

RADIATION ISSUES AT FUTURE COLLIDER IR

pp- and accelerator-related radiation loads in CMS-like collider detector and machine components at LHC/SLHC/VLHC

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OUTLINE

- Source terms
- Comparing machines: intensity and luminosity arithmetic
- Detector and event gallery at 40 TeV
- Simulated radiation loads in inner tracker and hadron calorimeter at $\sqrt{S}=14, 40$ and 200 TeV
- Detector and IR protection against pp-collision products
- Dipole-first layout
- Detector and IR protection against operational and accidental beam loss

SOURCE TERMS

1. pp collisions $\sim \mathcal{L}=10^{32}$ to $10^{35} \text{ cm}^{-2}\text{s}^{-1}$
2. Operational beam loss: tails from collimators and beam-gas scattering, \sim beam intensity $I = 10^{14}$ to 10^{15} .
3. Accidental beam loss: abort kicker prefire / unsynchronized beam abort, \sim beam intensity $I = 10^{14}$ to 10^{15} , up to 10% loss in IR if not intercepted in the abort section.

INTENSITY AND LUMINOSITY ARITHMETIC

| Machine | E (TeV) | I, 10^{14} | Q (GJ) | \sqrt{S} | \mathcal{L} , 10^{34} | σ_p (mb) | 10^{16} (int/10yr) |
|----------|---------|--------------|--------|------------|---------------------------|-----------------|----------------------|
| Tevatron | 0.98 | 0.1 | 0.0016 | 1.96 | 0.01 | 60 | |
| LHC | 7 | 3.1 | 0.35 | 14 | 1 | 80 | 4 |
| SLHC | 7 | 9.6 | 1.08 | 14 | 10 | 80 | 40 |
| VLHC-1 | 20 | 9.7 | 3.20 | 40 | 1 | 90 | 4.52 |
| VLHC-2 | 200 | 2.0 | 3.20 | 200 | 2 | 105 | 10.52 |

LHC rule:

$$\mathcal{L}_{10\text{yr}} = (0.1 + 1/3 + 2/3 + 7) \times \mathcal{L} \text{ at } 180 \text{ days/yr}$$

$$10\text{yrs} = 5 \times 10^7 \text{ s} \rightarrow 500 \text{ fb}^{-1}$$

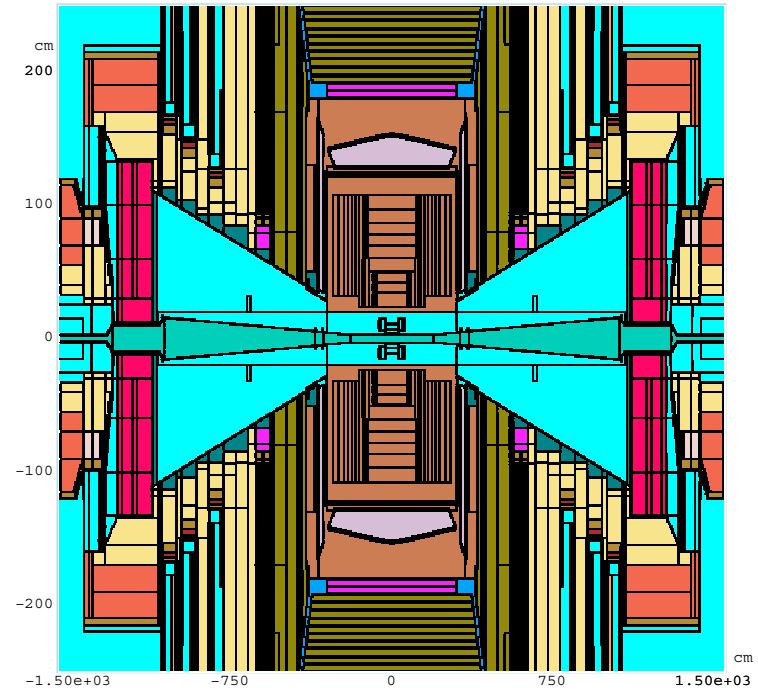
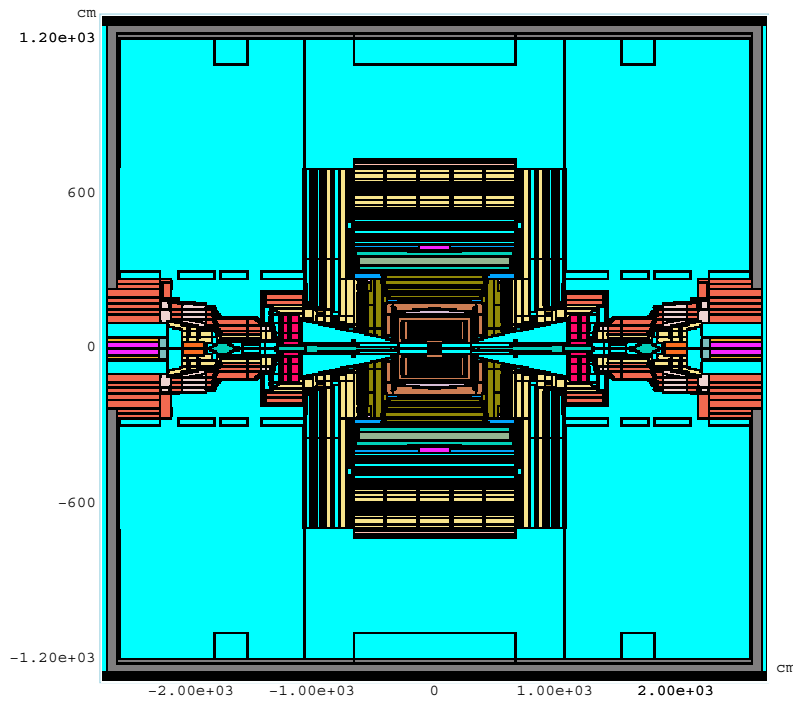
$$8 \times 10^8 \text{ int/s at } 80 \text{ mb and } 10^{34} \rightarrow 4 \times 10^{16} \text{ int/10yr}$$

PP-EVENT AT 14, 40 AND 200 TEV

Average multiplicity, energy and transverse momentum
in pp-collisions as simulated with DPMJET-3

| | \sqrt{S} (TeV) | 14 | 40 | 200 |
|-------------------------------|------------------|--------|--------|--------|
| $\langle n \rangle$ | p | 2.63 | 3.09 | 4.03 |
| | n | 2.13 | 2.61 | 3.55 |
| | π^0 | 35.49 | 44.76 | 62.91 |
| | All charged | 72.93 | 92.26 | 129.85 |
| | Total | 126.97 | 160.76 | 226.36 |
| E (TeV) | p | 3.58 | 9.84 | 49.34 |
| | n | 1.42 | 4.22 | 21.10 |
| | π^0 | 2.48 | 7.09 | 35.63 |
| | All charged | 8.61 | 24.43 | 121.41 |
| | Total | 14.00 | 40.00 | 200.00 |
| $\langle p_t \rangle$ (GeV/c) | π^\pm | 0.46 | 0.50 | 0.61 |

CMS COLLIDER DETECTOR IN FLUKA AND MARS



40-TeV pp event gallery

