ENERGY DEPOSITION WORKING GROUP SUMMARY

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VLHC Workshop on Accelerator Physics
The Abbey, Lake Geneva, Wisconsin
February 25, 1999

The major issues discussed in this working group were:

- Beam abort and absorbers
- Fast accidental beam loss
- Quench and beam loss limits
- Beam collimation
- Interaction region issues
- Components lifetime, survival of electronics in the tunnel
- Environmental issues

1 Beam Abort and Absorbers

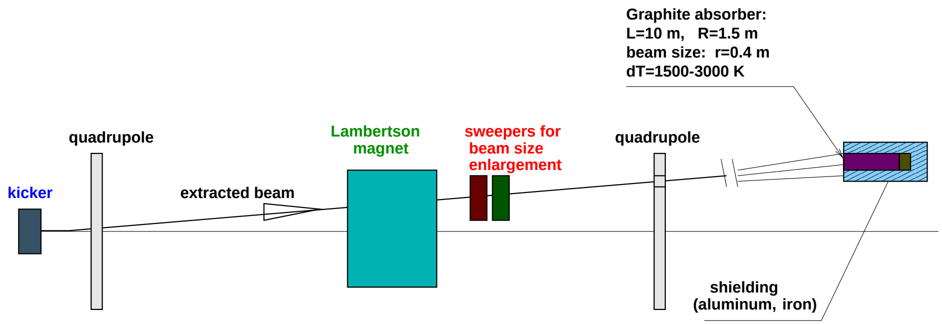

Figure 1: Abort system in the VLHC utility straight section.

Low-field VLHC: 1.12×10^{15} ppp at 50 TeV = 9 GJ = 2000 kg of TNT. A one-turn beam extraction (1.8 ms, $\sigma \approx$0.1 mm):

- $\sigma_0 \approx$1.5 cm: 60 m of 40 T/m blow-up quads
- Graphite absorber (L=10 m, R=1.5 m) at 3 km from the extraction point:
  - $\sigma_{x,y}$= 30 cm – out of the question;
  - "SSC" raster painting ±60 cm at 7.5 kHz – pileup;
  - spiral sweep R=30 cm at 10 kHz – may be OK
- Air-core absorber at 1 atm: L=6-7 km, flared R_{max}=1.5 m, highly turbulent air
- Grazing beam on a water pool...
- Graphite fibers or foam
- Window problem at $\sigma \approx$0.1 mm:
  - $\sigma \geq$ 0.5-1 cm;
  - differential pumping with several wire meshes;
  - windowless plasma porthole.

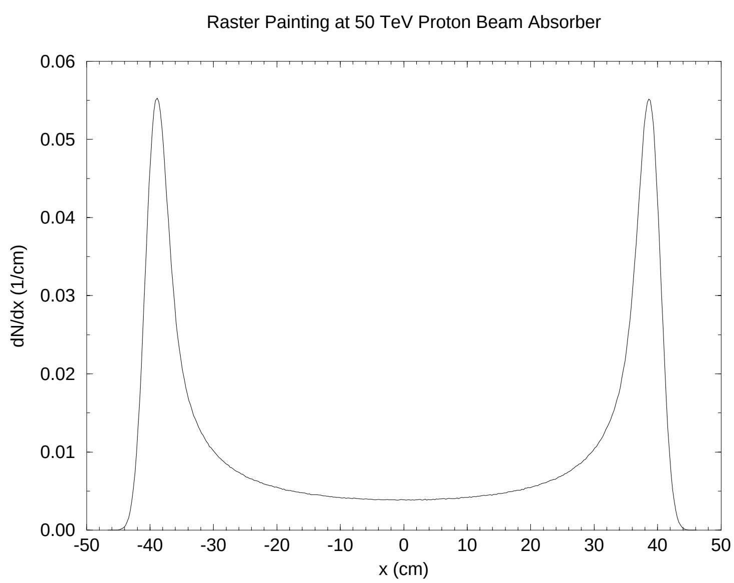

Figure 2: Raster painting at VLHC beam absorber.

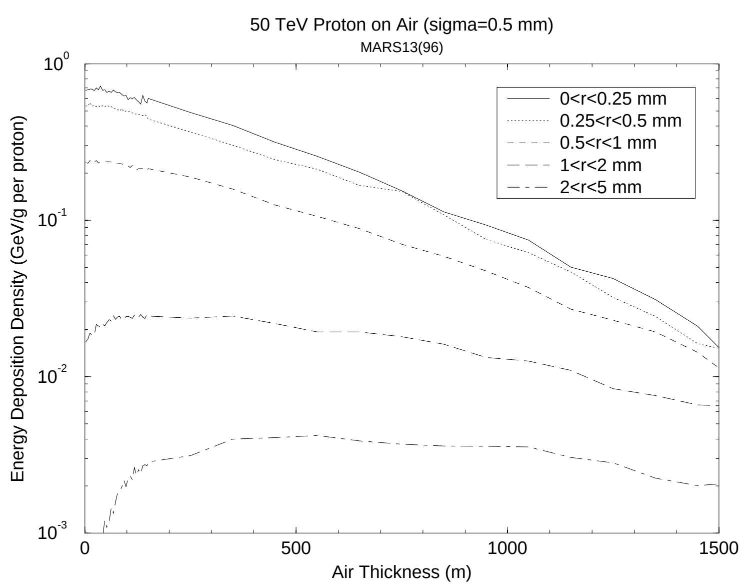

Figure 3: Energy deposition as a function of distance in VLHC air absorber.

2 Fast Accidental Beam loss

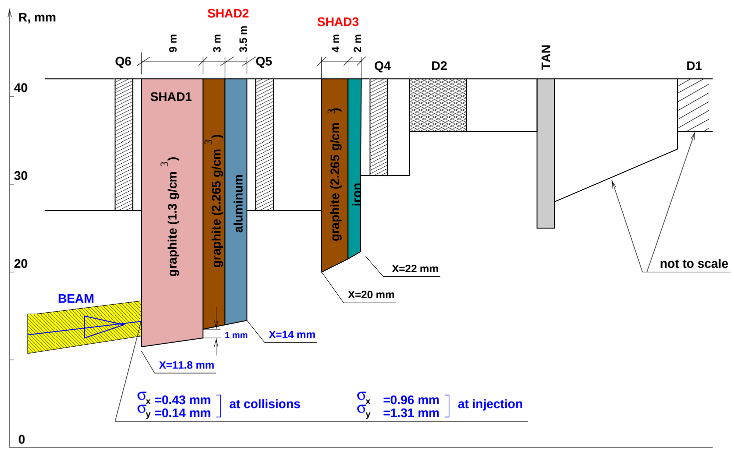

Figure 4: Shadow collimators for low-β quad protection at accidental abort kicker prefire.

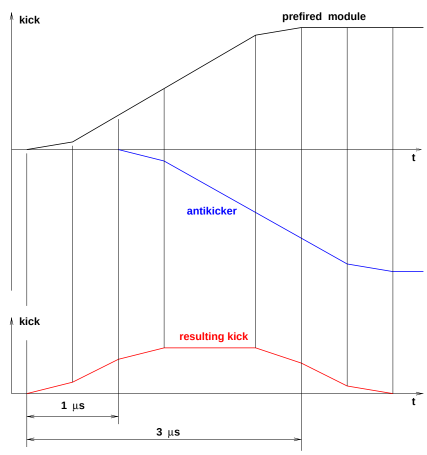

Figure 5: Resulting kick at accidental abort kicker prefire with compensation via antikicker.

BEAM INDUCED RADIATION EFFECTS IN THE VLHC TRANSMISSION LINE MAGNETS

A. Drozhdin, W. Foster and N. Mokhov

February 22-25, 1999

- MARS Magnet and Beam Loss Model
- Longitudinal, Lateral and Azimuthal Distributions at 3 and 50 TeV
- Effect of Plug Material
- Beam Loss at Injection
- Catastrophic Beam Loss

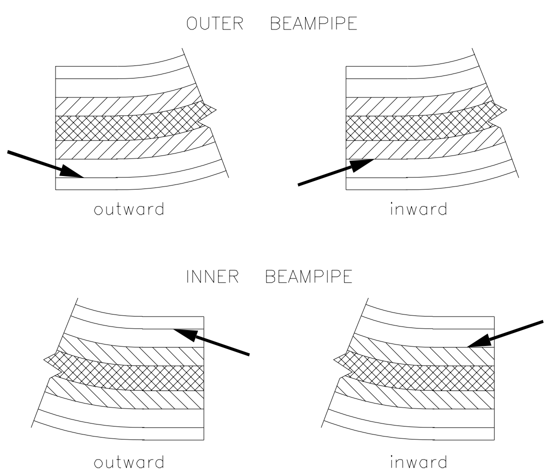

Figure 6: Beam loss on VLHC transmission lime magnet.

BEAM LOSS MODEL
IN THE VLHC TRANSMISSION LINE MAGNET

Magnet: 250 meter long, B_0=2 T, B_{inj}=0.1 T
Beam: $\epsilon_{95\%} = 15\pi$, β_{max}=200 m

Ring	Energy (TeV)	$\sigma_{x,y}$ (mm)	α_{inc} (mrad)
3-TeV	0.15	1.8	0.9
	3	0.4	0.2
50-TeV	3	0.8	0.4
	50	0.2	0.1

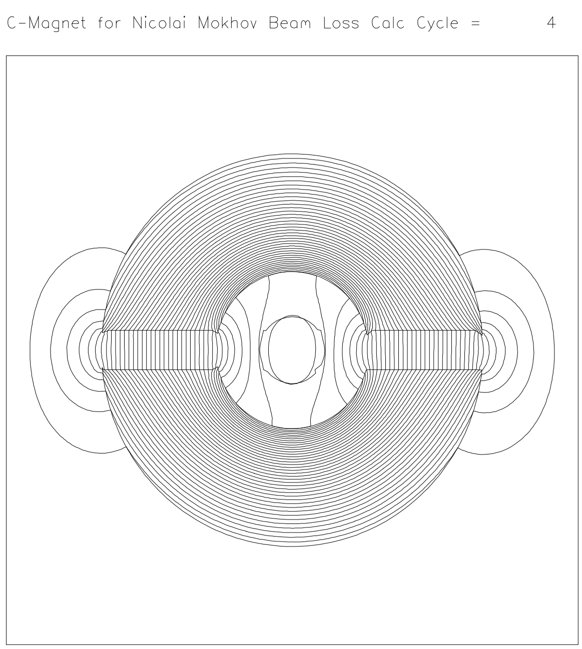

Figure 7: Magnetic field in the VLHC transmission line magnet.

TOLERABLE BEAM LOSS AT TOP ENERGY IN THE VLHC TRANSMISSION LINE AND TEVATRON MAGNETS

	Fast ppp	**Slow** p/s
3 TeV	3×10^8	1×10^9
50 TeV	1×10^7	3×10^7
Tevatron	4×10^7	3×10^8

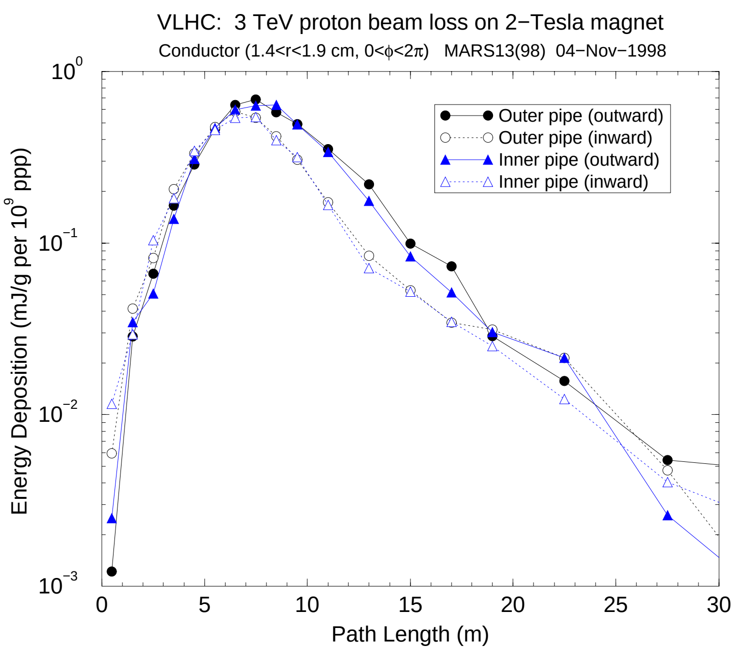

Figure 8: Longitudinal distribution of the peak energy deposition in the VLHC transmission line magnet.

3 Beam Collimation in VLHC

- J.B. Jeanneret and E. Wildner “Beam Losses and Collimation in VLHC”
  (contributed talk)
- A.I. Drozhdin, N.V. Mokhov, A.A. Sery “The Very Large Hadron Collider Beam Collimation System”
  (contributed talk)

4 Interaction Region Issues

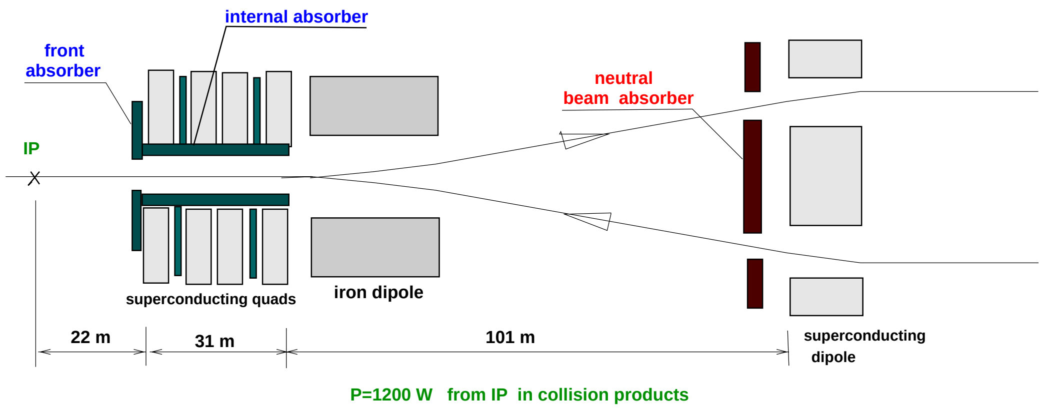

Figure 9: Protection system in the VLHC interaction region.

5 Components Lifetime, Survival of Electronics in the Tunnel and Environmental Issues

See SSC and LHC approaches.

6 Energy Deposition: Futher Studies

- Handling the fast accidental beam loss (antikickers, shadow collimators etc.)
- Absorber (sweeping, graphite fibers and air-core) and window (windowless)
- Survival of primary and secondary collimators
- Bent crystal as a primary collimator
- Full simulation for a generic detector
- Radiation map in the tunnel for low-field and high-field options
  (lattice, beam loss scenario and distribution, tunnel electronics in a hole, limits, local shielding in hot areas, environmental issues)
- **Measurement** of fast and slow spill quench limits for low-field and high-field magnets