Plans for the Muon Gas and Cooling Systems

LHCb infrastructure workshop February 19+20

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Outline

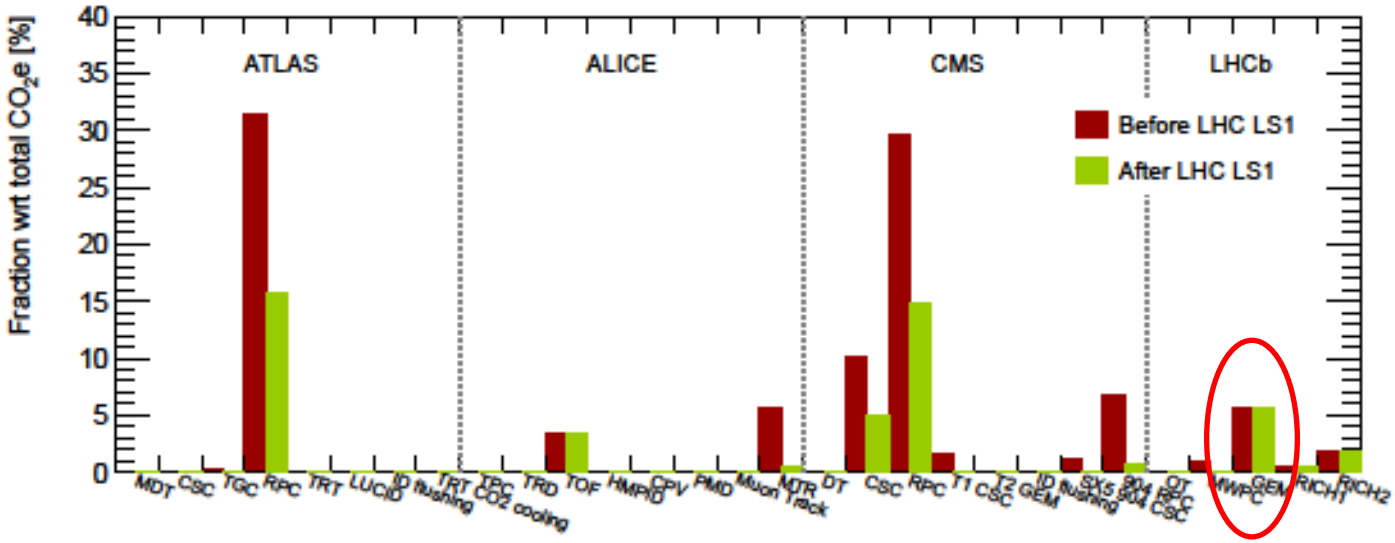
I. A recirculation gas system for the GEM detectors

- Parameters and operational cost
- Upgrade to a recirculation system cost
- Technical challenge:
  - Ongoing R&D study
- Conclusions and perspectives

II. Implications on the infrastructure if GEMs are used in R1 of M2/M3

III. Other Issues

Motivation, Parameters and operation cost



- Mixture composition
  - Ar 45%, CO_2 15%, CF_4 40%
- Mixture flow (2011)
  - 90-100 l/h
- Mixture cost
  - 54 CHF/m^3
- Operation cost (1 year → 300-360 days)
  - **40 – 50 kCHF/year**

NB: GWP of CF4 is 6500

Excluding ATLAS and CMS RPC systems, LHCb-GEM is coming just after CMS-CSC which is a 85 m^3 detector

Upgrade to a recirculation system

Unit	Status	Cost for upgrade (kCHF)
Control rack	To be modified (mandatory)	15
Mixer	To be modified (not mandatory)	Modification needed only if detector volume will increase significantly in the future
Distribution	To be modification (mandatory)	5
Circulation pump	New	41
Purifier	New	60
Exhaust	New	15
Buffer	New	12
Installation (connections and resources)	New	10
Total **Only mandatory items**		**158**
Return pipe from US to SG	Does it exist?	We assume **YES**
Mixture monitoring system	New	15

R&D study

- GEM detectors were never operated in recirculation mode
- First test started one year ago (mainly triggered by CMS-GEM project)
- Good results in the last 3 months of operation with GEM in recirculation

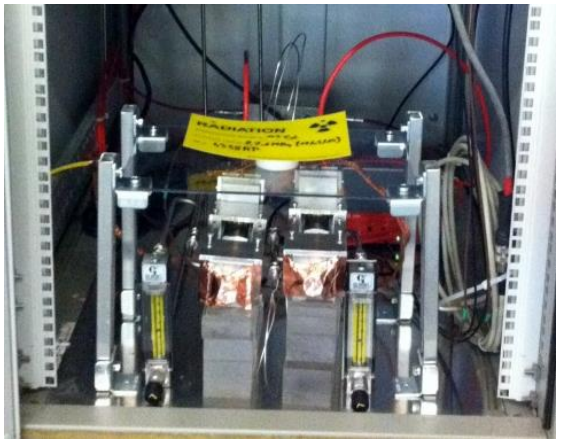
Setup:

Small recirculation system

10 x 10 cm^2 GEM

Mixture monitoring system

- Online O_2, H_2O sensors
- Gas Chromatograph
- Single Wire Chambers



- **Concern about permeability of GEM detectors**
- **Test needs urgently to be repeated with LHCb GEM chambers**

Conclusions on part I

- Upgrade to gas recirculation will be paid back in about 3 years of operation
- Significant reduction of greenhouse emission (CF_4)
- LHCb-GEM would be the first large GEM system operated in recirculation mode
  - Technical feasibility is under evaluation
- Monitoring system based on Single Wire chambers and small GEM developed
- Necessity to perform test with real LHCb detectors
  - Evaluation of **permeability**, leak rate and impurity accumulation in recirculation mode
- Possible installation window: end 2015

➢ **We have to decide by April this year!**

Implications on the infrastructure if GEMs are used in R1 of M2/M3

- In the present detector GEMs are only used in M1
- In case they would be chosen for M2/M3 R1, the gas racks on the A- and C-sides for M2/M3 have to be modified
  - ➢ **Needs to be investigated**
    - **non-trivial due to space constraints in the gas racks**
    - **as the rest of the system should be flushed 'continuously', new gas racks for M2/M3 would be needed (cost)**
- Gas pipes would need to be installed on the walls of M2/M3 supply the R1 chambers with the GEM mixture
  - ➢ **Doable, but significant effort**

Other Issues

- We intend to continue with the poor mans air-cooling system for the chambers for the next 10+ years.

- However, the air blowers need to be overhauled / changed, most likely already during Run II.
  - ➢ We should order spares parts now

- However, if they fail on M2-M5, this is not a big problem.