

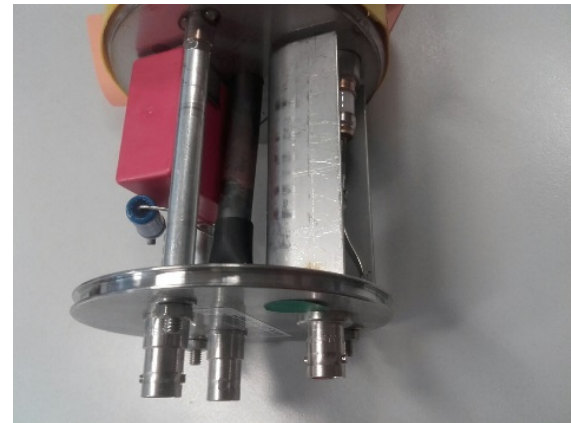
# Latest test results of ic BLM

**Viatcheslav Grishin, Irena Dolenc Kittelmann, Clement Derrez, Edvard Bergman (ESS ERIC)**  
Tatiana Medvedeva (CERN)

[www.europeanspallationsource.se](http://www.europeanspallationsource.se)

21/11/2017 V.Grishin 4<sup>th</sup> BI Forum Paris

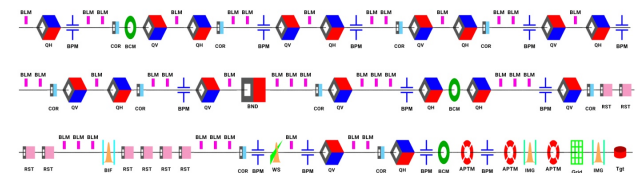
# BLM Ionization Chamber



# BLM Ionization Chamber at ESS

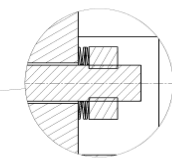
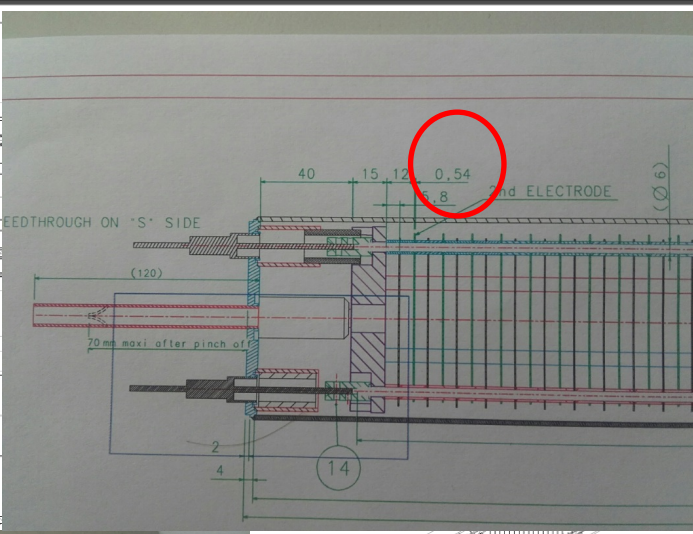
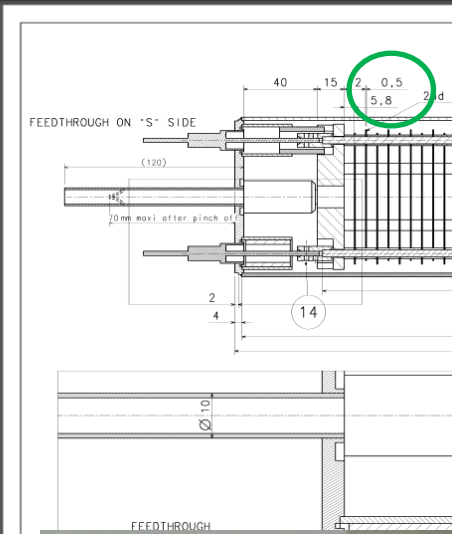


| LINAC section | Number of ionization chambers | Comment      |
|---------------|-------------------------------|--------------|
| DTL           | 5                             | 1 per Tank   |
| Spokes        | 52                            |              |
| Medium Beta   | 36                            |              |
| High Beta     | 84                            |              |
| HEBT          | 45                            | 3 per q-pair |
| Dog leg       | 21                            | 3 per q-pair |
|               | 2                             | 1 per dipole |
| A2T           | 15                            |              |
| Dump line     | 6                             |              |
| <b>Total</b>  | <b>266</b>                    |              |



# BLM Ionization Chamber 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)

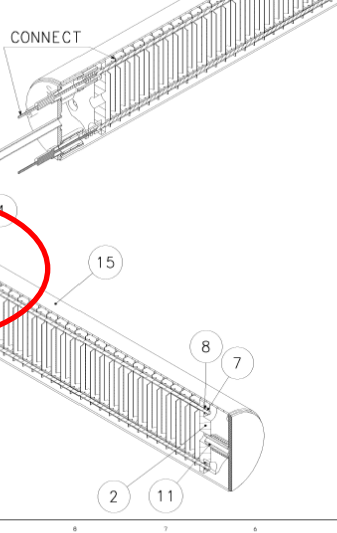
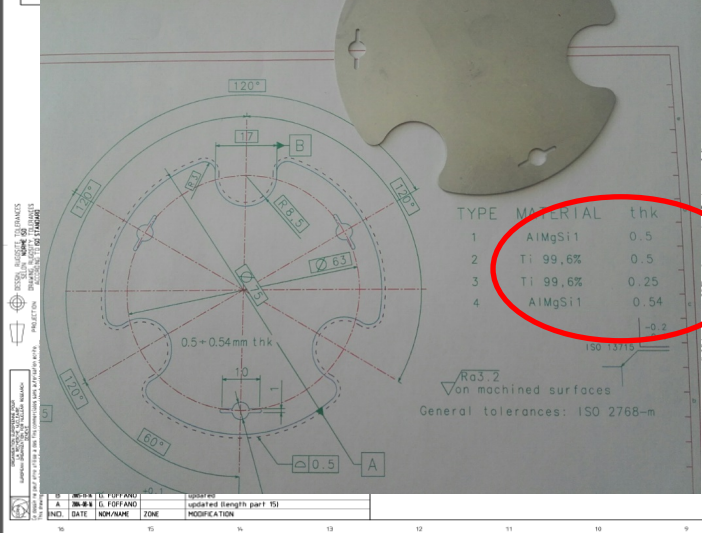


**MOUNTING SEQUENCE**  
Tighten nut M4 (Item 7) to completely compress washers, then unscrew 1/4 turn

**!!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 ARGON GAS SHIELDING  
- WITH BACK FORCE PROTECTION

**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 005/PA.18-05.  
- FOLLOWING PROCEDURE: TESTING AND FINAL CLEANING, THE COMPONENT SHALL BE LEAK TESTED BY ROOM TEMPERATURE WITH A SENSITIVITY OF  $10^{-10}$  mbar·m<sup>3</sup>/s USING A PERMANENT LEAK DETECTOR. THE LEAK DETECTOR SHALL NOT SHOW ANY DEVIATION WHEN THE COMPONENT IS ENCLOSURE IN A HELIUM FILLED ENVELOPE.



Mass = 3.8 kg

| NO | DESCRIPTION                      | QTY | UNIT | REMARKS            |
|----|----------------------------------|-----|------|--------------------|
| 1  | MULTIPLE ELECTRODE BLM - EXTERNA | 15  |      | LHCBLM_0010 TYPE A |
| 2  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 3  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 4  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 5  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 6  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 7  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 8  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 9  | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 10 | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 11 | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 12 | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 13 | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 14 | WELDED VERSION ASSEMBLY          | 1   |      |                    |
| 15 | WELDED VERSION ASSEMBLY          | 1   |      |                    |

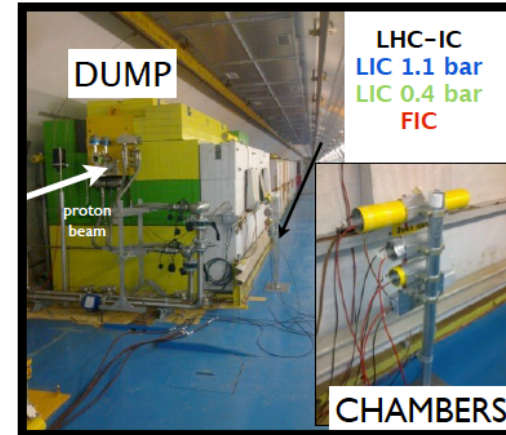
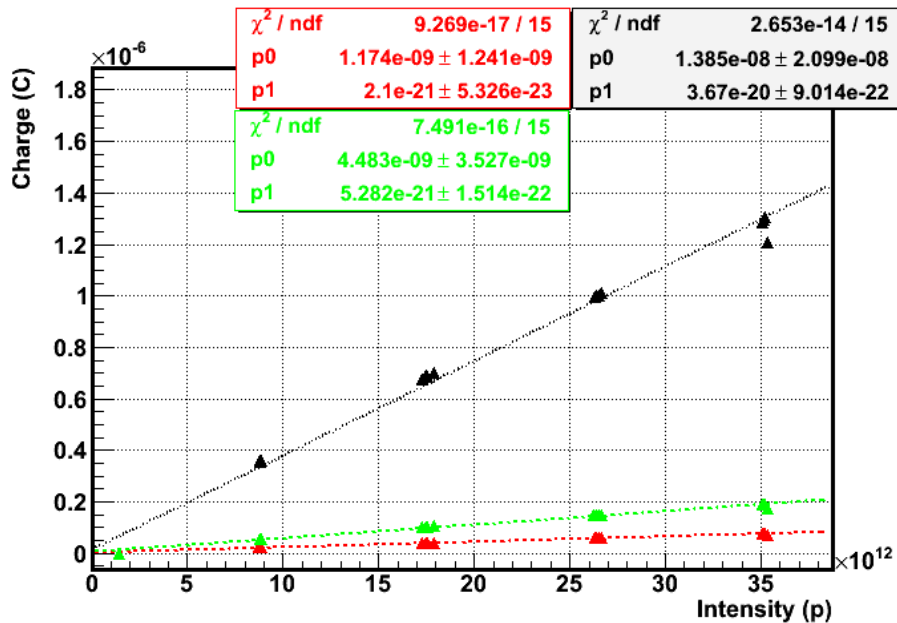
| NO | DESCRIPTION             | QTY | UNIT | REMARKS |
|----|-------------------------|-----|------|---------|
| 1  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 2  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 3  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 4  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 5  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 6  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 7  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 8  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 9  | WELDED VERSION ASSEMBLY | 1   |      |         |
| 10 | WELDED VERSION ASSEMBLY | 1   |      |         |
| 11 | WELDED VERSION ASSEMBLY | 1   |      |         |
| 12 | WELDED VERSION ASSEMBLY | 1   |      |         |
| 13 | WELDED VERSION ASSEMBLY | 1   |      |         |
| 14 | WELDED VERSION ASSEMBLY | 1   |      |         |
| 15 | WELDED VERSION ASSEMBLY | 1   |      |         |

# Motivation

- The main beam loss monitor type in accelerator chains at CERN, ESS, GSI is ionization chamber. 4250 monitors were produced in 2006-2008. In 2014-2017 a new production of 830 IC was performed to replenish spares for LHC and for ESS and GSI, which have the design difference.
- Calibration of ic17 and comparison of ic06 and ic17 tests are performed in mixed fields at HiRadMat to obtain irradiation conditions as close as possible to operational dose.
- After transport of the ic17 monitors to ESS by lorry, reception and calibration test are performed at the Source Testing Facility at Lund University

# HiRadMat at CERN set-up and 2015 results

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



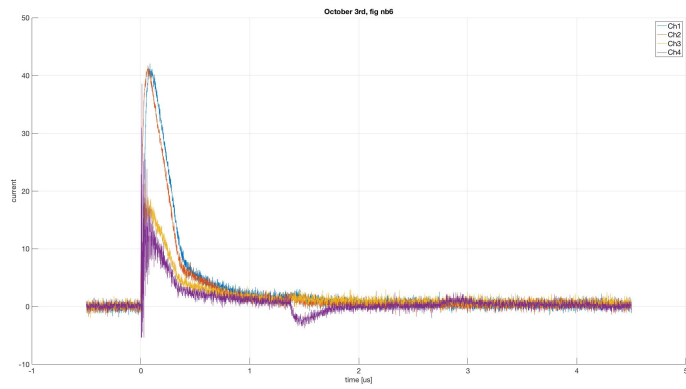
# HiRadMat at CERN set-up 2017



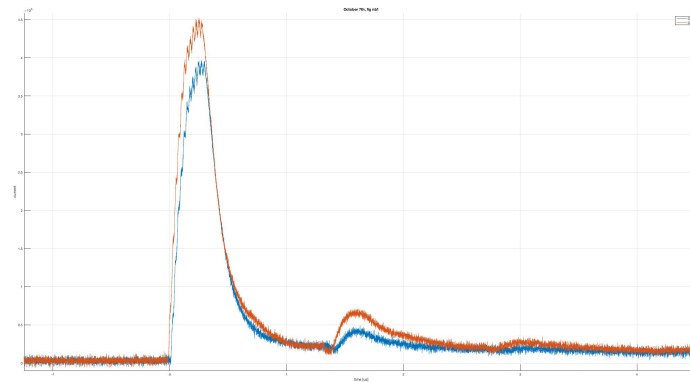


# Signal response at HiRadMat

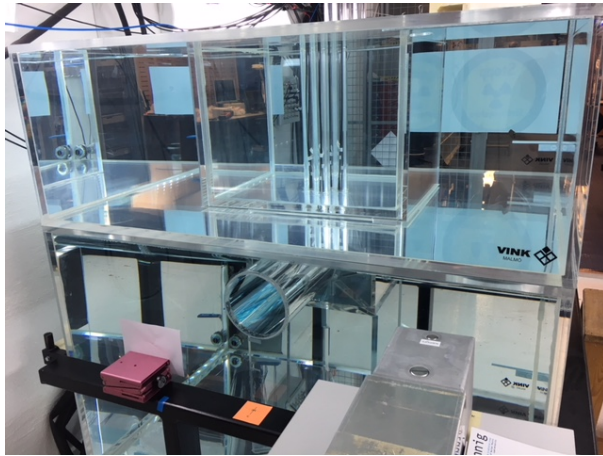
## 1 bunch



## 12 bunches



# The Source Testing Facility at Lund University

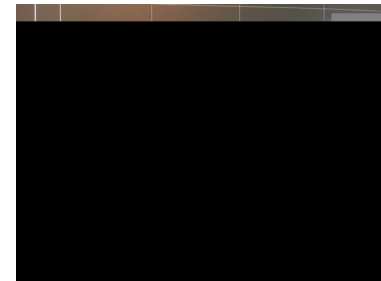


The Source Testing Facility (STF) is a laboratory providing access to radioactive sources and infrastructure for detector tests and characterizations.

It boasts a complete range of gamma-ray and Be-based neutron sources for characterizations of detectors and equipped with a the wide range of moderators and shielding materials, tools, electronic components.



# Leakage current and the source induced signals 1<sup>st</sup> test at STF



# Plans

- STF:  
acceptance and calibration test of some from 285 ESS ic BLM
  
- HiRadMat:  
the study of the signal, the signal linearity and response against intensity from 1 bunch up to saturation.

## 2018 Proposal of DAQ for BLM2@HRM

The use of 2 scopes in parallel would allow acquiring both the entire pulse length (300 us), including the long ions part on one of the scopes while the other oscilloscope would be set in a way to acquire only the electrons part (the first 300 ns). Having more than 8bits vertical resolution on these scopes would help with the current saturation issues.

These could be 2 actual oscilloscopes running windows (similar to the one you currently have there at HRM) and connected to Ethernet. They would be running scripts to automatically save waveforms to disk and re-arm. We could even have emails sent to us automatically in case an issue occurs, automatic saturation detection and settings adjustment or something like this.

Second option is 2 have USB Pico scopes connected to a PC. The PC would then be connected to Ethernet, running automated acquisition on the scopes and sending us data.

Another option is to use CERN FESA framework daq.