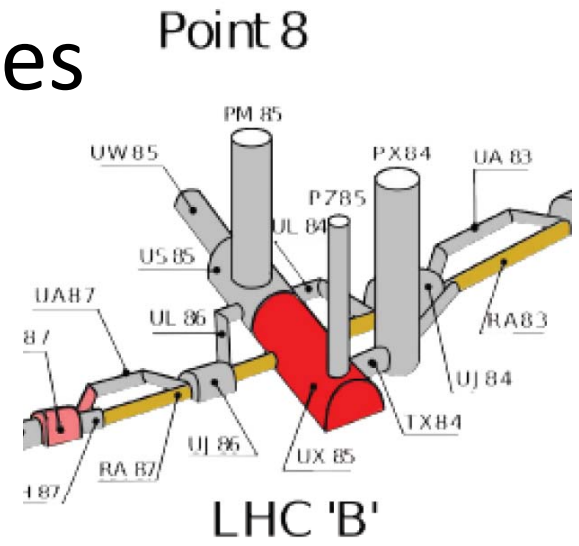
R2E-LHC Iterations

- Layout & Rack Locations
  - Collection of drawings
  - Inspection & Pictures
  - Review of monitor locations

  } collected in R2E Database
- Review of Radiation Levels:
  - normalisation for 2009/10
  - existing simulations
- Overview (Summary) of installed equipment
- Monitor Locations used for early monitoring
- Integration issues

-> **Goal**: to identify/quantify the impact for 2009/10 (and later) and provide all input for RadWG to start equipment iteration

R2E Proposed Objectives



R2E Meetings and Information:
https://ab-div.web.cern.ch/ab-div/Meetings/r2e/
Document Library & Questionnaire:
https://espace.cern.ch/info-r2e-documents/default.aspx

Today's Objectives:

- collect all required input
- from R2E:
  - equipment classes & location
  - review of radiation levels during 2009/10 and later
  - detailed monitoring during start-up to
    - compare radiation levels with simulations
    - deduce real attenuation in the US
- collect radiation test requirements
- full inventory required to start looking into mid/long-term solutions
- some (many) possible solution will require lots of time, thus an early start is mandatory (almost no easy solution!)

-> **Goal**: start now!

Loss/Luminosity Assumptions

M. Lamont prepared a first estimate:

http://cern.ch/lhc-commissioning/luminosity/09-10-lumi-estimate.htm

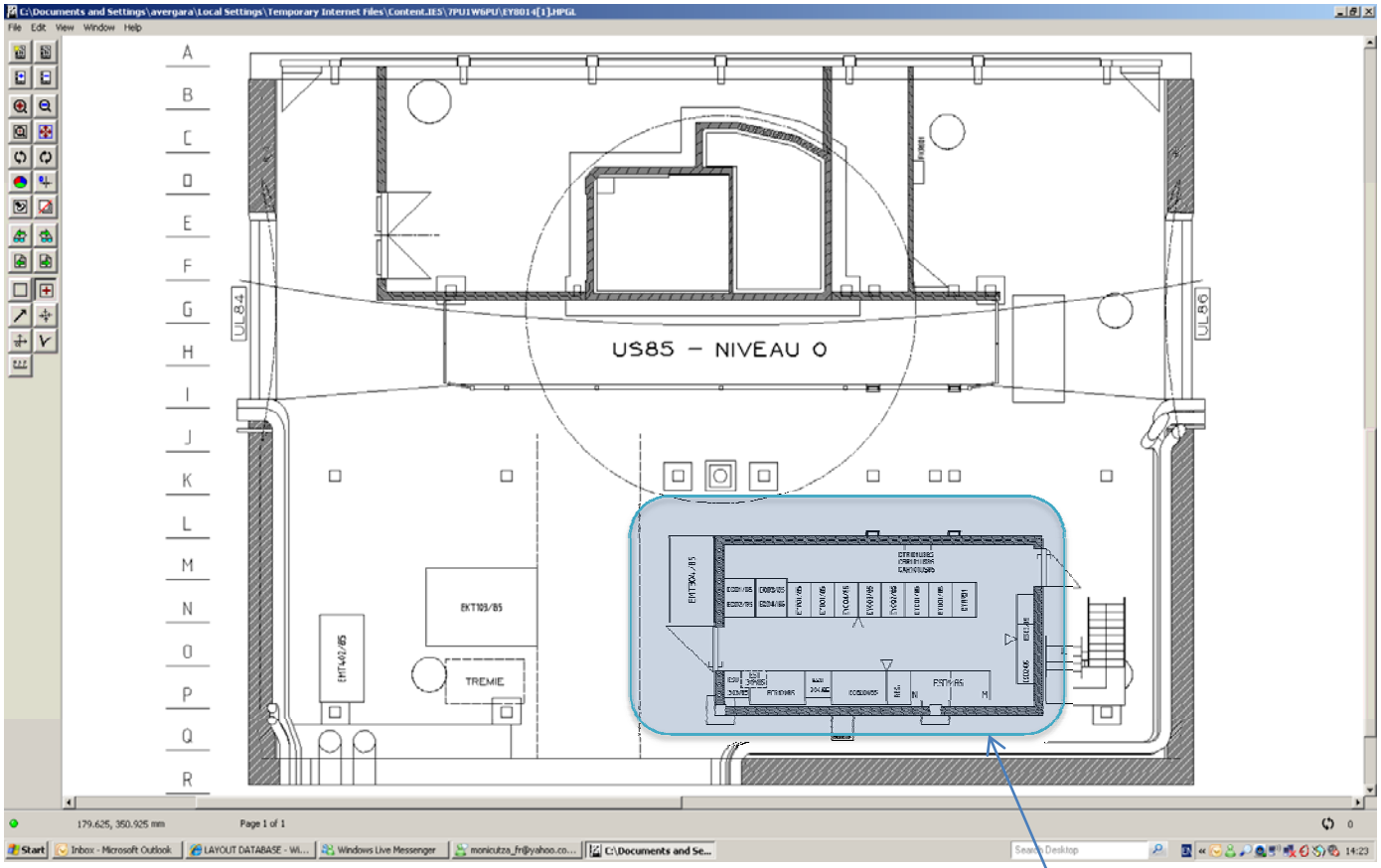
- At LHCb the radiation levels are driven by the respective luminosity.
- For the high-luminosity experiments the above estimate yields a maximum integrated luminosity of 300 pb^{-1}
- LHCb (nominal operation): $2x10^{32}$ (Luminosity) x $1x10^{7}$ (seconds per LHC year) = $1x10^{39}cm^{-2}$ <=> $1fb^{-1}$
- Only a limited number of bunches (1/2th to 1/4th) will be displaced to LHCb so that LHCb can get collisions before going to 75 ns
- They can only be squeezed to 4 m at 5 TeV (perhaps 3) and this won't be pursued as hard as in Point 1 & 5 (crossing angles, spectrometer bumps etc…)
- As compared to the high-luminosity experiments the current estimate is then about 1/3rd of the integrated luminosity at Point 1 & 5
- This yields for **2009/10 about 10% (~100pb^{-1}) of nominal integrated LHCb luminosity**

UX85

Elements mostly being displaced to UL84:

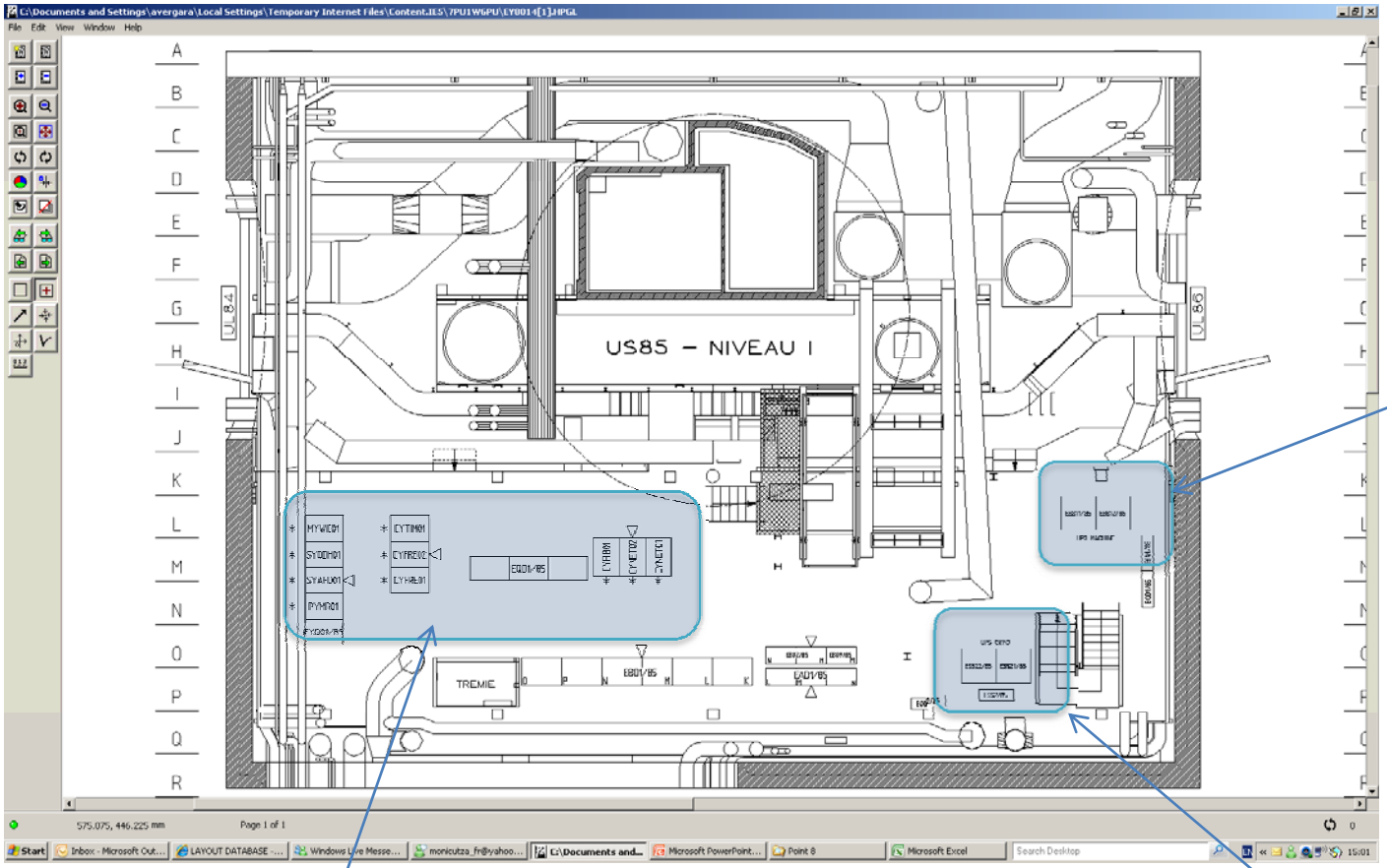
- PLCs, SD/PA couplers and controllers for QUI and QUIRC
- Digital valve positioners for QUI and QUIRC
- other -> see pictures later…

US85 – Level 0



CYRR01 – GSM – J.J.Gottraux IT-CS
CTRI – PCI timing receiver – R.Chery BE-CO
Electrical distribution equipment
CV equipment (outside safe room)

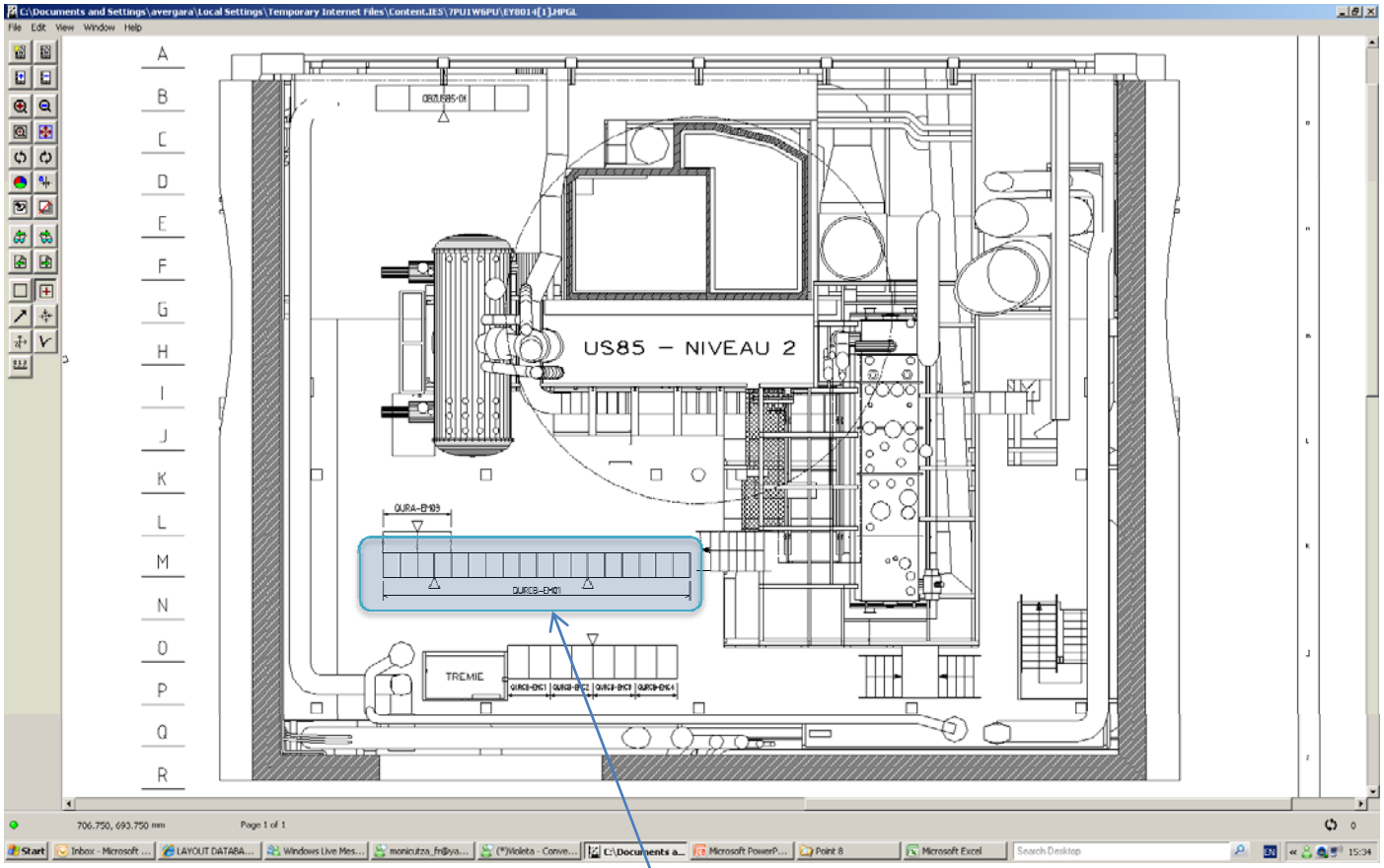
US85 – Level 1



UPS machine – Feeding:
- QPS (DS magnets)
- PIC

MYWIC – WIC – P.Dahlen TE-MPE
SYOHD – ODH – R.Nunes GS-ASE
SYAFD – Fire detection – R.Nunes GS-ASE
PYMR – RAMSES – D.Perrin DG-SC
CYTIM – Timing – R.Chery BE-CO
CYFRE – Front end – G.Surback BE-CO
CYFIB – Optical Fiber – L.Koert de Jonge EN-EL
CYNET – Ethernet – P.Andersen IT-DI

UPS CRYO (machine)

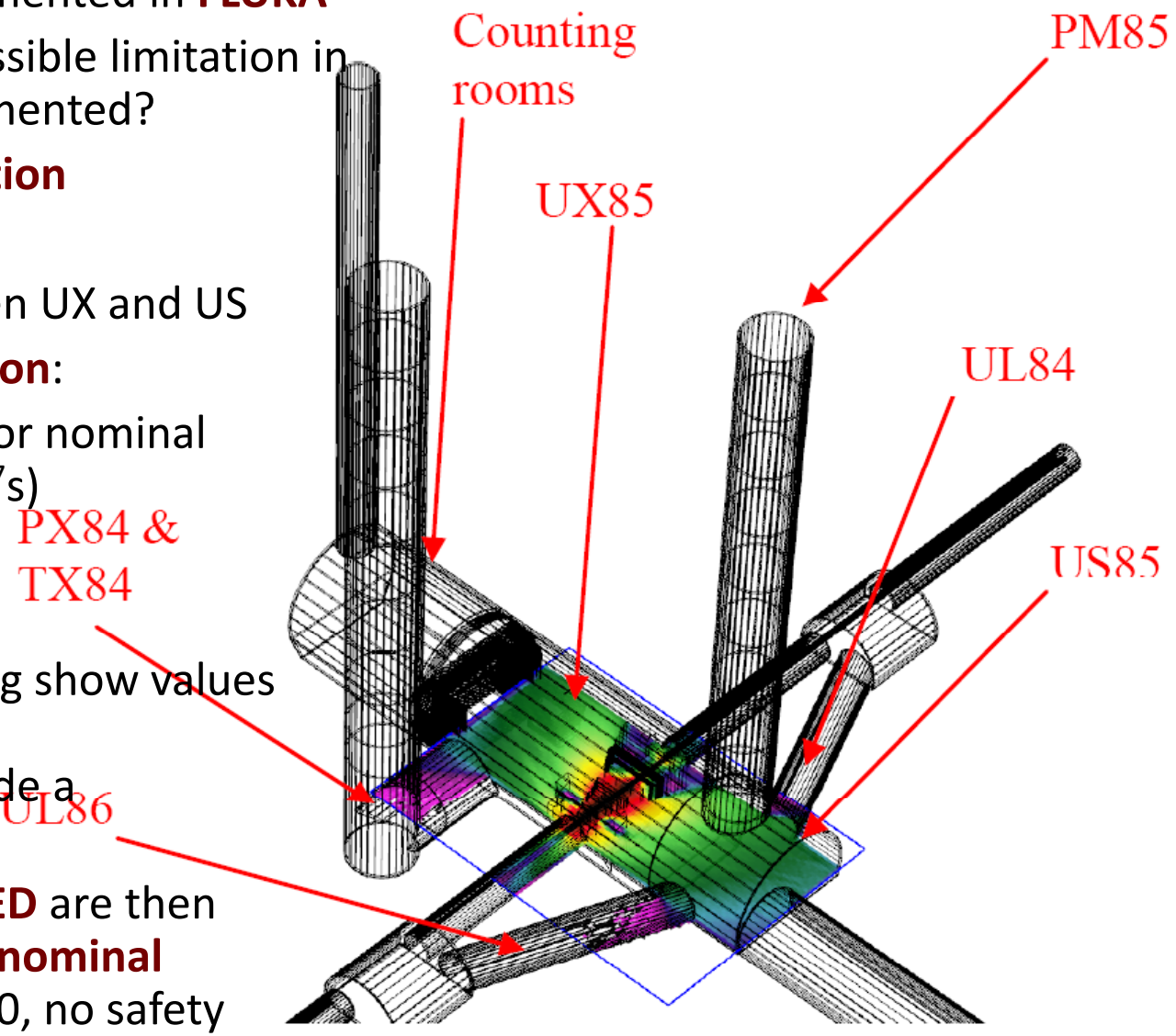


US85 – Level 2

Cold compressor electrical distribution

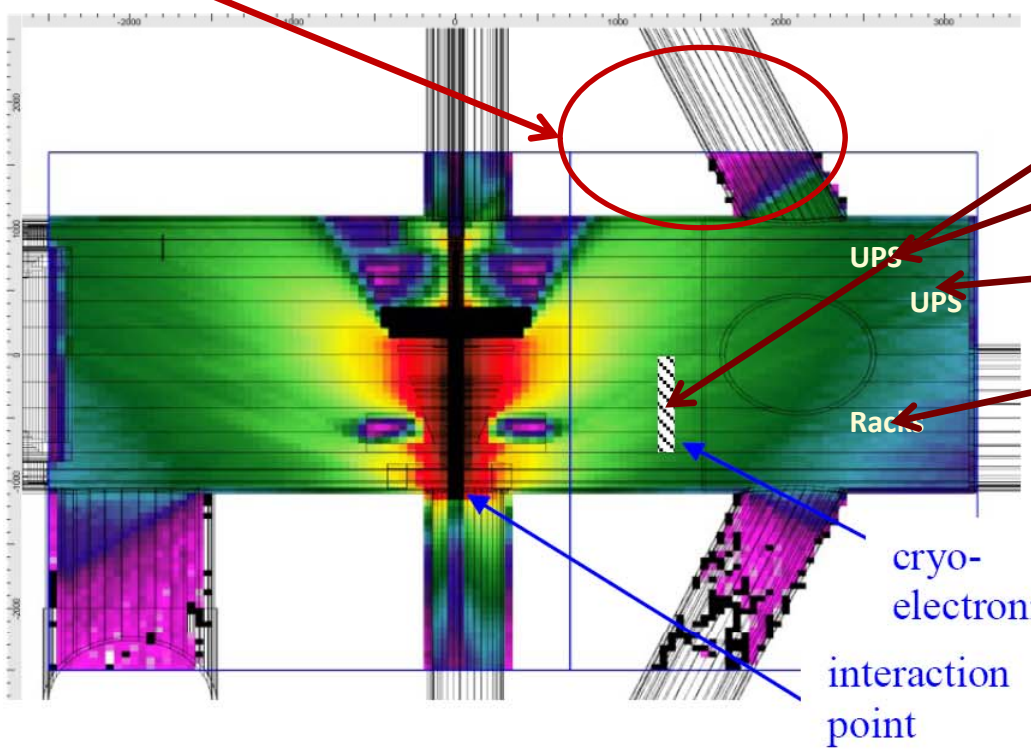
Expected Radiation Levels - FLUKA © C. Theis

- Geometry as implemented in **FLUKA**
- LHCb detector – possible limitation in how much is implemented?
- **Additional attenuation**
  - US85 is empty
  - No wall between UX and US
- Applied **normalization**:
  - 2×10^{32} $cm^{-2}s^{-1}$ for nominal LHC year (1×10^{7}s)
  - 1.6×10^{7} pp/s
- **Full 20MeV Cut-Off**
- Plots in the following show values for 10 years of operation and include a safety factor of 2!
- Values marked in **RED** are then rescaled **to 10% of nominal** (scaling factor of 100, no safety factor)



High-Energy Fluence – @ Niveau 1

UL Levels unphysical due to full absorption at the edge



2009/10

Up to $1x10^8$ cm^{-2}

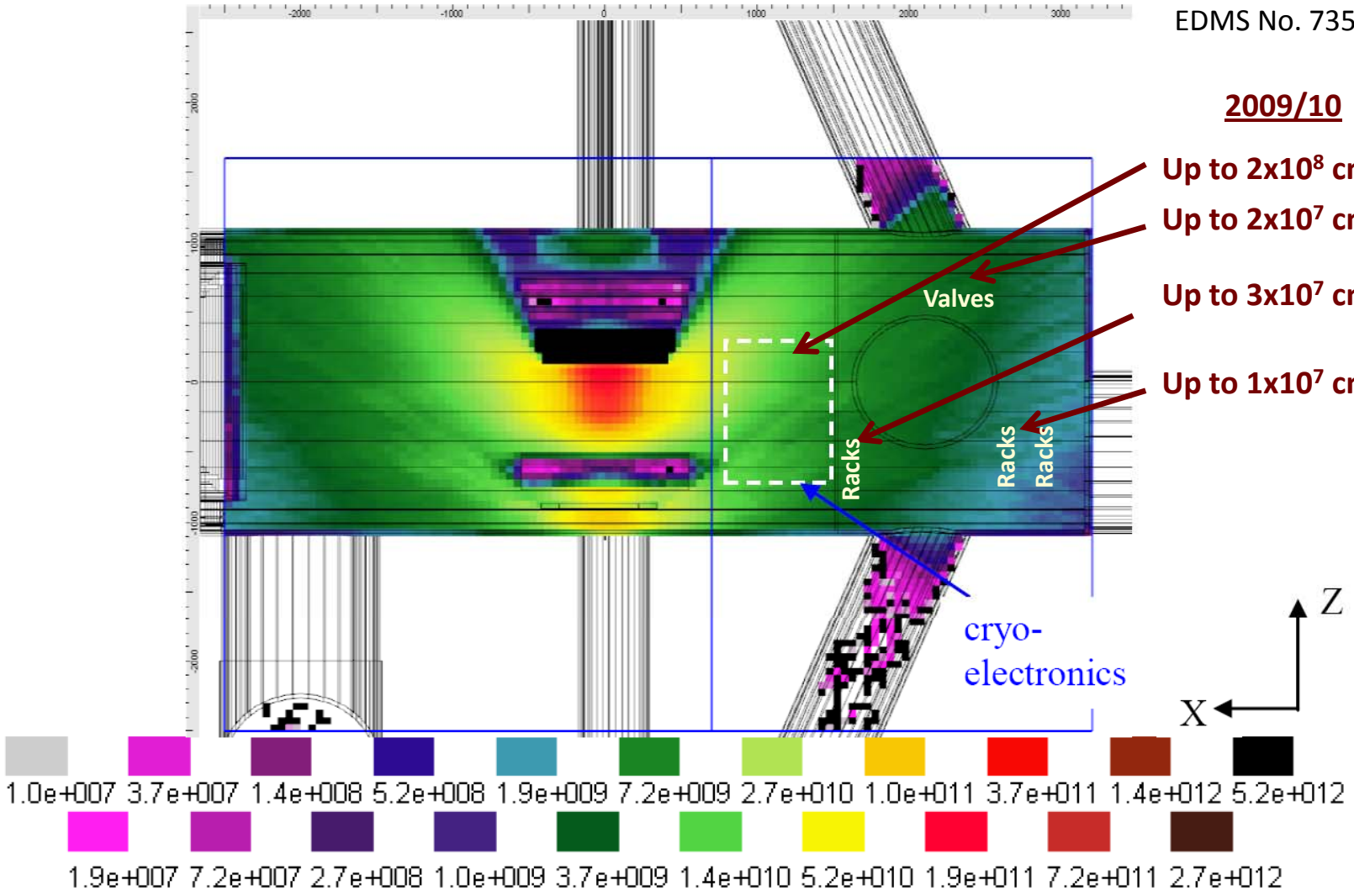
Up to $3x10^7$ cm^{-2}

Up to $1x10^7$ cm^{-2}

Up to $5x10^6$ cm^{-2}

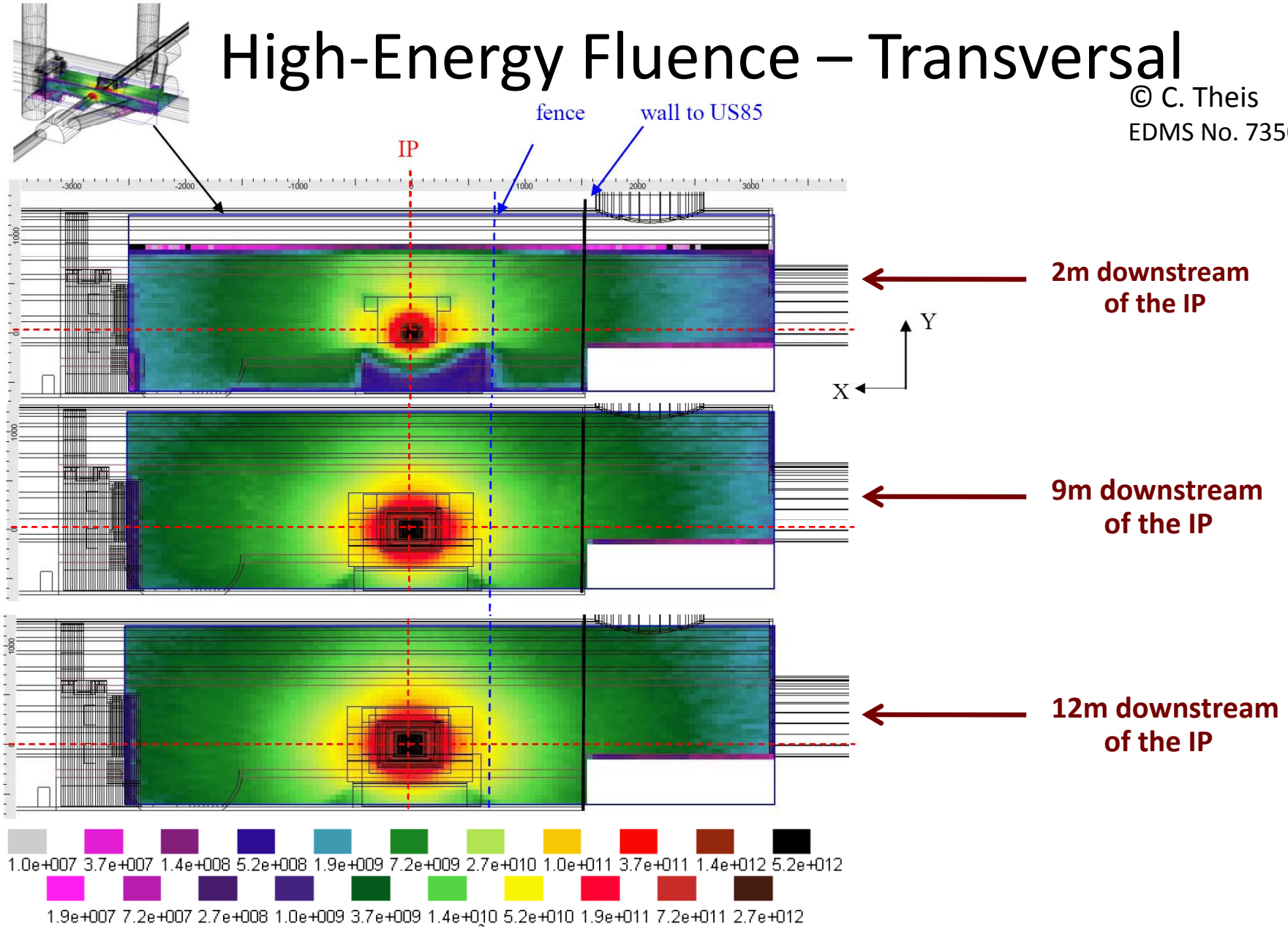
Graph - applied normalization: $2x10^{32}$ $cm^{-2}s^{-1}$, nominal LHC year ($1x10^7$s) -> $1.6x10^7$ pp/s, including a safety factor of two and for 10 years of operation!

High-Energy Fluence – @ Niveau 2



Graph - applied normalization: $2x10^{32}$ $cm^{-2}s^{-1}$, nominal LHC year ($1x10^7$s) -> $1.6x10^7$ pp/s, including a safety factor of two and for 10 years of operation!

High-Energy Fluence – Transversal



Graph - applied normalization: 2×10^{32} cm^{-2}s^{-1} , nominal LHC year (1×10^{7}s) -> 1.6×10^{7} pp/s, including a safety factor of two and for 10 years of operation!

Radiation Levels - Conclusion

- **US85 most probably ok for 2009/10**, however at the edge in case of optimistic operation (for some locations)
- **Conservative** simulations, thus this might help!
- **Early measurements** will show real attenuation, etc…
- Problems to be expected (on the long run) for **all electronics locations**?
- **Important amount** of racks/equipment concerned
- Detailed rack locations & list of equipment is a **crucial input** to go further
- Are additional radiation tests required/possible?
- **Solutions**: relocation partly?, shielding limited/difficult?, redesign possible/required?,… -> **NEXT**

Equipment Questionnaire

- **Collect all information** for future optimizations/actions
- **Required Identification Details:**
  - Location, Rack Identification
  - Equipment description
  - Contact Person
- **Detailed Assessment:**
  - Description of equipment, used and provided communication
  - Consequences of failure
  - Dependencies: systems the equipment depends on, and systems depending on the described equipment
- **Impact/Options for Relocation:**
  - Cable requirements
  - Maximum distances
  - Cooling requirements’
  - Other requirments/constraints