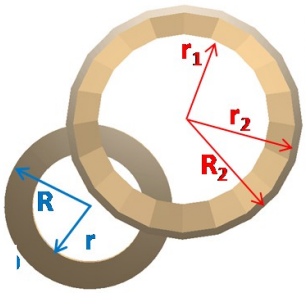
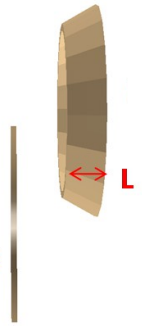
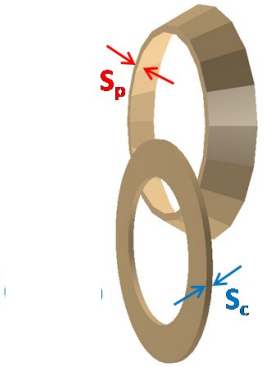
Simulation of Radiation monitors

A. Di Simone, S. Tammaro
INFN Tor Vergata

Implementation



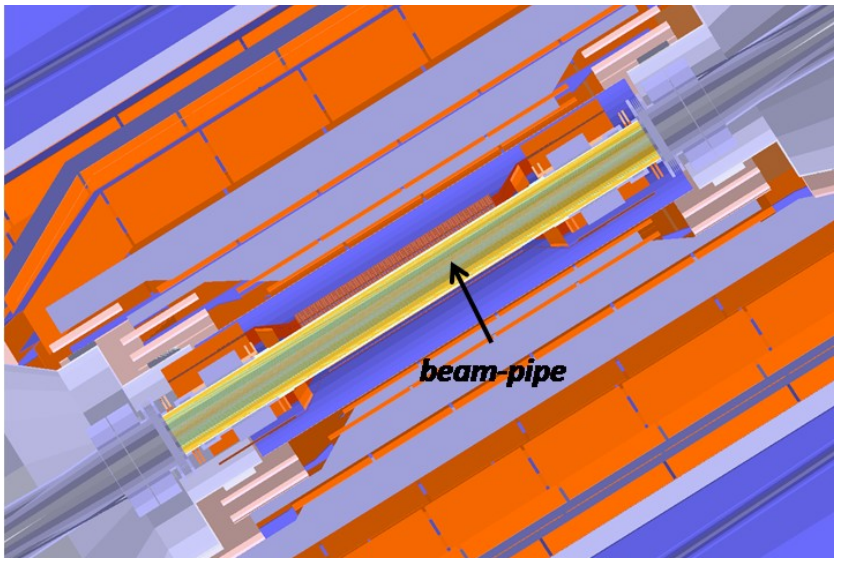


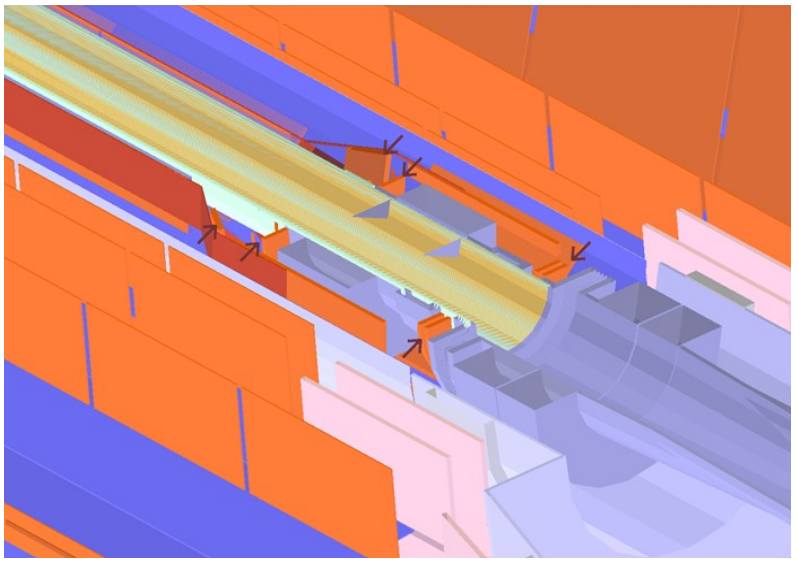


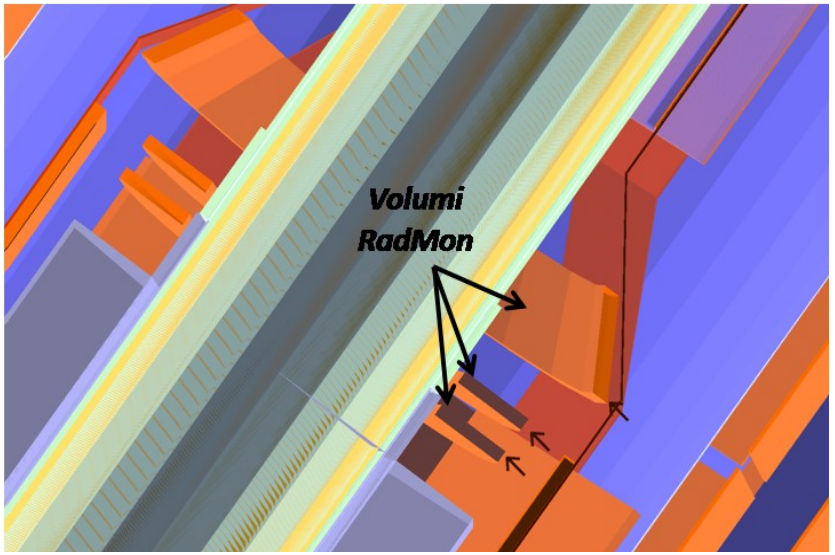
Tube
r=12 mm
R=18 mm
Sc=1 mm
Area=565.49 mm2

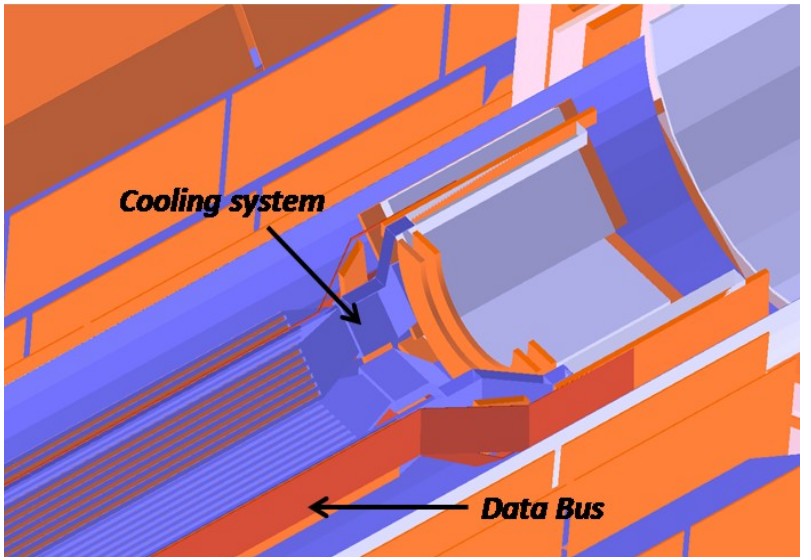
Polycone
r1=16.8 mm
R1=18.2 mm
r2=20.8 mm
R2=22.2 mm
L=7 mm
Sp=1.4 mm
Volume=3431 mm3

Implementation

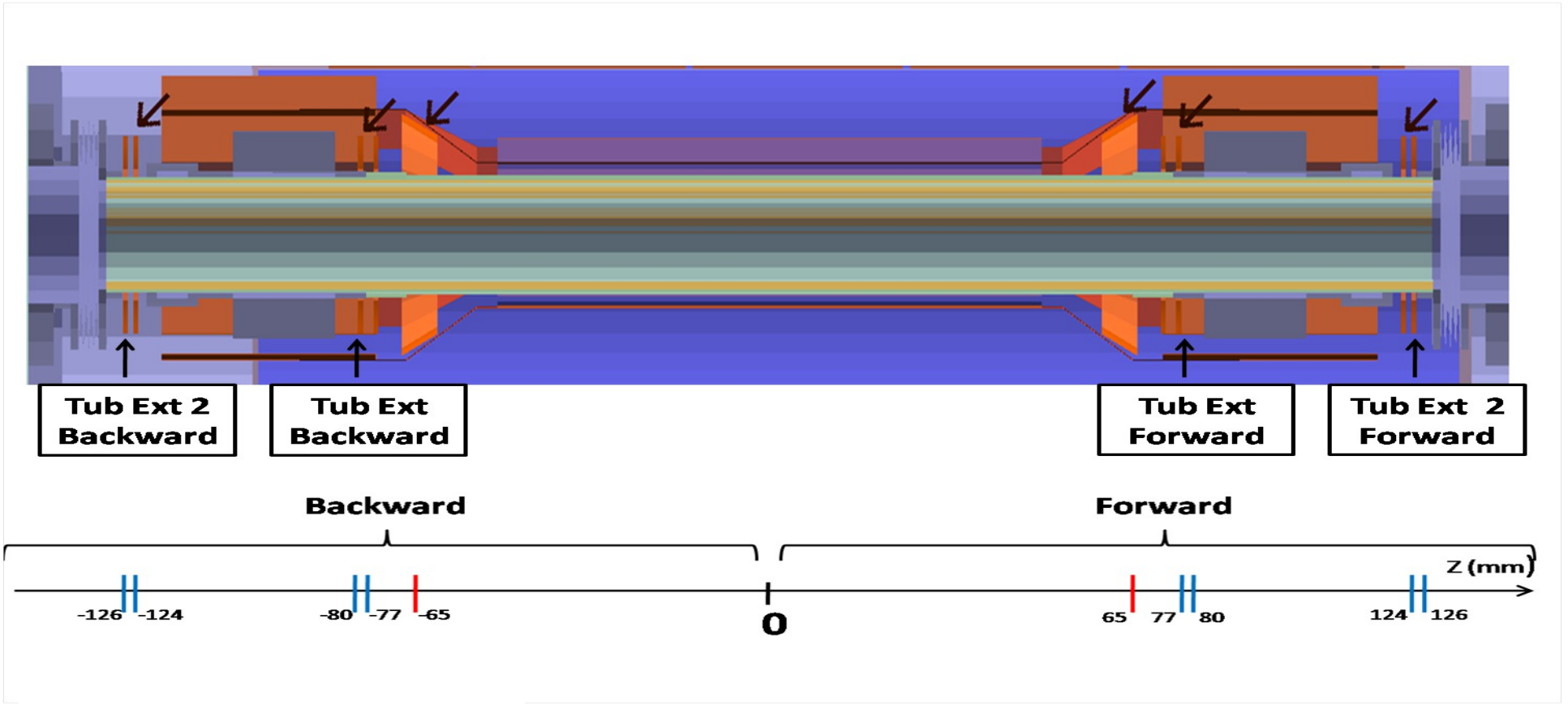








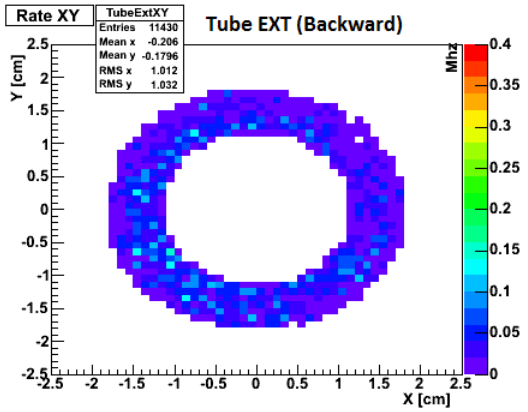
Implementation

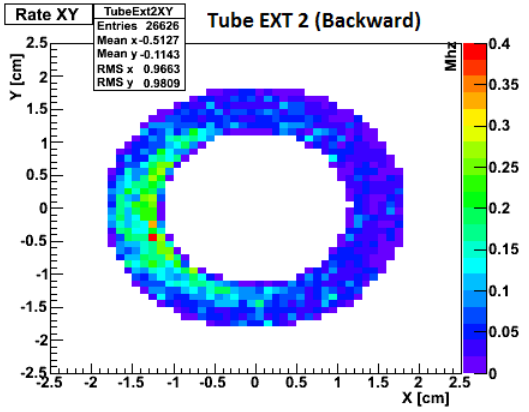


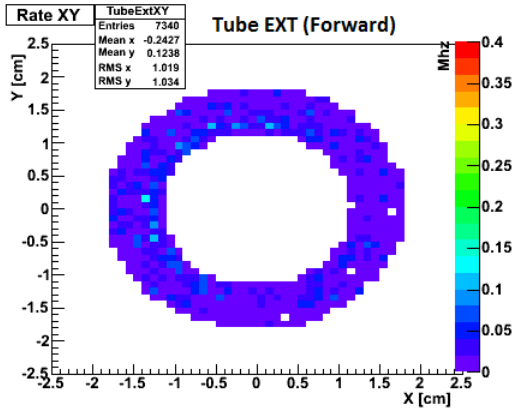
Simulation

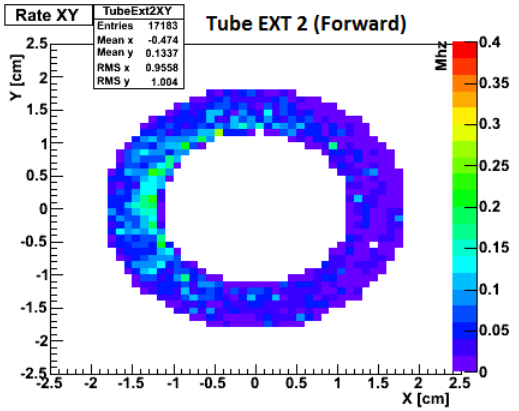
- Studies done on 130k RadBhabha events
  - Home-made, following Alejandro's prescriptions for official-like production
  - Plan to use officially produced data asap, including more background sources
- Analysis is presently limited to feasibility studies
  - Hit rates
  - Deposited energy
  - Arrival times
  - Using Riccardo's instructions for dose evaluation on electronics
- Will present here some preliminary results, on the ring-like volumes

Hit rates







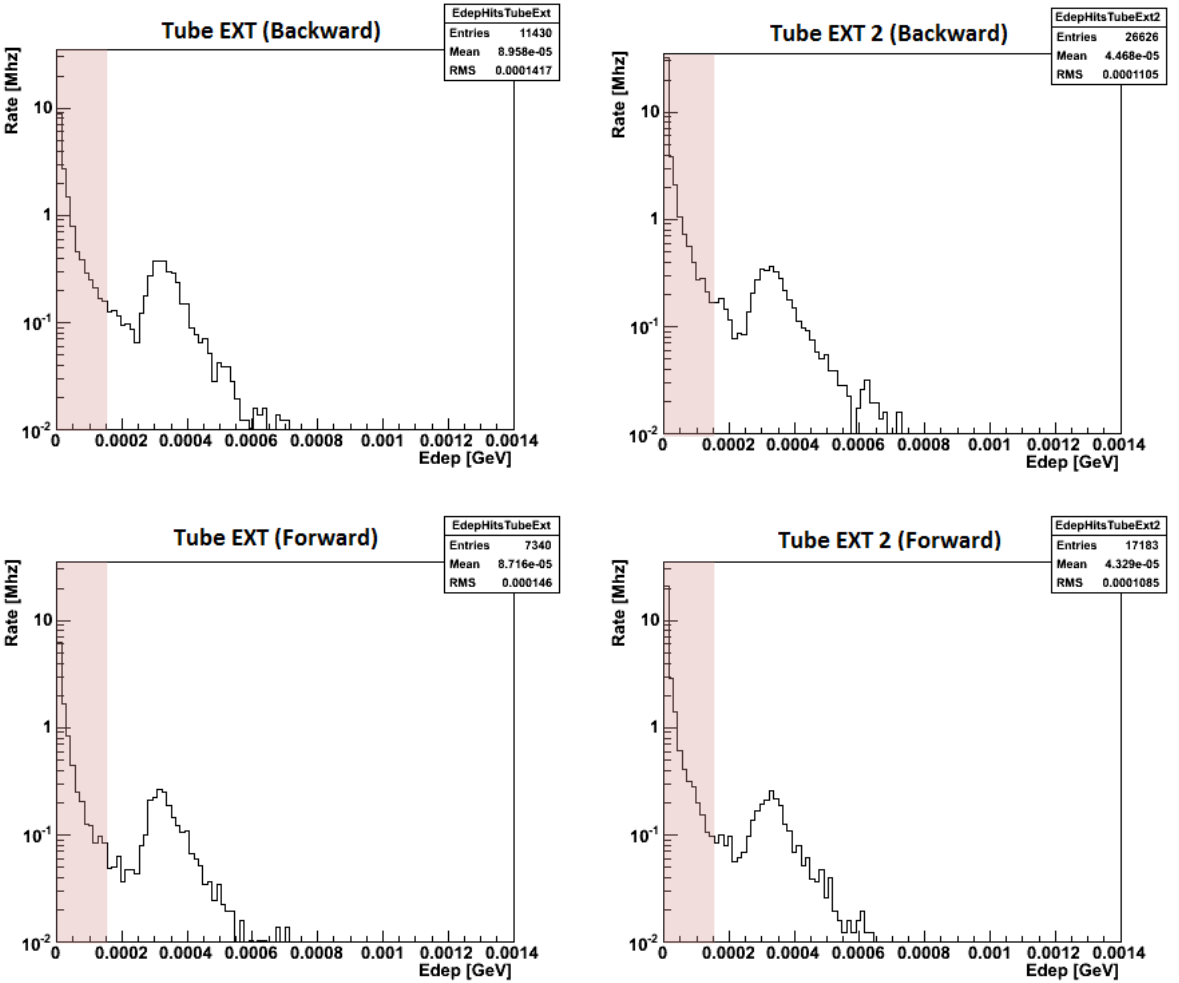


- In general, bwd volumes more populated
  - Probably an effect of the boost
- Points farther from IP have larger hit rate
  - Under investigation

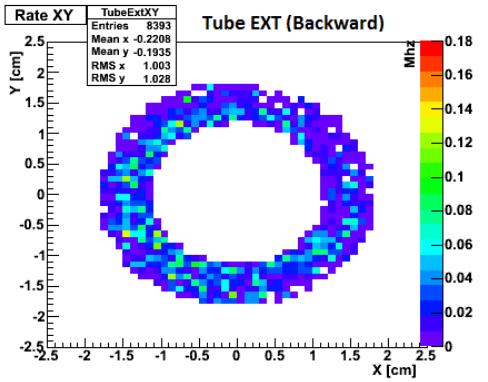
- Plot shows global hit rates, integrated in time, edep, particle type
  - Left: layer closer to IP
  - Right: layer farther from IP
  - Top: backward
  - Bottom: Forward
- Bin size is 1mmx1mm
- Assuming a 5mmx5mm sensor, one could expect rates as high as 12,5MHz per detector element
  - Note that most of this rate comes from very-low-energy particles, hence it would not map directly to occupancy

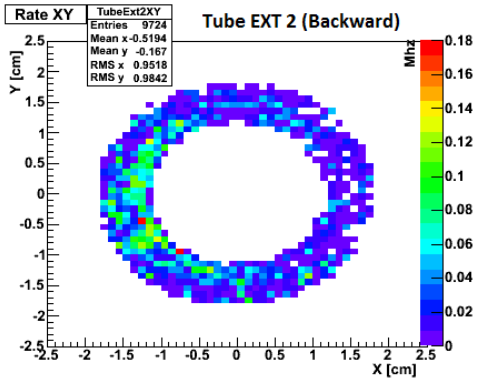
Energy depositions

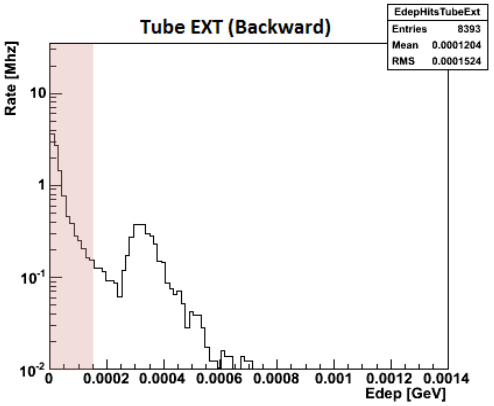
- Plot shows the expected rate, in bins of deposited energy
- Red band shows zone where a typical diamond-based sensor is NOT sensitive
- Small peaks at larger energies correspond to MIPs

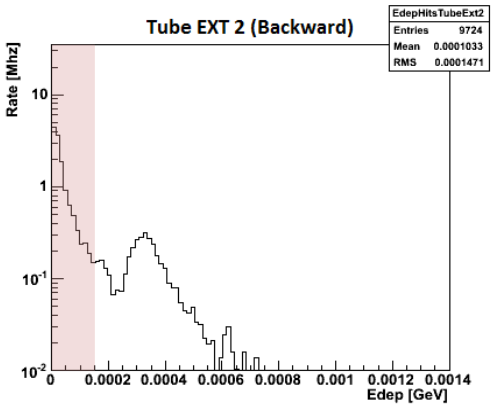


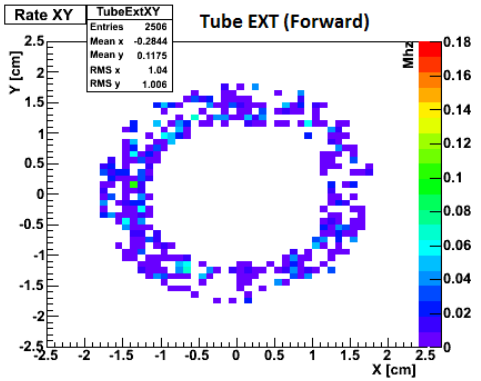
Results - electrons

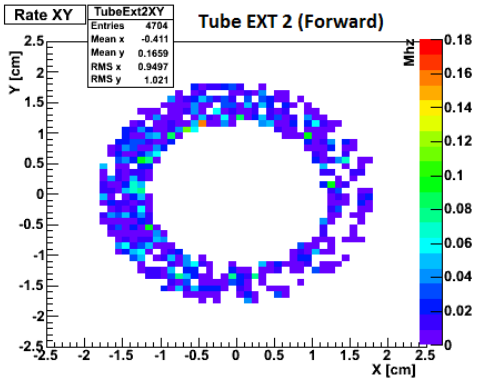


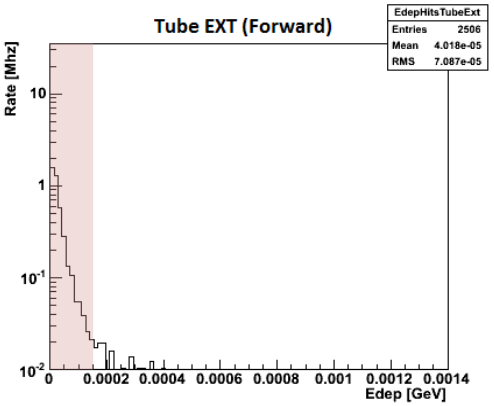


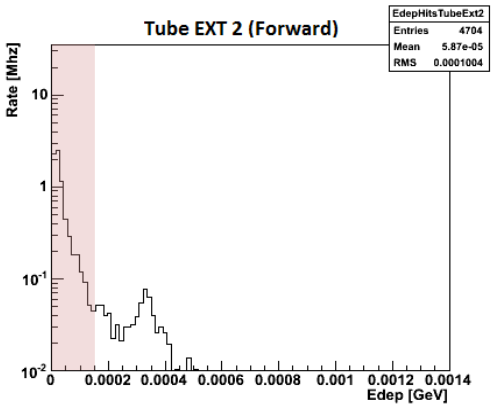






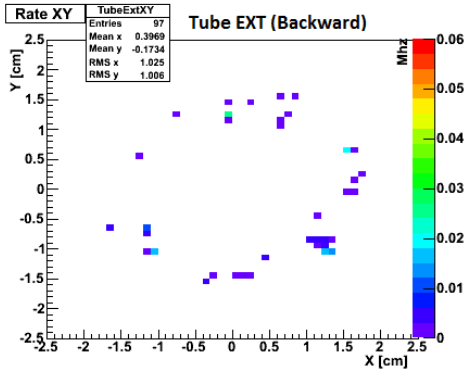


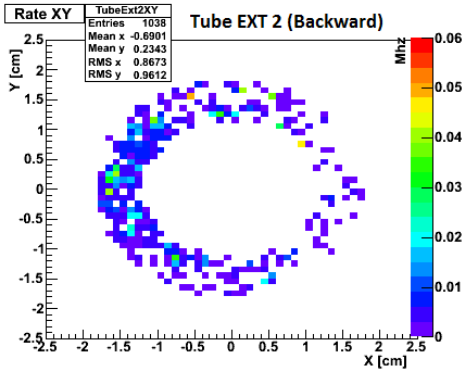


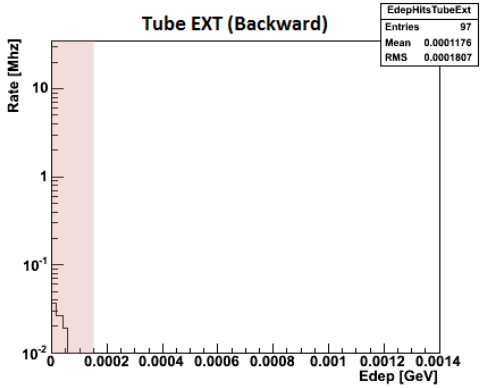


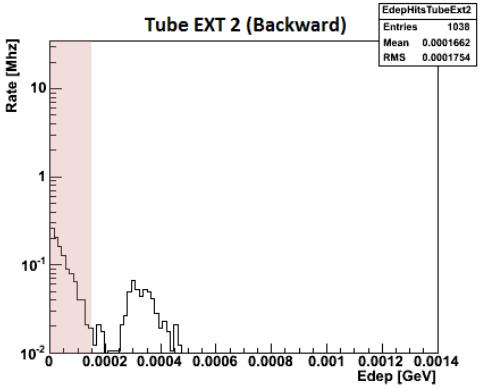
- Similar features as already seen in the global plots
- Note bwd volumes more populated, as expected by machine configuration

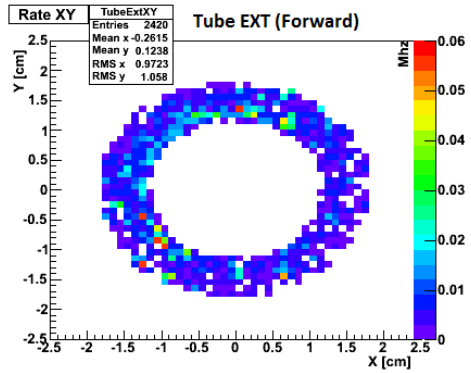
Results - positrons

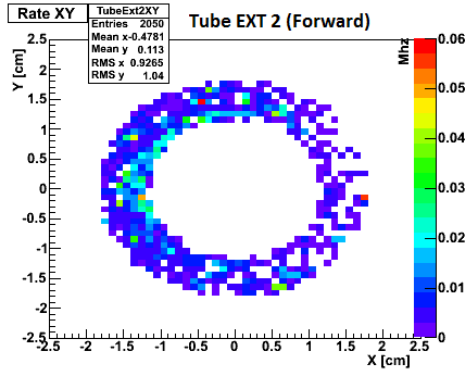


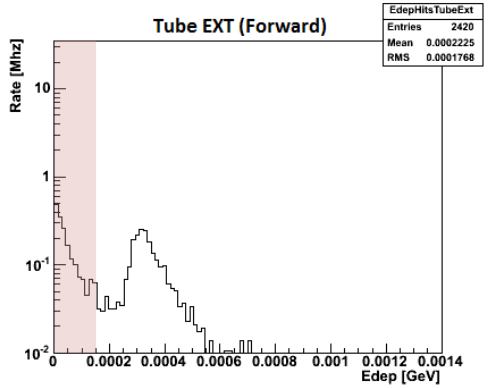


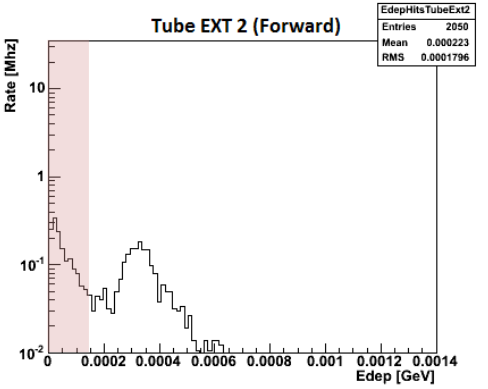






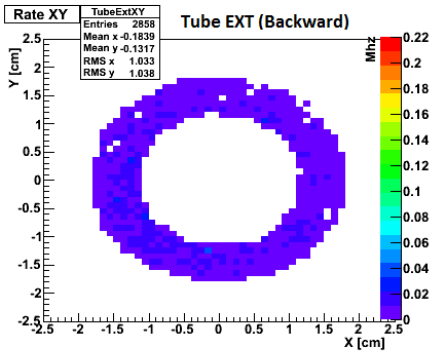


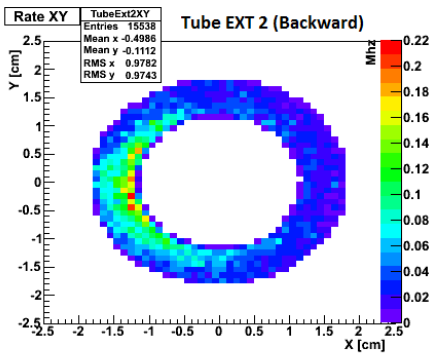


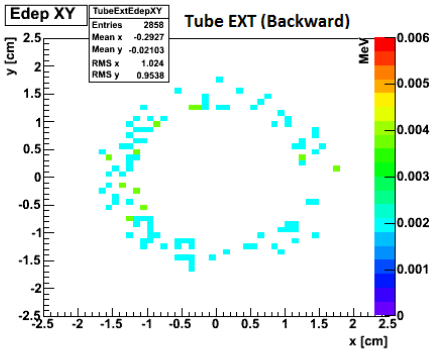


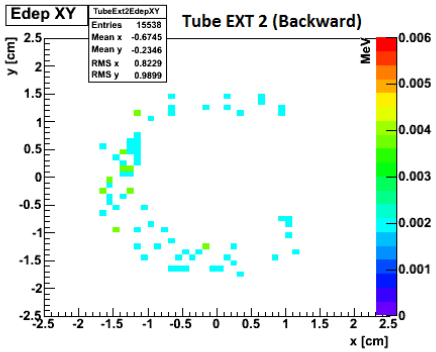
- Positrons plots are less populated
  - Probably an effect of the boost

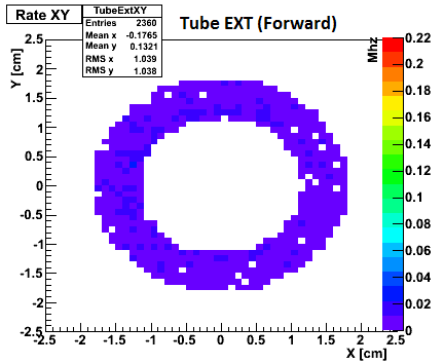
Results - photons

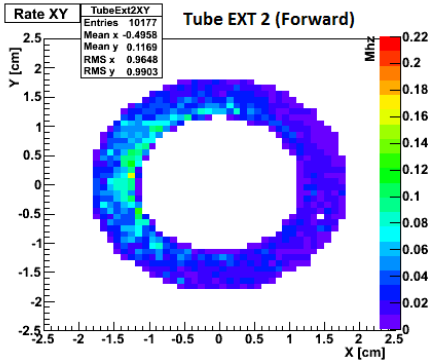


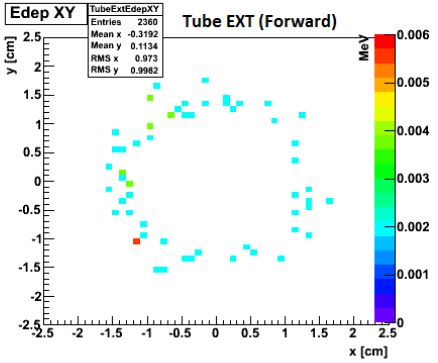


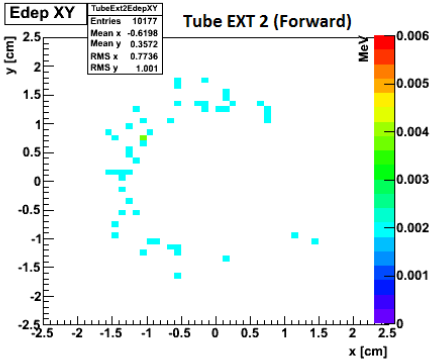












- Most of the observed rate comes from photons
  - Which, however, are all of very low energy, hence mostly undetectable

Results

Electrons	Rate (MHz)	Edep/sec (GeV/s)	nHits/Event	Edep/Hit (GeV)	Rate/mm2 (MHz/mm2)	Z (mm)
Tube Ext (Back)	14.6	1760	0.06	1.2x10-4	0.026	-80
Tube Ext 2 (Back)	17.0	1750	0.07	1.0x10-4	0.030	-126
Tube Ext (Forw)	4.4	175	0.02	0.4x10-4	0.008	80
Tube Ext 2 (Forw)	8.2	480	0.04	0.6x10-4	0.015	126

Positrons	Rate (MHz)	Edep/sec (GeV/s)	nHits/Event	Edep/Hit (GeV)	Rate/mm2 (MHz/mm2)	Z (mm)
Tube Ext (Back)	0.2	20	0.001	1.1x10-4	3.5x10-4	-80
Tube Ext 2 (Back)	1.8	300	0.008	1.7x10-4	0.003	-126
Tube Ext (Forw)	4.2	940	0.018	2.2x10-4	0.007	80
Tube Ext 2 (Forw)	3.6	795	0.016	2.2x10-4	0.006	126

Photons	Rate (MHz)	Edep/sec (GeV/s)	nHits/Event	Edep/Hit (GeV)	Rate/mm2 (MHz/mm2)	Z (mm)
Tube Ext (Back)	5.0	0.35	0.02	7.2x10-8	0.009	-80
Tube Ext 2 (Back)	27.1	0.24	0.12	0.9x10-8	0.048	-126
Tube Ext (Forw)	4.1	0.19	0.02	4.8x10-8	0.007	80
Tube Ext 2 (Forw)	17.8	0.16	0.08	0.9x10-8	0.031	126

Results

All particles	Rate (MHz)	Edep/sec (GeV/s)	nHits/Event	Edep/Hit (GeV)	Rate/mm2 (MHz/mm2)	Z (mm)	% Hits (>150KeV)
Tube Ext (Back)	19.9	1780	0.09	9.0x10-5	0.035	-80	22%
Tube Ext 2 (Back)	46.4	2080	0.20	4.5x10-5	0.082	-126	10%
Tube Ext (Forw)	12.8	1115	0.06	8.7x10-5	0.023	80	21%
Tube Ext 2 (Forw)	30.0	1305	0.13	4.3x10-5	0.053	126	10%

Conclusions

- Very first simulation of radiation monitor has provided a wealth of valuable information
  - Much more than we can digest in such a short time...
  - Discussion ongoing with detector/electronics experts on how to use these results to drive the technological choices
- Must look at more background events
- Must understand the source of the particles
  - Primaries? Secondaries?
- Must update the studies using more up-to-date geometry description