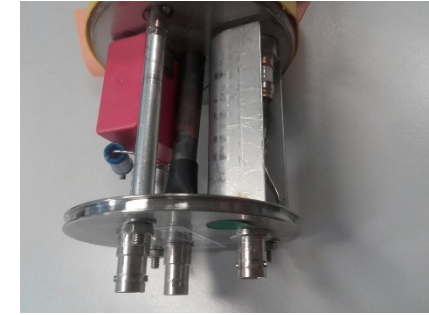
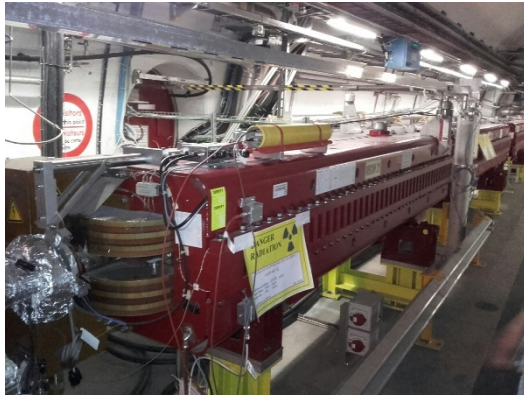


# BLM Ionization Chamber production

# BLM Ionization Chamber



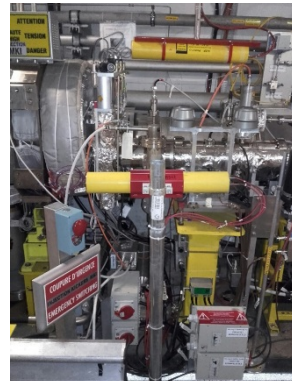
At the beginning of Run 2, BLM LHC system had 3929 monitors with 3518 Ionization Chambers (IC), 108 LIC and 191 SEM (and 1 FIC)



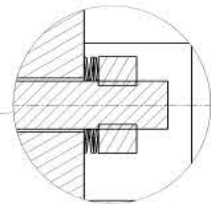
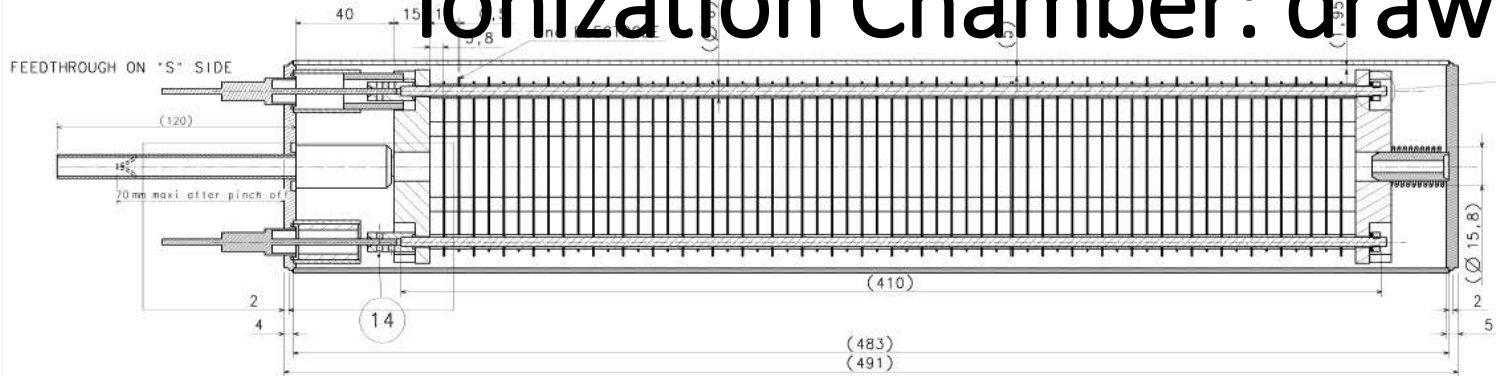
BLM PSB system had 32 installed IC.



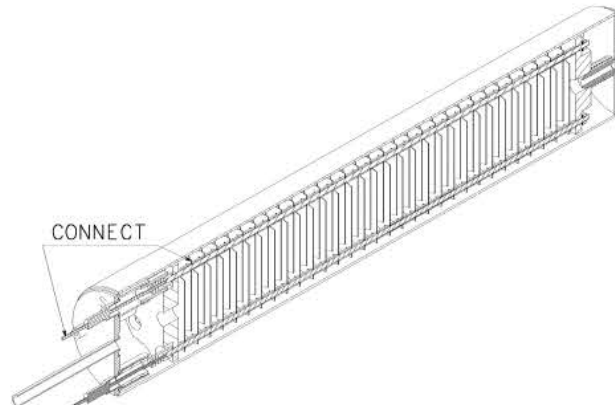
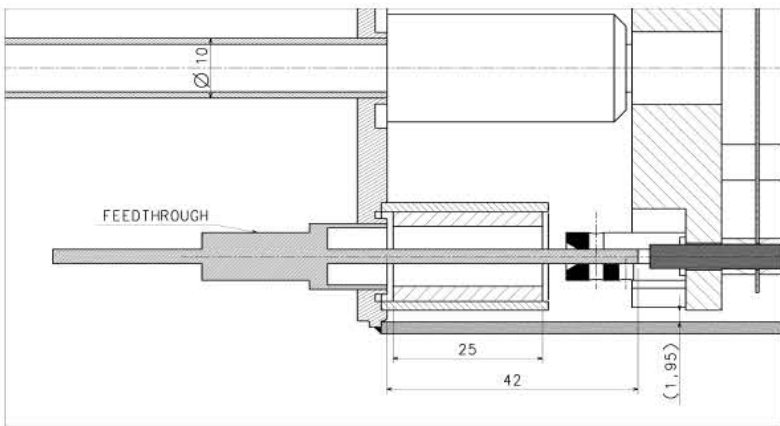
LINAC 2 had 5 IC  
LINAC 4 installed 24 IC  
Some IC are in PS



# Ionization Chamber: drawing



**MOUNTING SEQUENCE**  
Tighten nut M4 (Item 7) to completely compress washers, then unscrew 1/4 turn



**!! WARNING !!**  
CONNECT THE FEEDTHROUGH ON THE "S" SIDE WITH THE SECOND ELECTRODE

- WELDING SPECIFICATIONS:**
- THE WELDS MUST BE EXECUTED BY TIG WELDING
  - WITHOUT FILLER METAL
  - UNDER PROTECTIVE GAS
  - WITH 100% PENETRATION
- LEAK TESTING REQUIREMENTS FOR ULTRA HIGH VACUUM COMPONENTS:  
CLEANING OF THE COMPONENTS BEFORE THE LEAK TEST:  
THE COMPONENT SHALL BE CLEANED IN ACCORDANCE WITH TECHNICAL NOTE 3035-016-11-010  
FOLLOWING PRESSURE TESTING AND FINAL CLEANING, THE COMPONENT SHALL BE LEAK TESTED BY ROOM TEMPERATURE WITH A SENSITIVITY  $\leq 10^{-10}$  mbar·cm<sup>3</sup>/LEAK. A QUALIFIED LEAK DETECTOR THE LEAK DETECTOR SHALL NOT SHOW ANY DEVIATION WHEN THE COMPONENT IS ENCLOSED IN A HELIUM FILLED ENVELOPE.

Mass = 3.8 kg

| ITEM NO. | DESCRIPTION                           | QTY | UNIT       | REF. DES.                     | REF. QTY | REF. DES. |
|----------|---------------------------------------|-----|------------|-------------------------------|----------|-----------|
| 1        | MULTIPLE ELECTRODE BLM - EXTERNAL     | 1   | YS         | LHEBLM_0040 TYPE A            |          |           |
| 6        | VIS S.T.G.P.C BT POINT IN. 3X 3       | 1   | HL         | Bossard BN610                 |          |           |
| 2        | Slotted screw M3xL                    | 13  | A2-ISO1580 | Bossard BN652                 |          |           |
| 2        | ALUMINA TUBE $\varnothing 15/10$      | 12  | Al2O3      | L-25mm                        | 19.63.30 | 128.9     |
| 1        | COMPRESSION SPRING                    | 11  | 1.4.310    | Ferraflex VO-1804-14          |          |           |
| 4        | TIGHTENERS M4 -                       | 10  |            | LHEBLM_0016 TYPE A-VARIANTE 1 |          |           |
| 2        | TIGHTENERS M4 -                       | 9   |            | LHEBLM_0016 TYPE B-VARIANTE 1 |          |           |
| 16       | SPRING WASHER $\varnothing 8/4.2-8.2$ | 8   | 1.4.310    | BOSSARD BN638                 |          |           |
| 6        | LOCK NUT M4                           | 7   | A2         | DN 980V-BOSSARD BN5242        |          |           |
| 1        | BOTTOM COVER -                        | 1   |            | LHEBLM_0006-TYPE A            |          |           |
| 6        | ELECTRODE SPACERS -                   | 5   |            | LHEBLM_0007-TYPE C            |          |           |
| 183      | ELECTRODE SPACERS -                   | 4   |            | LHEBLM_0007-TYPE A            |          |           |
| 61       | ELECTRODE -                           | 3   |            | LHEBLM_0004-TYPE AI           |          |           |
| 2        | ALUMINE INSULATOR -                   | 2   |            | LHEBLM_0005                   |          |           |
| 1        | COVER ASSEMBLY -                      | 1   |            | LHEBLM_0002-TYPE A            |          |           |

DESIGN: INJECT TO BRANDES  
 DRAWING: 3035-016-11-010  
 PROJECT: ACCORDING TO DRAWING

| REV. | DESCRIPTION      | DATE                    |
|------|------------------|-------------------------|
| B    | NS-BA G. FÖFFAND | updated                 |
| A    | NS-BA G. FÖFFAND | updated length part 15i |

Beam Loss Monitor

MULTIPLE ELECTRODE BLM  
WELDED VERSION ASSEMBLY

SCALE: 1:1

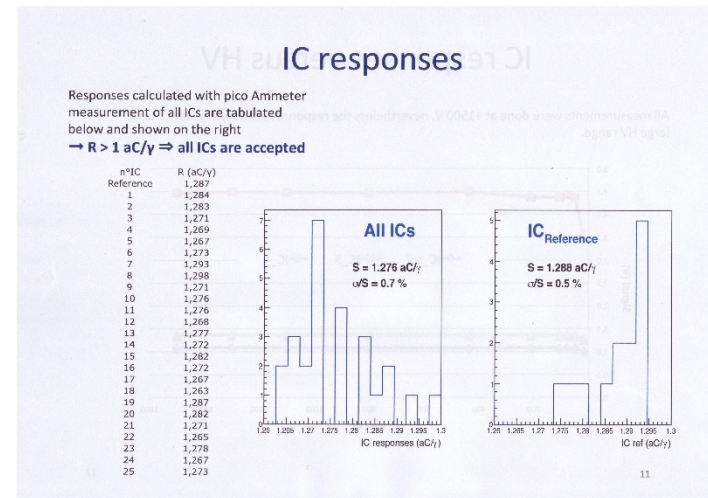
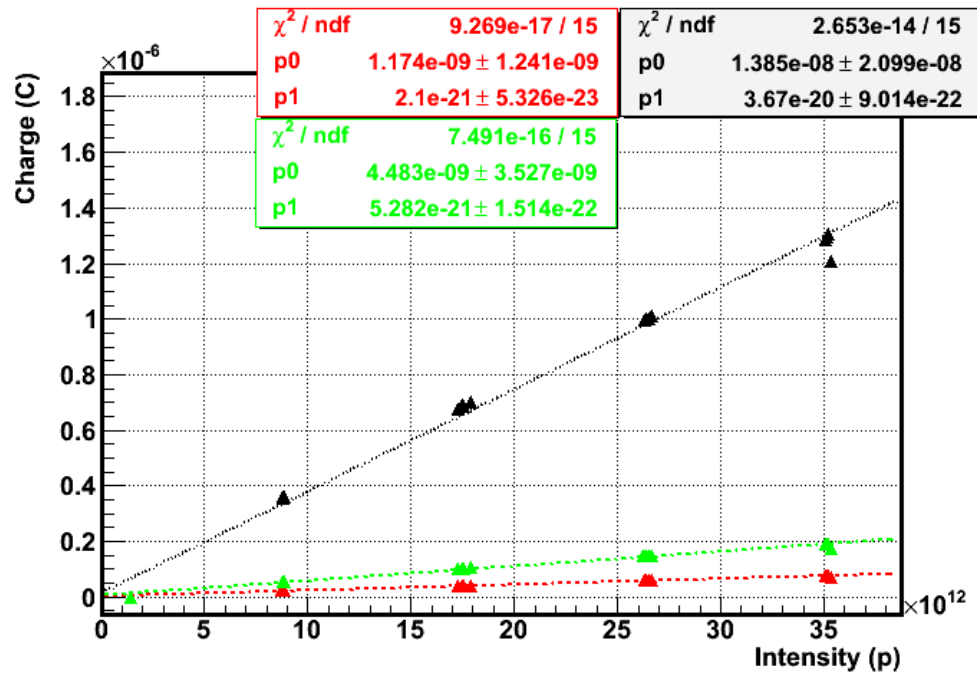
DESIGNER: G. FÖFFAND  
 CHECKED: R. PERRET  
 RELEASED: E. HELD  
 APPROVED: LHEBLM\_0040 (000001) (00000001)

DATE: 2004-09-08  
 DATE: 2005-12-06  
 DATE: 2007-12-06

ITEM NO.: HCRIM\_0001

# Ionization Chamber: test

plot of the integrated charge (over 40 us), Sep 2015 at HRM  
 black = IC, green = FIC, red = LIC



Ionization Chamber test  
 validation for LIPAc  
 with <sup>60</sup>Co γ of 1.25 MeV

Test done at Saclay (CoCase <sup>60</sup>Co source)  
 on June 10<sup>th</sup> to 14<sup>th</sup>, 2013

P. Abbate, J.-F. Denis, J. Marnierle  
 CoCase: K. Chouaib, F. Dally

# Ionization Chamber: materials



|  |      |      |      |         |
|--|------|------|------|---------|
| Time of test                                 |      |      |      |         |
| Signal in pA                                 |      |      |      |         |
| N° disk                                      |      |      |      |         |
| N°1  |      |      |      |         |
| N°2  |      |      |      |         |
| N°3  |      |      |      |         |
| N°4  |      |      |      |         |
| N°5  |      |      |      |         |
| N°6  | 44   | 43   | 43   | 40      |
| N°7  | 485  | 381  | 322  | 268     |
| N°8  | 355  | 351  | 342  | 323     |
| 3rd batch 2015                               |      |      |      |         |
| Offset of picometer                          |      |      |      |         |
| Signal in pA                                 | -3.8 | -0.5 | -0.3 |         |
| HV = 1500 V                                  |      |      |      |         |
| N° disk                                      |      |      |      |         |
| N°2  | 7.8  | 7.3  | 6.0  | 4.2 3.2 |
| N°3  | 14.0 | 9.2  | 6.3  | 4.2 2.6 |
| N°4  | 10.7 | 7.6  | 5.5  | 3.7 2.8 |
| 27.01.2016, Vacuum lab (bat 112) , pict21&22 |      |      |      |         |
| 3rd batch 2015                               |      |      |      |         |
| HV = 1500 V                                  |      |      |      |         |
| Signal in pA                                 |      |      |      |         |
| N° disk                                      |      |      |      |         |
| N°1  | 2.8  | 2.4  | 2.0  |         |
| N°2  | 3.8  | 3.2  | 1.7  |         |
| N°3  | 1.0  | 1.7  | 1.3  |         |
| N°4  | 4.3  | 2.3  | 1.5  |         |



| Sub system   | Company ( 2015)          |
|--|--------------------------|
| <b>LHCBLM_0001 and LHCBLM_0009</b>                     |                          |
| Material: tubes 1.4435 ss 88.9 x 2.0 x 6 mt            | Nicormal(Germany)        |
| tube inox 316L 483x88.9x2.0 LHCBLM_0040, IC            | Morfi ( Greece)          |
| tube inox 316L 105x88.9x2 LHCBLM_0038                  | Morfi ( Greece)          |
| AC, IC   | Friatec (Germany)        |
| BLM_0004 0.5X82,                                       | Metalvin (Spain)         |
| 007 type A   | ADM (France)             |
| 007 type C   | Ruprec(Portugal)         |
| 0006   | Ruprec(Portugal)         |
| _0006  | Morfi ( Greece)          |
| 16   | Morfi ( Greece)          |
| her)   | Morfi ( Greece)          |
| 0013)  | Morfi ( Greece)          |
| roflex   | Ferroflex (France)       |
| n  | Ceratec ( Netherlands)   |
| <b>Electrical connections LHCBLM_0036</b>              |                          |
| external plate LHCBLM_0037, manufacture                | Morfi ( Greece)          |
| st steel sheet LHCBLM_0037, manufacture                | NCP (Portugal)           |
| tube AlMgSi hard 4*7 L=60                              | Metallica (Swiss)        |
| in.steel.thr.rods A4 316 M4 L=85                       | Fournisseur EPI (France) |
| BNC HT RRI Polystyrene SHV 5KV                         | Huber+Suhner (Swiss)     |
| BNC 50ohm, connecteur coaxial, femelle,RRI Polystyrene | Huber+Suhner (Swiss)     |
| soldering lug, M4                                      | CERN                     |
| soldering lug, BNC                                     | CERN                     |
| wires (L=100, 1.5mm2)                                  | CERN                     |
| tinned copper wires, without insulation, D=0.91mm      | CERN                     |
| Resistor 10Mohm ,1W                                    | Etronics AG (Swiss)      |
| Capacitor (0.47uF, 2000V)                              | WIMA(Germany)            |
| shrinking tube   | CERN                     |

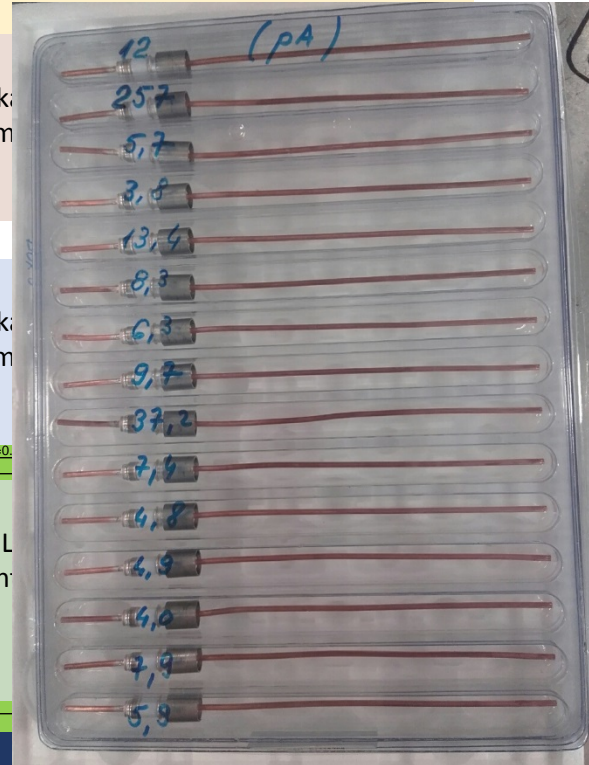
## High voltage 2000 V DC

|            |            |          |
|------------|------------|----------|
| Quantité   | 12         | 0 Pièces |
| TEST N°    | 1          |          |
| Quantité = | 120 pièces |          |
| Bonnes     | 42         |          |
| Rebuts     | 78         |          |

|            |           |  |
|------------|-----------|--|
| TEST N°    | 2         |  |
| Quantité = | 78 pièces |  |
| Bonnes     | 13        |  |
| Rebuts     | 65        |  |

|            |           |  |
|------------|-----------|--|
| TEST N°    | 3         |  |
| Quantité = | 65 pièces |  |
| Bonnes     | 42        |  |
| Rebuts     | 23        |  |

|                       |     |        |
|-----------------------|-----|--------|
| <b>RESULTAT FINAL</b> | 872 |        |
| Bonnes                | 97  | Pièces |
| Rebuts                | 23  | Pièces |



|                                |  |             |
|--------------------------------|--|-------------|
|                                | 1100   | 1100        |
|                                | 50   | 50          |
|                                | 20   | 20          |
|                                | 4  | 4           |
|                                | 4  | 4           |
| Gant cuir souple/soudure       | CERN   |             |
| CERN shipping permission       | Tom Wegelius (CERN+Swiss)                      | in progress |
| Protvino shipping permission   | Expert - OK; new IHEP Director - change of doc | in progress |
| Gaine thermo jaune s halogenne | Srati ( France)                                | OK          |



# Ionization Chamber: vacuum stand



**Rest pressure of the stand –  $3E-2$  mbar at  $T=22^{\circ}C$**

## Ultimate pressure of the pump stations

**a) before stand heating ( $T=22^{\circ}C$ )**

- station N1 –  $1.5E-6$ mbar ( $8.2E-7$  mbar with closed V1)

- station N2 –  $7.6E-7$ mbar ( $4.4E-7$  mbar with closed V8)

**b) after heating and 32 minutes cooling ( $T=148^{\circ}C$ )**

- station N1 –  $1.6E-7$ mbar ( $7.5E-8$  mbar with closed V1)

- station N2 –  $1.7E-7$ mbar ( $1.2E-8$  mbar with closed V8)

## Results of the He leak test

- leaks more than  $1E-10$  l · mbar/s are not found before heating

- leaks more than  $1E-10$  l · mbar/s are not found after heating and next 19 hours pumping.

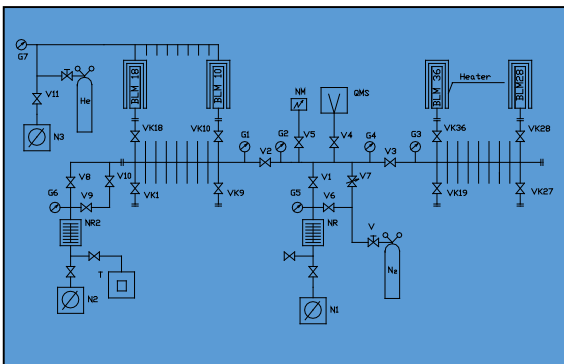
## Tightness of the main pump station valves

- pneumatic valves V1, V8 of the pump stations N1 and N2 are tight.

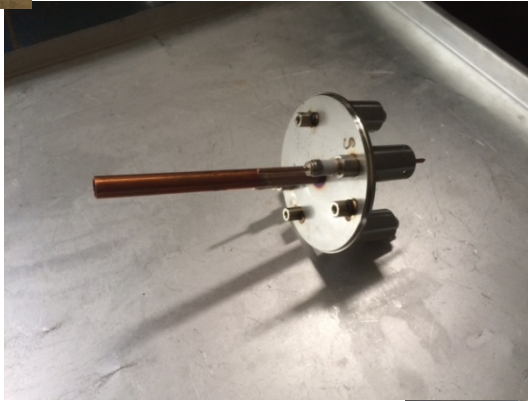
Partial pressure of the rest gas in the stand after heating and next 16 hours ion pumping at  $22^{\circ}C$  - only H2 –  $1.2E-10$  mbar.

The all main data are according to the previous data form stand.

-The signal of gas analyzer disappeared after stand heating:  
the bad connection contact of gas analyzer head to electronics box



# September 2016 Production





# Ionization Chamber: database



MTF Application - Folder: Properties Page 1 of 1

**Equipment Folder: Properties**

Equipment Identifier: HCBLM\_I001-05000057  
 Other Identifier: IHEP0057  
 Description: Beam Loss Monitor: Ionization Chamber

External Links: No external data link exists

**Property Values**

| Property                  | Unit | Value  |
|---------------------------|------|--------|
| Leakage Current (Assemb)  | µA   | 0.7    |
| Head Producer             | INFP | 2000   |
| High Voltage (Assembly)   | V    | 2000   |
| Filter                    |      |        |
| Batch Number              |      | 4      |
| Gas Bottle Number         |      | 1      |
| Spectrum (before filling) |      | 19     |
| Temperature (filling)     | °C   | 19.6   |
| Temperature (heating)     | mbar | 200    |
| Duration (heating)        |      | 6      |
| Spectrum (after filling)  |      | 19     |
| Leakage Current_v         | µA   | 0.73   |
| Leakage Current_I         | µA   | 0.74   |
| High Voltage (Leak-I)     | µA   | 2000   |
| Leakage Current (IHEP)    | µA   | 0.6    |
| High Voltage (Leak-I-C)   | V    | 1500   |
| Lorry Number              |      | 3      |
| IHEP Departure Date       |      | 38944  |
| CERN Arrival Date         |      | 39553  |
| High Voltage (Leak-C)     | V    | 2000   |
| Leakage Current (CERN)    | µA   | 0.5    |
| High Voltage              | µA   | 1500   |
| Currents                  | µA   | 70.344 |
| Over Rate                 | µA/h | 4.7    |
| Source Activity           | GBq  | 98     |

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MTF Application - Slot Folder: Main Info Page 1 of 1

**Slot Folder: Main Info**

Slot Identifier: BLMQI.B6L5  
 Other Identifier: BLMQI.06L5.B1130\_MQML\_XRP  
 Description: Beam Loss Monitor Type BLMQI

Slot main data

|              |                           |
|--------------|---------------------------|
| Manufacturer | BLM                       |
| Parent slot  | BLMQI.06L5.B1130_MQML_XRP |
| Location     | R532                      |
| Slot details | Link to Layout DB         |
| MRC          | D01                       |

Installation data

|           |                     |             |            |
|-----------|---------------------|-------------|------------|
| Item      | HCBLM_I001-05000057 | Decom Start | 13106.4706 |
| Equipment |                     | Decom End   | 13106.4706 |

Navigation

- Equipment
- Navigation
- Comments

Auth

|                  |            |    |              |
|------------------|------------|----|--------------|
| Created on       | 2005-01-01 | by | LHCWCOM      |
| Last modified on | 2015-09-10 | by | EDHS_RGR     |
| EDHS owner       | EDHSHPORT  |    | AB-BI-BL-MTF |

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MTF Application - Slot Folder: Properties Page 1 of 2

**Slot Folder: Properties**

Slot Identifier: BLMQI.B6L5  
 Other Identifier: BLMQI.06L5.B1130\_MQML\_XRP  
 Description: Beam Loss Monitor Type BLMQI

External Property Values

|              |     |            |
|--------------|-----|------------|
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |

Property Values

|              |     |            |
|--------------|-----|------------|
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |

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MTF Application - Slot Folder: Properties Page 1 of 2

**Slot Folder: Properties**

Slot Identifier: BLMQI.B6L5  
 Other Identifier: BLMQI.06L5.B1130\_MQML\_XRP  
 Description: Beam Loss Monitor Type BLMQI

External Property Values

|              |     |            |
|--------------|-----|------------|
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |

Property Values

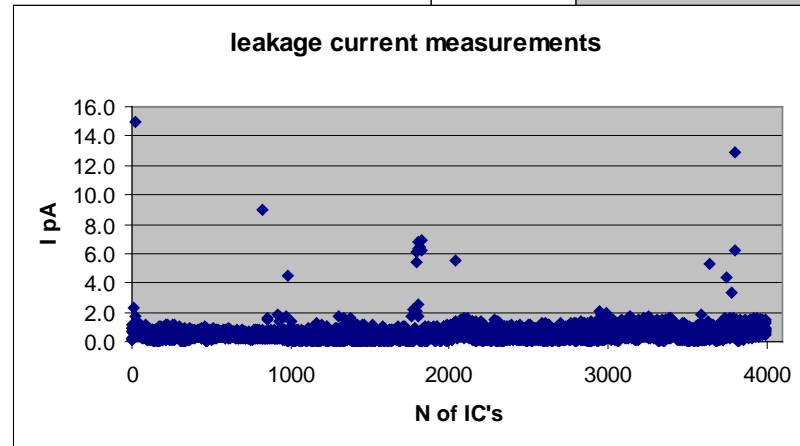
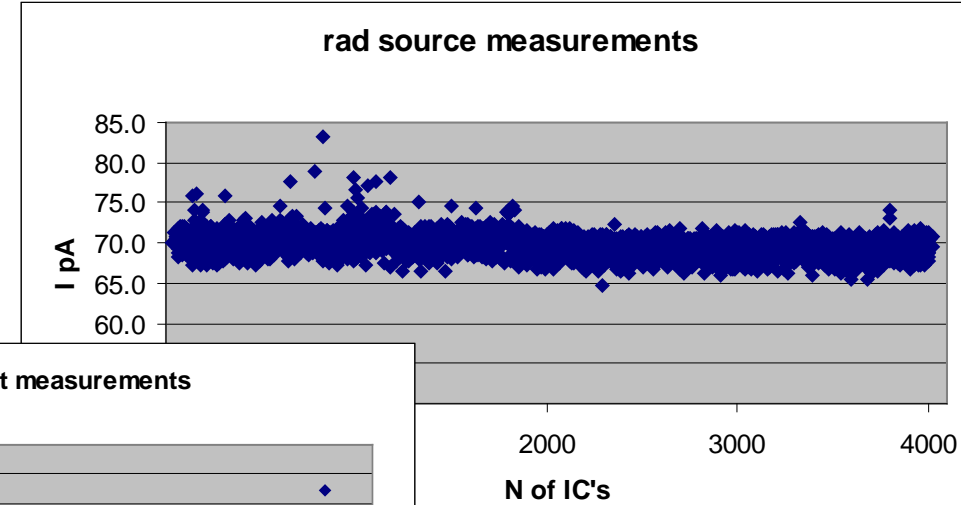
|              |     |            |
|--------------|-----|------------|
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |
| Manufacturer | BLM | 13106.4706 |
| Monitor DCUM |     |            |

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# GIF acceptance test

2016

2009

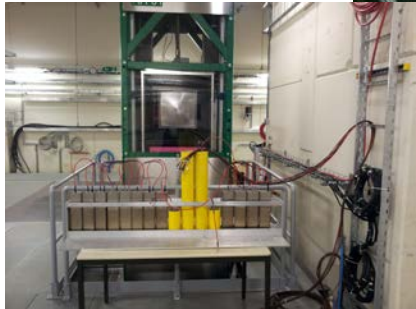
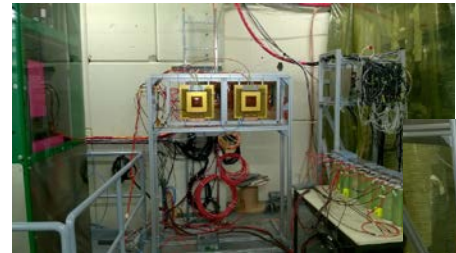


We made the reception tests of all IC's at CERN's General Irradiation Facility (GIF).

Reception tests consists from the leakage current and the signal from radioactive source measurements.

The procedure of tests was follows:

- Installation of one set from 15 IC on special support taking into account the uniformity of signals from radioactive source are +/- 5 % for one set.
- We kept the one IC as reference during the whole one batch measurements.
- We measured the leakage current, and after switch on the radioactive source we measured for same chambers the signal from radioactive source.
- The all data wrote to DataBase. **The finally we didn't accept 20 IC from 4250.**



## BLM production schedule (update 28.09.2016)

### 1. Order, receiving, tests of materials (CERN)

December 2014 – June 2016

### 2. Shipping of materials from CERN to Russia

1. July 2016 ( for 20 “spare” IC and the cleaning detergent, the copper tubes)
2. August 2016 (for 830 IC production)

### 3. Custom in Russia

1. August 2016 – done ( for 20 “spare” IC)
2. September 2016 – in works

### 4. IC Production ( Protvino) – 6 – 8 months

October 2016 – March 2017

### 5. Shipping of IC from Protvino to CERN

1. December 2016 (? 300 IC)
2. March 2017

### 6. Reception test at GIF++ (CERN)

1. January 2017 (? 300 IC)
2. April 2017

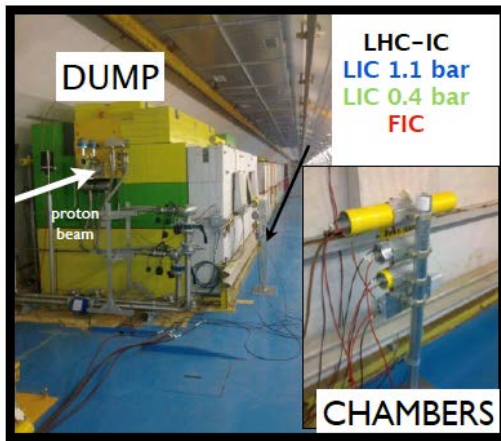
Some slides

# Detector description

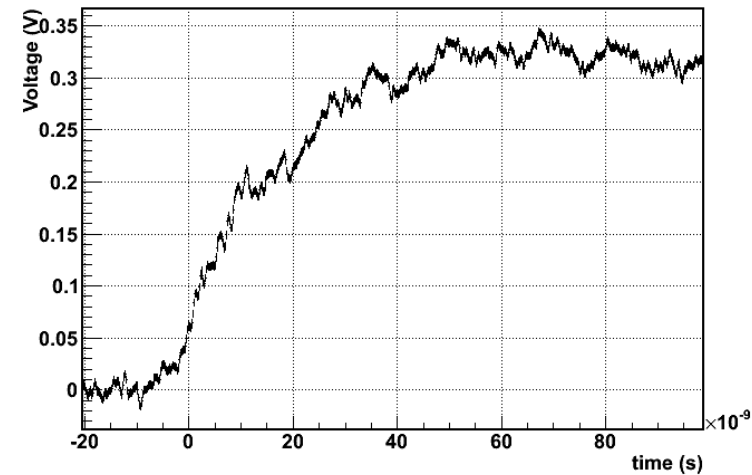
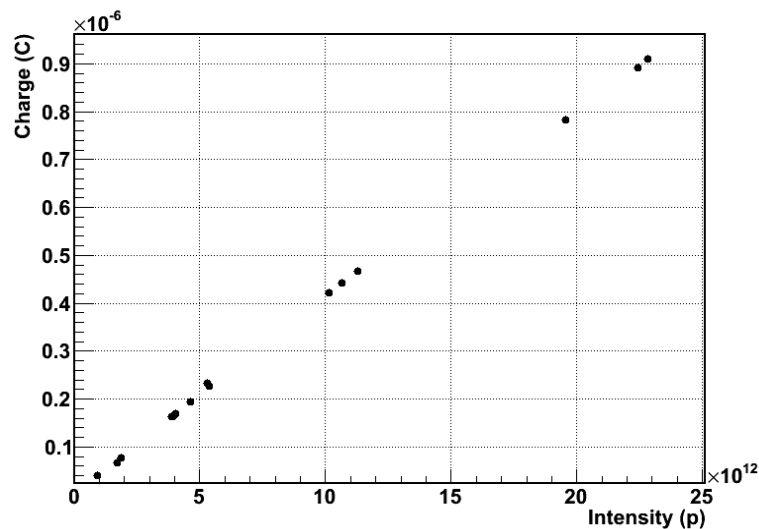
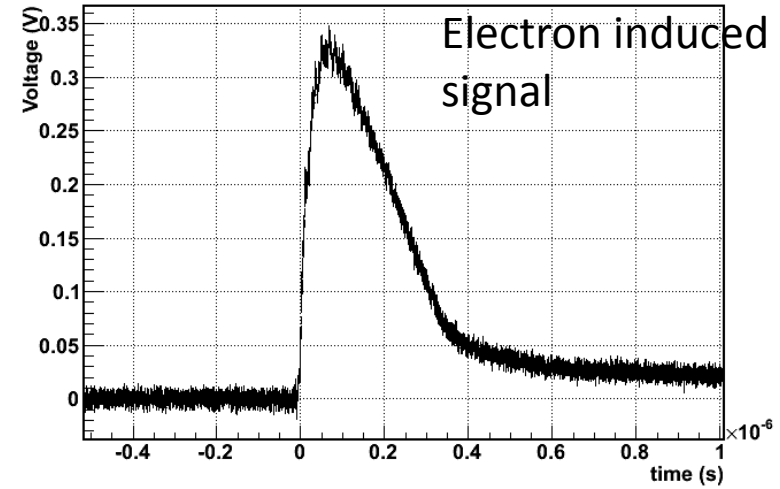
- 61 circular parallel plate Al electrodes
- HV = 1500V
- 1.5 l N<sub>2</sub> gas (1.1 bar pressure)
- Sensitivity:  $5.26 \times 10^{-5}$  C/Gy derived from
  - $\rho(\text{N}_2) = 1.2 \text{ kg/m}^3$
  - $W = 34.8 \text{ MeV}$  (avg energy for ionization)
- Dynamic range ( $10^{+7}$ ) limited by:
  - Leakage current (1 pA)
  - Saturation effects (space charge)



# Detector performance I

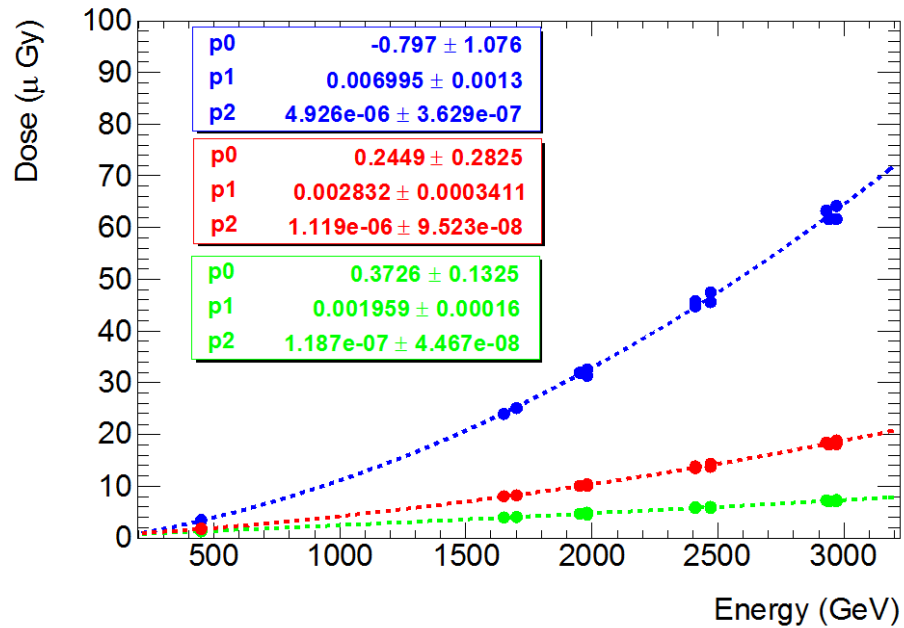


- Response to 1 ns pulsed (mixed radiation field. Protons onto dump)
- Raise time/FWHM  $\sim 40/200$  ns
- Total (ion) charge collected in 300us
- Response linear with intensity



# Detector performance II

- LHC losses



- UFO (unidentified Falling Objects):  
Micron size dust falling into beam

- Losses observed during wire scans (3x IC downstream)

