CMS-CSC longevity studies at GIF++

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# Goals of longevity and performance studies at GIF++

**Assess longevity of CSCs with the nominal gas for HL-LHC lifetime**

- Completed

**Auxiliary: study chamber/electronics performance at HL-LHC-like rates**

## Find eco-friendlier modus operandi at HL-LHC

*(CERN directive: reduce GHG footprint by 70%)*

- with adequate **performance**
  - (efficiency, timing, spatial resolution)
- with adequate **longevity**

=> Option A: reduce amount of CF4

=> Option B: replace CF4 with a "greener" gas

## Three ways to reduce or eliminate CF4 use or exhaust:

- **CF4 recuperation**: EP-DT – efficiency of the CF4 recuperation plant was increased from 30% to ~60% during LS2
- **CF4 reduction**:
  - lab studies with small prototypes ('miniCSC')
  - tests with full-scale production chamber at GIF++
- **Searches for CF4 substitutes**
  - just started, the study sequence will be the same as for CF4 reduction
• Downstream setup:
  - since 2015…
  (ME2/1 was not present in 2019-2020)

• Upstream – installed in 2021. Removed to prep.area due to DAQ problem with extended cables, work on cable extension to be resumed in 2023 in prep area
longevity studies at GIF++ (downstream)

For two CSC types which exposed to the highest BG flux at CMS

Lab systematic tests with small prototypes and 10-5-2-0 % CF4

2% CF4 was observed to be risky in lab tests

**ME1/1:**
- Q(HL-LHC) ~ 0.20 C/cm
- Q(10%CF4) ~ 0.33 C/cm
- Q(2%CF4) ~ 0.37 C/cm
- Q(5%CF4) ~ 0.03 C/cm, ongoing

**ME2/1:**
- Q(HL-LHC) ~ 0.13 C/cm
- Q(10%CF4) ~ 0.33 C/cm
- Q(2%CF4) = 0 C/cm
- Q(5%CF4) ~ 0.04 C/cm, ongoing
**Experienced problems**

- All of them are related to the gas
  - Gas gain instability during the TB2021
  - ME2/1 Malter currents in close loop

=> we need guaranteed good and stable gas quality for both the irradiation and TB measurements => straw-based gas monitor

Monitoring SW and testing is ongoing in 904

Goal is to install at GIF++ gas rack in the exhaust line end 2022-beginning 2023
Requires 55Fr source permanently installed, was blessed by the RP
CMS-CSC plans for 2023

- **Downstream**: continue irradiation, focusing on ME2/1 chamber with 5% CF4 have to be **as close as possible to the source** to reach at least 1-1.5 mC/day

- **Regular testbeam measurements** to monitor longevity (the beginning, mid and the end of the SPS operation year)

- **Upstream**: the setup will serve searches for eco-friendly gas CSC gas mixture
  - Lab studies to be done with various gas mixtures followed by
  - Performance measurements with GIF++ test beams
  - Longevity studies with small prototypes
  - Longevity studies with ME1/1add (not earlier than second half of the year)
  
  ...will require **installation of the second gas system** to be run in parallel with the downstream Ar/CO2/CF4 longevity program...

  => subject of available manpower... we’ll see during the year
• We are very grateful to Martin and Giuseppe for really outstanding support!!

• We really enjoy the muon beam rates and running stability – many thanks to Nikos!

• And many thanks to the EP-DT group for their help and advices on the gas system!
Backup
Additional studies of Malter current (moving to upstream)

Studies of spontaneous self-sustaining discharges (so-called Malter effect) at the irradiation intensities corresponding to HL-LHC conditions – **require low source intensity**.

Original downstream position required att.6-10.

In 2020 the chamber was relocated to the extended upstream area.

We still need to provide infrastructure (gas, cabling, DAQ in prep.area)

GIF++: automatic HV training of ME1/1_add layer having Malter current

**LHCb MUON**

*automatic training SW*

Program interface setting up HV training limits, current Dispersion etc.

**In downstream the training time was limited by the “source scan mode” duration, in upstream we hope to run tests at the nominal irradiation intensity.**