RESIDUAL DOSES AND AIR ACTIVATION FOR THE BUMPS IN DECAY RING

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CERN

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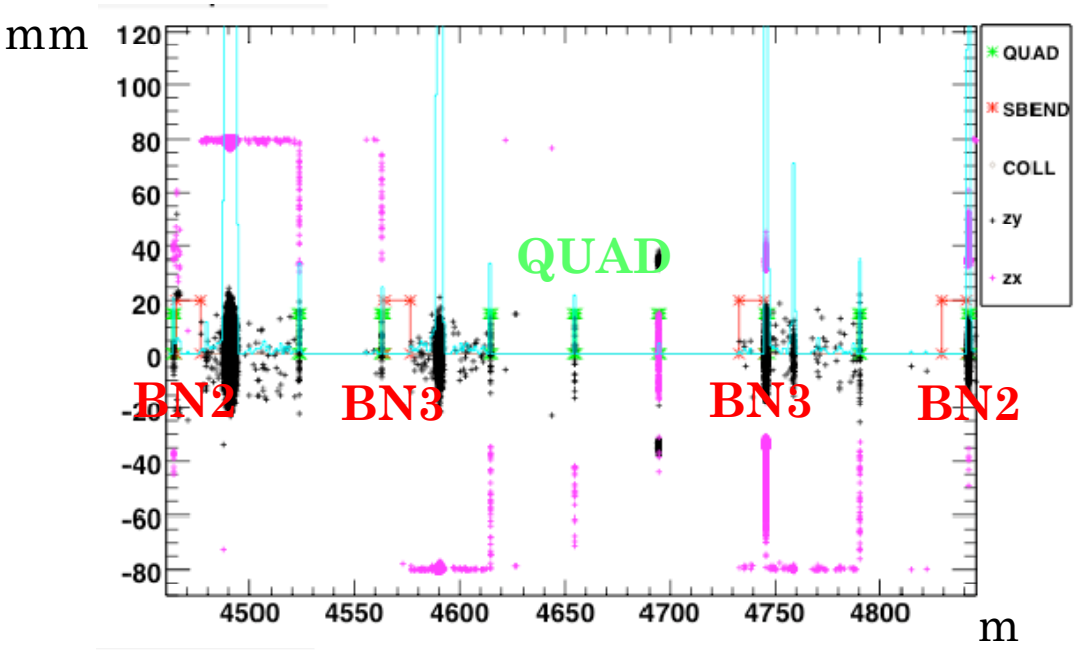
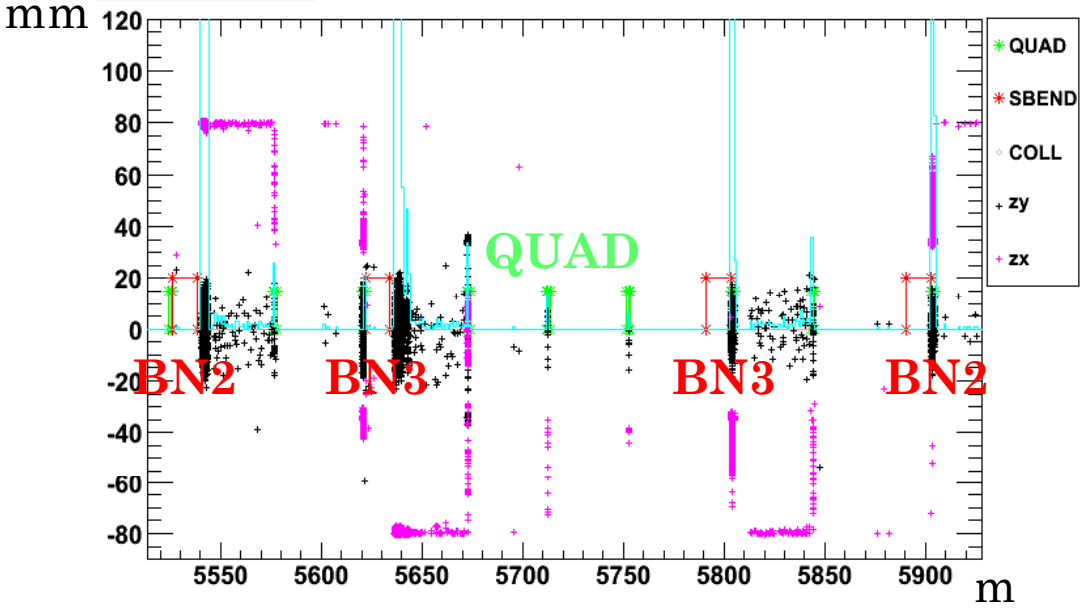
- Loss maps for ^{6}He
- Loss %s and comparison between the 2 bumps
- Geometry layout
- Residual dose rates
- Air activation: production rates
- Comparison with the RCS

BUMP LOSSES OF ^{6}He: LAYOUT



1ST BUMP

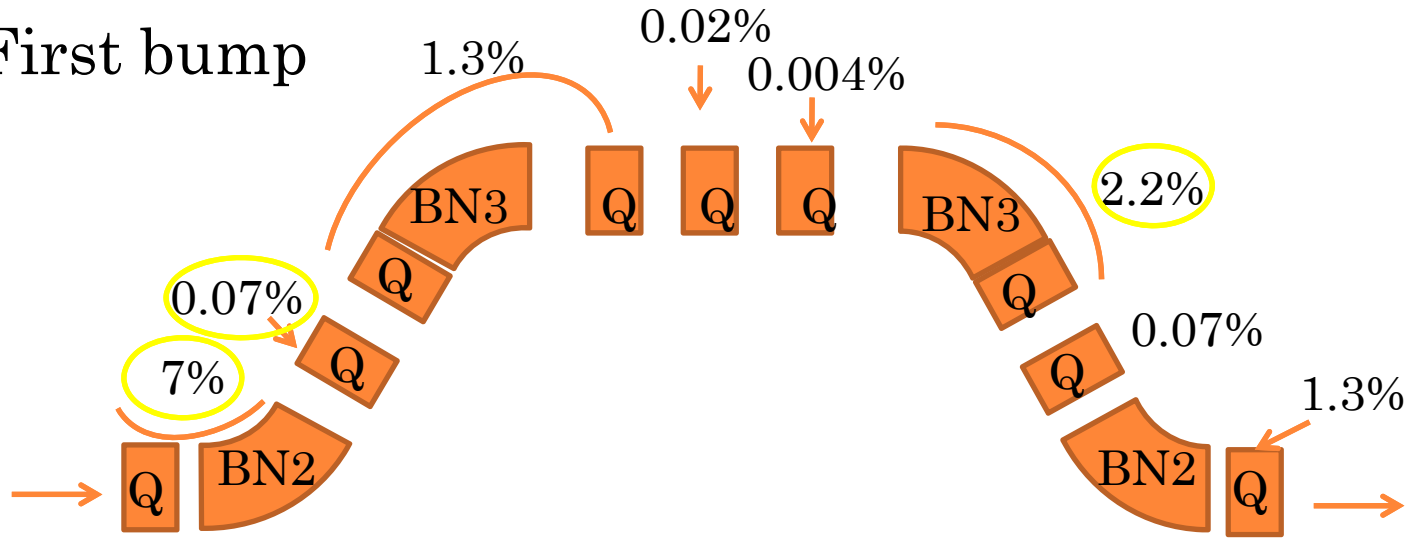


2ND BUMP

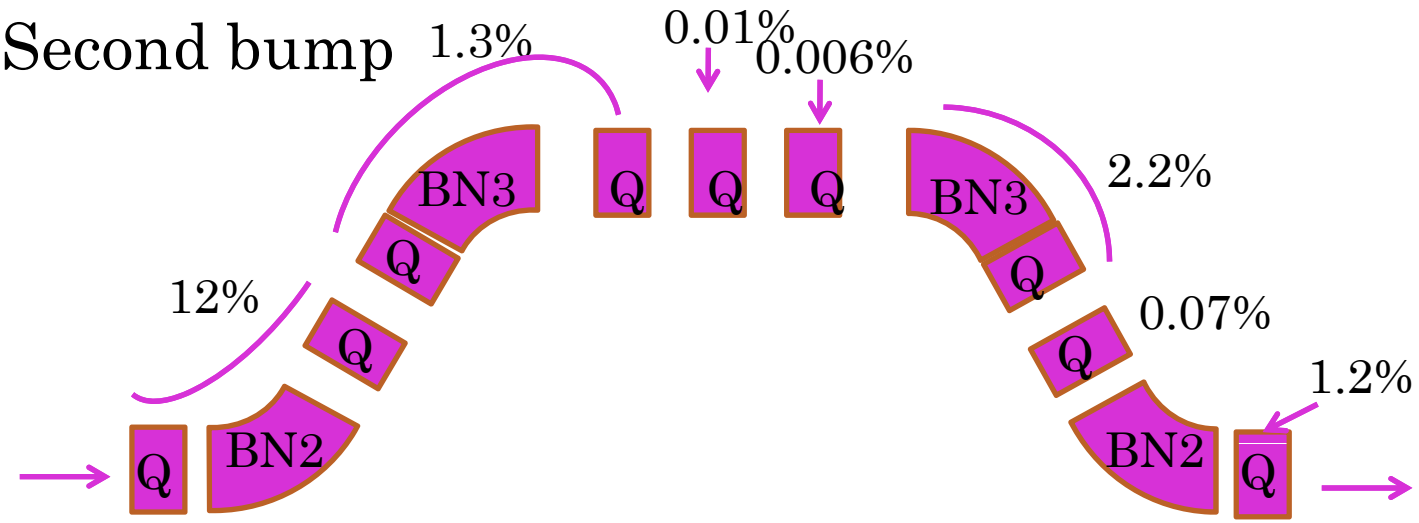
from Pierre Delahaye

Decay loss % for ^{6}He

- First bump



- Second bump



OTHER SECTIONS

- Each bump can be subdivided in "similar" sections according to loss distributions.
- Loss map in bump 1 = Loss map in bump 2 (normalization required!)
- With 3 simulations it is possible to describe the 2 bumps.

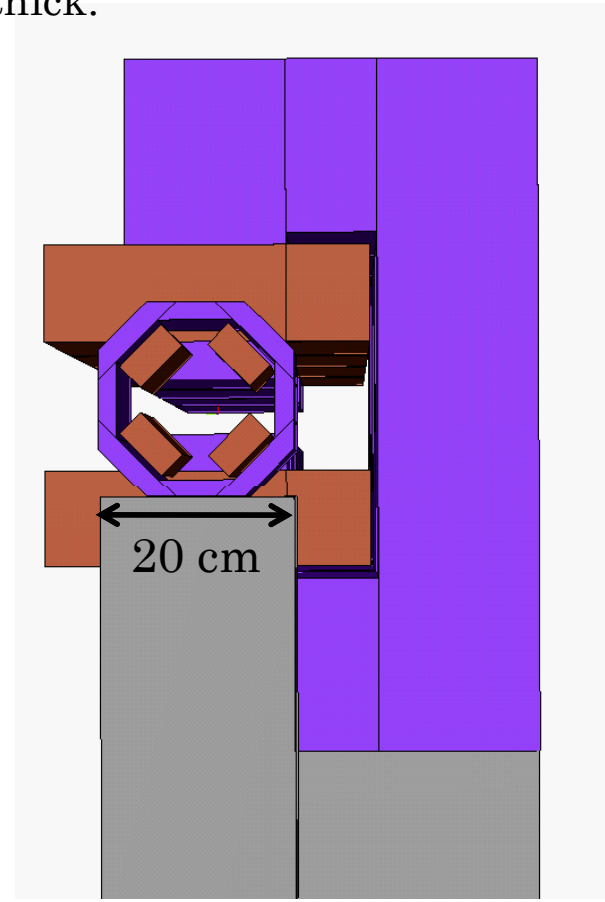
GEOMETRY IMPLEMENTATION IN FLUKA

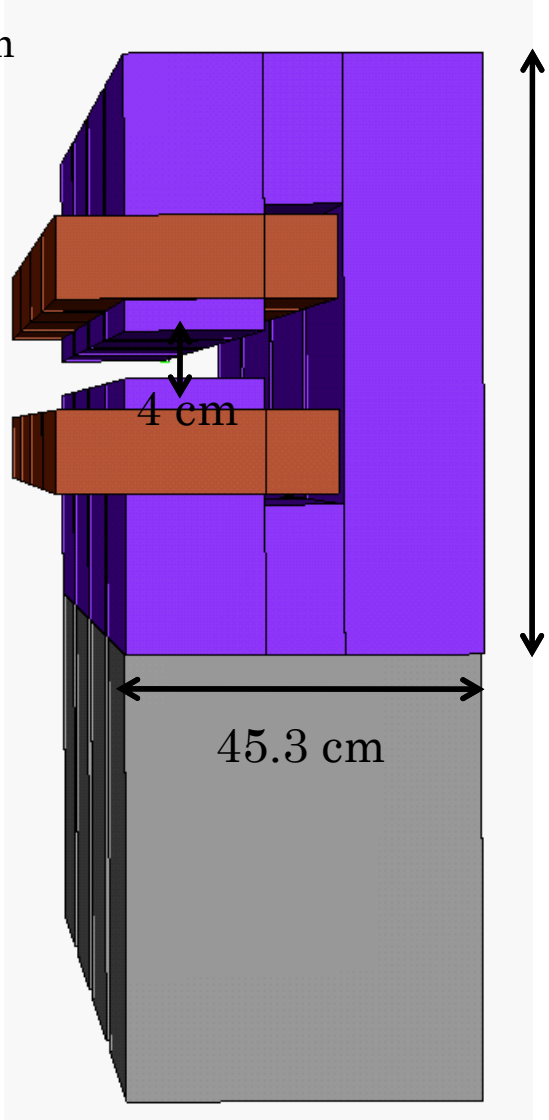
Magnet layouts from SESAME. Different lengths → different masses

Quadrupole: 2 m long

Dipole: 12 m long

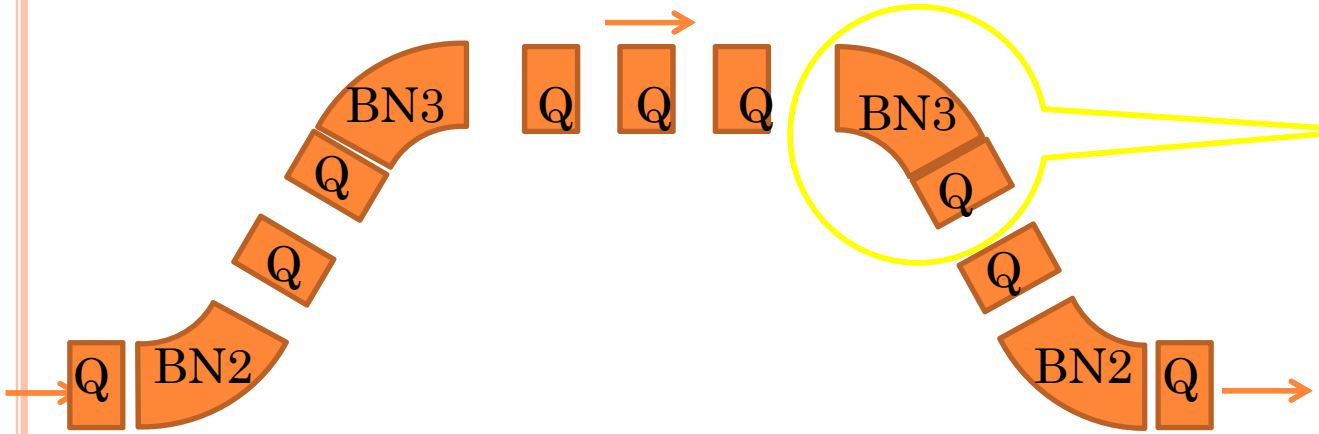
Beampipe: 8 cm aperture hor., 1.5 cm vert., 1mm thick.





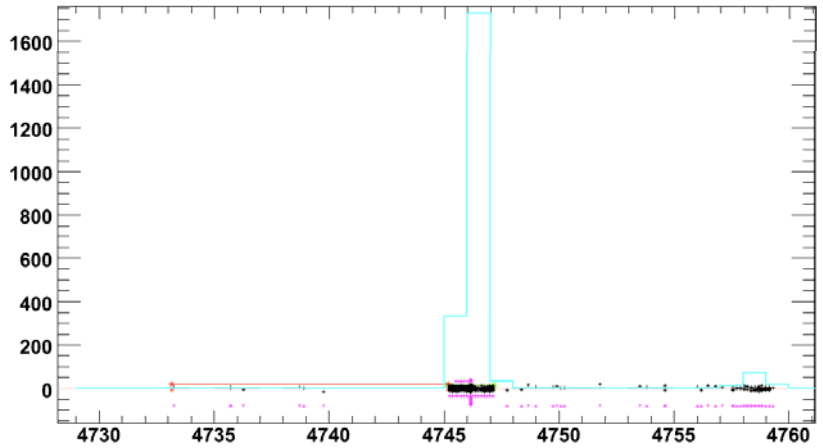
2ND BN3 IN THE FIRST BUMP

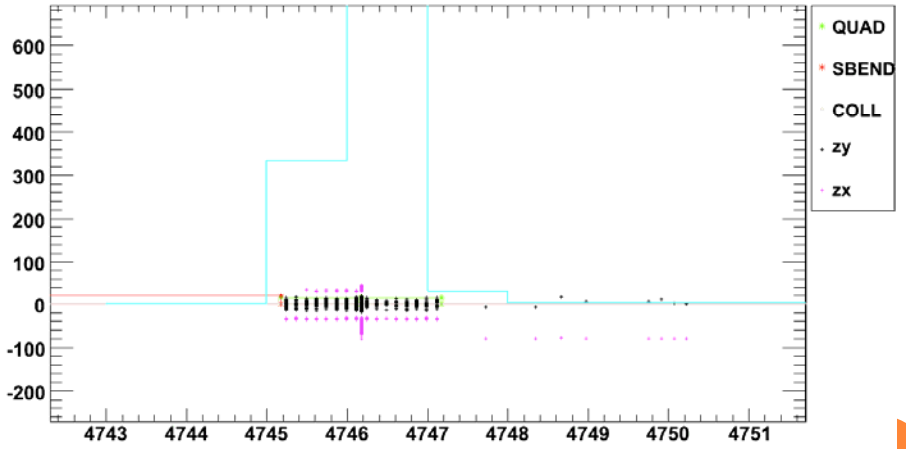
- dipole+quadrupole+ long straight section→25 m



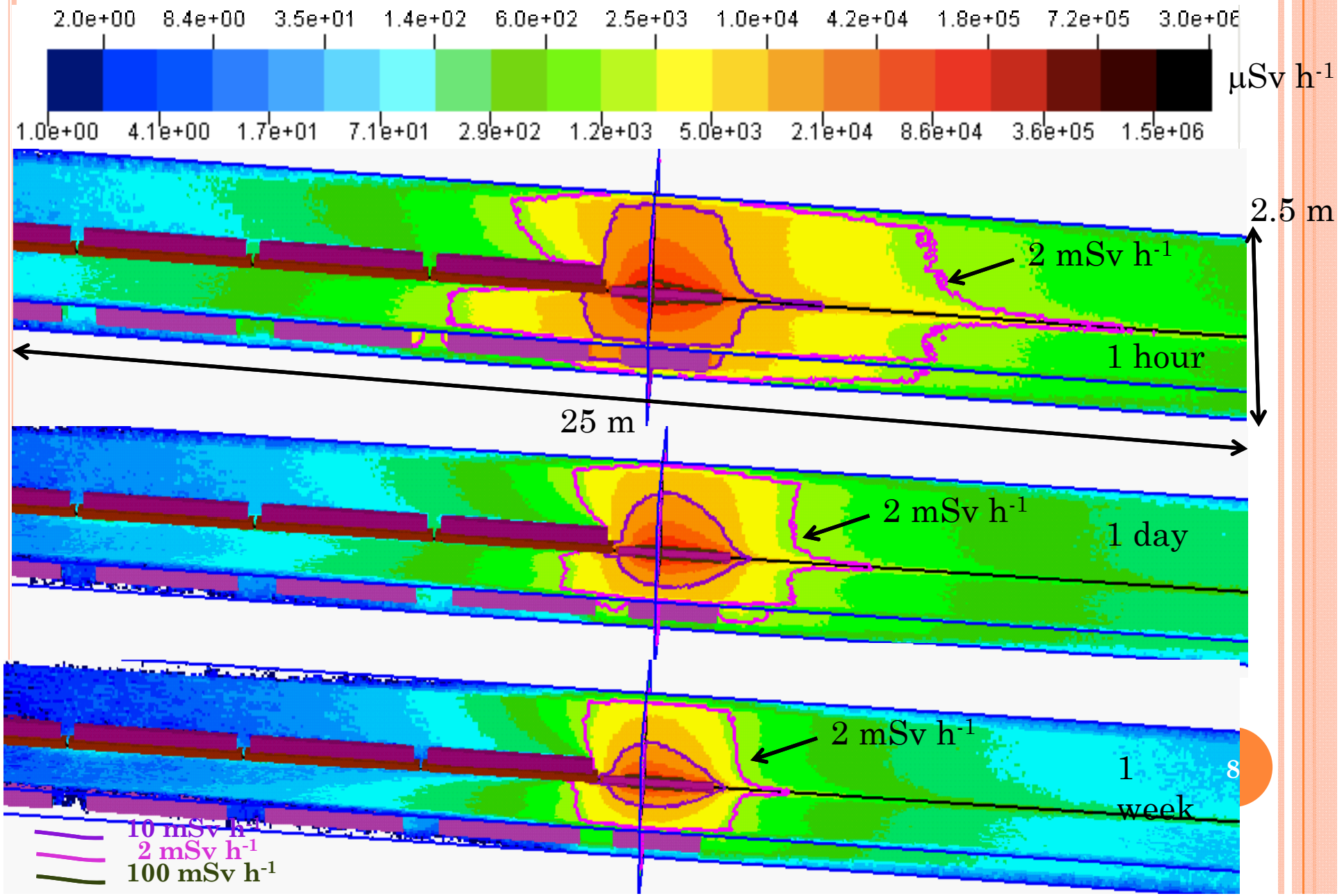
2nd BN3

~10^{10} parts s^{-1} over 25 m

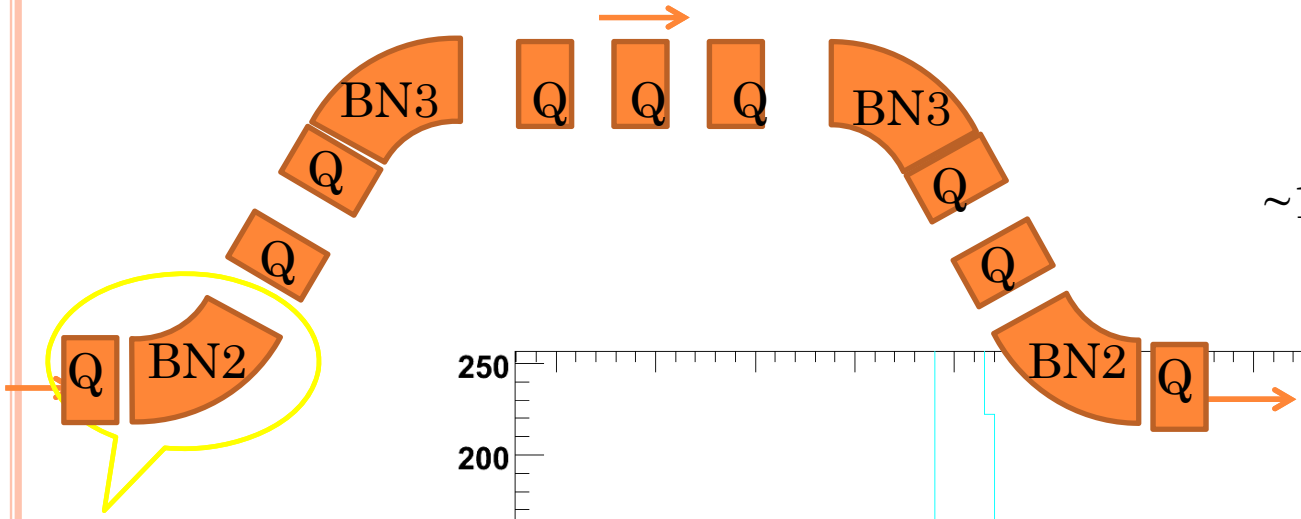




RESIDUAL DOSE RATES AFTER 3 MONTHS OF IRRADIATION

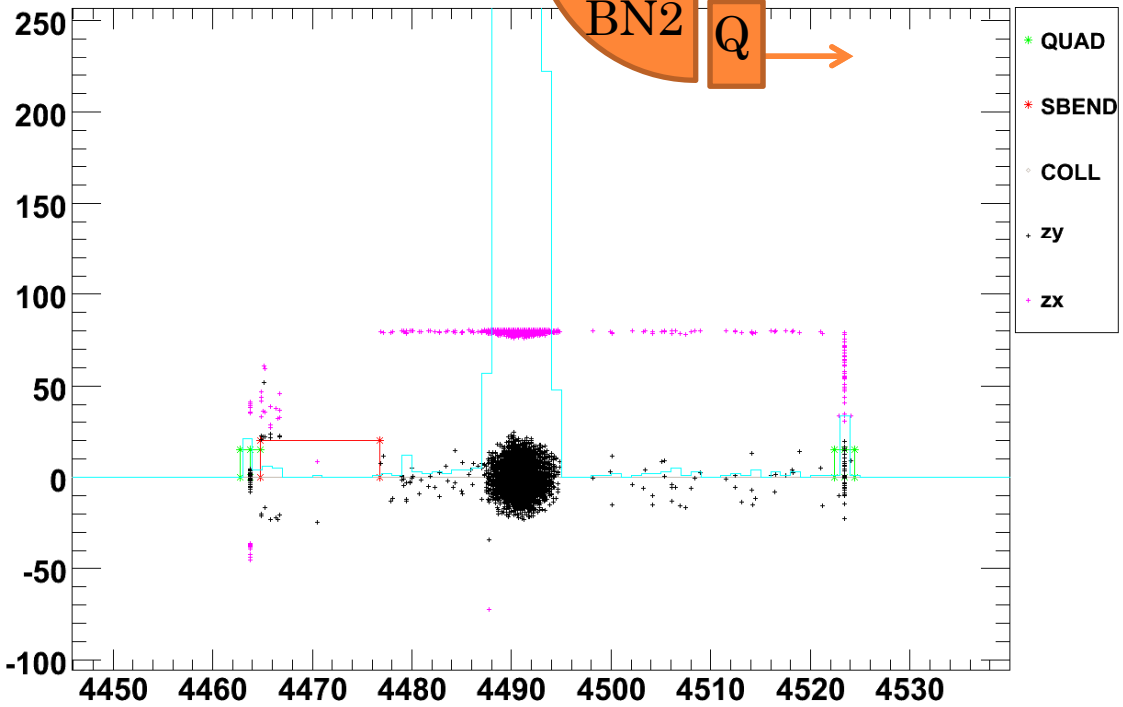


FIRST BN2



~10^{10} parts s^{-1} over 44 m

1st BN2



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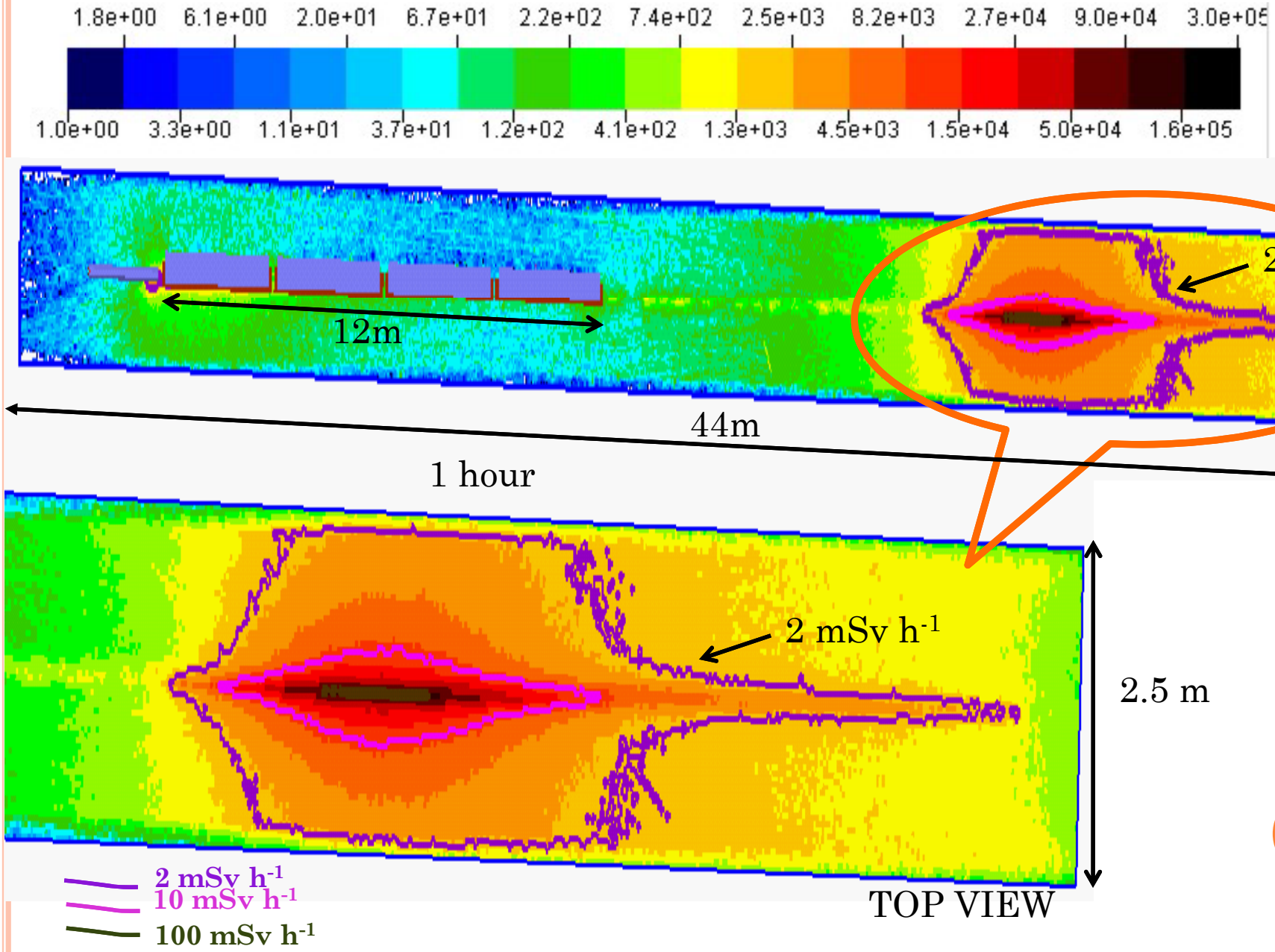

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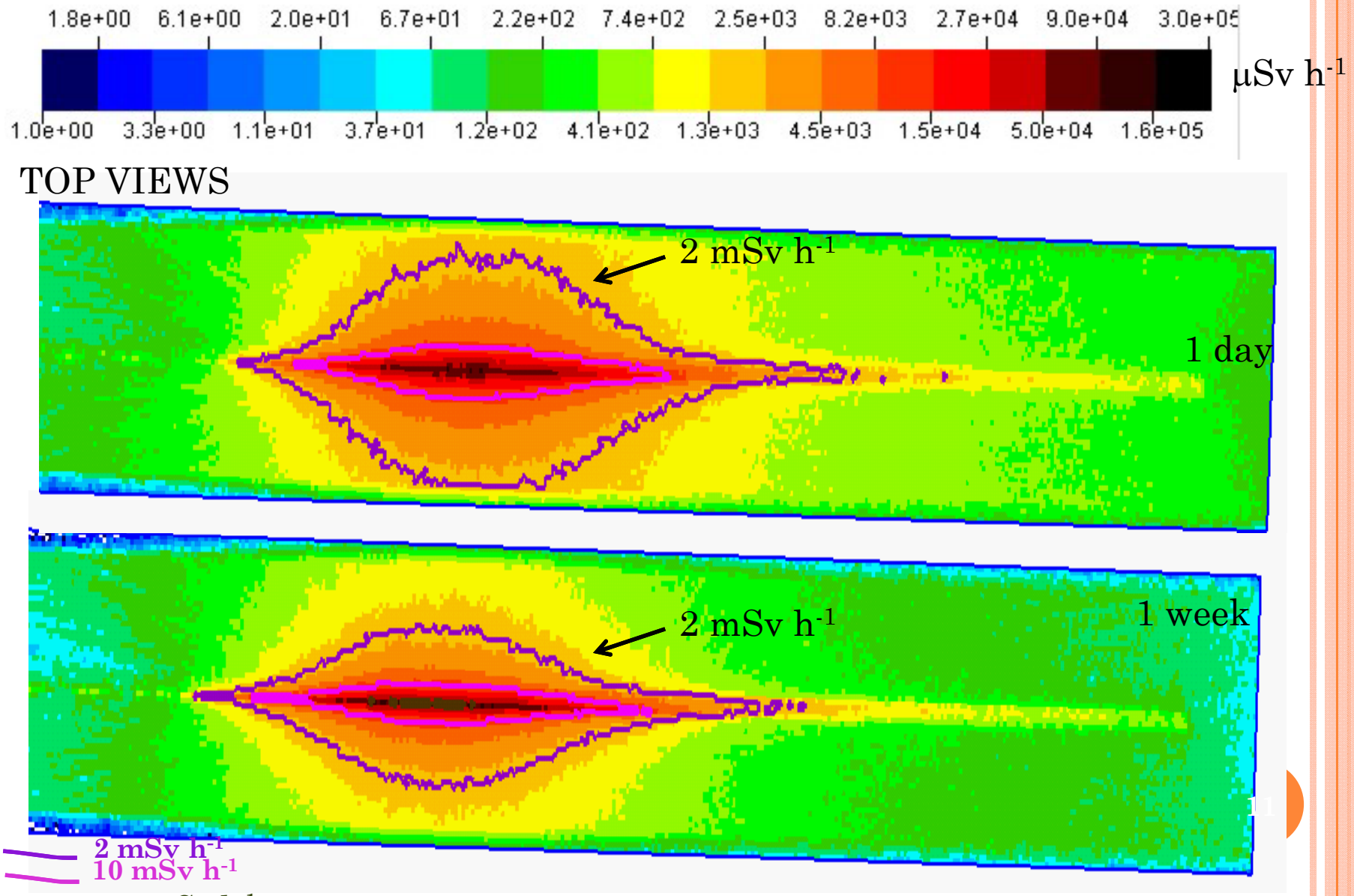
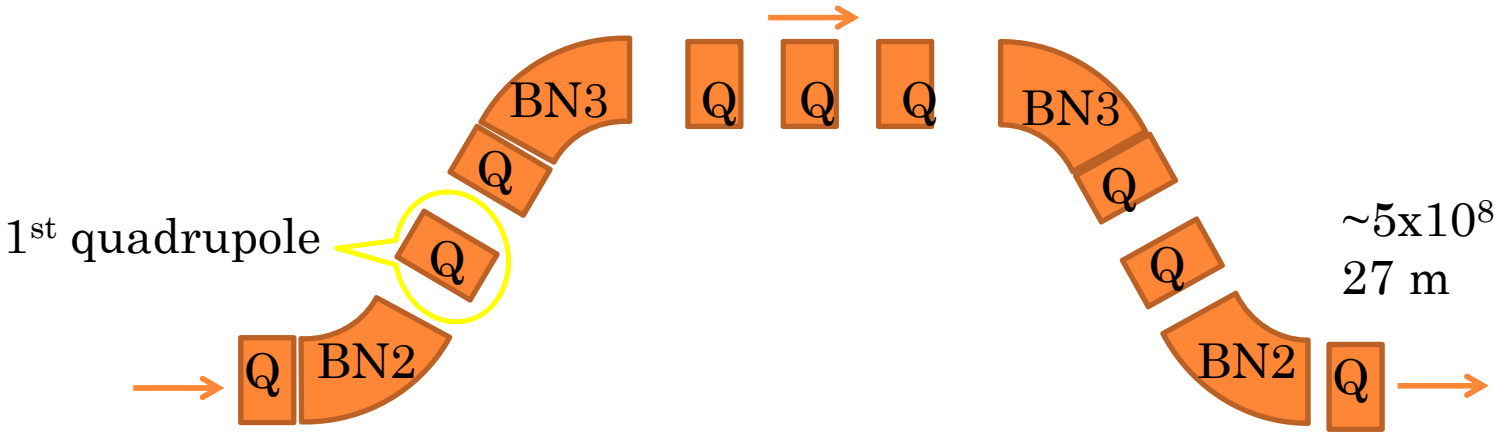
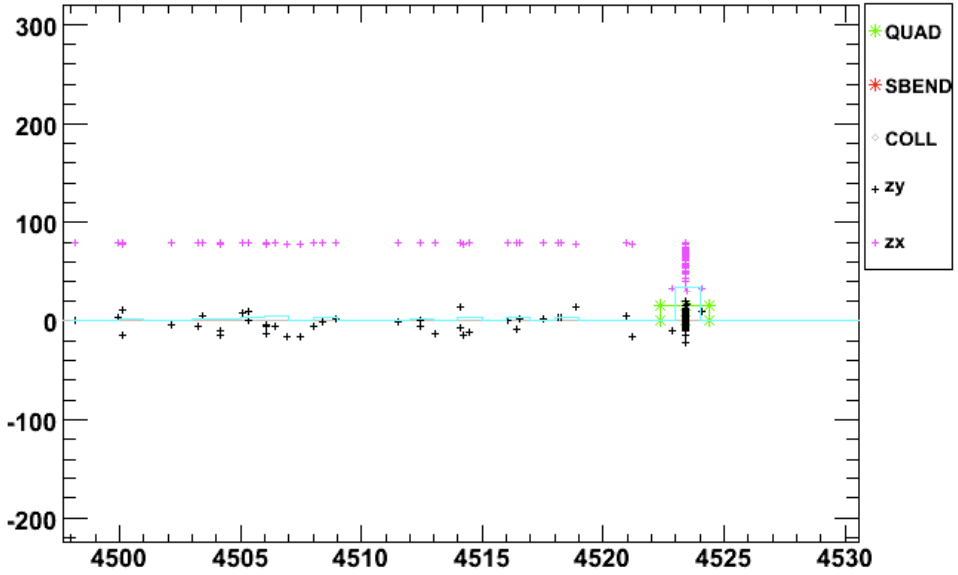


FIRST QUADRUPOLE



~5x10^{8} parts s^{-1} over 27 m



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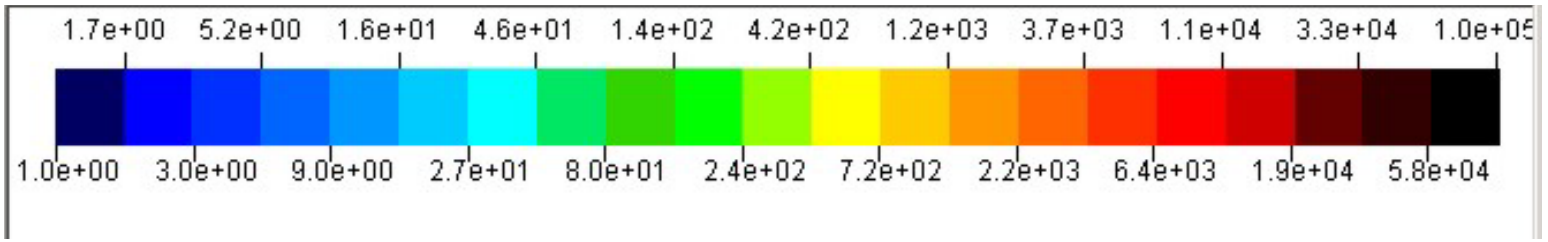
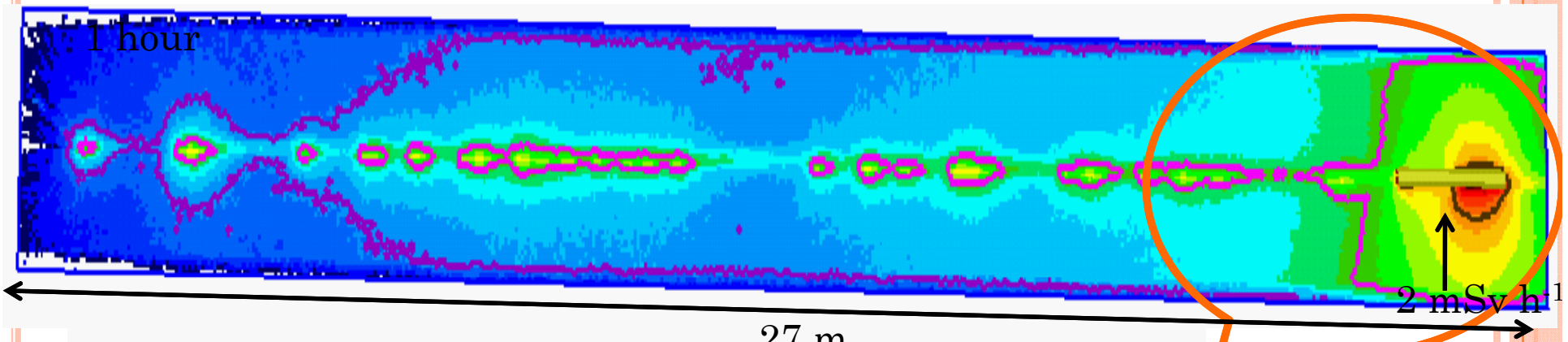
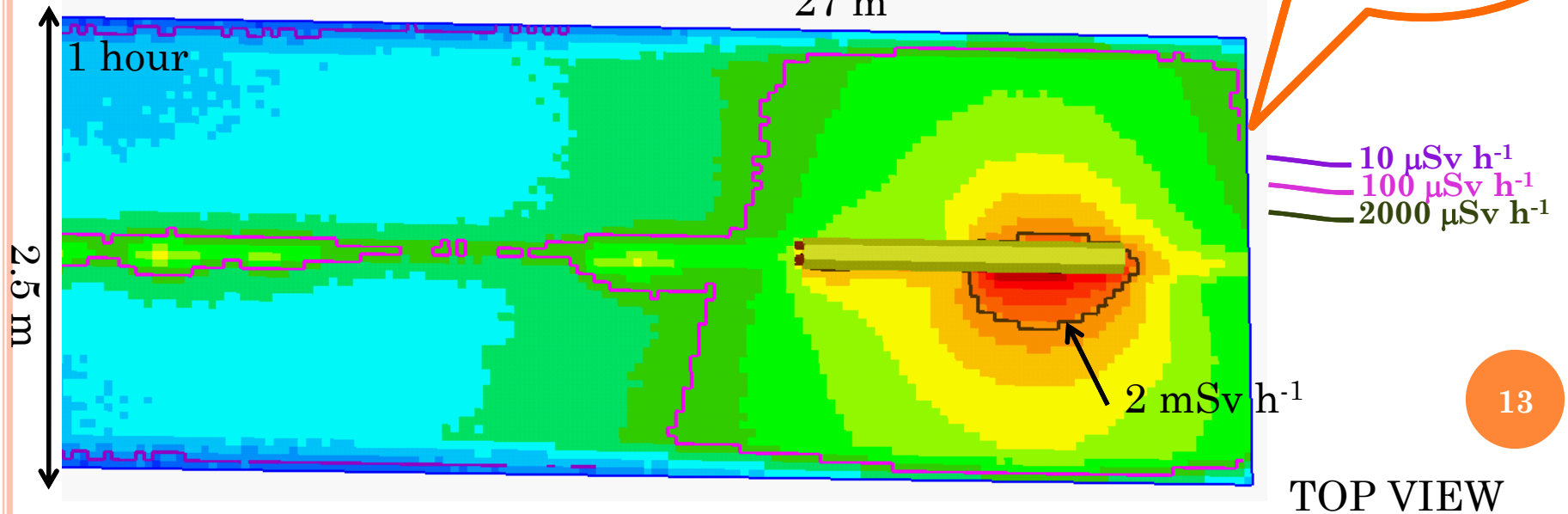


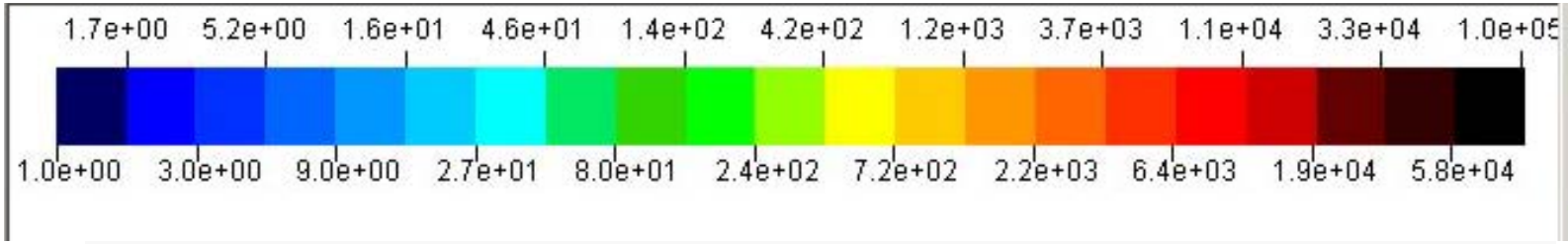
µSv h^{-1}



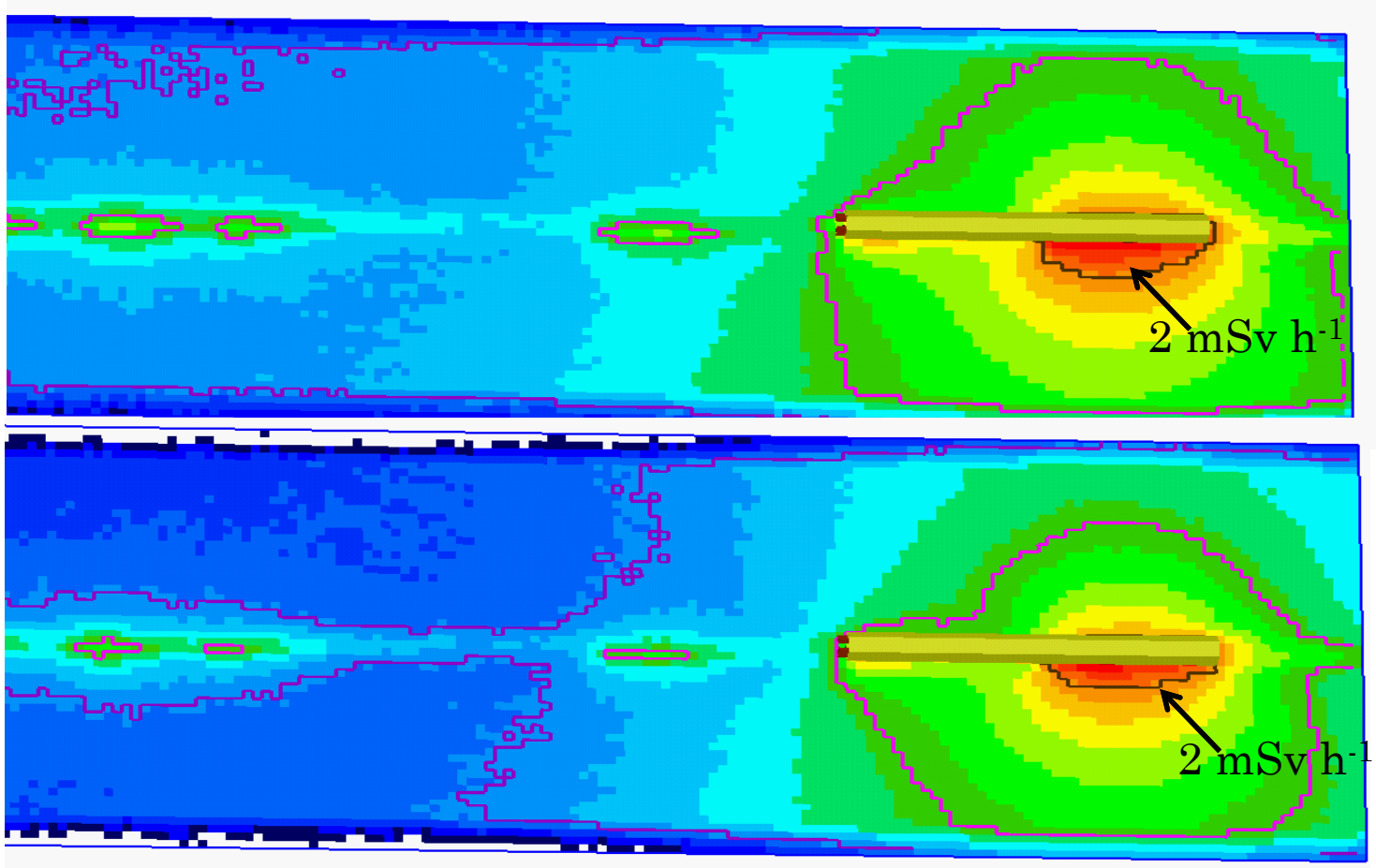


TOP VIEW

RESIDUAL DOSE RATES AFTER 3 MONTHS OF IRRADIATION



$\mu Sv\ h^{-1}$



1 day

1 week

TOP VIEWS

AIR ACTIVATION

- Preliminary calculations.
- n, p, $\pi^{+,-}$ spectrum folding with isotope production cross sections.
- For effective dose assessment more information is required:
  - **calculations for the entire machine**
  - volume of the air in the tunnel
  - **ventilation parameters**
  - decay ring location

yields per primary particle

INPUT FOR DOSE ASSESSMENT

- Yields per primary particle:

radio nuclides	first BN2	first quad	second BN3	RCS quad	LHC cleaning insertions
N-13	2.55E-02	3.48E-02	5.51E-02	2.94E-03	5.74E-01
Ar-41	1.53E-03	4.71E-03	1.47E-02	3.69E-03	2.59E-01
C-11	2.24E-02	2.73E-02	3.78E-02	1.30E-03	4.38E-01
O-15	2.18E-02	2.83E-02	4.30E-02	1.77E-03	4.73E-01
Cl-39	5.08E-04	6.88E-04	1.09E-03	5.98E-05	1.17E-02
Cl-38	2.56E-04	3.70E-04	6.20E-04	3.67E-05	6.33E-03
O-14	1.73E-03	2.20E-03	3.10E-03	1.02E-04	3.68E-02
Be-7	**1.73E-02**	**1.94E-02**	**2.41E-02**	**6.75E-04**	**3.07E-01**

COMPARISON WITH THE RCS

- Air: higher production yields.
- Residual doses and area classification:

Area Classification	Dose limit	Ambient dose equivalent rate *At permanent work places*	Ambient dose equivalent rate *In low occupancy areas*	Access Personnel categories
Simple Controlled Radiation area	20 mSv/y	< 10 µSv/h	< 50 µSv/h	Controlled Class A workers Class B with time limit
Limited stay area	20 mSv/y		< 2 mSv/h	Controlled Class A workers Class B with time limit
High radiation area			<100 mSv/h	
Prohibited area			>100 mSv/h	

RCS

DECAY RING ?

DECAY RING: "TO DOs"

- Bumps: normalizations for 2nd bump, residual nuclides.
- Arcs: residual dose rates, air activation, residual nuclides.
- Straight sections: residual dose rates, air activation, residual nuclides.
- Dumps: ? (with straight sections?)
- Injection: ?
- Collimation: residual dose rates, air activation, residual nuclides.

PhD application at EPFL accepted for a thesis on b-beam radiation protection studies.