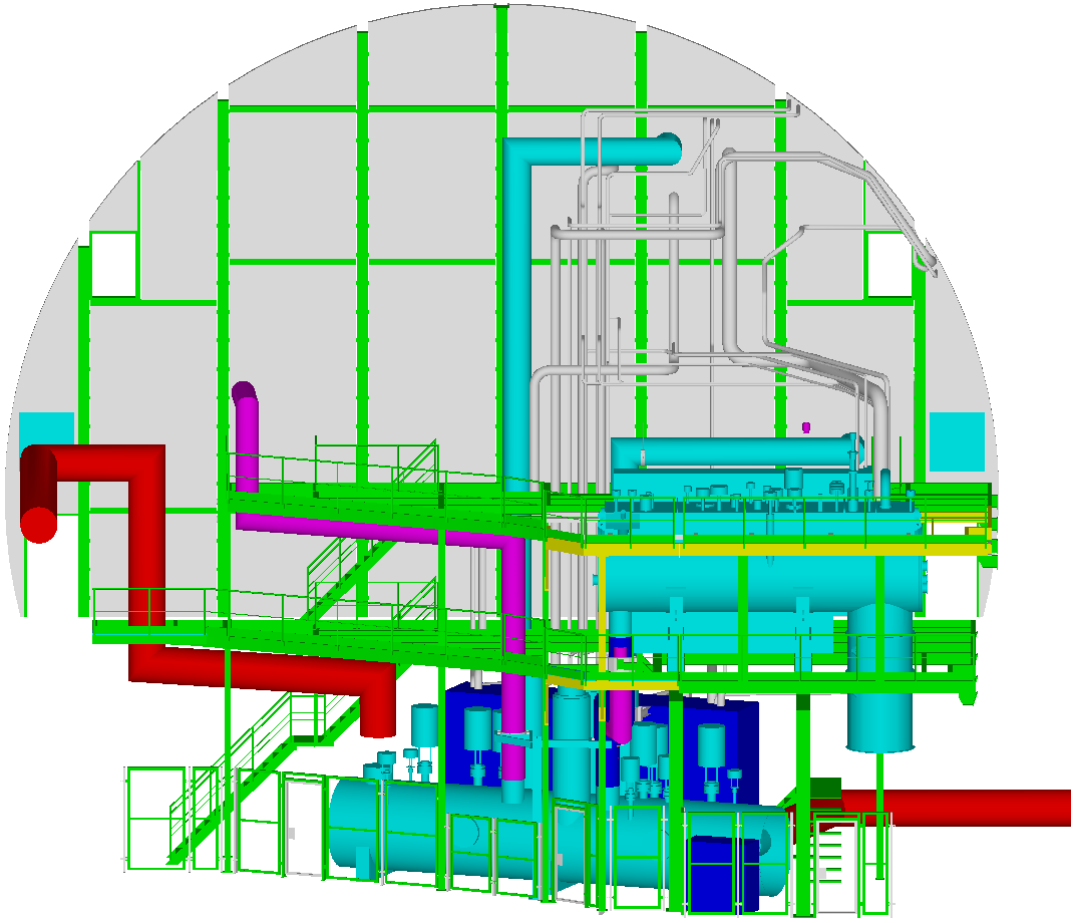
RADMON monitors in the LHCb cavern for the cryogenic equipment and the LHCb experiment



A.- L. Perrot (TS/LEA)

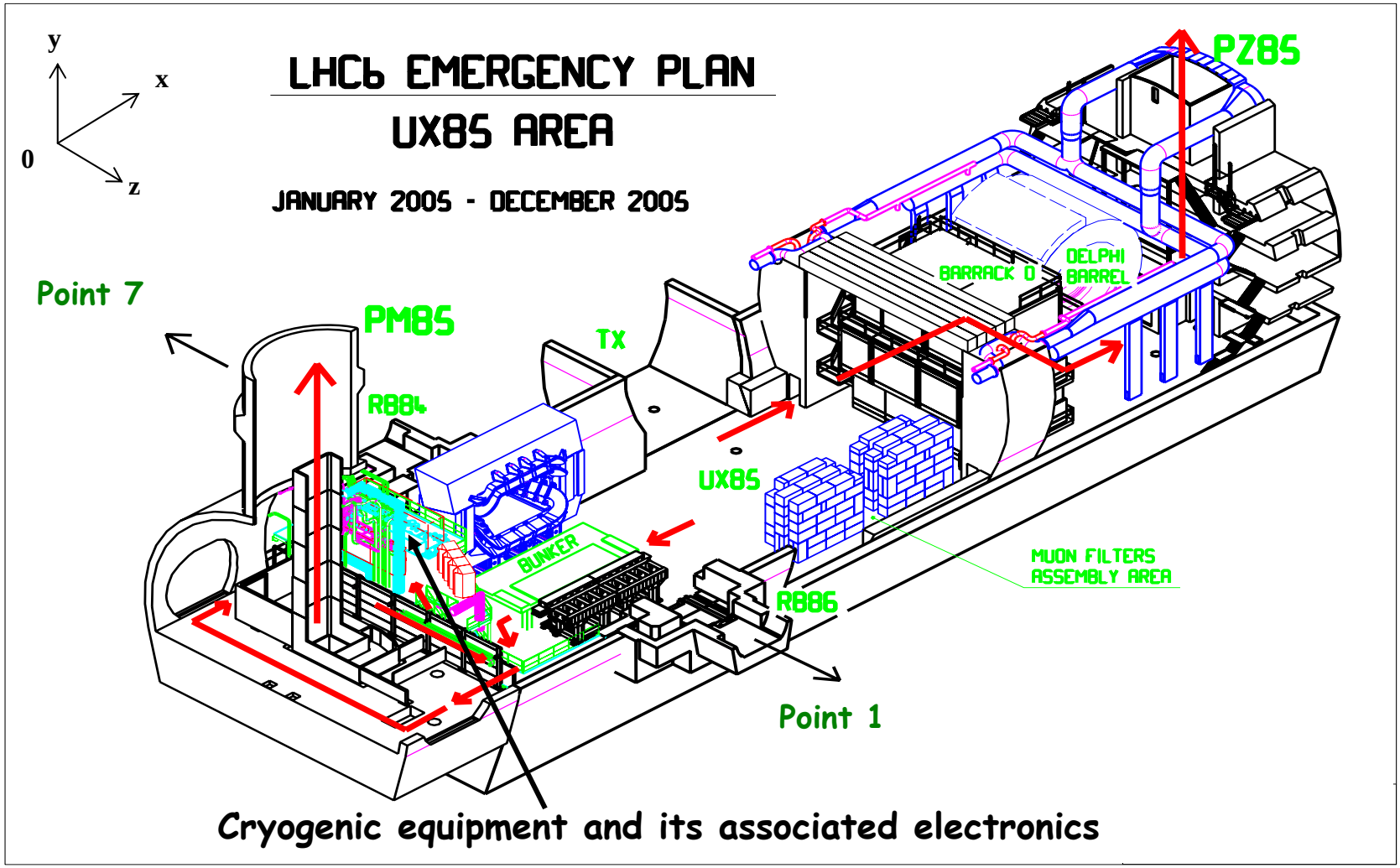
Contents

1. Introduction
2. Location of the cryogenic equipment in the LHCb cavern
3. Radiation level at the cryo. equip. location
4. Cryo. equip. and estimated radiation damages
5. Installation and commissioning of the RADMON monitors
6. Conclusions and perspectives

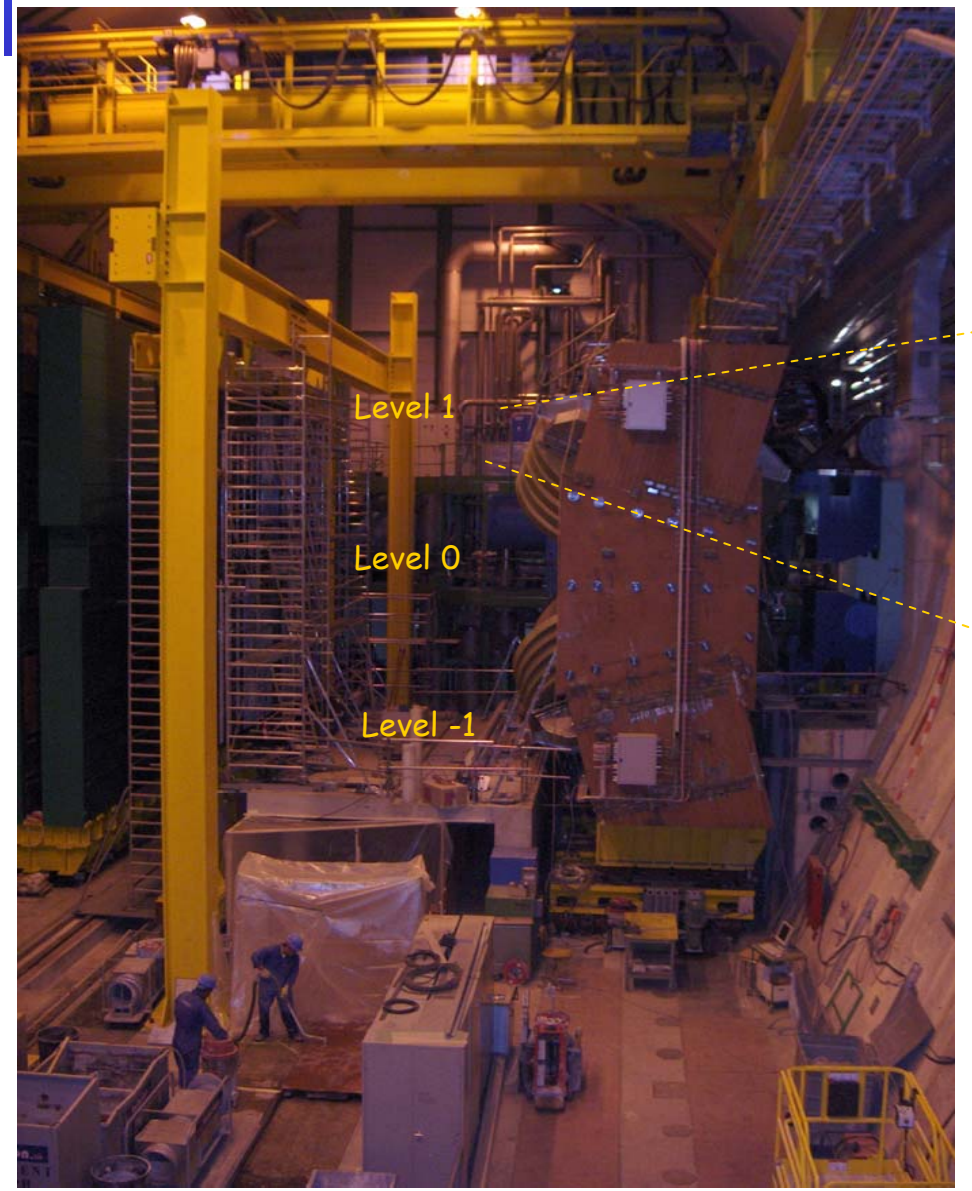
Introduction

- Cryo equipment in UX85
  - Cools cold magnets between Pt1 and 7 via QRL
  - Crucial equipment for LHC operation
  - Presently installed, commissioned and fully operational
- Radiation from collisions could
  - Damage equipment from day 1 onwards
  - Interfere with LHC operation
- RADMON monitors close to the cryo. equip. in UX85 and US85

Cryo Layout in UX85 (I)



Cryo Layout in UX85 (II)



3 levels platform
with the cryogenic equipment

Radiation level in the LHCb cavern

Radiation simulation with FLUKA

Inputs to simulation: L= 2×10^{32} cm^{-2} s^{-1} 1.6×10^{7} interaction/s

Statistic 35000 pp collisions.

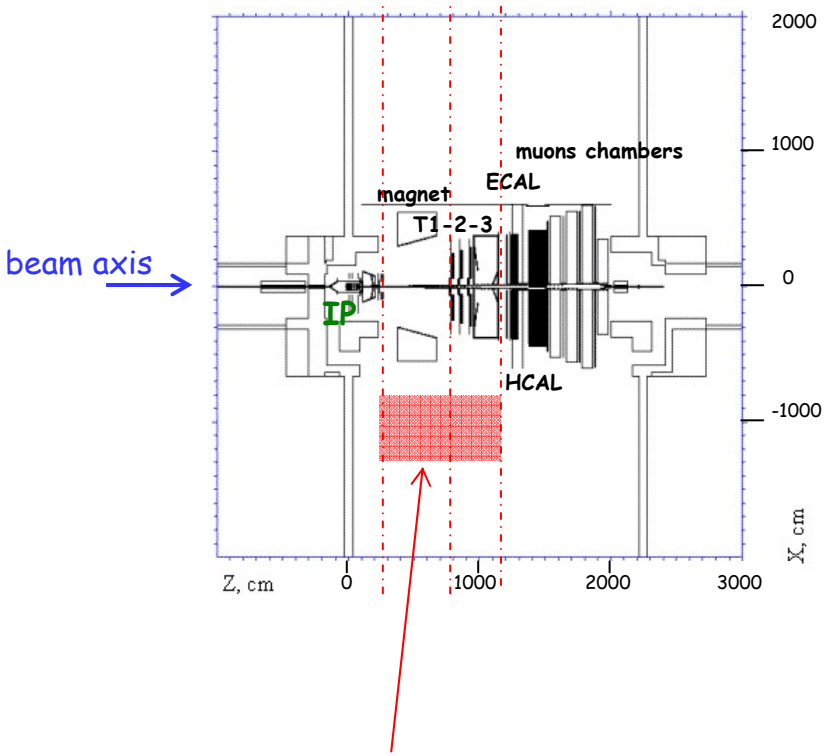
Safety factor simulations = 2

Radiation level computed for 10 LHC years

http://lhcb-background.web.cern.ch/lhcb-background/Radiation/RadLevels.htm

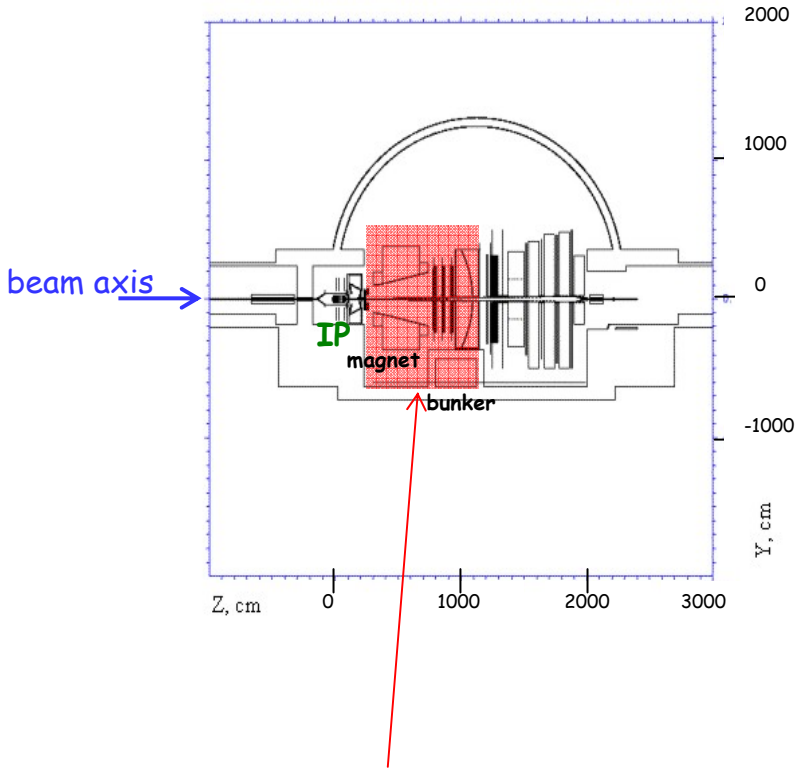
Geometry layout - simulation

Top-view



Location of the cryogenic equipment

Side-view

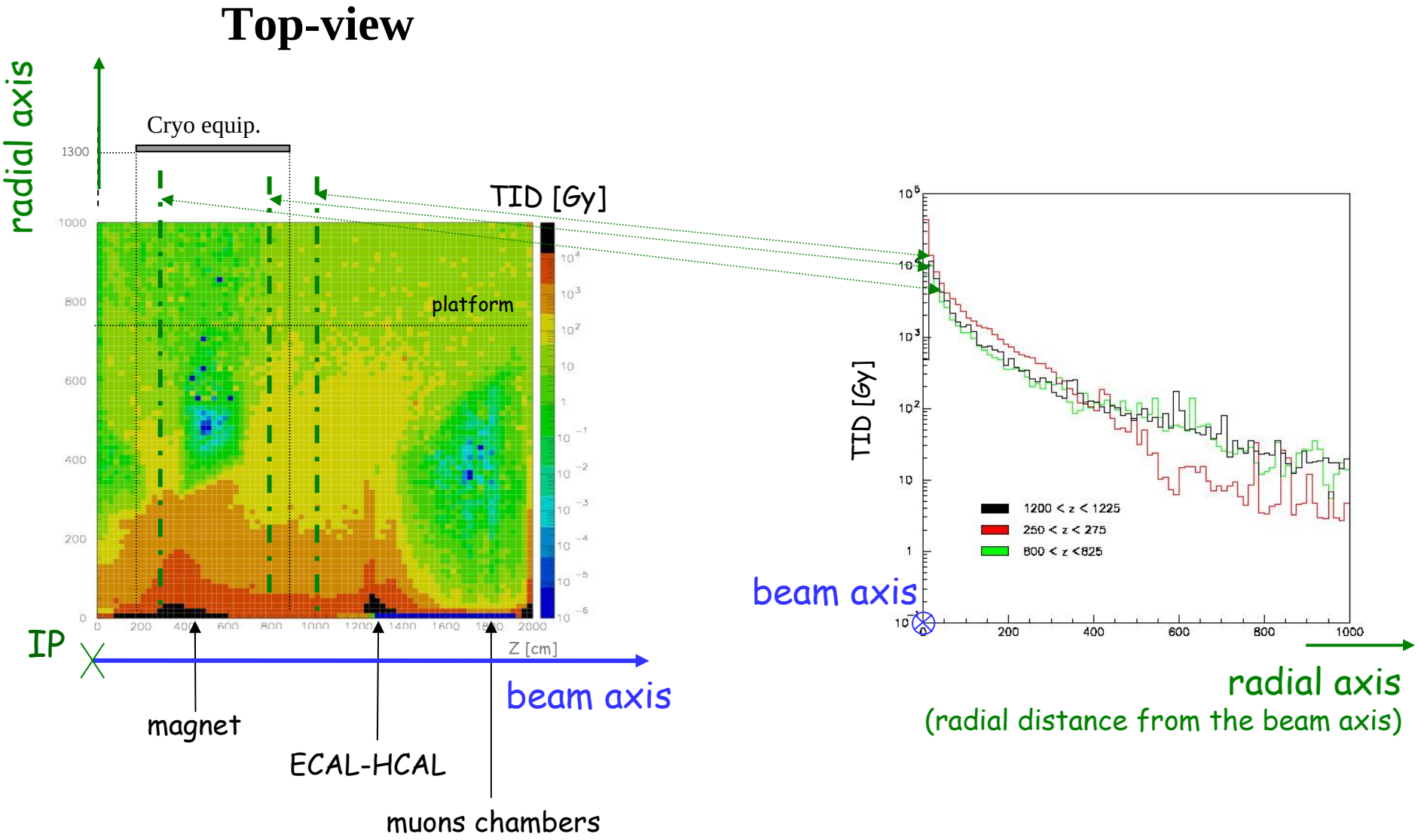


Location of the cryogenic equipment

Courtesy of G. Corti and L. Shektman (LHCb collaboration)

Total Ionizing Dose

Horizontal cross-section @ beam level (y=0m)

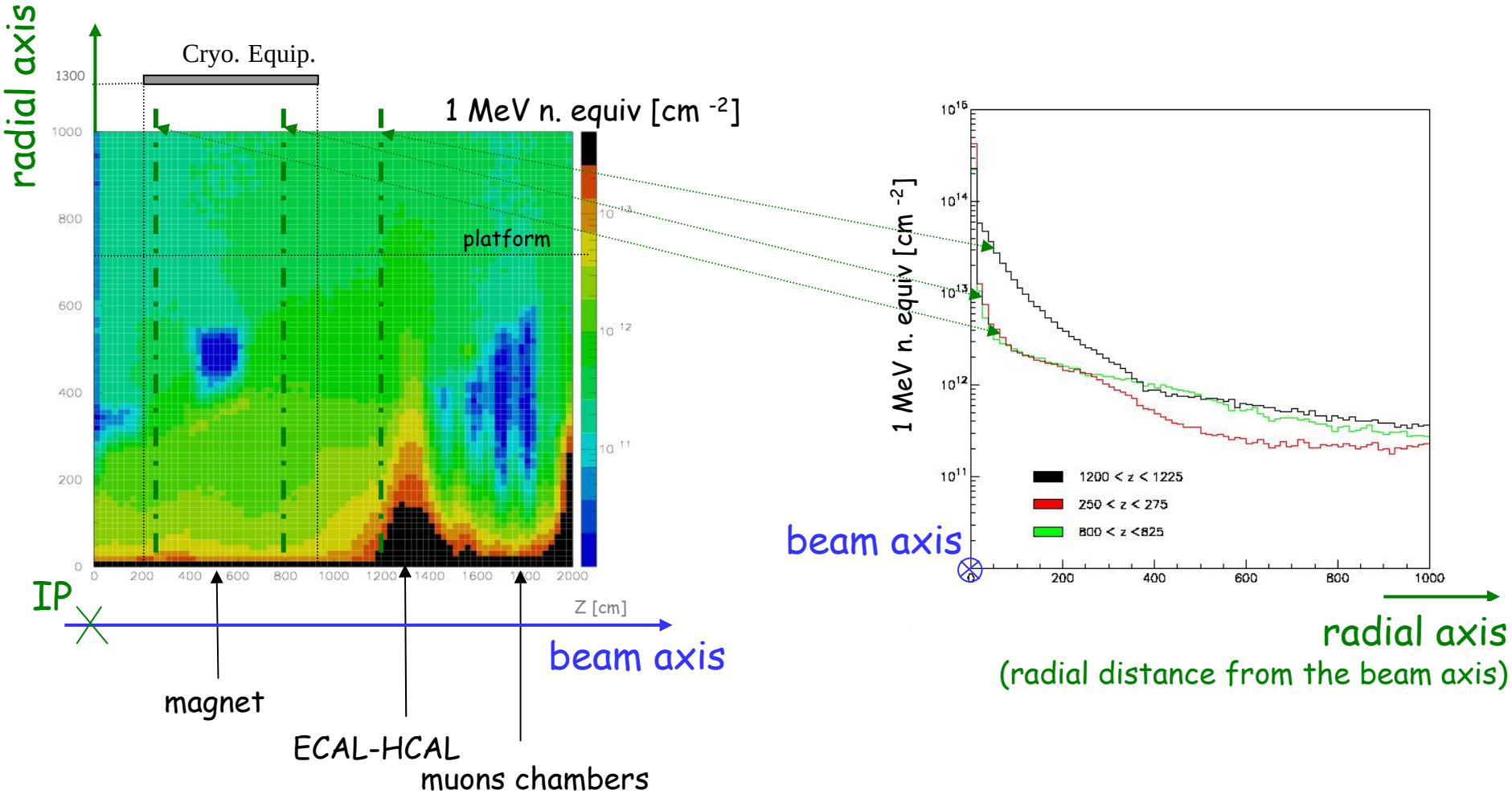


TID @ cryo equip. : 1-10 Gy for 10 LHC years

1 MeV n. equiv. fluence- Displacement damage

Horizontal cross-section @ beam level (y=0m)

Top-view

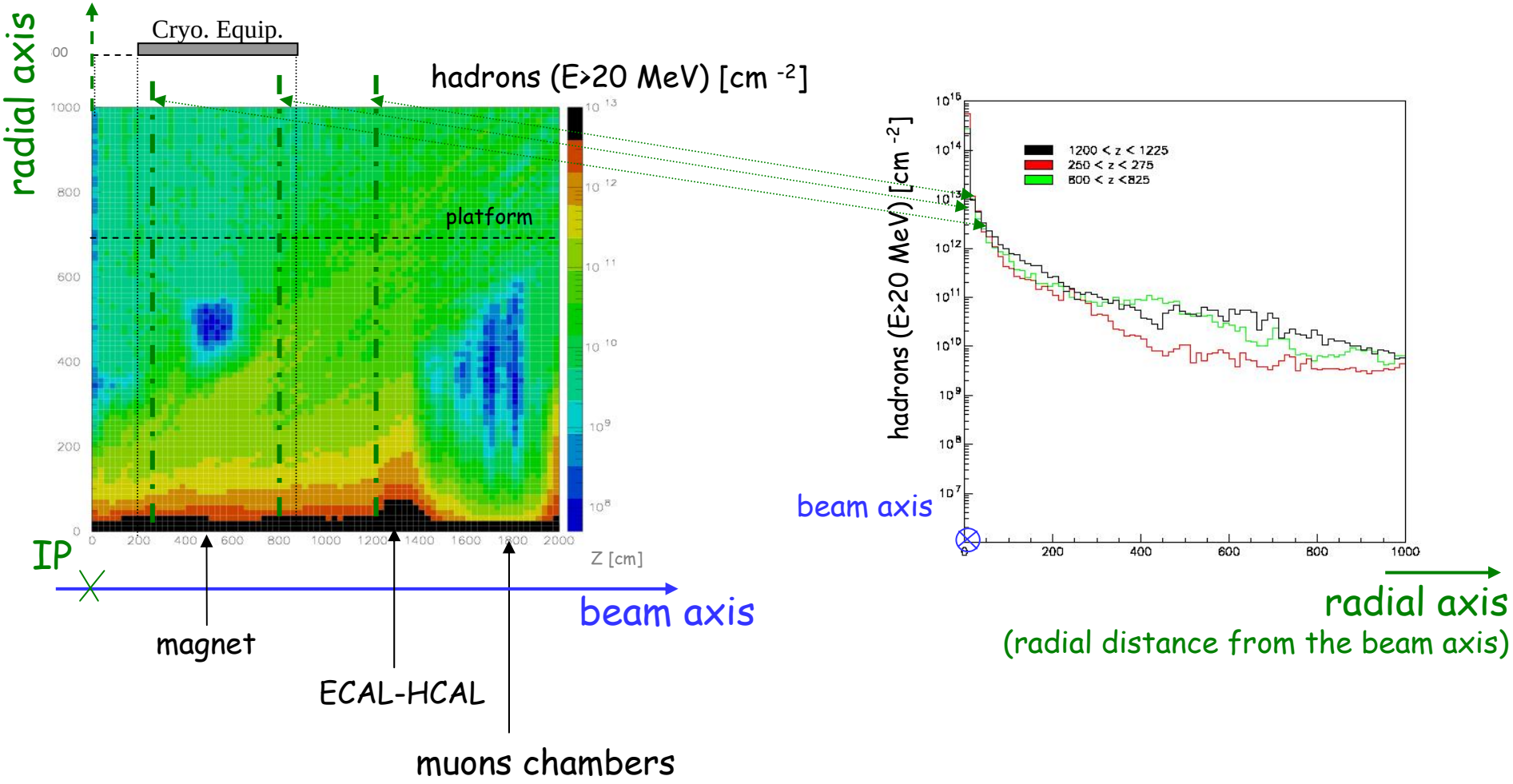


1 MeV n. equiv. @ cryo equip.: 10^{11} - 10^{12} /cm^2 for 10 LHC years

Hadrons (E>20MeV) fluence- Single events

Horizontal cross-section @ beam level (y=0m)

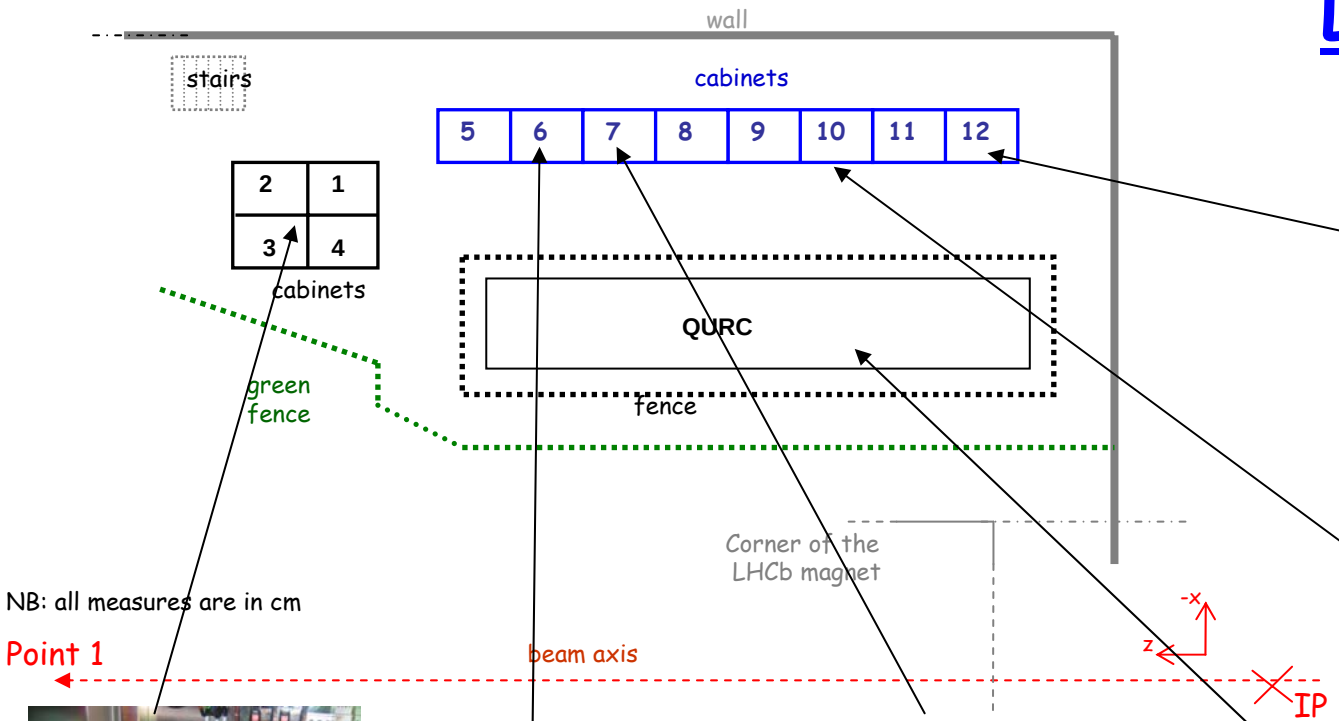
Top-view



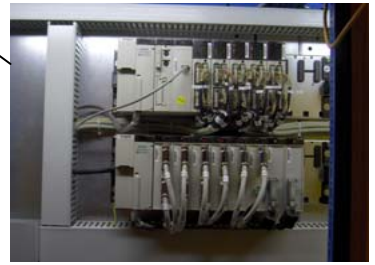
Hadrons (E >20 MeV). @ cryo equip.: 10^{9} - 10^{10} /cm^2 for 10 LHC years

Radiation sensitive devices - cryo. equip. (I)

Level 1



DP/PA couplers and links (Siemens)



PLCs Schneider (Modicon)

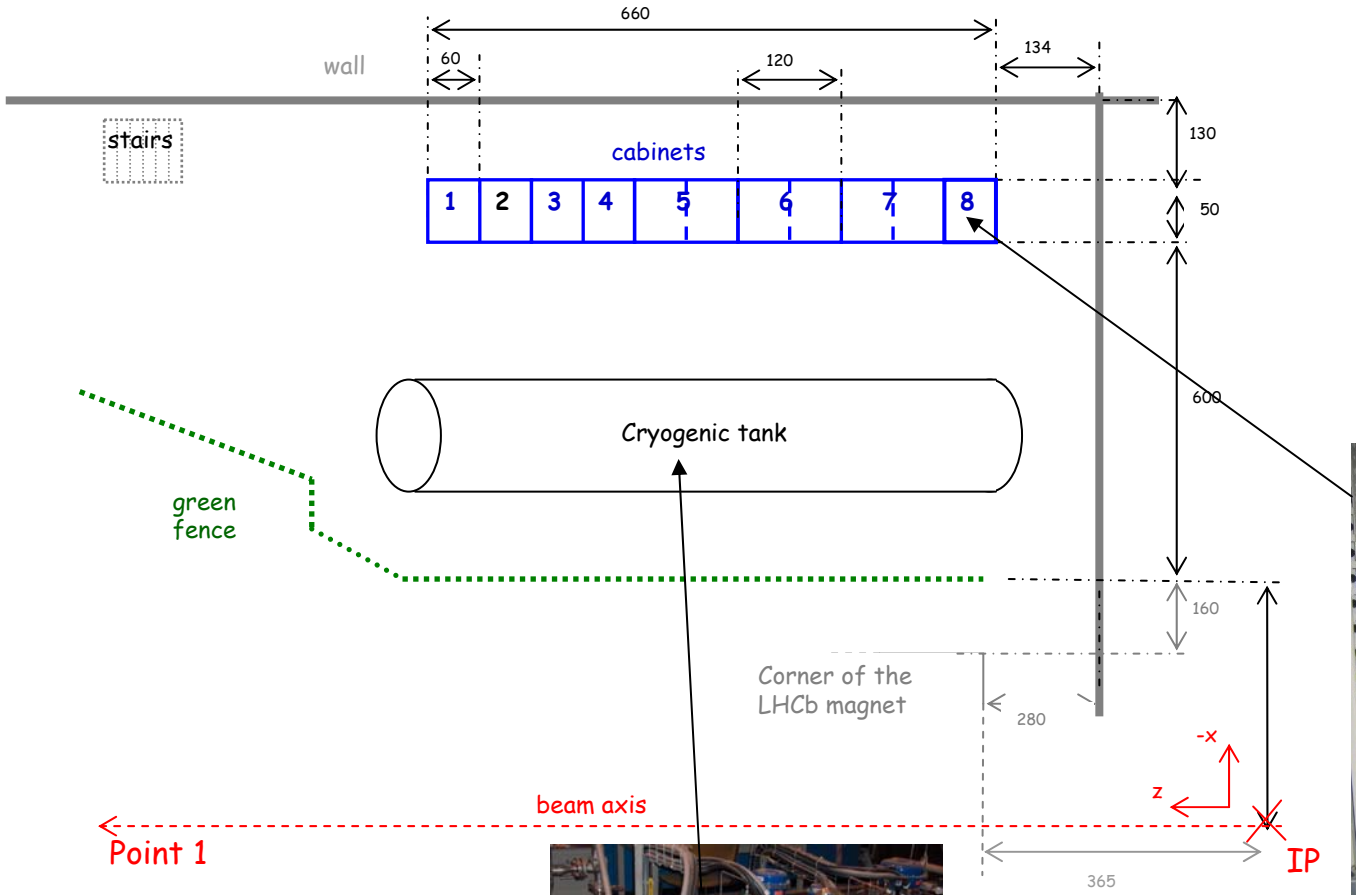
High frequency converters, Magnetic level controllers.

Thyristors

PLCs Siemens S7-300

Electro-pneumatic valves positioners (Weka)

Radiation sensitive devices - cryo. equip. (II)



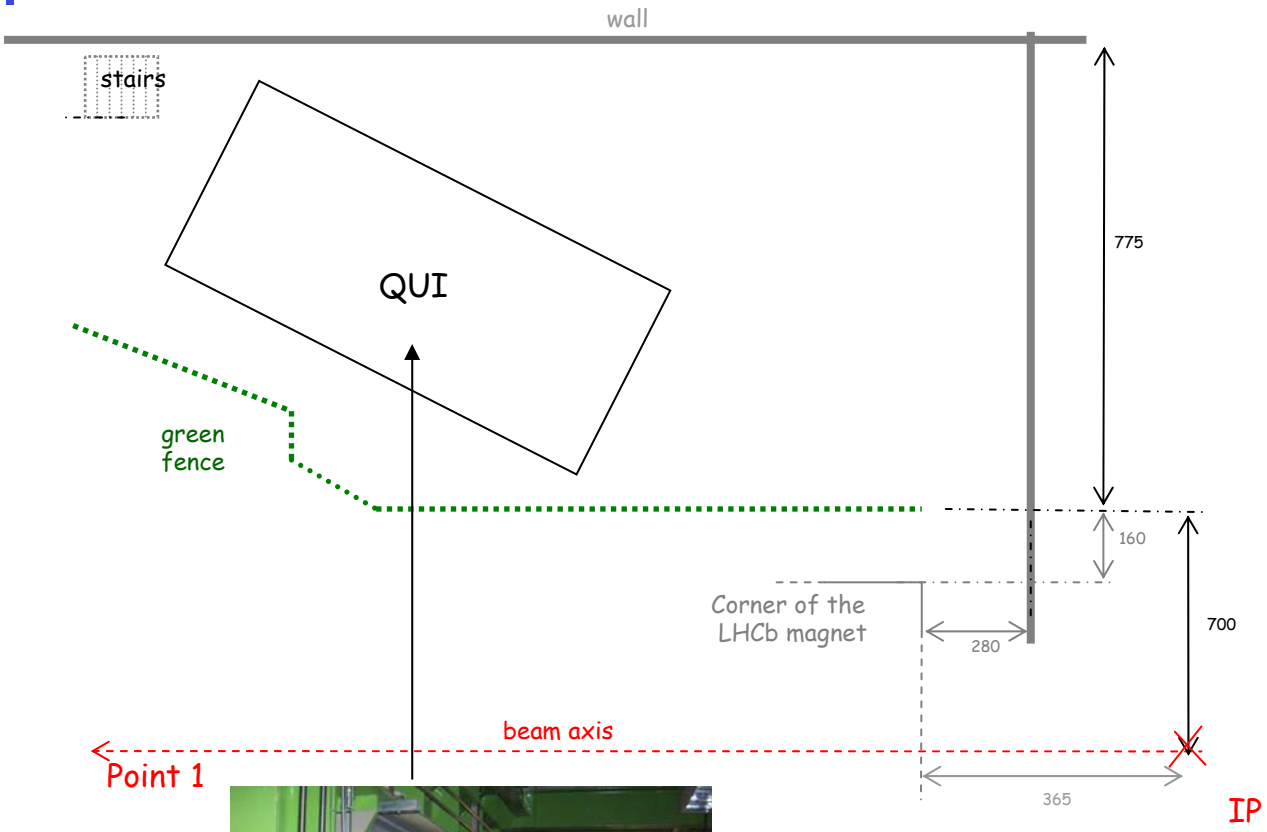
Level 0

(beam level)

Electro-pneumatic
valve positioners (Weka)

PLCs Schneider (Modicon)
DP/PA couplers and links (Siemens)

Radiation sensitive devices - cryo. equip. (III)



Level -1

NB: all measures are in cm

Electro-pneumatic
valve positioners (Weka)

Radiation damage effects to the cryo. equipment

Rad. sensitive device	Irradiation test	Rad. damage effects
High freq. converters	no	?
Magnetic level controllers	no	?
Thyristors	no	?
PLCs	yes	**SEE**, TID
DP/PA couplers & links	yes	**SEE**, TID
Electro-pneumatic valves positioners	yes	**SEE**, TID

Radiation damages to cryogenic equipment (I)

From the radiation simulation results and irradiation tests

•Automates and Remote I/Os

1 functional interrupt per day,
'Hard' Single Events in modular power supplies ,
'Soft' Single Events in PLC and "intelligent" I/Os.

•Electro-pneumatic valve positioners (ref. tests of W. Hees- AT/ACR):

- in QURC (top and beam level platforms):
  1 critical erratic valve position every 11 days (beam dump).
- in QUI (ground level):
  1 critical erratic valve position every 77 days (beam dump).

Radiation damages to cryogenic equipment (II)

Recommendations

1- Relocation of PLCs and 'intelligent' I/O in US85,

2- Remote valve controllers electronics instead of integrated,

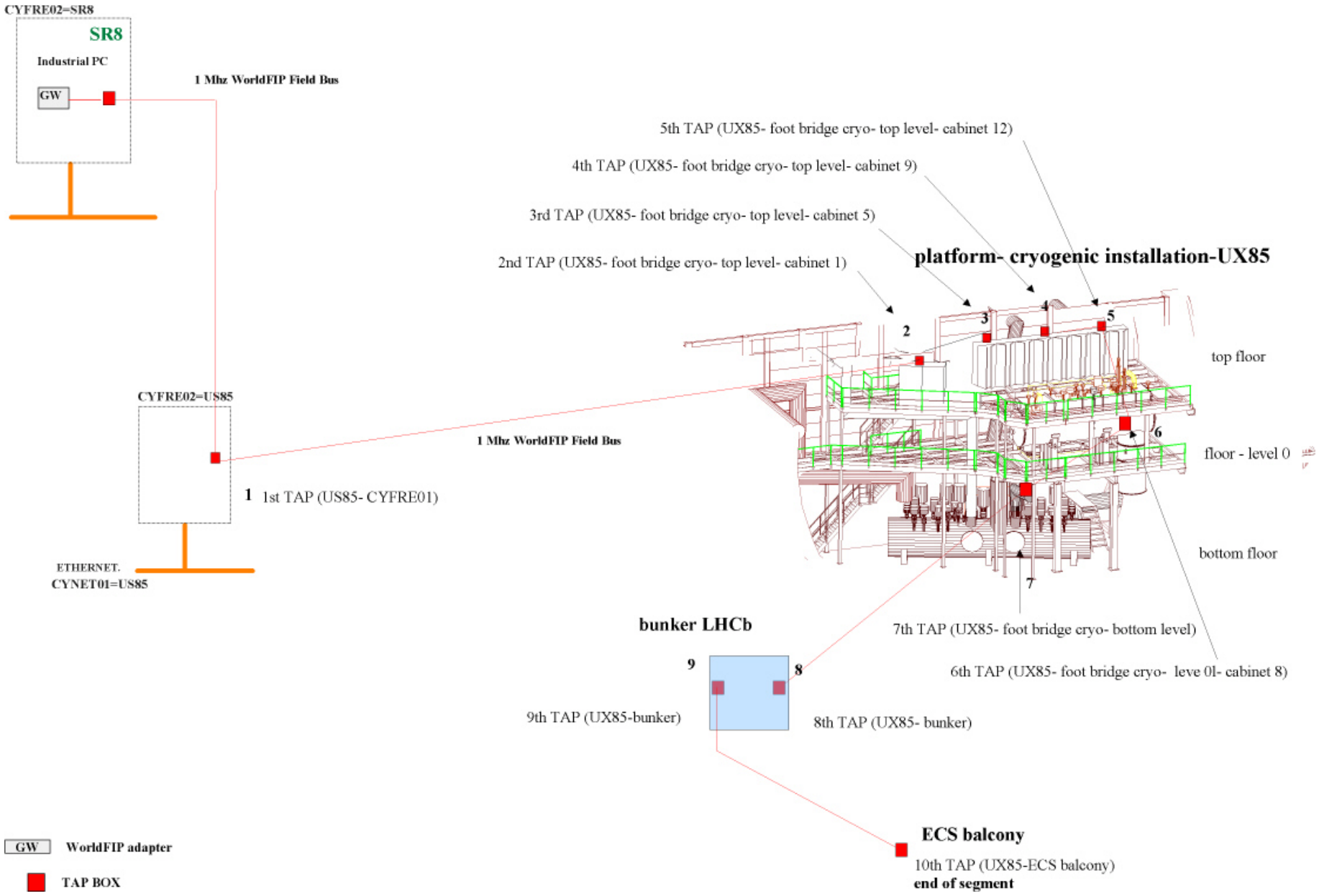
3- Replacement of power supplies by radiation tolerant types,

4- Individual resets for all 'intelligent' electronics,

5- Radiation Monitoring close to the equipment from day 1,
(RADMON monitors, see T. Wijnands talk).

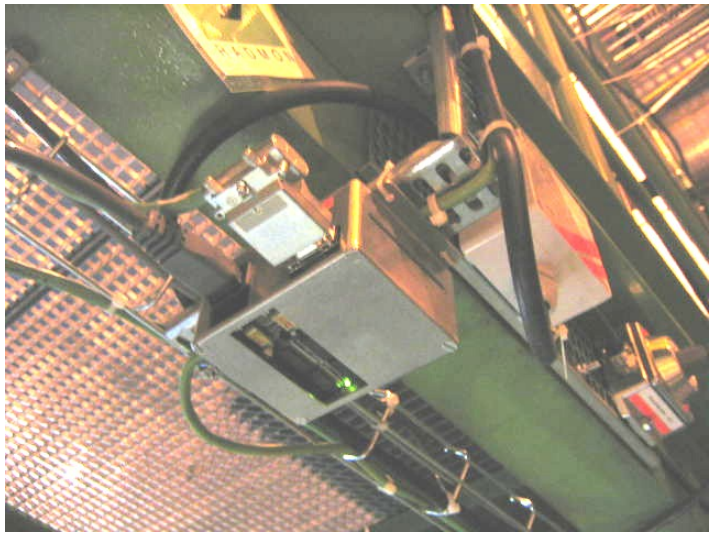
Installation and commissioning of the RADMON monitors (I)

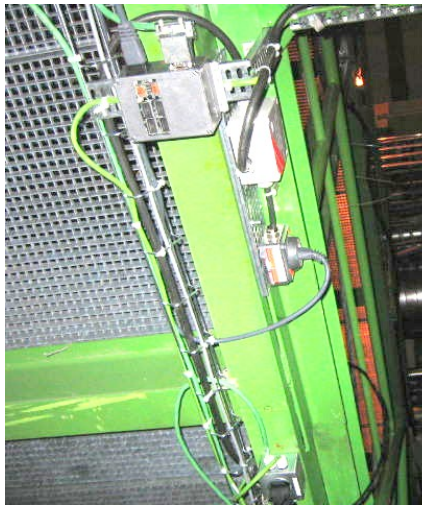
Layout of RADMON monitors in the LHCb cavern



Installation and commissioning of the RADMON monitors (II)

- All the cable network = installed (TS/EL, AB/CO),
- Installation of first 3 dosimeters, 7 others at beginning of 2006 (TS/LEA),
- Network successfully commissioned on 17th November (TS/LEA).





Conclusions and perspectives

- Sensitive equipment from Cryo in UX85,

  Risk of interference with LHC operation.

- Exposure to radiation at first collisions in Pt 8,

  Rad. damage effect may appear from day 1.

-Recommendations:

  Relocation of sensitive equipment,

  Radiation monitoring from day 1.

Acknowlegements

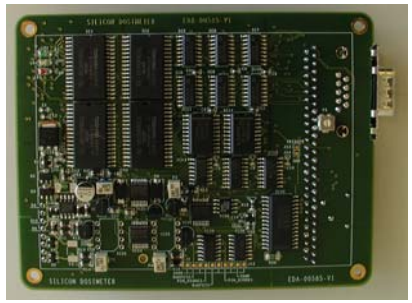
Thanks to

the LHCb collaboration, the AT/ACR, AB/CO, TS/EL and TS/LEA groups

and especially to
J. F. Bel, A. Bouillot, J. Brahy, S. Claudet, G. Corti, G. Ferlin, W.Hees, A.J.F. Herranz Alvares, D. Lacarrère, C. Pignard, J. Ridewood and T. Wijnands.

Installation and commissioning of the RADMON monitors (I)

- Dev. in **TS-LEA** (T. Wijnands and C.Pignard).
- single integrated design with - RADFETS,
  - pin diodes,
  - SEUs counters.



- Operation up to 200 Gy.
- Radiation data @ 50 Hz max.
- Measure:
  - dose, dose rate,
  - 1 MeV equivalent neutrons fluence,
  - hadrons (E>20 MeV) flux and fluence.
- Readout on line via fieldbus (WorldFip)