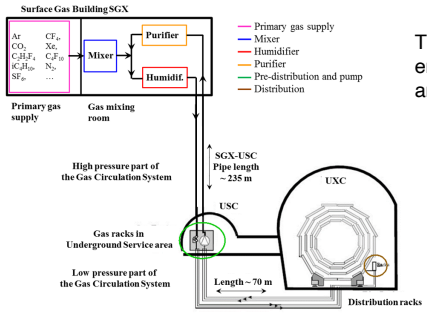
Gas recirculation systems for RPC detectors: from LHC experiments to laboratory set-ups

Roberto Guida, Beatrice Mandelli, Gianluca Rigoletti
CERN

EP-DT
Detector Technologies

RPC 2022

Gas Systems for particle detectors



30 Gas Systems at LHC

The gas systems are complex apparatus that have to ensure an extremely high reliability in terms of stability and quality of the gas mixture delivered to the detectors.

- **Different types of operation**
  Open mode or recirculation system
- **Huge detector systems**
  Thousands of m² and up to 800 m³
  300 gas racks all over CERN

Gas recirculation systems compulsory when greenhouse gases are used → *GHG emissions reduced of 90% and up to 100%*

In medium and small experiments often the gas mixture is flushed to atmosphere. In these cases, GHG emissions could be even higher than the ones of the LHC large systems that work in gas recirculation!

↓

It is worth to build gas recirculation systems also for these experiments

But LHC gas systems are very complex and expensive

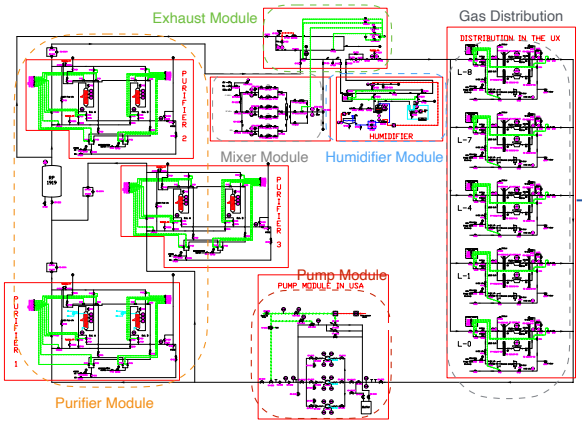
↓

Development of new gas recirculation systems designed for small/medium experiments and laboratory

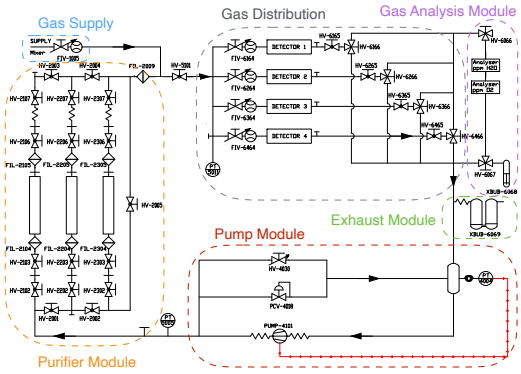
More affordable and simple

Comparison of the three different gas recirculation systems

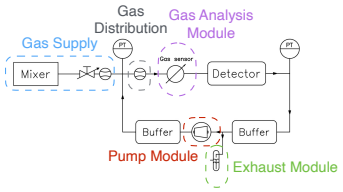
Standard LHC gas recirculation system

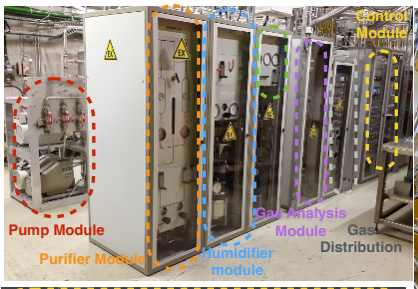


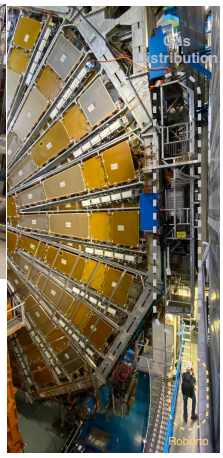
Medium to small gas recirculation system

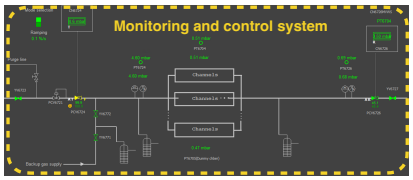


Micro gas recirculation system

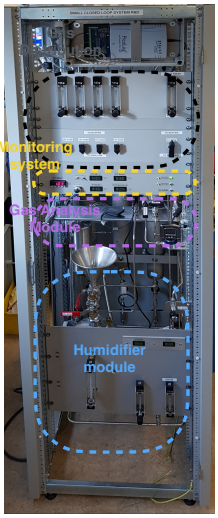




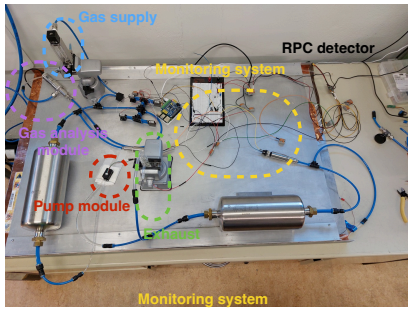




Front View



Rear View



Big experiments	*Medium/small experiments*	*Laboratory set-ups*
Hundreds/Thousands of detectors	*Tens of detectors*	*Few detectors*
Tens-hundreds m³	*Hundreds litres*	*Few litres*
Hundreds kCHF	*Tens kCHF*	*~ kCHF*

- It extends over surface, underground service and experimental cavern
- Controlled with industrial PLC (Programmable Logic Controller)
- Sophisticated control and monitoring system based on SCADA WinCC-OA applications
- Hundreds of sensors and thousands of parameters to tune
- Regulation of detector pressure at level of 0.1 mbar
- Very flexible and adaptable systems
- Possibility to add a gas recuperation system

- One single rack can contain the full system
- Control system based on simple PLC
- Monitoring system based on Grafana
- Possible to have some parameters controlled remotely
- Few sensors
- Five gas systems already produced and in use

- It should fit in a small box
- Monitoring system based on RaspBerry PI and Grafana
- Manual (optional remote) control
- Limited number of electronic sensors
- Very cheap components

Conclusions

The use of gas recirculation systems is fundamental for detector applications to reduce greenhouse gas (GHG) emissions.
At the CERN LHC experiments all gaseous detectors using GHGs or expensive gases work under gas recirculation. Small and medium experiments can also have a significant impact on GHG emissions but an LHC gas systems is oversized. A small gas recirculation system was therefore developed and nowadays it is already in use in some applications. To further reduce GHG consumption, a new micro gas recirculation system has been developed for laboratory set-ups.