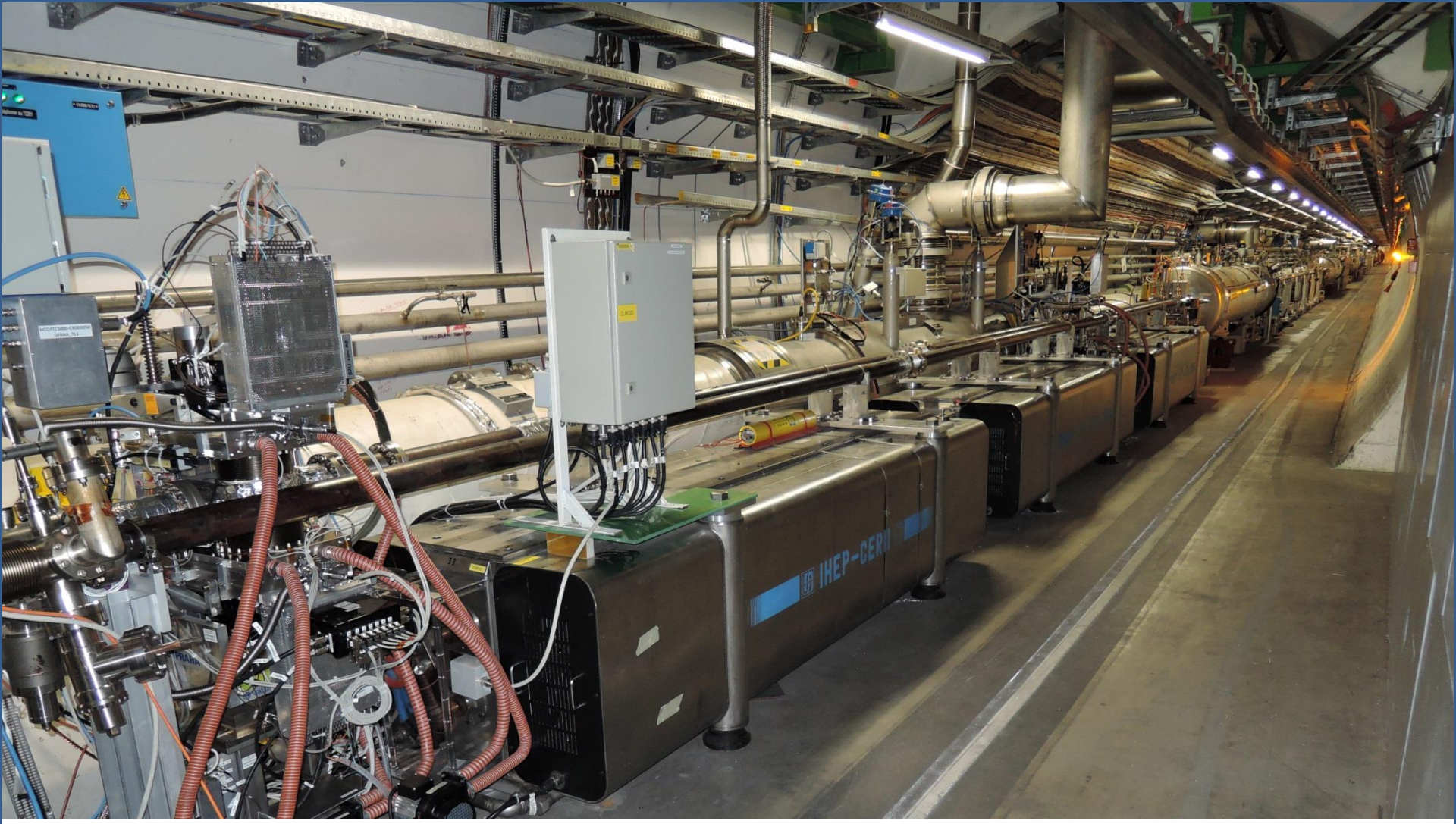


ATLAS-ALFA update for MPP

Sune Jakobsen

On behalf of the ATLAS-ALFA community

117th MPP 25-09-2015

Changes made to interlock system - reminder

All the beam dumps were coursed by only one LVDT comparison failing.

Change approved by the 110th MPP: Only extract the Roman Pots and lower the USER_PERMIT if 3 consecutive LVDT/limit comparison fail.

The extraction/dump time changed from ~6 ms to ~18 ms.

In 18 ms a Roman Pot at full speed moves ~5 µm (one step).

Additional logging implemented - reminder

A special logging for the LVDT values has been introduced directly on the PXI.

The raw ratio of the LVDT are logged every 4 ms.

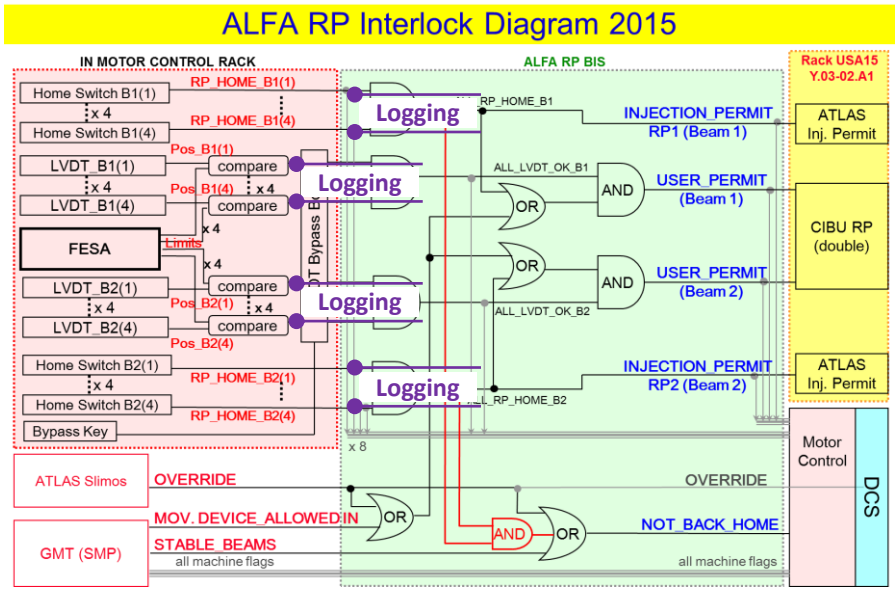
This is only meant to be used for commissioning as it takes a lot of resources on the PXI.

Analyzing the values none of the LVDTs is outstanding in terms of noise.

Logging on change of HOME switch values has been introduced directly on the PXI.

Logging on change of the results of the LVDT/limit comparison has been introduced directly on the PXI.

The logging is _BEFORE_ the LVDT bypass box and it is therefore possible in LVDT_BYPASS_MODE to check if the USER_PERMIT potentially would have been lost.



ATLAS BIS signal to DCS has been prolonged to minimum ~3 s and thereby made visible in the current logging.

Stability

Only one log file analyzed (as the other is split over many small files and included running periods)

The file contains data from 45 days period starting 18-06-2015 where ALFA was in garage and with LVDT comparison bypassed.

Comparison failed:

1 clock cycle: 148 times

2 clock cycles: 1 time

3 clock cycles: 0 times

Or in other word: With the system before the update, ALFA would have requested 148 beam dumps and with the update system 0 beam dumps where requested.

All comparison failures came from A7L1L.

It is therefore planned to replace the LVDT and corresponding electronics in the YETS.

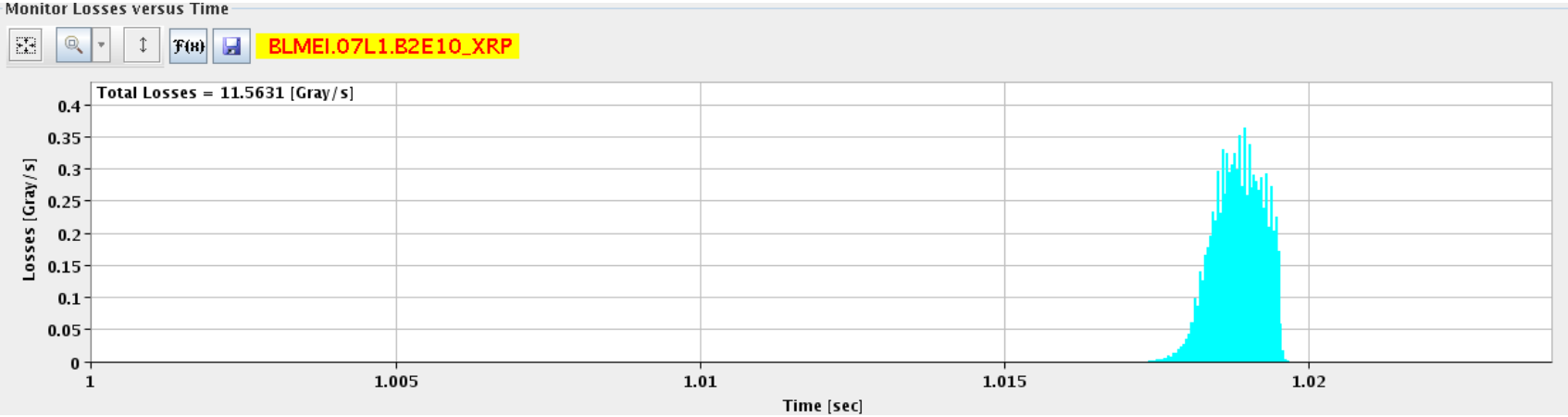
To avoid a new survey laser calibration it is planned to cross calibrate the new LVDT to the motor steps.

Beam dump by UFO at ALFA station

At fill 4268 for the ALICE/LHCb vdM, the ALFA Roman Pots were inserted shortly after Stable Beams were declared.

Unfortunately the beams were dumped (124 % of dump limit) by the first BLM after the ALFA station A7L1.

The signal of the BLM clearly indicates losses due to a UFO.



This station has generated lots of UFOs since the start of Run2, but never anything close to the dump threshold.

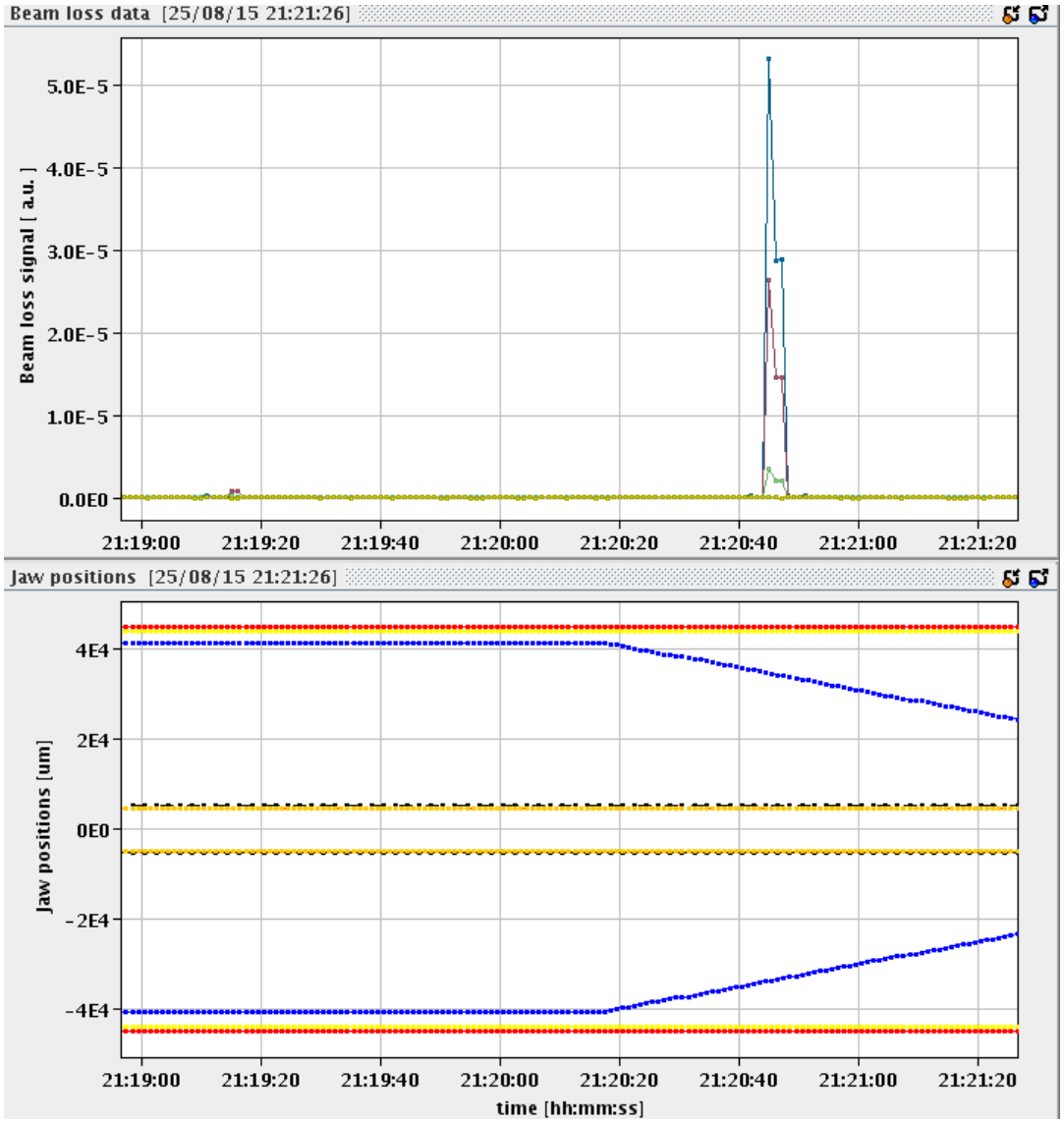
The insertion during theATLAS/CMS vdM fill was investigated and showed another UFO signature of the BLM signal (23.8 % of dump threshold) when the ALFA Roman Pots were moved.

ALFA End-of-Fill UFO study

ALFA made an End-of-Fill study druring the fill for the LHCb vdM: Insertion of Roman Pots to check for UFOs.

All Roman Pots but the ones in station A7L1 were inserted by sequence without any problems.

A7L1 was move in alone and again a clear UFO signature was seen in the BLM signal (23.7 % dump threshold).

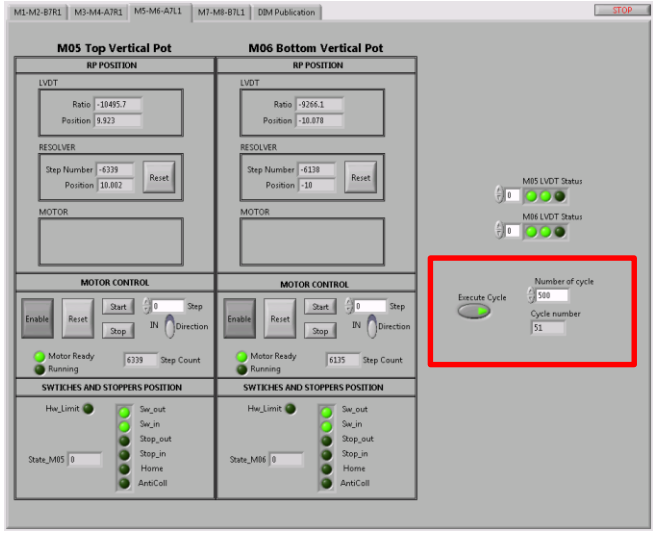


Technical stop 2 activities – cycled movement

After discussion with the CERN vacuum group it was decided to move the Roman Pots in A7L1 as often as possible without beam.

The hope was to shake off all dust and thereby get rid of (or minimize) the UFO problem.

Caution: If the UFOs are due to e.g. two ferrites grinding each other this procedure could aggravate the problem (but CERN vacuum group experience shows that it normally helps).



It was foreseen to move in/out at least 500 times during TS2.

A special low level program (thanks to PH-DT for making it) has therefore been made that continuously moves the Roman Pots of A7L1 between the garage position and 10 mm.

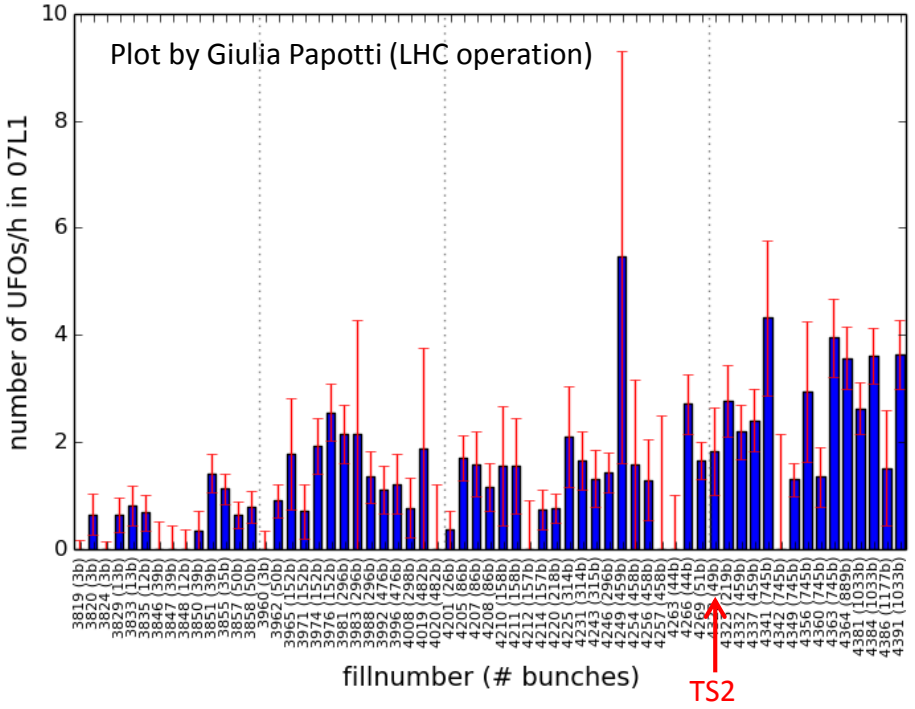
172 movement cycles were performed performed between Monday and Tuesday in TS2, but stopped as LHC collimation teams requested LMC endorsement before continuing with the program.

LMC did not endorse any additional movement, but suggested to check the impact of the 172 cycles before eventually continuing in periods without beam.

Status of UFO problem

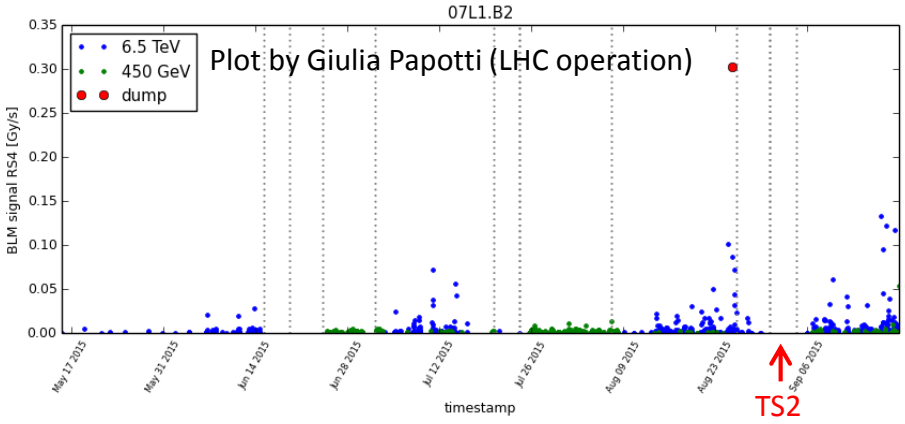
The rate of the UFOs is constantly monitored.

No change observed after the 172 cycles after TS2.



Most of the UFOs are rater small, but some are up to ~40 % of dump limit.

Scaling with intensity to nominal total intensity, the ALFA induced UFOs will course beam dumps with the current BLM thresholds (see next talk for new thresholds proposal).



ALFA insertions and temperatures

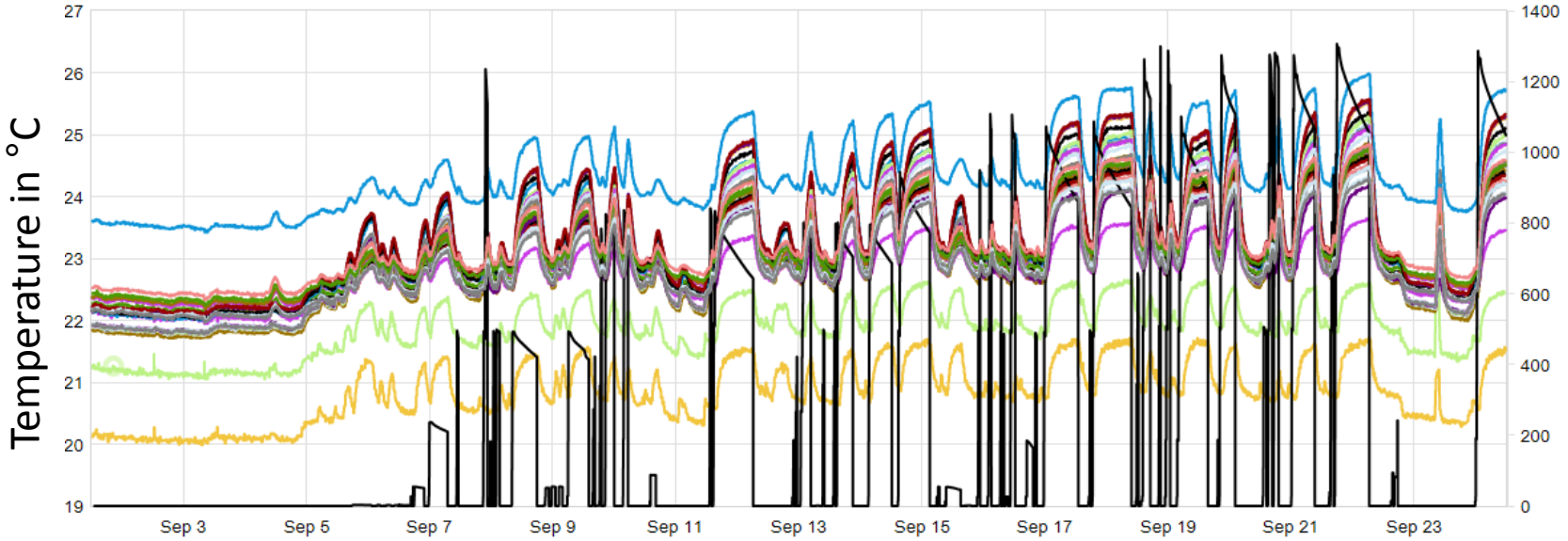
The ALFA Roman Pots are only used in high beta fills with low intensity.

Besides the discussed UFO problem, no problems has been observed.

The temperatures of the ALFA Roman Pots are constantly monitored.

A check of the temperatures has been performed for each intensity step.

The temperatures are in general much lower than in Run1 => the reduction of impedance heating has been successful.



The temperature rise is dominated by changes in the air temperature in the tunnel.

The rise in temperature due to impedance looses is at least an order of magnitude smaller than if no change had been made.

Roman Pot position for elastic β = 90 optics fill*

After the alignment the Roman Pots will be retracted by 0.5 $\sigma_{nominal}$ (2 $\sigma_{nominal}$ for TOTEM horizontal) from the primary collimator (as agreed with collimation).

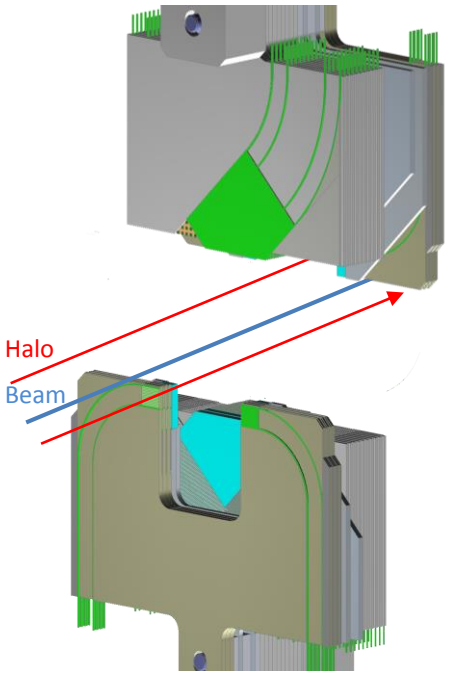
Then “quiet beam” (no Roman Pot or collimator movement etc.) should be declared to allow ATLAS inner detector at nominal HV.

Stay like this for ~8 hours for elastic physics data taking (with one break to change configuration).

Roman Pot position for loss maps and diffractive fills

The originally agreed distance of TCSG7 + 3.5 $\sigma_{nominal}$ = 11.8 $\sigma_{nominal}$ is problematic for the ALFA Roman Pots distance measurement.

- The distance between the upper and the lower Roman Pots needs to be determined with very high accuracy.
- Therefore a dedicated part of the Upper and the lower detector overlaps to use halo particles for the distance measurement.
- With the β = 90 m optics and Roman Pots at 12 $\sigma_{nominal}$ the overlap is only ~1.5 mm.
- That is really on the limit to determine the distance and even 1 mm would help enormously.
- If at all possible the Roman Pots should therefore be closer to the beam.
- There is also large acceptance gain in even a small distance closer to the beam.



Suggestion (after first discussion with collimation)

- For first loss map move the Roman Pots to e.g. 10 $\sigma_{nominal}$.
- Make first loss map with one probe.
- If large losses at the Roman Pots are observed, move Roman Pots out by 0.5 $\sigma_{nominal}$ and repeat loss map with another probe.
- Repeat if needed.
- **The suggested operation is all in the same fill and only cost a probe + ~10 min for each distance.**
- Do all loss maps in the position deemed safe by collimator expert (by evaluation of the first loss maps).
- **Important: Collimator expert needed in CCC to judge directly the losses at the Roman Pots.**

	Sigma-V [um]
XRPV.B7L1.B2	603
XRPV.A7L1.B2	665
XRPV.A7R1.B1	667
XRPV.B7R1.B1	604

Loss maps for β* = *90 optics*

Full set of loss maps (summarized for discussion):

	90 m squeezed	Collision
Betatronic - Horizontal	Without RP	With RP
Betatronic - Vertical	Without RP	With RP
Off-momentum +	Not needed	With RP
Off-momentum -	Not needed	With RP
Asynchronous dump	Without RP	With RP

Backup

ATLAS-ALFA requests for β* = 90 m fills

Sune Jakobsen

Filling for Elastic β = 90 m

2 colliding bunch.

1 none-colliding bunch per beam + none-colliding pilots (for loss maps) up to total intensity just below 3E11.

Minimum bunch separation: 1 µs.

Bunch intensity: 7-8E10.

Emittance: 2.5 µrad or lower at data taking.

Filling scheme files asap for cross checks and check of ATLAS trigger rate limitations.

Request for Elastic β = 90 m run operation

Wire scans for each real bunch at INJECTION. Dump and refill in case of bad emittance (limit ~2.0 µrad).

Wire scans for each real bunch end of RAMP.

De-squesee to β* = 90 m with crossing angle. Wire scans for each bunch.

Collapse the crossing angle.

Find collisions.

Alignment of Roman Pots (2-3 hours).

Wire scans of all bunches. Dump and refill in case of bad emittance (limit ~2.5 µrad).

Position Roman Pots at TCP + 0.5 nominal sigma (or further out depending on background).

Require “quiet beam” (no Roman Pot or collimator movement etc.) to allow ATLAS inner detector at nominal HV.

Data taking in “quiet beam” for about 2 hours.

ATLAS lower HV of the inner detector and “quiet beam” is ended.

Request to move out the TOTEM horizontal Pots and the collimators protecting them (primary source of background in ALFA).

Adjust ALFA Roman Pot position to new background level.

Require “quiet beam” to allow ATLAS inner detector at nominal HV.

Data taking in “quiet beam” for about 6 hours.

(If the beams are lost: Refill and repeat until a total ~8 hours of data has been collected in “quiet beam”).

ATLAS lower HV of the inner detector and “quiet beam” is ended.

Move ALFA Roman Pot to loss map positions (next slide).

Reintroduce crossing angle.

Loss maps.

Roman Pot position for loss maps and diffractive fills

The originally agreed distance of TCSG7 + 3.5 $\sigma_{nominal}$ = 11.8 $\sigma_{nominal}$ is problematic for the ALFA Roman Pots distance measurement.

The distance between the upper and the lower Roman Pots needs to be determined with very high accuracy.

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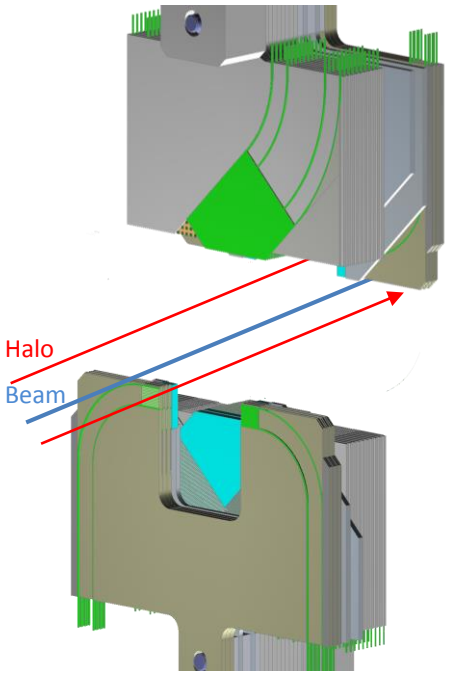

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Make first loss map with one probe.

If large losses at the Roman Pots are observed, move Roman Pots out by 0.5 $\sigma_{nominal}$ and repeat loss map with another probe.

Repeat if needed.

The suggested operation is all in the same fill and only cost a probe + ~10 min for each distance.

Do all loss maps in the position deemed safe by collimator expert (by evaluation of the first loss maps).

Important: Collimator expert needed in CCC to judge directly the losses at the Roman Pots.

	Sigma-V [um]
XRPV.B7L1.B2	603
XRPV.A7L1.B2	665
XRPV.A7R1.B1	667
XRPV.B7R1.B1	604

Filling for Diffractive β = 90 m runs

Assuming the step and time on each step proposed by the machine, the ATLAS which for the filling would be:

~50 bunches steep (3-4 hours):

At least 100 ns between bunches (but more is better).

Preferred to spread out bunches and trains almost the ring (detail proposal in backup).

At least 2 none-colliding bunches per beam.

Filling scheme files asap for cross checks and check of ATLAS trigger rate limitations.

~250 bunches steep (3-4 hours):

At least 100 ns between bunches (but more is better).

Preferred to spread out bunches and trains almost the ring (detail proposal in backup).

At least 2 none-colliding bunches per beam.

Filling scheme files asap for cross checks and check of ATLAS trigger rate limitations.

~700 bunches steep:

At least 100 ns between bunches

(Preferred to spread out bunches and trains almost the ring).

At least 4 none-colliding bunches per beam.

Filling scheme files asap for cross checks and check of ATLAS trigger rate limitations.

LHCb SMOG

An accurate emittance determination is crucial for the total cross section measurement.

Therefore it would be greatly appreciated if LHCb could run with SMOG and take beam imaging data.

Optimal would be in the elastic fill, but since there is no Stable Beam, this is probably not possible.

Instead a cross check/cross calibration of the BSRT values could be made in the diffractive fills.

At least one fill with 3 hours of data taking in Stable Beam is needed, but more is also useful.

Radiation limit

The radiation limit (luminosity limit) of the ALFA detectors are not accurately known.

It is estimated that the limit is higher than what is expected during the β* = 90 m campaign.

In case the limit should be reached, it will be requested to slightly separate the beams at IP1 to lower pile-up and luminosity.