Removal of distance margin for ATLAS-AFP

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With input from:
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Introduction

General agreed settings for horizontal Roman Pots in 2017:

General Roman Pot setting: TCT + 3 $\sigma_{nominal}$ + 0.3 mm = 12 $\sigma_{nominal}$ + 0.3 mm

Minimum 1.5 mm (not relevant for AFP).

Extra margin for new system for startup phase: TCT + 3 $\sigma_{nominal}$ + 0.3 mm + 0.5 mm = 12 $\sigma_{nominal}$ + 0.8 mm

Settings for AFP in startup phase:

	$\sigma_{nominal}$ [mm]	Roman Pot position [mm]
B6R1.B1	0.103	2.041
A6R1.B1	0.192	3.106
A6L1.B2	0.201	3.208
B6L1.B2	0.109	2.107

Ultimate settings for AFP:

	$\sigma_{nominal}$ [mm]	Roman Pot position [mm]
B6R1.B1	0.103	1.541
A6R1.B1	0.192	2.606
A6L1.B2	0.201	2.708
B6L1.B2	0.109	1.607

ATLAS-AFP requests to move to the ultimate settings after MD2/vdM.

Operational experience

ATLAS-AFP has been inserted in all allowed fills following the philosophy:

First fill at intensity step: Not inserted.

Second fill at intensity step: Inserted after 2 hours of Stable Beam.

Third fill at intensity step and onwards: Inserted directly after Stable Beam.

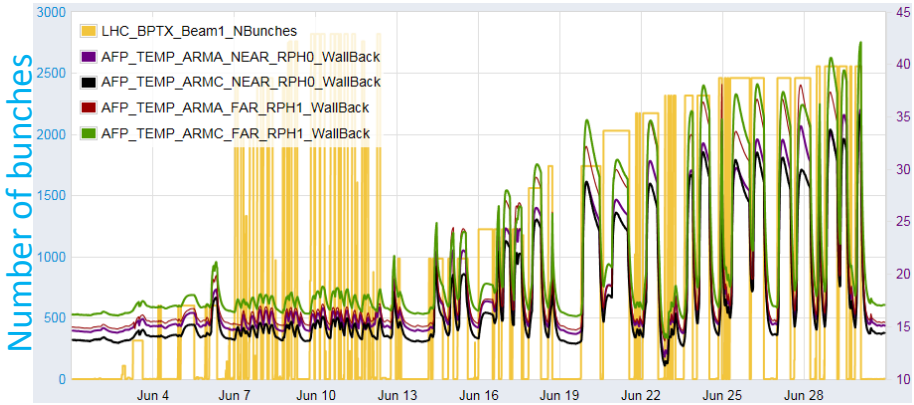
ATLAS-AFP has not experience any problems with insertions:

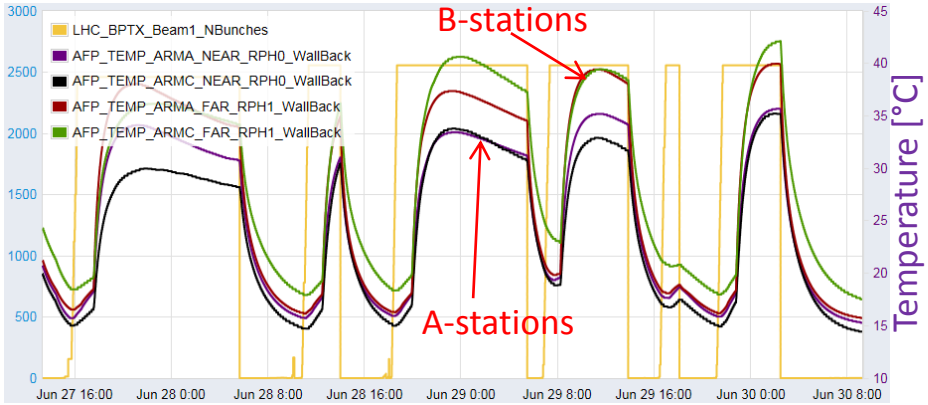
No unexpected extractions of Roman Pots.

No beam dumps coursed by AFP interlocks.

No problems with the sequences used to move in/out AFP (after the “Update absolute position” was made none-parallel).

Operational experience – Temperature of the Roman Pots





Clear correlation between number of bunches and temperature increase of the AFP Roman Pots.

The heating is significantly more pronounced for the B-stations, which has Roman Pots closer to the beam.

Maximum temperature observed on a Roman Pot is 42 °C (Roman Pots are baked-out at ~200 °C).

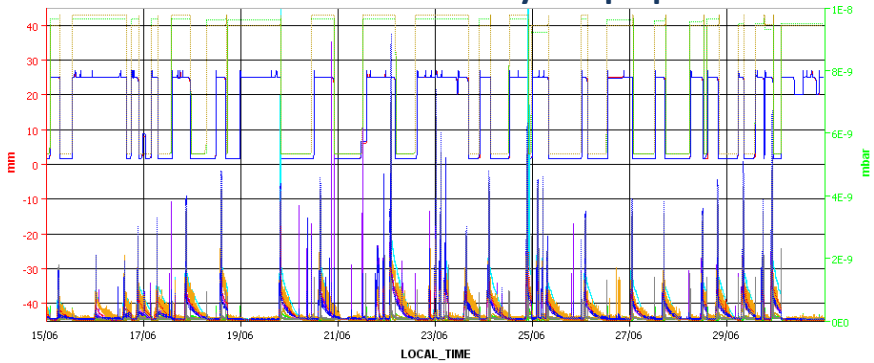
Even for the most pessimistic estimate of thermal expansion (~2 µm/°C) the distance from beam changes less than 1 $\sigma_{nominal}$ for any realistic temperature increase.

By moving the Roman Pot closer to the beam additional heating is expected (+ ~30 %), **but the temperatures of the Roman Pots are not worrying** (however the detector cooling might need to be revisited => **not a LHC safety concern).**

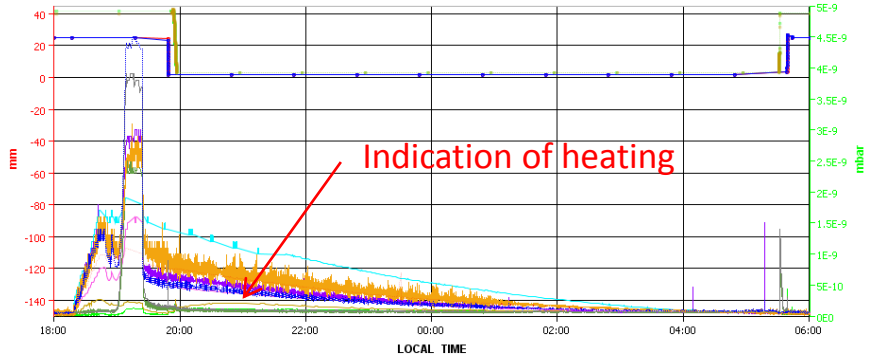
Operational experience – Primary vacuum

Vacuum layout in backup slides

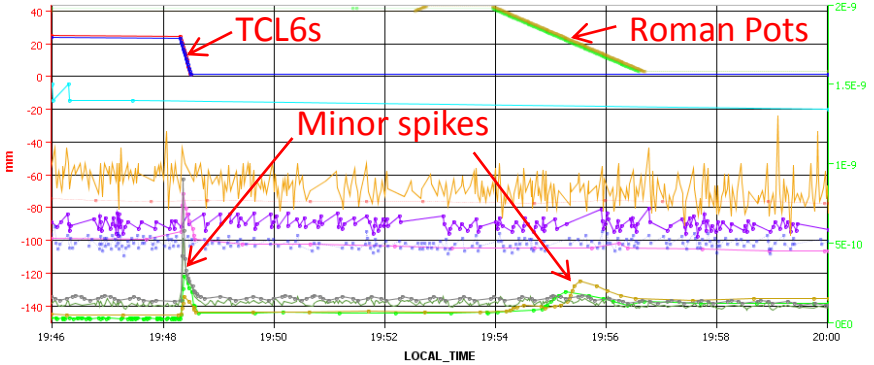
Overview of intensity ramp up



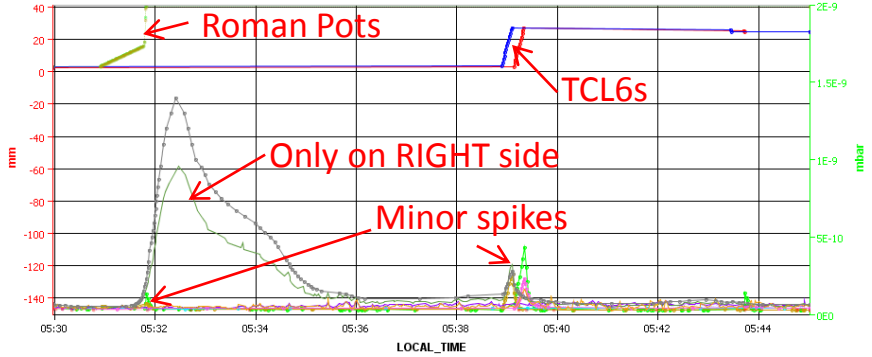
One fill



Insertion of AFP Roman Pots and TCL6



Extraction of AFP Roman Pots and TCL6



Vacuum behavior very reproducible from fill to fill.

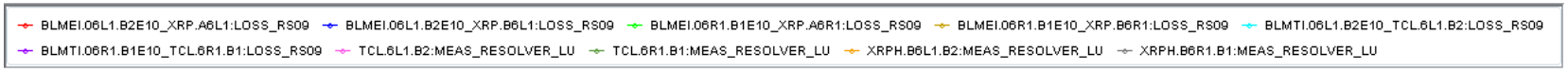
Some indication of heating on the vacuum pressures.

Minor (~1E-9 mbar) spikes systematically observed when moving the TCLs or AFP Roman Pots.

When moving OUT the AFP Roman Pots on the RIGHT side, larger/longer vacuum spikes are observed.

The spikes are observed both with and without beam, which could indicate it comes from friction.

Operational experience – slow losses (RS9)



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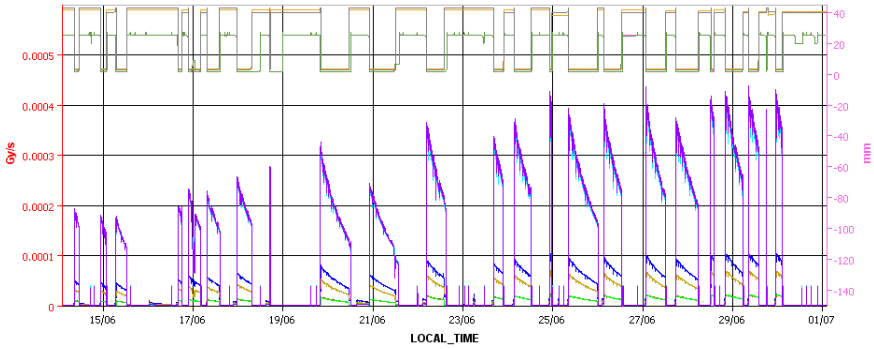
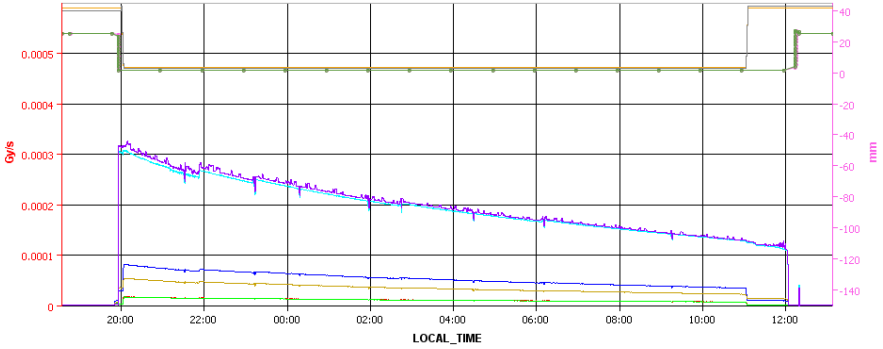


One fill



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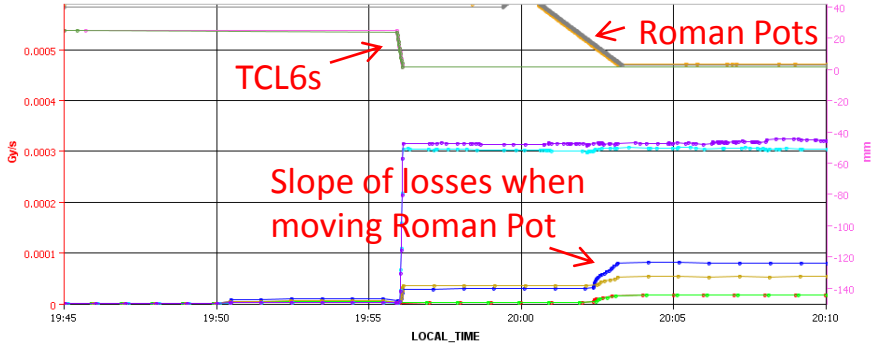

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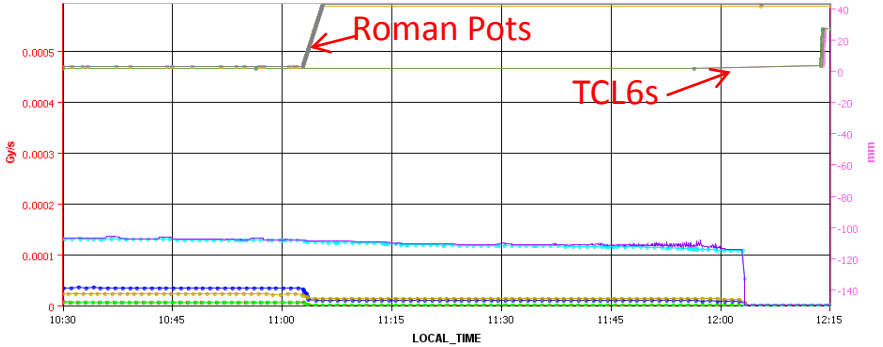


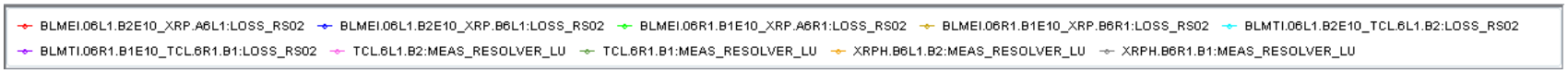
Movement of TCL6 and AFP Roman Pots clearly visible.

Slope losses vs Roman Pot position not alarming.

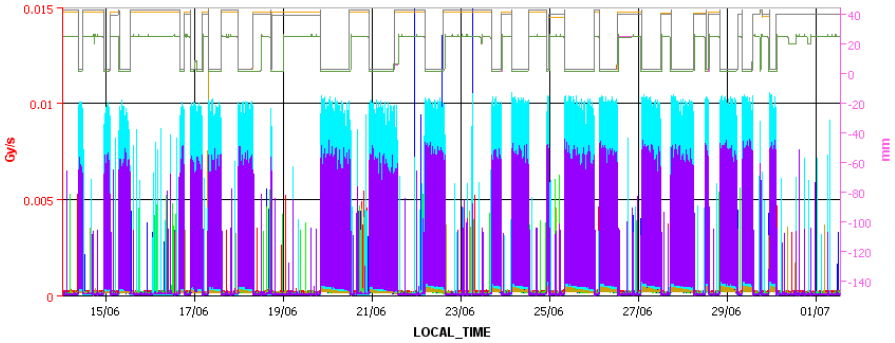
BLM threshold (RS09) XRP ~0.007 Gy/s, TCL6 ~0.004 Gy/s, so all losses below 10 % of threshold.

Analysis repeated for BLM threshold RS12 the results confirmed.

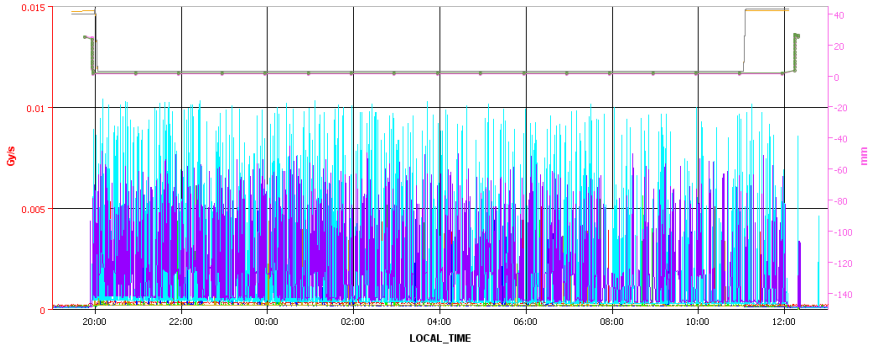
Operational experience – fast losses (RS2)



Overview of intensity ramp up



One fill



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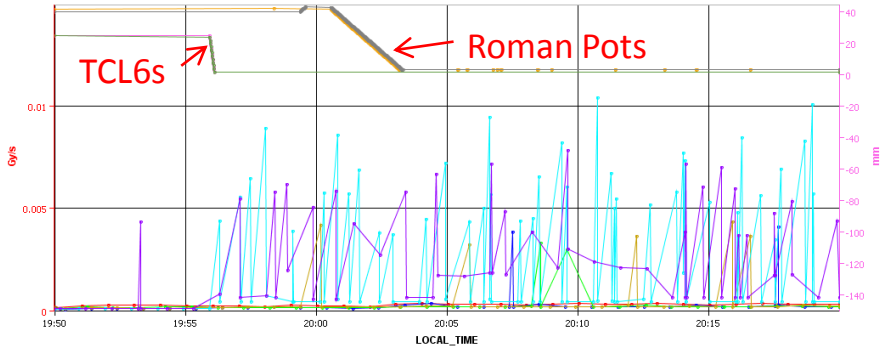
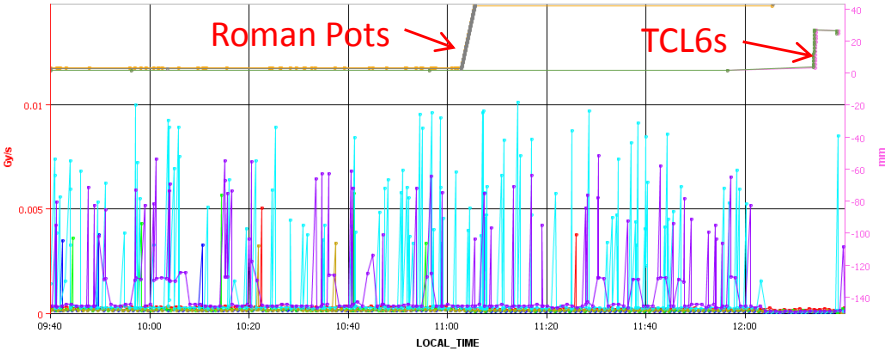


Extraction of AFP Roman Pots and TCL6



No particular spikes when moving the Roman Pots or TCL6.

BLM threshold (RS02) XRP ~7.7 Gy/s, TCL6 ~23.2 Gy/s, so all losses below 1 % of threshold.

Operational experience – UFOs

Analysis curtesy of Giulia Papotti and Markus Albert.

Conclusions:

UFOs observed at AFP (until 15/7):

B1: 7 UFOs

B2: 37 UFOs

The number of UFOs are not outstanding nor alarming.

Most UFOs are 2-3 % of BLM dump threshold.

No UFO at AFP reached 25 % of BLM dump threshold.

Conclusion

Various check made:

- Temperature of Roman Pots
- Primary vacuum (friction observed when moving OUT)
- Slow losses
- Fast losses
- UFOs

No alarming point discovered.

All loss maps performed with ultimate setting (no instabilities or problematic losses).

ATLAS-AFP therefore requests to move to the ultimate settings after MD2/vdM.

Settings for AFP in startup phase:

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Backup

Vacuum layout – cutesy of Christina Yin Vallgren