Studies and Historical Analysis of ALBA Beam Loss Monitors

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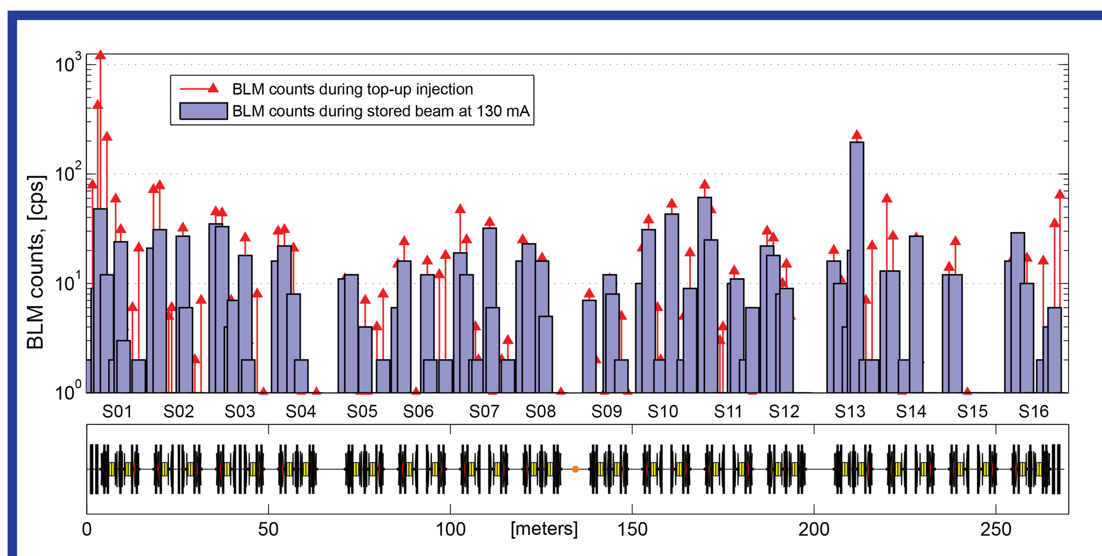
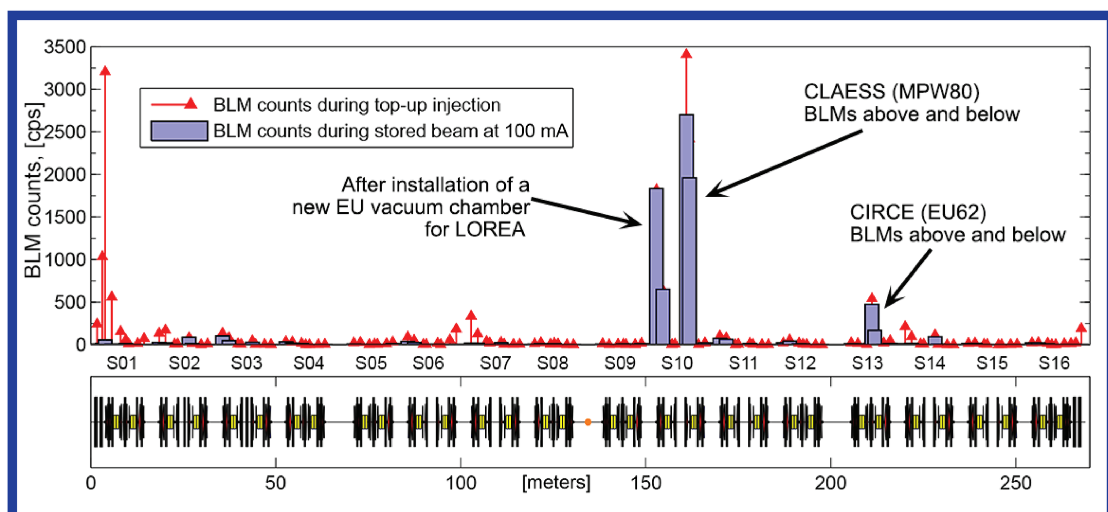
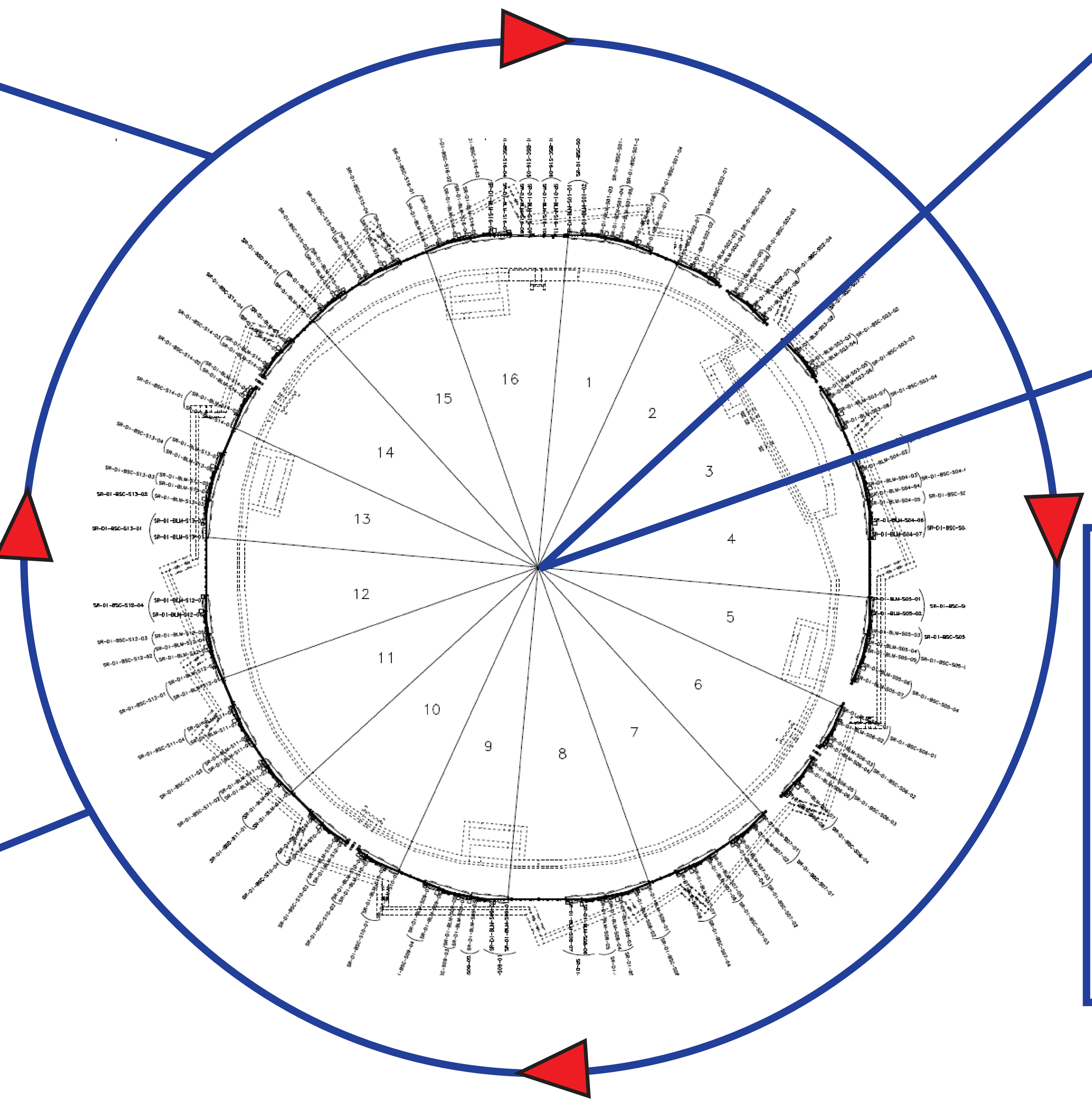
During 5 years of operation in the 3 GeV storage ring of ALBA, the 124 BLMs have provided stable loss measurements around the machine, with around 10% breakdown of units. We have made an attempt to analyze these BLM failures and correlate them with integrated received doses and any special conditions of each BLM location which might have led to their breakdown.



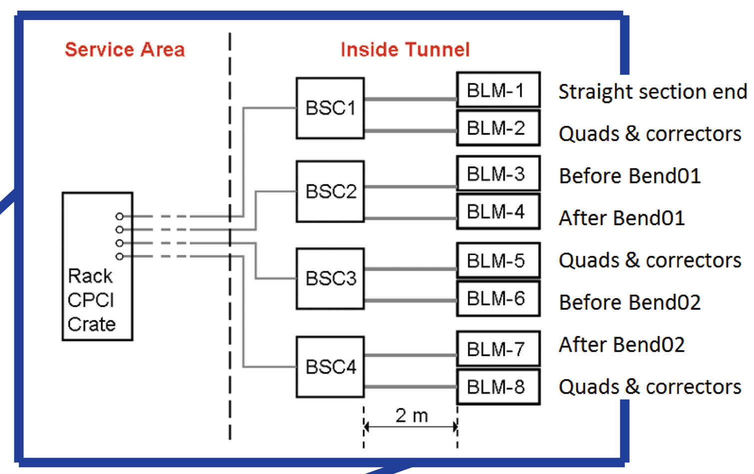
Nominal operational beam loss distribution (log scale) around the ALBA storage ring. Typical counts level: ~10-20 cps during beam decay mode; 10-100 cps during injections.



Up-to-date (02.09.2016) beam loss distribution (linear scale) around the ALBA storage ring as observed in the control room. Its shows high-loss regions, possibly related to misalignment issues in the vacuum chambers of insertion devices.



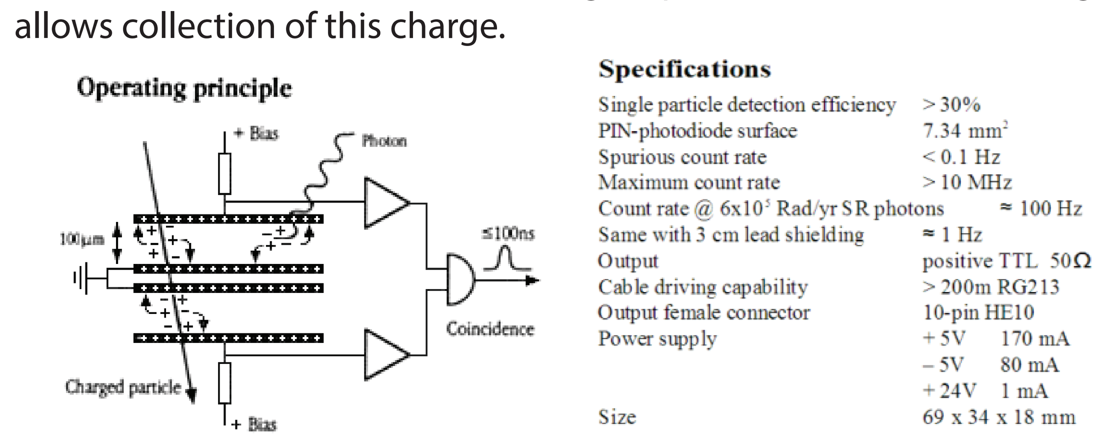
Beam loss detection system of ALBA per storage ring sector.

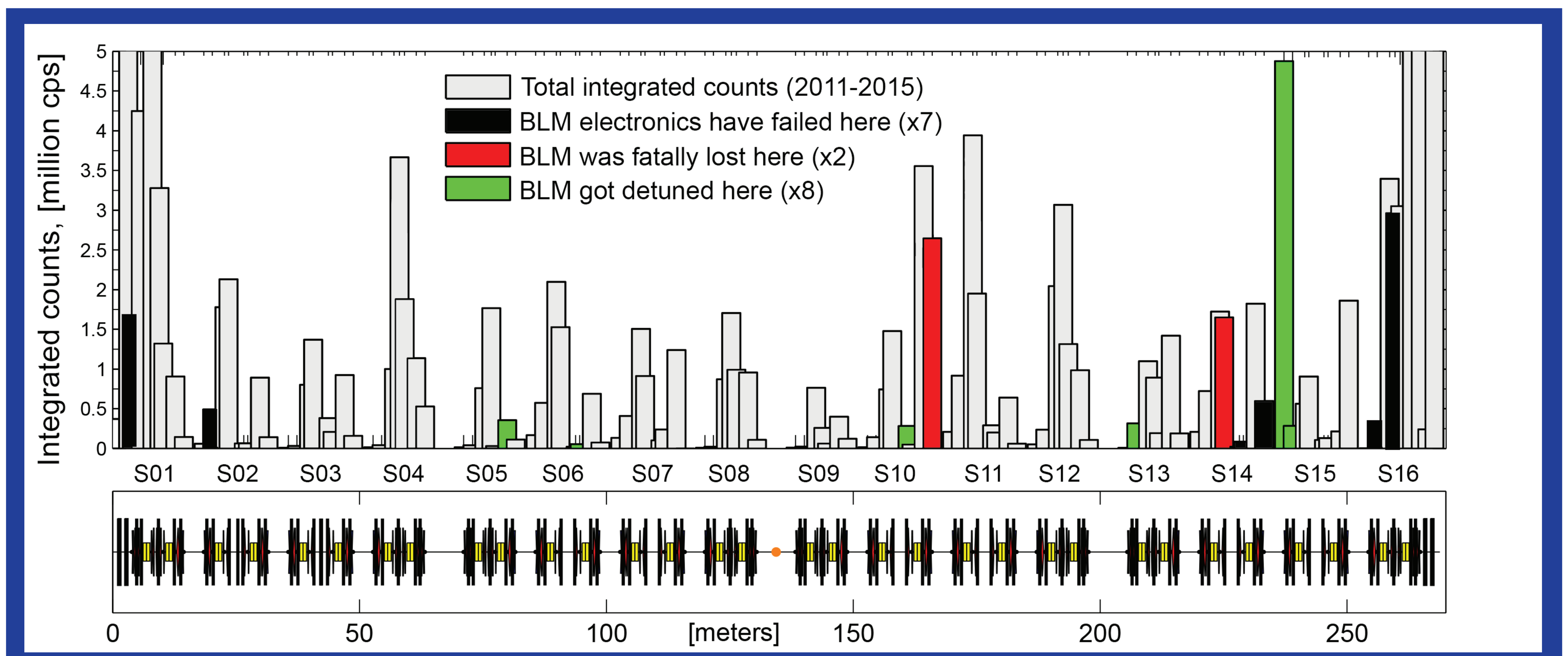


Beam signal conditioner (66 units)

Bergoz beam loss monitors (124 units)

A Bergoz BLM is composed of two PIN-diodes mounted face to face to form a 2-channel coincidence detector. When an ionizing particle >700 keV hits a PIN-diode, an electric charge is produced, and a bias voltage allows collection of this charge.



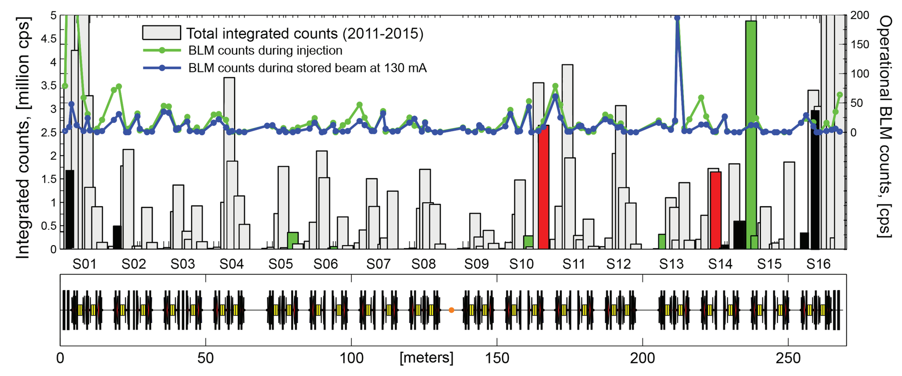


Overall integrated counts (2011-2015) for every storage ring BLM location vs. BLM failures.

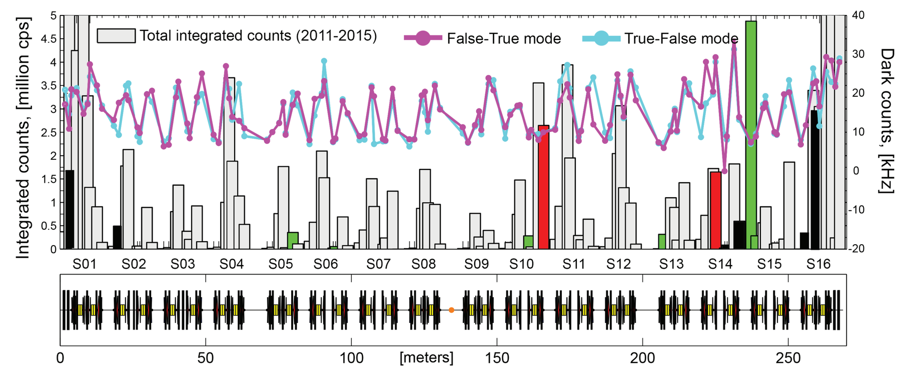
Locations of 9 failed BLM units are highlighted:
2 fatal (red, non-repairable),
7 with failed on-board electronics (black, repairable): 4 dead video amplifiers, 1 inductor, 1 transistor,
+ 8 detuned units (green, repaired in-situ),
+7 BSCs lost (1 fatally).

No correlation could be established: the high amount of received counts did not lead to a loss of BLM unit.

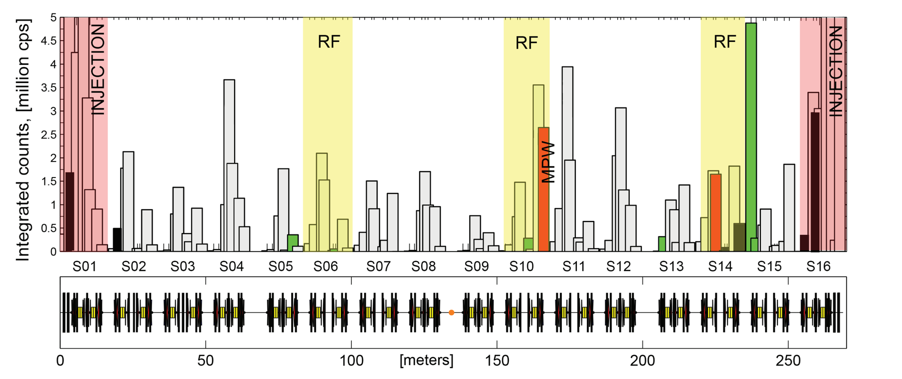
The total integrated counts and failed BLMs are also correlated with some other implicit operational conditions of BLMs:



- with operational counts at 1 Hz during stored beam and a top-up injection: **no correlation**;



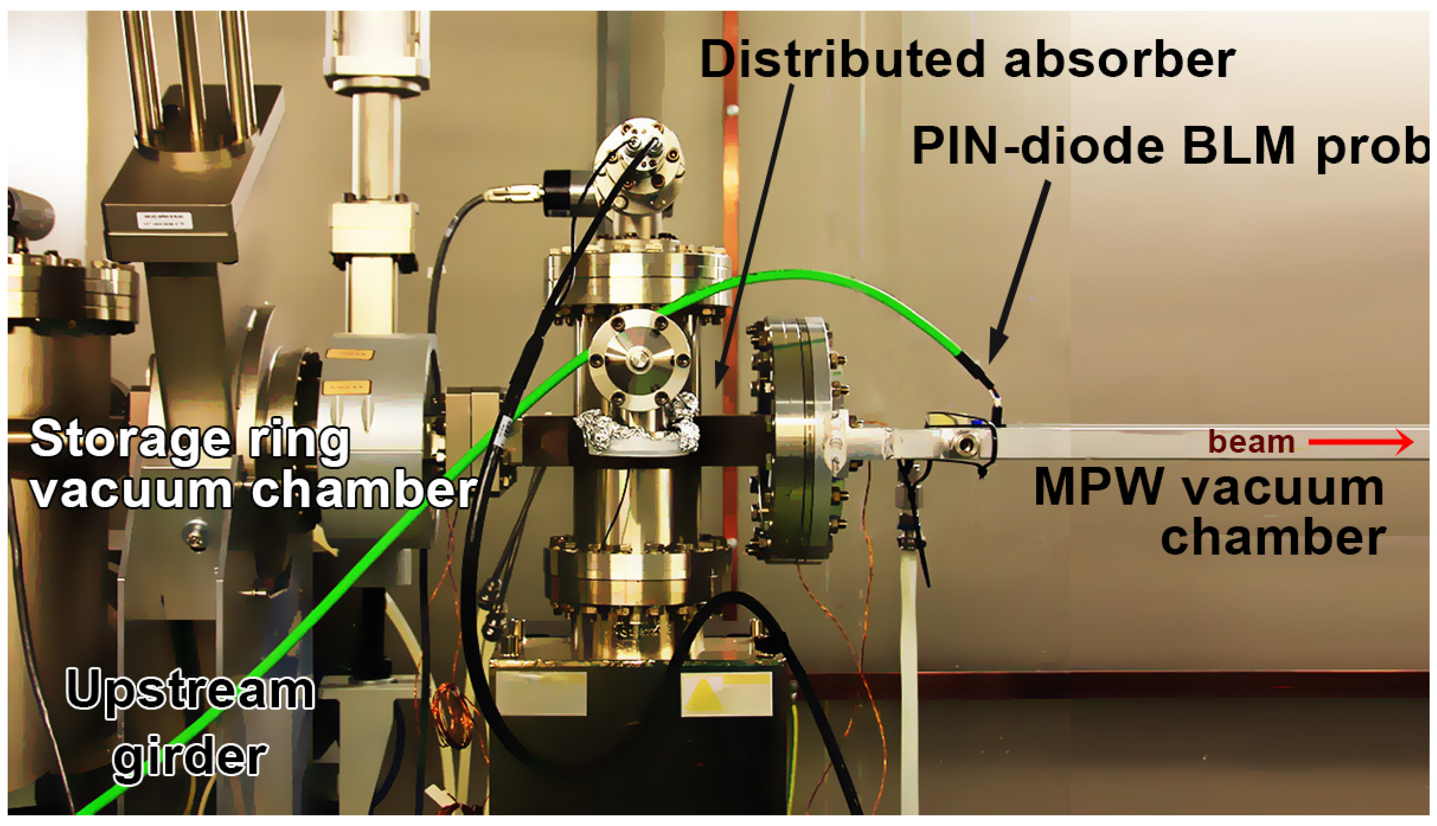
- with the dark (spurious) counts taken during beamtime: **no correlation**;



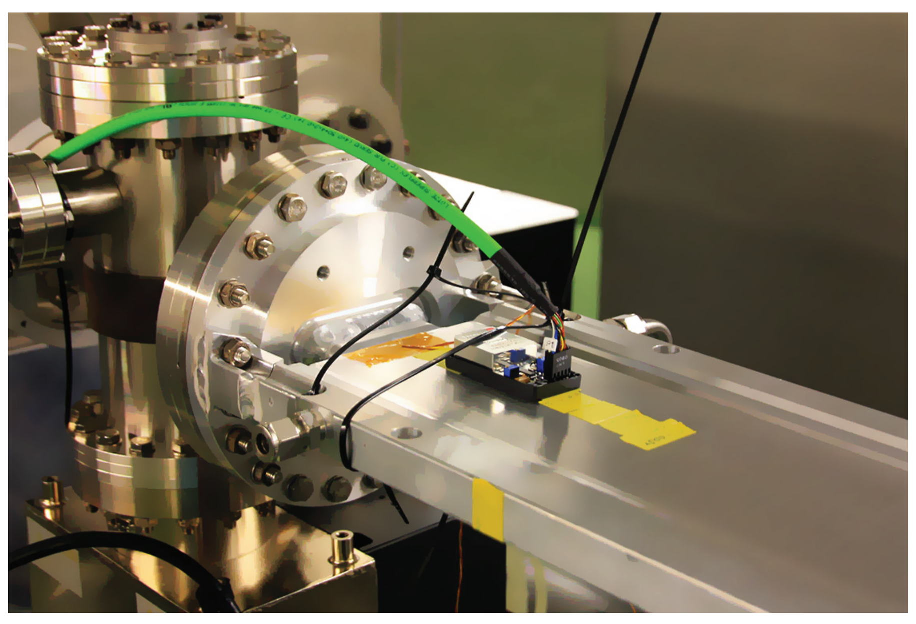
- with the high radiation environment around the ring: the RF plants and the injection sector. The majority of failed (7/9) and half of the detuned (4/8) BLMs units were located in these areas, which **can indicate their degradation**.

ALBA storage ring operates 6 insertion devices to produce high-brilliance X-rays. Among them is the multipole wiggler (MPW).
In this work we show studies of beam losses, possibly induced by the (suspected to be) misaligned 2m long vacuum chamber of MPW.

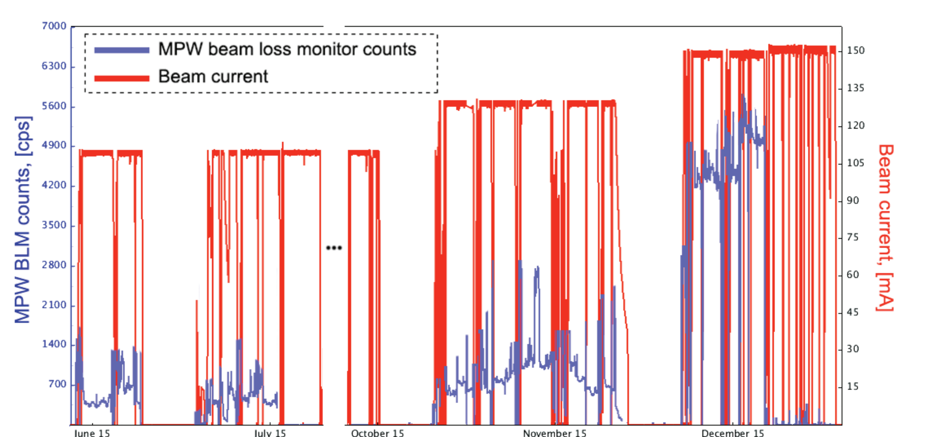
The 2m long vacuum chamber of MPW is placed in a straight section between two sectors. It is elliptic, machined in an 8mm thick rectangular aluminum block. It is attached to an upstream and downstream storage ring vacuum chambers (28mm thick) with the distributed absorbers, which bear the octagonal-to-elliptic transitions.



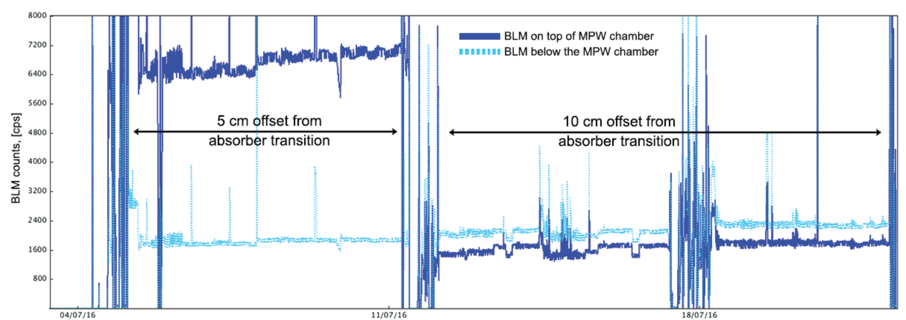
An alignment survey had indicated that the upstream girder is misaligned by 0.8mm downwards with respect to the downstream girder, thus tilting the MPW chamber. A pair of BLMs were placed on top and under the MPW chamber upstream to monitor possible beam losses. Very high, beam current-dependent losses were indeed detected, more on top of MPW than below.



Beam loss monitor placed on top of the MPW vacuum chamber to study losses induced by misaligned storage ring sections.



Beam losses measured on top of the MPW vacuum chamber in 2015, indicating a drastic dependence on beam current rising from 1000 cps at 120 mA to 6000 cps at 150 mA.



Longitudinal "scanning" of beam losses on top and bottom of the MPW vacuum chamber: the counts above decrease as the BLM gets farther from the misaligned region, while the counts below stay constant.