

Alignment activities during LS2 period

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LS2
Days

7th & 8th November 2016

<http://indico.cern.ch/event/564604/>

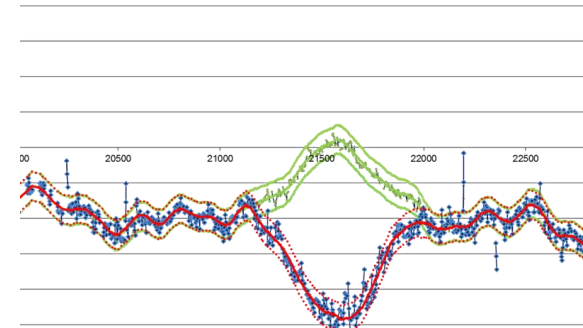
Agenda

- Towards LS2
 - EYETS 2016-2017
 - Preparation of LS2
 - Contributions to other groups
- The LS2
 - Alignment activities
 - Contributions to other groups

Towards LS2 : EYETS

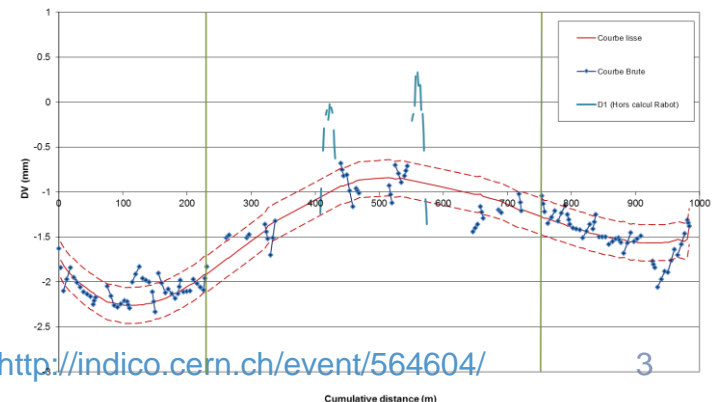
- Activities triggered by SU
 - LHC
 - Vertical survey of 2 sectors S78 and Horizontal of 1 sector (S81)
 - Survey of LSS1 (D1 magnets), LSS5 (D1 magnets and -2 mm vertical re-alignment (?) asked by CMS) and LSS6 (TD68 side)

Vertical smoothing of Sector



Arc	Deviation wrt the smooth curve (mm) <small>Cumulative distance [m]</small>			Realigned magnets	
	Rms	Min	Max	%	Nb>1mm
12	0.21	-0.86	1.01	26	1
23	0.28	-1.88	1.20	37	5
34	0.35	-2.09	1.39	45	8
45	0.26	-1.71	0.96	46	2
56	0.25	-1.39	1.12	24	4
67	0.23	-1.53	0.78	29	3
78	0.27	-2.04	1.22	34	4
81	0.38	-1.61	1.65	45	9
all				36	36

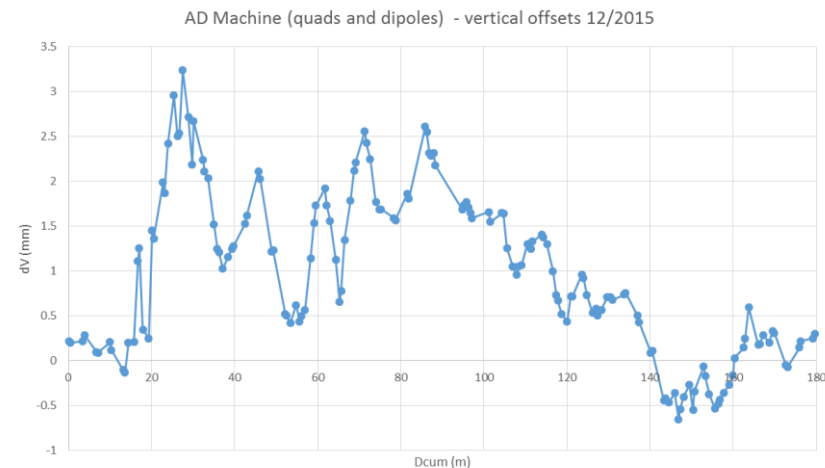
LSS1 : vertical smoothing



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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

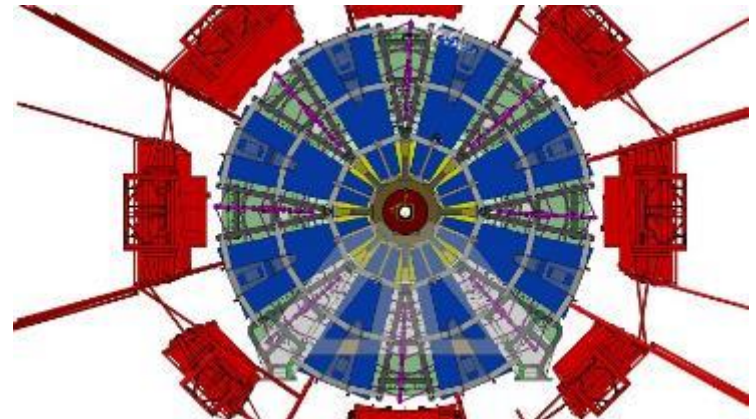


Towards LS2 : EYETS

- 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

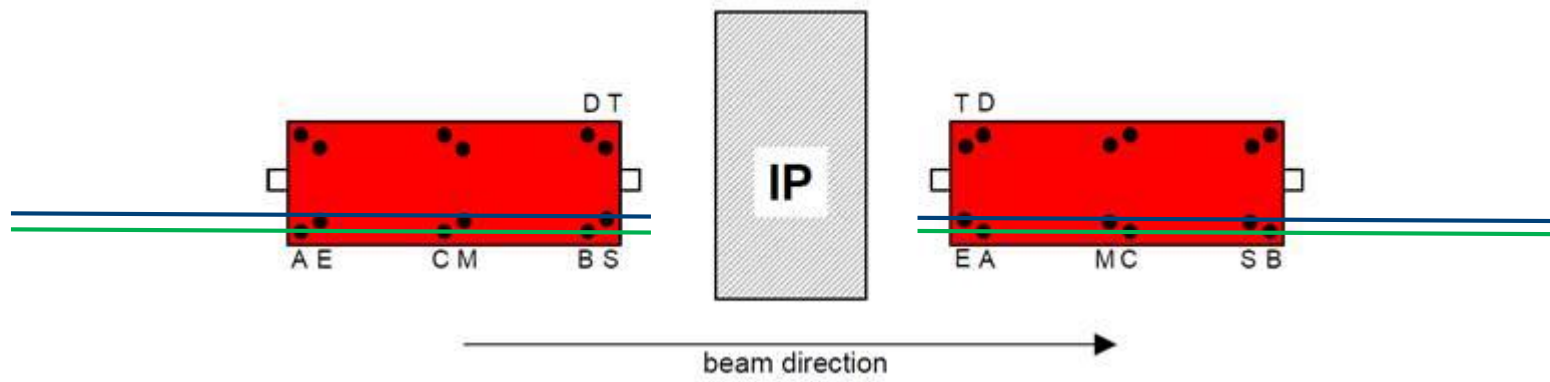
Towards LS2 : Preparation

- 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 Ressources
 - 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)

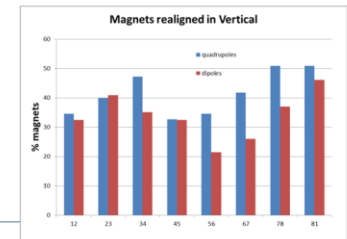
LS2

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

Smoothing 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

Arc	Deviation wrt the smooth curve (mm)				Realigned magnets	
	Rms	Min	Max	%	Nb>1mm	
12	0.15	-.74	0.55	31	0	
23	0.16	-.46	0.52	39	0	
34	0.16	-.55	0.68	36	0	
45	0.15	-.65	0.47	31	0	
56	0.13	-.55	0.55	24	0	
67	0.12	-.37	0.38	29	0	
78	0.13	-.76	1.03	39	1	
81	0.21	-.89	1.38	45	1	
all				34	2	



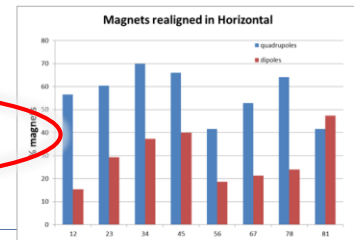
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Smoothing the Arcs

- Radial
 - Offsets wrt a stretched wire, between Q8R_n to Q8L_{n+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 1mm
 - twice more quads than dipoles

Arc	Deviation wrt the smooth curve (mm)				Realigned magnets	
	Rms	Min	Max	%	Nb>1mm	
12	0.21	-.86	1.01	26	1	
23	0.28	-1.88	1.20	37	5	
34	0.35	-2.09	1.39	45	8	
45	0.26	-1.71	0.96	46	2	
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LS2
Days

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

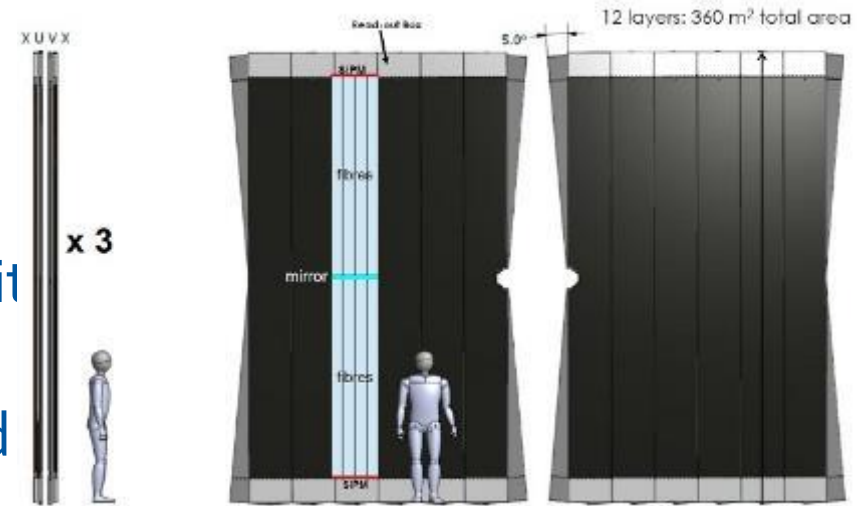
- Inner triplets monitoring system
 - Corrective and preventive Maintenance in PT₁, 2, 5 and 8
 - Consolidation : exchange of fiducials and of old sensors in Pt2 and 8
 - In situ calibration in Pt₁ and 5

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

LS2

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

LS2

- Issues during LS1
 - Smoothing of the LSSs done at warm with other activities
 - A lot of time lost during LS1
 - 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 !

