# Objectives of Monitoring System

**Provide an on-line monitor for beam conditions and possibility to request beam-abort, injection inhibit or ramp down detector voltages**

**Provide an initial mapping of the radiation field to check accuracy of background simulations and identify leaks in the shielding**

**Provide a long-term monitoring of integrated radiation exposure to aid in post-mortem diagnosis in case of device failure and to aid in corrective measures for background mitigation**

# Beam Conditions Monitor (BCM)

**We propose to study the use of small diamond detectors very close to the beam pipe at about z=1.5–2 m from the IP**

**Have to discriminate beam-loss against normal background from pp**

**1 proton on TAS: $10^{-10}$ Gy/p**

**Normal pp at $10^{34}$: 0.02 Gy/s**

$\Downarrow$

**100 ns sampling time gives sensitivity to loss of $>$20 protons on TAS**

# BCM functions

**Connect to LHC beam abort system to be able to send abort or injection inhibit request in case of major abnormalities**
**Connect to CMS DCS in order to be able to ramp down detector voltages in case of minor abnormalities**

**Potentially useful for diagnostics during beam set-up of the machine**

**Continuous monitoring of beam and background conditions with short sampling time. A record of these data form the centerpiece of the CMS radiation monitoring system, which otherwise might be mostly based on passive monitors. Thus it might be only the BCM which gives data with (very) high time resolution.**

# The first $10\,\mathrm{fb}^{-1}$ – initial mapping

**Need to establish relationship between BCM readings and radiation levels throughout CMS**

⇓

**Need active monitors in various parts:**

- **dummy/real pixel sensors on pixel structure**
- **the Si-sensors of the silicon Tracker**
- **the muon chambers**
- **special monitors (counters) in the UXC**

**Need to map the radiation field to inspect integrity of shielding and accuracy of simulations**

⇓

**Same monitors as above + additional passive monitors collected at the end of the run for readout**

# Long-term monitoring

**The BCM is the centerpiece of the monitoring system**

- **Passive monitors at critical locations inside detector and UXC**

⇓

**Not able to see beam losses which contribute only tiny percentage of normal exposure**

⇓

**Add a few active monitors, e.g. in collaboration with TIS**

# Radiation levels

| | | |
|---|---|---|
| **Tracker:** | **1 kGy–1 MGy** | **for 500 fb$^{-1}$** |
| | **0.02–20 kGy** | **for 10 fb$^{-1}$** |
| | **10–$10^4$ mGy/h** | **at L=$10^{33}$** |
| **ECAL:** | **100 Gy–100 kGy** | **for 500 fb$^{-1}$** |
| | **2–2000 Gy** | **for 10 fb$^{-1}$** |
| | **1–1000 mGy/h** | **at L=$10^{33}$** |
| **HCAL, MUON:** | **$<$100 Gy** | **for 500 fb$^{-1}$** |
| | **$<$ 2 Gy** | **for 10 fb$^{-1}$** |
| | **$<$ 1 mGy/h** | **at L=$10^{33}$** |
| **UXC:** | **$<$10 Gy** | **for 500 fb$^{-1}$** |
| | **$<$ 200 mGy** | **for 10 fb$^{-1}$** |
| | **$<$ 0.1 mGy/h** | **at L=$10^{33}$** |

**The PMI monitors of TIS have a dynamic range of 10 $\mu$Gy/h–400 mGy/h**

$\Downarrow$

**Perfectly suited as active monitors for UXC**

# Conclusions

**Diamond based BCM close to beam line is the centerpiece of the whole radiation monitoring system**

**Pixel and Tracker can do their own radiation mapping during pilot run, first physics run and even thereafter**

**Muon system might also be able to act as its own radiation mapping device (?)**

**PMI monitors used by TIS have perfect dynamic range for UXC and around HF**

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**Consider using ∼20 of these within the RAMSES network**

**Investigate cost effective and suitable passive monitors for initial mapping and long term monitoring**

**ECAL and HCAL RBX only outstanding issue: PMIs do not fit into the region – need smaller devices. Do we need active monitors here ?**