

# **Why change something to the LHC collimation system**

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`/Coll/2002/heat_data/maric_march/maric.tex`

## OutLine

- Short history and present organisation
- Compare
  - Yellow Book specification
  - New specification
- Dump kicker errors
- Heat and mechanical issues for the collimators  
(Optics and Quench Prevention Properties shall not change)
- Future

## Short history and present organisation

- Activity followed by PLC, with emphasis on
  - Layout optics , magnets, aperture and Quench prevention
- Beginning 2001: PLC disappeared, replaced by LCC. Now emphasis on
  - Operation, Collimator hardware
- Creation of a LHC Beam Cleaning Study Team
- Organisation of a Collimation Day 25.01.2002, CERN-wide, an hardware review with most of CERN experts

## **LHC Beam Cleaning Study Team**

### **Mandate:**

Study beam dynamics and operational issues for the LHC collimation system. Identify open questions, assign priorities, and show the overall feasibility of the LHC cleaning system.

**WEB-SITE** <http://lhc-collimation.web.cern.ch/lhc-collimation/>

### **MEMBERS**

R. Assmann (chairman), I. Baishev, O. Bruening, M. Brugger, H. Burkhardt, G. Burtin, B. Dehning, C. Fischer, E. Gschwendtner, M. Hayes, J.B. Jeanneret, R. Jung, V. Kain, D. Kaltchev, M. Lamont, H. Schmickler, R. Schmidt, J. Wenninger

## Specified Performance of the collimation system - a subset -

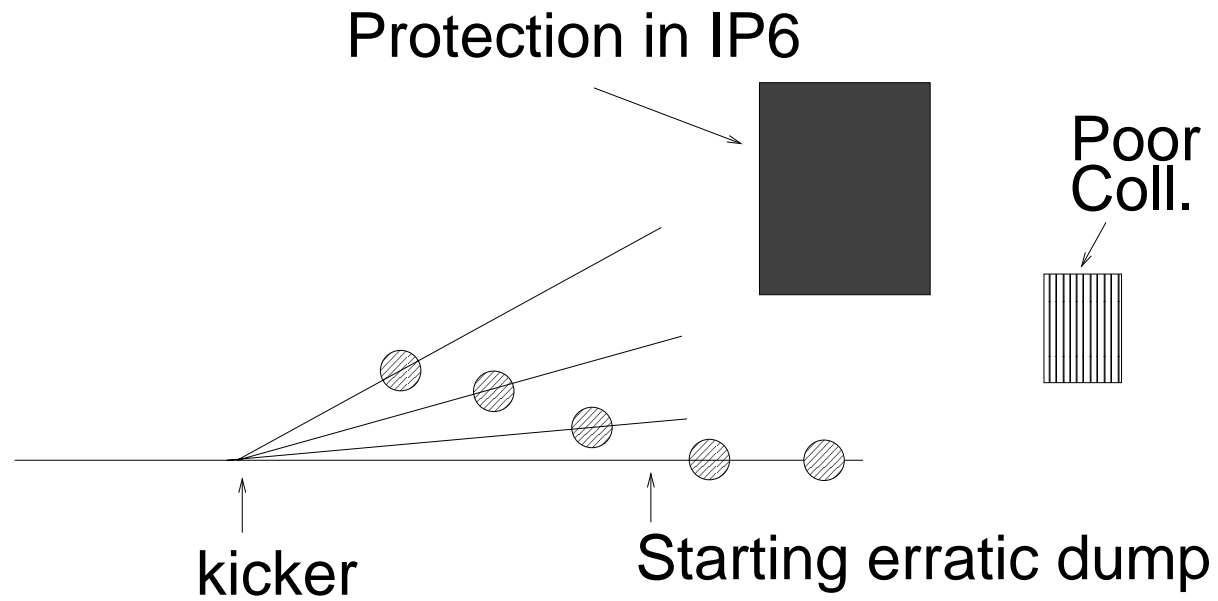
	Yellow Book	LCC/bc-st (prov.)
Off-bucket at ramping	3% of coast	unchanged
Beam lifetime at 7 TeV	30 hr*	1 hr + 0.2 hr during 10 s

\* Margin factor was 20

**NEW FACT:** Dump kicker failures more frequent than foreseen earlier

Today :        Self-trigger of a module per year

## Erratic dump kicker



## Nuclear and E-M parameters vs. Atomic Number

Material	$Z$	$L_r$ [cm]	$\lambda_{nuc}$ [cm]	$\lambda_{nuc}/L_r$
Be	4	35.3	40.6	1.15
C	6	18.8	38.1	2.02
Al	13	8.9	39.4	4.4
Cu	29	1.4	15.0	10.7

The lowest ratio  $\lambda_{nuc}/L_r$  minimises the Energy Density  
 $\Rightarrow$  low  $Z$  much better

## Dump kicker case

Case: possible reduction of mech. properties (allowed once/year)

Compare expected losses to allowed ones

	$N$ [bunches]	Margin Factor
Expected	6	
Allowed for:		
Beryllium	16 – 20	2-3
Graphite	5 – 9	0.8-1.5
Copper/Aluminium	0.1/0.5	0.01-0.1

To be used with care - Need real expertise



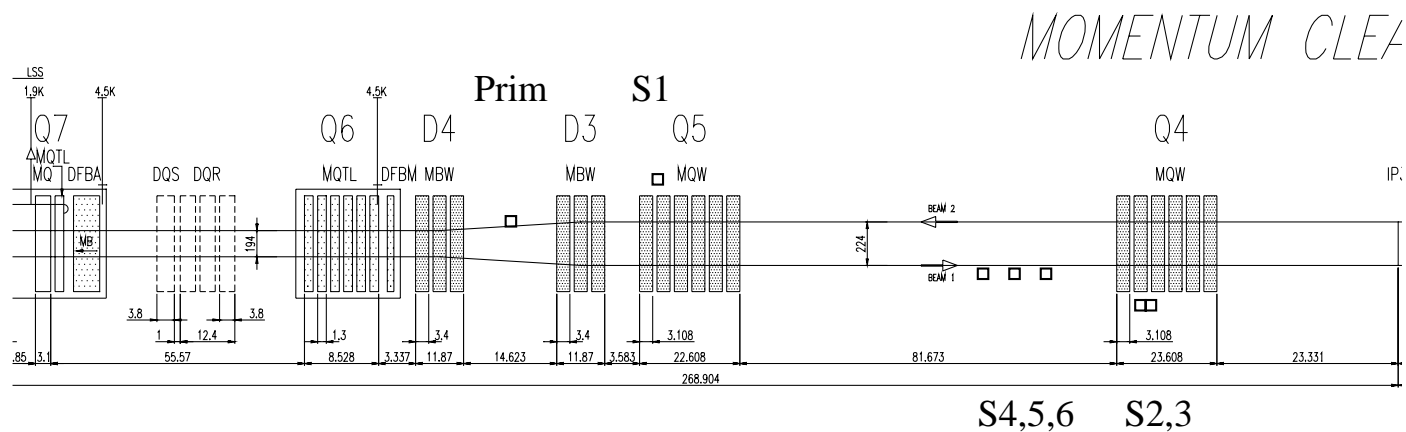
## Intermediate conclusion

- NEED low-Z materials
- Serious candidates:
  - Be, but toxicity
  - Pyrolythic Graphite, but brittle+dust, but poor conductor
  - Boron Nitride, but clay, but dielectric
- Challengers:
  - Fiber reinforced ceramics, Carbon-carbon, (diamond coating)
- Composite jaws: graphite core with Be plate near beam,...

Consequence: longer jaws (longer  $\lambda_{abs}$ )

Cu/Be:           50 to 120 cm

## Schematic layout of the Momentum Cleaning Insertion



- No space problem for longer collimators
- Slight rearrangement around warm magnets
- Anyway small changes for updated  $n_2/n_1$  ratio  
(more robust ratio  $7/6 \rightarrow 8/6$  ? (on-going work)  
 $\Rightarrow$  new phases  $\Rightarrow$  new locations

## Conclusions for layout

- No change for cold elements, little ones for warm quads

BUT

- Substantial studies for erratic dump errors (SL/BT)
- Substantial thermo-mechanical studies for collimators proper

## Future

- Task Force 5 proposes to create a Targetry Group
  - Dumps, absorbers, targets and collimators -

I personally believe that this is a very good proposal

In the meantime:

- Energy release in collimators studied between SL-AP, IHEP-Protvino and EST/ME

## **bibliography**

R. Assmann and J.B. Jeanneret, "Input on LHC collimation from the BI review". Dec. 2001. Available at:

[http://www.cern.ch/lhc-collimation/files/Bi\\_sum.pdf](http://www.cern.ch/lhc-collimation/files/Bi_sum.pdf).

R. Assmann et al., *Preliminary Beam-based Specifications for the LHC Collimators*, LHC Project Note 277, Feb. 2002.

R. Assmann, C. Fischer, J.B. Jeanneret and R. Schmidt, *Summary of the CERN Meeting on Absorbers and Collimators for the LHC*, LHC Project Note 282, to be issued March 2002.