Alignment activities during LS$_2$ period

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Agenda

• Towards LS2
  • EYETS 2016-2017
  • Preparation of LS2
  • Contributions to other groups

• The LS2
  • Alignment activities
  • Contributions to other groups
Towards LS2 : EYETS

- Activities triggered by SU
- LHC
  - Vertical survey of 2 sectors S78 and Horizontal of 1 sector (S81)
  - Survey of LSS1 (D1 magnets), LSS5 (D1 magnets and -2 mm vertical re-alignement (?) asked by CMS) and LSS6 (TD68 side)

<table>
<thead>
<tr>
<th>Arc</th>
<th>Deviation wrt the smooth curve (Cumulative distance [m])</th>
<th>Realigned magnets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rms</td>
<td>Min</td>
</tr>
<tr>
<td>12</td>
<td>0.21</td>
<td>-0.86</td>
</tr>
<tr>
<td>23</td>
<td>0.28</td>
<td>-1.88</td>
</tr>
<tr>
<td>34</td>
<td>0.35</td>
<td>-2.09</td>
</tr>
<tr>
<td>45</td>
<td>0.35</td>
<td>-1.71</td>
</tr>
<tr>
<td>56</td>
<td>0.25</td>
<td>-1.39</td>
</tr>
<tr>
<td>67</td>
<td>0.23</td>
<td>-1.53</td>
</tr>
<tr>
<td>78</td>
<td>0.27</td>
<td>-2.04</td>
</tr>
<tr>
<td>81</td>
<td>0.38</td>
<td>-1.61</td>
</tr>
</tbody>
</table>

all  | 36 | 36 |

7th & 8th November 2016

http://indico.cern.ch/event/564604/
Towards LS2 : EYETS

- SPS complex
  - SPS: quads levelling, monitoring TT10
  - TI2 : Measurements and realignment of all elements (done in 2013, anticipation of LS2)
- TT20 : Measurements and realignment (last time done in 2003, many unique jacks have sunk by 2mm)
- PS Complex
  - AD : vertical measurements and realignment
  - LEIR, Linac3 and transfer lines
Towards LS$_2$ : EYETS

• Inner triplets monitoring system
  • Maintenance, validation, calibration in situ

• Contributions
  • For accelerators
    • AWAKE, ELENA ok
    • all validated in PLAN
  • Experiments
    • Networks redetermination around each detectors
    • Alignment of new detectors
Towards LS2 : Preparation

- Accelerators
  - LHC
    - Fiducialisations of
      - Cryo-magnets for exchange
      - collimators (50)

- Detectors
  - Surface assembly works: ATLAS NSW, LHCb trackers, etc
  - CENF: EHN1 ext., WA104, WA105, ProtoDUNE
Towards LS2 : Preparation

• Inner triplets monitoring system
  • Consolidation of the system in PT2 and 8
    • exchange of fiducials
    • Sensors (dating from LEP)
    • New sensors on C Fiducials of Q2
Towards LS2

- Manpower Resources
  - Globally ok
  - Due to heavy load of HL-LHC, one missing staff

- Budget
  - Not completely finalised for EYETS
  - No allocated budget for the inner triplets consolidation (300K)
LS2

- Activities triggered by SU
- LHC
  - Vertical and Horizontal survey of all sectors
  - Vertical and Horizontal Survey of all LSSs
  - Link to the Experiments Network

Smoothening the Arcs

- Vertical
  - DNA03, Cholevsky, Outward and Return
  - Calculation fixed on the deep references, smoothing with PLANE
  - 34% magnets realigned
  - Very small degradation of the rms except Arc81
  - No big difference between quads and dipoles

Smoothening the Arcs

- Radial
  - Offsets wrt a stetched wire, between Q8Rn to Q8Lm+1
  - Calculation fixed on Q8s, radial constraint, smoothing with PLANE
  - Quite important degradation of the r.m.s., especially in Arc 34 and 81
  - 36% magnets realigned, 36 magnets by more than 1 mm
  - Twice more quads than dipoles
LS2

- Activities triggered by SU
  - SPS complex
    - SPS: quads levelling
    - TI8 : Measurements and realignment of all elements (done in early 2014)
    - TT10 : Measurements and realignment of all elements
  - PS Complex
    - Smoothing of LT, LTB, BI for connection with PS Booster
    - L4 : Smoothing of main linac and L4T
LS2

- Inner triplets monitoring system
  - Corrective and preventive Maintenance in PT1, 2, 5 and 8
  - Consolidation: exchange of fiducials and of old sensors in Pt2 and 8
  - In situ calibration in Pt1 and 5
LS2

- Contribution
  - ATLAS
    - Full opening and closing (ECT/EBA/EBC/ECA/ECC/EB/Big Wheels, Muon Barrel ends), TAS
    - Installation of JD and New Small Wheels (A+C-side), change of Muon BIS7/8
  - CMS
    - Full Opening of all CMS Endcaps and Barrel Wheels, MABs survey, Muon GE1/1, partly beam pipe replacement, MilliCan, DT, Full Closing of CMS Endcaps and Barrel Wheels, HF, Beam pipes parts Z+/Z-adjustments, TAS control and re-alignment

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**LS2**

- **ALICE**
  - Full opening of L3 zone with TPC and entirely new ITS, Work zones in surface and cavern.

- **LHCb**
  - Checking of Beam Pipe in different conditions, UT surface assembly and installation, alignment of RICH 1+2 Mirrors, VELO, replacement of M1 and IT/OT by SciFi

- **Isolde**: measurement and realignment of the entire ‘Hall Isolde’ lines (agreed two weeks ago?)
  - survey, fiducialisation, alignment
LS₂

- LHC: alignment of new components (collimators, 11T dipoles, CC, ...)
- SPS: aC coating, new beam dump, crab cavity
- PS complex
  - PS ring: Renovation of 45 MU
  - TT₂: Renovation of 40 quads
  - East area: network from the current position of magnets, link to PS, marking, alignment of 4 new lines
- Transfer lines from ELENA to AD experiments (2019)
- FAIR: fiducialisation of 50 magnets
LS2

- HL-LHC:
  - Surface network (should be done before LS2)
  - Orientation of the 2 new galleries
  - Link to LHC tunnel
  - Monitoring the LHC components due to the boring of UPR areas
  - Scans
  - Fiducialisation of magnets for the SM18 string

- Preparation and studies has to be continued during LS2
LS2

- Contributions
  - Huge demand for the PS complex (1 FTE in 2019)
  - Validated in PLAN except:
    - Isolde lines (budget ?)
    - East area (no manpower in 2019)
    - Transfer lines from ELENA to AD (no manpower in 2019)
LS\textsubscript{2}

- Issues during LS\textsubscript{1}
  - Smoothing of the LSSs done at warm with other activities
    - A lot of time lost during LS\textsubscript{1}
  - Smoothing of the LHC has to be done below 100k and therefore coactivity with ELQA
    - Work in shift?
LS2

- Manpower
  - Almost the same number as for the LS1
    - But with 40% of field staff and a new contractor (12) not having participated to LS1 in the accelerator unit
  - For the Monitoring of triplets
    - 1 fellow and 1 mechanical technician needed
  - For experiments
    - ATLAS ok with JINR (to be confirmed for 2020)
    - ALICE, CMS and LHCb still to be discussed
      - help from collaborations needed
      - 2 PJAS needed: participation of EN and EP requested
      - 2 industrial support persons needed

- 2LD arriving at the end of their contract in 2020!!
Conclusions

• For SU, the workload in LS2 will be as huge as for LS1
  • Preventive maintenance
    • Same activity for LHC
    • For the SPS complex, it starts during the EYETS
    • A bit lighter for PS complex
  • Requested contributions will be much higher for SPS and PS
Conclusions

• Manpower
  • Pb with East area and AD experiments Transfer lines
  • pb for HL-LHC as the work has to continue during LS₂
• For experiments still to be solved
• Budget issues to be clarified for
  • consolidation
  • Experiments
Thank you for your attention!