

Comparison of the beam position analysis by LHCf with the LHC BPM data



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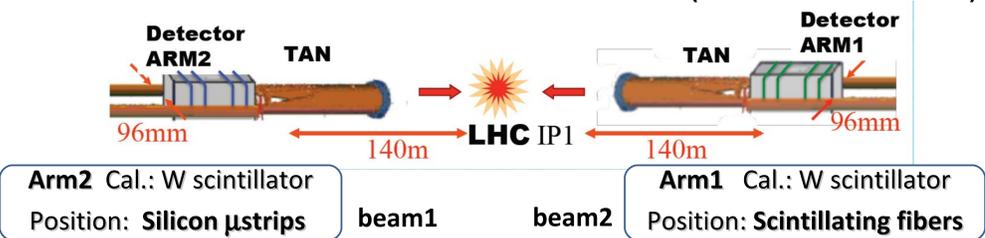


Abstract: The LHCf experiment measures neutral particles produced in the very forward rapidity region at 140m far from the IP1 interaction point. The results of the beam position analysis by LHCf are compared with the information provided by the LHC Beam Position Monitor analysis. Here I present the consistency between the results of the two different analyses.

The LHCf experiment¹

is a small experiment (~30 people) dedicated to high-energy cosmic-ray physics. It measures the energy and position of γ (from π^0 decays) and neutrons produced in pp interactions at $|\eta| > 8$.

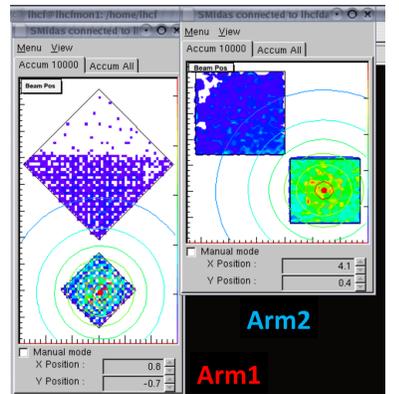
The detector "Arm" is composed of two electromagnetic calorimeter (16 layers) with 4 position sensitive layers, and located at 140m far from IP1 on both sides (named Arm1 & 2).



Here I concentrate on the beam position analysis².

Position measurement by LHCf

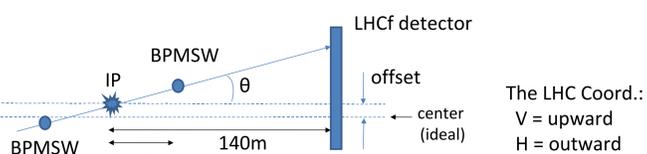
Each event is produced by daughter particles from pp interaction, so, in order to see the beam positions, **accumulated hitmaps** must be monitored during the LHC operations. We also analyzed the accumulated hitmaps in the following offline analyses. For this, the measurements below have one data point for a fill, or a stable beam.



The position-sensitive layers are different by Arms, so we applied different methods to extract center values from the above hitmaps. See below for details.

Beam Position Monitor (BPM)

The nearest BPM to IP1 is BPMSW at 21.3m, the warm directional stripline coupler for Q1³. The beam position at the LHCf location is calculated using the measurements by 2 BPMSW's:



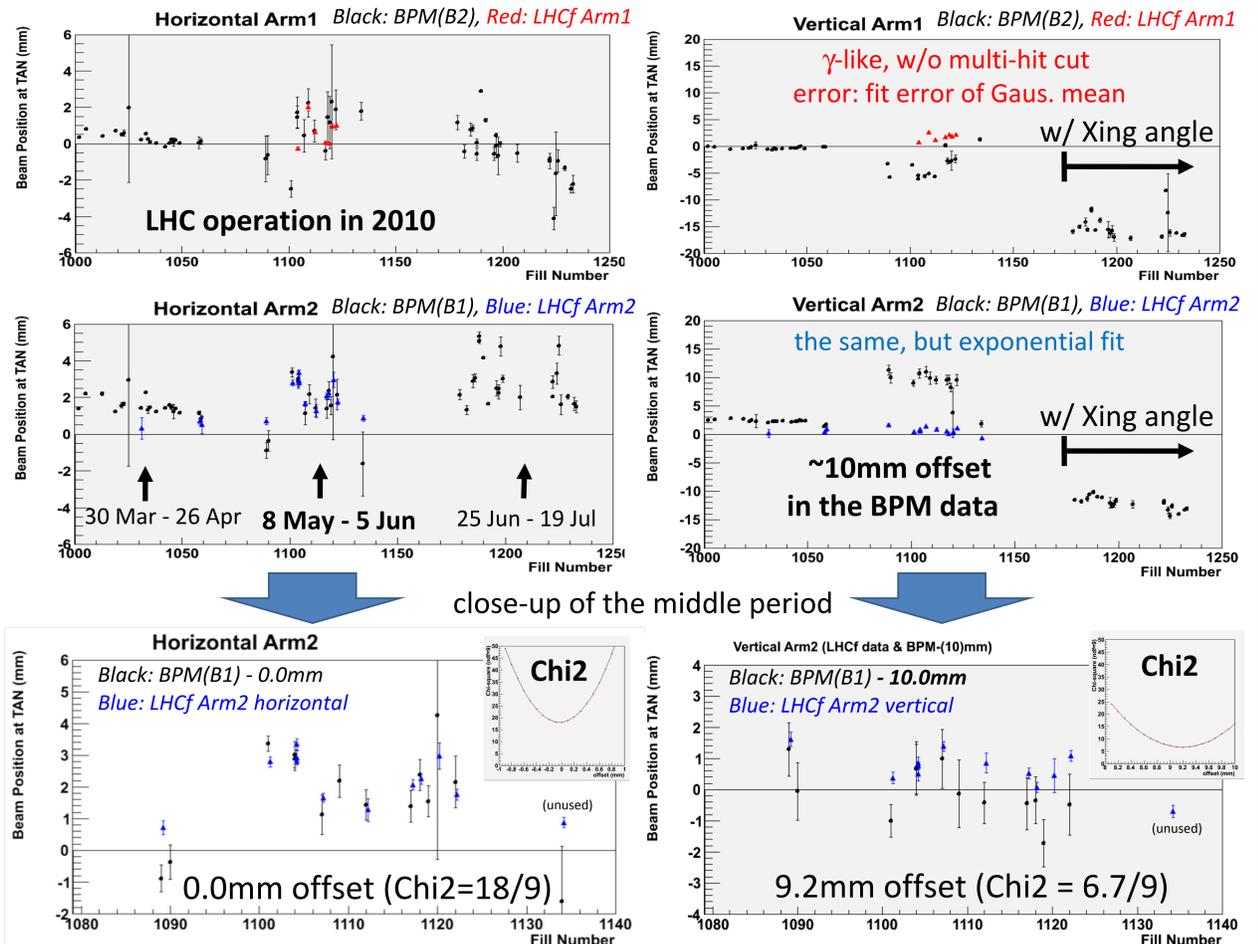
I extracted the measurements (with its error) of 8 BPMSW's: R&L, B1&B2, H&V, provided by Beam Instrumentation via TIMBER database⁴.

During early periods, the processing electronics, responsible for the **accuracy** (absolute position) of the measurement, was not fully calibrated. Measurement **resolution** has been taken into account with the error and RMS through a fill.

References:

- [1] LHCf TDR, CERN-LHCC-2006-004.
- [2] Others are in O. Adriani (2011) in preparation; O. Adriani (2011), in the open session of this LHCC.
- [3] "Signal Processing for Beam Position Monitors", G. Vismara (BIW 2000).
- [4] "Tool for Information Monitoring: Browsing, Extraction & Rendering", LHC Logging Project.

Results



Absolute offsets have been estimated by the chi-square method. After subtraction of them, we found **0.5mm level consistency at the LHCf location**

Summary, discussion, & acknowledgment

Our position-sensitive layers perform very well, especially in Arm2. The consistency with the BPM data is about 0.5mm with an absolute offset of the BPM side. The LHCf data could be used for the calibration of BPM.

We especially thank S. White for teaching us about the BPM data.