LHC MD meeting

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Triplet aperture measurements at 3.5 TeV in IP1 and IP5

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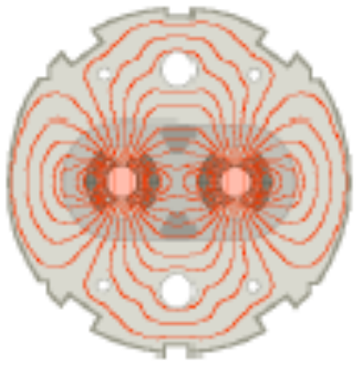
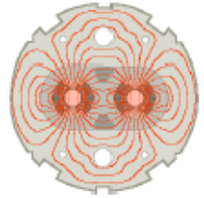


Goals of the measurements



Present status of triplet aperture estimates:

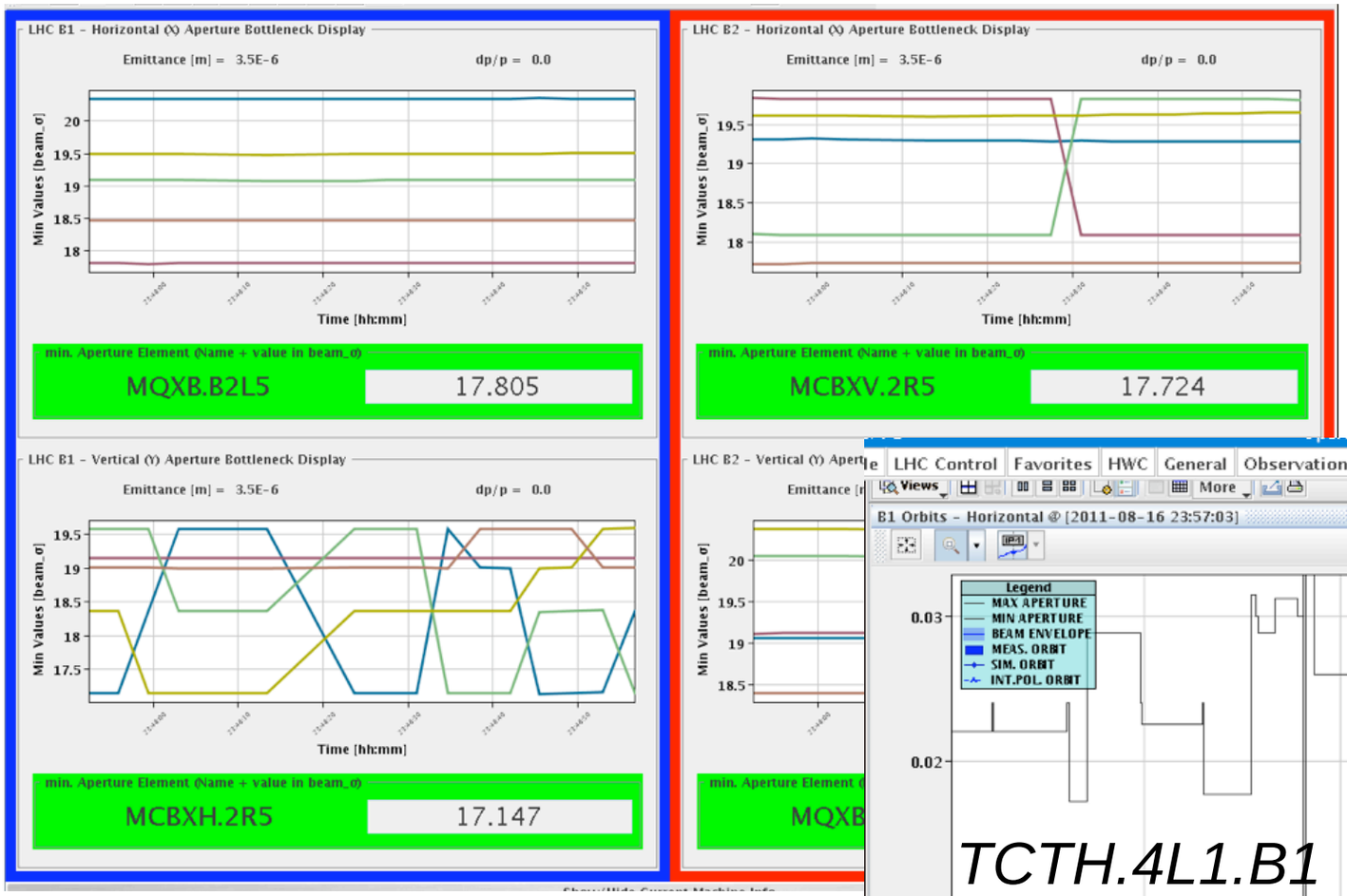
- *Top-energy aperture with squeezed optics (β*=1.5m) inferred from the injection measurements*
- *Complex model taking into account orbit drifts, optics errors, etc (R. Bruce)*
- *Direct beam-based measurements provide results in the relevant conditions, with possible impact on β* reach.*

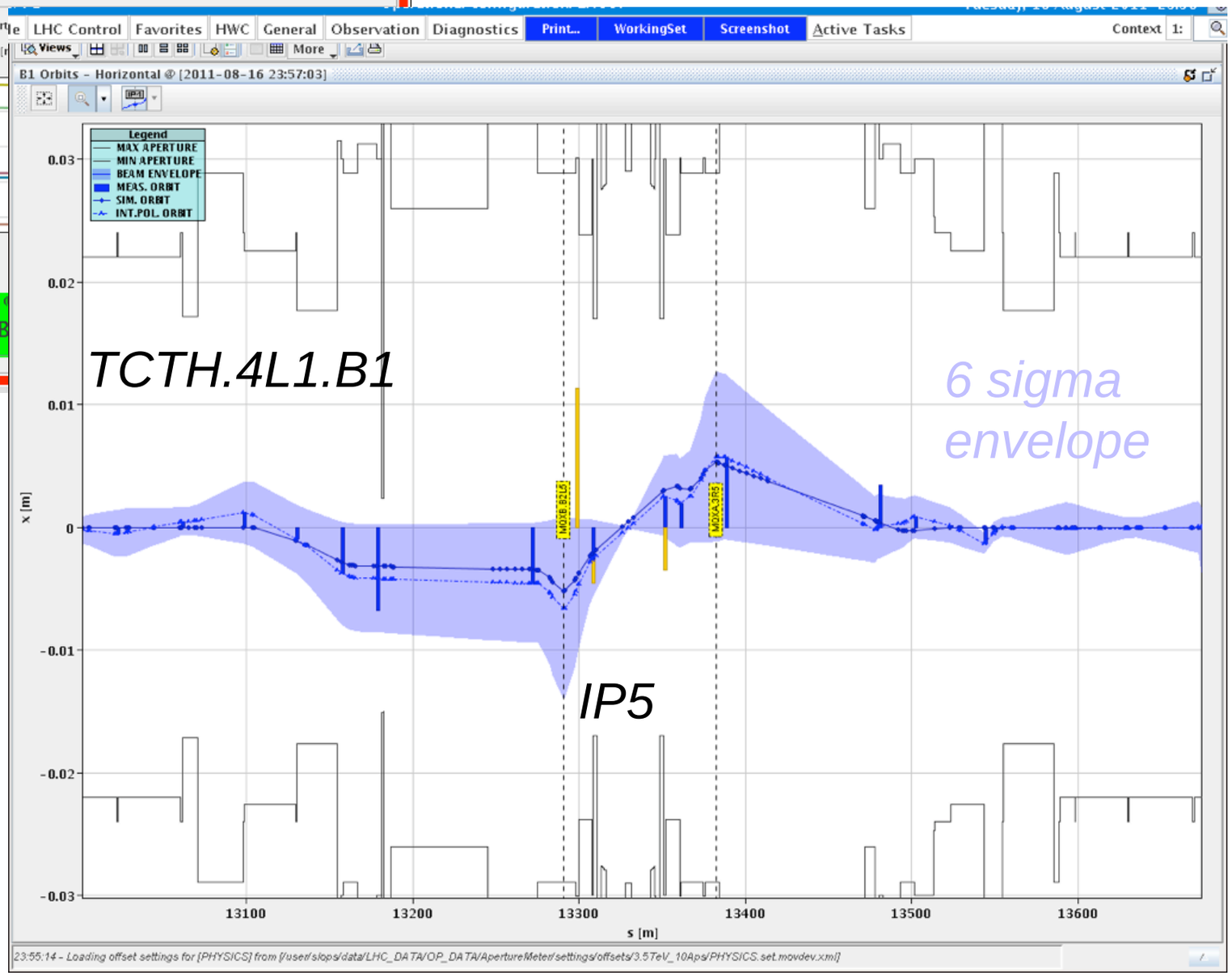
Goals for these measurements:

1. *Measure the local triplet aperture in the **crossing planes** of IP1 (V) and IP5 (H)*
2. *Measure the local triplet aperture in the **separation planes** of IP1 (H) and IP5 (V)*
3. *Re-centre the collision point with appropriate transverse scans to optimize the available aperture, if necessary.*

<u>Remarks</u>: We will measure the aperture in terms of retraction between TCT collimators and triplet aperture. TCT collimators will shade the magnets
We will use the standard crossing and separation bumps to increase "touch" the triplet aperture.

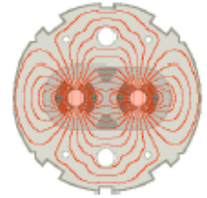
Predictions based on nominal model





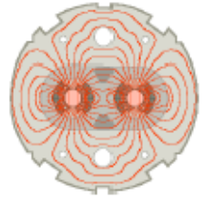
Gabriel's aperture meter with nominal aperture

LHC configuration and beam conditions



- Beams required [1, 2, 1&2]	Both beams
- Beam energy [GeV]	3500
- Optics (injection, squeezed, special)	**Squeezed (1.5 m), separated beams (0.7mm).**
- Bunch intensity [#p, #ions]	**Pilot bunch (<1E10)**
- Number of bunches	1 per beam
- Transv. emittance [m rad]	**3-4 microns**
- Bunch length [ns @ 4s]	Not relevant
- Optics change [yes/no]	No: nominal end-of-squeeze conditions
- Orbit change [yes/no]	No:
- Collimation change [yes/no]	**Yes: Need to move the TCTs.**
- RF system change [yes/no]	No
- Feedback changes [yes/no]	No. To be switched off at the end of the squeeze as in nominal operation.
- What else will be changed?	Nothing.
- Are parallel studies possible?	No
- Special settings relevant for MP	Work with **relaxed safe beam flag**. BIC masks: **BLMs**, **collimator positions** in IP1/5 SIS masks: now taken care of automatically **Relaxed BCM thresholds to ATLAS/CMS.** **Open discrete position thresholds of TCTs.**

Plan for beam tests (i)



A. Preliminary checks at the end of the squeeze:

0. Set the required interlock configuration.

1. Measure emittance and make sure it is >3 microns (blow it up with MKQ)

2. Check beam halo extension with TCP collimators

B. Procedure for safe beam measurements:

1. Start with crossing angle in IP1

2. Increase the crossing knob in steps until the vertical collimators are touched, as see on the local BLMs on TCTVA.4L1.B1 and TCTVA.4R1.B2.
E.g.: steps of 20μrad should give ~250μm at each TCT, i.e. 0.5 sigma.

3. Retract both TCTs by 0.5 sigma.

4. Increase the angle further until one of the TCTs is touched again.

5. Repeat (3) and (4) iteratively until the MQX aperture is exposed, i.e. until losses are seen at the MQX (Q2).

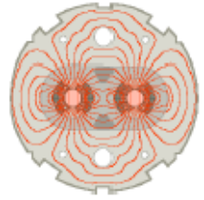
6. Trim back the knob to the nominal value. Retract the TCTs by 2 sigmas to protect.

Remarks:

- The triplet aperture will only be exposed at most by 0.5 sigmas.

- If the current limits of the power converters is reaches (RCBX?), external bumps should be added on top of the crossing.

Plan for beam tests (ii)



C. Repeat in the other planes / IP in this order:

1. *Horizontal (crossing) in IP5*
2. *Vertical (separation) in IP5*
3. *Horizontal (separation) in IP1*

D. Re-centre the collision points *(preliminary)*

1. *Test the “offset” bumps for transverse IP positions (never used so far!!)*
2. *Restore the previous conditions with bump touching the aperture of the triplet, with symmetric TCT settings.*
3. *Start with the plane / IP that showed the smallest aperture.*
4. *Without moving the TCTs from the previous (symmetric) positions, shift the IP toward the TCT that was not touched.*
5. *Move the IP in steps corresponding to 0.5 sigmas at the TCT, until the TCT with more aperture is touched.*
6. *Record the offsets necessary to re-centre the aperture.*