



Beam Instrumentation (WP13)

FRAS requirements

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HL-LHC alignment review 26/08/2019

WP13 equipment in the FRAS area

- **Affected by FRAS:**

- Beam Position Monitors (BPM) – 13 instruments
- Experiment timing (BPTX) – 1 instrument
- Luminosity monitoring (BRAN) – 1 instrument

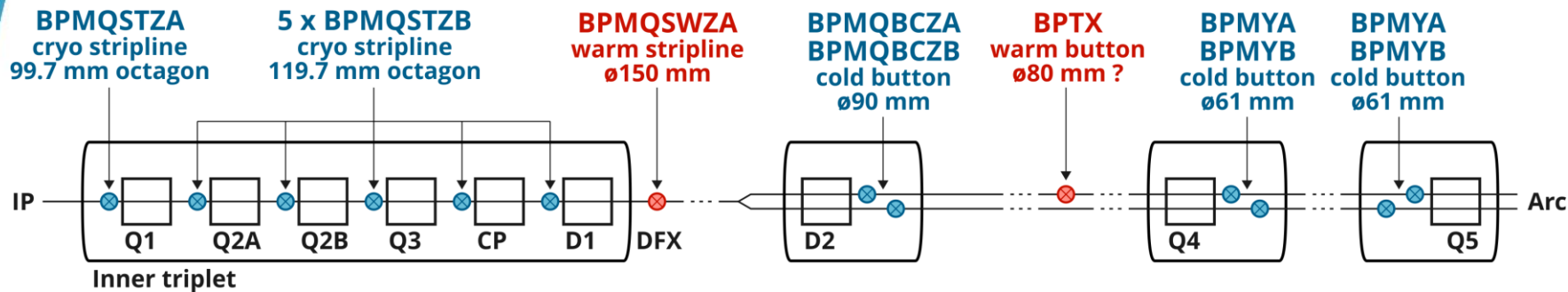
- **Not affected by FRAS:**

- Beam Loss Monitors (BLM) - ~40 instruments

- **Not in the baseline but would be affected by FRAS:**

- Beam-Beam Long Range wire compensation (BBLR)

BPMs / BPTX in the FRAS area



Cold BPMs

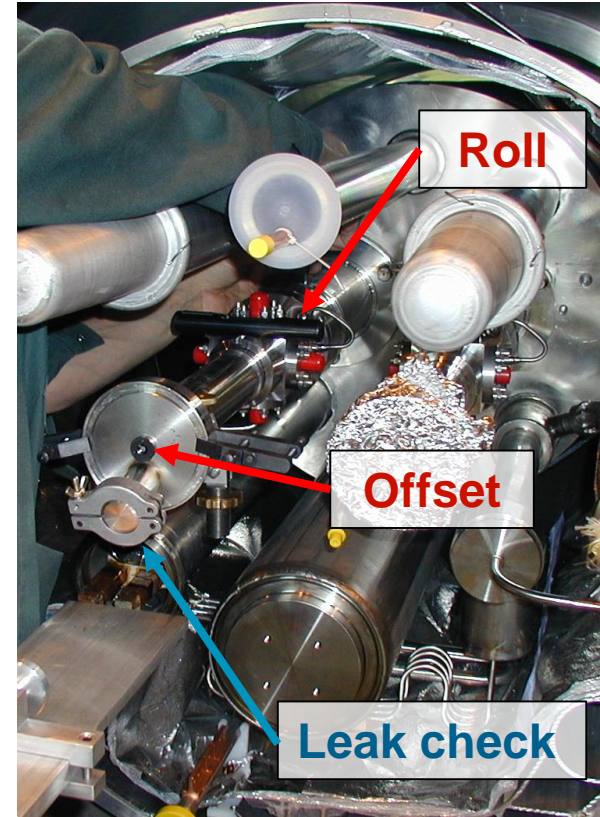
- Welded to the vacuum chamber
- Aligned only during installation
- Move rigidly with the magnet

Warm BPMs

- Installed on individual platforms
- Can be realigned during TS
- Move “independently”

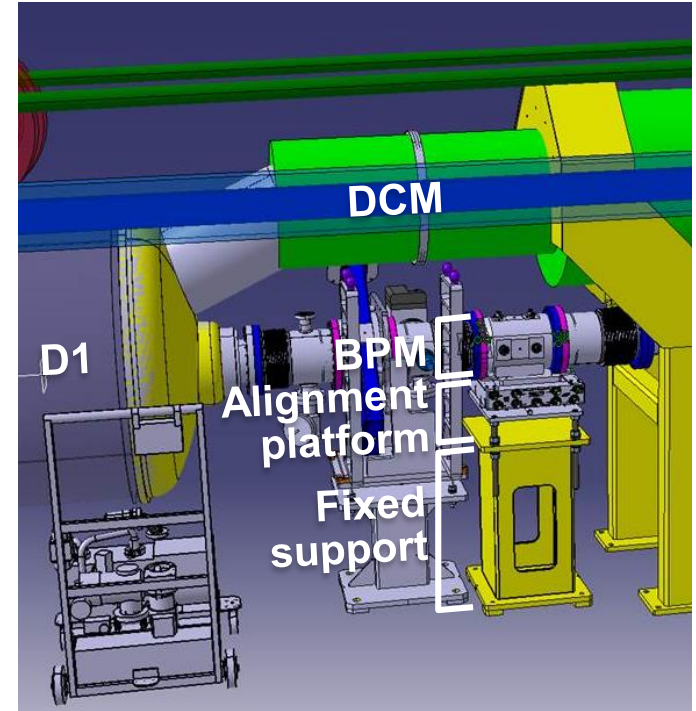
Cold BPMs

- BPM is a part of the magnet assembly
- D2 BPMs moved from outside (IP side) to within the D2 cryostat (arc side)
- Position of each BPM is known:
 - Metrology after manufacturing
 - Electrical measurements in the lab
 - Alignment during installation
 - Measurement after installation
- Offset and roll can be corrected



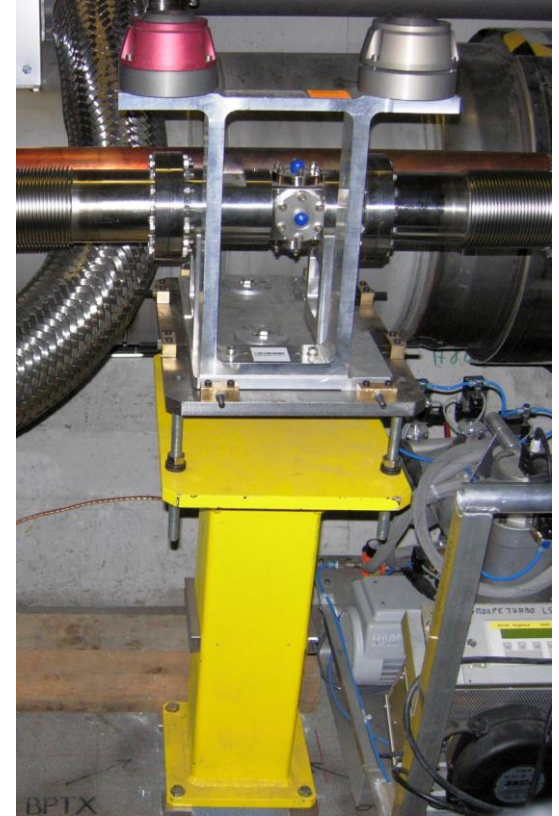
Warm BPM under the DFX / DCM

- Installed on a semi-manual standardized alignment platform
- Fiducialised on surface, aligned during installation, measured after installation
- No WPS integration foreseen but permanent targets integrated
- Realignment only during YETS and LS
 - If other components are realigned what becomes the BPM reference?
 - Can we assume that the BPM moves together with the D1 extremity?



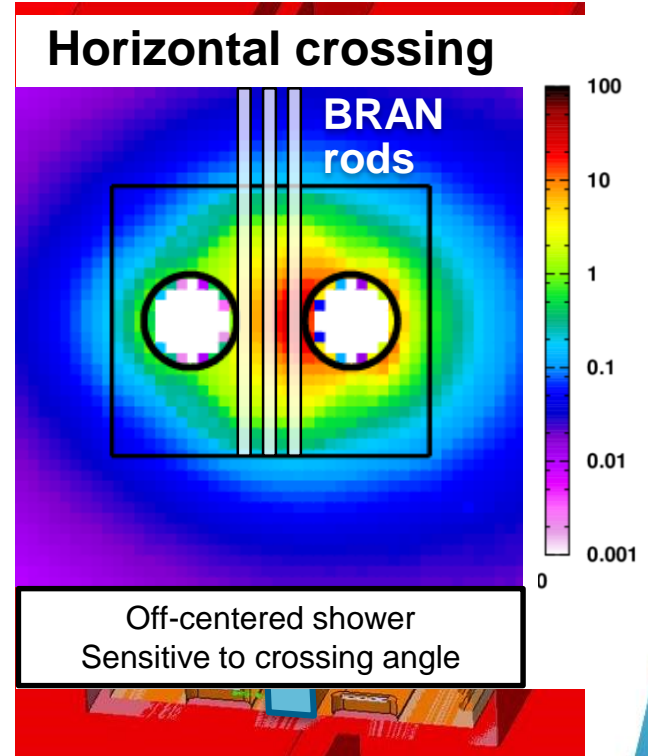
BPTX

- Timing monitor used exclusively by the experiments
- Precise transverse alignment not required for functionality
- Installed like a typical BPM: fiducialised, aligned, measured
- No realignment planned after installation
- Required aperture large enough to allow ± 5 mm displacement
- WP13 plans to use 80 mm aperture – needs to be validated by WP2



BRAN

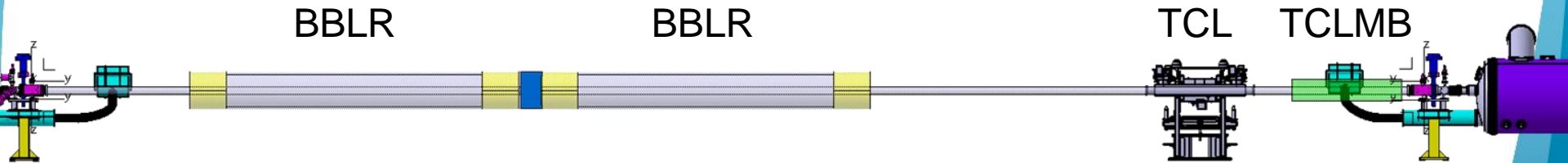
- Luminosity monitor integrated between the two beam pipes inside the TAXN
- Measures the rate of neutral debris
- Moves rigidly with the TAXN
- HL-LHC BRAN needs to handle changing crossing angle – effect comparable to the instrument's transverse movement
- Realignment towards the optimal orbit is only good for the BRAN signal



BRAN envelope inside TAXN

BBLR

- If wire BBLR compensation becomes HL-LHC baseline, remote alignment will be requested for the wire chambers
- 3 – 4 m long chambers installed between Q4 and Q5 on both beams, left and right of IP1 and IP5
- Preferred alignment solution would be similar to platforms designed for WP5 equipment



Summary

- **Cold BPMs:** move with the magnets, fully compatible with FRAS
- **Warm BPM under the DFX:** open question how to establish a reference axis after other components are moved
- **BPTX:** no alignment required for functionality, aperture large enough to accommodate ± 5 mm displacement after installation
- **BRAN:** moves with the TAXN, can cope with misalignment, realignment towards optimal orbit beneficial
- **BBLR:** if it becomes baseline, remote alignment will be requested



Thank you for your attention

