

# CMS Permits

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On Behalf of CMS

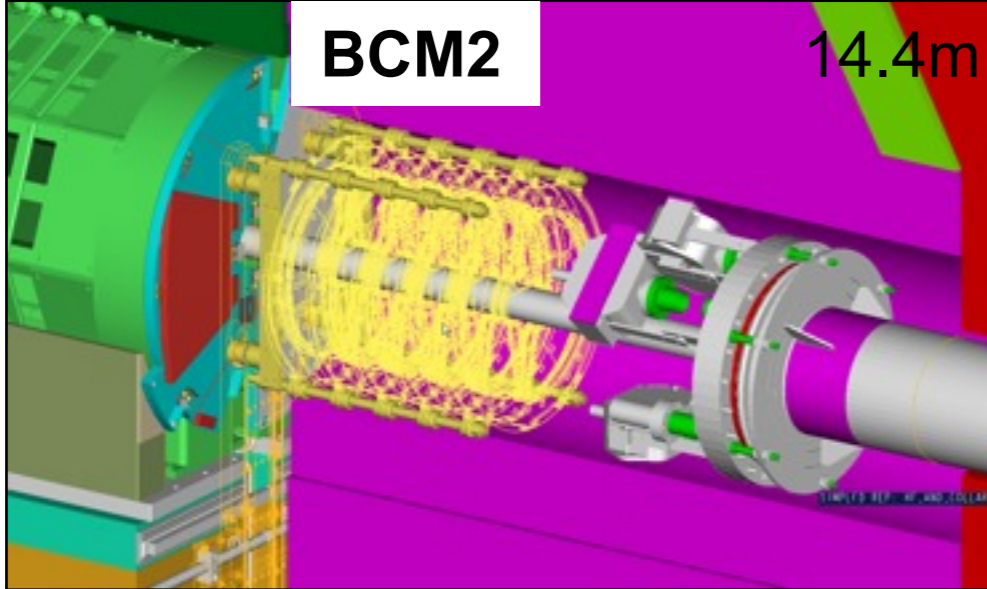
LHC Machine Protection Panel  
Friday 18th September 2009

# BEAM\_PERMIT

- Purpose:
  - Protect CMS when “fast” beam losses are high enough that CMS detector is in danger of immediate damage
  - Protect CMS from “slower” beam losses which might, if continued, reduce sub-detector lifetime significantly
  - A veto in the event of CMS not being in a safe state for beam operation
  
- CMS uses 3 CIBU units
  - Magnet
  - Crash Button in CMS Control Room (borrowed from TOTEM detector input for 09/10 run)
  - Beam Condition Monitors
- Logic takes input from following sources:
  - Magnet (however just continually asserts PERMIT at the moment, no logic involved)
    - CMS wishes to demonstrate quickly that the operation of the CMS solenoid has no effect on beam operation and thus that this input is not needed
  - Crash Button in CMS Control Room
    - Usage scenarios: Hard “off” for shutdowns/access days, “emergencies”
  - Beam Condition Monitors
    - ABORT can be triggered by high “fast” losses, high “slow” losses and BCM hardware failure
    - See following slides
- BEAM\_PERMIT was commissioned last year before beam
  - Recommissioning should be quick
  - Will start once cooling is back at CMS (next week)

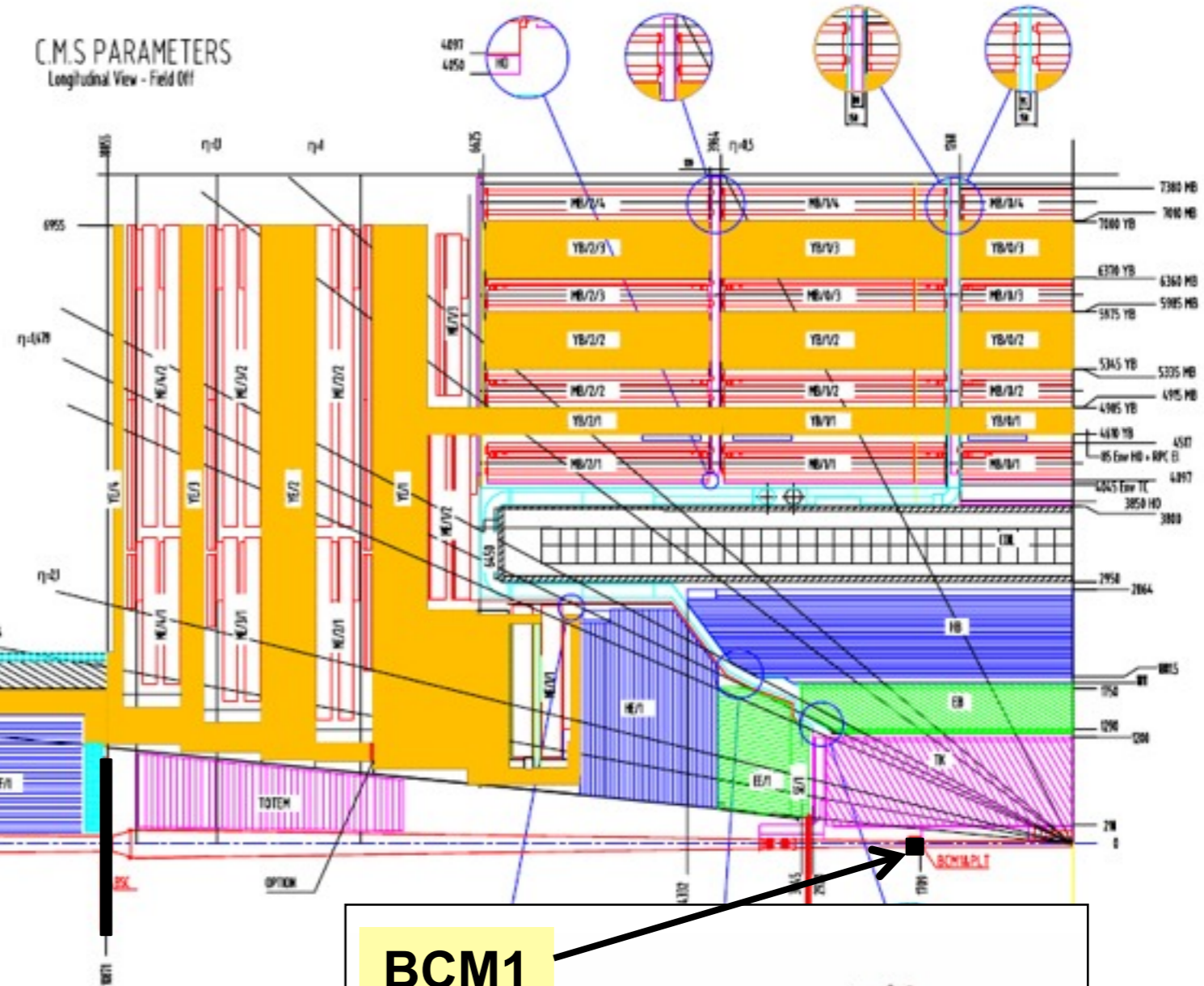
## BCM2: Leakage current monitor

Location:  $z = \pm 14.4\text{m}$ ,  $r = 29\text{cm}$ ,  $4.5\text{cm}$   
8 stations in  $\varphi$ , 24 sensors total



Readout: 25kHz / 40 us  
Front End: BLM tunnel cards

C.M.S PARAMETERS  
Longitudinal View - Field Off



## BCM1L: Leakage current monitor

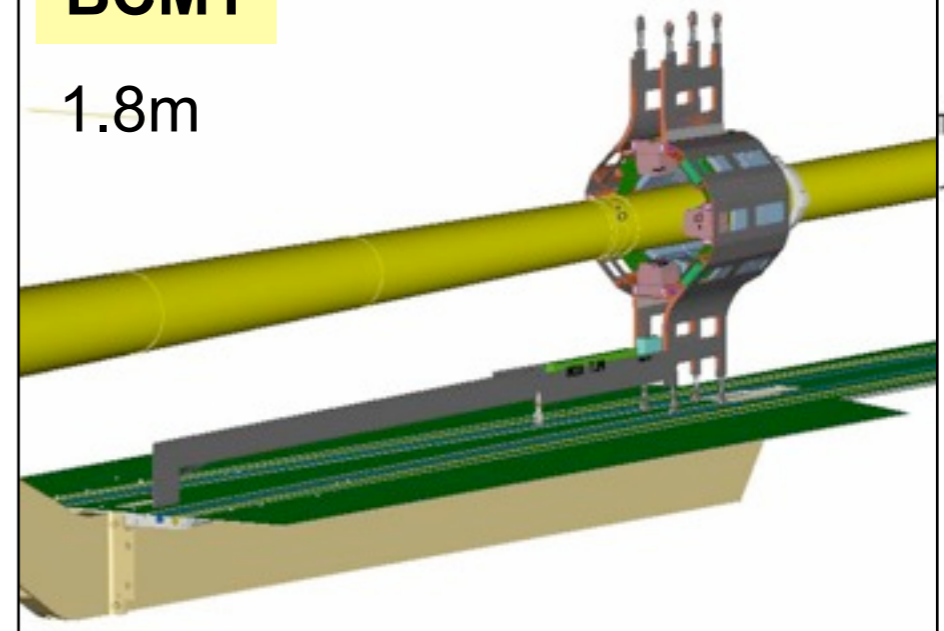
Location:  $z = \pm 1.8\text{m}$ ,  $r = 4.5\text{cm}$   
4 stations in  $\varphi$ , 8 sensors total  
Readout: 200kHz / 5us  
No front end electronics

Sensors:  $1\text{cm}^2$  polycrystalline cvd Diamond

Back End Readout: Strictly BLM Standard hardware + code

## BCM1

1.8m



ember 2006  
UB



# ABORT Thresholds

- Active Detectors:
  - Initially only 8 diamonds (4 per end) in inner ring on BCM2 will be “active” in asserting BEAM\_PERMIT
  - BCM1L hardware will be connected to the ABORT from the beginning, however thresholds will NOT be set until after a suitable commissioning period with beam
  - BCM1L detectors and inner ring of BCM2 are at ca. 4.5cm radius, approximately the same as innermost layer of pixel detector
  - Thresholds are per diamond. No coincidence required
  - Reminder:
    - BCM2 is strictly a “BLM”, except a diamond is attached as detector. All FE and BE readout BLM standard
    - BCM1L uses BLM readout architecture
- Obviously all levels will be continually reviewed as experience of beam conditions is gained
- “Fast” threshold: (previously presented)
  - Designed to protect against large fast losses that might overload FE electronics in CMS sub-detectors
  - Damage scenario envisaged by tracker / pixels is ca.  $10^9$  particles per accident per  $\text{cm}^2$  in a few bunch crossings
  - Number taken from testbeams done by tracker and pixels and from experience from CDF tracker
  - Set a large safety factor here of  $10^3$  meaning look for single losses of ca.  $10^6$  particles
  - Signal response in the diamond detector is:
    - $1.5 \cdot 10^{-15}$  A for 1 MIP/s
    - Assume 36 e/h pairs per  $\mu\text{m}$  and 250  $\mu\text{m}$  CCD
  - Integration time of BCM2 is 40  $\mu\text{s}$ , so this corresponds to 18.75  $\mu\text{A}$ 
    - Initial threshold set to 10  $\mu\text{A}$  in RS1 = 40  $\mu\text{s}$  time bins
  - Integration time of BCM1L is 5  $\mu\text{s}$ , so this corresponds to 150  $\mu\text{A}$ 
    - Threshold to be set to 60  $\mu\text{A}$  in RS1 = 5  $\mu\text{s}$  time bins (to be activated later)
- “Slow” threshold (>1s): (new)
  - Designed to protect against large losses which continue for a considerable period of time potentially eating into sub-detector lifetime radiation budget
  - A “large” integration time (>s) will be used here.
  - Take a value as 3 times “nominal” luminosity as the threshold level (“nominal”  $L = 2 \times 10^{34}$ )
  - This corresponds to losses of ca.  $3 \times 10^8$  MIPs  $\text{s}^{-1} \text{cm}^{-2}$  at a radius of 5cm (300 nA currents in BCM2/BCM1L)

# INJECTION\_PERMIT

- Purpose:
  - Signal whether CMS is in a safe state for injection to proceed
  - Hold off re-injection until post-mortem analysis from previous dump is understood
  - (Possibly) In the event of bad injection to hold off further injection until it is understood without dumping beam
    - Will not be activated unless need is shown
- CMS uses 2 CIBFU units
  - Beam 1 and Beam 2
  - Input into CIBFU is identical
- Logic takes input from following sources:
  - CRASH Button in Control Room
  - CMS State given by DCS
    - CMS\_ON means INJECTION\_PERMIT=FALSE
    - CMS\_STANDBY means INJECTION\_PERMIT=TRUE
    - State predominantly determined by tracker and pixels HV
  - Hardware input giving voltage state of tracker and pixels (foreseen, not initially active)
    - HV\_ON for either pixels or tracker drops the INJECTION\_PERMIT
- System able to take an input from the Beam Conditions Monitors, but not used in initial logic
  - Will decide at a later stage whether to enable inputs based upon experience of the beam
- After a dump, will manually hold-off INJECTION\_PERMIT until post-mortem analysis understood (i.e. dump was clean, or losses understood)
  - For all dumps, not just those initiated by CMS
- INJECTION\_PERMIT was commissioned last year before beam
  - Recommissioning should be quick
  - Will start once cooling is back at CMS (next week)

# Summary

- Initial usage of BEAM\_PERMIT and INJECTION\_PERMIT by CMS given here
- To be recommissioned next week
  - Will be relatively stable after that point (ie PERMIT will typically be asserted), however there will be occasional expert intervention
  - At what date should they be considered “live”?
- TOTEM inputs not addressed here (though they have their own inputs at Pt 5)