Particle rates and spectra at the CRTs of NP04-Single phase

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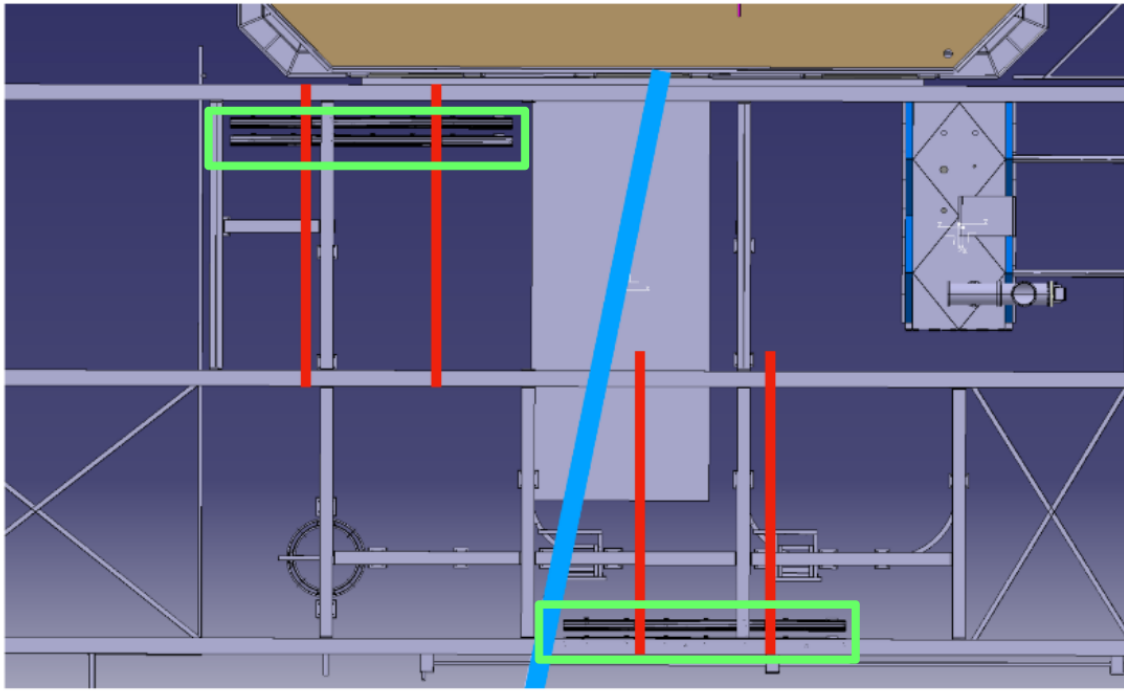
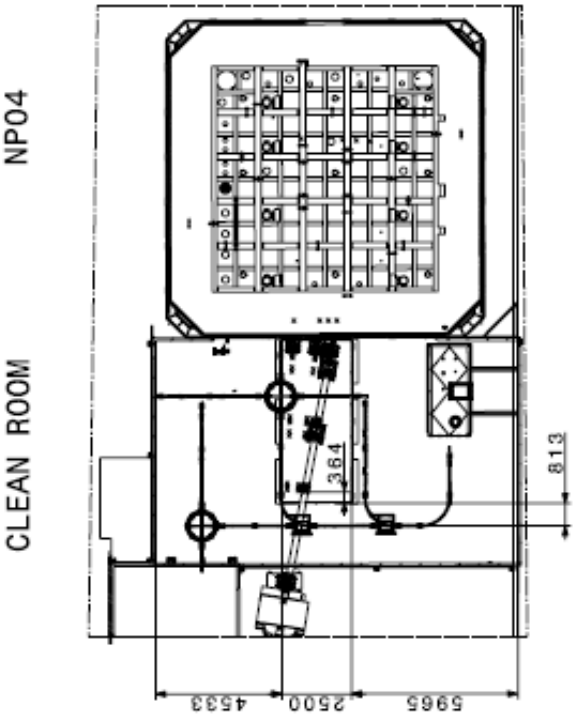
E. Nowak, P. Sala

Assumptions

- 10^6 particles/spill from the primary target, 4.8 s spill, 20s of the repetition rate
- Composition of the secondary hadron beam (+80 GeV/c): pions (69.4%), protons (28.7%), kaons (1.9%)
- Beam size: x=3.337 cm , y=2.529 cm (FWHM), Δx=0.457 mrad, Δy=0.137mrad
- Δ p/p =1%
- Detectors/Beam Profile Monitors/Cherenkov's materials included
- Selected: a positive 7GeV/c tertiary beam (for which we expect the highest background at the cryostat and NP04 detector) out of positive 80GeV/c beam on the VLE secondary target
- Target material:
  - **Copper (3-7] GeV/c**
  - **Complementary : tungsten [1-3] GeV/c**
- Particles transported down to 100keV and neutrons to thermal energies (new upstream positions study), for downstream modules: 10MeV particle transport threshold

CRT Frame Positions

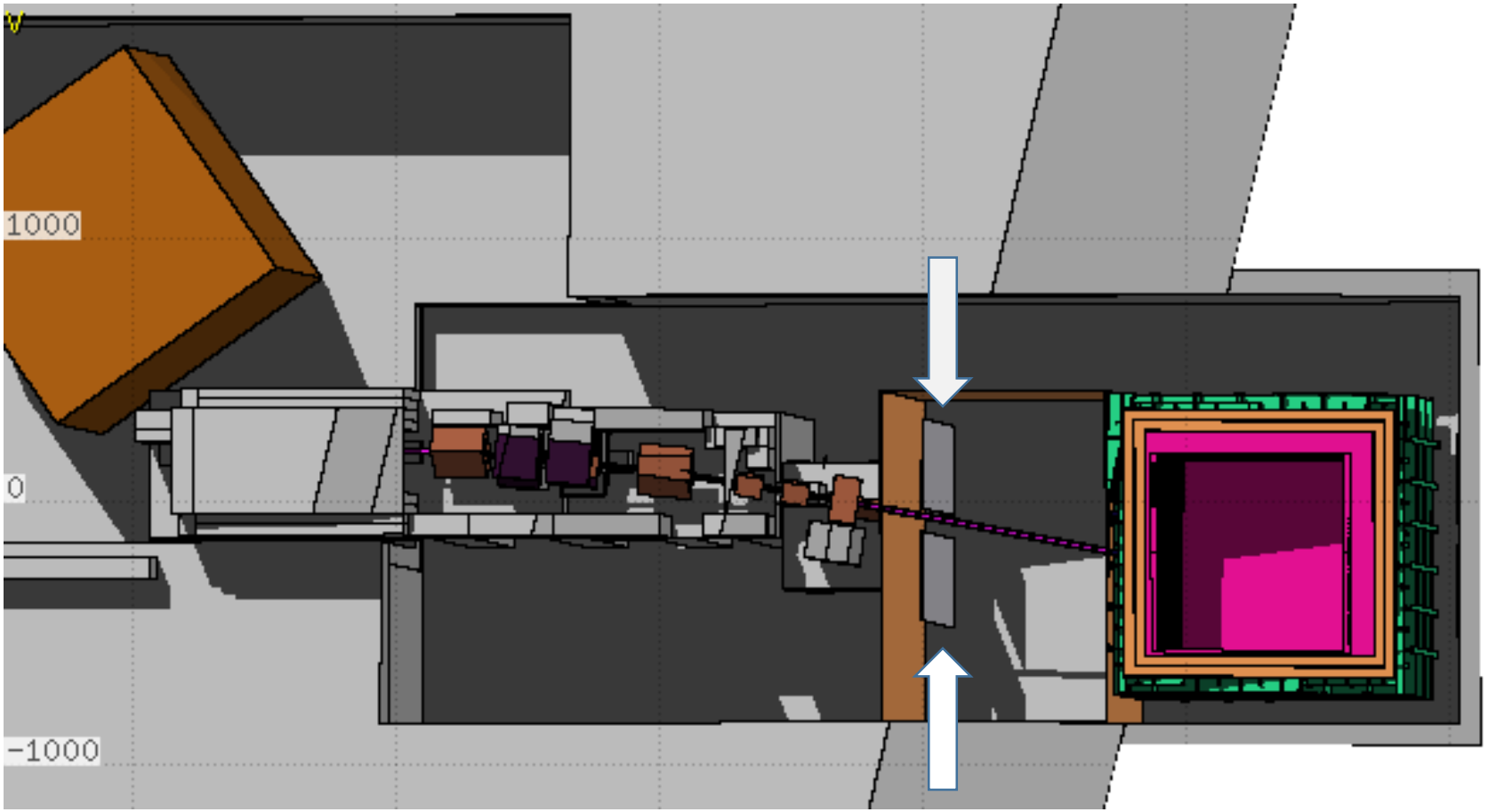




- 4 modules upstream; 4 downstream
- Upstream modules staggered: 3m and 7m?

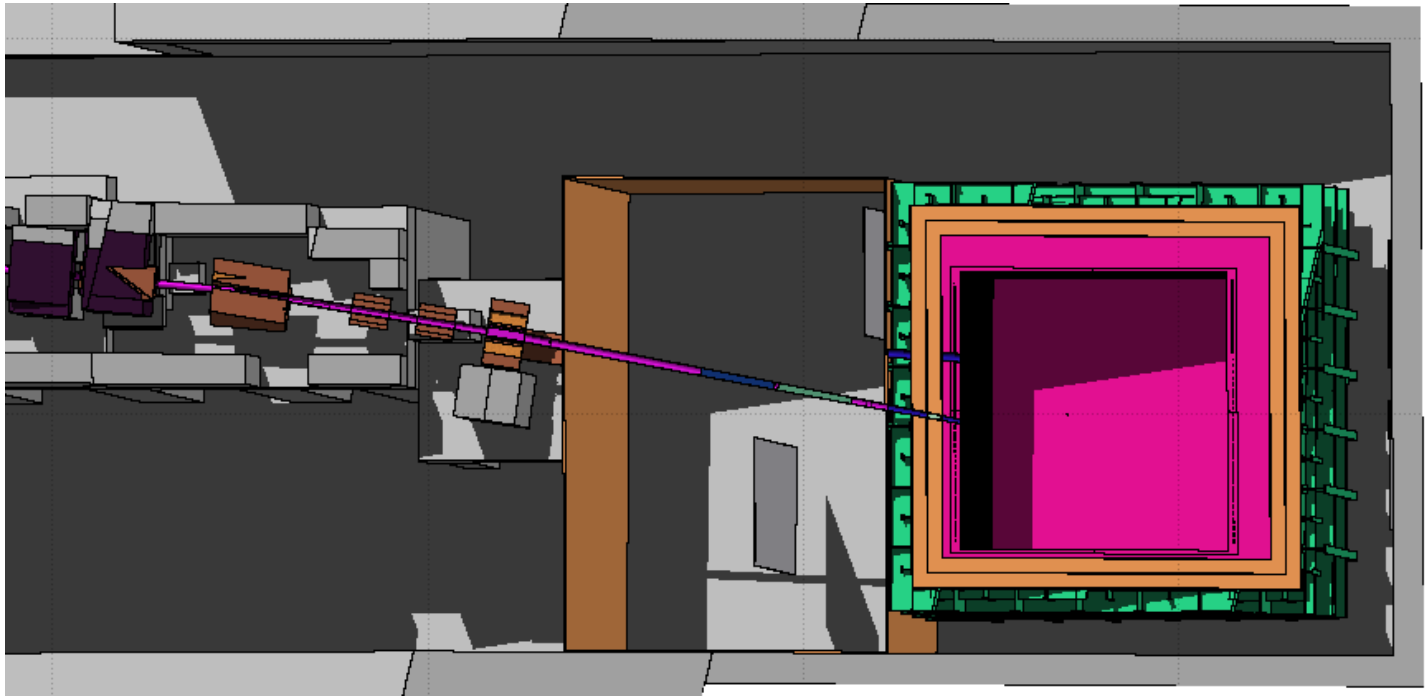
By Camillo Mariani

Position 1
Left and right CRT modules - 7m from the NP04 cryostat



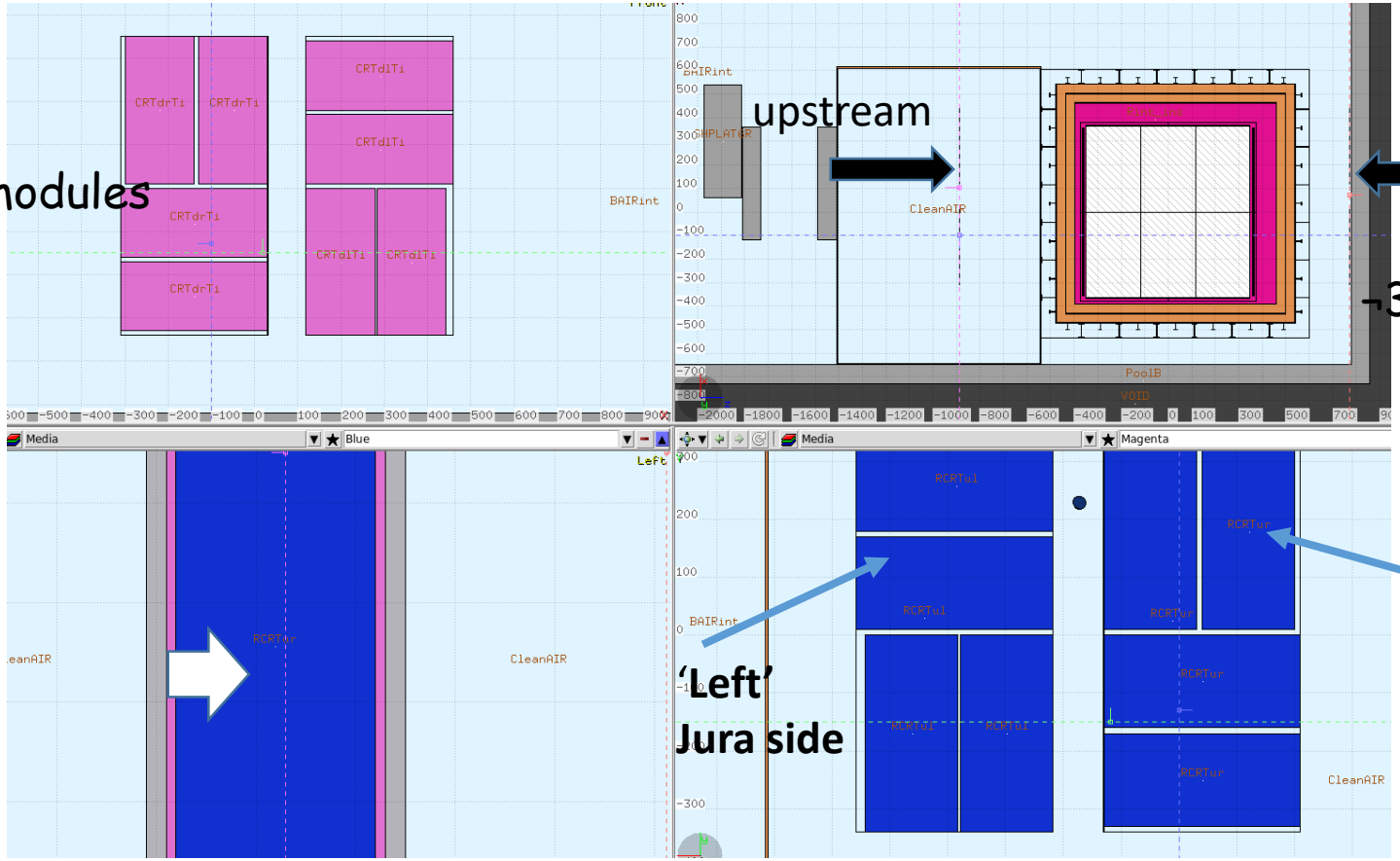
Position 2
Left CRT- 50cm from the cryostat
Right CRT – 3.5m from the cryostat

50cm left – 1.62m from the BP
3.5m right – 1.35m from the BP



- Each scintillator module is 3.4x1.6m2 (an active area)
- 4 supermodules, each of 4 scintillator modules: two horizontal and two vertical
- Vertical position – 2m from the top of the cryostat (active LAr surface)

Two supermodules



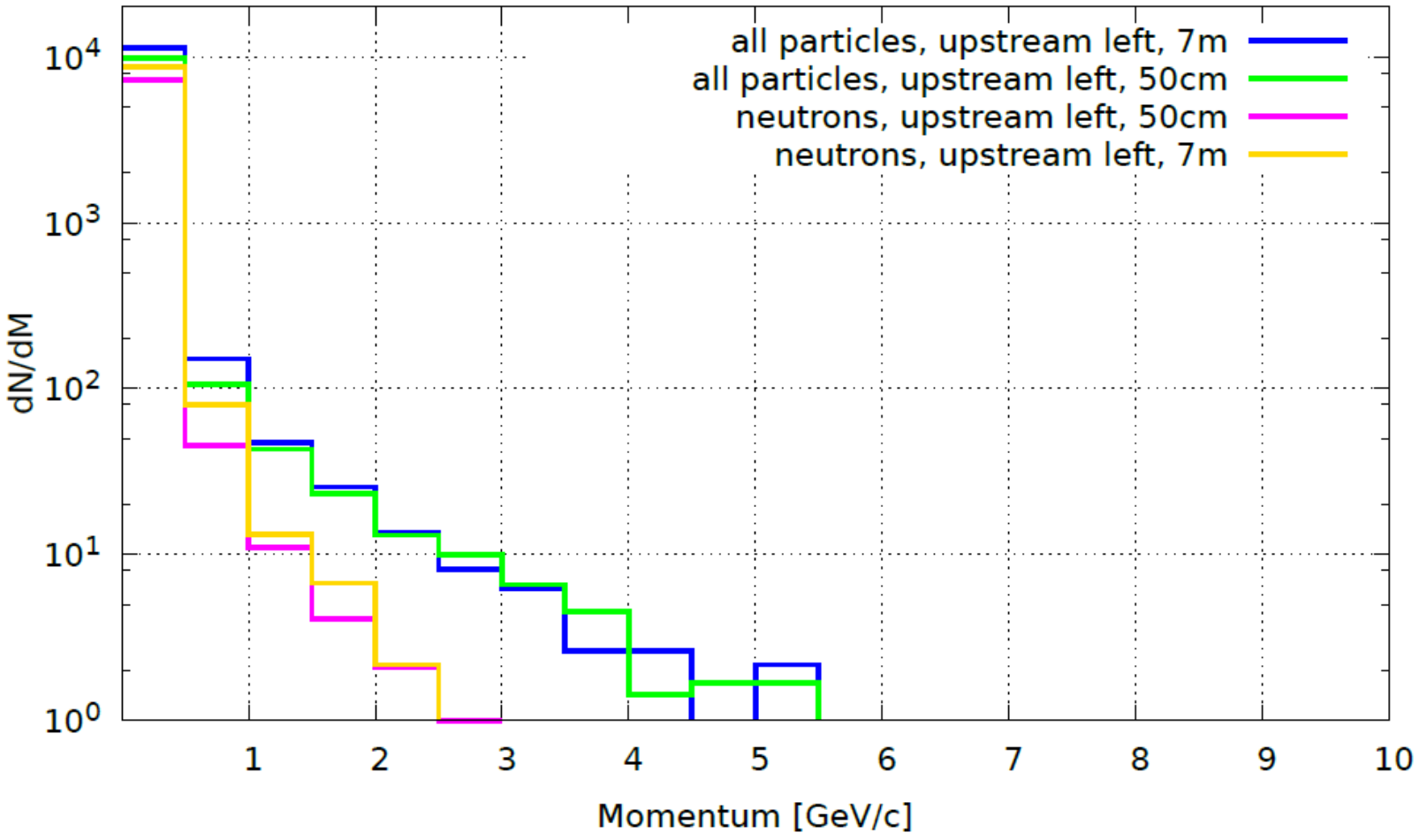
Transversal view across the module

2cm – C8H8- scintillator (polystyrene)

1mm of TiO + 1mm of Al

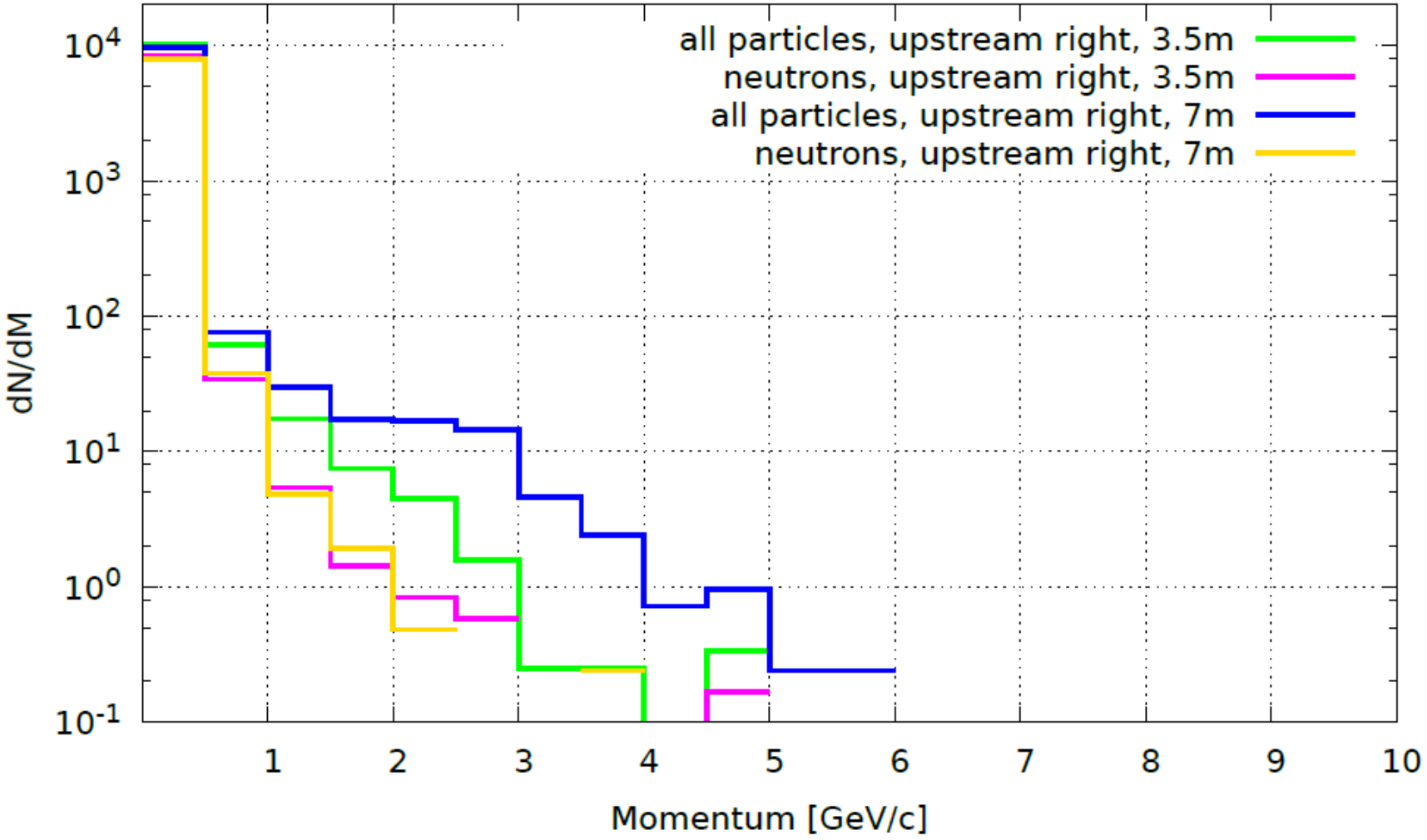
	Upstream, left module rate [Hz] 50cm correct
All particles	**5044 (21)**
All positive part.	**100.3 (2.2)**
All negative part.	**101.4 (2.4)**
Pions+	11 (0.7)
Pions-	8.8 (0.6)
Protons	14.7 (0.8)
Electrons	79.9 (2.1)
Positrons	29.2 (1.3)
Muons+	**41.8 (1.3)**
Muons-	**12.3 (0.7)**
Kaons+	0.67 (0.16)
Kaons-	0.21 (0.09)
Neutrons	**3685 (13)**

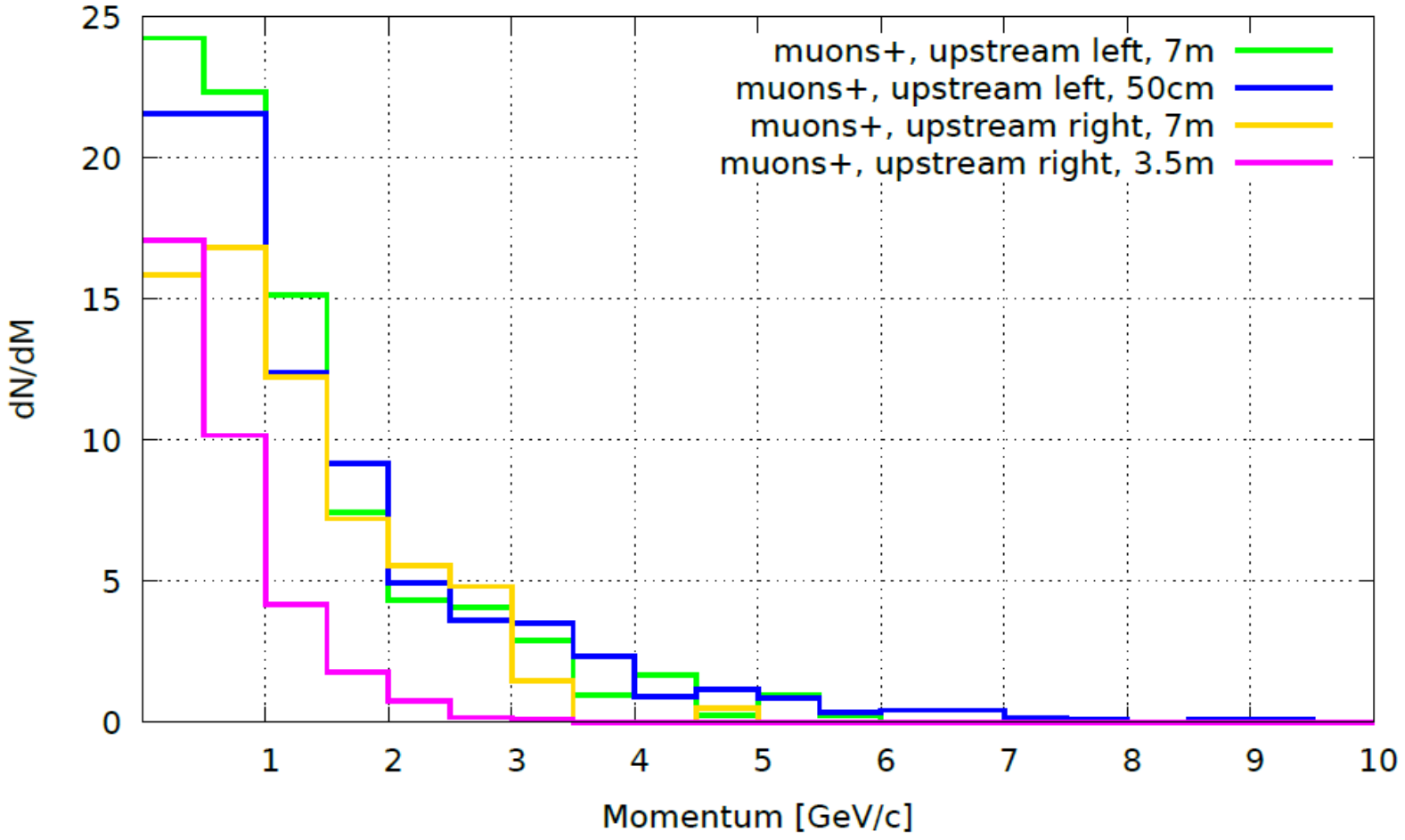
	Upstream, left module rate [Hz] 7m
All particles	**5792 (40)**
All positive part.	**104.7(3.8)**
All negative part.	**103.7 (3.9)**
Pions+	15 (1.4)
Pions-	12.7 (1.2)
Protons	17.6 (1.4)
Electrons	80 (3.5)
Positrons	25.8 (1.9)
Muons+	**42.2 (2.2)**
Muons-	**10.3 (1.1)**
Kaons+	0.13 (0.039)
Kaons-	0.24 (0.16)
Neutrons	**4394 (26)**

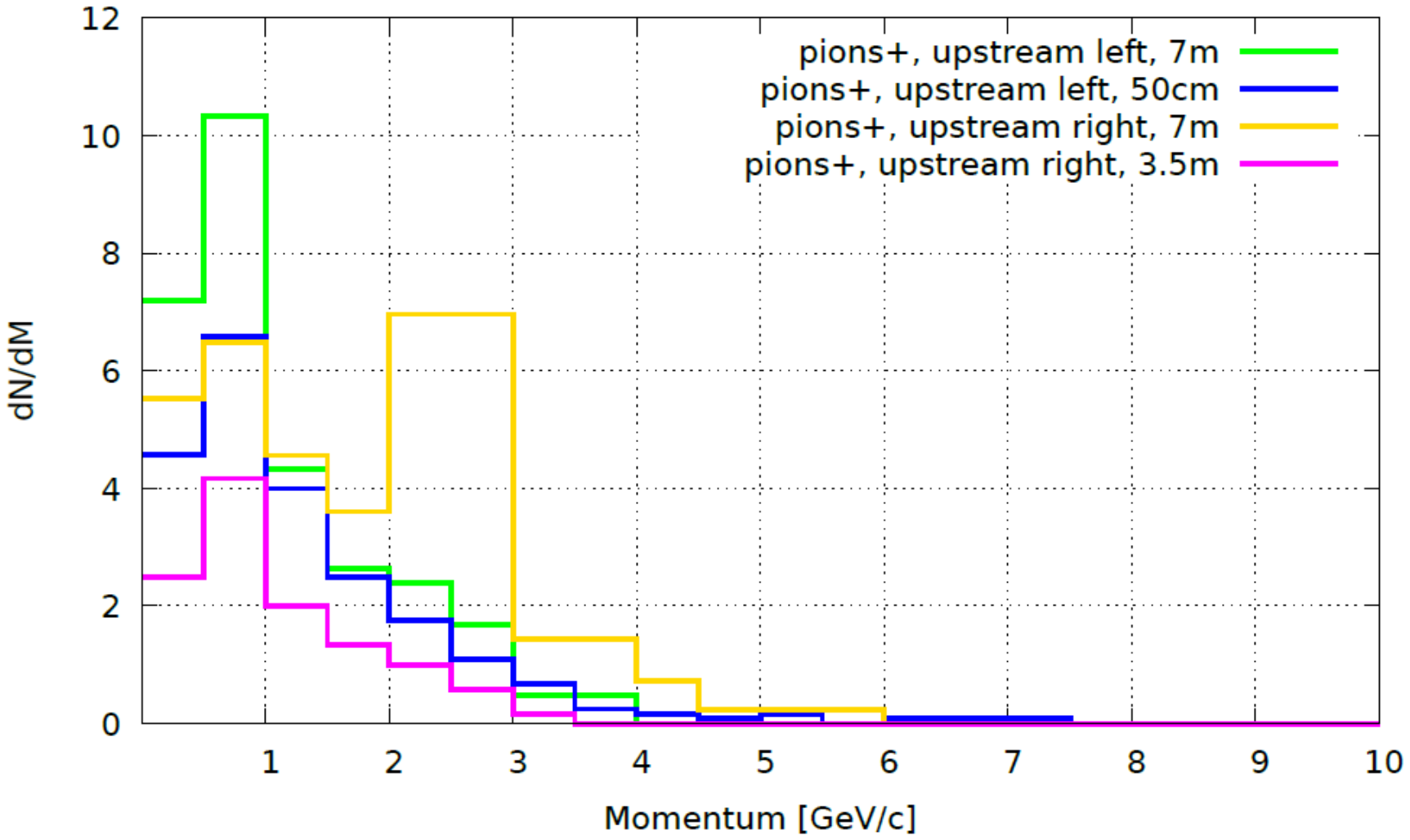

all particles, upstream left, 7m
all particles, upstream left, 50cm
neutrons, upstream left, 50cm
neutrons, upstream left, 7m
dN/dM
10^4
10^3
10^2
10^1
10^0
1
2
3
4
5
6
7
8
9
10
Momentum [GeV/c]

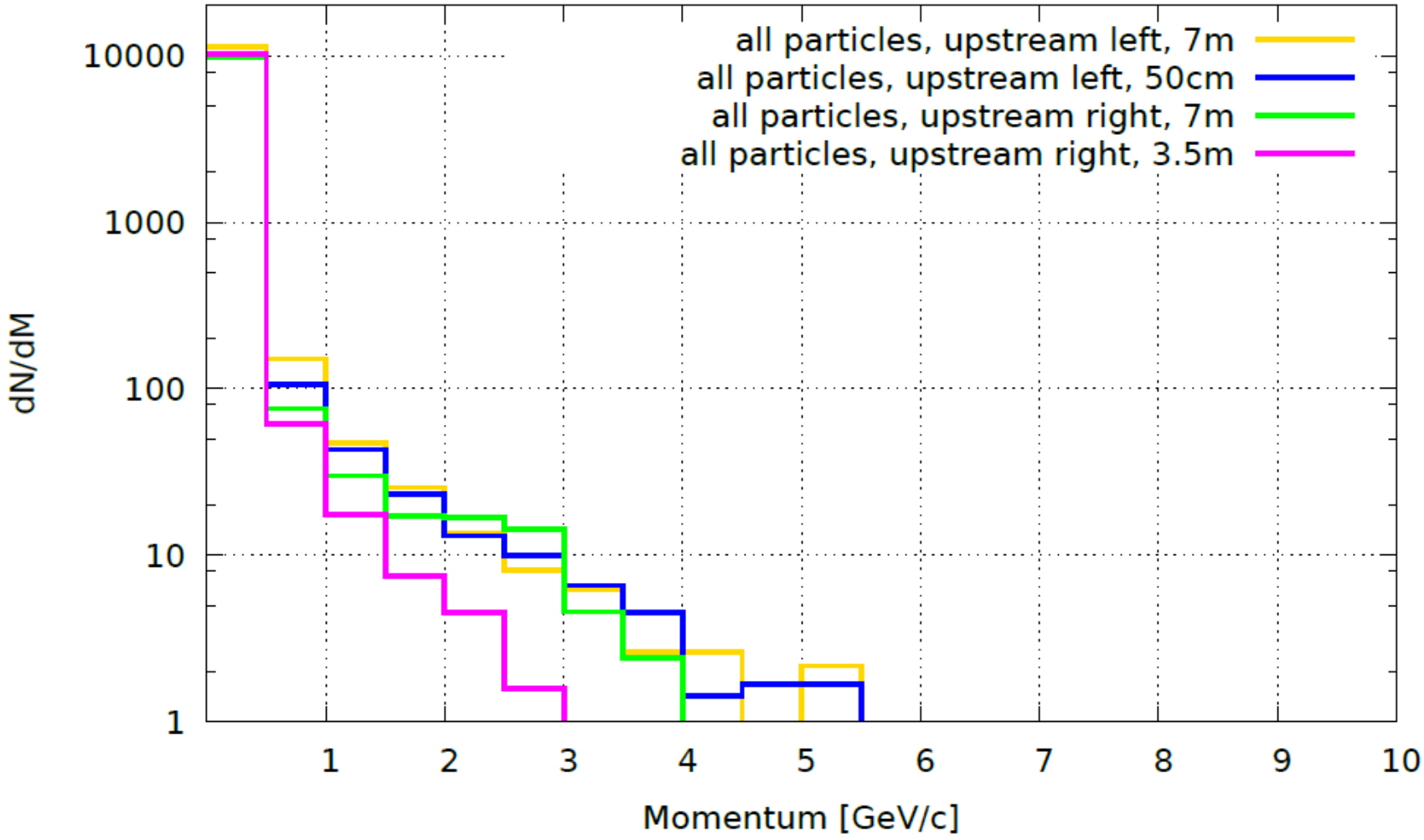
	Upstream, right module rate [Hz] 3.5m
All particles	**5153 (19)**
All positive part.	**49.3 (1.5)**
All negative part.	**49.8 (1.8)**
Pions+	5.9 (0.5)
Pions-	1.9 (0.28)
Protons	9.2 (0.6)
Electrons	42.6 (1.6)
Positrons	15.5 (0.97)
Muons+	**17.1 (0.8)**
Muons-	**5.3 (0.47)**
Kaons+	0.37 (0.12)
Kaons-	-
Neutrons	**4248 (14.4)**

	Upstream, right module rate [Hz] 7m
All particles	**4948 (33)**
All positive part.	**83.8 (3.3)**
All negative part.	**48 (2.7)**
Pions+	19.2 (7.6)
Pions-	3 (0.6)
Protons	11.8 (1.3)
Electrons	41.7 (2.6)
Positrons	18 (1.6)
Muons+	**32.2 (1.9)**
Muons-	**3.4 (0.6)**
Kaons+	0.84 (0.35)
Kaons-	0.12 (0.12)
Neutrons	**3953 (23)**


all particles, upstream right, 3.5m
neutrons, upstream right, 3.5m
all particles, upstream right, 7m
neutrons, upstream right, 7m
dN/dM
Momentum [GeV/c]
10^4
10^3
10^2
10^1
10^0
10^-1
1
2
3
4
5
6
7
8
9
10


muons+, upstream left, 7m
muons+, upstream left, 50cm
muons+, upstream right, 7m
muons+, upstream right, 3.5m
dN/dM
Momentum [GeV/c]
0
5
10
15
20
25
1
2
3
4
5
6
7
8
9
10

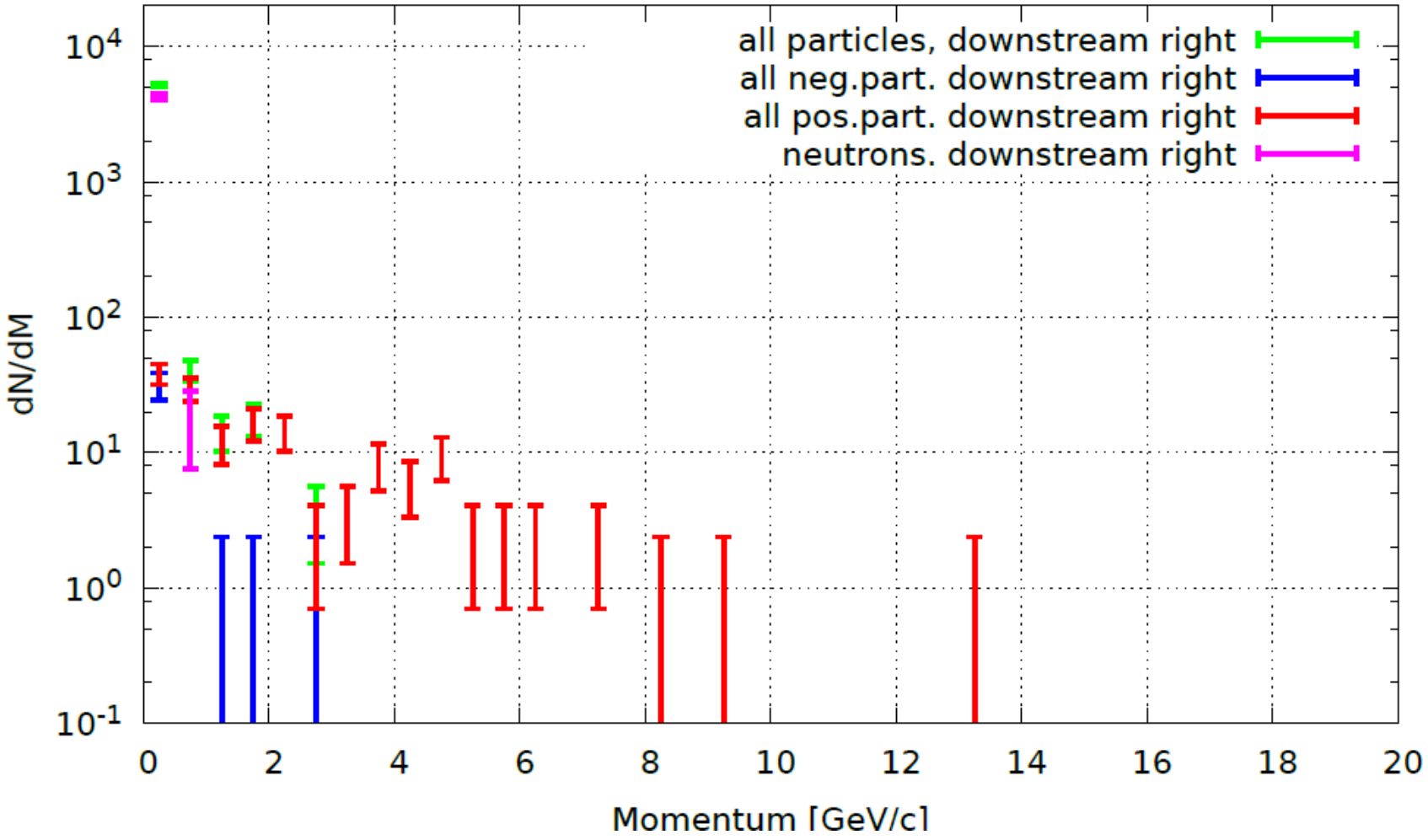

pions+, upstream left, 7m
pions+, upstream left, 50cm
pions+, upstream right, 7m
pions+, upstream right, 3.5m
dN/dM
Momentum [GeV/c]
0
2
4
6
8
10
12
1
2
3
4
5
6
7
8
9
10

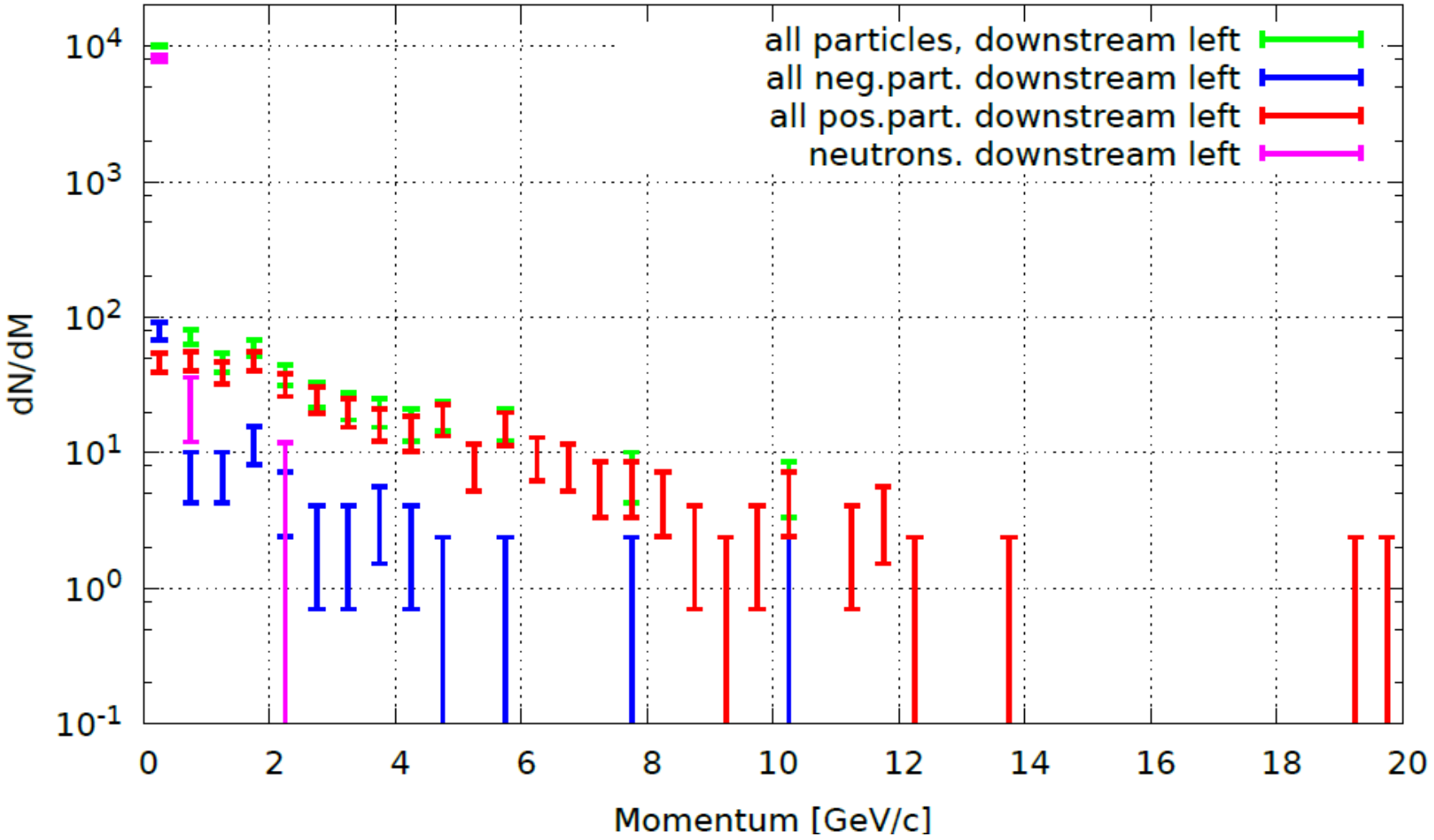

all particles, upstream left, 7m
all particles, upstream left, 50cm
all particles, upstream right, 7m
all particles, upstream right, 3.5m
dN/dM
10000
1000
100
10
1
1
2
3
4
5
6
7
8
9
10
Momentum [GeV/c]

3.5 m from the cryostat
Next to the BP
-old configuration, 2mm Al-

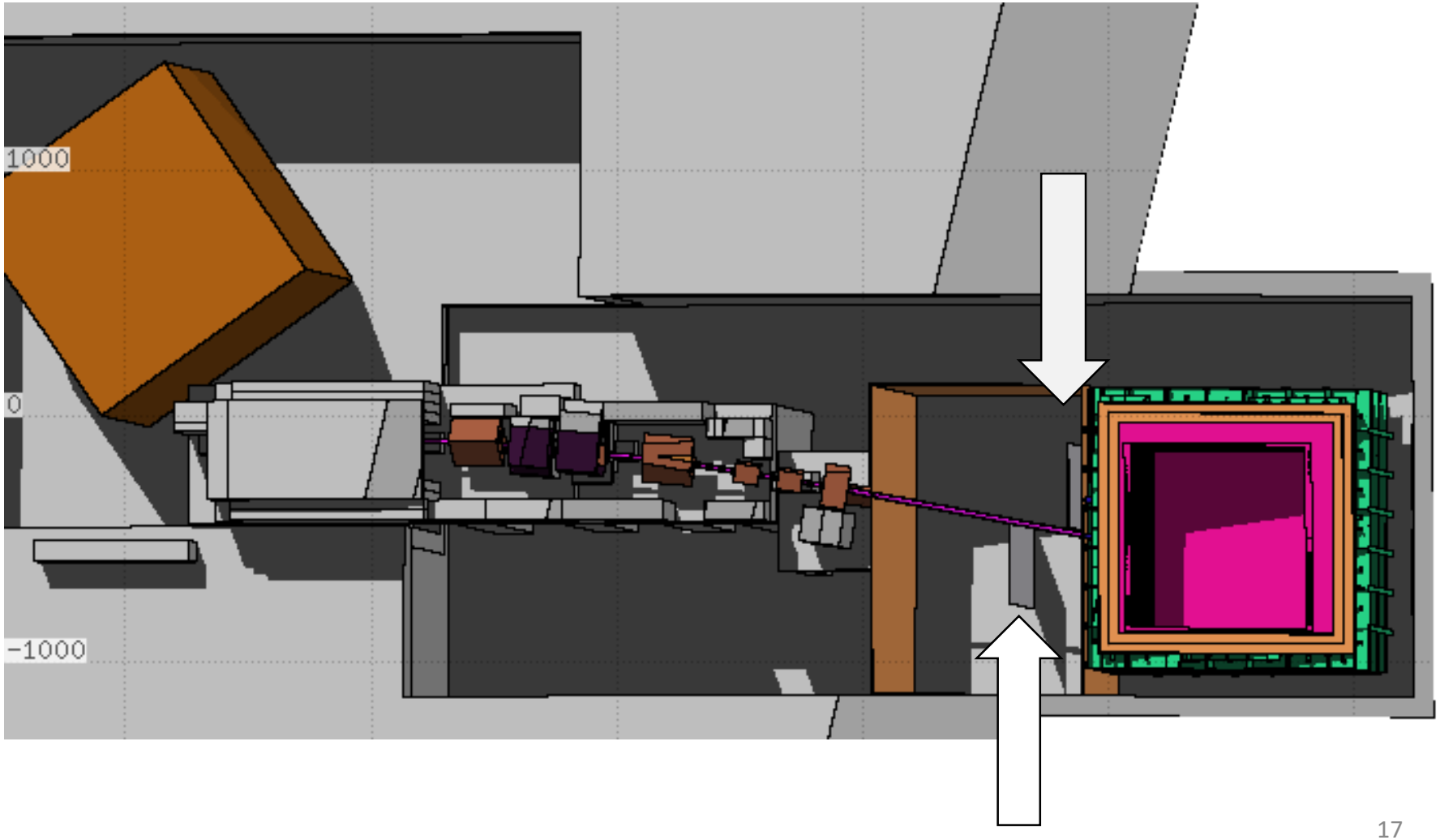
	Upstream, left module rate [Hz]	Upstream, right module rate [Hz]	Downstream, left module rate [Hz]	Downstream, right module - rate [Hz]
All particles	5039 (25)	4910 (23.8)	5229 (104)	2655 (58)
All positive part.	**125 (2)**	**113.7 (2)**	194.67 (10.5)	77.1 (6.7)
All negative part.	**84.8 (2.5)**	**55.3 (2.2)**	63.08 (6.3)	17.6 (3.5)
Pions+	14.4 (0.6)	24.75 (0.88)	-	-
Pions-	10.7 (0.6)	5.59 (0.38)	-	1.2 (0.83)
Protons	2.66 (1.2)	16.65 (0.63)	-	-
Electrons	16.7 (2.3)	44.55 (2.2)	36.23 (5.38)	13.4 (3.2)
Positrons	30.5 (7.5)	21.67 (6.9)	5.57 (1.78)	3.7 (1.4)
Muons+	**59.9 (1.3)**	**47.62 (1.19)**	**186.6 (10.2)**	**72.8 (6.5)**
Muons-	**10.7 (0.56)**	**5.09 (0.37)**	**26.8 (4.02)**	**2.4 (1.1)**
Kaons+	1.1 (0.19)	1.19 (0.19)	-	-
Kaons-	0.21 (0.07)		-	-
Neutrons	4054 (40)	4087 (41)	4072 (203)	2149 (94)

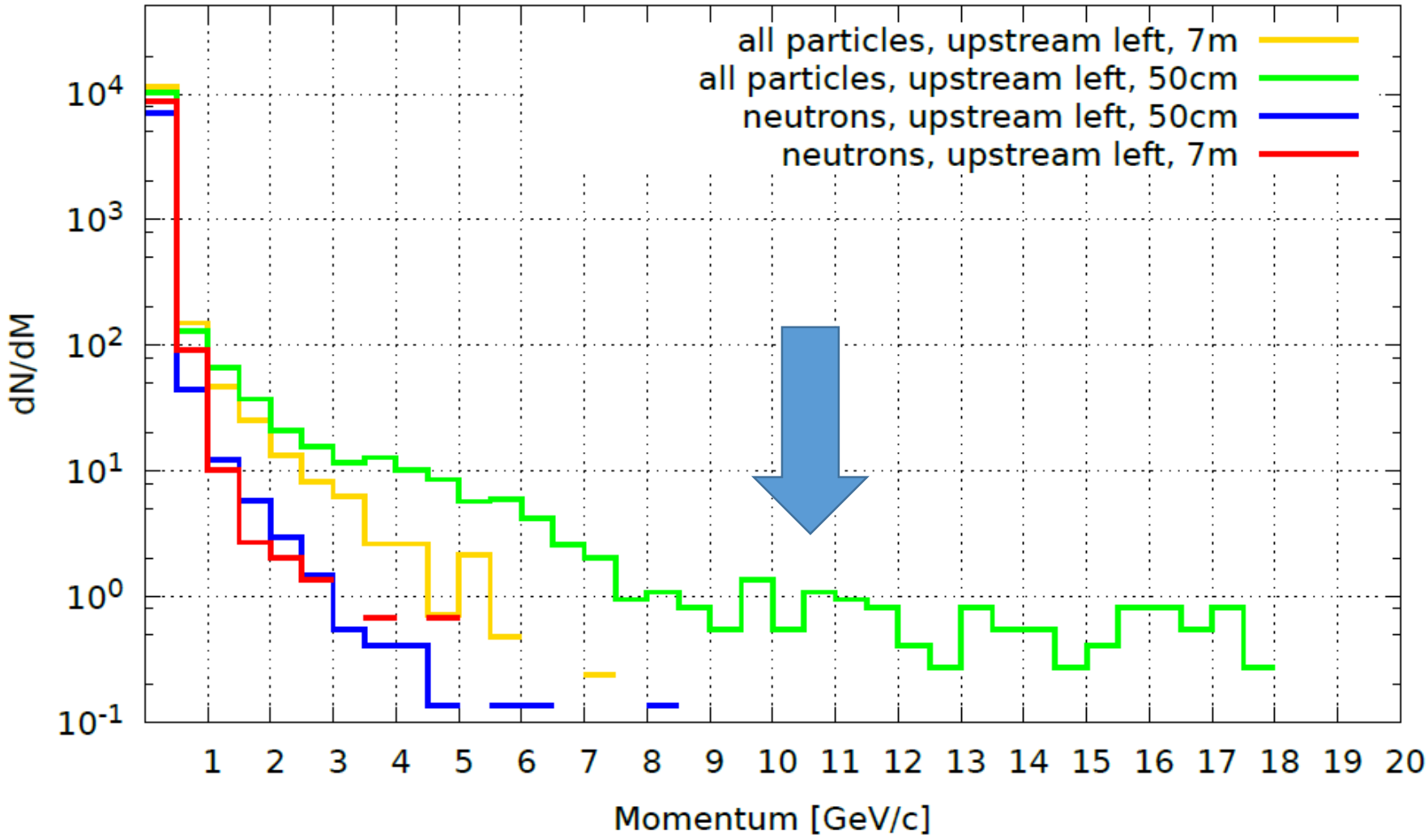
10MeV transport cut


all particles, downstream right
all neg.part. downstream right
all pos.part. downstream right
neutrons. downstream right
dN/dM
Momentum [GeV/c]
10^4
10^3
10^2
10^1
10^0
10^-1
0
2
4
6
8
10
12
14
16
18
20


all particles, downstream left
all neg.part. downstream left
all pos.part. downstream left
neutrons. downstream left
dN/dM
Momentum [GeV/c]
10^4
10^3
10^2
10^1
10^0
10^{-1}
0
2
4
6
8
10
12
14
16
18
20

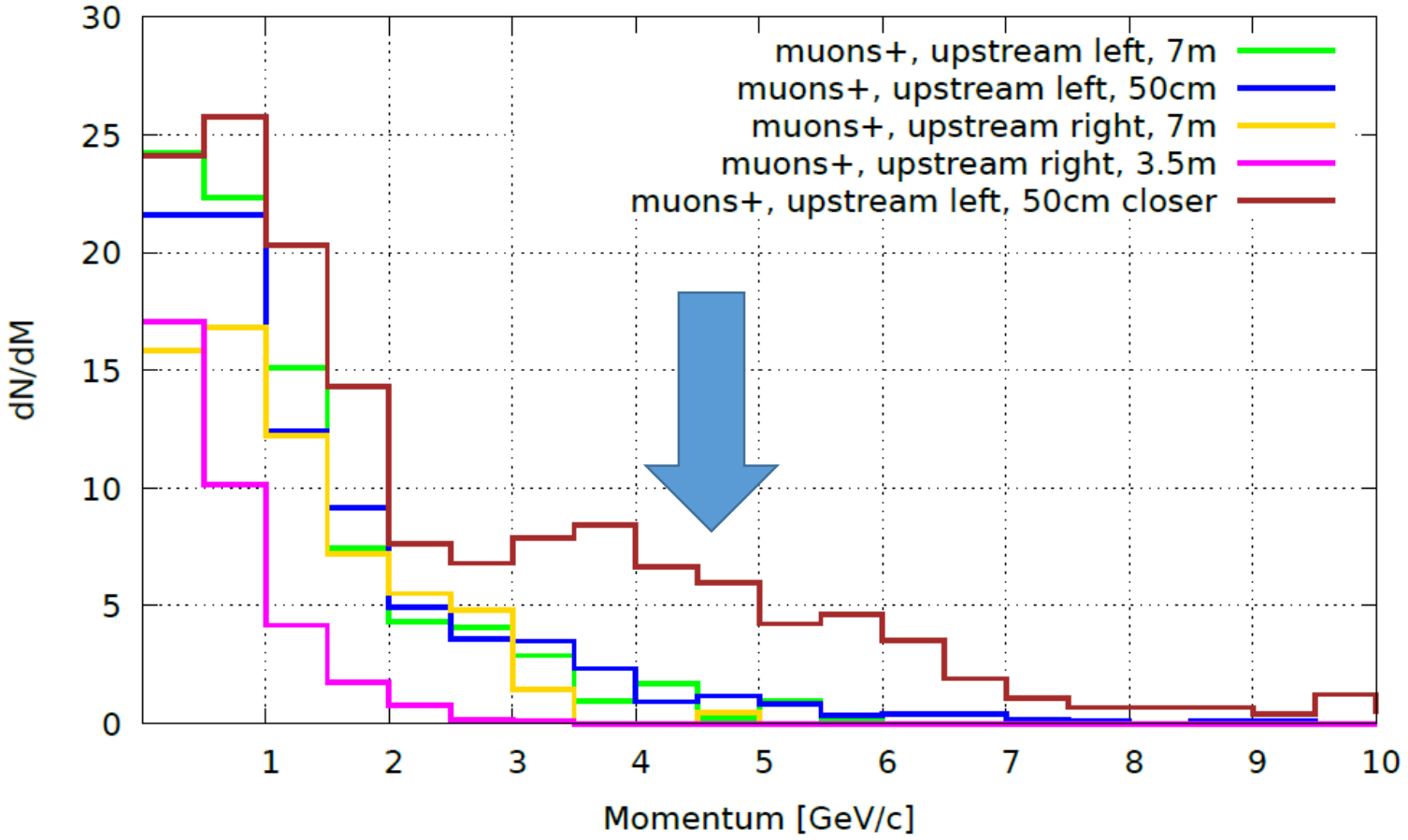
CRT modules placed closer to the beam pipe



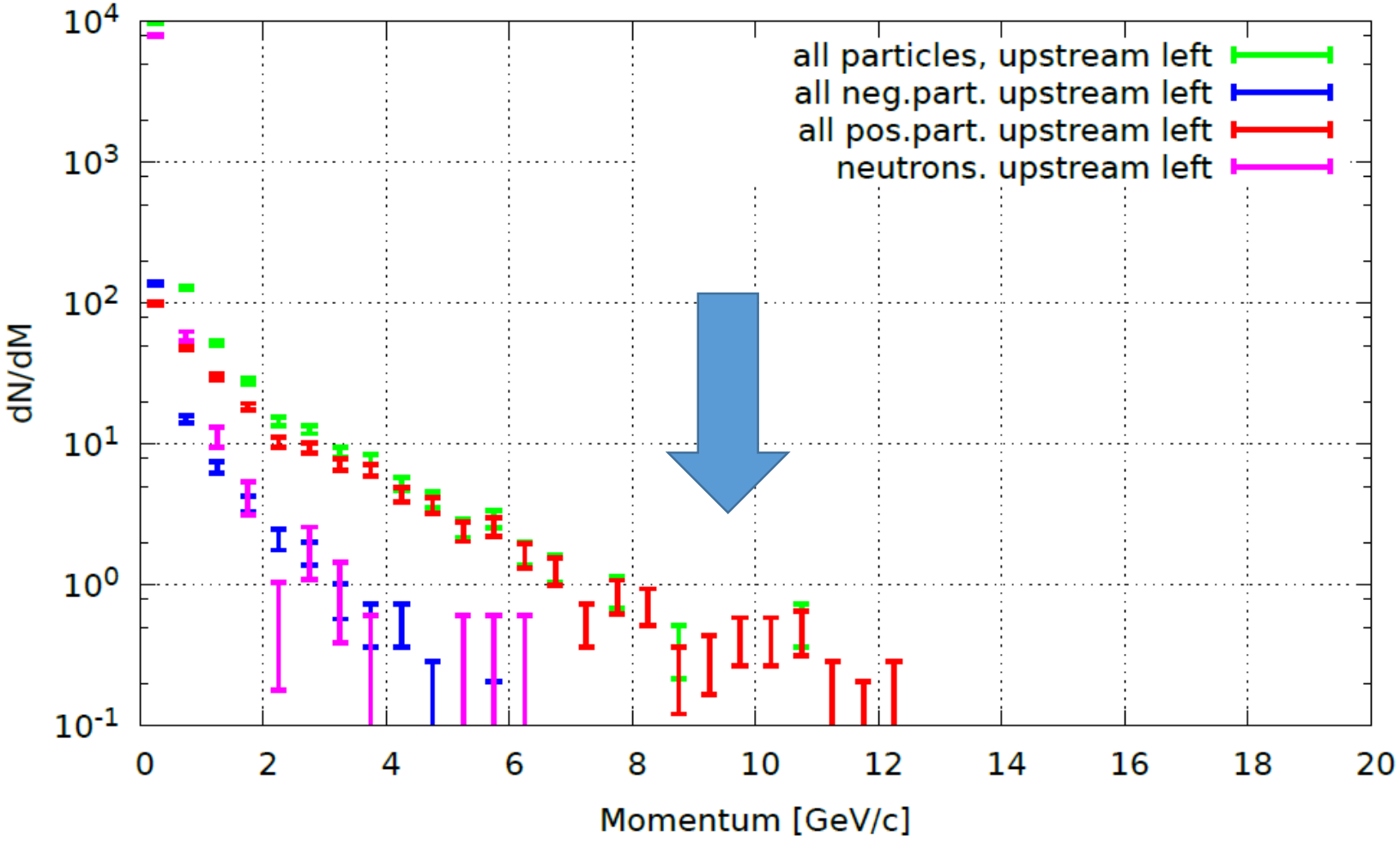


The left CRT panel for 50cm distance – too close to the BP,

- the correct position (1.6m from the BP)
- the spectrum differs wrt the real case - high momentum tail


muons+, upstream left, 7m
muons+, upstream left, 50cm
muons+, upstream right, 7m
muons+, upstream right, 3.5m
muons+, upstream left, 50cm closer
dN/dM
Momentum [GeV/c]
0
5
10
15
20
25
30
1
2
3
4
5
6
7
8
9
10

3.5m from the cryo,
Next to the BP (20cm)

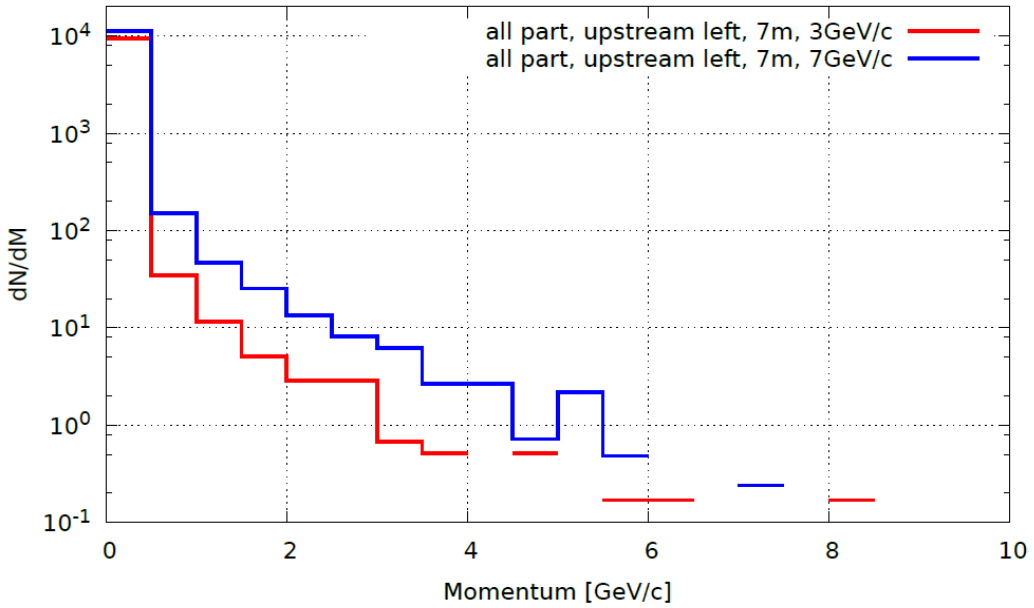


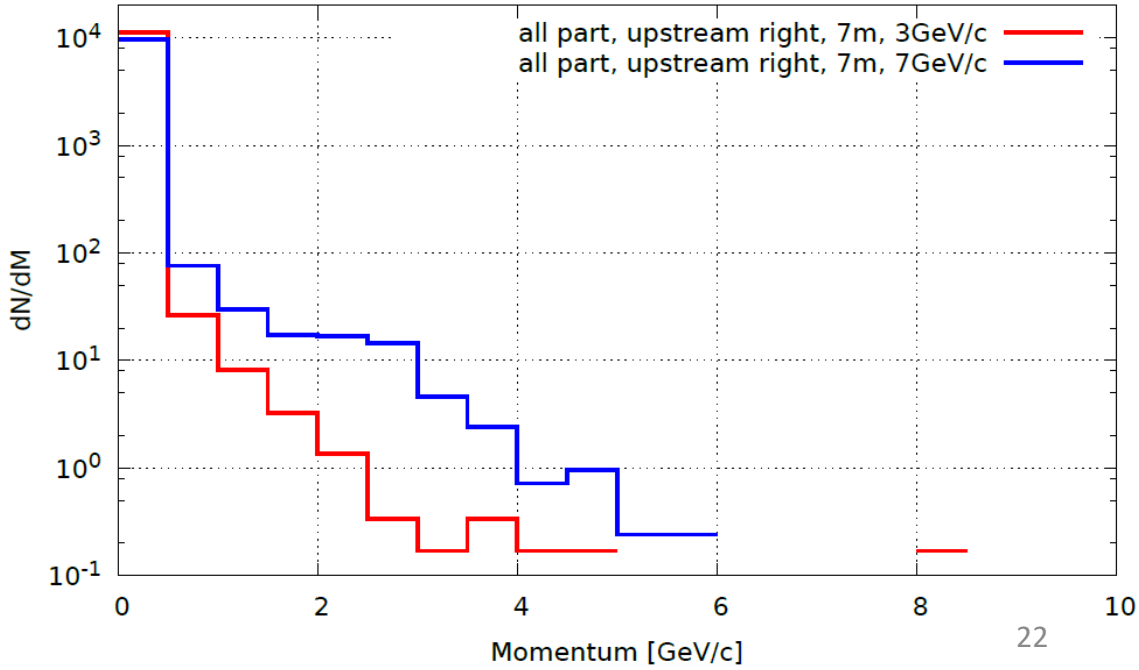
3 GeV/c momentum selection, tungsten target

7m from the cryostat

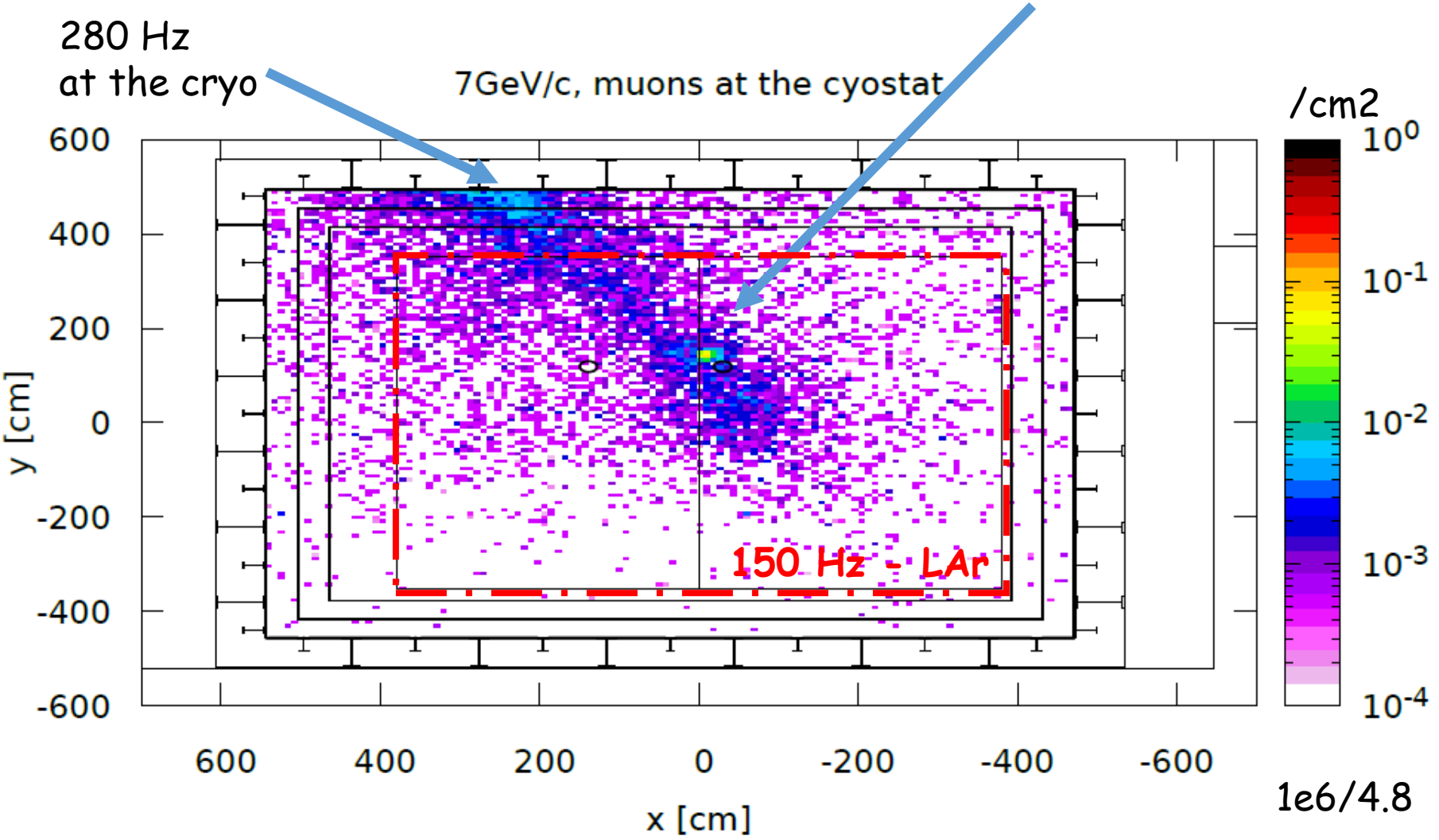
	Upstream, left module rate [Hz] 7m
All particles	**4755 (25)**
All positive part.	**27.9 (1.5)**
All negative part.	**37 (2)**
Pions+	3.2 (0.52)
Pions-	1.27 (0.31)
Protons	4.0 (0.59)
Electrons	30.9 (1.8)
Positrons	6.8 (0.75)
Muons+	**12 (0.96)**
Muons-	**4.8 (0.63)**
Kaons+	0.34 (0.17)
Kaons-	-
Neutrons	**3966 (22)**

	Upstream, right module rate [Hz] 7m
All particles	**5613 (27)**
All positive part.	**20.6 (1.3)**
All negative part.	**31.7 (1.8)**
Pions+	2.5 (0.45)
Pions-	0.68 (0.23)
Protons	3.3 (0.5)
Electrons	28.6 (1.7)
Positrons	4.83 (0.63)
Muons+	**8.9 (0.87)**
Muons-	**2.37 (0.42)**
Kaons+	-
Kaons-	-
Neutrons	**4886 (23)**


all part, upstream left, 7m, 3GeV/c
all part, upstream left, 7m, 7GeV/c
dN/dM
Momentum [GeV/c]


all part, upstream right, 7m, 3GeV/c
all part, upstream right, 7m, 7GeV/c
dN/dM
Momentum [GeV/c]

Background muons – origin VLE-H4 target

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