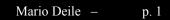


CT-PPS XRP Recommissioning



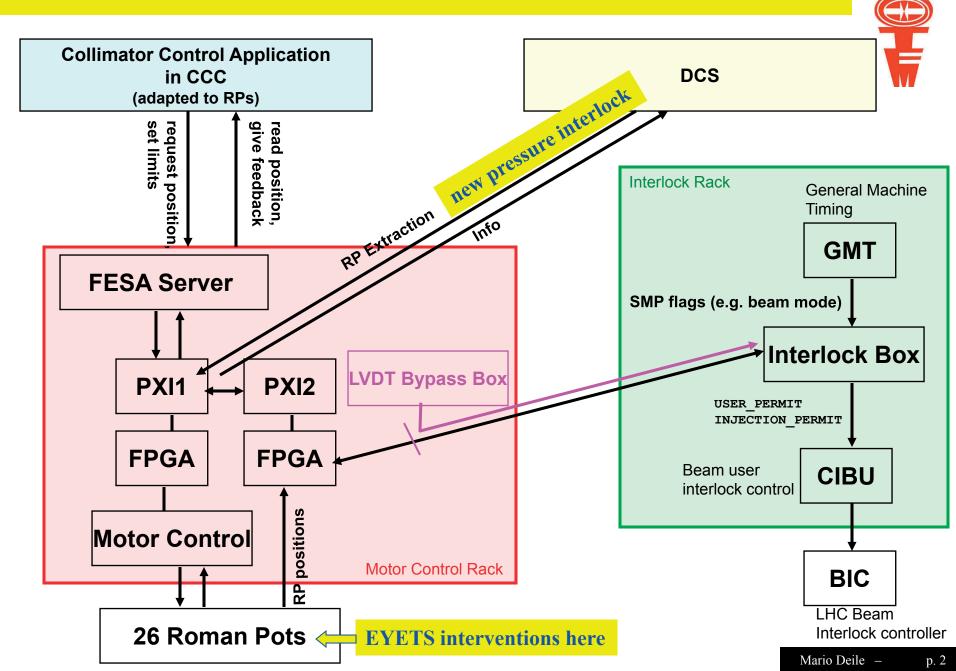
Mario Deile

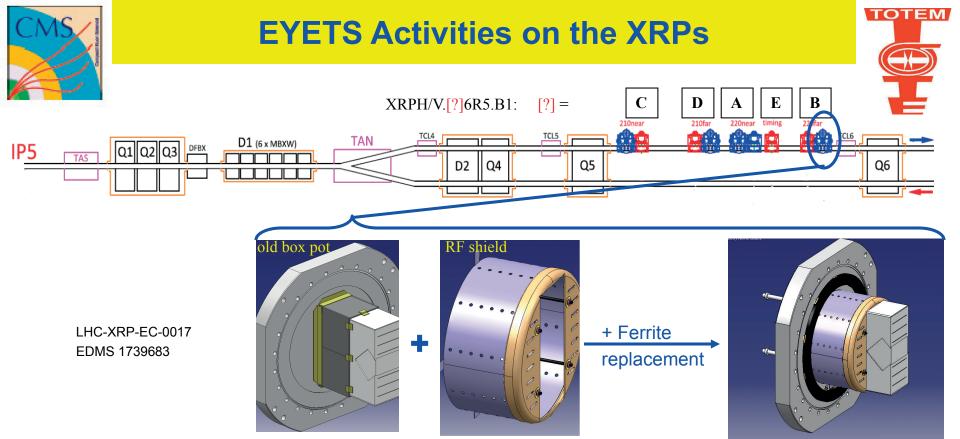
MPP Meeting 12 May 2017



Movement System Architecture (strongly simplified)

TOTEM





Main work: XRPH.B6R5.B1 (and ~B6L5.B2) equipped with RF shield for impedance mitigation

 \rightarrow ALL detector packages removed to allow bake-out of the sector,

then re-installed, partly with completely new detectors:

now 4 technologies:

tracking: silicon strips, 3D pixels,

- timing: ultra-fast silicon, diamond
- → Interlock-relevant signal cables disconnected/reconnected (HOME switches, end stoppers, LVDT)
- \rightarrow Communication between motor control rack and XRPs had to be re-tested.
- + New laser/LVDT/motor calibration curves for modified pots (EN-ACE-SU metrology) !

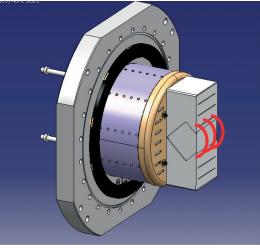


XRP Extraction via DCS Pressure Interlock



Secondary vacuum loss in XRP (leak + pump failure)

 \rightarrow thin pot window bulges towards beam into primary machine vacuum (0.5 mm for cylindrical pot)



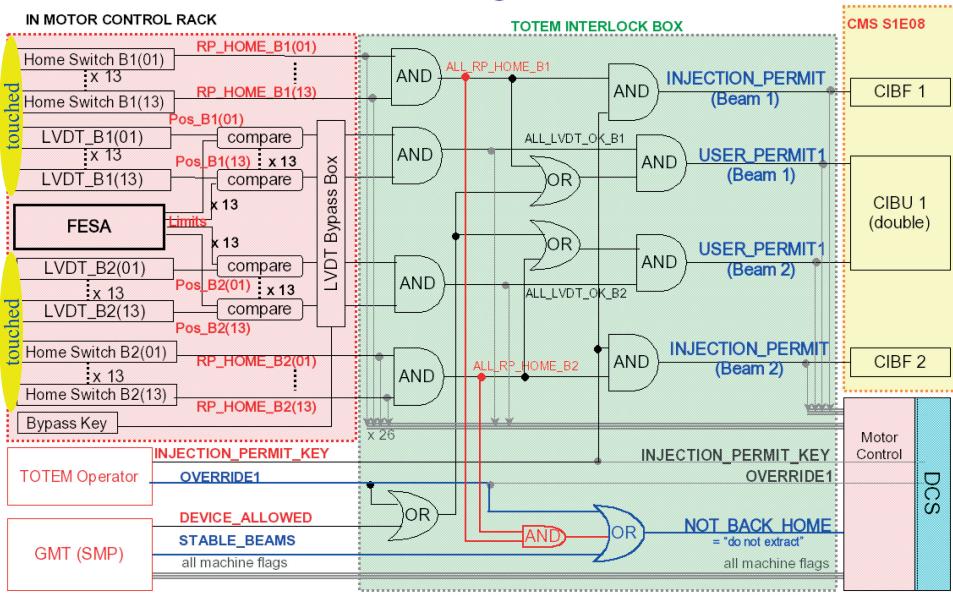
During EYETS: implementation of a new local DCS interlock (no interference with interlock box feeding into machine BIS):

- DCS samples secondary vacuum pressure every 35 ms
- If pressure increase > 200 mbar → XRP extraction via springs and prevention of re-insertion extraction speed ~ 15 mm/s,

i.e. the first 0.5 mm within 33 ms

 \rightarrow not as fast as BLM but additional protection layer

Interlock Logic 2015



Simplified Interlock Functionality

• User Permits (1 per beam):

User Permit is removed if:

(a pot is outside garage in the wrong beam mode) or (a pot is not within position limits) → beam dump and retraction of all RPs with the springs

• Injection Permits (1 per beam):

Injection Permit is removed if a pot is outside garage (defined by electrical link from HOME switch)

... apart from an Override key and an LVDT bypass key (consult the full logic)

Logic implemented on a programmable circuit ("Interlock Box")

Revalidation

- Beam-mode dependent tests not done (They concern the logic in the hardware "interlock box": not touched)
- Retested:
 - 1. Correct reaction of the injection permits (by moving pots out of garage and back)
 - 2. Correct transmission of all position limits to the interlock PXI and read-back to the CCC collimator application
 - 3. Correct system reaction to violations of the limits (RP retraction for violation of warning limits, RP retraction + dump for violation of dump limits)

For all 26 RPs (even the ones not used in 2017 since not immobilised by hardware) and for all inner limits:

- old inner dump
- new inner dump ("IPL")

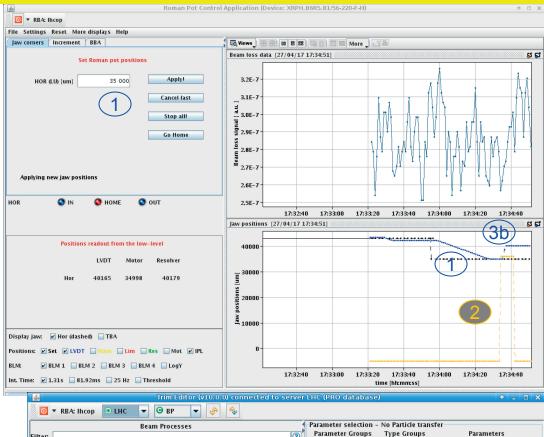
Inner warning limits tested for a subset of pots.

Outer limits: no operational meaning \rightarrow retraction and dump tested for a subset of pots.

EDMS 1803133 in work.



Example from Collimation Elog (27.04.2017)



| | Beam Processes | | | Parameter selection - | No Particle tran | ister | | |
|----------|---|--------------|---|------------------------|------------------|-----------------|----------------|----|
| Filter: | | | ? | Parameter Groups | Type Groups | | meters | |
| NON MU | ILTIPLEXED_LHC | | | ABORTGAP_CLEANER | LHCRomanPot | | | 0 |
| | LHCRING_ADT_INIECTION | | | ADT-BLOW_UP | LHCRomanPot | ARTH.AULJ.BZ/ | milerrottimits | |
| | _LHCRING_INJ_KICKER_V1 | | | ADT-DSPU | | XRPH.A6R1.B1/ | InnerPotLimits | |
| ADT-TEST | Γ_V1 | | | ADT-OBSOLETE | | XRPH.A6R5.B1/ | InnerPotLimits | |
| | rBP-CoarseRamp-2016-ATS-MD | | | ADT_BEAMPOS_FESA: | | XRPH.B6L1.B2/ | InnerPotLimits | |
| | rBP-CoarseRamp-2016-ATS-MD@0_[START] | | | ADT_BEAMPOS_TEST | | XRPH.B6L5.B2/ | InnerPotLimits | |
| | rBP-CoarseRamp-2016-ATS-MD@1210_[END] | | | COLLIMATORS | | XRPH.B6R1.B1/ | InnerPotLimits | |
| | rBP-Parking | | | LHCINIKICKERS | | XRPH.B6R5.B1/ | InnerPotLimits | |
| | DISCRETE_LHCRING_ADTBPOS_HIGH | | | ROMAN POTS | | XRPH.C6L5.B2/ | InnerPotLimits | 1. |
| | DISCRETE_LHCRING_ADTBPOS_NOMINAL DISCRETE_LHCRING_ADTBPOS_PILOT | | | TEST COLLIMATORS | | XRPH.C6R5.B1/ | InnerPotLimits | |
| | DISCRETE_LHCRING_ADTDSPUS_PILOT DISCRETE_LHCRING_ADTDSPU_BW_ENHANCED DISCRETE_LHCRING_ADTDSPU_BW_STANDARD | | | UNUSED_COLLIMATO | | XRPH.D6L5.B2 | | |
| | | | | ~NONE | | XRPH.D6R5.B1 | | |
| | LHCRING_ADTDSPU_FLATTOP_OBSOLETE | | | | | XRPH F61 5 R2/ | | |
| | DISCRETE LHCRING ADTDSPU PHYSICS | | | | | | ect All | |
| DISCRETE | DISCRETE_LHCRING_ADTDSPU_PPb | | | | | | 1 | _ |
| DISCRETE | _LHCRING_ADTDSPU_PREP_RMP | | • | Select All | Select All | Hierarchy | Show Fiel. | • |
| OPERATIC | DNAL | | - | Search parameter by n | ame: | | | ? |
| | Setting part: Value Target Correction | Trim History | Т | ime base: SuperCycle | e 🔿 Cycle/Bean | nprocess 🔿 Injo | ection | |
| | Parameter | | | TE_LHCRING_INJ_KICKER | _V1 | | | _ |
| XRPH.B6R | 5.B1/InnerPotLimits#innerTopLimitLU | 36.0 | | | | | A | |
| | | - (2) | | | | - 3 | 🖁 Trim | |
| | | | | | | | | |
| | | | | | | | | |

- 1. Move pot to 35 mm
- 2. Set IPL to 36 mm with Trim Editor
- \rightarrow 3a. USER_PERMIT to false
- \rightarrow 3b. pot is extracted with springs

\rightarrow 4. USER_PERMIT back to true

| Permit | Timesta | mp | Visibility | Event Type | Description |
|--|-----------|---------------------|-------------|-------------|-------------|
| | | 7 17:34:33.580574 | ALL | USER PERMIT | |
| | | 7 17:34:33.580574 | ALL | USER PERMIT | 2 A F-T 4 |
| μμ | | 7 17:34:33.430731 | ALL | USER PERMIT | 2 A T F |
| | | 7 17:34:33.430730 | ALL | USER PERMIT | 2 B T-F 3 |
| | | 7 17:32:41.339716 | ALL | USER PERMIT | 2 A F-T |
| | | 7 17:32:41.339715 | ALL | USER PERMIT | 2 B F-T |
| m m | | 7 17:32:41.119880 | ALL | USER PERMIT | 2 B T-F |
| | | 7 17:32:41.119879 | ALL | USER PERMIT | 2 A T-F |
| pa pa | 27-04-1 | 7 17:30:31.438415 | ALL | USER_PERMIT | 2 A F-T |
| | 27-04-1 | 7 17:30:31.438415 | ALL | USER PERMIT | 2 B F-T |
| p pa | | 7 17:30:31.248584 | ALL | USER PERMIT | 2 B T-F |
| m pa | 27-04-1 | 7 17:30:31.248582 | ALL | USER PERMIT | 2 A T-F |
| pin pin | 27-04-1 | 7 17:28:17.877902 | ALL | USER PERMIT | 2 A F-T |
| in pi | 27-04-1 | 7 17:28:17.877901 | ALL | USER_PERMIT | 2 B F-T |
| pp | 27-04-1 | 7 17:28:17.728071 | ALL | USER_PERMIT | 2 B T-F |
| | 27-04-1 | 7 17:28:17.728069 | ALL | USER_PERMIT | 2 A T-F |
| in pi | 27-04-1 | 7 17:25:35.577278 | ALL | USER_PERMIT | 2 A F-T |
| pin pin | 27-04-1 | 7 17:25:35.577278 | ALL | USER_PERMIT | 2 B F-T |
| pin pin | 27-04-1 | 7 17:25:35.427445 | ALL | USER_PERMIT | 2 B T-F |
| in po | 27-04-1 | 7 17:25:35.427444 | ALL | USER_PERMIT | 2 A T-F |
| in po | 27-04-1 | 7 17:23:27.737969 | ALL | USER_PERMIT | 2 A F-T |
| p pa | 27-04-1 | 7 17:23:27.737969 | ALL | USER_PERMIT | 2 B F-T |
| iii iii | 27-04-1 | 7 17:23:27.568137 | ALL | USER_PERMIT | 2 B T-F |
| p p p | 27-04-1 | 7 17:23:27.568135 | ALL | USER_PERMIT | 2 A T-F |
| mm | | 7 17:21:29.356532 | ALL | USER_PERMIT | 2 A F-T |
| p p p | | 7 17:21:29.356532 | ALL | USER_PERMIT | 2 B F-T |
| pp | | 7 17:21:29.196703 | ALL | USER_PERMIT | 2 B T-F |
| p p p | | 7 17:21:29.196701 | ALL | USER_PERMIT | 2 A T-F |
| pp | | 7 17:19:23.625006 | ALL | USER_PERMIT | 2 A F-T |
| pp | | 7 17:19:23.625006 | ALL | USER_PERMIT | 2 B F-T |
| | | 7 17:19:23.455176 | ALL | USER_PERMIT | 2 B T-F |
| | | 7 17:19:23.455175 | ALL | USER_PERMIT | 2 A T-F |
| | | 7 17:16:42.857184 | ALL | USER_PERMIT | 2 A F-T |
| | | 7 17:16:42.857183 | ALL | USER_PERMIT | 2 B F-T |
| | | 7 17:16:42.677350 | ALL | USER_PERMIT | 2 B T-F |
| | | 7 17:16:42.677348 | ALL | USER_PERMIT | 2 A T-F |
| | | 7 17:14:20.425856 | ALL | USER_PERMIT | 2 A F-T |
| | 27.04.1 | 7 17:14:20.425855 | ALL | USER_PERMIT | 2 B F-T |
| ilters | ; | | | | |
| | vport rog | isters Type name: U | ISER PERMIT | Descript | tion: 2 |



Note on the Spare Interlock Box

Present situation:

A spare interlock logic box is available on a shelf in a lab. Electronic tests have been performed in the lab (logic and levels).

Steps to install and validate the spare box in case of need:

- 1. Installation needs expert intervention (EP-ESE)
- Test of the electronic levels in situ
 To be done by the team of Christophe Martin (relatively easy and quick to allow resuming machine operation)
- 3. Test of the logic in situ \rightarrow needs a sequence of machine modes to be set by OP Is the lab test with emulated machine input flags sufficient ?





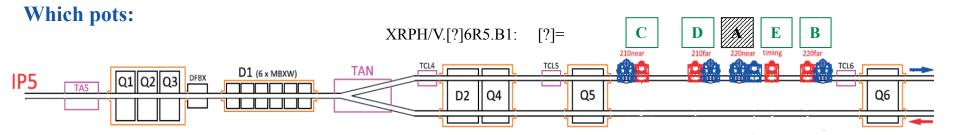
Plans for Intensity Ramp-Up



In each intensity step insert the XRPs:

- not in the first fill
- in the 2nd fill after 2 hours
- in the $\geq 3^{rd}$ fill immediately

If possible, not simultaneously with AFP (to separate the effects in the diagnostics)



Horizontal:

- D, E, B: always used
- C unit: for now empty, detector package possibly to be installed later
 - \rightarrow needs to participate in validation and intensity ramp-up, then stays out until further notice
- A unit: stays out for the full year

Vertical:

• Vertical pots of units D and B inserted in calibration runs, A and C stay out.

Wish: several hardware groups to keep flexibility during detector commissioning



2017 ATS Option 3bis (β* = 40 cm): XRP Positions



 $\sqrt{s} = 13$ TeV, $\beta^* = 0.4$ m, $\alpha_X = 300$ µrad, $\epsilon_n = 3.5$ µm rad XRPs @ TCT + 3 σ + 0.3 mm

For TCT = 9 σ :

Sector 5-6 (Beam 1):

| Horiz. XRP | $\sigma_{x,beam}$ | XRP pos. max($12 \sigma + 0.3 mm$, 1.5 mm) |
|--------------|-------------------|--|
| C6R5 (210-N) | 0.212 mm | $2.844 \text{ mm} = 13.4 \sigma$ |
| D6R5 (210-F) | 0.144 mm | $2.028 \text{ mm} = 14.1 \sigma$ |
| E6R5 (220-C) | 0.120 mm | $1.740 \text{ mm} = 14.5 \sigma$ |
| B6R5 (220-F) | 0.094 mm | $1.500 \text{ mm} = 16.0 \sigma$ |

Sector 4-5 (Beam 2):

| Horiz. XRP | $\sigma_{x,beam}$ | XRP pos. max($12 \sigma + 0.3 mm$, 1.5 mm) |
|--------------|-------------------|--|
| C6L5 (210-N) | 0.208 mm | $2.796 \text{ mm} = 13.4 \sigma$ |
| D6L5 (210-F) | 0.141 mm | $1.992 \text{ mm} = 14.1 \sigma$ |
| E6L5 (220-C) | 0.118 mm | $1.716 \text{ mm} = 14.5 \sigma$ |
| B6L5 (220-F) | 0.093 mm | $1.500 \text{ mm} = 16.1 \sigma$ |

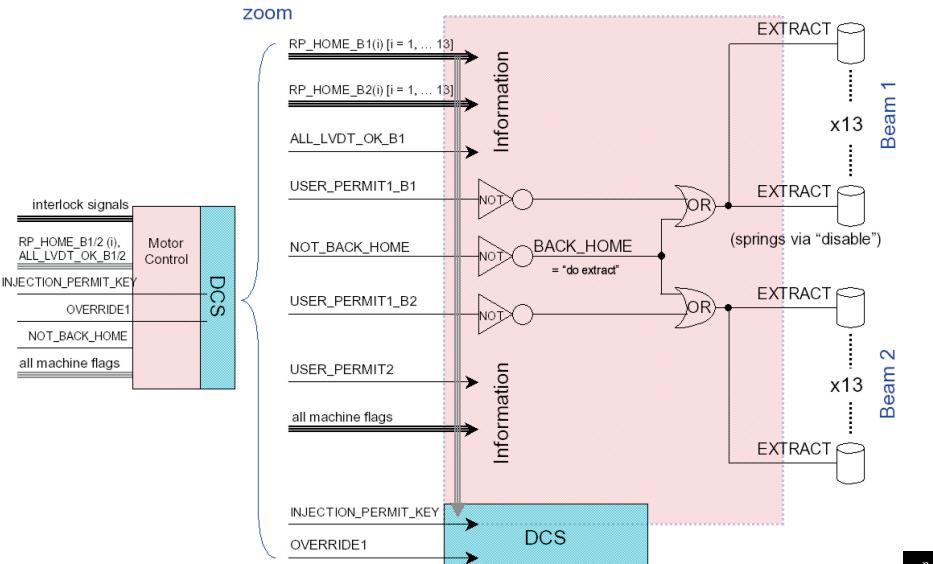
 $(12 \sigma + 0.3 \text{ mm} < 1.5 \text{ mm})$





Additional Material

Interlock Logic 2015 (Zoom on the motor control)



TOTEM