Aging Studies on the First Resistive-Micromegas Quadruplet @ GIF++ — Preliminary Results —

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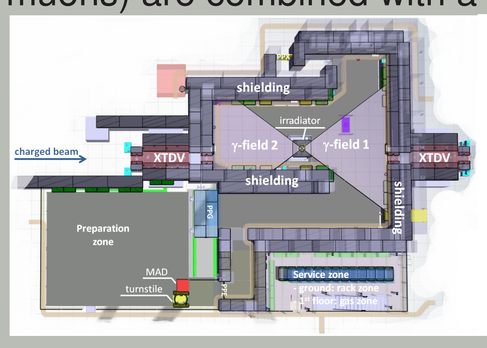
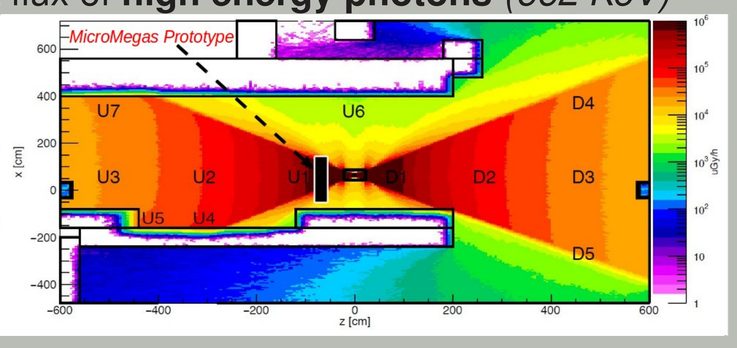
Abstract

A resistive-micromegas quadruplet built at CERN, serving as prototype of the ATLAS micromegas, has been installed at the new CERN Gamma Irradiation Facility (GIF++) with the aim of carrying out a long-term aging study. We give an overview of the ongoing tests at GIF++ in terms of particle rate, integrated charge and spatial resolution of the micromegas detectors.

Gamma Irradiation Facility (GIF++) at CERN

Unique place where **high energy charged particle beams** (mainly muons) are combined with a flux of **high energy photons** *(662 KeV)*



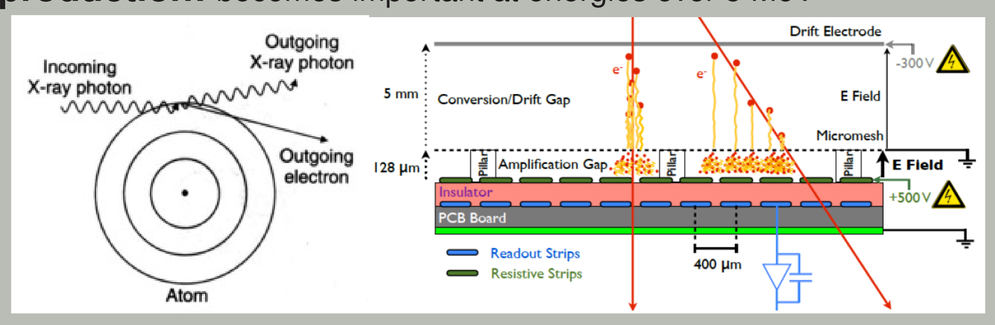


The high source activity produces a **very intense background gamma field** allowing to accumulate doses equivalent to **High Luminosity LHC (HL-HC)** experimental conditions in a reasonable time.
Filter system permits attenuating the photon rate in several steps to reach **attenuation factors** of several orders of magnitude ($\sim 10^4$ - 10^5)

Aging Studies → Gamma (Photon) Exposure

Aging studies are mandatory to asses the capability of the detectors to handle the rate and level of radiation at the HL-HLC

- Gamma radiation ionizes via 3 **processes**:
  - **Photoelectric effect:** dominant process for γ with energies below 50 keV
  - **Compton scattering:** principal mechanism for 0.1-10 MeV **(main @ GIF++)**
  - **Pair production:** becomes important at energies over 5 MeV



Description of the MicroMegas used in GIF++

- **MMSW2** *(MicroMegas Small Wheel)*: four active layers $\sim$0.5 m^2, 4096 read-out strips and sputtered **resistive** layer, with mechanical floating mesh, strip pitch 415μm.
  Exposed 1 week during muon beam period

- **T-Chambers**: **resistive** bulk-micromegas chambers, 10x10 cm^2, strip pitch 400μm.
  Exposed at GIF++ more than 3 months

Data-taking Measurements and Working Conditions

Measurements performed varying the attenuation filters and the amplification voltage

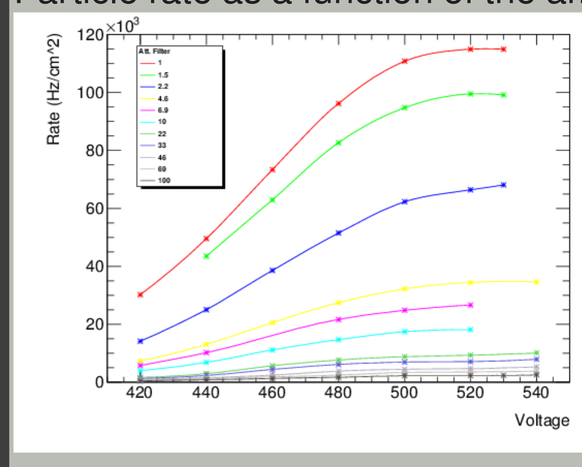
- **Att. Factors:** 1, 2.2, 4.6, 10, ..., 10000
- **Amplification Voltage Scan:** for MMSW2 [540-560] V and T chambers: [420-540] V
- Source **ON**/**OFF** + Muon Beam

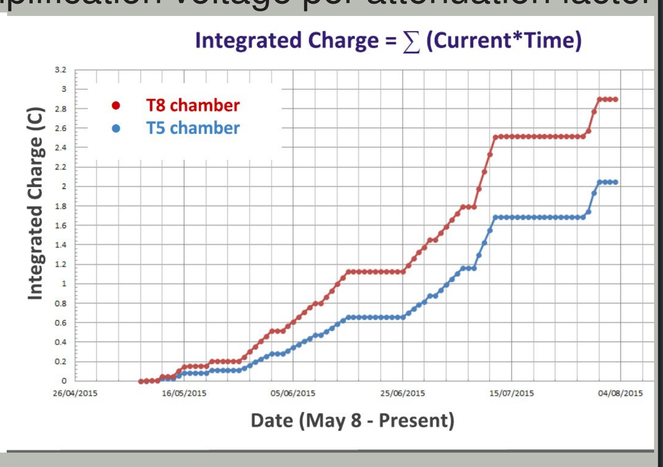
Working conditions:

- **Gas:** $ArCO_2$ 93%, 7%, **Gas Flow:** 5 l/h
- **Amplification Gap:** 128 μm, **Drift Gap:** 5 mm, **Drift Field:** 600 V/cm
- **Operating Gain:** $\sim$ 5x10^{-3}

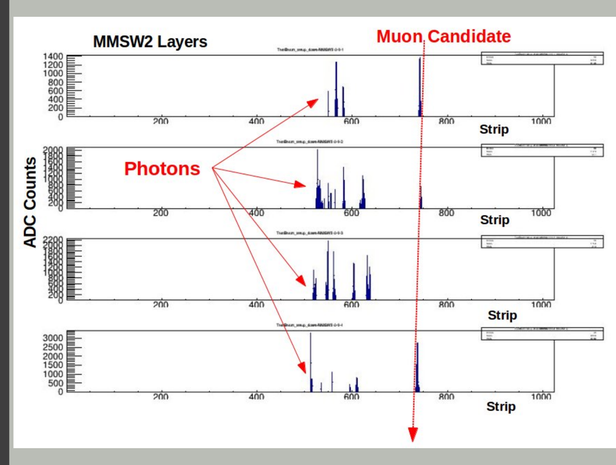
Particle Rate for T-chambers and Integrated Charge

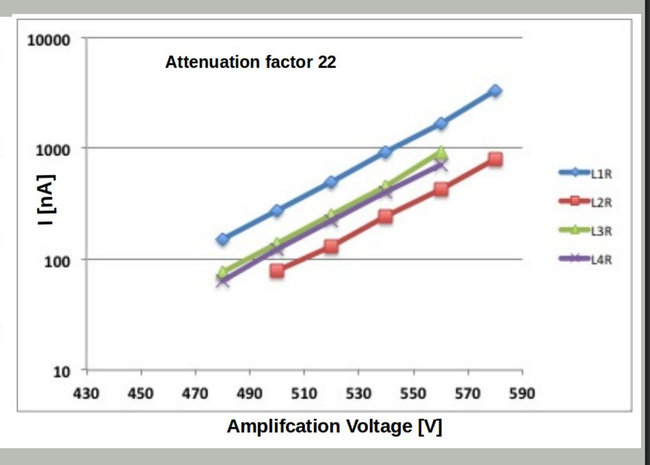
Particle rate as a function of the amplification voltage per attenuation factor



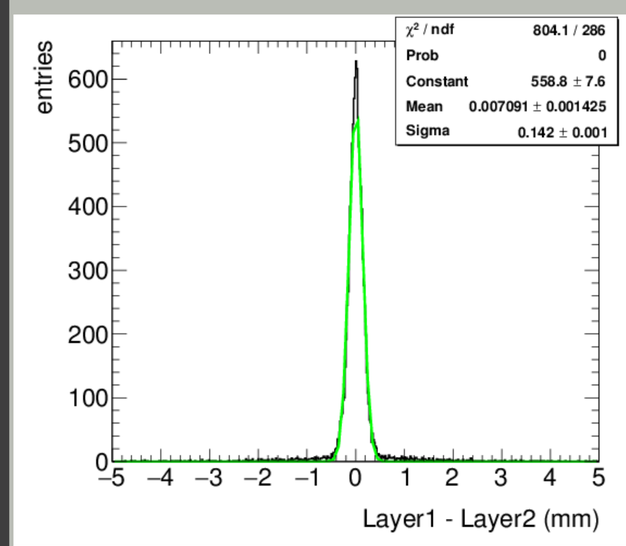


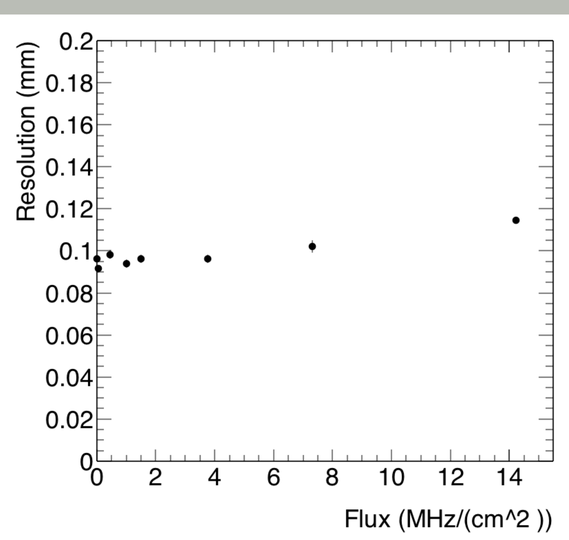
Event Display and Current as a function of HV for MMSW2





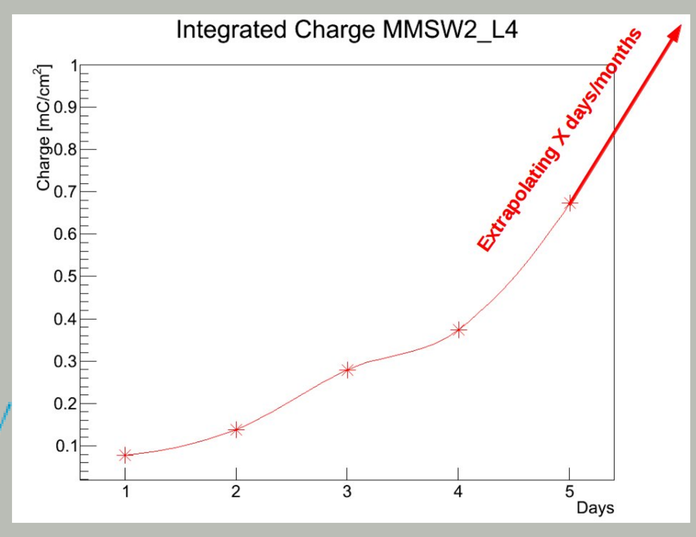
Resolution as a Funcion of the Flux for Layer1 of MMSW2





Prospects and Plans

Exposure of the **resistive-micromegas chambers** up to $\sim 1C/cm^2$ in order to accumulate the same integrated charge expected after 10 years of the LHC operations and study the performance in this very high particle rate enviorement. Detector aging effects in terms of currents, efficiency and noise stability as a function of the integrated charge.



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