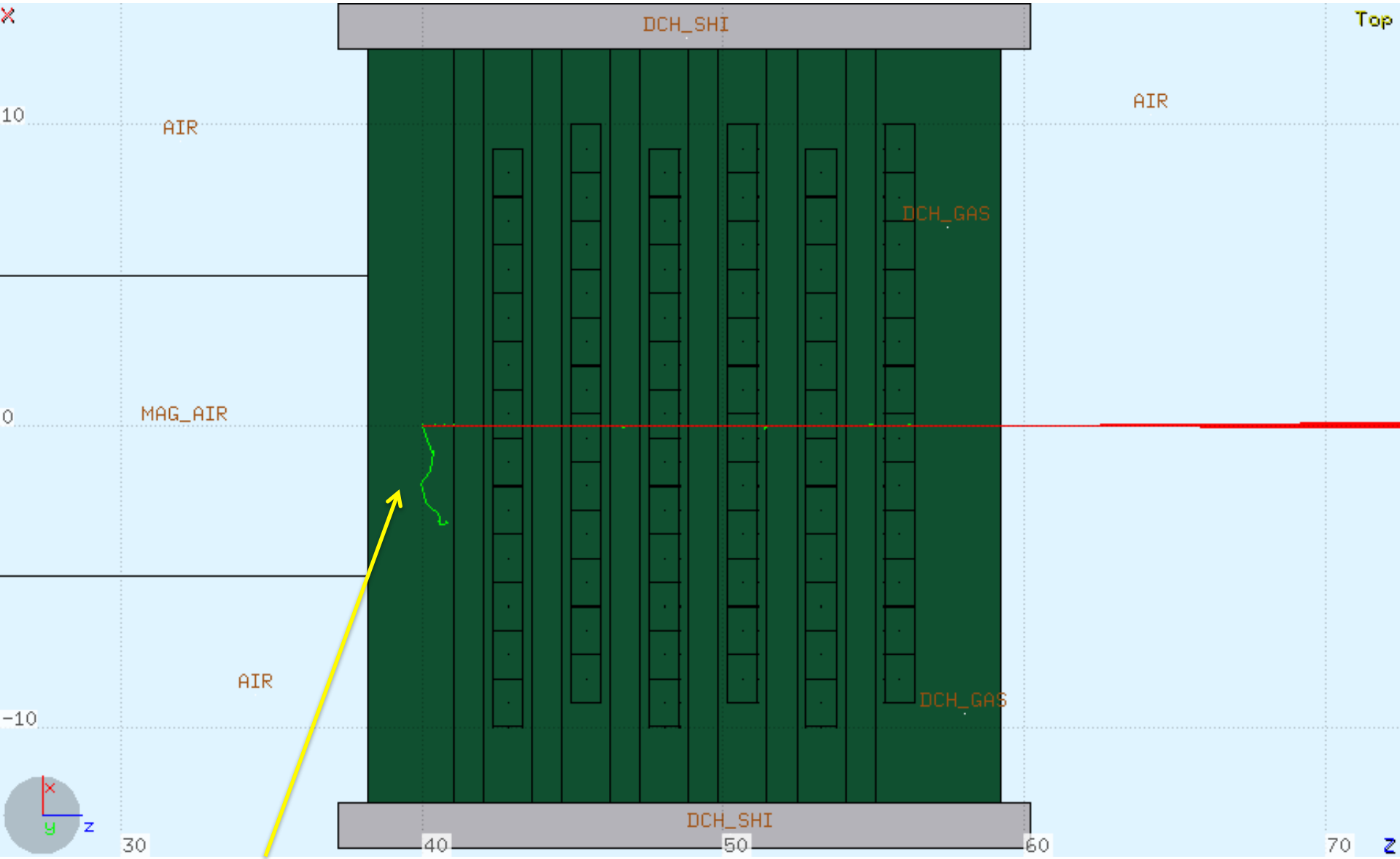
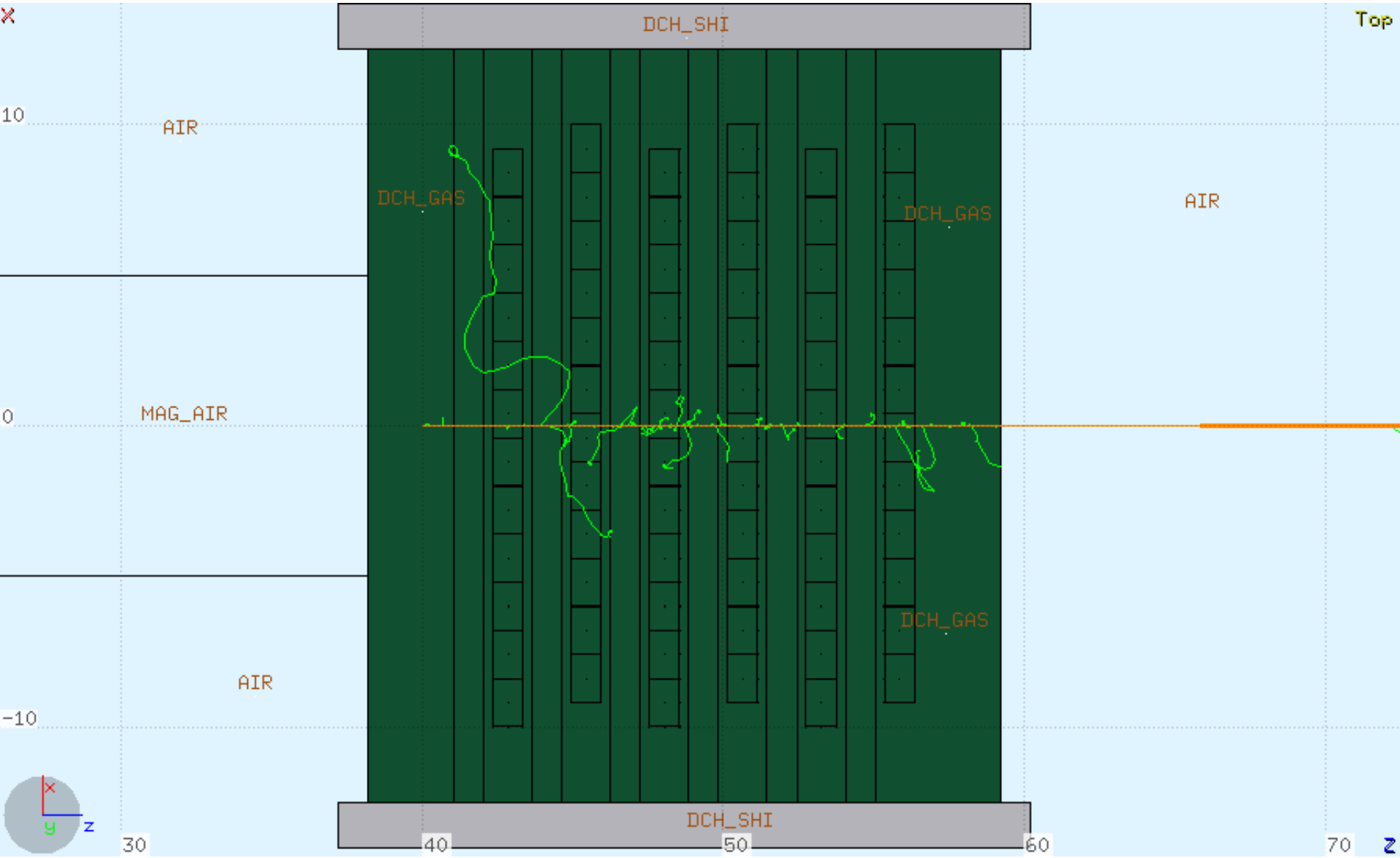
DCh and δ-rays

10 tracks of protons superimposed

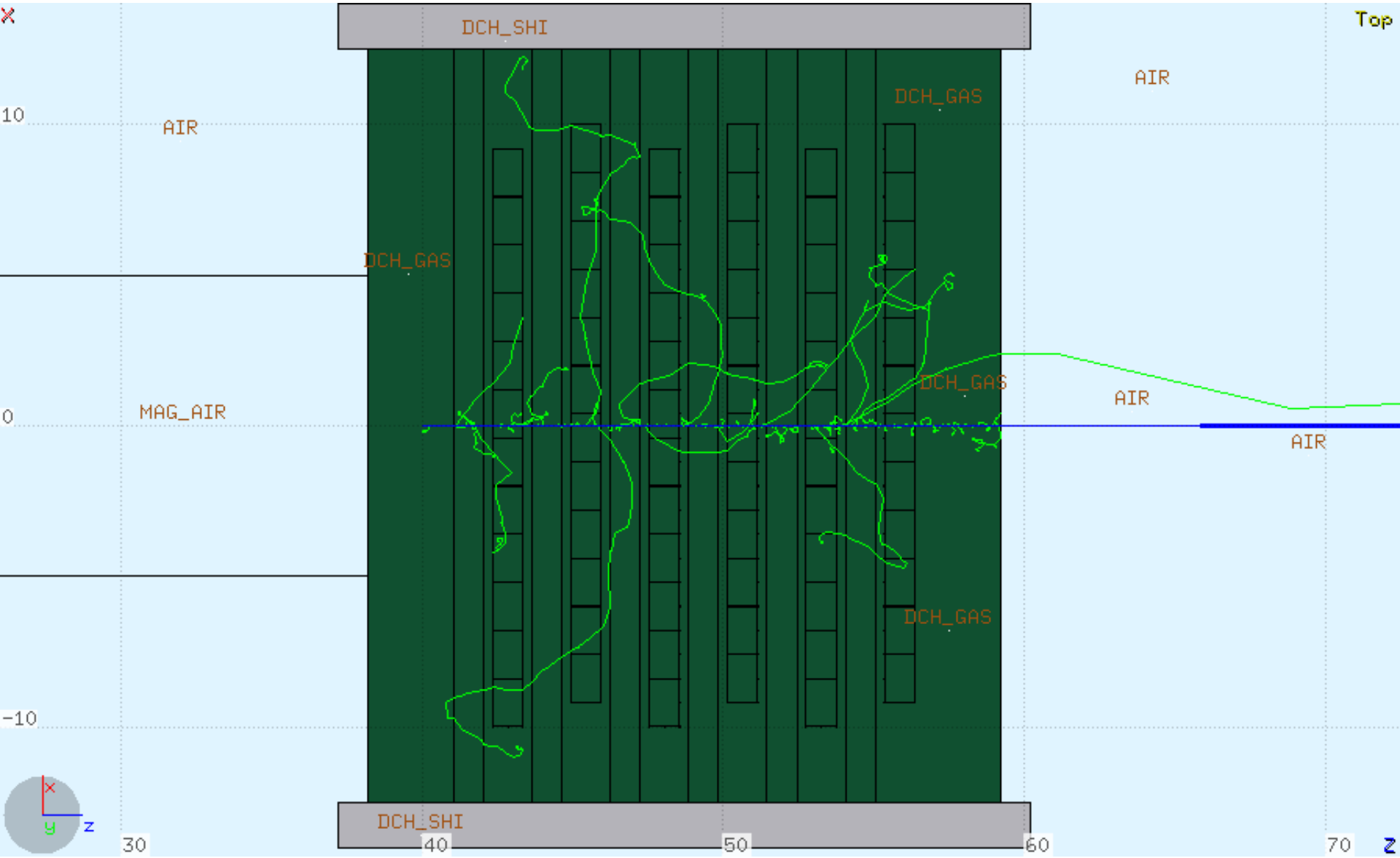


δ-rays

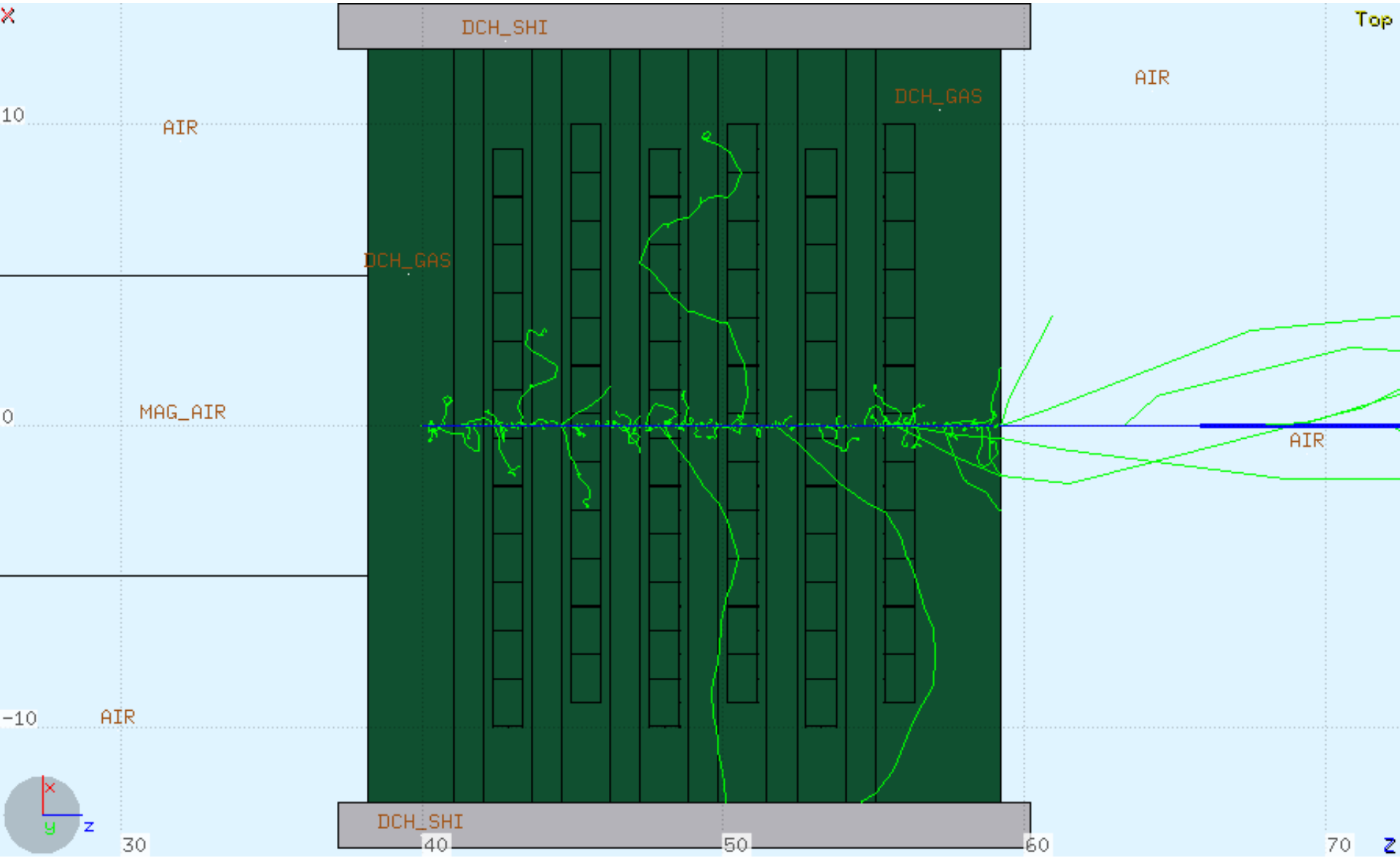
10 tracks of ^{4}He superimposed



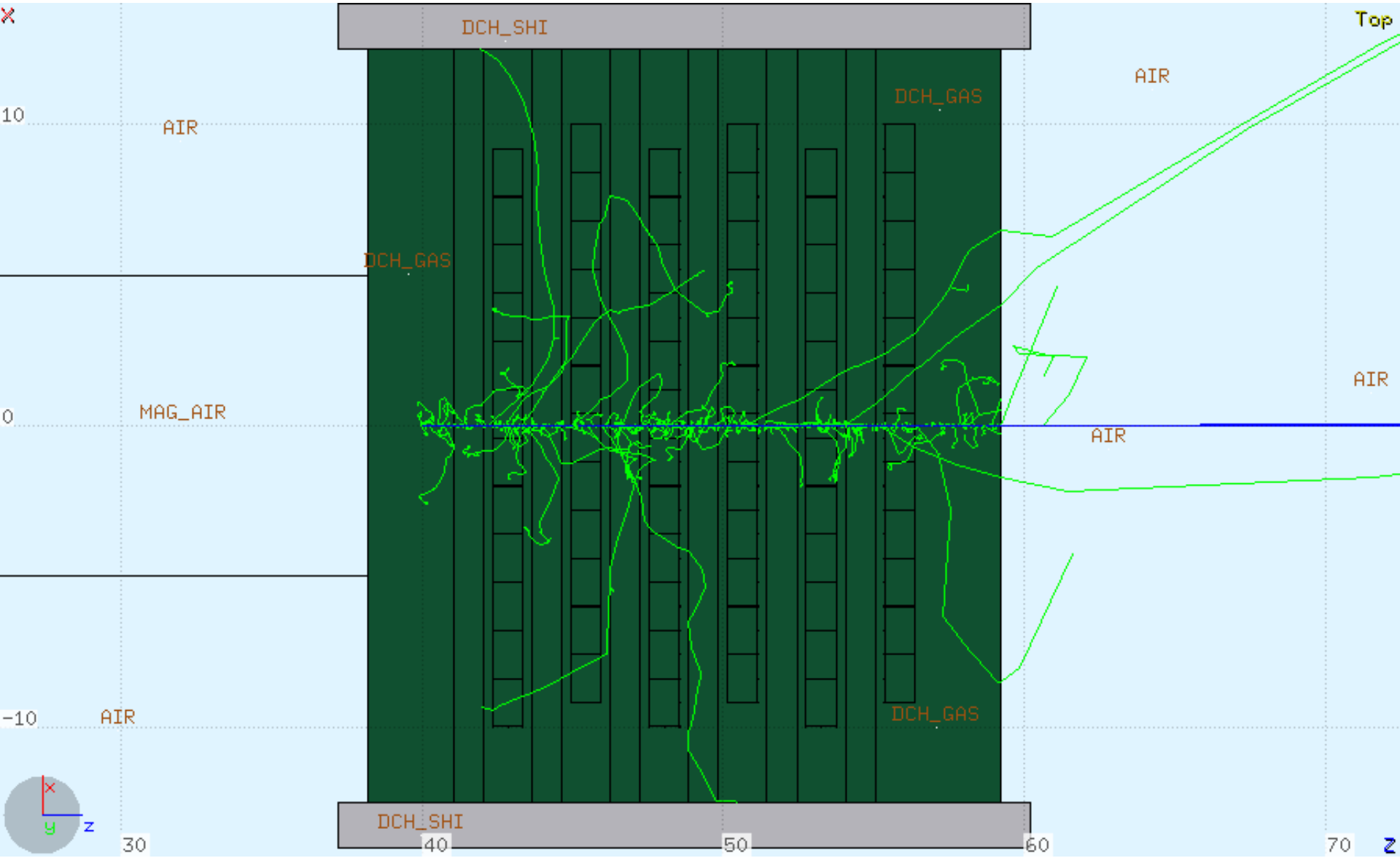
10 tracks of ^{9}Be superimposed



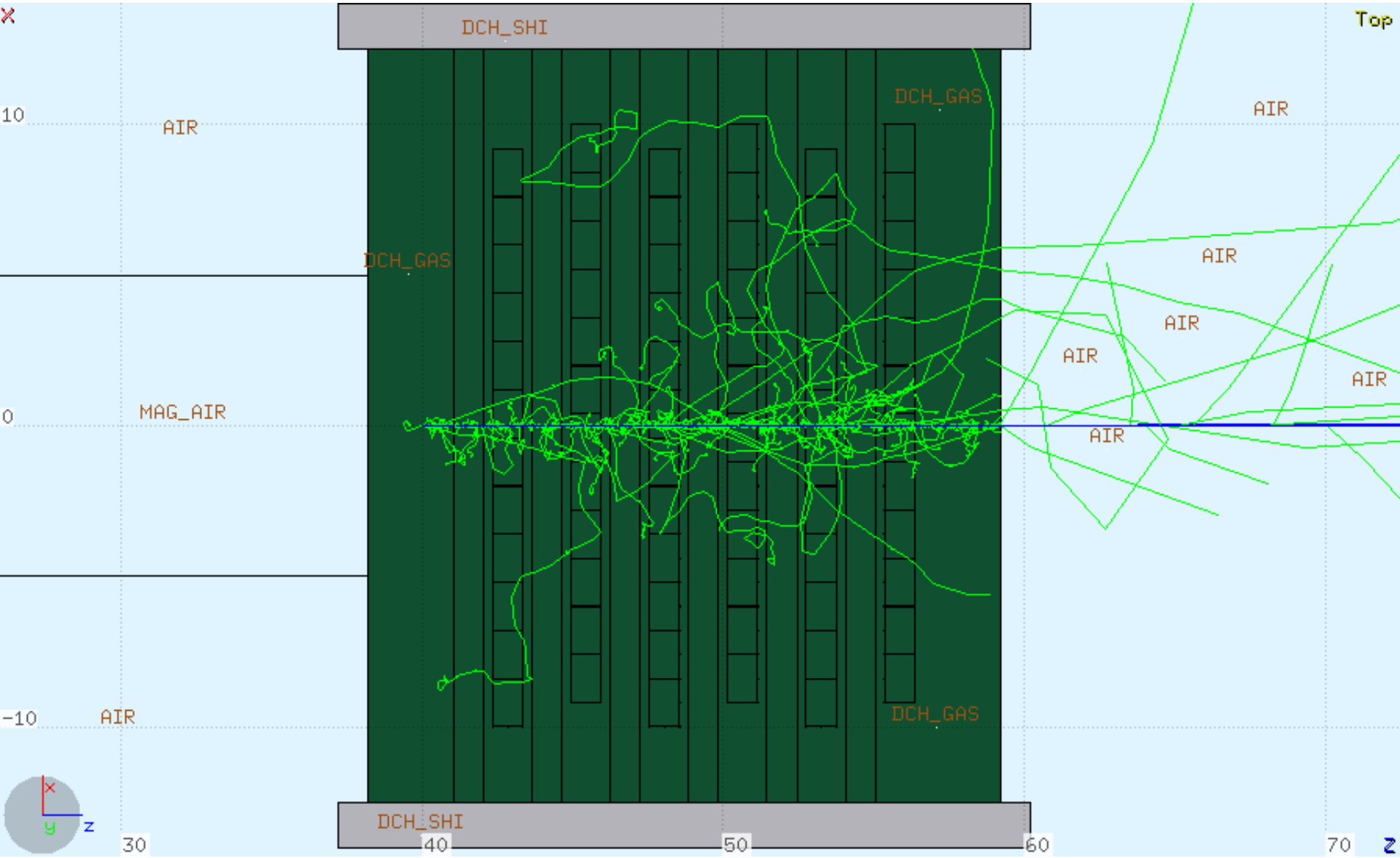
10 tracks of ^{6}Li superimposed



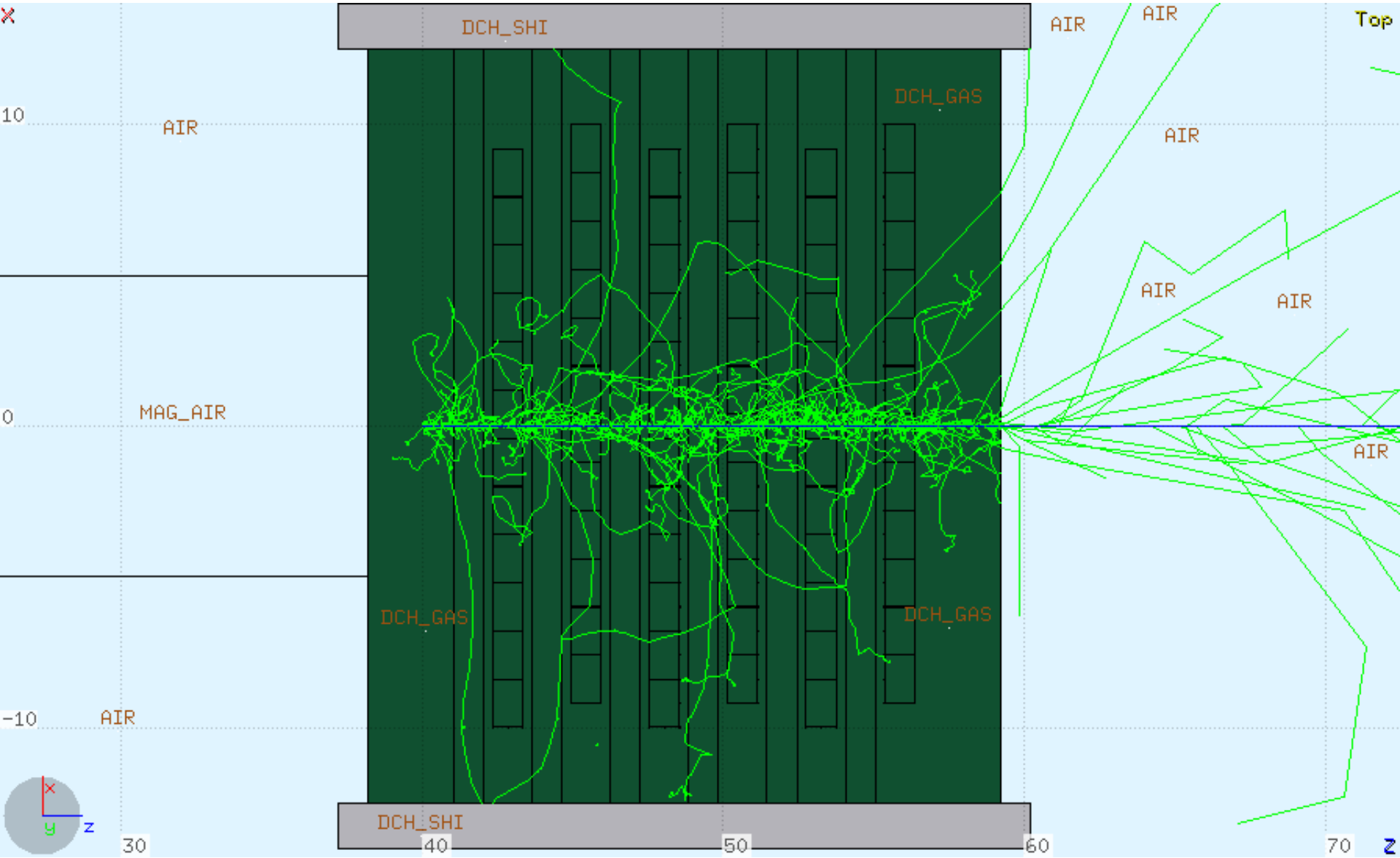
10 tracks of ^{11}B superimposed



10 tracks of ^{12}C superimposed

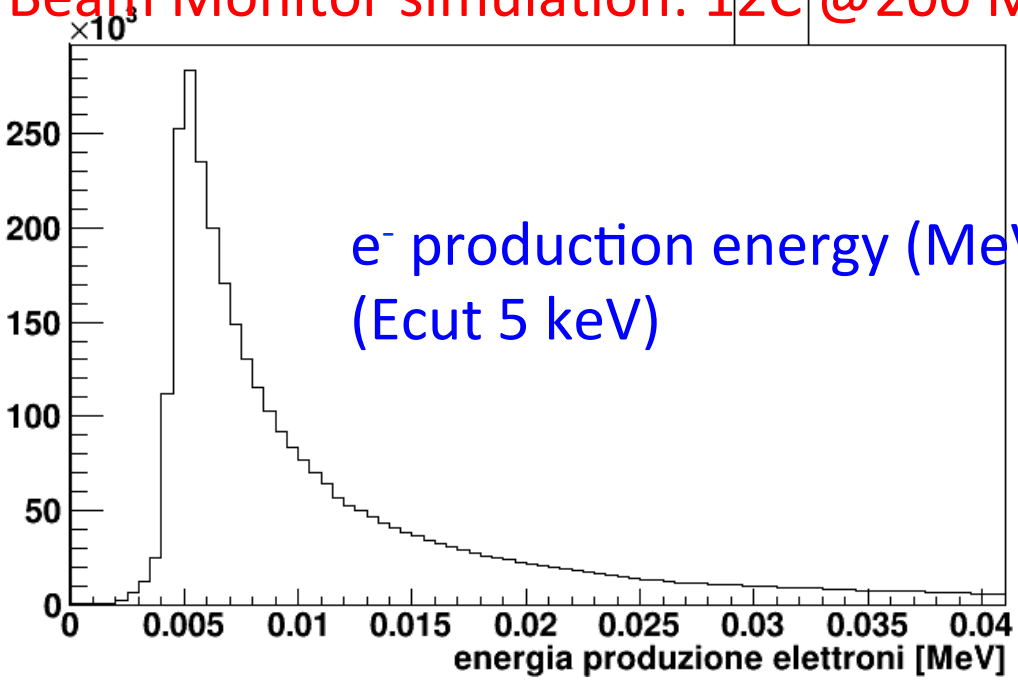


10 tracks of ^{16}O superimposed

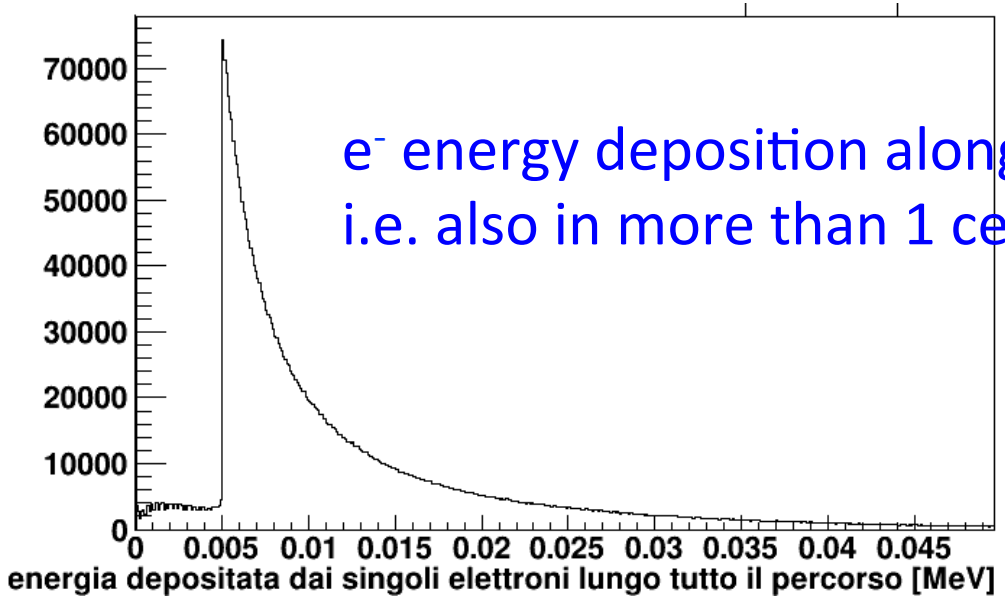


Of course one should weight by energy loss in the cells...

Beam Monitor simulation: 12C @200 MeV/u Ecut for δ-rays 5 keV

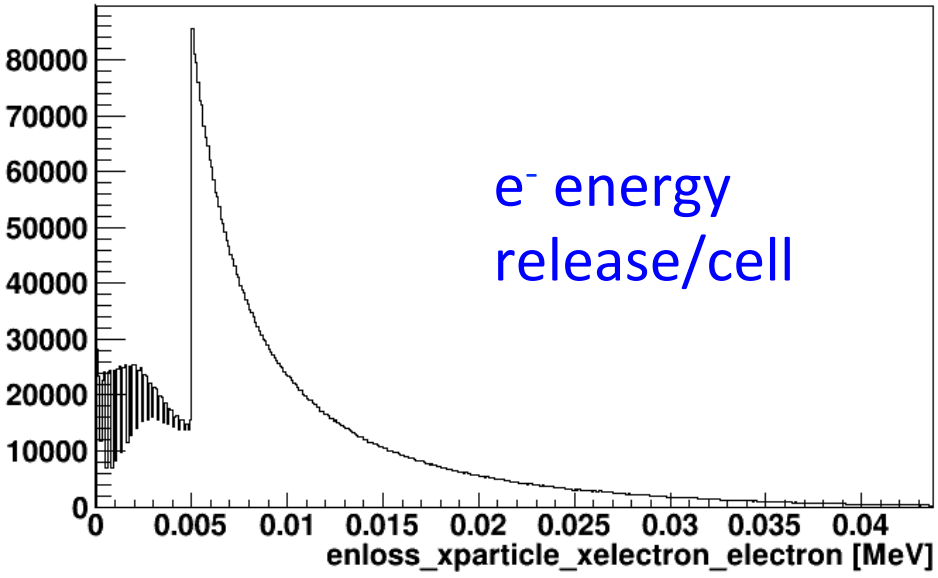


e^- production energy (MeV)
(Ecut 5 keV)

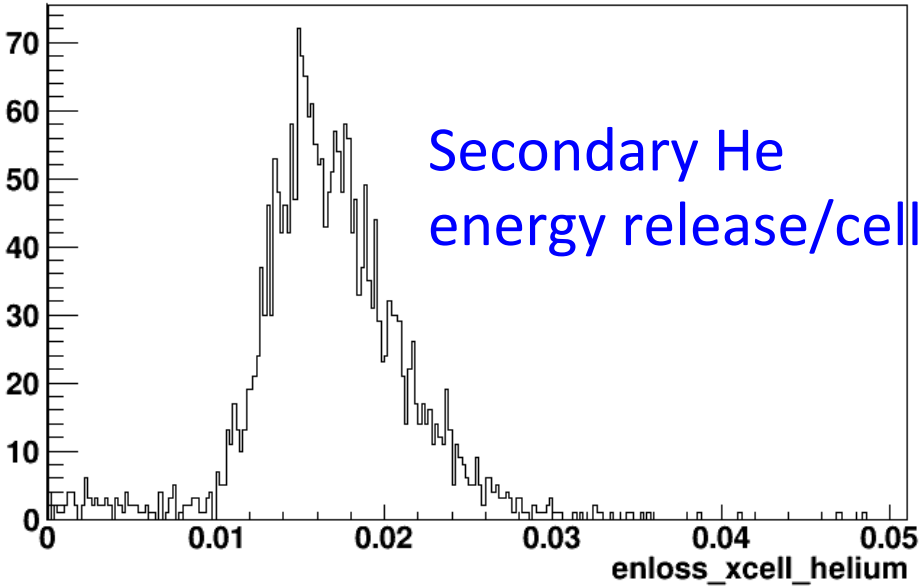


e^- energy deposition along the whole track (MeV)
i.e. also in more than 1 cell

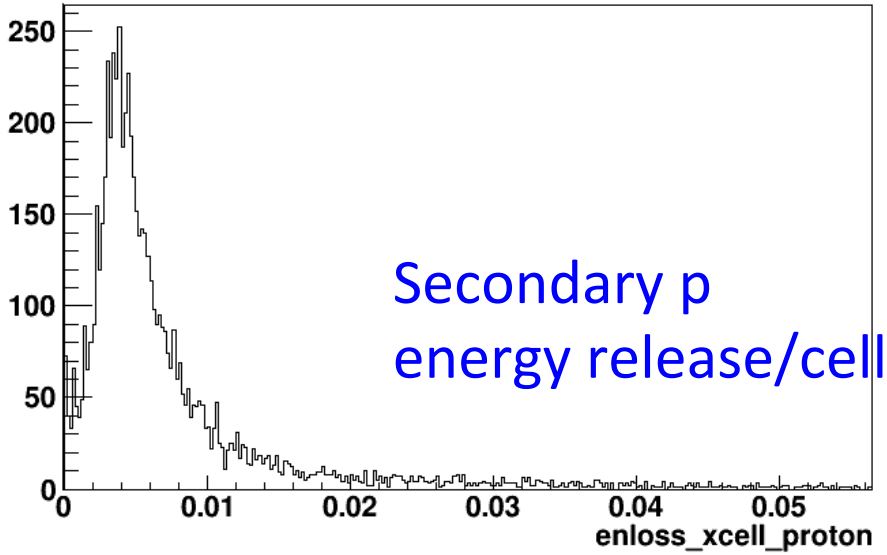
Beam Monitor simulation: 12C @200 MeV/u Ecut for δ-rays 5 keV



e^- energy release/cell



Secondary He energy release/cell



Secondary p energy release/cell

Approx. Analytical Estimates

Spin 0 particles

$$\frac{dN_\delta}{dT\,dx} = \frac{1}{2} K z^2 \frac{Z}{A} \frac{1}{\beta^2} \frac{\left(1 - \beta^2 T / W_{\max}\right)}{T^2}$$

$$W_{\max} = \frac{2mc^2\beta^2\gamma^2}{1 + 2\gamma mE/M + (m/M)^2}$$

Gas: Ar-CO2 80/20; E = 200 MeV/u

e^- 60 keV ➜~ 0.5 cm in gas

after analytical integration:

Z	Wmax	$N_\delta(E_\delta>5$ keV)/cm	$\langle E_\delta \rangle$	$N_\delta(E_\delta>60$ keV)/cm	$\langle E_\delta \rangle$
1	486 keV	~0.1	21.8 keV	0.005	137 keV
2	"	0.3	"	0.019	"
3	"	0.6	"	0.045	"
4	"	1.1	"	0.078	"
5	"	1.8	"	0.121	"
6	"	2.6	"	0.175	"
7	"	3.5	"	0.238	"
8	"	4.6	"	0.310	"

- For Z>2 fragments we may have problems
- Can we cut electrons with a discrimination threshold? May be not so simple:
  - We can loose protons and cells crossed by Z>2 particles only with a small portion of track
  - in any case fluctuations in energy loss, both in physics and in multiplication gain, are large