CMS Shielding @ SLHC

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(Based on simulations of 2002-2003)

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CMS Shielding Concept

Take full profit of the iron Yoke

- provides excellent protection of Barrel Muon system
- reduces background on FW muon system

Optimized (conical) shape of beam pipe for z < 10.6m

- reduces significantly background in FW muon system at $\eta > 2$

FW Calorimeter outside main detector

- freedom to add shielding around, easy service routing,...

"Rotating shielding" around TAS

- allows fast opening of CMS and access to detectors
- no shield/beam-pipe dismanteling -> reduces radiation exposure
- at its weight limit ! -> not possible to upgrade

Pushing for 1E35...

If predictions get confirmed, CMS should be ~OK up to ~2E34

Beyond that:

- barrel HCAL & Muon detectors probably ~OK
- increase of pile-up (= noise) in barrel ECAL
- usefulness of FW HCAL doubtful (I don't really know)
- endcap calorimeters likely to die or be severely compromised
- reduce significantly FW muon acceptance (to add shielding)

I SEE NO WAY TO MAINTAIN PRESENT PERFORMANCE

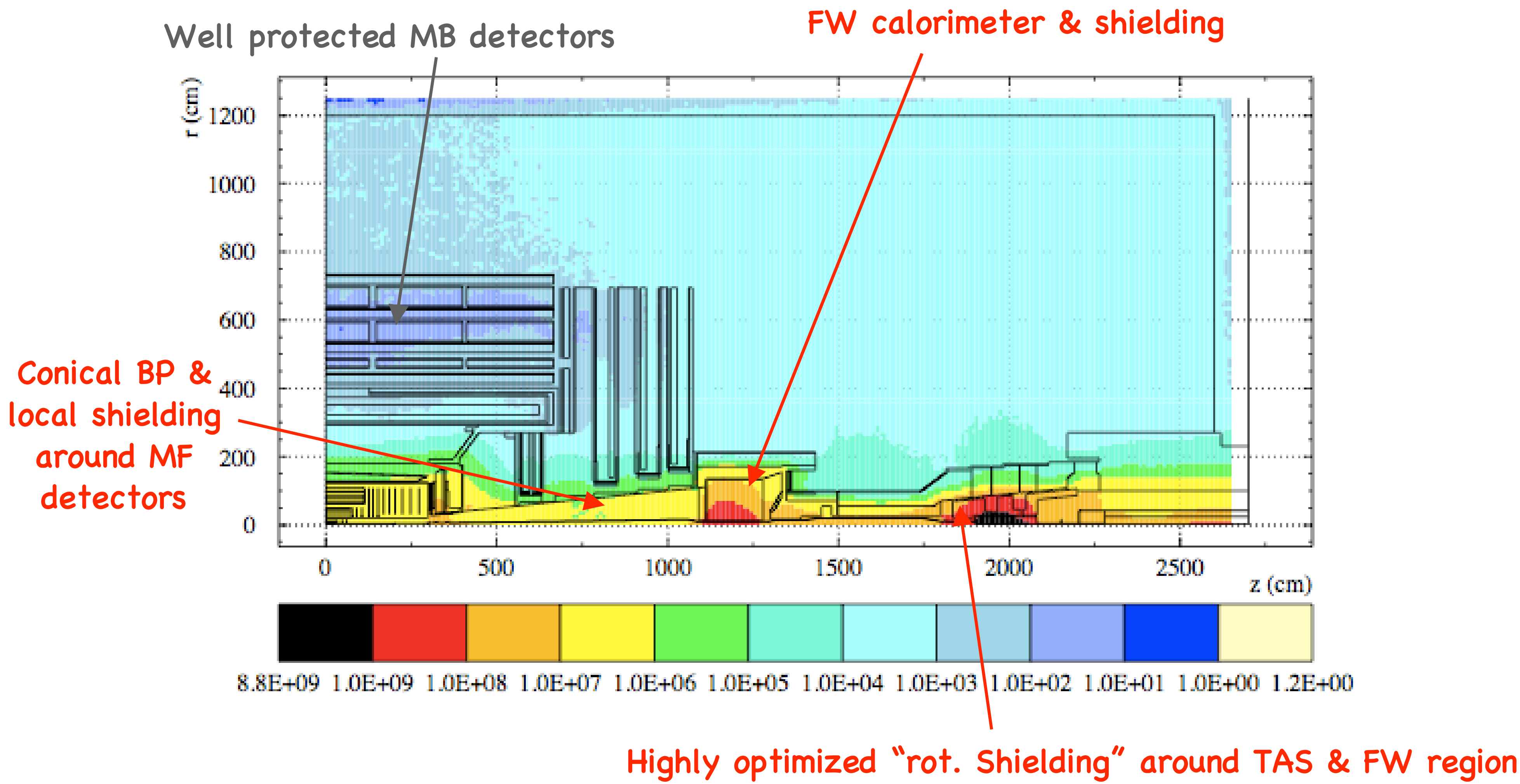
And...

- reinforce FW shielding (rule of thumb: 1 m concrete = factor of 10)

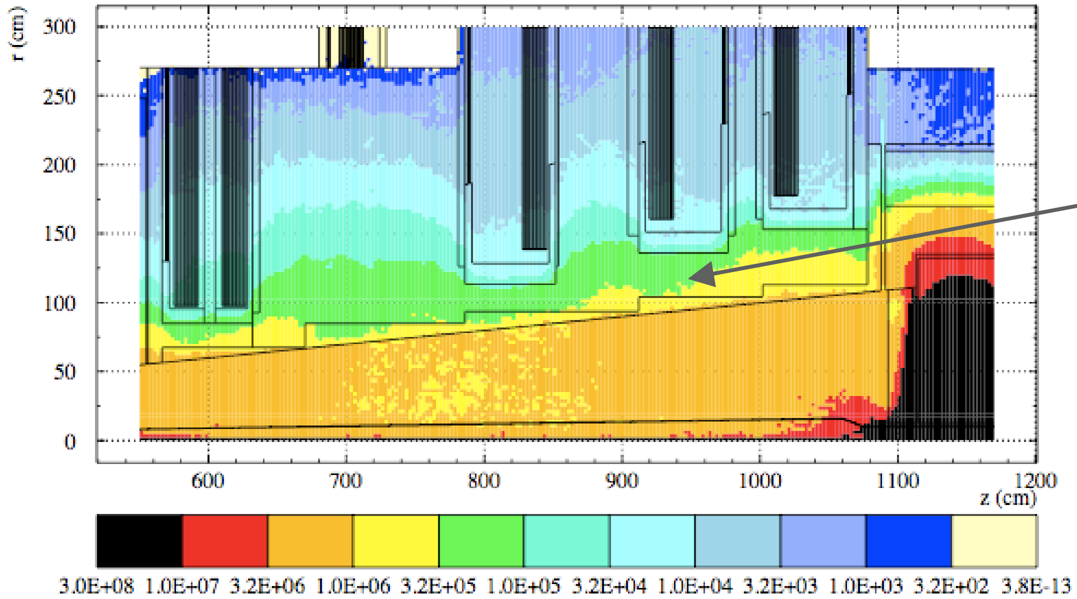
But this will need extra support structures

!!! Activation will be a severe problem !!!!

CMS Fw shielding at 1E34

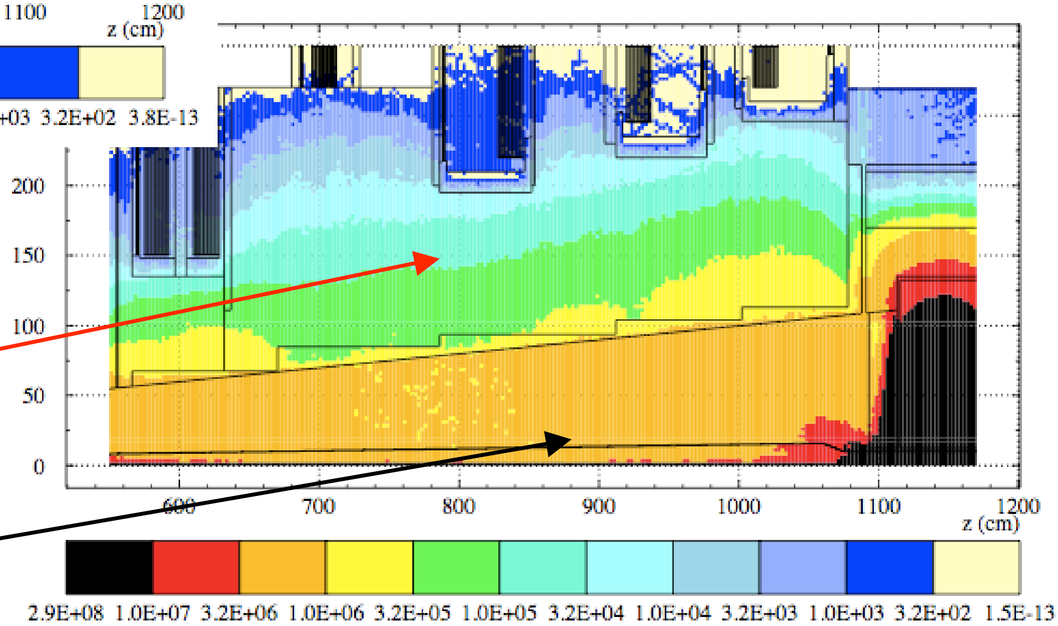


Problem area: “η=3 cone”



This is our predicted neutron flux (n/cm^2/s) at 1E34 (CSC acceptance up to η=2.4)

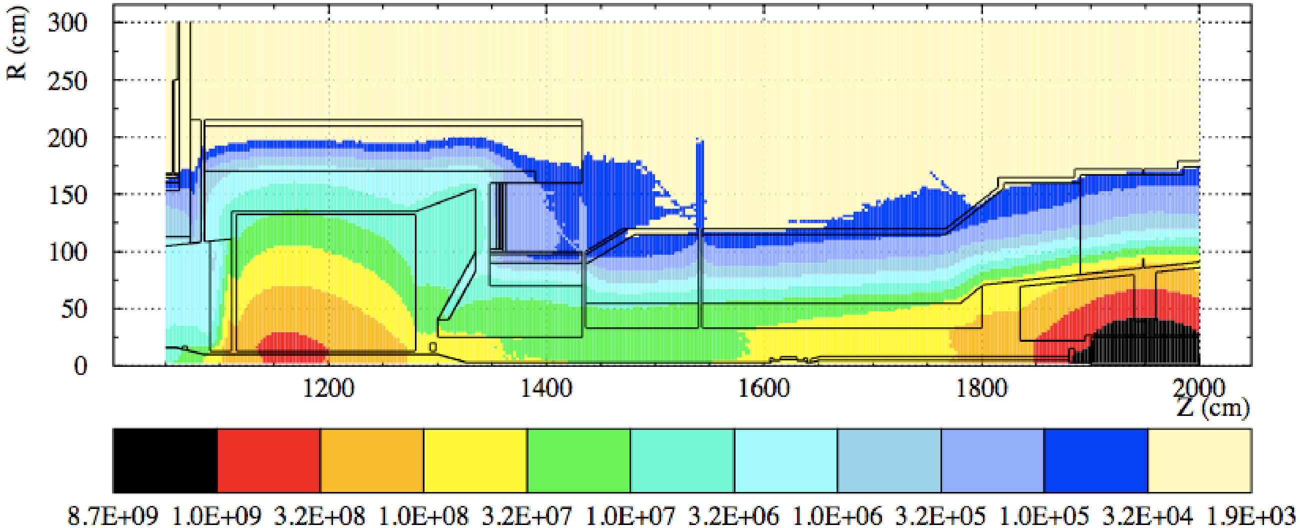
This was our study of shielding Increase in order to tolerate 1E35 (CSC acceptance up to η=2.0)



A magnet here would be terrible…

FW Shielding Performance

The FW shielding is optimized for the TAS to be the major source

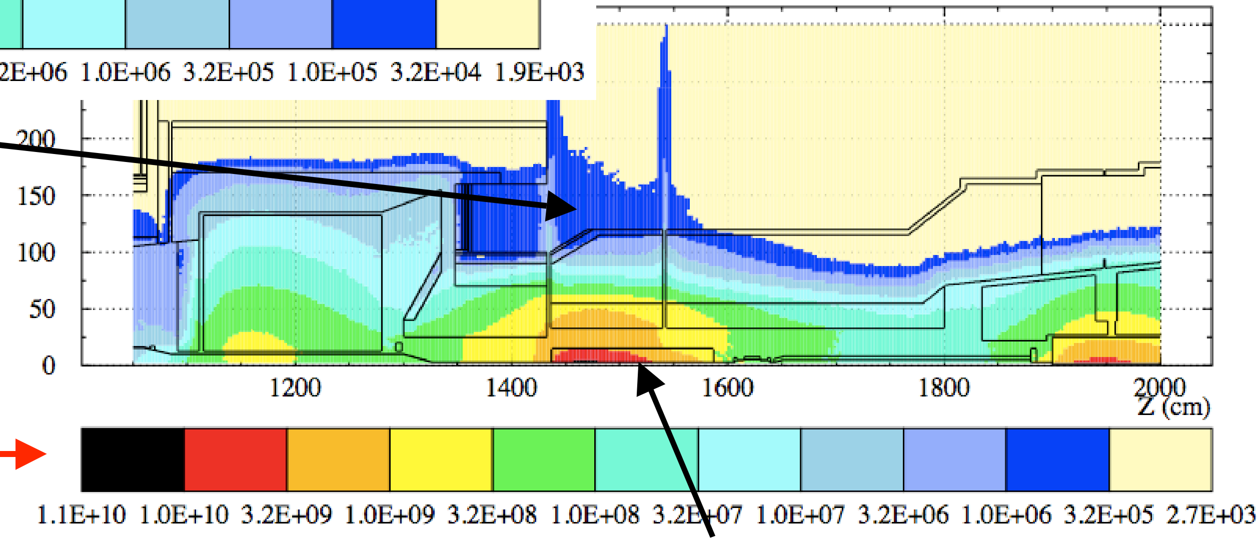


Shielding slightly modified in 2003 in order to accommodate CASTOR (tungsten calorimeter)

~10 times more(local) leakage

Running with CASTOR possible, up to ~1E33

Note: scale shifted by Factor 10 !



Castor

CASTOR vs moved TAS

CASTOR has an inner aperture of R=30 mm @ 14.3m (η~6.8)

TAS has an inner aperture of 17mm @ 19m (η~7.7)

Thus simulations for CASTOR give an idea what a TAS (or a magnet) closer to the IP would cause

Semi-quantitative conclusion (for magnet at 14.5m and 1E35)

Background in UXC increases by factor 10
+ another factor 10 from 1E34-> 1E35

To maintain "nominal" UXC radiation levels, need about 200cm Additional borated concrete around thin part of FW shielding

Magnets in UXC – consequences

z>~14m:

See previous slide

- present FW shielding has to be replaced or reinforced (~2m more)

11m<z<14m:

Conflict with present HF

- abandon HF (= decrease acceptance !) and use present absorber as shielding
- build new HF at z~4m (and introduce problems there…)

Z<11m:

“Blind” parts of HF (do we really care…?)

Introduce SEVERE background to FW Muon system

- abandon, or restrict severely (η~1.7 ?) FW muon acceptance
- very large aperture Q0 (could it be R>>100mm ?)
- fill all of “h=3 cone” with shielding (Fe or Cu)
- build new HF at z~4m (and introduce problems there…)

Conclusions

CMS is designed for 1E34 and the limit probably comes soon thereafter

This design is the result of >10 years (!) careful optimisation (of performance, cost, functionality...)

A luminosity of 1E35 is bound to degrade CMS performance

A magnet in UXC is going to make background in UXC even worse

(in addition to intensity increase, this
brings the source closer to our sensitive detectors
and is incompatible with our general shielding concept (page 2))

...but probably it's not making it any more impossible to maintain full performance

(I don't even want to think, how to handle the activation)

Good luck...