Status of ALICE
Beam Conditions Monitoring System

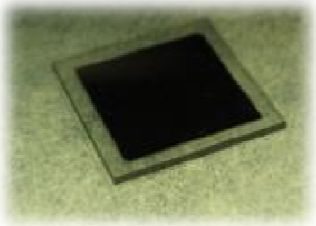
ALICE Offline Week

08 October 2007

ALICE BCM

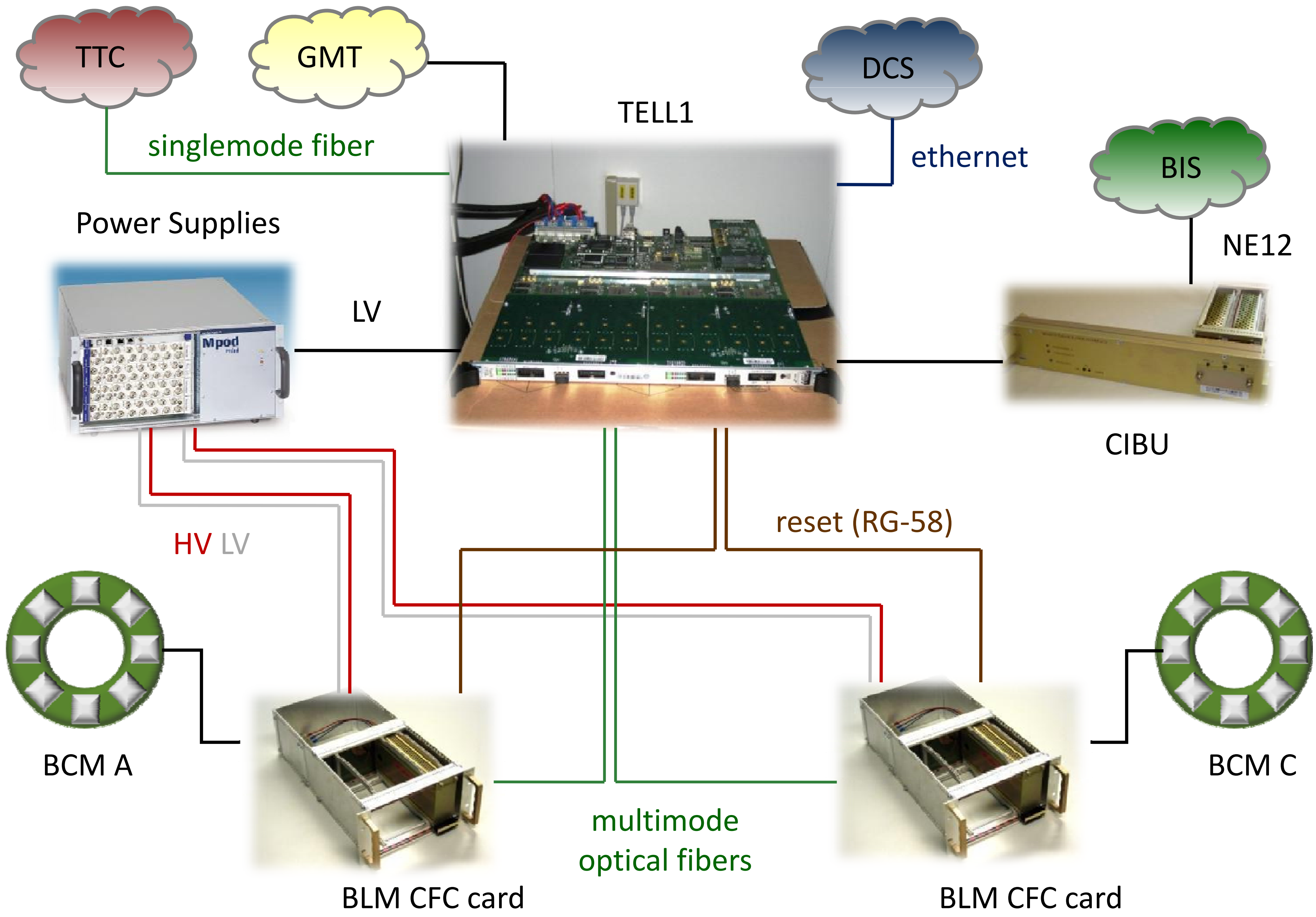
Aim

- detection of adverse beam conditions within the ALICE experimental region
- active protection of detectors (in particular the ITS) against multi-turn beam failures
- monitoring of background level



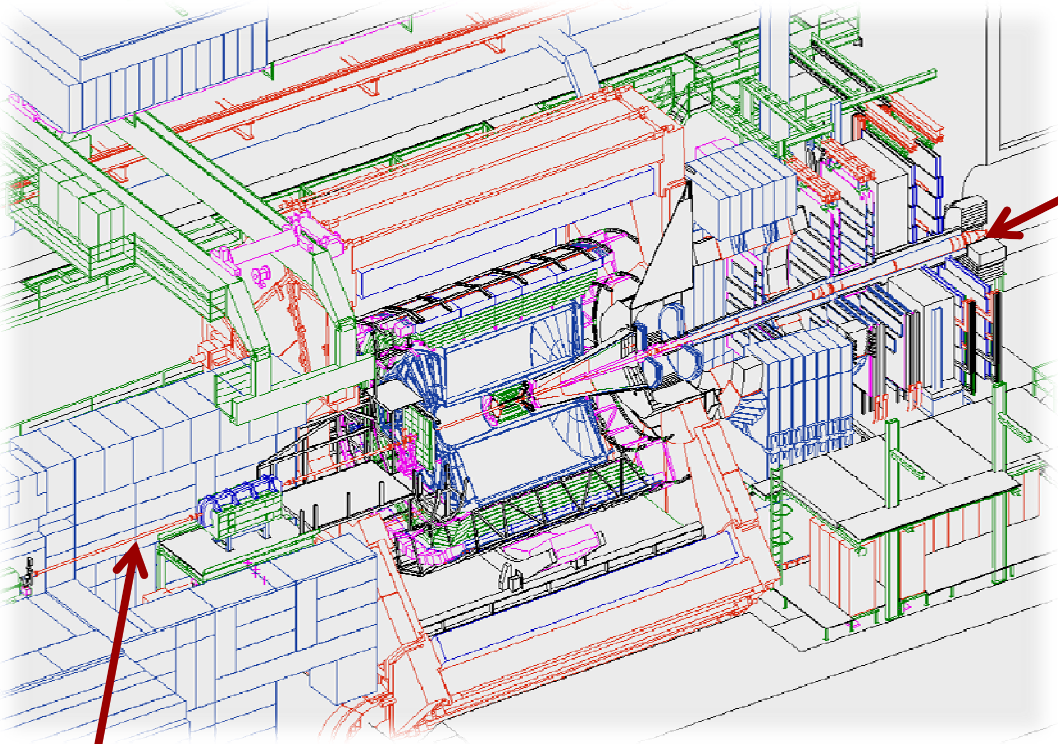
Concept

- based on pCVD diamond sensors (1 cm^2 x 500 µm)
- DC monitoring, integration over 40 µs, always active
- initiates beam dump via Beam Interlock System if signal is above threshold
- time span between occurrence of a critical situation and complete extraction of the beam 200 – 290 µs
- design and components copied (to a large extent) from the **LHCb BCM**.



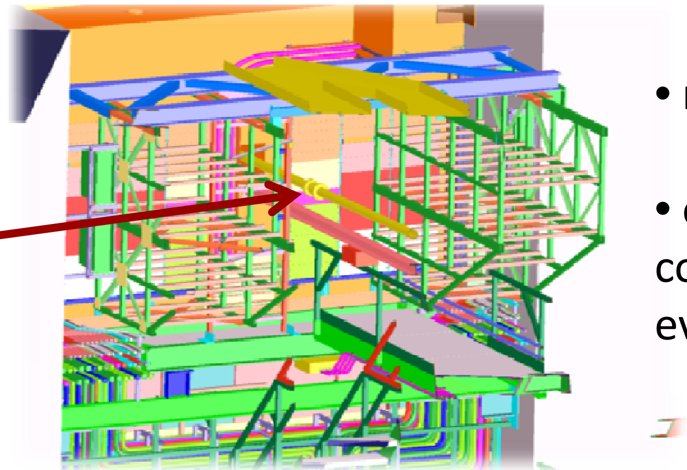
TTC
GMT
DCS
TELL1
singlemode fiber
ethernet
BIS
Power Supplies
NE12
LV
CIBU
reset (RG-58)
HV LV
BCM A
BCM C
multimode
optical fibers
BLM CFC card
BLM CFC card

Locations



BCM C
behind last muon absorber
(z = -19.1 m)

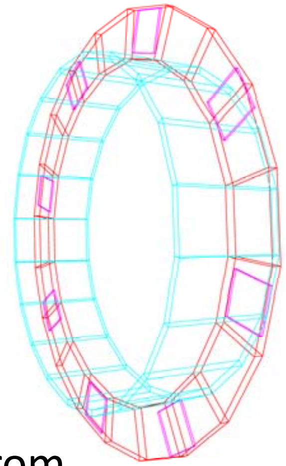
BCM A
between Compensator
Magnet and Low β
shielding
(z=+15.6 m)



Why these locations?

- no other space left on muon arm side
- expect signals due to minimum bias collisions and due to background events to be of comparable intensity

Simulations



Purpose

- Estimate detector signal for nominal conditions
- Verify detector positions

Geometry of BCMs in AliRoot:

8 sensors per station at r = 5±0.5 cm (BCM A) and r = 6±0.5 cm (BCM C) from nominal beam line

”Supports“: aluminium tube, PCB annulus

Additional BCM station at z = + 8 m (**alternative location** for BCM A)

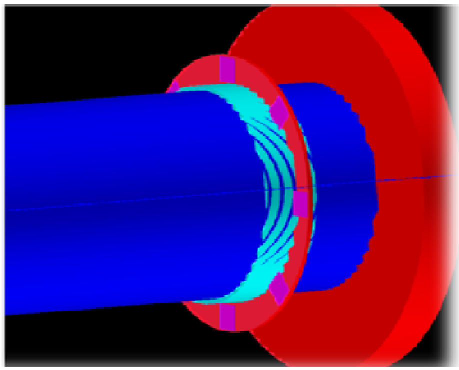
Outer detectors not included

Detector response

Simulation of **hits** in BCM → **mean current** estimated from deposited energy

$$\langle I \rangle = \eta e \frac{\langle E_{dep} \rangle}{W} R$$

W = 13 eV, $\eta \approx 0.5$ (CCE)



Event Generation

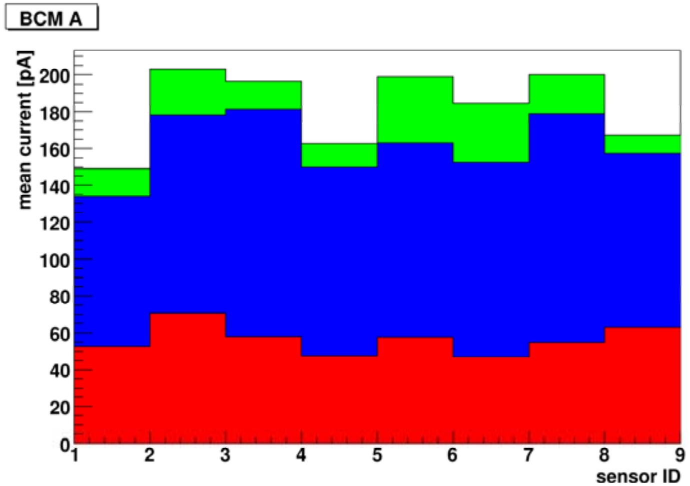
3 **contributions to radiation environment** taken into account:

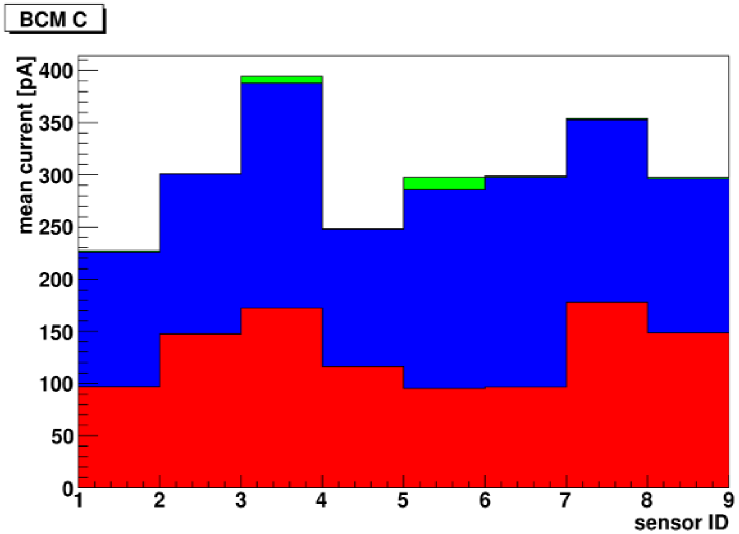
- minimum bias **pp collisions** (14 TeV) at IP
  `AliGenPythia`
  R = 200 kHz
- **beam-gas** interactions (pO collisions at 7 TeV) inside experimental region
  `AliGenBeamGasNew`
  R = 12 kHz/m
- **machine background** from beam-gas interactions in IR2 Straight Section
  `AliGenHaloProtvino`
  gas density distribution scenario ”3rd year + 90 days“

Not (yet) taken into account:

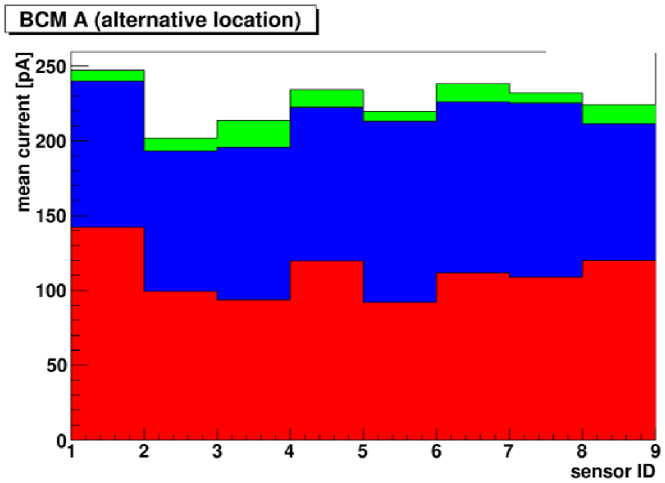
- machine background from beam losses on **tertiary collimators**
  → use source files from LHCb?

	BCM A		BCM A (alt.)		BCM C	
I_{pp} [pA]	56	(31%)	111	(49%)	131	(43.5%)
$I_{beam-gas}$ [pA]	106	(58%)	105	(46.5%)	168	(55.5%)
I_{MIB} [pA]	21	(11%)	10	(4.5%)	3	(1%)
I_{total} [pA]	**183**		**226**		**302**	





→ pp collisions at IP
→ beam gas event inside experimental region
→ machine induced background



Sensitive range of CFC card
10 pA – 1 mA

Beam Failures

Failures at Injection

Time scale

< single turn

Scenarios

- wrong settings of LHC magnet(s)
- failure of injection kicker

Protection

- correct settings
- passive protection elements (absorbers, collimators)
- all detectors in a configuration of no signal production (low bias voltage at ITS, HV below gas multiplication in gaseous detectors, limited HV in PMTs)

Failures with Circulating Beam

Time scale

several turns

Scenarios

various

possibly dangerous for experiments:

- uncontrolled local orbit bump in combination with fast magnet failure

Protection

- detection by surveillance systems (BLM, Power Interlock, BCM)→beam dump via BIS

Ref.: D. Macina, *Report from the Joint Machine-Experiment Meeting on the experiments protection from beam failures,* EDMS Document 856468

To Do

- Machine Induced Background from losses on Tertiary Collimators
- Get estimate for threshold settings
- Simulation of possible beam failure scenarios and their impact on ALICE

Suggestions are welcome!

Injection Failures

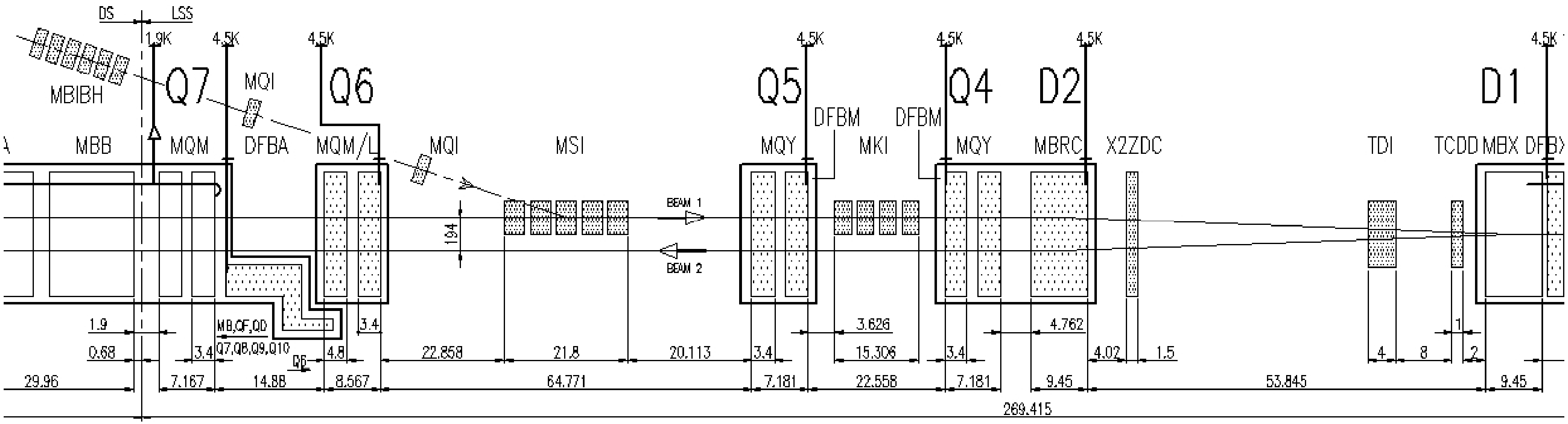
Ref: B. Pastirčák et al., *Radiation from Misinjected Beam to LHC,* ALICE Internal Note 2001-03

Failure scenarios:

- grazing: full batch (4.13×10^{13} p) missing the TDI beamstopper, worst case but very unlikely
- sweep: beam passage coincides with kicker rise time, ≈ 20 bunches escape TDI

several times/year → main contribution

Results: Accumulated dose during 10 years due to misinjection is in worst case (SPD detector and electronics) ≈ 1 krad (1% of total dose)



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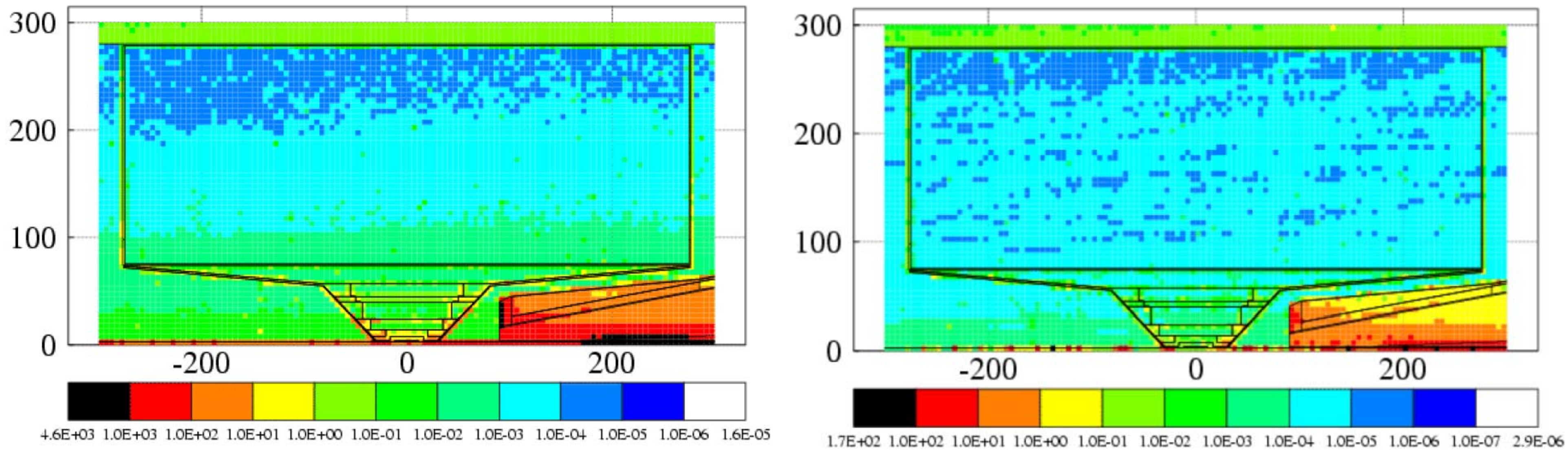
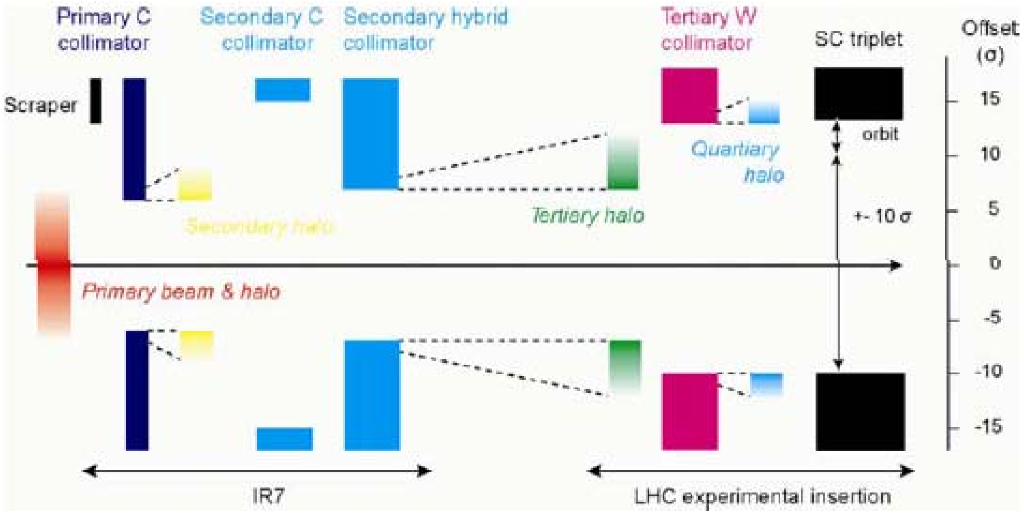
Longitudinal section through ALICE central part

Energy deposition (rad) for grazing (left) and sweep (right) impact (10 years)



Collimator Background



Beam halo due to cleaning inefficiencies in IR7/IR3 and beam-gas interactions in cold sections is lost at next aperture limit.

Resulting **loss maps** are available

Simulation by V. Talanov for **LHCb:**

- particle cascade transported to **scoring plane** at *z* = -1 m from IP8
- different versions available (with/without shielding)
- can be scaled with loss rate and beam lifetime
- dominating background for LHCb