

# CMS GEM Project : Status of GIF and Materials Study

Jeremie Merlin  
(IPHC,CERN)

On Behalf of the CMS GEM Collaboration

Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

## Goals

- **E**nsure the long term operation of GEM detectors for CMS
  - Reach an accumulated dose equivalent to 10 years operating in CMS
- **A**scertain the effect of high radiation on the Full Scale GE1/1 Detectors
  - Observe the behaviour of the chambers under high radiation
- **S**tudy the outgassing properties of GE1/1's components
  - Analyse the component in different configuration (TEMP,RADIATION,FLOW,...)
- **Y**ears of operation understood with one year of data taking
  - Keep the system under control by monitoring all the relevant parameters



Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

## Goals

- **E**nsure the long term operation of GEM detectors for CMS
  - Reach an accumulated dose equivalent to 10 years operating in CMS
- **A**scertain the effect of high radiation on the Full Scale GE1/1 Detectors
  - Observe the behaviour of the chambers under high radiation
- **S**tudy the outgassing properties of GE1/1's components
  - Analyse the component in different configuration (TEMP,RADIATION,FLOW,...)
- **Y**ears of operation understood with one year of data taking
  - Keep the system under control by monitoring all the relevant parameters

Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

## Goals

- **E**nsure the long term operation of GEM detectors for CMS
  - Reach an accumulated dose equivalent to 10 years operating in CMS
- **A**scertain the effect of high radiation on the Full Scale GE1/1 Detectors
  - Observe the behaviour of the chambers under high radiation
- **S**tudy the outgassing properties of GE1/1's components
  - Analyse the component in different configuration (TEMP,RADIATION,FLOW,...)
- **Y**ears of operation understood with one year of data taking
  - Keep the system under control by monitoring all the relevant parameters



Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

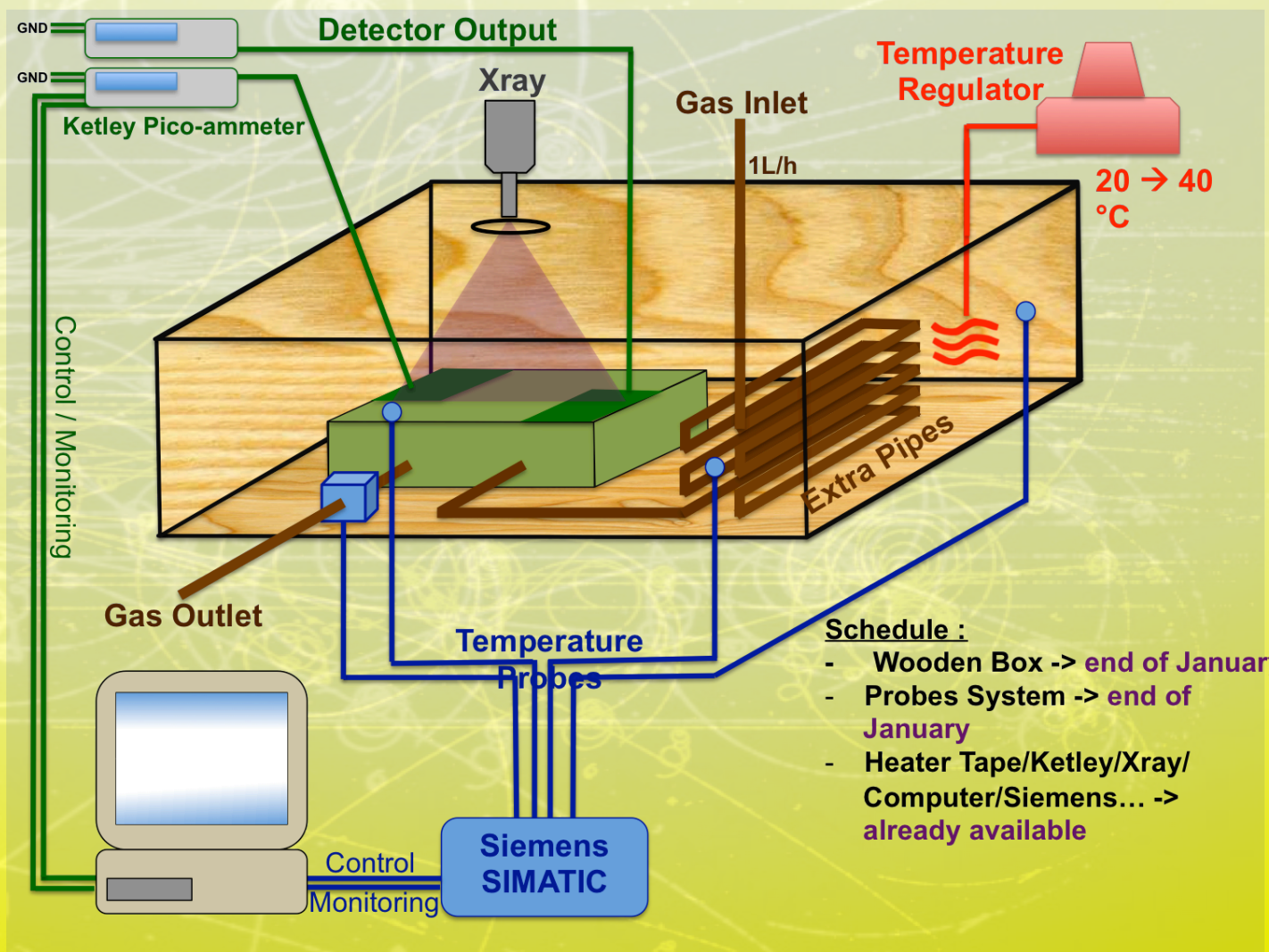
## Plan

- 2013-2014 : Ageing test at the Gamma Irradiation Facility (GIF,CERN)
- 2013 : Outgassing tests (GIF,CERN)
- 2013 : Temperature test (RD51 lab,CERN)
- 2014 : Neutron background test (Dubna and/or Ljubliana)
- 2014 : Neural Network based on 2013 results
- 2014 : Propose a set of recommendations to operate GE1/1 Detectors for CMS

**Temperature Test :**

Understand the gain variations versus the temperature.

Build a model to correct these variations and recover a gain independent from the temperature



- Schedule :**
- Wooden Box -> end of January
  - Probes System -> end of January
  - Heater Tape/Ketley/Xray/ Computer/Siemens... -> already available



Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

## Outgassing Test :

Validate the use of the components inside the GE1/1 detectors

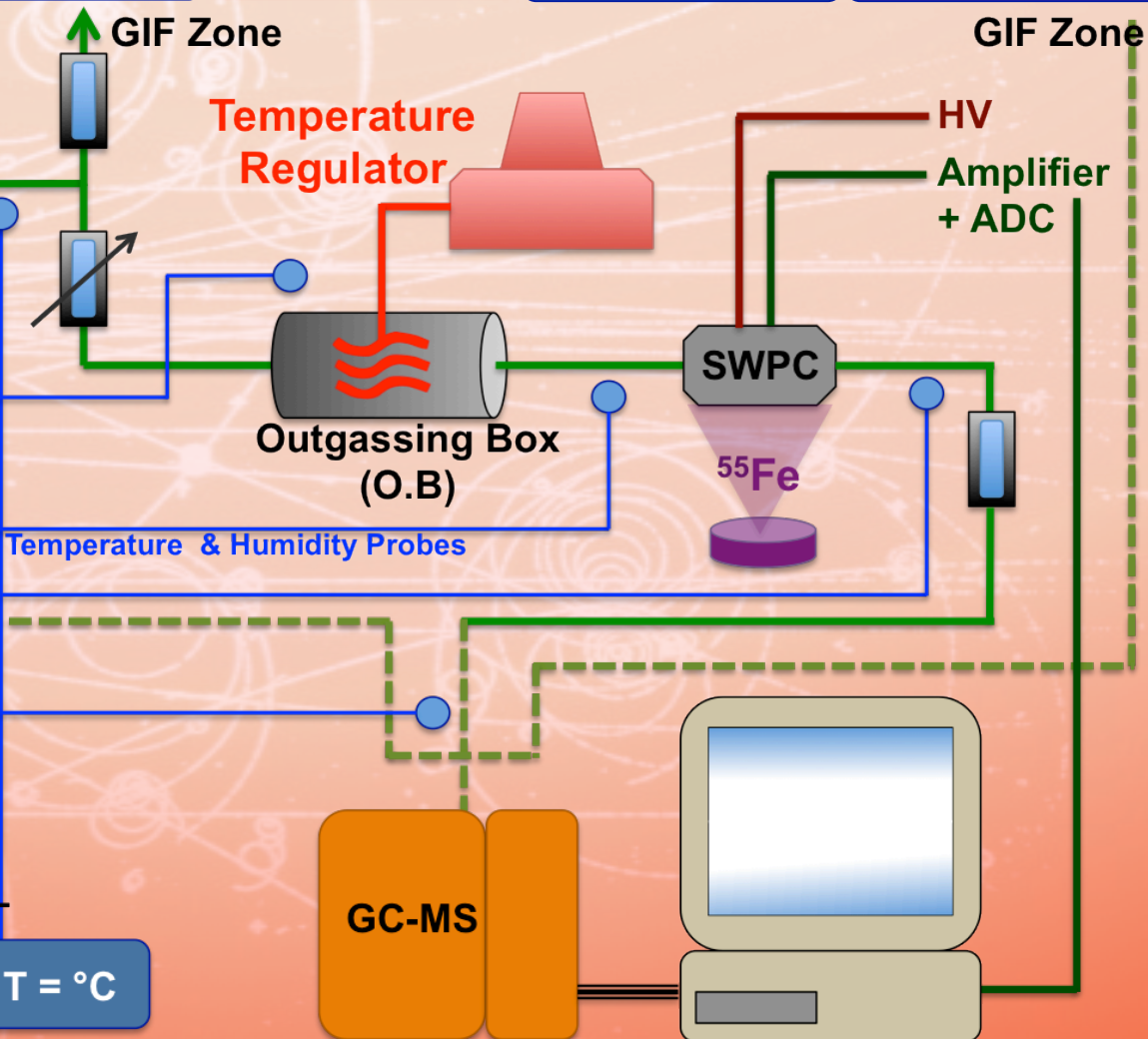
Prevent the ageing by providing a set of recommendations to operate and build GE1/1 chambers

Ar/CO<sub>2</sub>/CF<sub>4</sub> – 45-15-40

### Materials :

- Nitrile Butadiene
- INOX A2
- Polyamide
- Nickel Plated Brass
- Ethyl Cyanoacrylate
- Polyether
- Syainless Steel 316L
- FR4 Substrate
- Fiberglass
- ...

T = °C



Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

### Gamma Irradiation Facility GIF :

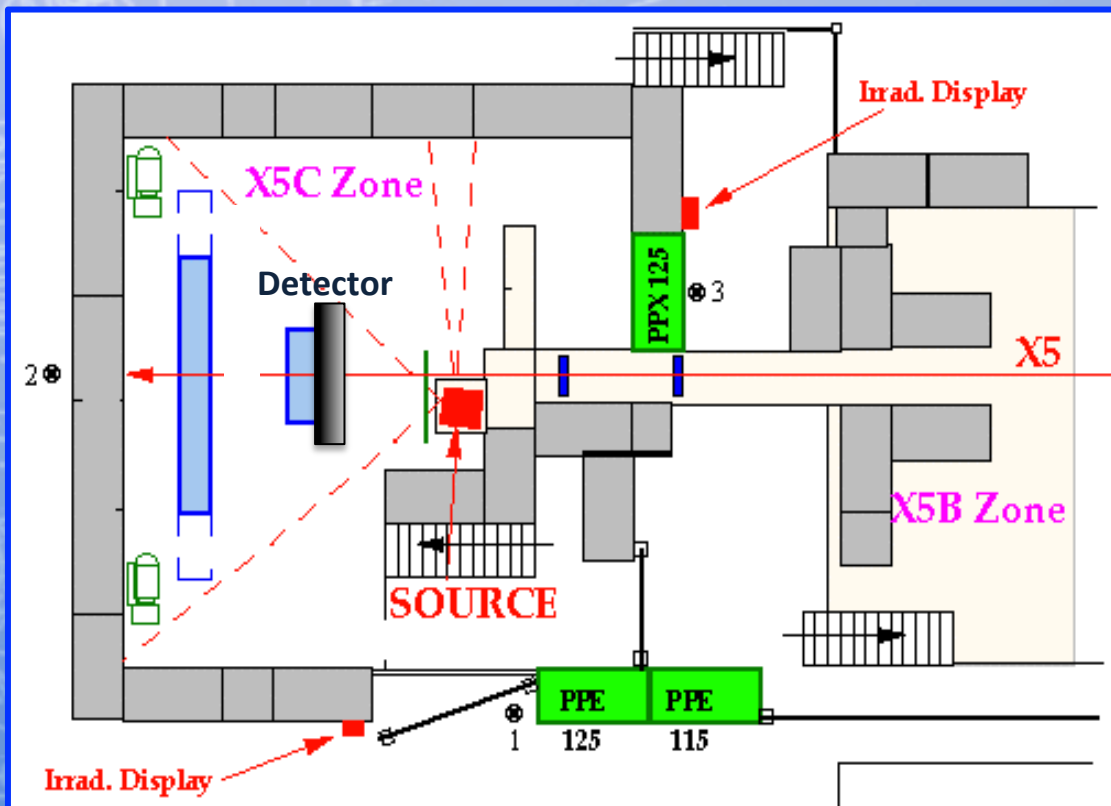
- Bld 190
- Source :  $^{137}\text{Cs}$  566 GBq
- Radiation :  $\gamma$  662 keV

### Setup :

- Duration  $\geq$  6 months ( 5 C/cm<sup>2</sup>)
- Large triple-GEM for CMS
- Ar/CO<sub>2</sub>/CF<sub>4</sub> – Gain = 10 000

### Reference Measurement :

- Two Single Wire Proportional Chambers (SWPCs) irradiated by  $^{55}\text{Fe}$
- Meteo Station (Temperature, Pressure, Humidity)
- Gaz Chromatography (GC) to monitor the gas mixture and the impurities





Goals

Plan

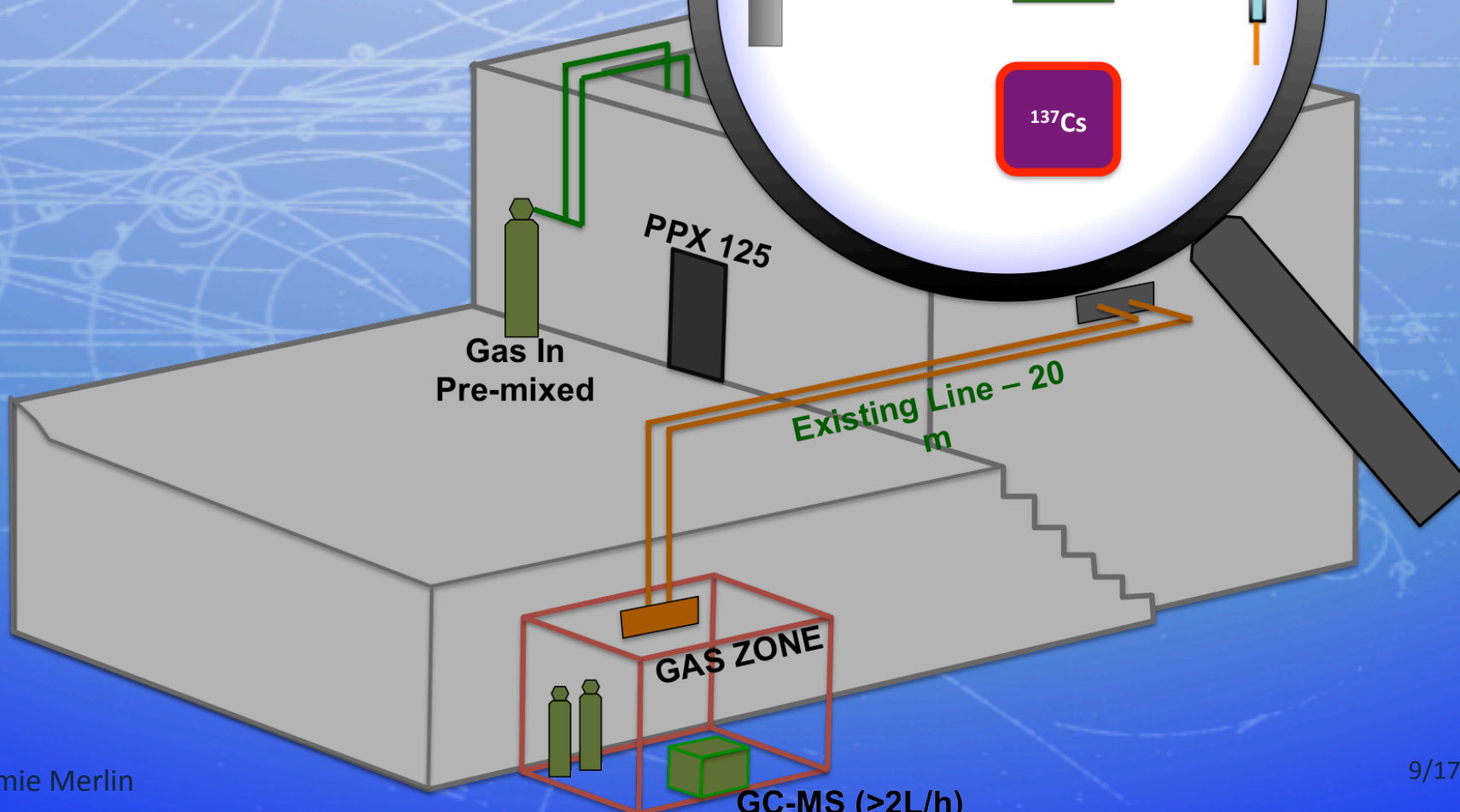
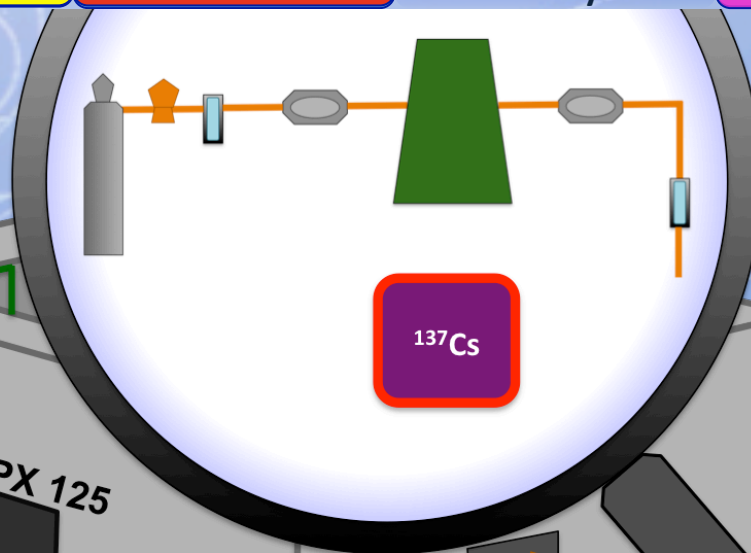
Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

Gamma Irradiation Facility GIF :





Goals

Plan

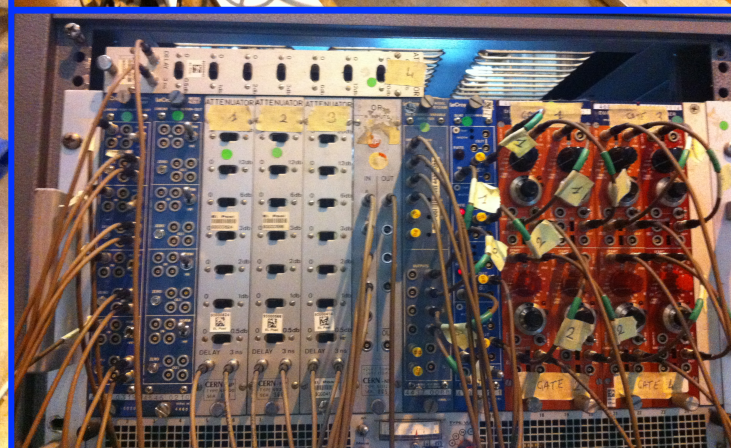
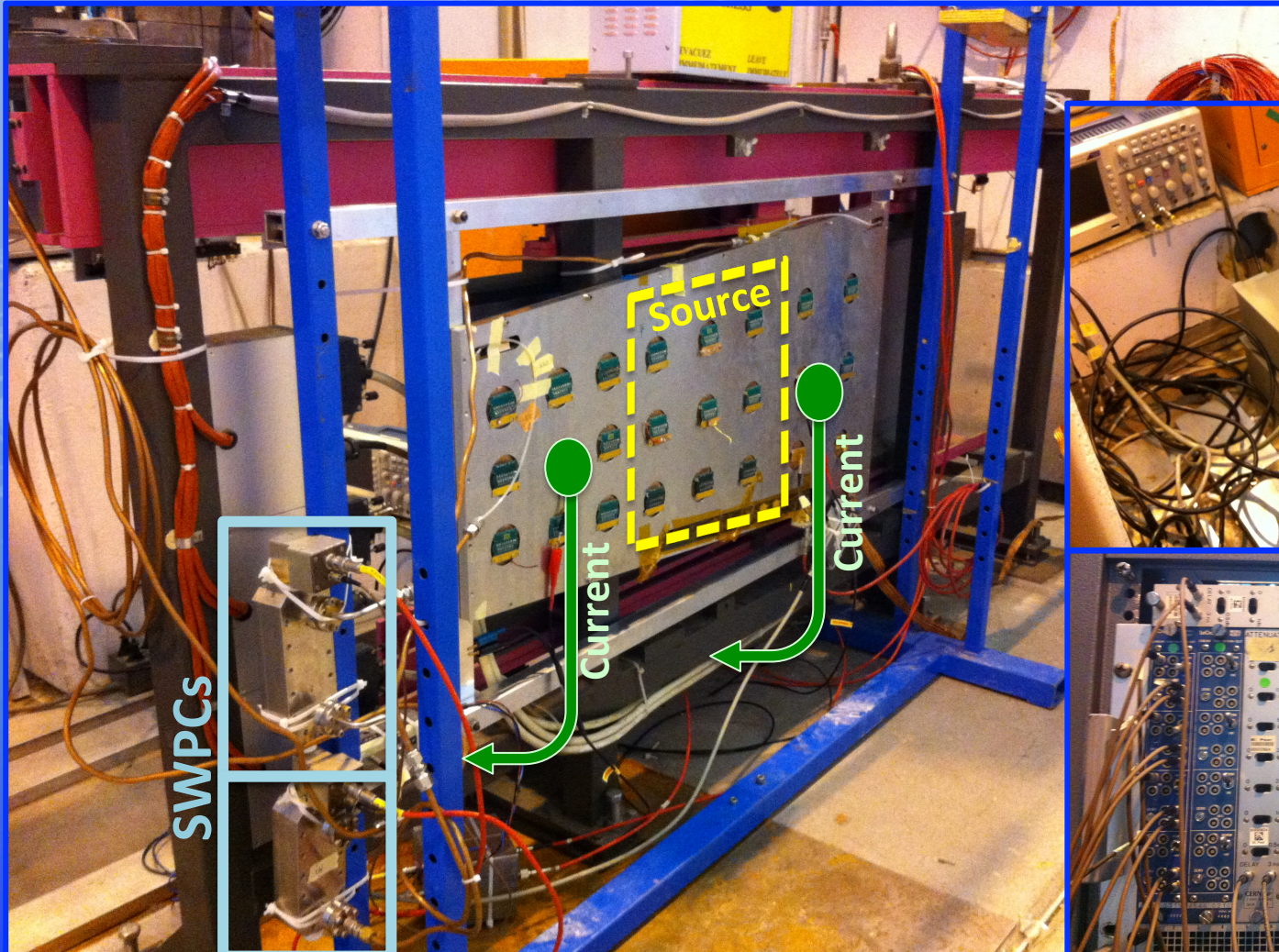
Temperature Test

Outgassing Test

Preliminary Study

Upgrade

Vue d'ensemble de l'expérience :





Goals

Plan

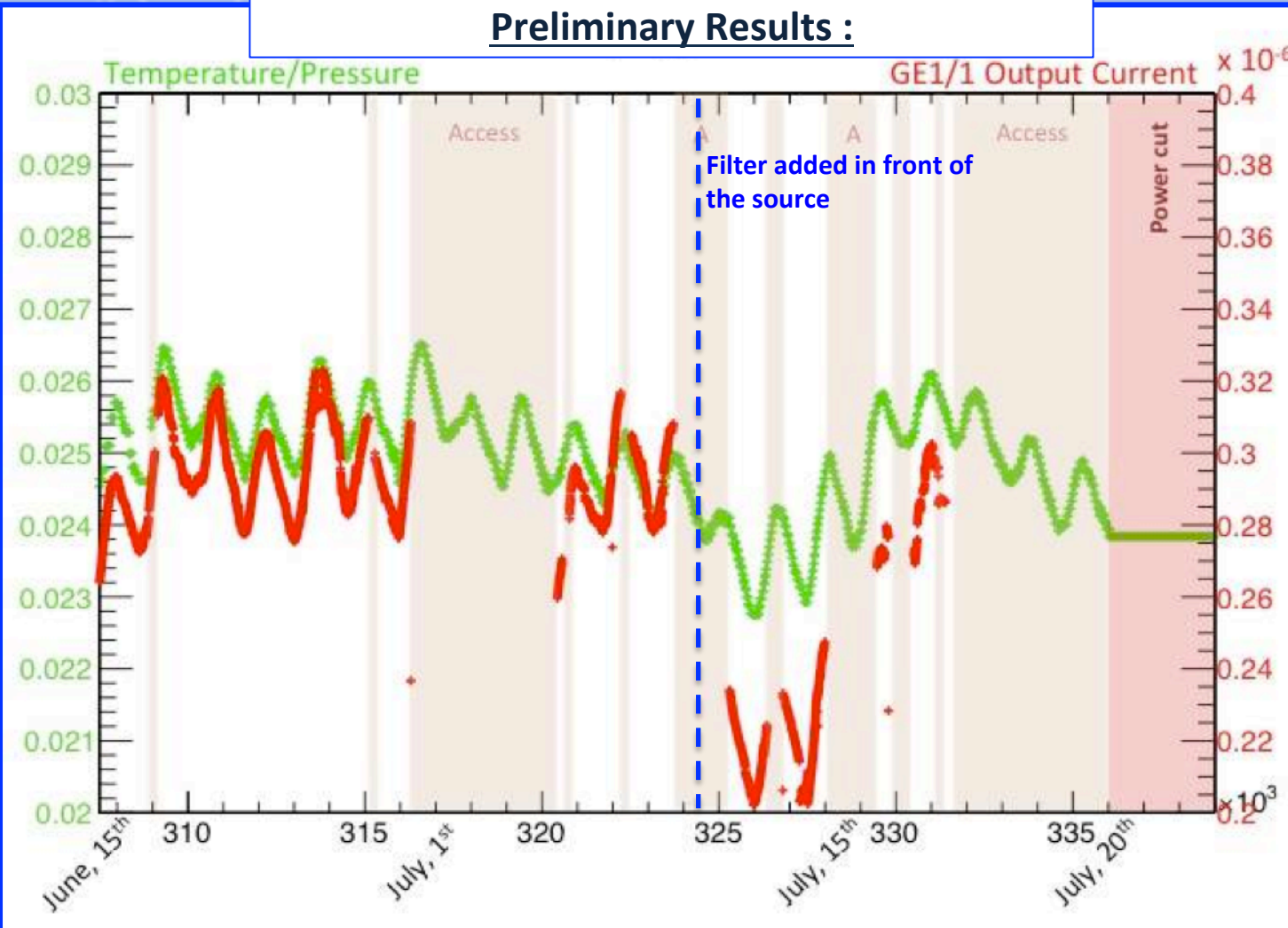
Temperature Test

Outgassing Test

Preliminary Study

Upgrade

**Preliminary Results :**



Goals

Plan

Temperature Test

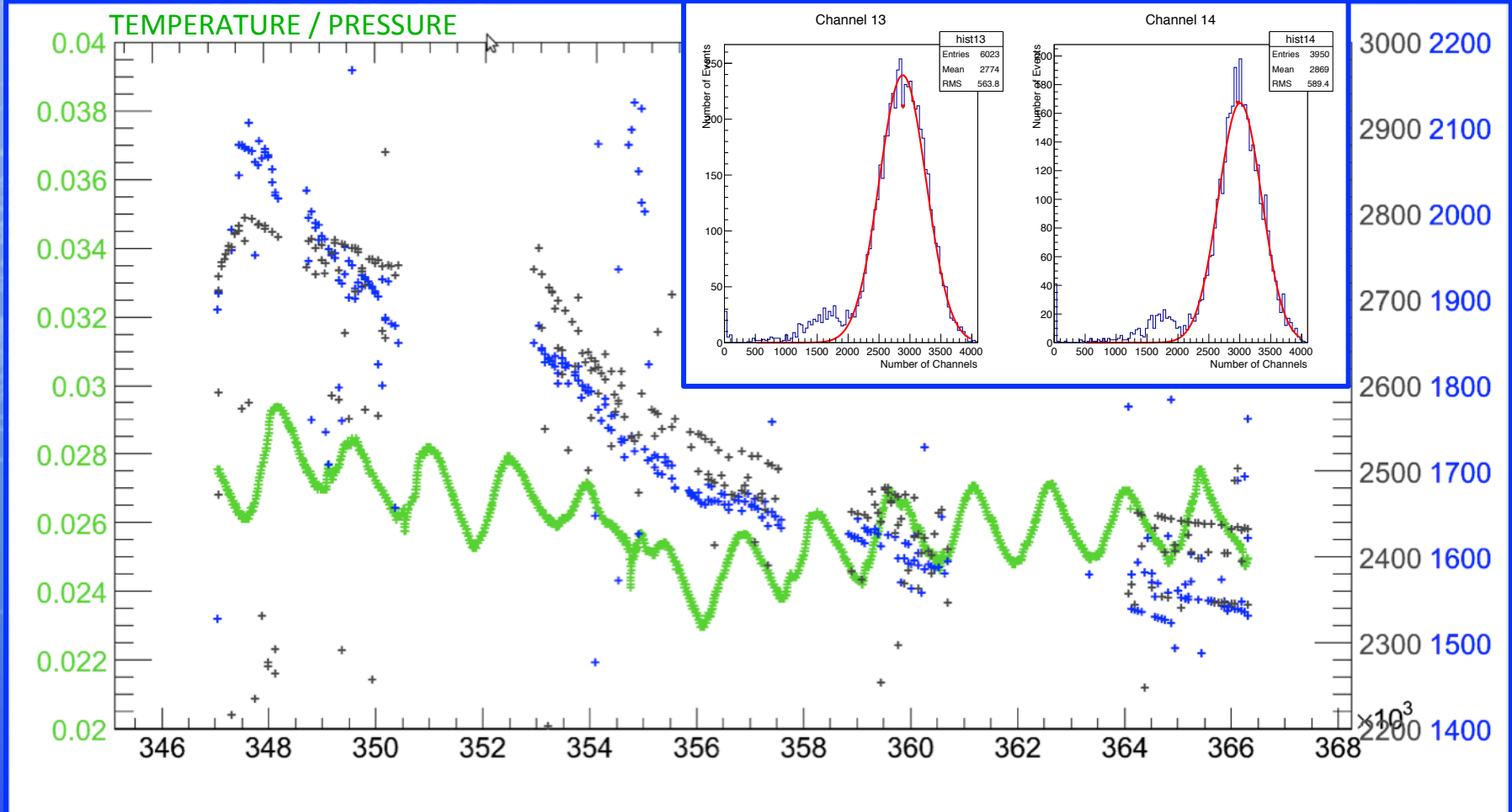
Outgassing Test

Preliminary Study

Upgrade

**Résultats préliminaires :**

SWPCs  
 Gain (CHANNEL NUMBER)





Goals

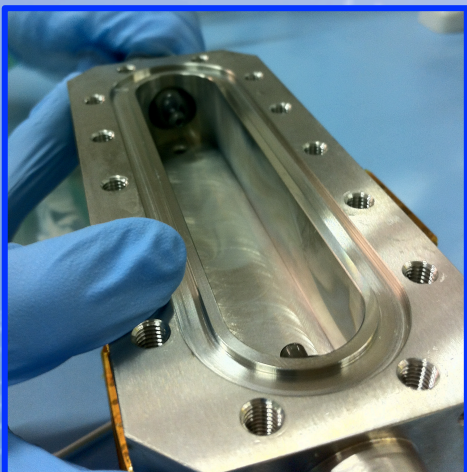
Plan

Temperature  
 Test

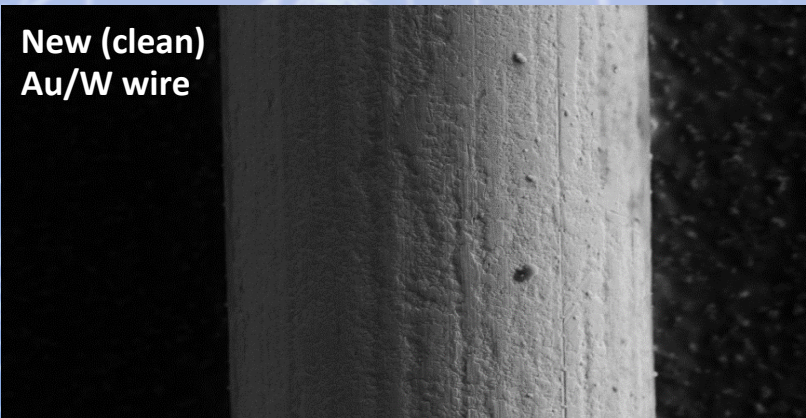
Outgassing Test

Preliminary  
 Study

Upgrade



New (clean)  
 Au/W wire

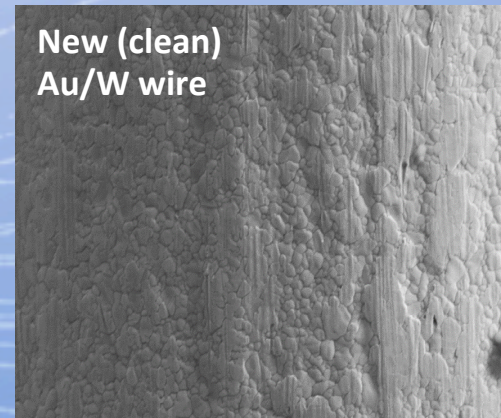


2 μm  
 EHT = 5.00 kV  
 WD = 2.1 mm  
 Signal A = SE2

W wire: Au plated 5%  
 Sample 1 - new

Mag = 2.95 K X  
 Barbora BARTOVA  
 Date :24 Aug 2012

New (clean)  
 Au/W wire



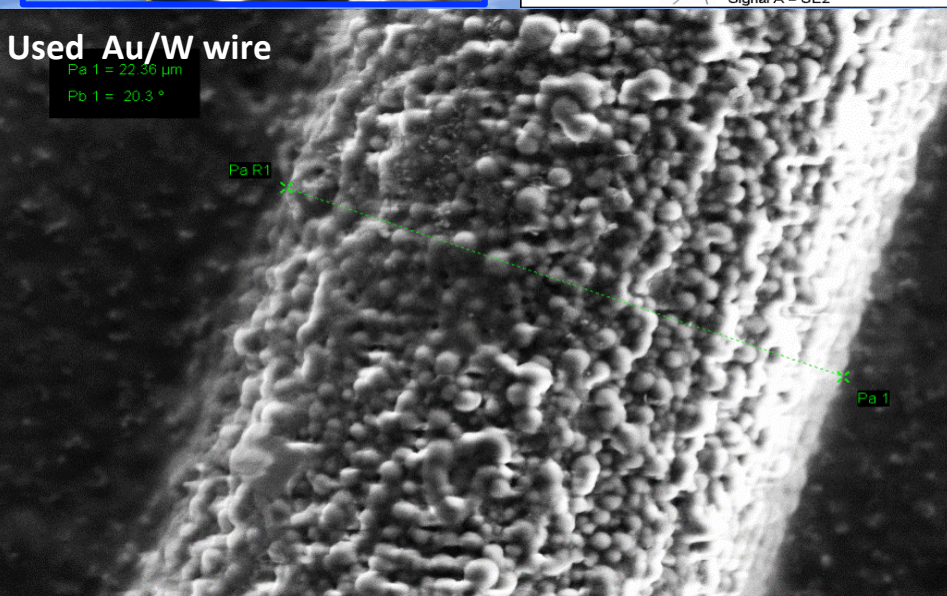
1 μm  
 EHT = 5.00 kV  
 WD = 2.1 mm  
 Signal A = SE2

W wire: Au plated 5%  
 Sample 1 - new

Mag = 10.16 K X  
 Barbora BARTOVA  
 Date :24 Aug 2012

Used Au/W wire

Pa 1 = 22.36 μm  
 Pb 1 = 20.3 °



2 μm  
 EHT = 5.00 kV  
 WD = 1.9 mm  
 Signal A = SE2

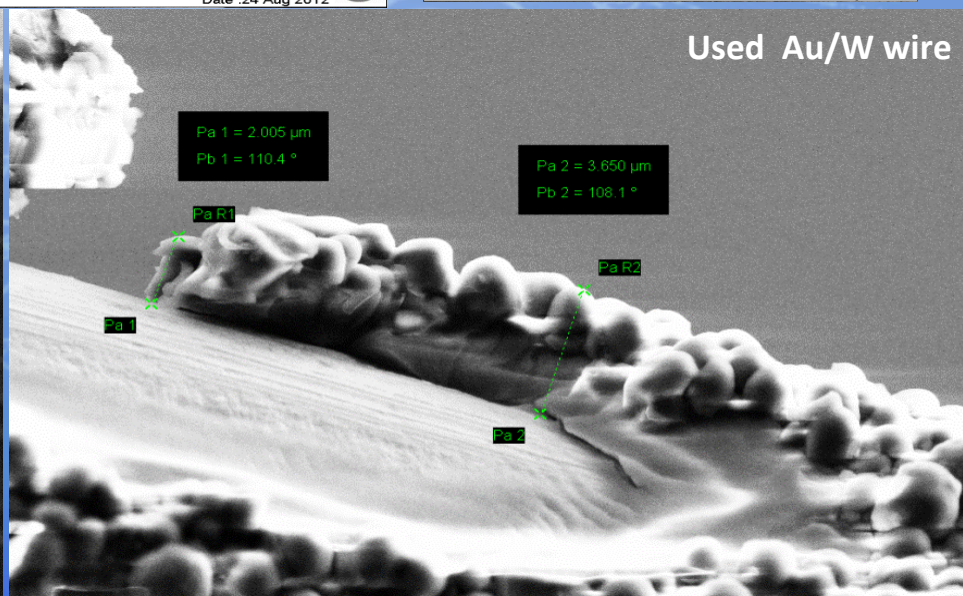
W wire: Au plated 5%  
 Sample 3 - used in single w 3

Mag = 3.17 K X  
 Barbora BARTOVA  
 Date :24 Aug 2012

Used Au/W wire

Pa 1 = 2.005 μm  
 Pb 1 = 110.4 °

Pa 2 = 3.650 μm  
 Pb 2 = 108.1 °



2 μm  
 EHT = 5.00 kV  
 WD = 1.3 mm  
 Signal A = SE2

W wire: Au plated 5%  
 Sample 3 - used in single w 3

Mag = 4.63 K X  
 Barbora BARTOVA  
 Date :24 Aug 2012



**Goals**

**Plan**

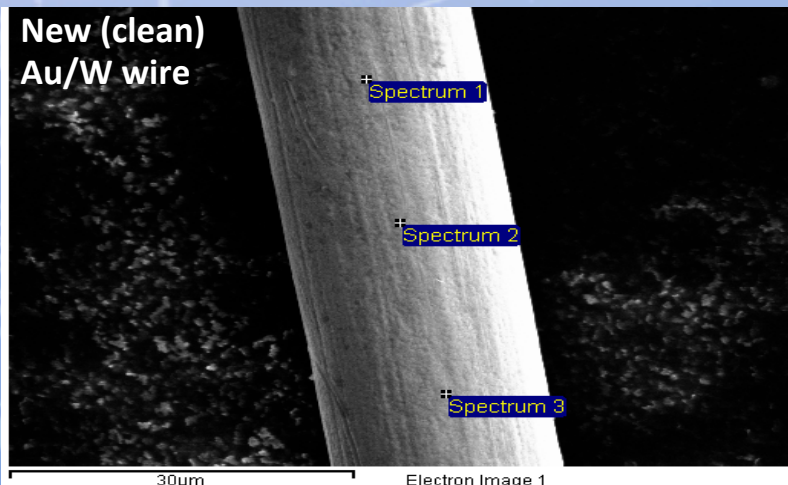
**Temperature Test**

**Outgassing Test**

**Preliminary Study**

**Upgrade**

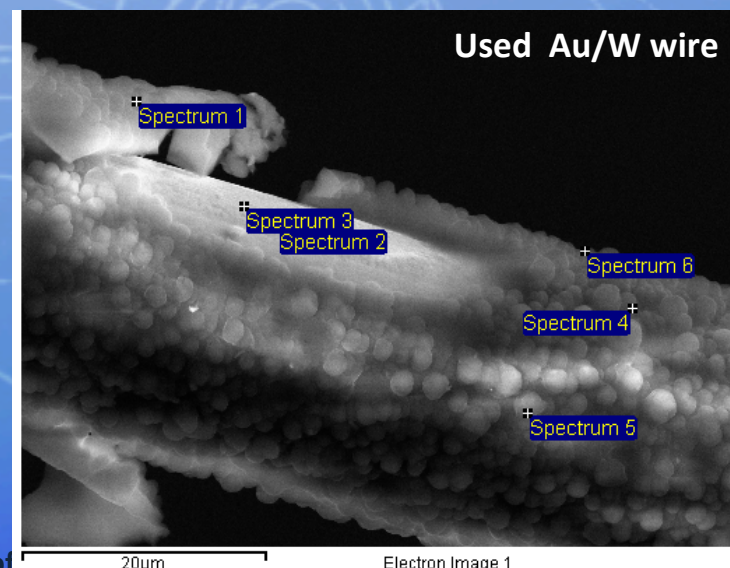
Spectrum	In stats.	W	Au
Spectrum 1	Yes	19.1	80.9
Spectrum 2	Yes	20.0	80.0
Spectrum 3	Yes	19.3	80.7



Spectrum	C	O	F	Al	S	Au
Spectrum 1	81.8	15.3	1.7	0.7	0.2	0.3

Spectrum	Al	W	Au
Spectrum 2	4.1	15.0	81.0
Spectrum 3	4.8	12.8	82.4

Spectrum	C	O	F	Au
Spectrum 4	78.0	19.9	1.8	0.3
Spectrum 5	82.6	14.8	1.3	1.3





Goals

Plan

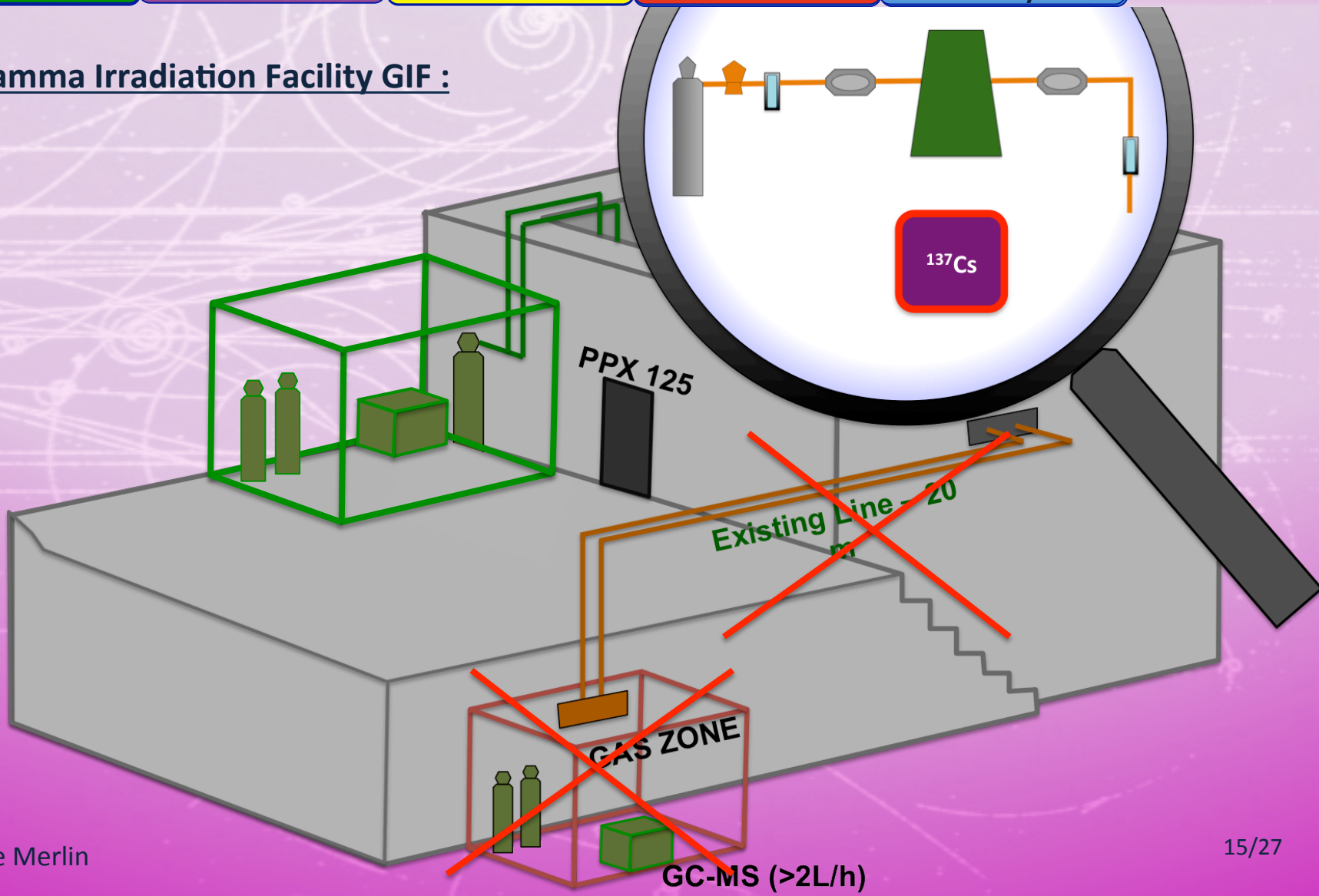
Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

Gamma Irradiation Facility GIF :



Goals

Plan

Temperature  
Test

Outgassing Test

Preliminary  
Study

Upgrade

## What we want to replace/change/Add :

- **GE1/1 Prototype II → GE1/1- NS2 technology**
- **10x10 removable triple – GEM detector**
- **Outgassing box :**
  - **Parallel line with variable gas flow**
  - **Heating tape (20 → 80 °C)**
  - **Temperature/Humidity sensors**
  - **SWPC for gain monitoring**
- **Gas system :**
  - **Pre-mixed bottle (Ar/CO<sub>2</sub>/CF<sub>4</sub> – 45/15/40)**
  - **Clean Stainless Steel pipes**
  - **Reduced flow (5L/h → 1L/h)**
  - **New GC-MS for the Gas Analysis**
- **Software :**
  - **Upgrade of existing programs**
  - **Online monitoring of the data**
  - **Alarm in case of problems (automatic SMS ? Mail ?)**
  - **Store files on the network**



**Thank you**

