
Positioning of the LHC Beam Loss Monitors

L. Ponce (AB/BI)

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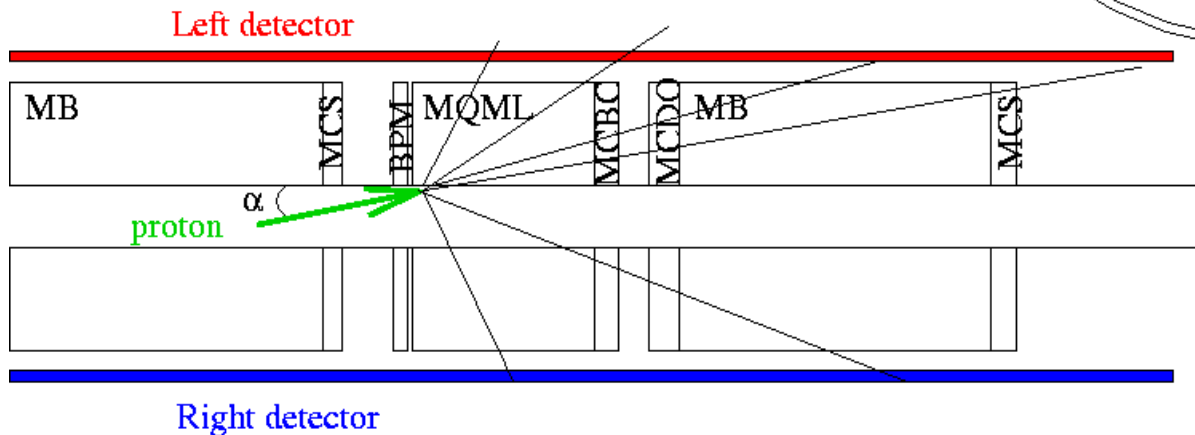
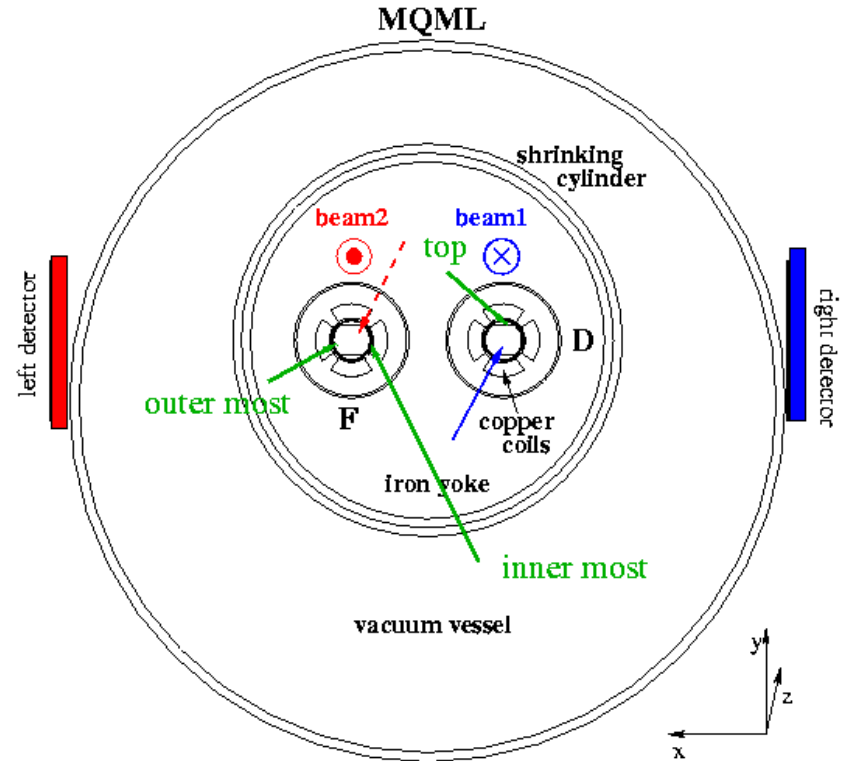
1. Principle of the simulation
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1. Principle of the simulation

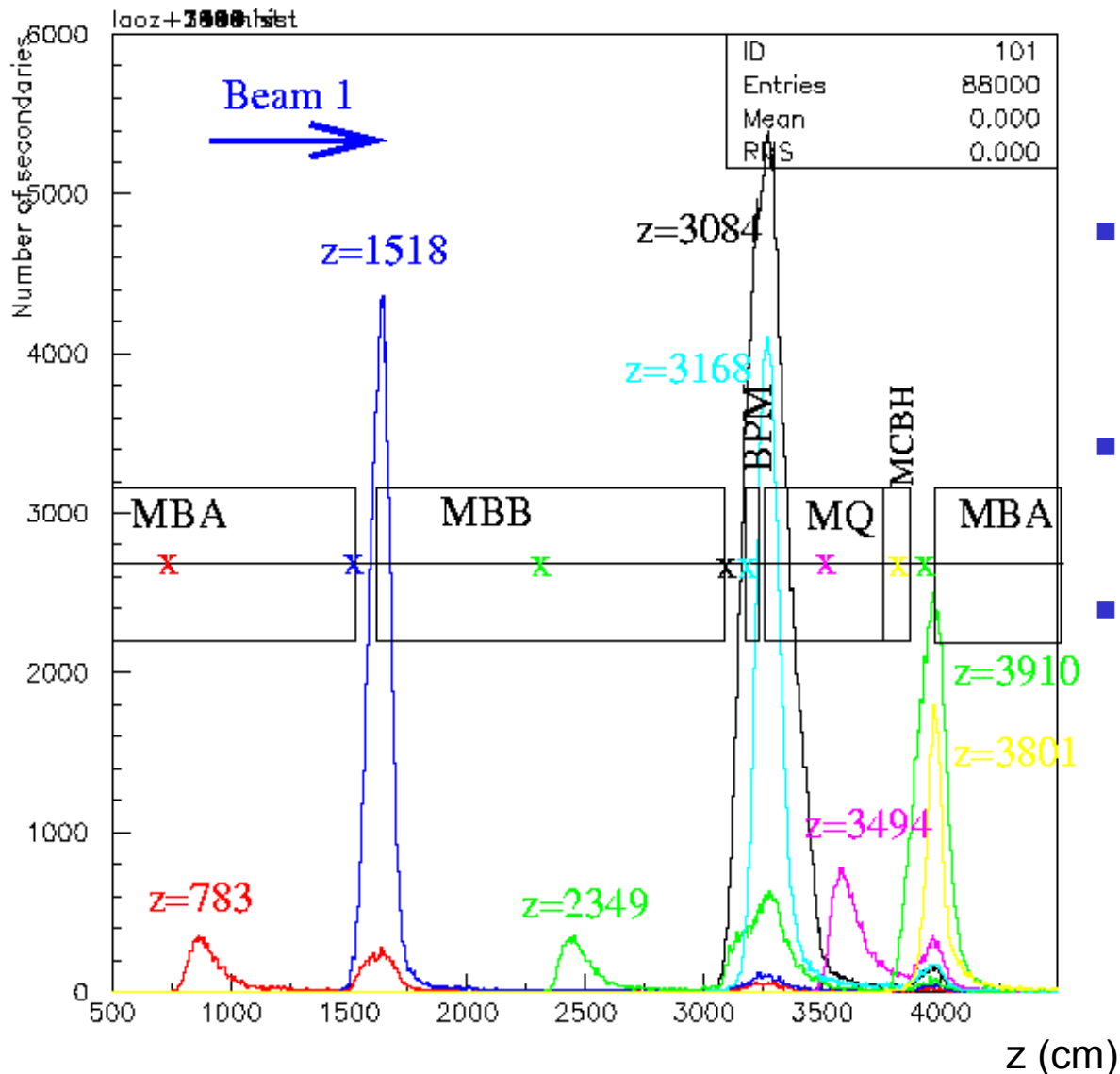
- Loss pattern given by R. Assmann team (C. Bracco, S. Redaelli, G. Robert-Demolaize)
- GEANT 3 simulation of the secondaries shower created by a lost proton impacting the beam pipe
- simulation of the detector response to the spectra registered in the left and right detector (M. Stockner with G4)
- 500 protons same z position and same energy
- impacting angle is 0.25 mrad
- longitudinal scan performed to optimize the BLM location

Geometry description

3 transverse positions of impact outermost, innermost and top

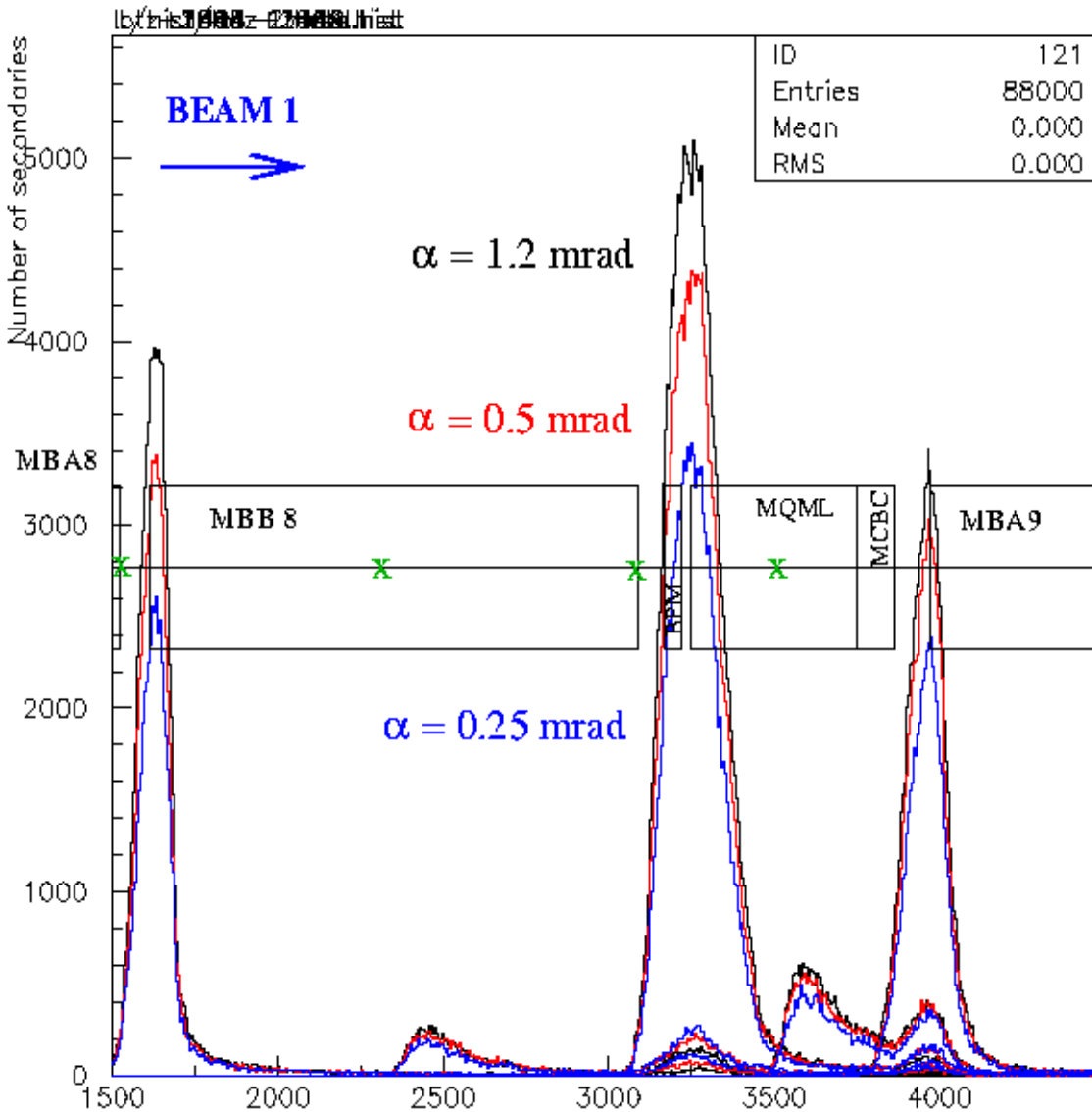


Typical result



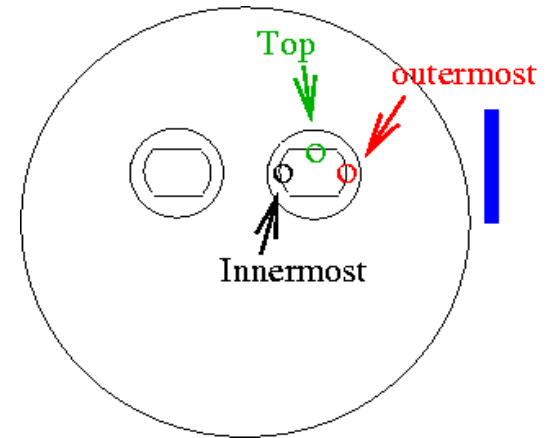
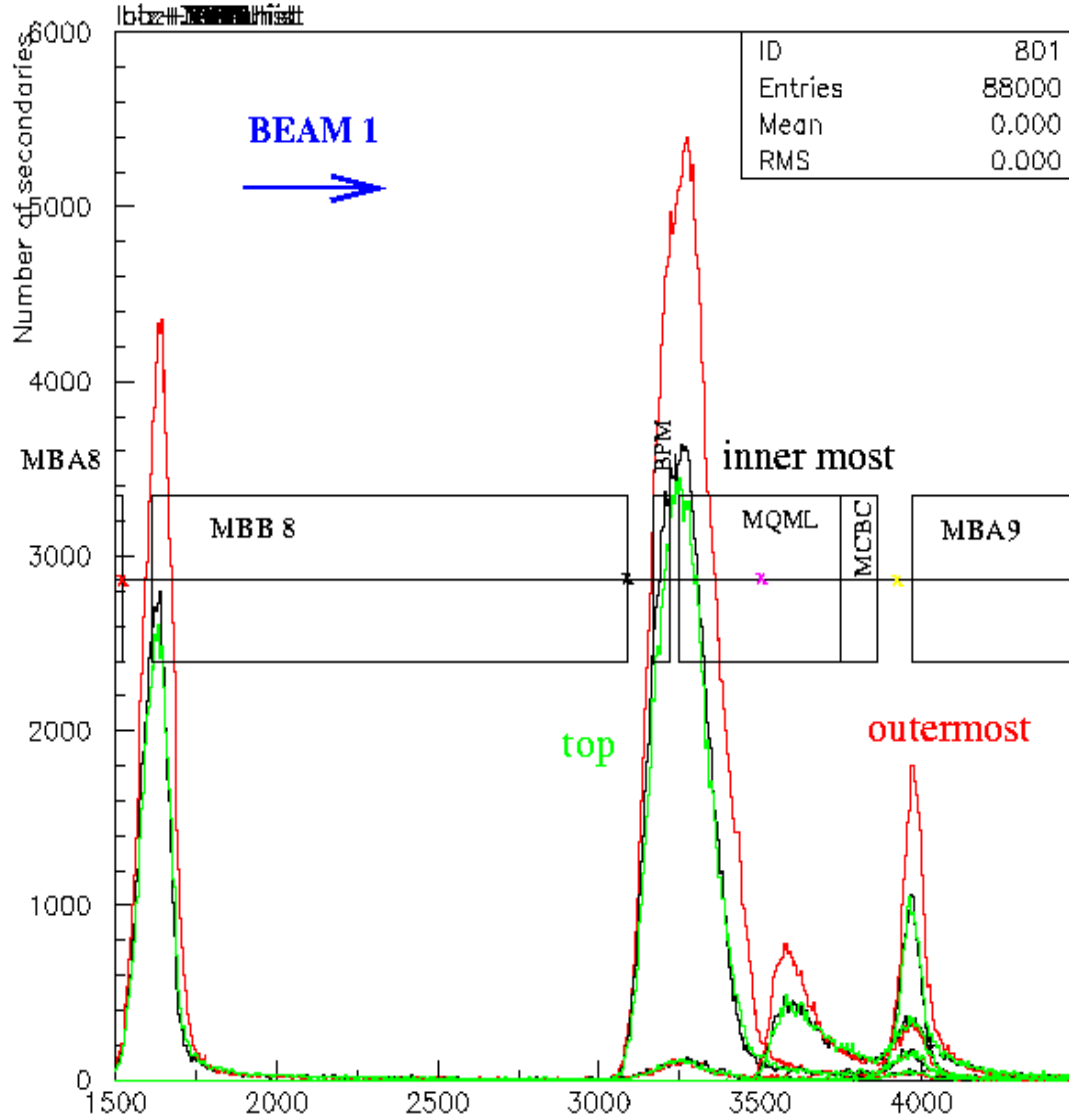
- Maximum of the shower ~ 1m after impacting point in material
- increase of the signal in magnet free locations
- factor 2 between MQ and MB

dependence on impacting angle



- 1.2 mrad impacting angle for sector test
- no influence on the peak position
- 20 % effect on the amplitude of the peak by doubling the angle

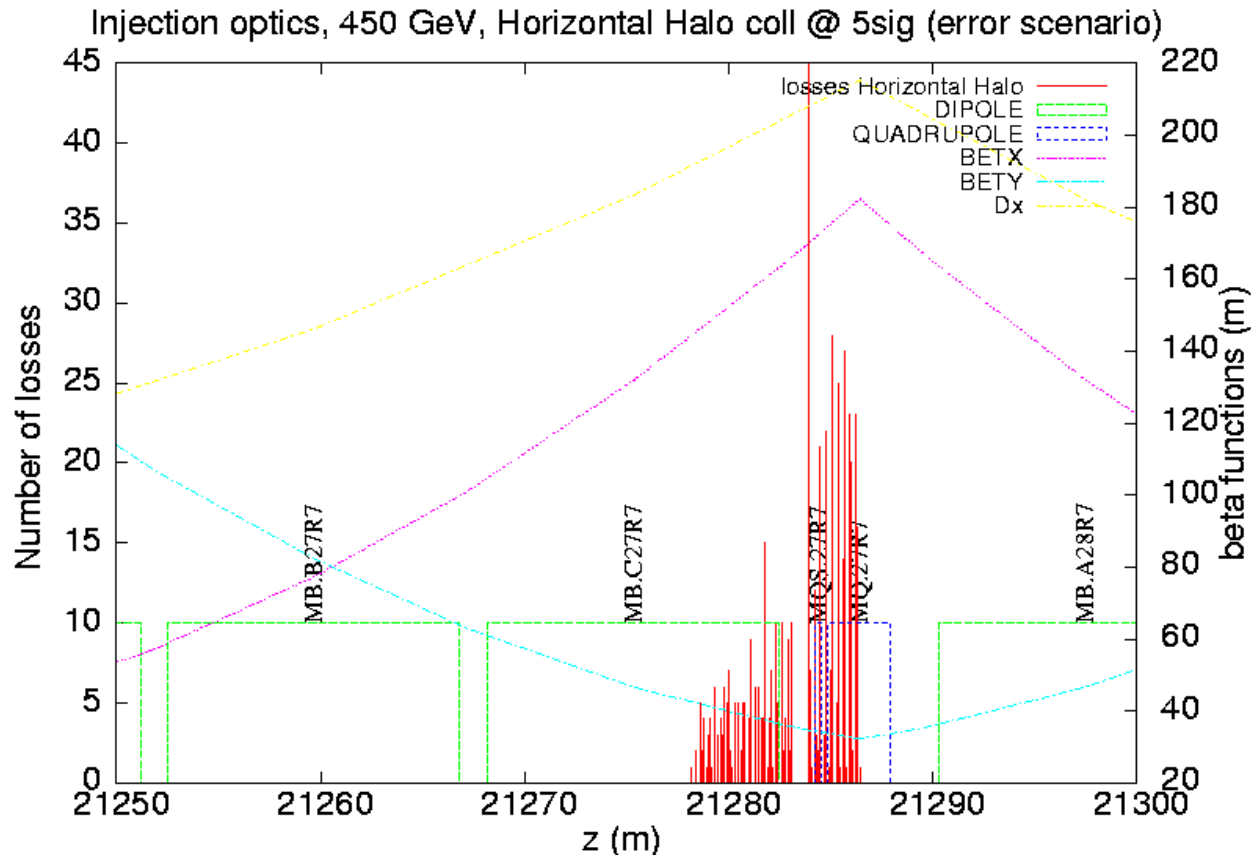
Dependence on transverse position



- about 40 % less signal between outermost and top/innermost
- less than 10% between top and innermost
- unavoidable source of uncertainty

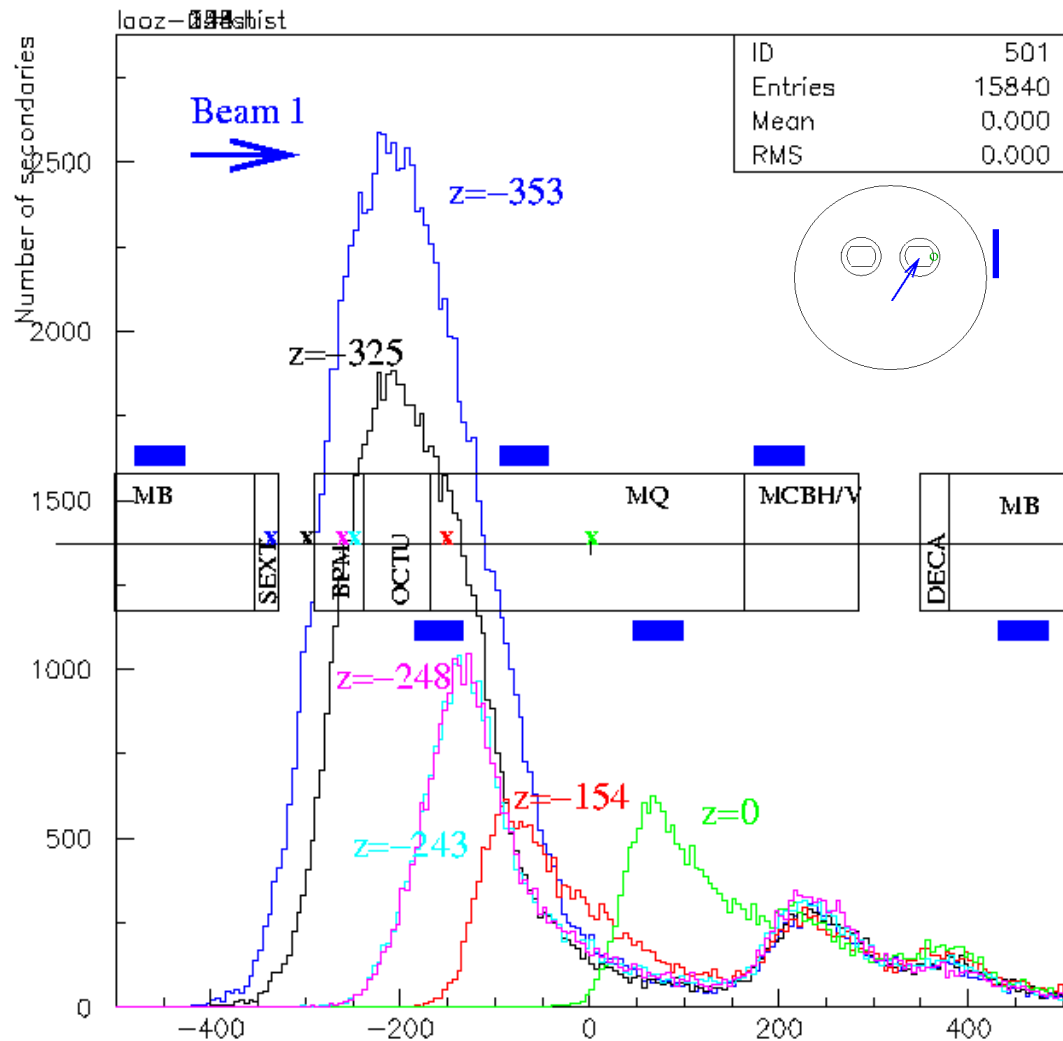
2. Position in the ARCS

- Example of topology of Loss (MQ27.R7)
- Peak before MQ at the shrinking vacuum pipe location (aperture limit effect)
- End of loss at the centre of the MQ (beam size effect)



More simulation are needed to get better evidence (higher populated tertiary halo)

Particle Shower in the Cryostat



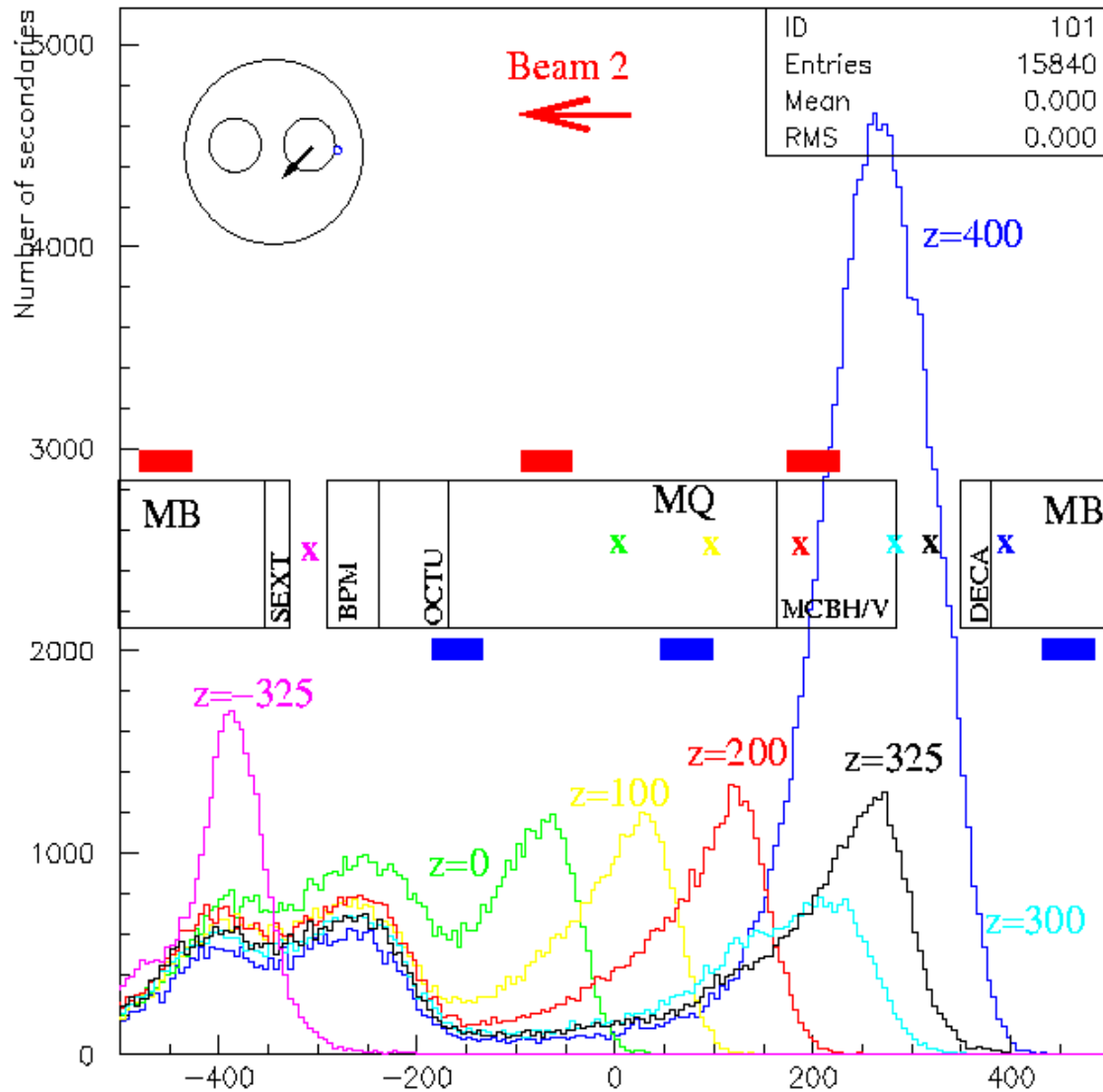
Position of the detectors optimized to:

- catch the losses:
 - MB-MQ transition
 - Middle of MQ
 - MQ-MB transition
- minimize uncertainty of ratio of deposited energy in the coil and in the detector
- B1-B2 discrimination

Positions of the BLMs

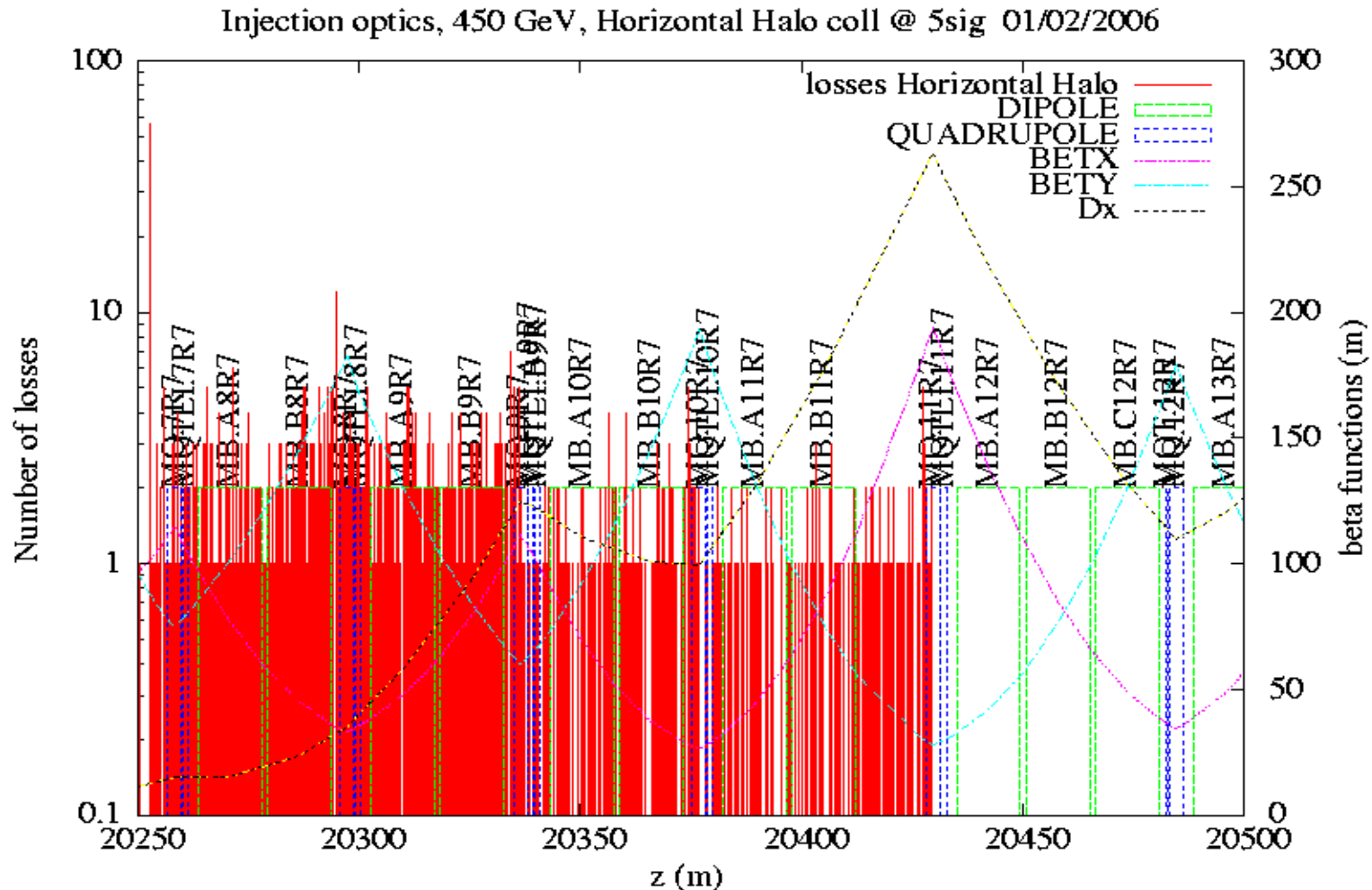
Octant	Position of the BLMs from the magnetic center of MQ (cm)											
	BLM1_B1		BLM2_B1		BLM3_B1		BLM3_B2		BLM2_B2		BLM1_B2	
1 Left	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
1 Right	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
2 Left	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
2 Right	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
3 Left	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
3 Right	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
4 Left	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
4 Right	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
5 Left	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext
5 Right	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
6 Left	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
6 Right	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
7 Left	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
7 Right	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
8 Left	-143	Ext	70	Ext	450	Ext	-450	Int	-50	Int	200	Int
8 Right	-143	Int	70	Int	450	Int	-450	Ext	-50	Ext	200	Ext

for beam 2



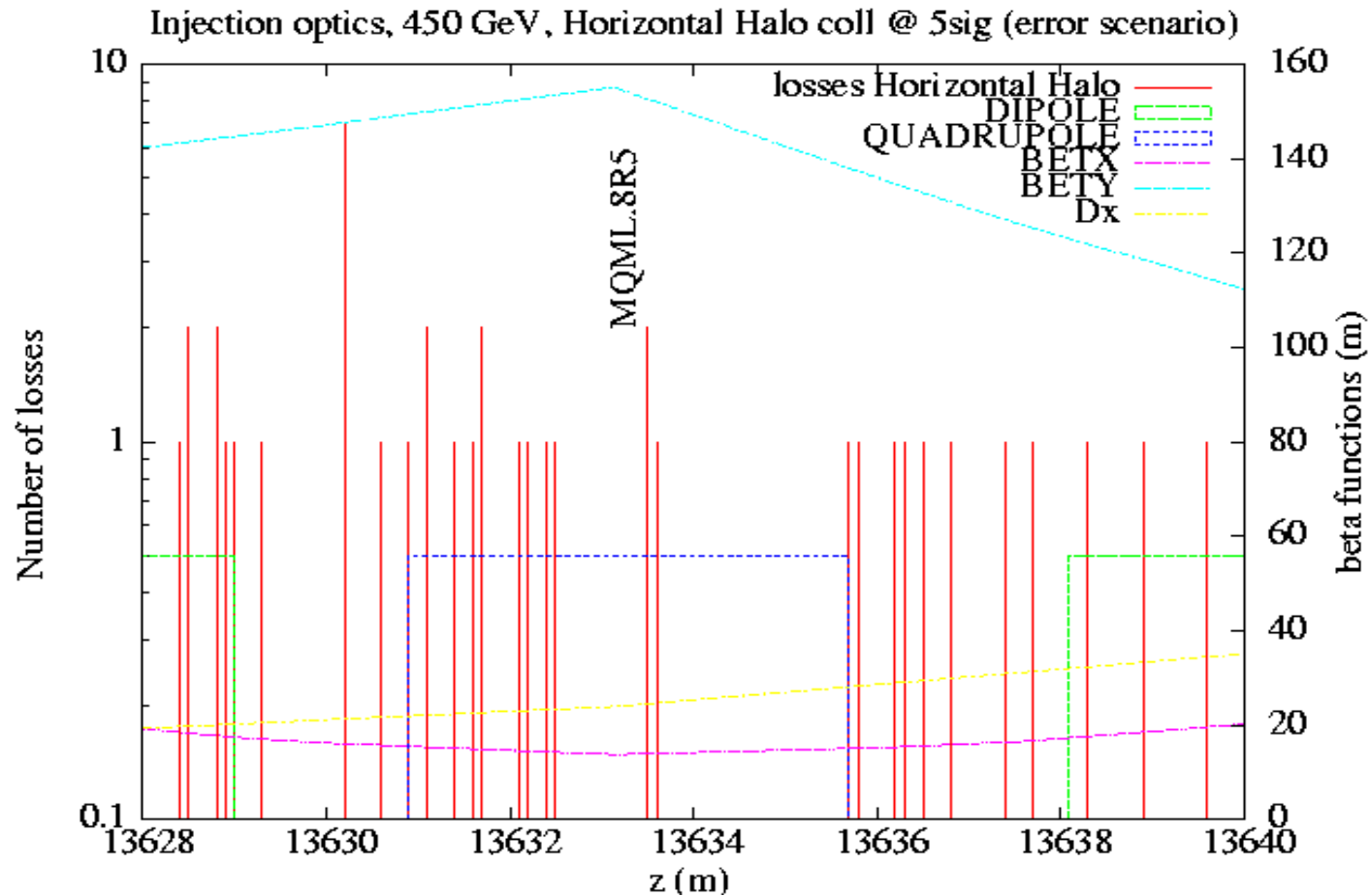
- Same assumptions for beam 2 for loss locations
- Same positions for the detectors wrt the physical apertures

3. Position in the dispersion suppressors

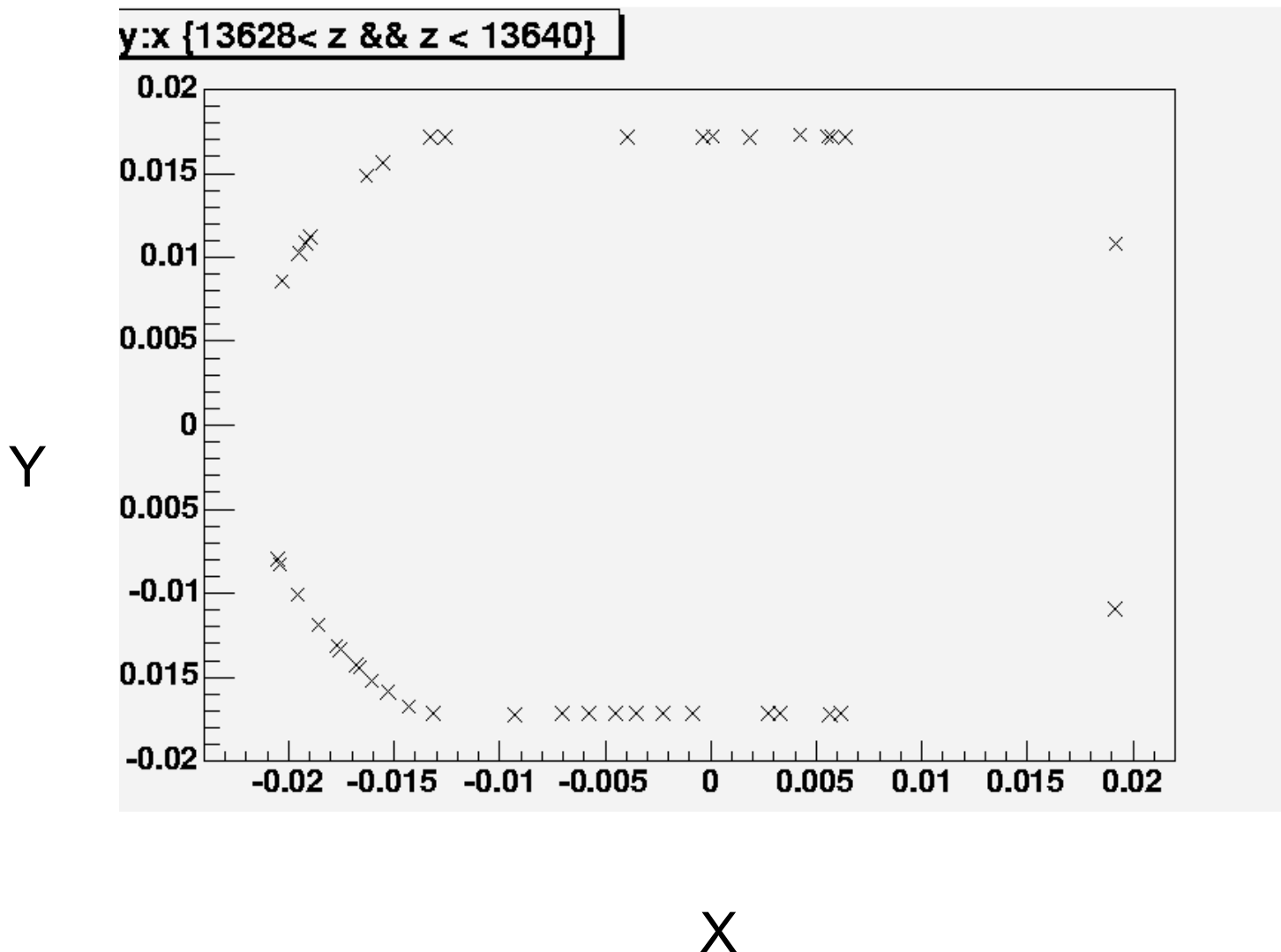


- peak before the MQs and losses all along the magnets

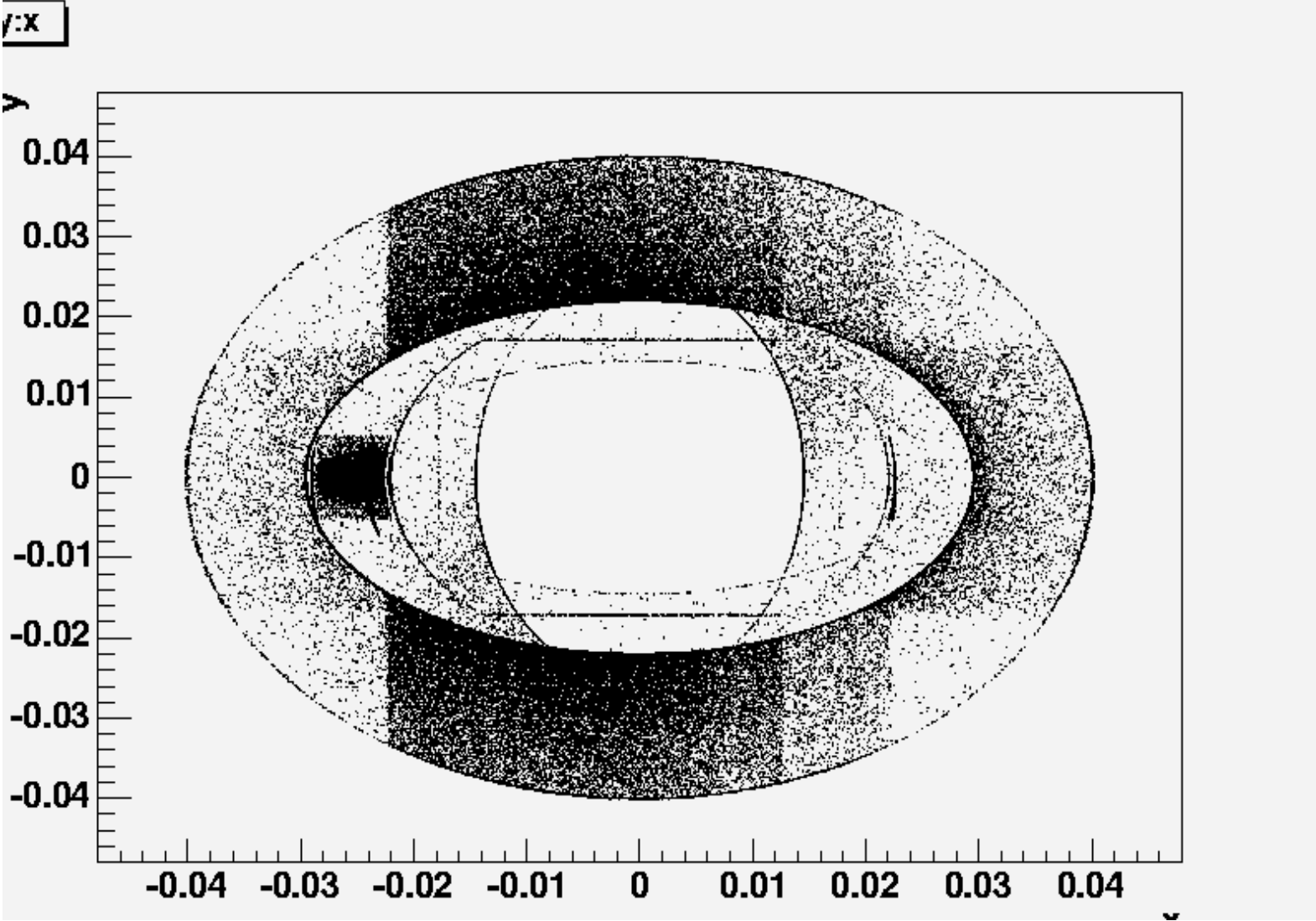
Zoom on Q8R5



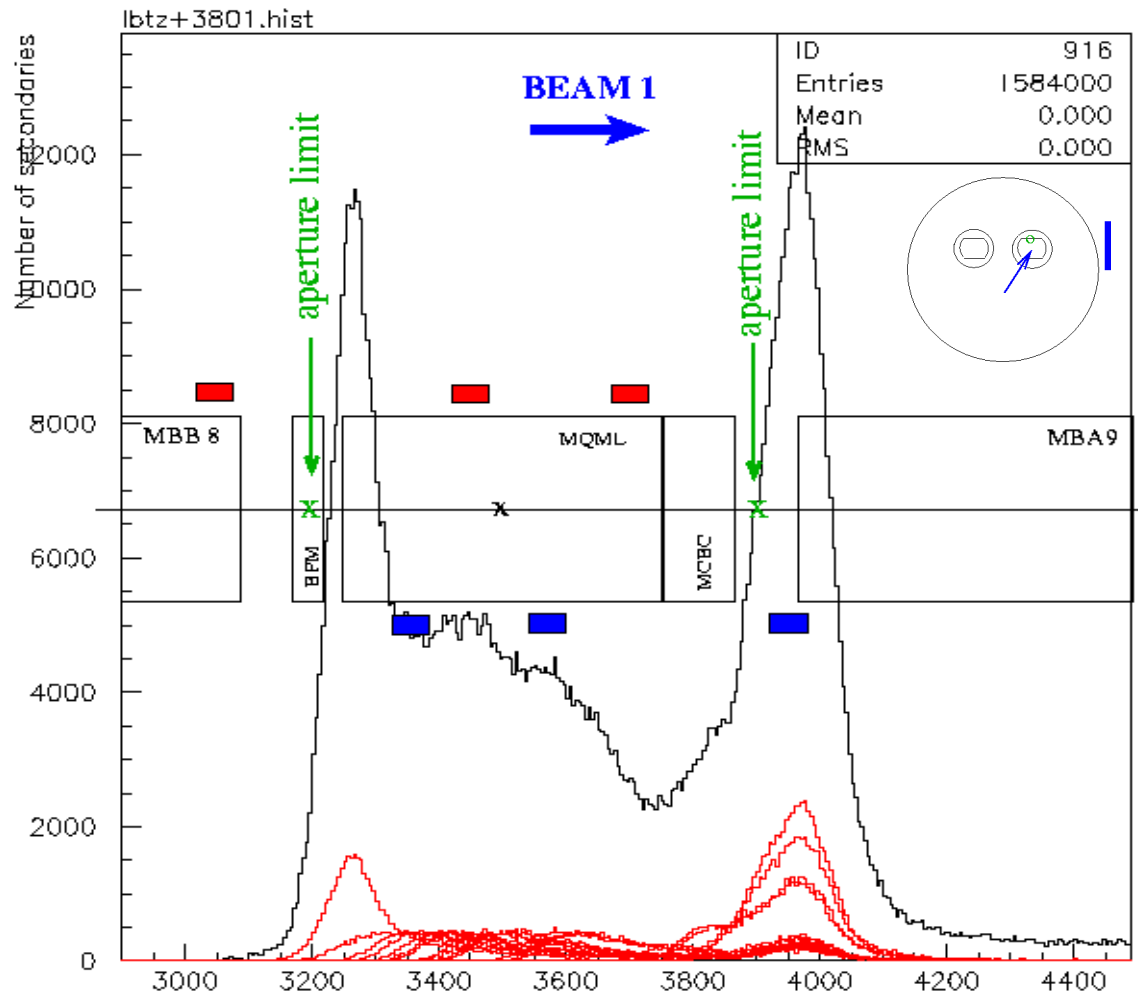
Transverse distribution of the losses in Q5R8



projection of all the transverse positions of losses in the whole LHC

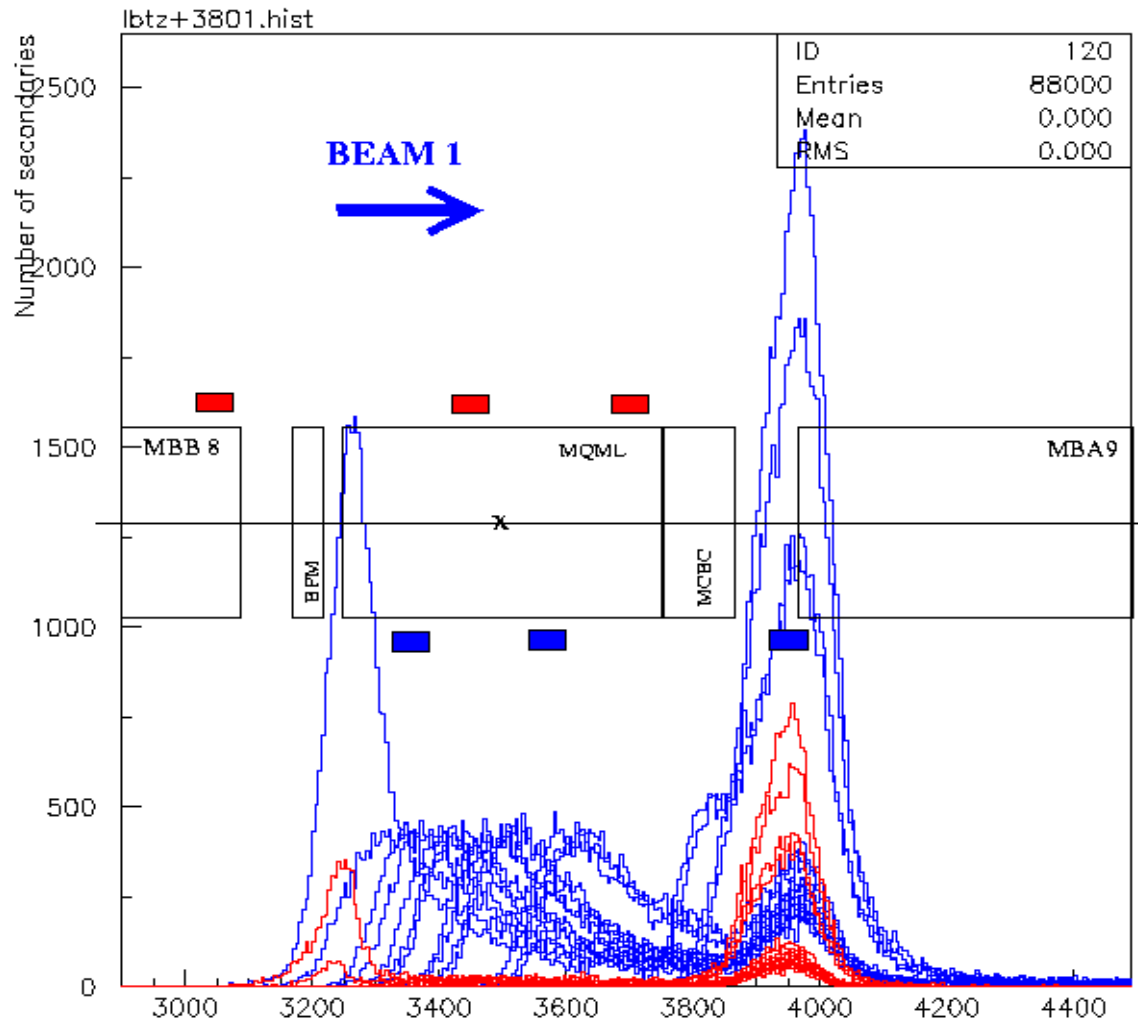


Particle shower in the detector



- Addition of all the weighted signals from the previous locations
- Positions chosen for the arcs also optimum for the DS.

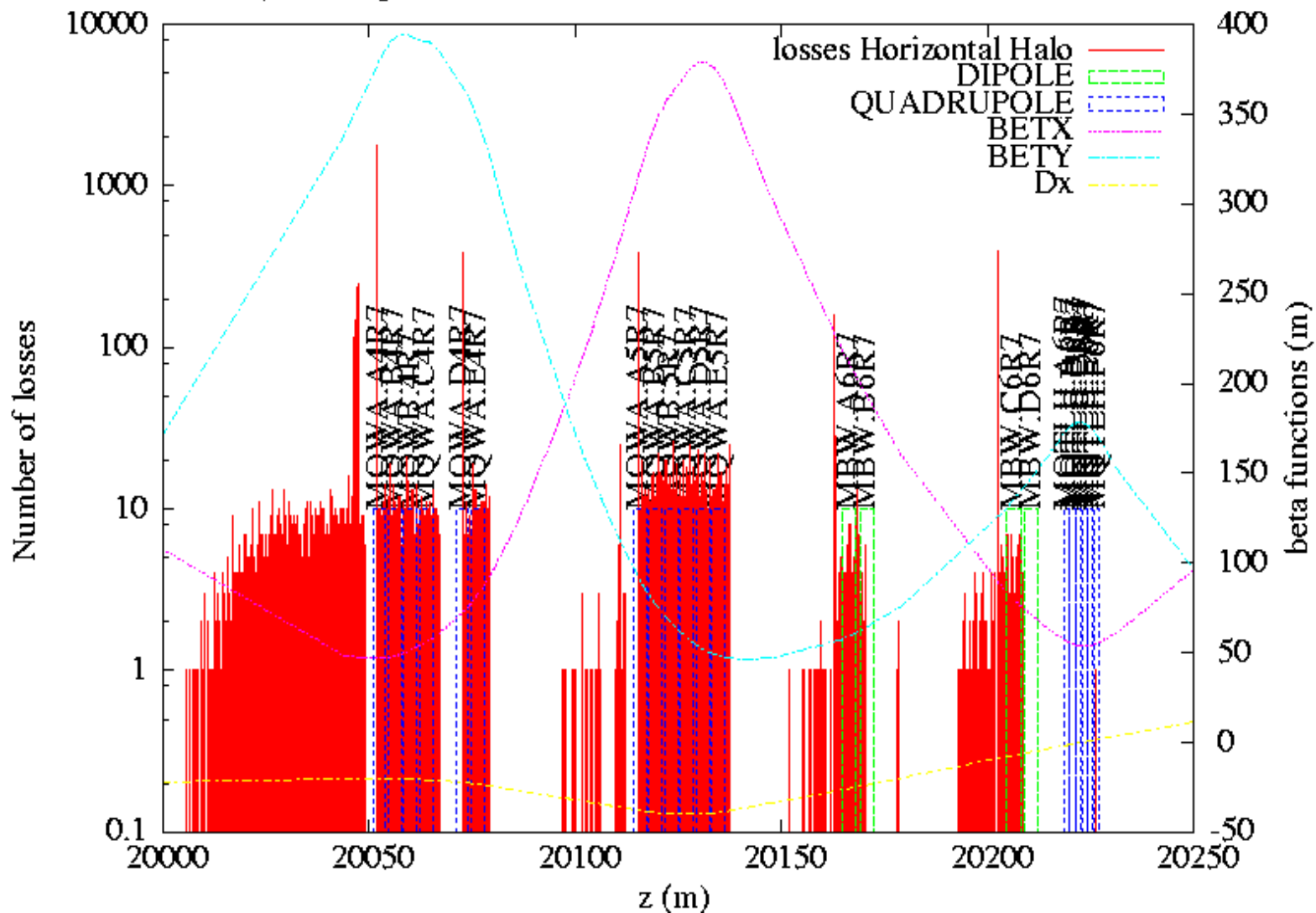
Cross talk



- Signal seen on the left detector for a loss in the right beam pipe (and opposite)
- more than a factor 10
- Good discrimination between the two beams

3. Position in the IRs

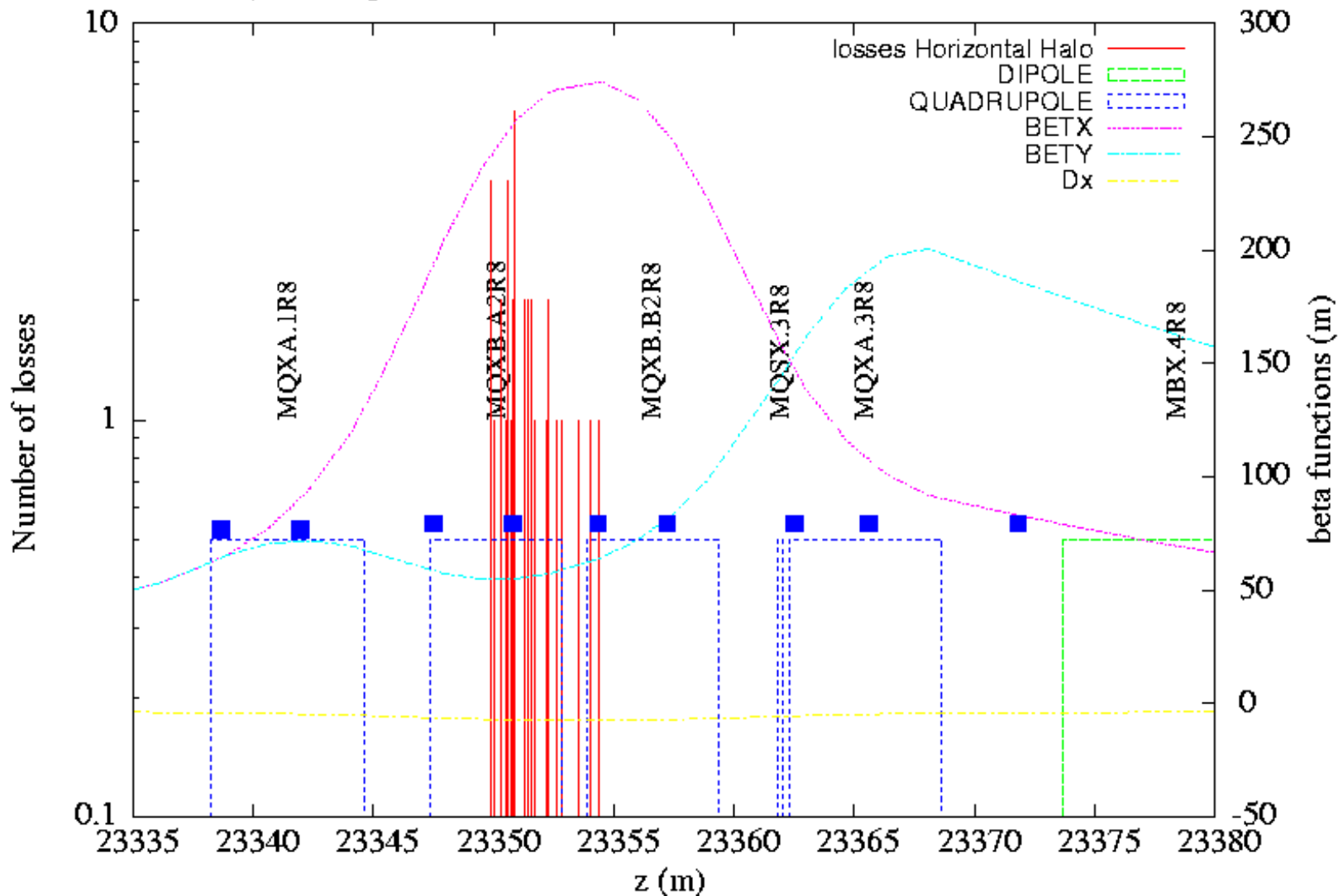
Injection optics, 450 GeV, Horizontal Halo orbit error 14/02/2006

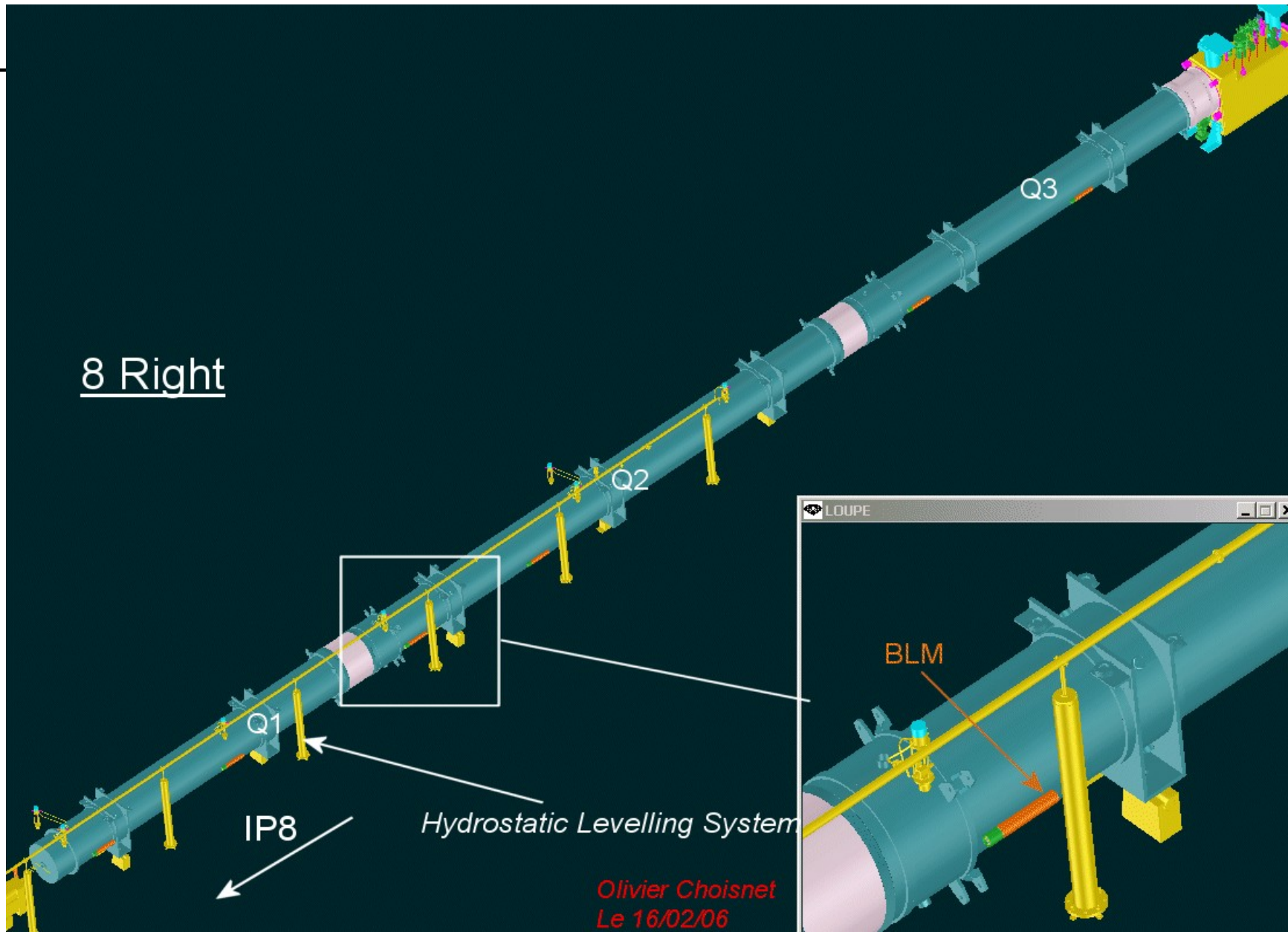


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- Geometry not yet available for simulation : plan to implement it for GEANT4 simulation (GDML?)
 - Loss pattern look like in the arcs and DS.
 - So same rules for placement in conjunction with the integration possibilities : 1 m after the interconnection bellows, 50 cm after the magnetic centre

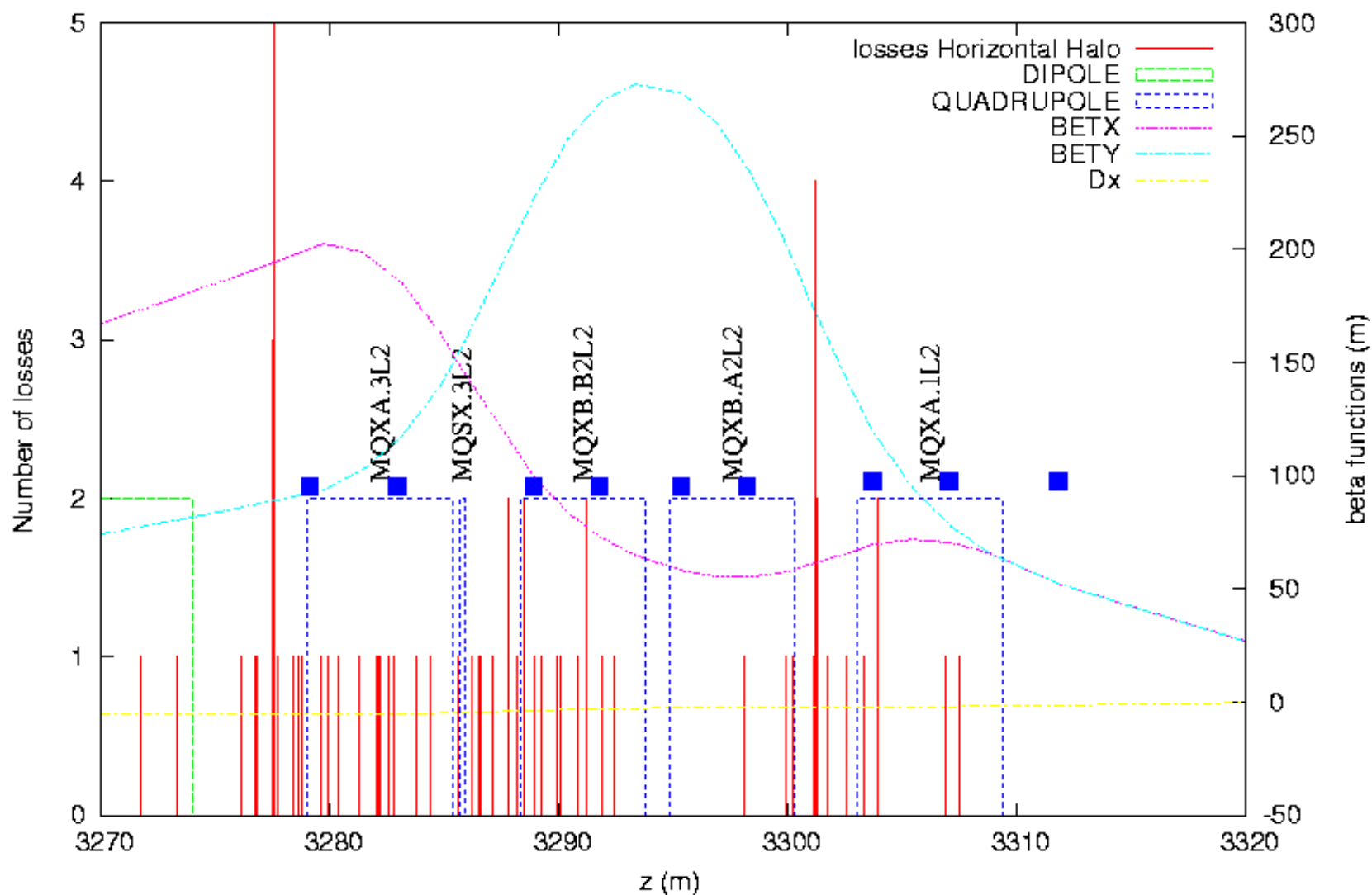
Positions at the triplets

Injection optics, 450 GeV, Horizontal Halo orbit error 14/02/2006



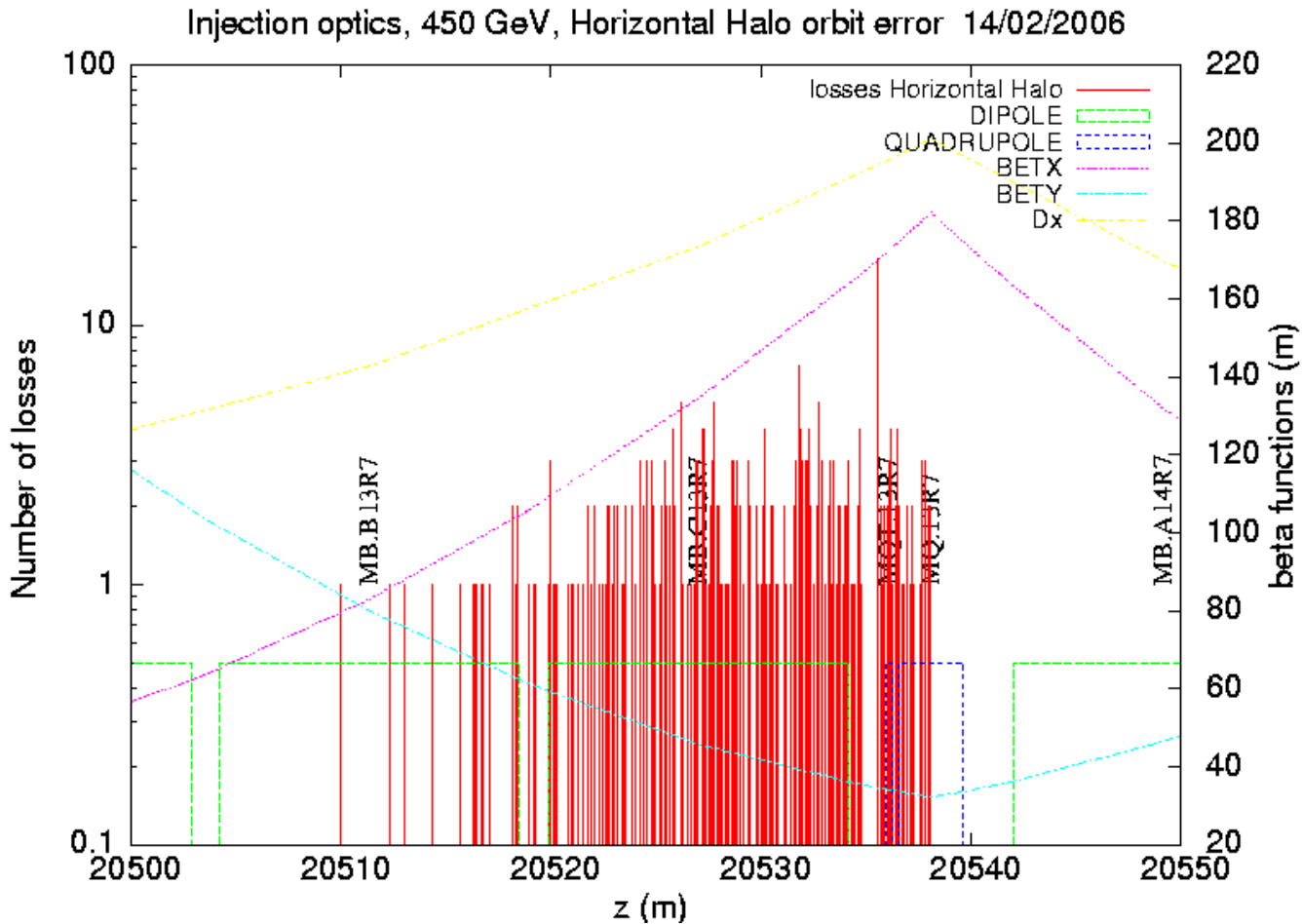


Injection optics. 450 GeV. Horizontal Halo coll @ 5sig (error scenario)

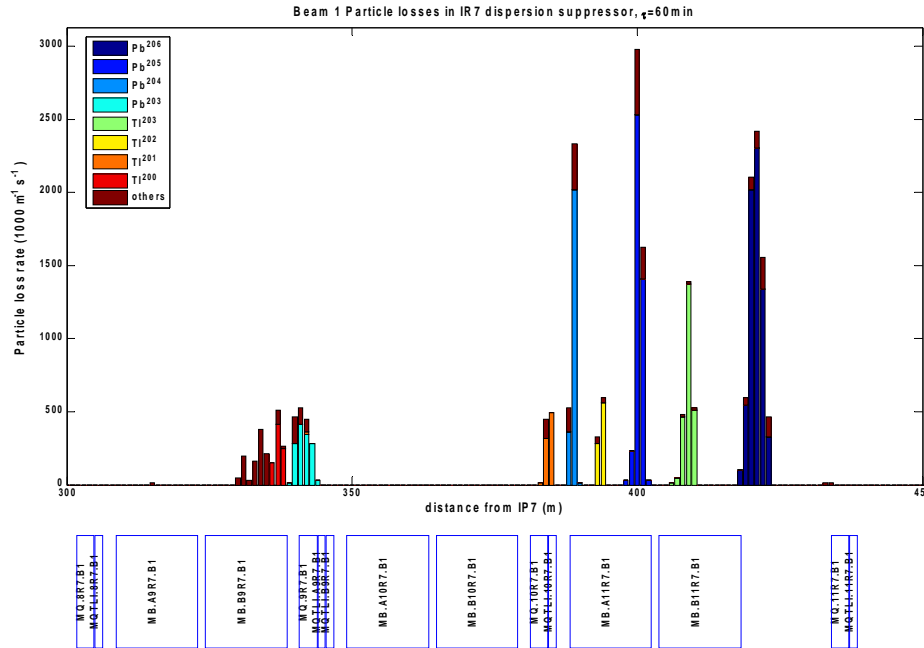


4. Some special requirements

- Additional monitors for MB.C13R7



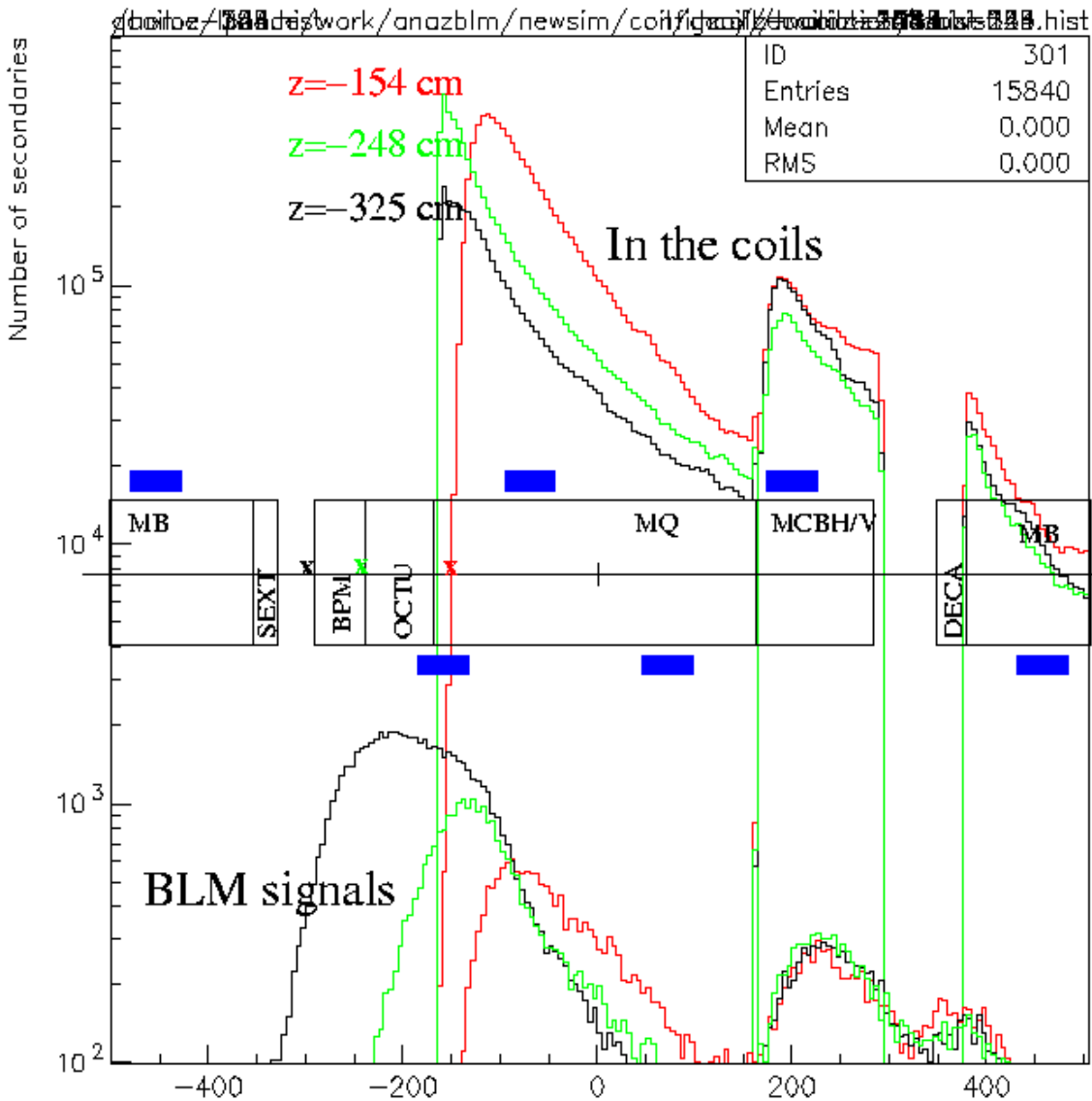
- Some special loss locations for the ions:



H. Braun

- Electron capture by pair production: direct loss in MB.B10.R2 (J. Jowett)

Energy Deposition in Coil and Detector



- Secondaries crossing the full volume of magnet coil
- preliminary results, only 10 protons
- reached limitation of the code, need to migrate to G4.
- peak position in the coil in agreement with note 44 (40 cm from impact)

Conclusions

- Positions for the arcs and dispersion suppressors: 6 monitors per quad (3 per beam)
- Positions in the IRs to be finalized, based on same rules
- Some special requirements added. Some more?
- Beam 2 loss patterns missing => assumptions to be checked