S. Mazzoni, S. B. Pedersen, BE-BI

Status of BSRA HW, automatic checks and future plans.

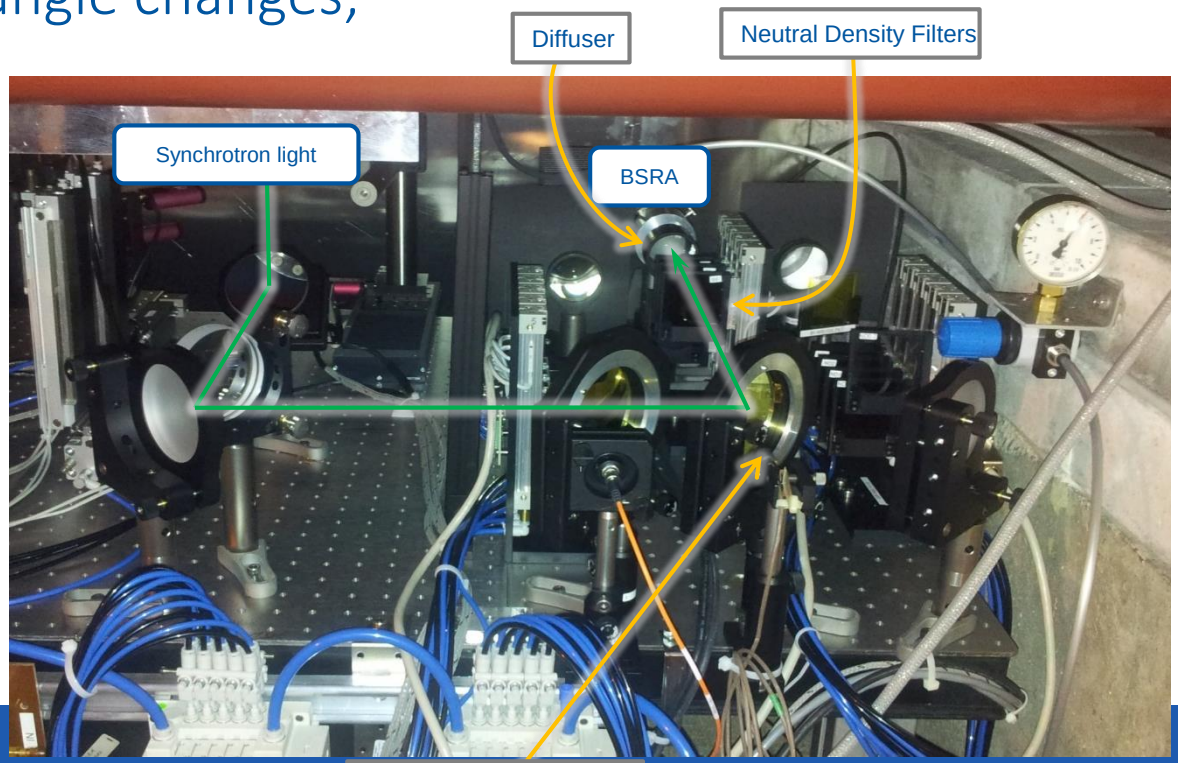
Outline

- Summary of BSRA performance in 2015.
- 2016 YETS improvement.
- Outlook.

2015: optical line

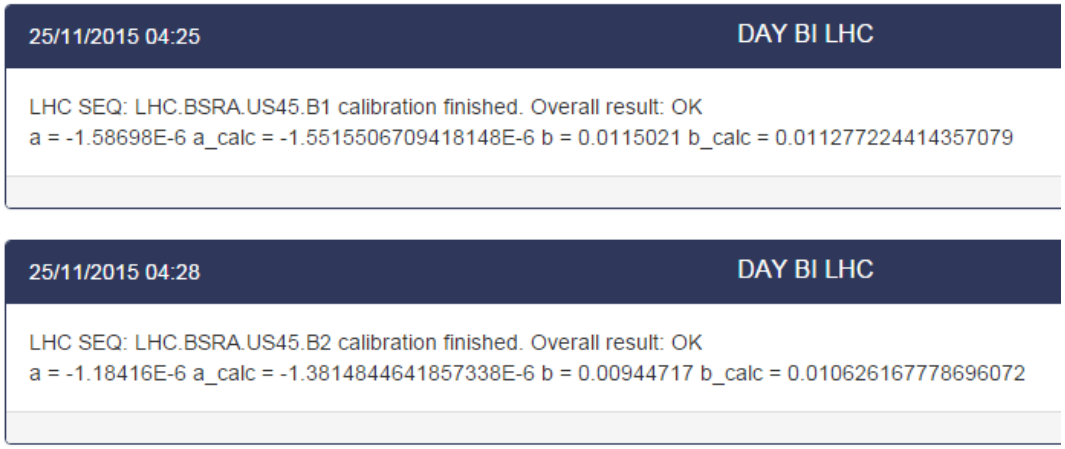
Re-design of optical line in 2015 YETS

- New extraction mirror;
- BSRA + LDM separated from imaging/interferometry lines;
- New optics: 2”, 75 mm dia lens, more tolerant to source angle changes;



Calibration checks

- As of October 2015: Voltage/Gain calibration check performed by the LHC sequencer before injection, results published in BI LHC logbook. Acceptance threshold: +/- 30% (to be reviewed in 2016)



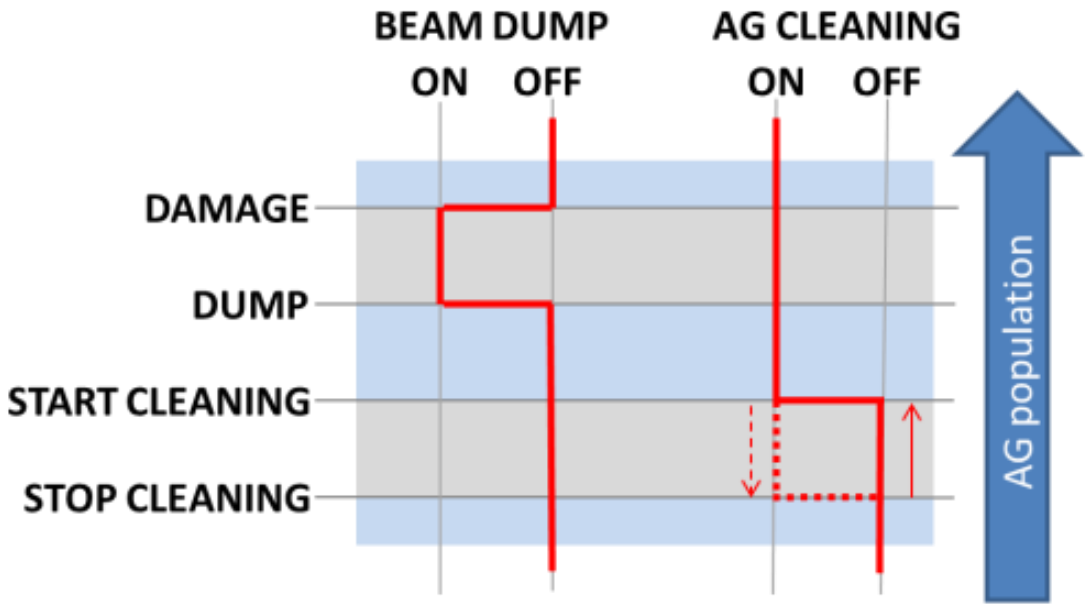
25/11/2015 04:25	DAY BI LHC
LHC SEQ: LHC.BSRA.US45.B1 calibration finished. Overall result: OK a = -1.58698E-6 a_calc = -1.5515506709418148E-6 b = 0.0115021 b_calc = 0.011277224414357079	

25/11/2015 04:28	DAY BI LHC
LHC SEQ: LHC.BSRA.US45.B2 calibration finished. Overall result: OK a = -1.18416E-6 a_calc = -1.3814844641857338E-6 b = 0.00944717 b_calc = 0.010626167778696072	

- To be implemented: Periodic checks using FBCT reading (now less critical due to improved optical line and extraction mirror design)

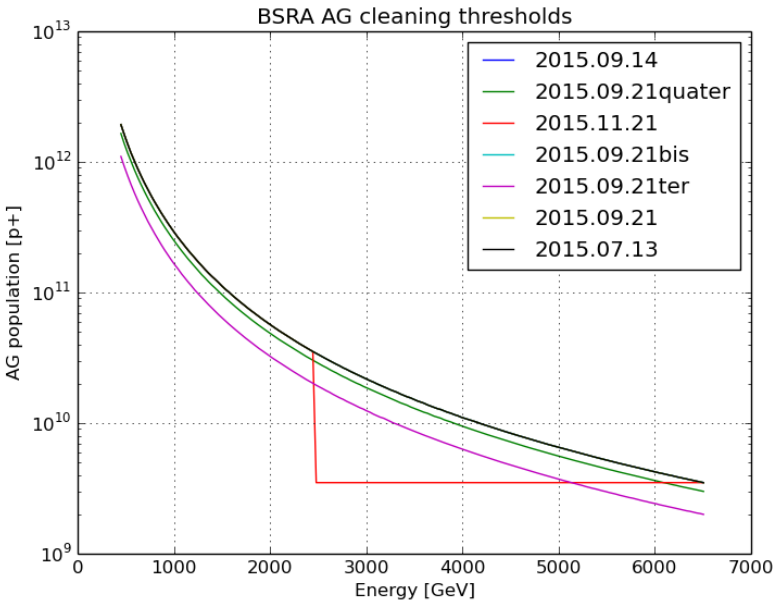
Thresholds

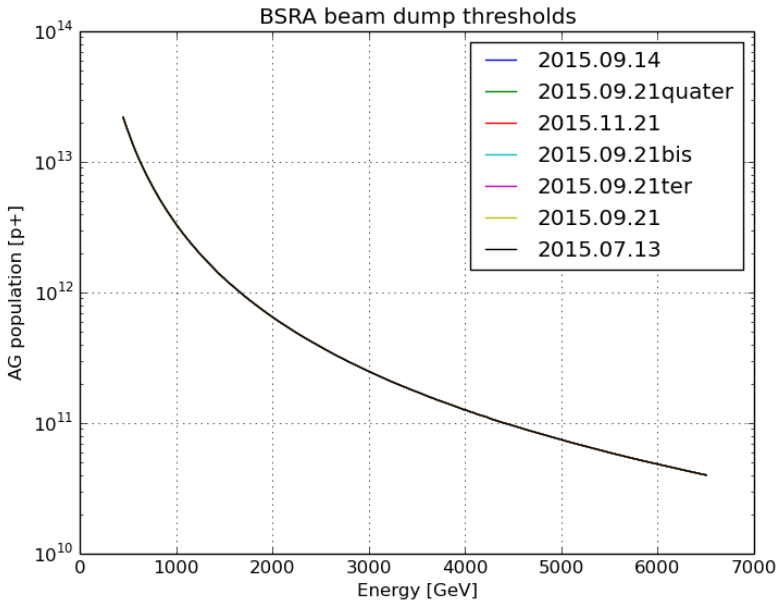
- Since 2015, new AG population threshold scheme
- Two flags published by BSRA: AG cleaning, beam dump:



Thresholds

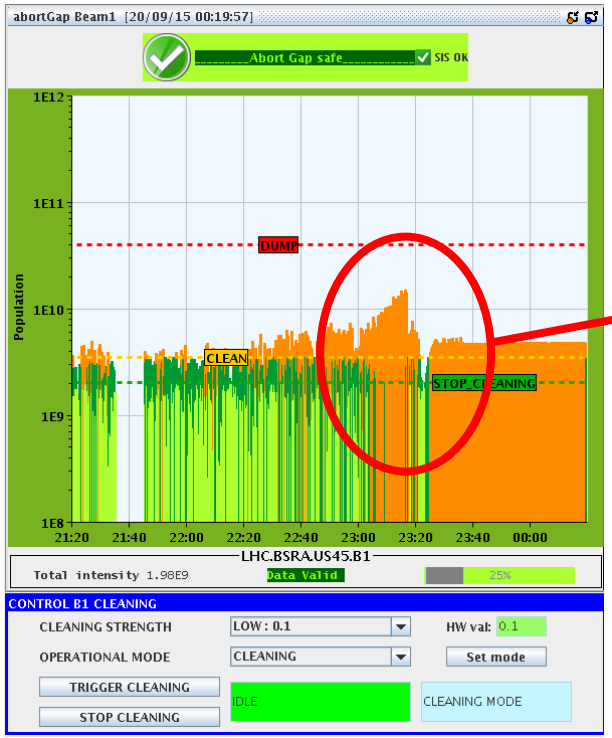
- Actual values used in 2015

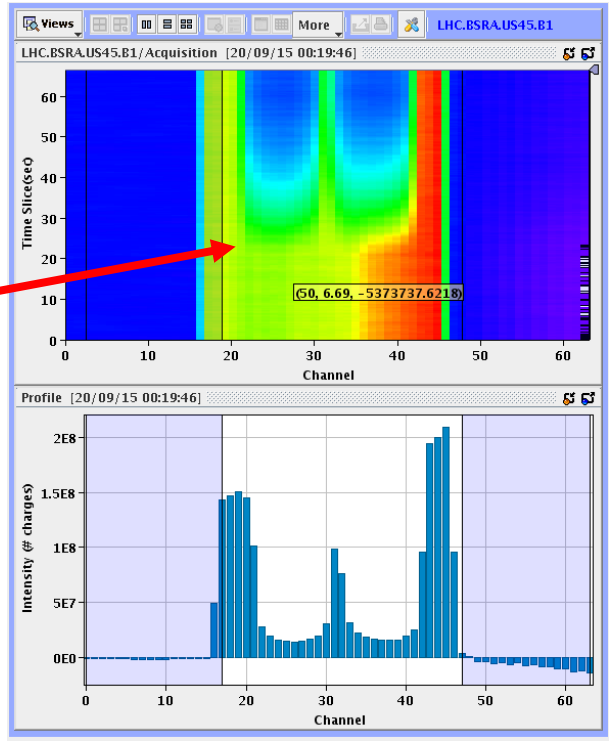




Machine protection

- AG cleaning now triggered by SIS based on BSRA reading. Tested in June 2015, now routinely used in operation
- Beam dump flag masked.





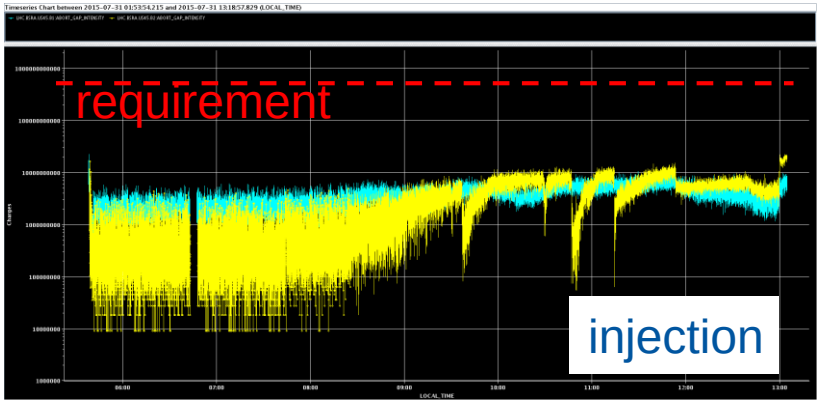
BSRA performance: Sensitivity

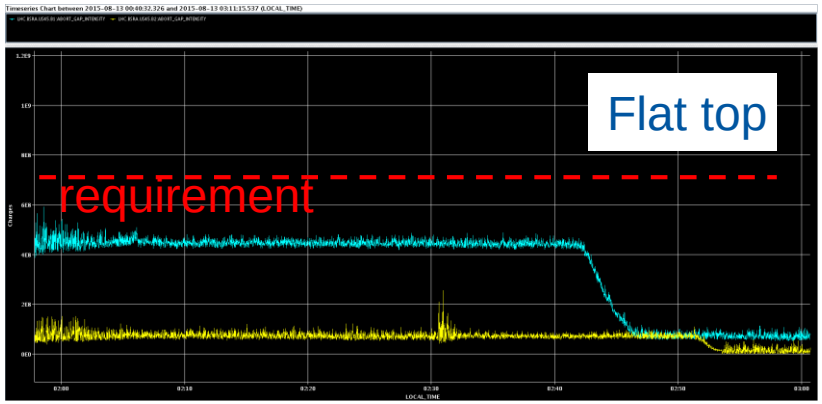
Requirement ("HIGH SENSITIVITY MEASUREMENT OF THE LONGITUDINAL DISTRIBUTION OF THE LHC BEAMS", LHC-B-ES-0005.00 rev 2.0):

BSRA B1

BSRA B2

	Required [p/100ns]	Measured [p/100ns]	
Injection	< 4×10^9	10^7 (typ)	**OK**
Flat top	<6×10^6	8×10^5 (typ)	**OK**





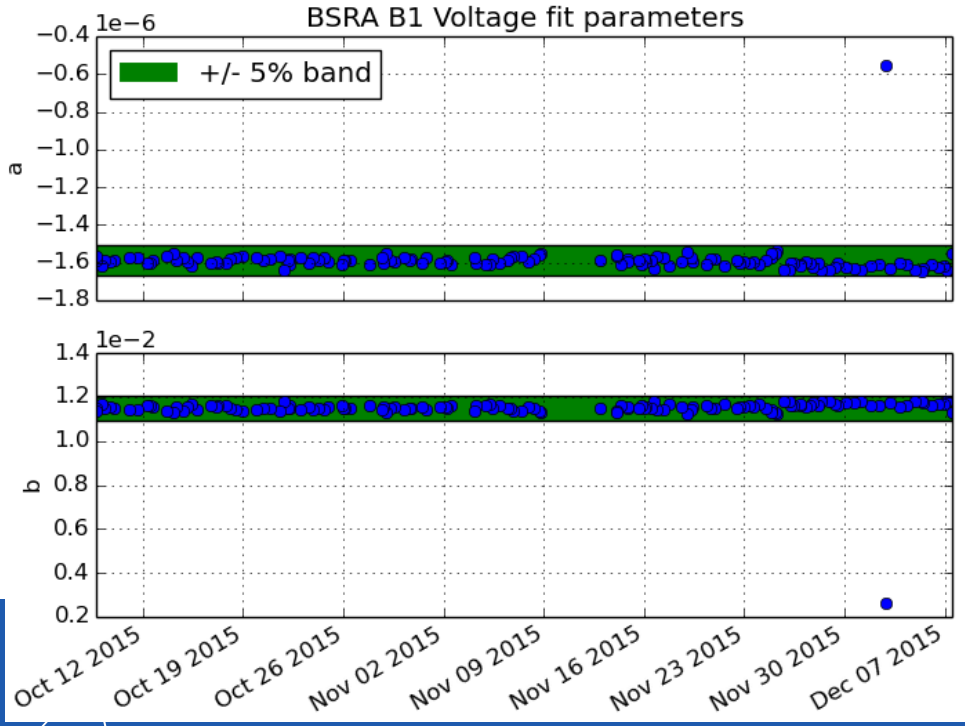
Min detectable AG population is therefore:

- 3×10^8 (injection)
- 2.4×10^7 (flat top)

BSRA performance: B1 accuracy

Requirement ("HIGH SENSITIVITY MEASUREMENT OF THE LONGITUDINAL DISTRIBUTION OF THE LHC BEAMS", LHC-B-ES-0005.00 rev 2.0):

- better than +/-50% absolute accuracy at flat top. B1 OK, B2 ?
- better than +/-5% absolute accuracy at injection NOT POSSIBLE WITH PRESENT SYSTEM (needed?)



B1 Calculated accuracy at 6.5 TeV:

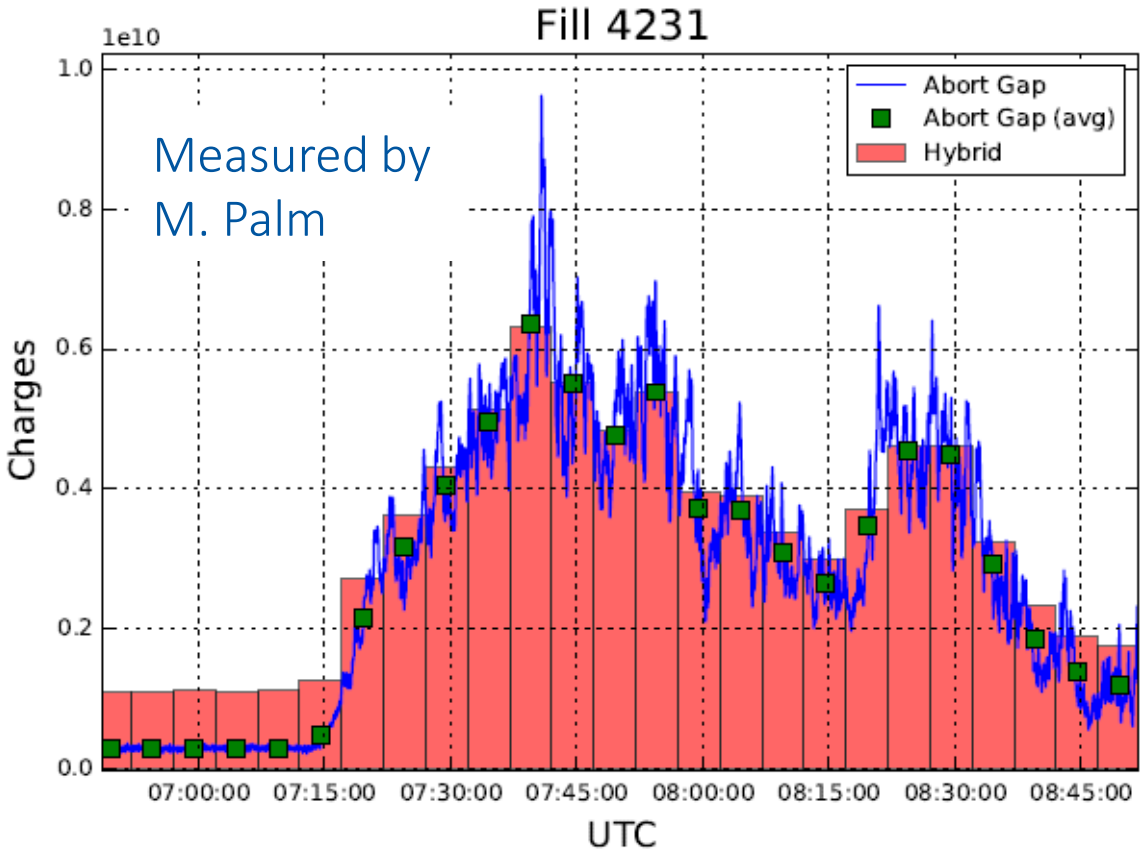
+/- 35.4 % OK

From voltage-gain calibration historical data (backup slides).

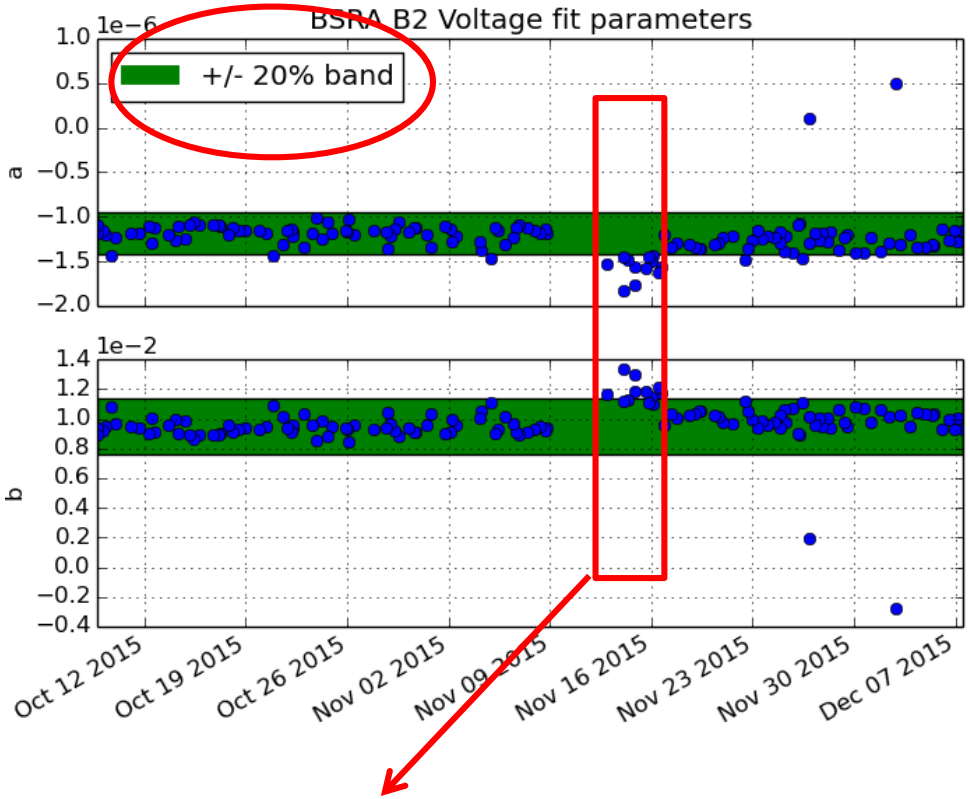
B1 gain curve known with good precision.

BSRA performance: B1 Accuracy

- A confirmation for B1: fill 4231, comparison with Longitudinal Density Monitor Hybrid PMA. Agreement within +/- 18%



BSRA performance: B2 accuracy



Outliers after technical stop

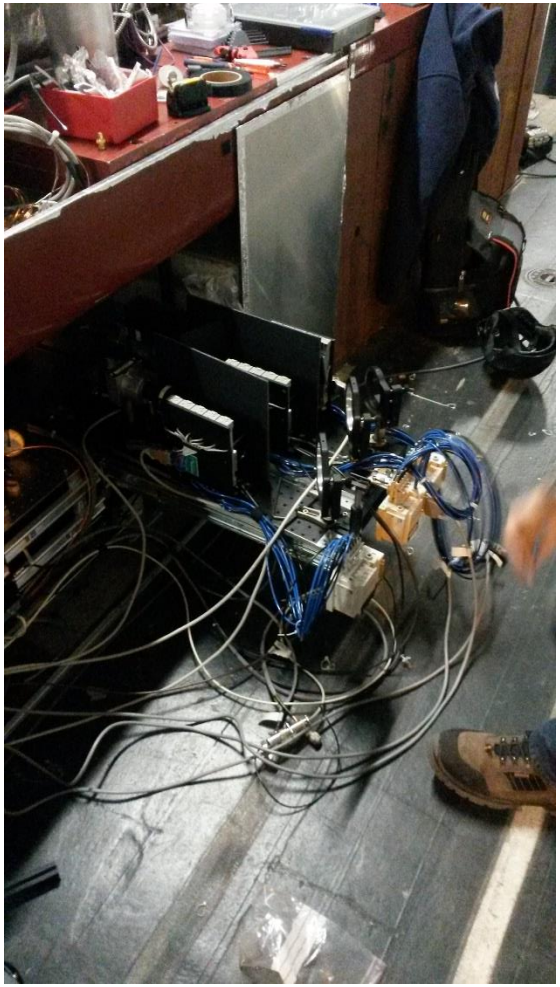
B2 Calculated accuracy at 6.5 TeV:

+/- 69.1 % NOT OK

Due to low signal in calibration procedure. Fixed in YETS 2016.

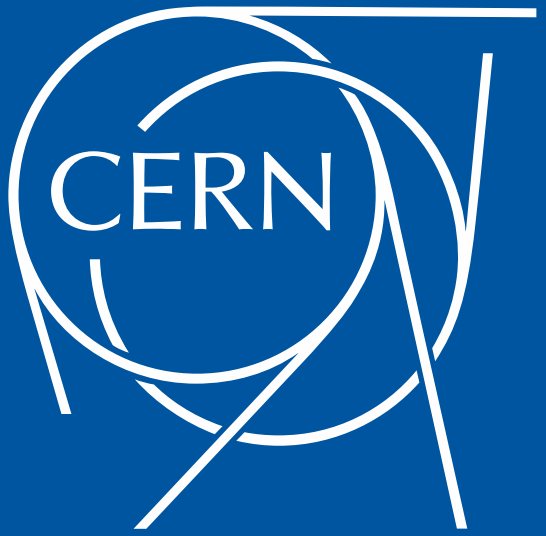
Improvements during YETS 2016

- Improvement of layout. BSRA (and Longitudinal Density Monitor) now mounted on a sliding table.
- Better optical alignment and light collection. With 500 nm LED: approx. 2x sensitivity improvement.



Outlook 2016

- BSRA ready for LHC startup.
- A new amplifier has been developed. Tests to be completed, possibly deployed end of summer.
- System ready for automatic beam dump tests.
- Modification to the way population is calculated (over entire/a portion of the AG) is possible but preferably after a few months of operations.


CERN

Calculation of accuracy (backup)

From raw to calibrated data:

$$p \propto \frac{A_{flt}(E)}{W(E)} \frac{1}{10^{aV^2+bV}} I$$

Where p is the AG pop, A_{flt} the ND filters attenuation, W the normalised photon emission per particle, V the PMT voltage, a, b gain curve fit parameters.

Predominant contribution to σ_p is error on a, b parameters:

$$\sigma_p = \sqrt{\left(\frac{\partial p}{\partial a}\sigma_a\right)^2 + \left(\frac{\partial p}{\partial b}\sigma_b\right)^2}$$

where σ_a, σ_b derived from historical gain curve fit data.