

TOTEM

Total Cross Section, Elastic Scattering and Diffraction Dissociation at the LHC

EDMS No.: 342167

TOTEM Experiment document No.:

TOTEM Roman Pots Services in IP5

The TOTEM Collaboration.

Summary

The TOTEM ¹ experiment is using detectors close to the beams up to 400 m upstream the IP5 region to measure the elastic scattering of protons at the LHC. Concerning the integration, these detectors must be regarded very similar to LHC instrumentation, like beam position monitors and collimators. In this note we present a first very preliminary estimate of the General Services for the Roman Pots and the detectors inside, in particular the routing and the cross-sections of the different cables. More details will be presented at the end of 2002 in the Technical Design Report (TDR) of TOTEM.

¹ <http://totem.web.cern.ch/Totem/>

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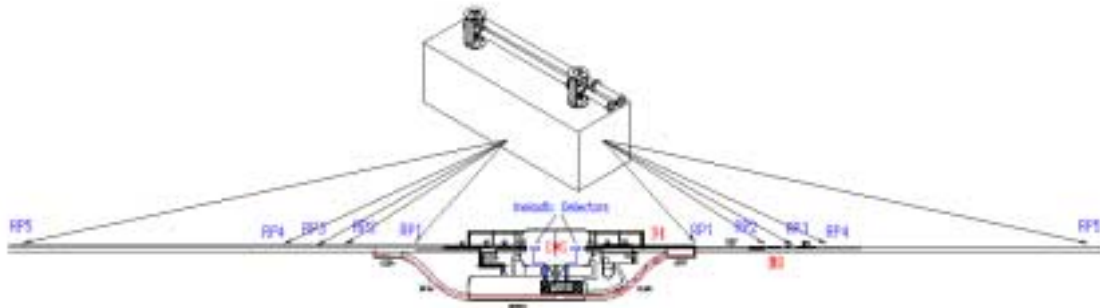
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1. INTRODUCTION

The TOTEM experiment [1] has been approved by the LHCC in November 1999 to measure Elastic and Total Cross Section in IP5.

TOTEM is preparing a Technical Design Report, to be submitted to the LHC Committee at the end of 2002. The present document summarizes the technical information available on the TOTEM Roman Pots.

The following contains a short description of the TOTEM experimental apparatus and a first estimation of a cross section for the cables of the experiment.

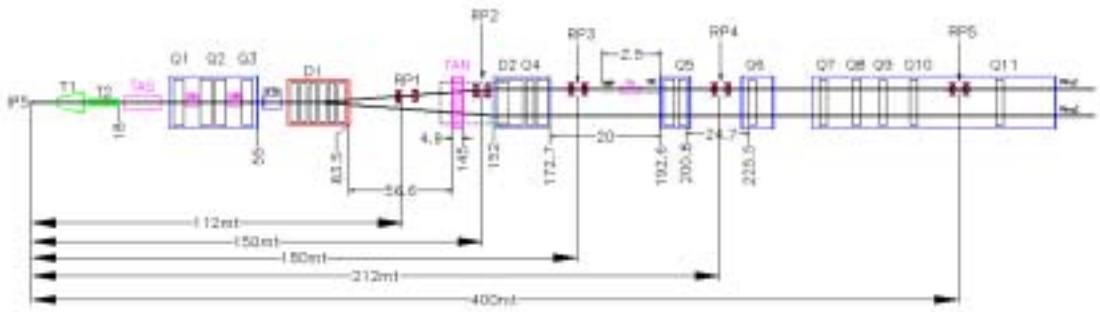


2. BRIEF DESCRIPTION OF THE EXPERIMENT

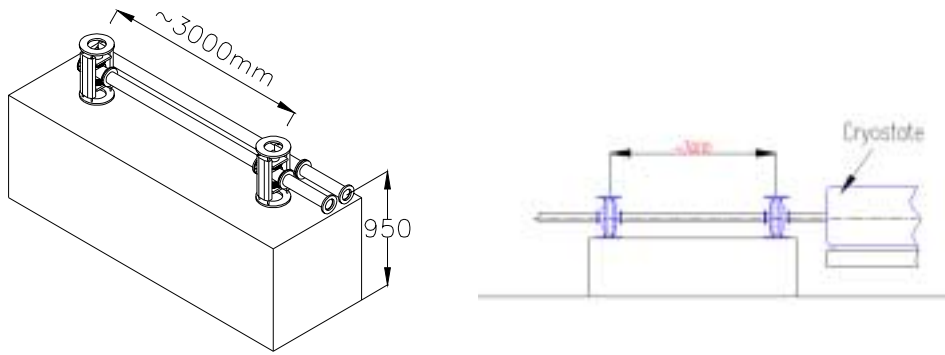
The TOTEM experiment will use a set of measuring stations called Roman Pots located symmetrically on each side of Interaction Point 5 in the tunnel of the Long Straight Section. These Roman Pots stations, given the space available in the LHC machine, will be installed at the following position wrt IP5:

RP1	~	112mt
RP2	~	150mt
RP3	~	182mt
RP4	~	215mt
RP5	~	400mt

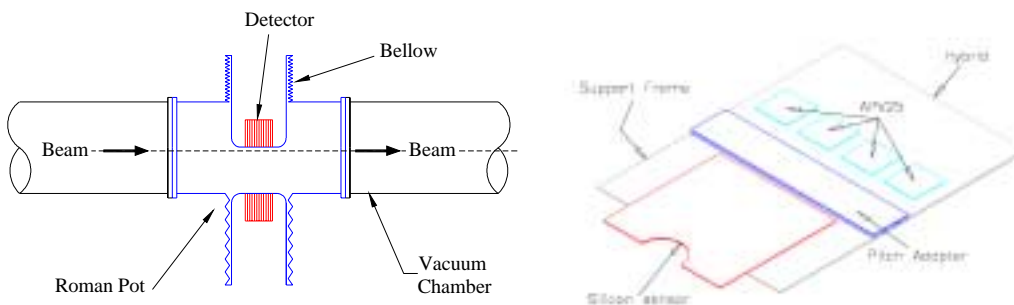
RP4 and RP5 do not appear in the TP and are presently under study but should nonetheless be considered at this stage of planning for the General Services installation in the machine tunnel since the five Roman Pots Stations need to be electrically and mechanically integrated in the design of the machine.



Two Roman Pots devices make a Roman Pots Stations. The station is integrated in a support structure where the cooling system for the detectors is installed.



Each Roman Pot in turn is composed of two up-down sliding Pots, which can be moved very close to the beam. Silicon detectors with $5 \times 3 \text{ cm}^2$ sensitive area cooled to liquid Argon temperature and a hybrid supporting the electronics to read out the detector are installed in the pots.



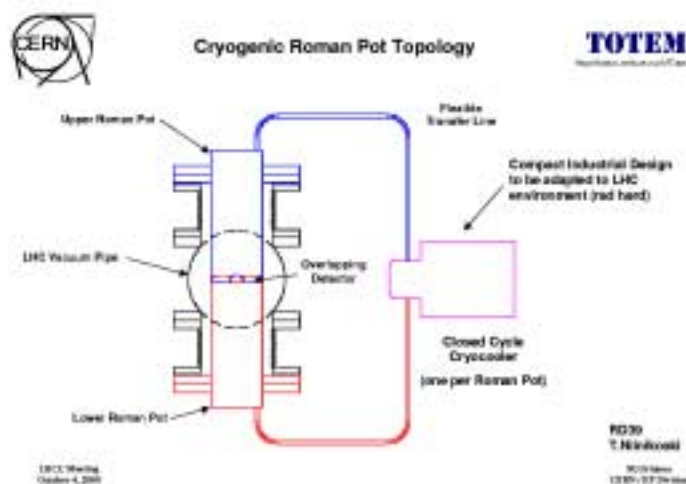
3. DESCRIPTION OF THE SERVICES NEEDED FOR THE ROMAN POTS

The Roman Pots mechanics is part of the main machine vacuum and given the possibility to move the Pots very close to the LHC beams they must be considered LHC instrumentation, very similar to a generic LHC collimator.

The services required by a Roman Pots Station can be divided in three groups:

1. Services to read out the detectors: Trigger/Readout, and Controls
2. Services to operate the detectors: Bias Voltage, Low Voltage
3. Services for the Roman Pots electro mechanics: power supply, controls, machine interlock and links to the Beam Instrumentation

The amount and the routing of the services of category 3 above will be defined by TOTEM together with the appropriate LHC machine group and will not be considered further in this document.



TOTEM foresees the use of silicon detectors cooled at liquid Argon temperature. Since the cryogenic fluid flow required will be very small (of the order of 0.05g/sec of Argon at 130K) each Pot will be equipped with its own cryo-cooler plant, located very close to the detector. The routing of the cooling transfer line from the cryo-cooler to the pot is integrated in the design of the Roman pot device, and no cryogenic transfer lines are required for TOTEM in the LHC tunnel. Each cryo-cooler plant needs only connection to electric power and this is accounted for in the request for General Services for the Roman Pots.

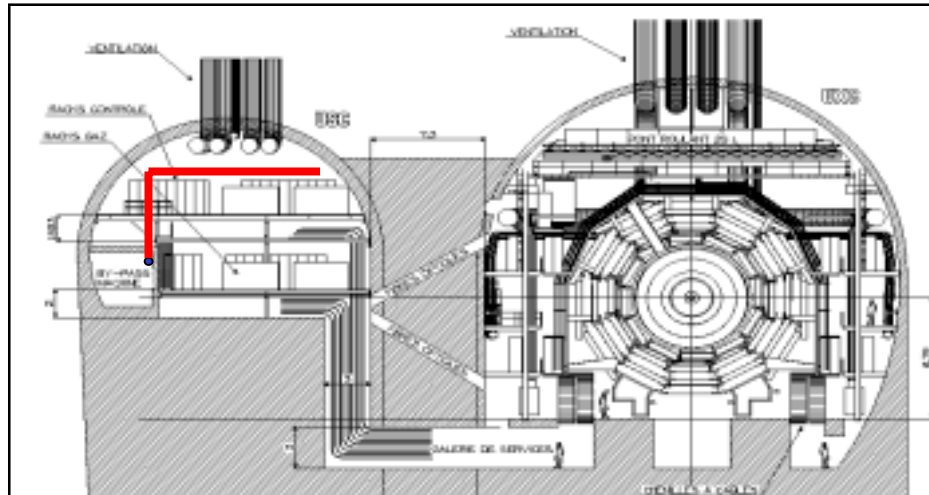
4. CABLES ROUTING

The TOTEM experiment requires the connection of the detectors in the Roman Pot stations to the counting room USC55. The basic requirement for this connection (at least for the elements in category 1 above) is to have the shortest length possible, in order to reduce the latency of the Trigger signal, the distance of Roman Pots from the USC55 Counting Room being already at the limit of their possible exploitation.

To facilitate the evaluation of the length of the cables we have considered separately three regions. The details of the local routing in each region are the real integration issue.

Region 1: Cables leave the Roman Pots devices to join the cable trays in the tunnel allocated to TOTEM by the general services of LHC (*which is the appropriate routing to follow and how long will it be?*).

Region 2: The cables, once in the cable tray, have to pass through the machine tunnel and then through the by pass tunnel switching in correspondence of the alcove UJ57(UJ53). Once the routing for the switching to the by pass will be known this will determine the extra length of

Region 3

For the estimation of the typical cross section of the bundle of cables for one Roman Pot we have assumed the following contributions:

- Bias Voltage	10 cm ²
- Low Voltage	15 cm ²
- Trigger/DAQ	15 cm ²
- Slow Controls	15 cm ²
- Total of above	55 cm ²

$$\text{Contingency factor} \times \text{Packaging factor} = 1.3 \times 1.3 = F = 1.7$$

The total cross section required for one Roman Pot station on a cable tray in the tunnel is then $F \times \text{Nominal Cross Section} \sim 10 \times 10 \text{ cm}^2$. The total cable cross section on the cable trays will depend on the position in the tunnel, since cables of different stations will run together on the cable trays.

4. CONCLUSIONS

The numbers quoted are very preliminary and they should be used mainly to:

- Define the impact of the TOTEM cabling on the general services of LHC
- To study the shortest way possible to connect the detectors to the counting rooms.

A detailed description of the detectors will be available in the Technical Design Report, with a more refined description of the services needed in the Machine tunnel. For the integration, Roman Pots must be considered very similar to LHC instrumentation, like collimators or Beam position Monitors. The machine interlock and link to the Beam Instrumentation must be designed together with LHC.

REFERENCES

[1]: TOTEM Collaboration, TOTEM Technical Proposal, CERN/LHCC 99-7, LHCC-P5, 15 March 1999.