



# **Values for Safe-Injection/Safe-Beam Flag**

## **The ATLAS Point of View**

Sigi Wenig

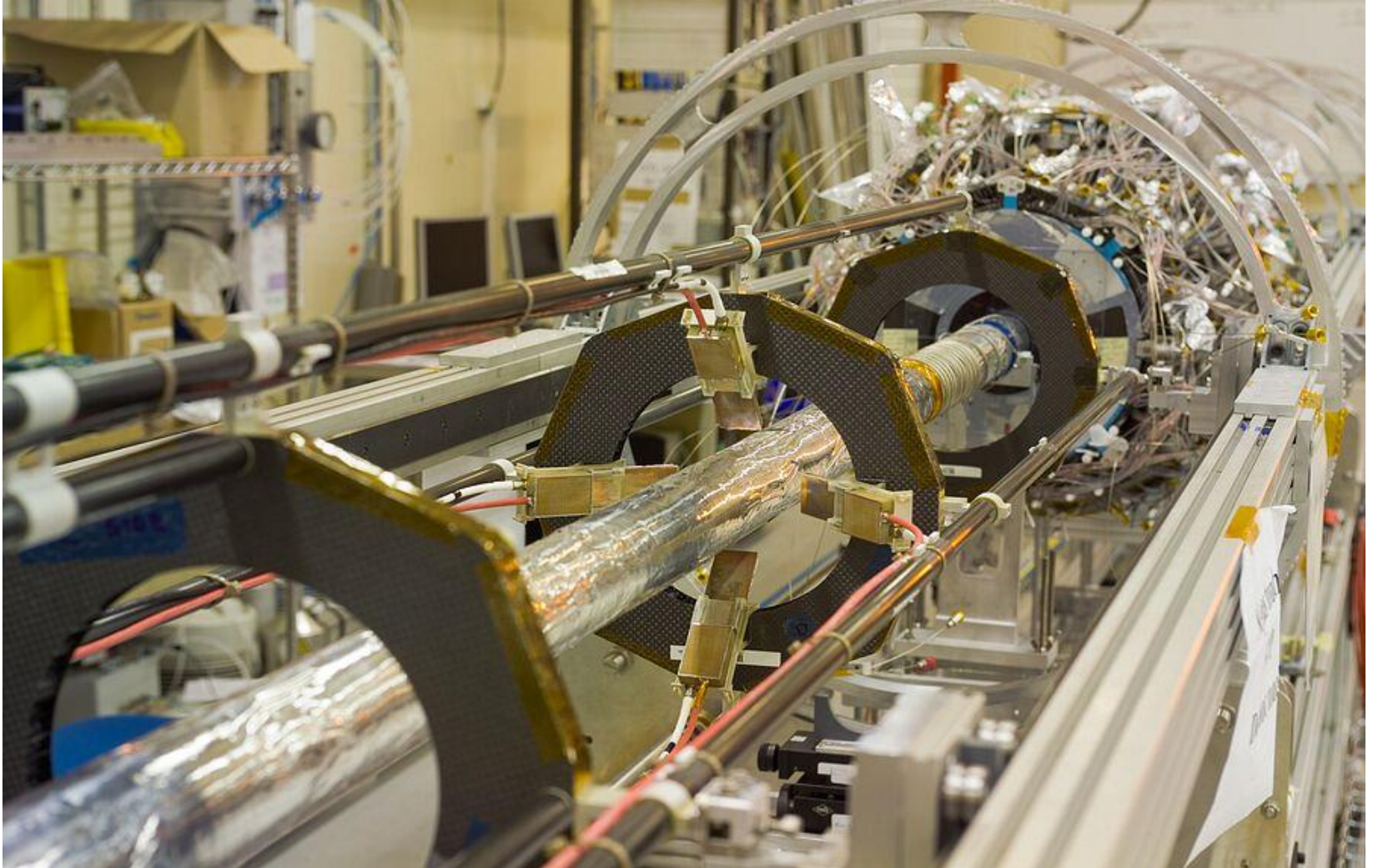
MPWG 16-Nov-2007

# Introductory Remarks

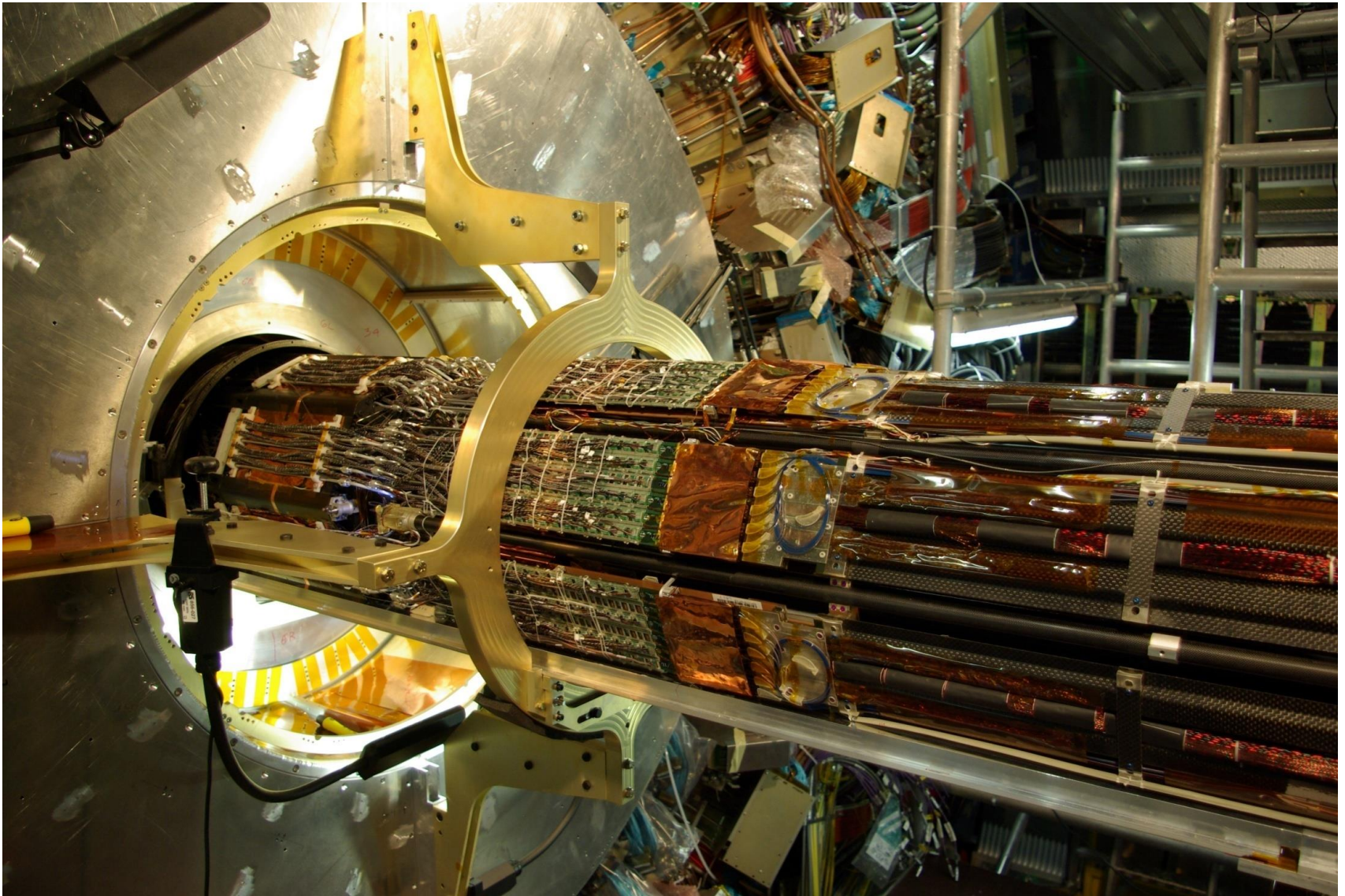
- The ATLAS Pixel Detector is installed
- It cannot be removed for beam commissioning
  - Removal necessitates complete opening of one side of ATLAS detector
  - Beam pipe is integrated
  - BCM system is integrated
- A removal/re-installation would need several months
- The Pixel Detector is worth 15 MCHF (material costs only)
  - There is no replacement existing
  - Replacement of inner layer (B-Layer) foreseen the earliest in 2012



# ATLAS Beam Pipe and BCM

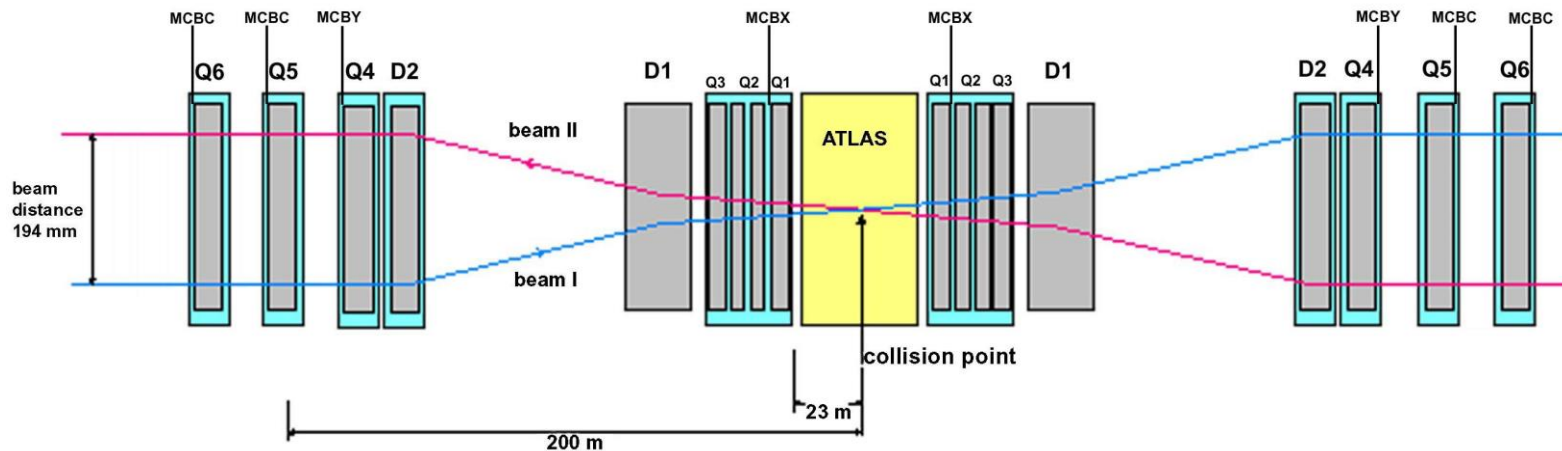


# Pixel Installation in Cryostat

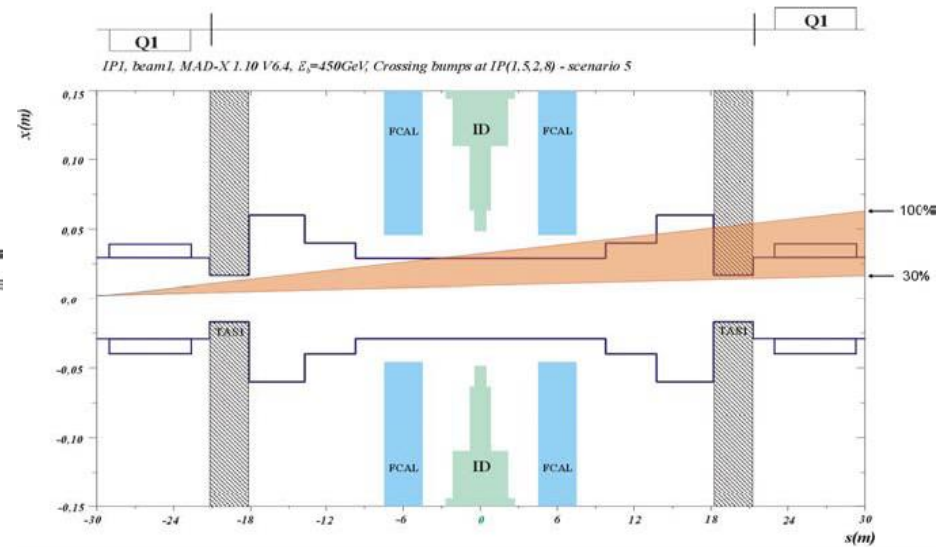
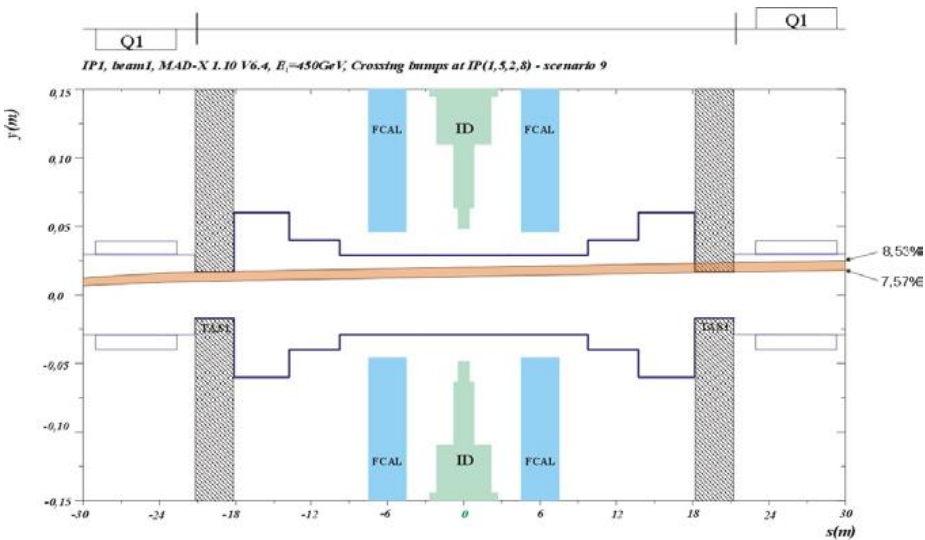


# Simulation Machine

- LHC Project Note 335 by Dariusz Bocian, January 2004  
*Accidental Beam Losses during Injection in the Interaction Region IR1*
- It is based on
  - Pilot bunch of  $5 \times 10^9$  p (in 370 ps)
  - Various wrong settings of Magnets MCBXV, MCBXH, D1, D2 (at injection)



# Simulation ATLAS - Two Scenarios

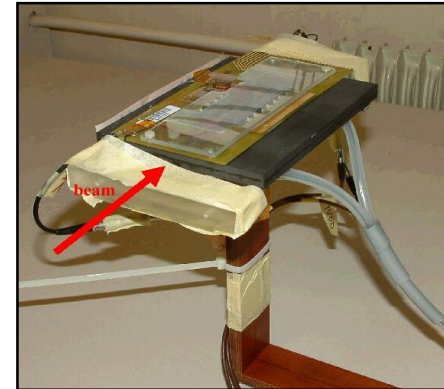


- Wrong setting of D1
  - Pilot bunch scrapes TAS towards IP
- 1 pilot bunch deposits  $5 \times 10^{-3}$  Gy in Pixel B-Layer
  - $10^7$  particles per  $\text{cm}^2$
  - $10^7$  times more than during normal operation at design luminosity

- Wrong setting of MCBX
  - Pilot bunch hits beam pipe close to Pixel detector
- Factor of 30 - 40 more

# Pixel Study at the PS

- Fast extracted beam at 24 GeV/c
  - User selected shots of  $n$  (1 to 8) bunches; 213 bunches in total
  - $10^{11}$  p per bunch
  - 42 ns long bunches separated by 256 ns
- 1 pixel module exposed “edge on” to beam
- For 1 bunch
  - $7.5 \cdot 10^8$  p cross the module
  - $10^{10}$  times more hits, i.e. charge carriers produced than in normal operation
  - 3 Gy deposited in module
    - ❑ Factor 600 more than in “scraping” scenario
    - ❑ Factor 15-20 more than in “beam pipe hit” scenario
- Pixel module survived 213 exposures like this without apparent damage
  - Trip of LV power supply
  - Loss of configuration data



*A. Andreazza et al, NIM A565, 2006, 50*



# Conclusion from Pixel Study

- In terms of dose (Gy) we have a
  - Safety factor 600 for the “scraping” scenario
  - Safety factor 15-20 for the “beam pipe hit” scenario
- If this is scaled to the same bunch length (370 ps vs 42 ns) these factors have to be divided by 100 (→ instantaneous dose)

→ Therefore ATLAS requests to set

- “Safe Injection” flag to  $5 \cdot 10^9$
- “Safe Beam” flag to the minimum intensity required for commissioning

# Worries and Questions to the Machine

- **Bocian scenarios** should be cross checked and followed up
  - This is important because the ATLAS simulation results depend dramatically on incident direction and position of collision
- What are the potential **accident scenarios during beam commissioning** which comprises a lot of steps
  - Aperture scans
  - “Safe beam” condition with masked instrumentation
  - Squeezing
  - ....
- What is the final word about **closed bumps** during normal operation
  - How big can they be at IP1
- What about **beam loss in IR1 due to miss-kicked beam** at extraction (see workshop summary)