Collision Rate Monitors

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LHC Machine Collision Rate Monitor

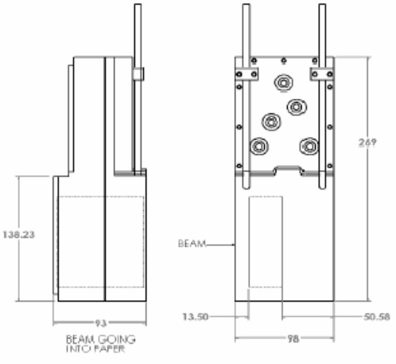
- Anticipated Applications
  - Initial beam finding & overlap maximization
  - Manual maximization of collision rate for physics runs
  - Equalization of the collision rates amongst the experiments
  - Monitoring of the crossing angle
  - Bunch by bunch measurement of the collision rate

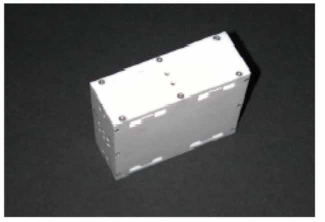
IR1 (ATLAS) and IR5 (CMS)

- Monitor to be installed in slot inside TAN Absorber at IR1 and IR5
- A major constraint on the choice is given by the required radiation hardness necessary to survive in IR1 and IR5.
  - Fast Ionization Chamber

Ionization Chamber

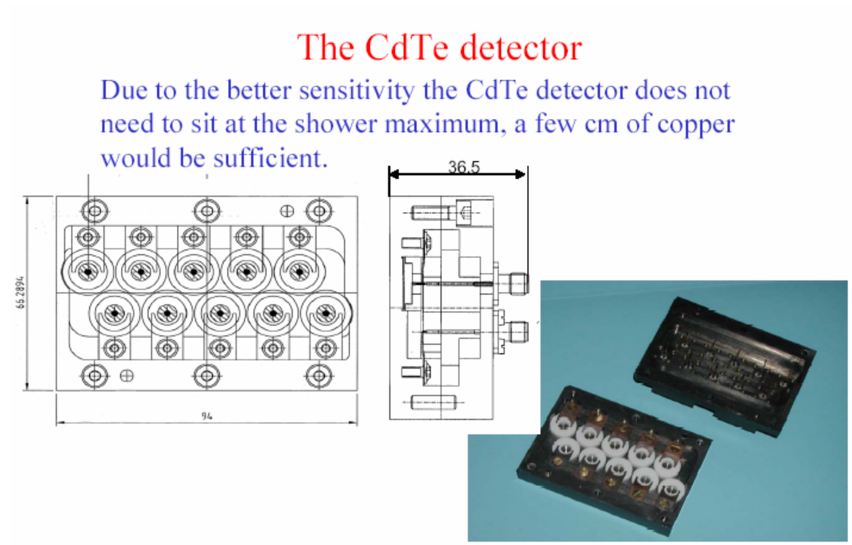
The ionization chamber requires ~30cm of Cu in front of it to act as a converter and start the shower





IR2 (ALICE) and IR8 (LHCb)

- LTC Minutes (27.4.2005)
  - US LARP Collaboration may not provide luminosity monitors for IR2 and IR8.
  - Ask ALICE and LHCb to provide these monitors for IR2 and IR8



Fast Ionization Chambers

Modified Beam Loss Monitors

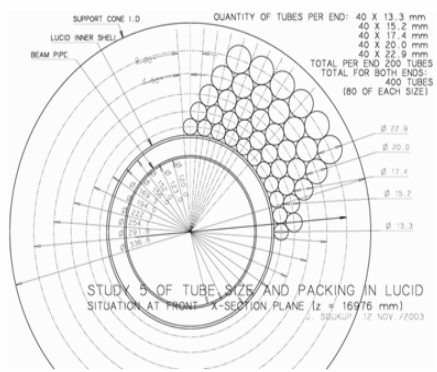
LHC Machine Collision Rate Monitor

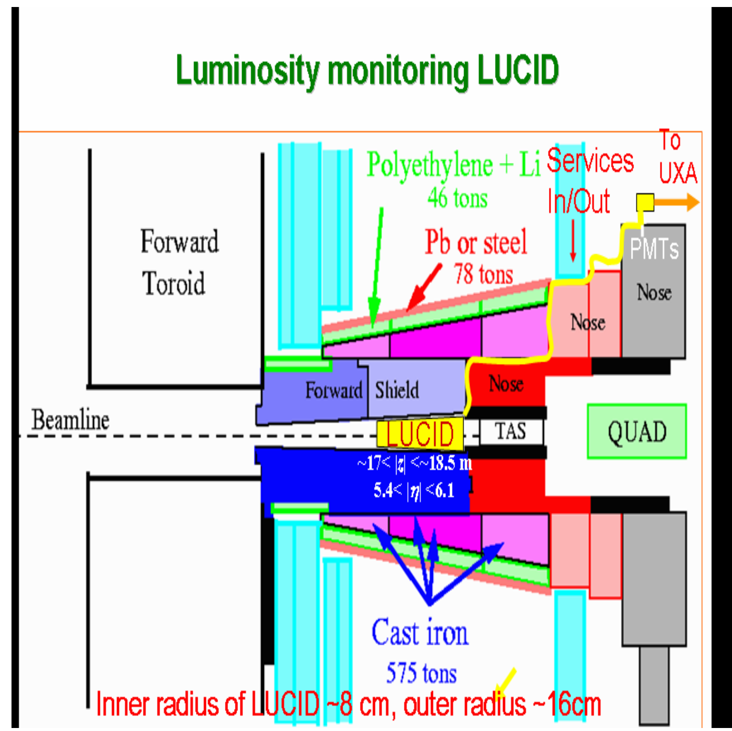
Luminosity sub-range	particle	Resolution		integration time
		Beam structure	Luminosity	
$1.0 \times 10^{26} \rightarrow 1.0 \times 10^{28}$	p-p	beam	± 10%	~ 1 mn
$1.0 \times 10^{28} \rightarrow 3.0 \times 10^{34}$	p-p	beam	± 1% (0.25%)	~ 1 s
$1.0 \times 10^{33} \rightarrow 3.0 \times 10^{34}$	p-p	bunch	~ ± 1%	~ 10s
$1.0 \times 10^{24} \rightarrow 5.0 \times 10^{25}$	Pb-Pb	beam	± 10%	~ 1 mn
$5.0 \times 10^{25} \rightarrow 0.5 \times 10^{27}$	Pb-Pb	bunch ?	± 1% (0.25%)	~ 1 s

ATLAS Collision Rate Monitoring

- **ATLAS proposes a dedicated detector- LUCID**
  "LUminosity measurement using Cerenkov Integrating Detector

- There are 200 gas filled (C_4F_{10}) Cerenkov tubes per end.
- Use Al lined Carbon fibre Cerenkov tubes for heat resistance.
- The tubes are deployed in 5 layers of increasing diameter
  - each row has 40 tubes.
- Tube orientation allows some position sensitivity

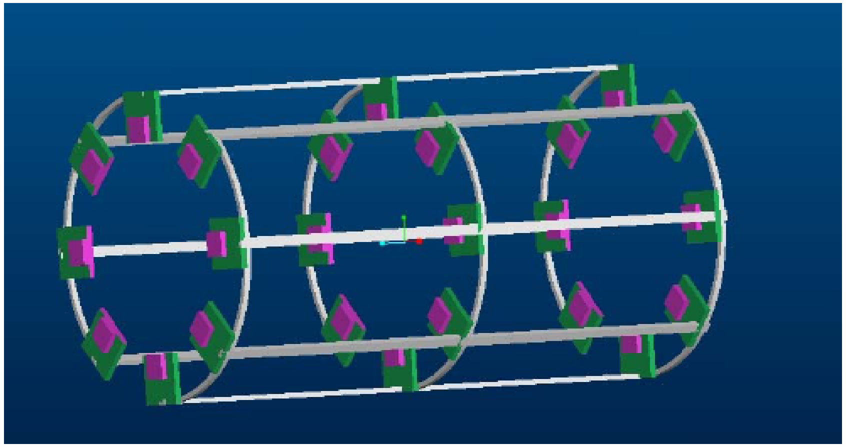




CMS Collision Rate Monitor

Measure luminosity bunch-by-bunch

- Small angle (~1°) pointing telescopes
- Three planes of diamond sensors (8 mm x 8 mm)
- Diamond pixels bump bonded to CMS pixel ROC
- Form 3-fold coincidence from ROC fast out signal
- Located at r = 4 cm, z = 170 cm
- Total length 20 cm
- Eight telescopes per side



Count 3-fold coincidences
on bunch-by-bunch basis

Rutgers/Princeton/UC Davis