1000060120 Track:85 pos(mm):{6.718, -433.1, -204.5}	
Mod:3 Pln:3 Ch:5 Edep:3.266 MeV PID:11 Track:200 pos(mm):{-235.7, -346.2, -208.6}	
Mod:3 Pln:3 Ch:4 Edep:673.2 keV PID:11 Track:199 pos(mm):{-230.6, -357.8, -200.8}	// neutrino 14
Mod:3 Pln:2 Ch:4 Edep:12.08 MeV PID:2212 Track:3 pos(mm):{-63.65, -371.8, -315}	// muon 13
Mod:3 Pln:4 Ch:7 Edep:2.899 MeV PID:2212 Track:243 pos(mm):{69.5, -235.9, -102.9}	// P 2212
Mod:3 Pln:1 Ch:2 Edep:3.256 MeV PID:11 Track:524 pos(mm):{-67.12, -477.6, -420}	// N 2112
Mod:3 Pln:2 Ch:7 Edep:339.3 keV PID:11 Track:606 pos(mm):{-61.91, -247.1, -310.9}	// Pi0 111
Mod:3 Pln:2 Ch:6 Edep:2.112 MeV PID:11 Track:605 pos(mm):{-57.29, -251.9, -308.8}	// Pi+ 211
Mod:3 Pln:2 Ch:5 Edep:3.995 MeV PID:11 Track:653 pos(mm):{-99.39, -343.4, -312.5}	// Pi- -211
	// Eta0 221
=== hits in veto (red) ===	// K+ 321
Mod:3 Pln:13 Ch:12 Edep:15.25 MeV PID:2212 track:91 pos(mm):104.7 -661.5 75}	// Lambda 3122
	// omega 223

==== Track with Parent ID = 0 (means primary particle) ===

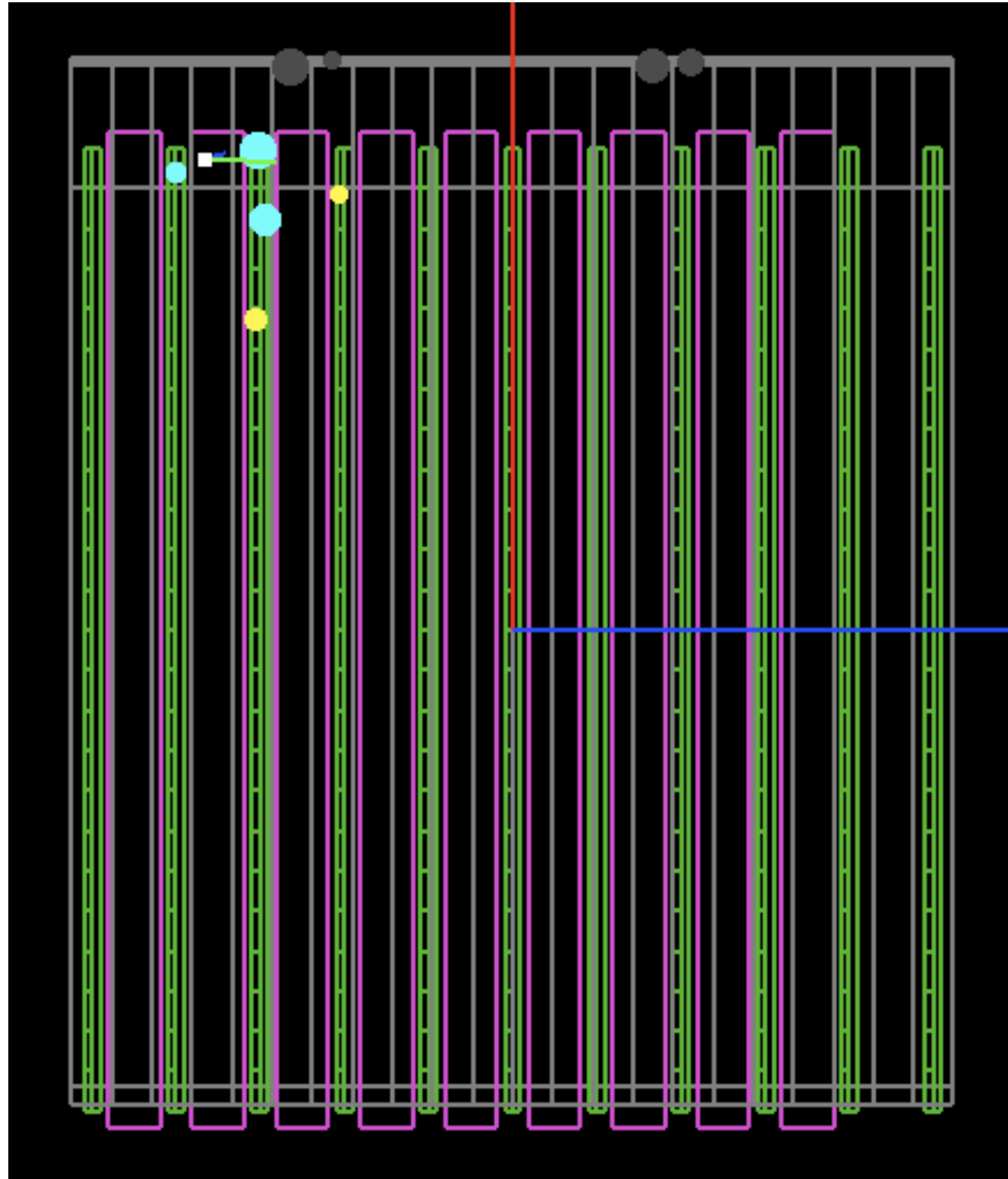
Track: 21 PID: neutron(2112) Init Mom: {-92.98, -260, 19.54} [MeV]
Track: 20 PID: proton(2212) Init Mom: {143.9, -412.2, 473} [MeV]
Track: 19 PID: neutron(2112) Init Mom: {-128.2, 85.13, 337} [MeV]
Track: 18 PID: neutron(2112) Init Mom: {80.34, 20.91, -238.7} [MeV]
Track: 17 PID: proton(2212) Init Mom: {-130.1, 1.702, -276.6} [MeV]
Track: 16 PID: neutron(2112) Init Mom: {-190.5, -386.5, 41.23} [MeV]
Track: 15 PID: proton(2212) Init Mom: {-1.458, -275.3, -156.4} [MeV]
Track: 14 PID: proton(2212) Init Mom: {-305.6, -165.3, 444.2} [MeV]
Track: 13 PID: neutron(2112) Init Mom: {126.7, 13.36, 291.5} [MeV]
Track: 12 PID: neutron(2112) Init Mom: {-163.5, -115.9, 172.3} [MeV]
Track: 11 PID: neutron(2112) Init Mom: {-335.3, 84.88, -14.05} [MeV]
Track: 10 PID: neutron(2112) Init Mom: {-219.1, -43.93, 238.2} [MeV]
Track: 9 PID: proton(2212) Init Mom: {-348.1, 179.5, -129.2} [MeV]
Track: 8 PID: proton(2212) Init Mom: {93.4, -36.04, 342.5} [MeV]
Track: 7 PID: proton(2212) Init Mom: {-186.1, -340, 59.81} [MeV]
Track: 6 PID: proton(2212) Init Mom: {202.6, -55.81, -219.2} [MeV]
Track: 5 PID: neutron(2112) Init Mom: {294.1, 504.1, 218.4} [MeV]
Track: 4 PID: neutron(2112) Init Mom: {-182.7, 83.4, -180.5} [MeV]
Track: 3 PID: proton(2212) Init Mom: {311.2, 383.3, 945} [MeV]
Track: 2 PID: pi-(-211) Init Mom: {-33.43, 44.42, 75.69} [MeV]
Track: 1 PID: pi0(111) Init Mom: {219.2, 472.7, 501.6} [MeV]

neut + N/P $\rightarrow$ neut + N/P + Mesons

side view



top view



=== Neutrino Information from Jnubeam ===

ParentID: 8 Neut Production Mode: 11 Neut interaction Mode: 46

Energy: 5.603 GeV Direction: {0.00165,-0.06309,0.998}

Vertex (cm): {58.8, 50.87, -38.23} Module: 3

=== Shoted Particle information ===

Particle: 2112 Index: 3 Parent Index: 1

Tracking Flag: 1 Interaction Code: 0

Momentum:-51.19 615.5 747

Kinetic Energy: 410.3

Particle: 211 Index: 4 Parent Index: 1

Tracking Flag: 1 Interaction Code: 0

Momentum:629 -680.2 2658

Kinetic Energy: 2679

// neutrino 14

// muon 13

// P 2212

// N 2112

// Pi0 111

// Pi+ 211

// Pi- -211

// Eta0 221

// K+ 321

// Lambda 3122

// omega 223

==== Track with Parent ID = 0 (means primary particle) ===

Track: 2 PID: pi+(211) Init Mom: {629, -680.2, 2658} [MeV]

Track: 1 PID: neutron(2112) Init Mom: {-51.19, 615.5, 747} [MeV]

=== hits in XLayer (yellow) ===

Mod:3 Plane:2 Ch:23 Edep:1.944 MeV PID:2212 Track:156 pos(mm):{598.2, 469.9, -315.5}

Mod:3 Plane:3 Ch:22 Edep:945 keV PID:2212 Track:352 pos(mm):{542.9, 489.2, -215.1}

Mod:3 Plane:2 Ch:19 Edep:2.917 MeV PID:1000060120 Track:347 pos(mm):{388.9, 331.5, -319.3}

=== hits in YLayer (cyan) ===

Mod:3 Pln:1 Ch:21 Edep:1.748 MeV PID:1000060120 Track:27 pos(mm):{570.5, 493.8, -418.7}

Mod:3 Pln:2 Ch:21 Edep:19.93 MeV PID:2212 Track:156 pos(mm):{598.2, 469.4, -315}

Mod:3 Pln:2 Ch:20 Edep:7.248 MeV PID:2212 Track:346 pos(mm):{512.1, 423.6, -306.8}

=== hits in veto (red) ===

Mod:3 Pln:12 Ch:5 Edep:10.4 MeV PID:211 track:7 pos(mm):704 406.2 -275}

Mod:3 Pln:12 Ch:6 Edep:1.459 MeV PID:211 track:7 pos(mm):711.2 399.6 -225}

Mod:3 Pln:12 Ch:14 Edep:8.441 MeV PID:2212 track:5 pos(mm):704 488.9 175} **// neutrino 14**

Mod:3 Pln:12 Ch:15 Edep:5.497 MeV PID:2212 track:5 pos(mm):709.9 488.3 225} **// muon 13**

// P 2212

// N 2112

// Pi0 111

// Pi+ 211

// Pi- -211

// Eta0 221

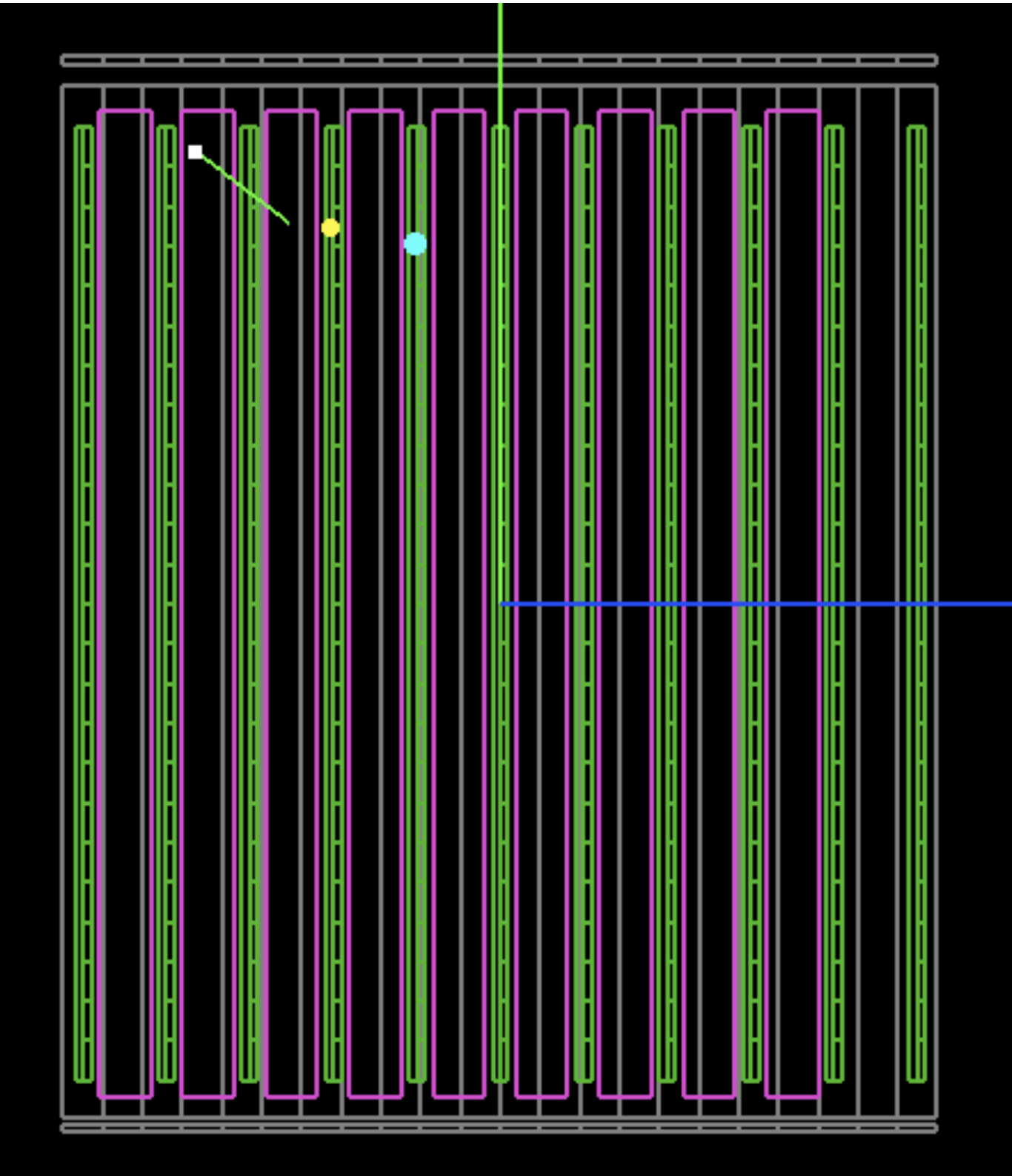
// K+ 321

// Lambda 3122

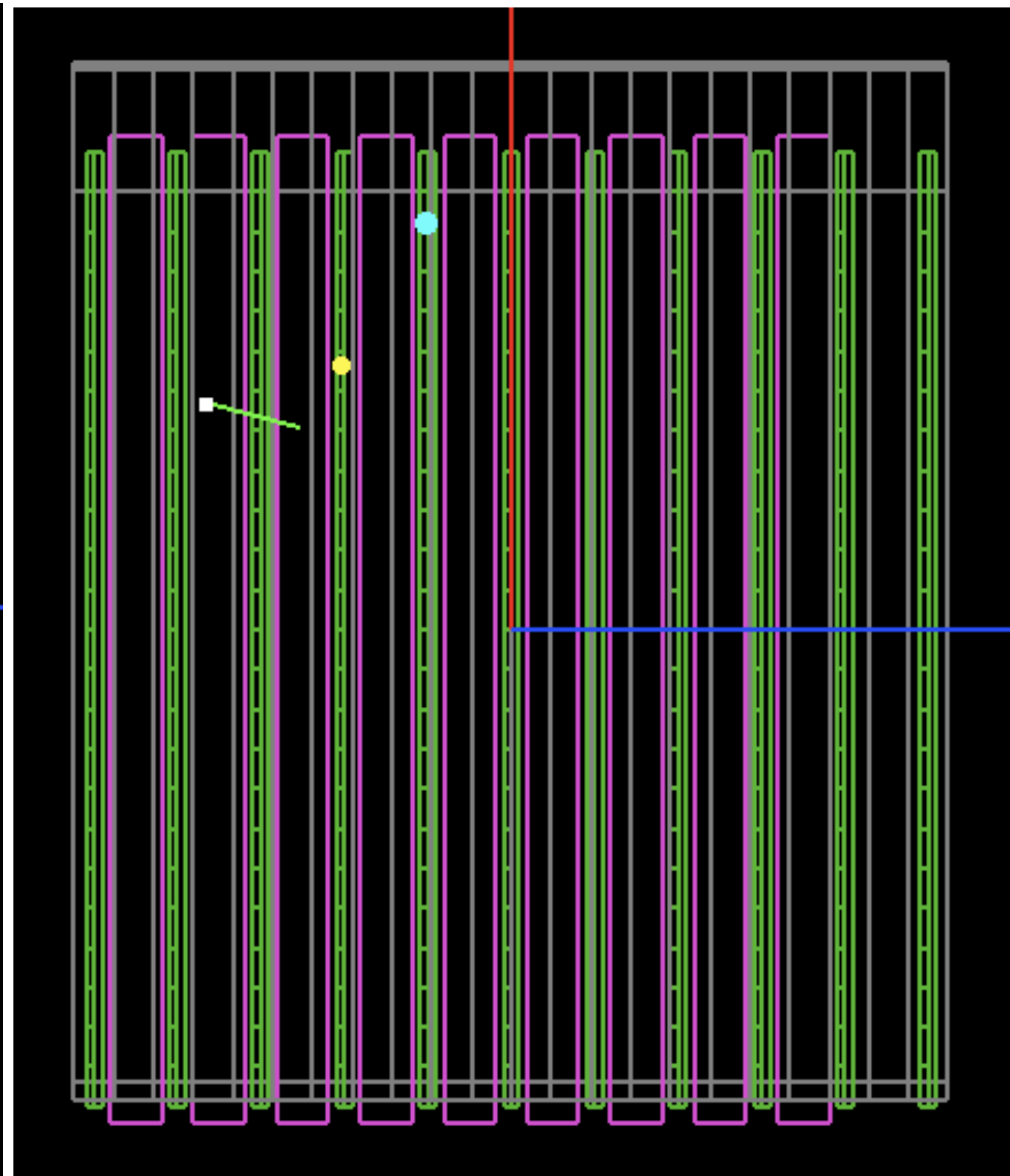
// omega 223

$$\text{neut} + \text{N} \rightarrow \text{neut} + \text{N}$$

side view



top view



=== Neutrino Information from Jnubeam ===

ParentID: 8 Neut Production Mode: 11 Neut interaction Mode: 52

Energy: 0.6393 Direction: {0.0004766,-0.06202,0.9981}

Vertex (cm): {28.49, 56.91, -38.23} Module: 3

=== Shoted Particle information ===

Particle: 14 Index: 2 Parent Index: 0

Tracking Flag: 1 Interaction Code: 2

Momentum:245.7 259.4 158.5

Particle: 2112 Index: 3 Parent Index: 1

Tracking Flag: 1 Interaction Code: 0

Momentum:-145.2 -416.8 541.9

Kinetic Energy: 231.4

// neutrino 14

// muon 13

// P 2212

// N 2112

// Pi0 111

// Pi+ 211

// Pi- -211

// Eta0 221

// K+ 321

// Lambda 3122

// omega 223

=== hits in XLayer (yellow) ===

Mod:3 Plane:3 Ch:18 Edep:1.242 MeV PID:1000060120 Track:30 pos(mm):{334.7, 473.4, -212.3}

=== hits in YLayer (cyan) ===

Mod:3 Pln:4 Ch:21 Edep:2.854 MeV PID:2212 Track:35 pos(mm):{511.9, 455.4, -104.8}

==== Track with Parent ID = 0 (means primary particle) ===

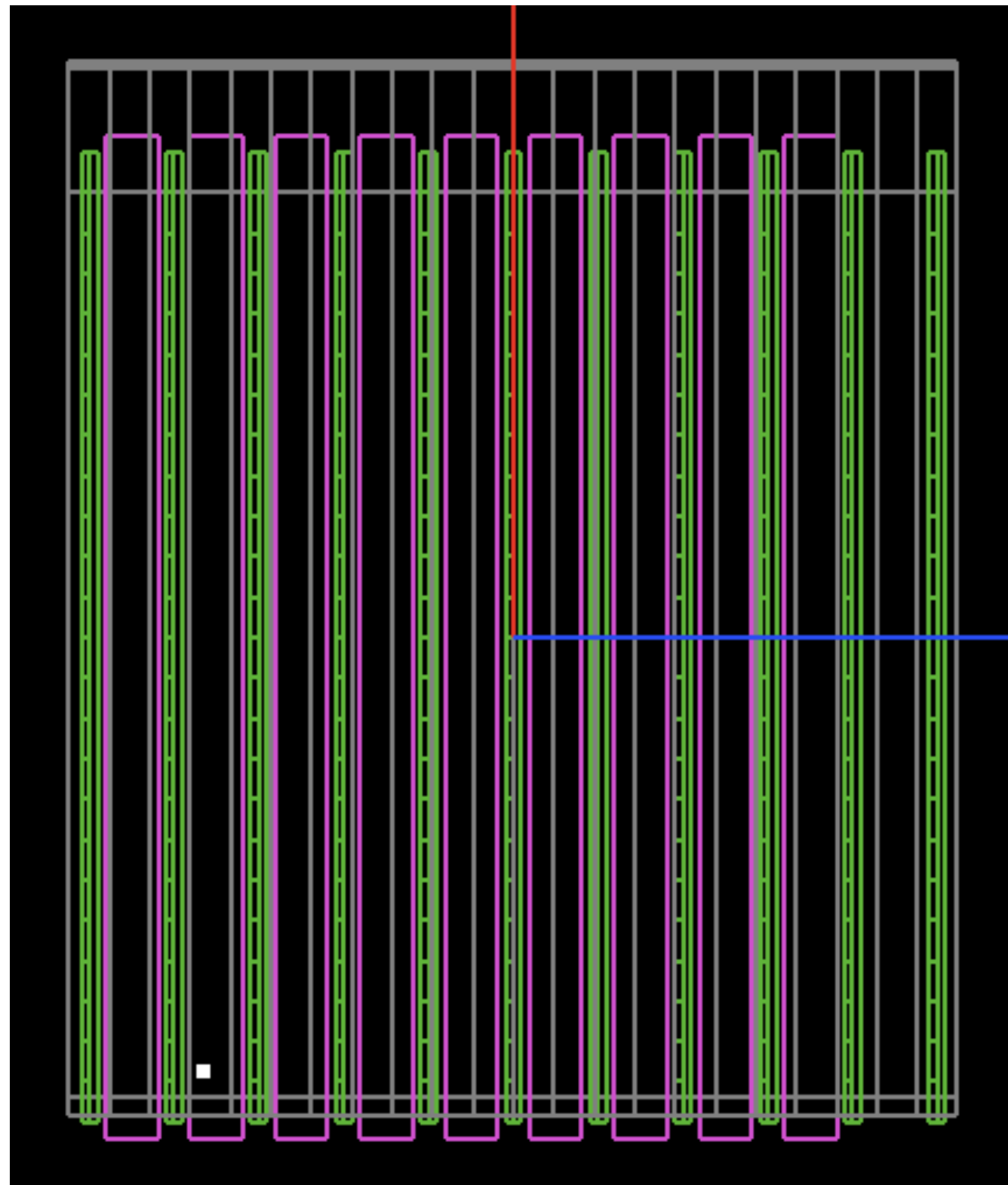
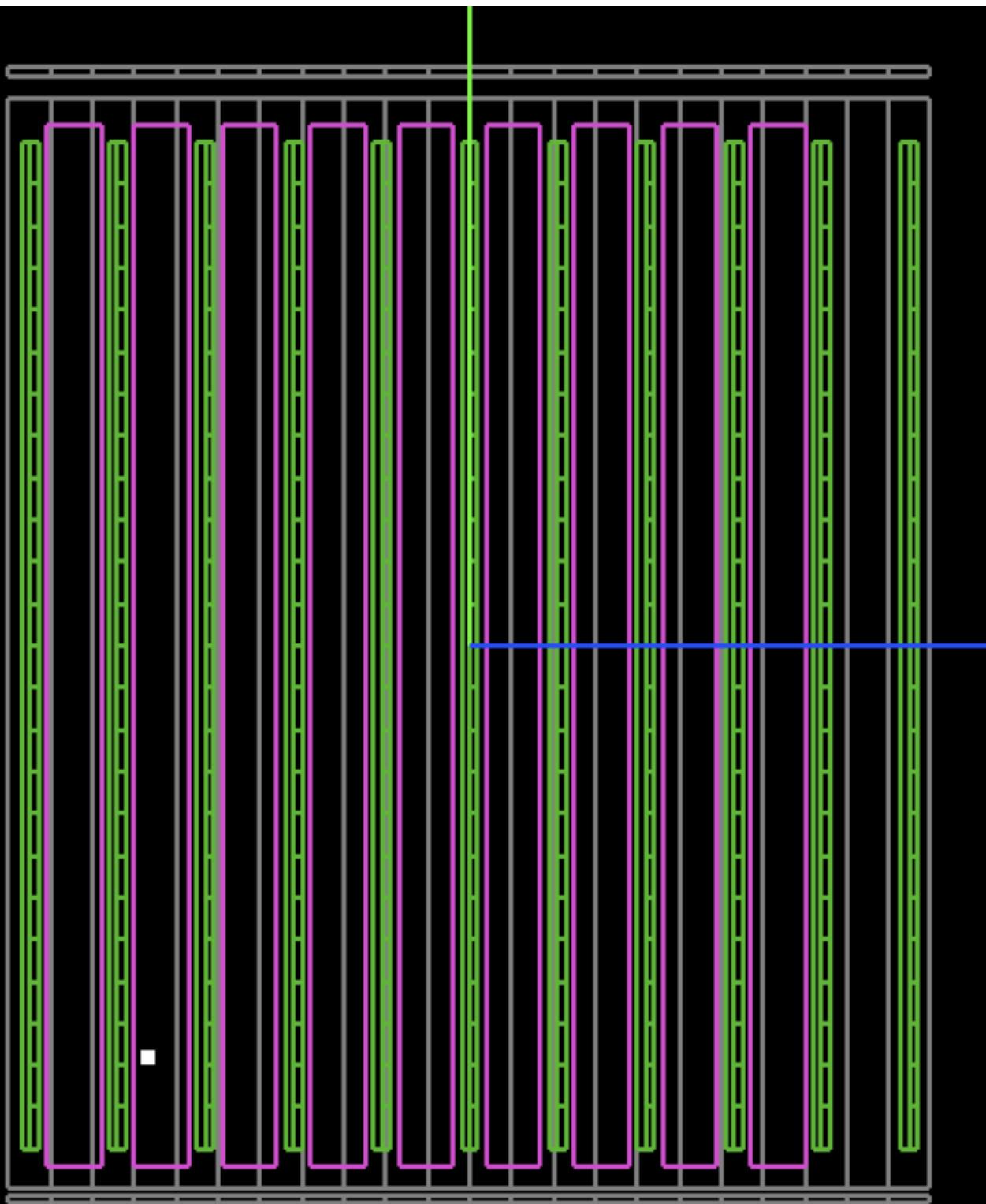
Track: 1 PID: neutron(2112) Init Mom: {-145.2, -416.8, 541.9} [MeV]



Single Pi from DELTA Resonance:

side view

top view



=== Neutrino Information from Jnubeam ===

ParentID: 8 Neut Production Mode: 11 Neut interaction Mode: 31

Energy: 1.067 Direction: {-0.005066,-0.06719,0.9977}

Vertex (cm): {-53.63, -49.06, -38.23} Module: 3

=== Shoted Particle information ===

Particle: 14 Index: 0 Parent Index: -1

Tracking Flag: 0 Interaction Code: -1

Momentum:-5.405 -71.68 1064

Particle: 2112 Index: 1 Parent Index: -1

Tracking Flag: 0 Interaction Code: -1

Momentum:103.5 -65.13 -125.7

Particle: 14 Index: 2 Parent Index: 0

Tracking Flag: 0 Interaction Code: 2

Momentum:345.3 -3.033 203.4

Particle: 2112 Index: 3 Parent Index: 1

Tracking Flag: 0 Interaction Code: 0

Momentum:186.2 -119.8 634.2

Particle: 200000 Index: 4 Parent Index: 1

Tracking Flag: 0 Interaction Code: 7

Momentum:-433.5 -13.95 101.1