

Update on LHC and non-LHC Experiments Activities during LS2

M. Brugger for the EN-EA Group with particular thanks to

A. Ball, Q. Bouirek, J. Bernhard, F. Butin, R. Catherall, T. Eriksson, S. Evrard, A. Fabich, L. Gatignon, E. Gschwendtner, Y. Kadi, R. Lindner, L. Pontecorvo, W. Riegler, E. Siesling, A. Tauro, E. Thomas, M. Wilhelmsson

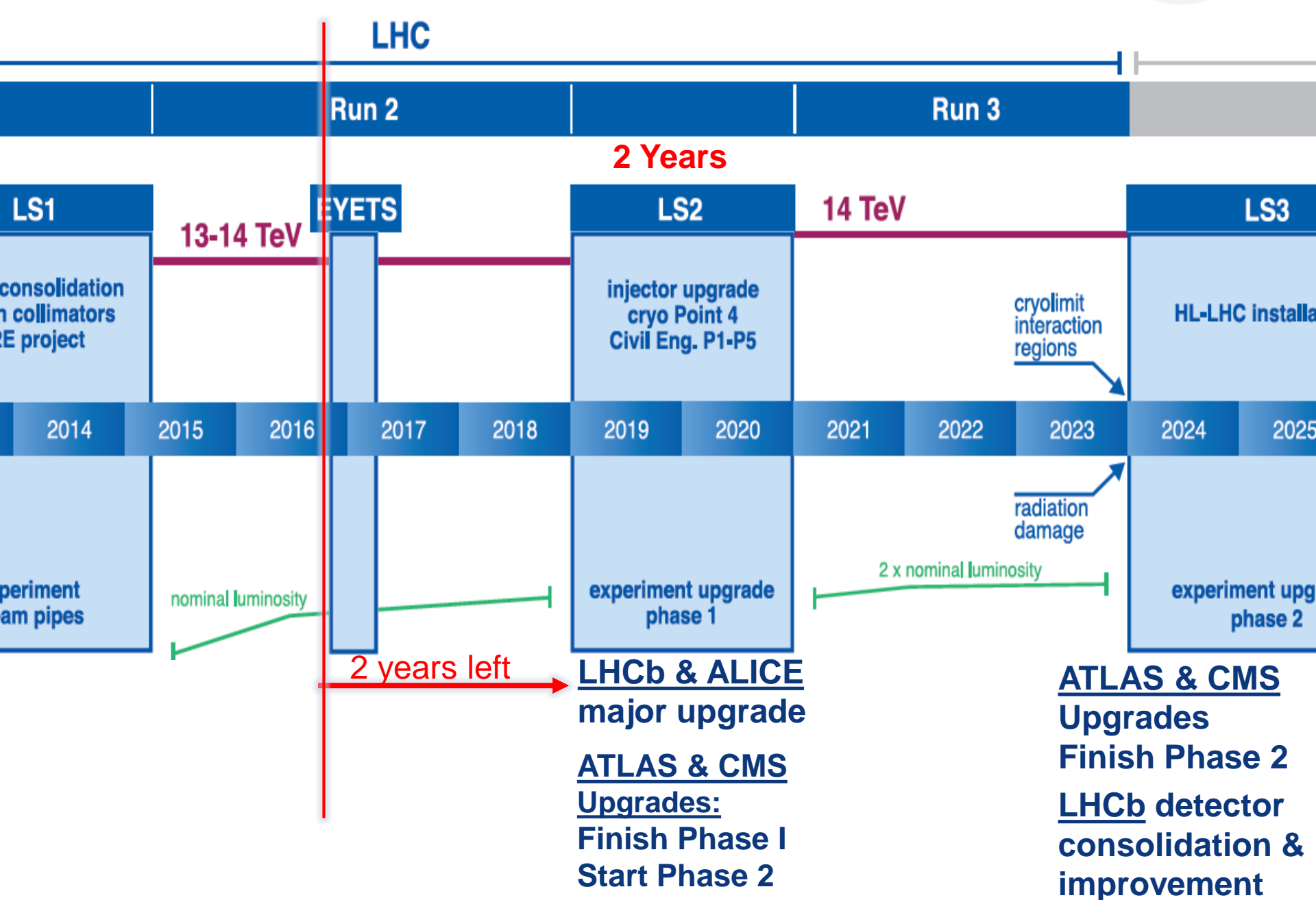
...and all contributing equipment and service groups



Content & Constraints

- **Focus on LS2 activities**
 - LHC Experiments:
 - Non-LHC Experiments:
- **Not including**
 - AD/nToF target area (see Marco's talk)
 - East-Area consolidation (see Sebastien's presentation)
- **Already covered by previous talks and partly recently also during the combined IEFC/LMC/LS2C**
 - EYETs activities of the experiments
- **Time limitation**
 - Not possible going through all activities -> to be followed-up
 - Current Status of PLAN: summary tables established

LHC Experiments



Introduction

A large number of activities is foreseen for the LHC Experiments in LS2

- ✓ either on the detector or on infrastructures,
- ✓ either in service or in experimental cavern

ALICE and LHCb will undergo major upgrades of the experiment

ATLAS and CMS pursue the upgrade in two phases, spread over 3 shutdowns with the most intense detector activities during LS3, but **vital preparations during LS2**

For ATLAS and CMS the “Usual” maintenance plan is not described here, however LS1 has proven that this **should not be underestimated**

- Significant impact on system resources
- Time availability at the end of the shutdown period when e.g, for ATLAS the detector is nearly closed to work on the Forward Region
- Possible downtime in detector commissioning because of disruptive infrastructure maintenance

These activities do not define the critical path of LS2. But they will add a significant amount of work during the shutdown.

History

- **Past presentations/discussions:**
 - LS2 days / Chamonix / LETEM / ECFA
- **Outcome**
 - helped showing/discussing the large work required
 - contributions by the collaboration (institutes) together with the required support from CERN
 - some of the activities are (almost) in parallel at all four sites, such as the beam pipe dismounting and re-installation
 - conclusion were/shall be made and action were/shall be taken by groups from EN/TE/BE/SMB and HSE together with the experiments
- **Planning**
 - EN-ACE provides master schedule frame -> facility coordinators to implement detailed implementation
- **Continued iterations on all levels and close planning are required**

Constraints

- HL-LHC (in construction phase + budget)
- **ATLAS & CMS (final definition phase in order to best exploit the physics potential of HL-LHC -> budget approval pending)**
- TDR's are being written now, will mostly be approved during 2017
- **EDR's (and thus the final specification of design) \geq 2018**
- Additional features are emerging in the design of the detectors, the facilities needed to build them and the supporting infrastructure -> leading to **requirement and planning changes** (likely to continue until after the TDR's are approved)
- **Some of these can/will have an impact on infrastructure and services, possibly also within LS2 activities** (e.g. for CMS, the tracker design now needs a new central beampipe and a proposed fast timing detector under discussion would require additional assembly space at Meyrin or Preveessin)

ALICE, LS2 upgrade scope



Motivation:

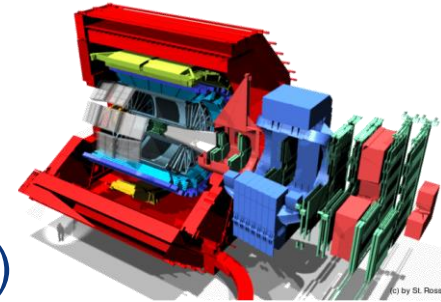
Focus on **high-precision measurements of rare probes** at low p_T

- cannot be selected by hardware trigger
- need to record **large sample of events**

Goal:

Pb-Pb recorded luminosity $\geq 10 \text{ nb}^{-1}$, (plus pp and p-Pb data)

- **8×10^{10} events to gain a factor 100 in statistics** over the Run1+Run2 programme



Strategy:

New Inner Tracking System (ITS)

- Read out all Pb-Pb interactions at a maximum rate of 50kHz (*i.e.* $L = 6 \times 10^{27} \text{ cm}^{-1} \text{ s}^{-1}$) upon a minimum bias trigger
- Perform online data reduction based on reconstruction of clusters and tracks
- Improve vertexing and tracking at low p_T

Electronic readout almost completely exchanged

ALICE Critical Activity Overview



- **EN-HE:**

- Transport interventions (10970)

Start/End: opening and dismantling/mounting -> transport team on critical path

- **EN-EL:**

- Fiber installation (11246-7-8-9, 10280)
- Powering O2 computing centre (10278)
- Cabling new ITS and MFT cooling plants (10284)

- **EN-ACE:**

- Survey during opening and closing of Experiment

Availability of survey team critical during the TPC upgrade (cleanroom and cavern)

- **EN-CV:**

- New ITS and MFT cooling plant (10284)
- New ITS/MFT dry air plant (10287)

- **TE-VSC, EN-MME:**

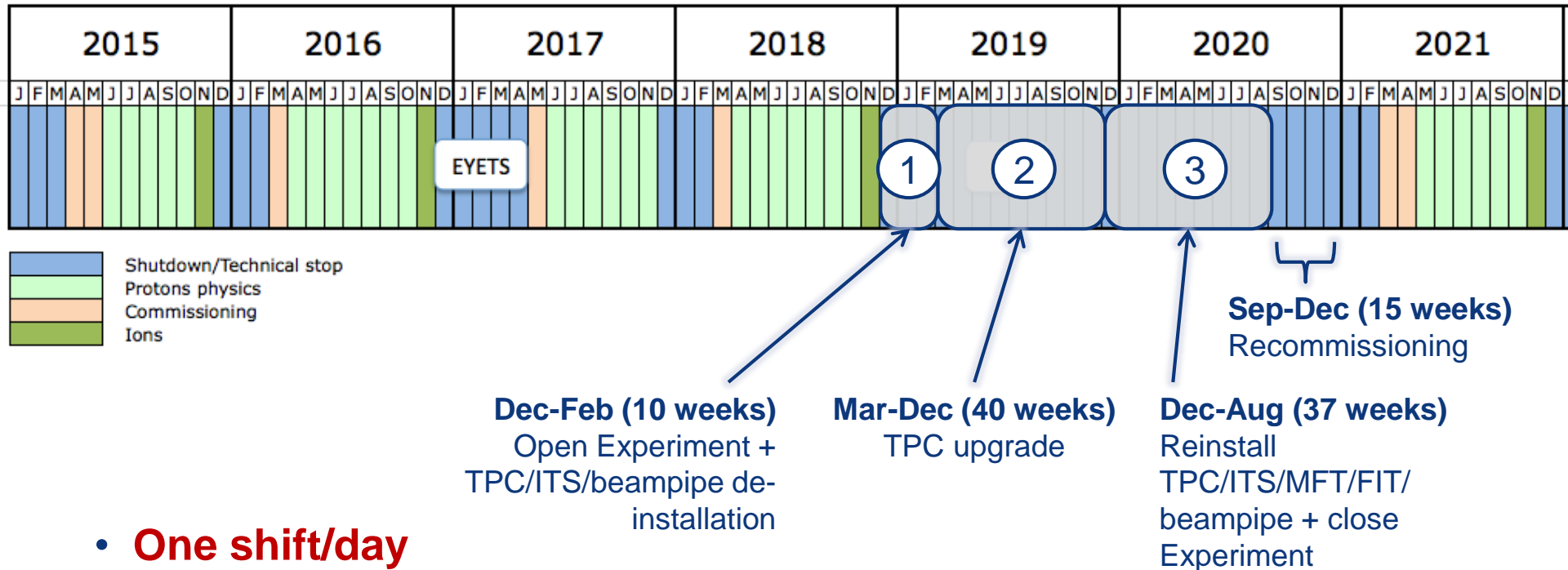
- New ALICE beampipe, removal/reinstallation RB24 beampipe (10281)
- Displace gauge from RB24 to RB26 (10971)
- Make ion pump in aluminum (10971)

Vacuum group on critical path for some activities
(e.g, dismantling and especially for the installation of the new beampipe and vacuum equipment)

- **EN-EA:**

- LV & signal cables for ITS/MFT/FIT detectors (10286)

ALICE LS2 schedule



- **One shift/day**
- **‘Long’ days foreseen for transport tasks**
- **24h/24 for few specific tasks (e.g. TPC RO tests)**
- **Tight but fitting**

ATLAS, LS2 upgrade scope



Motivation: maximize physics performance

- Precision measurements of Higgs coupling and other SM processes
- Search/investigate new Physics signals
- **Design choices driven mainly by physics considerations**

Goal:

Phase-I upgrades for $L=2-3 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ (about to start production)

- Improve the **trigger system** to maintain low LVL1 thresholds for muons and electrons
- Improve rate capability of **forward muon detectors**

LS2 Strategy:

Improve detector and readout system and prepare for LS3

- New Small Wheel & Calorimeter Trigger Electronics
- Trigger and DAQ upgrade and partial Barrel Inner Sector installation
- 2016-2017: FastTracker (FTK) Forward Proton detector (AFP)
- 2017: MDT installation in feet sectors (called BMG)
- 3-year detector maintenance

ATLAS, Impact on Schedule

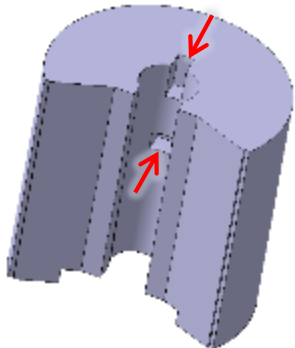
Courtesy G. Bregliozzi

Consolidation and maintenance

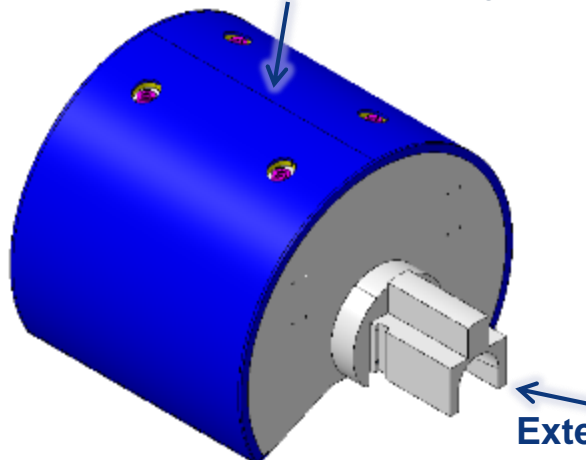
- VA vacuum chamber repair on C-side
- Gas leak repair of MDT EOL chamb.
- TGC chamber replacement
- Lift replacement (PM15 and PX15)

Possible anticipation of LS3 activities (under approval)

Machining of pockets in Cylindrical Shielding (activated steel)



JFC2 (unchanged)



- Forward Shielding modification to accommodate future VAX system
- Toroid shielding modification
- Beam pipe support to be shortened
- Machining of Nose shielding washer : in UX15, at 12m high from ground level

Extension to be added to existing JFC2

ATLAS Main Other Activities



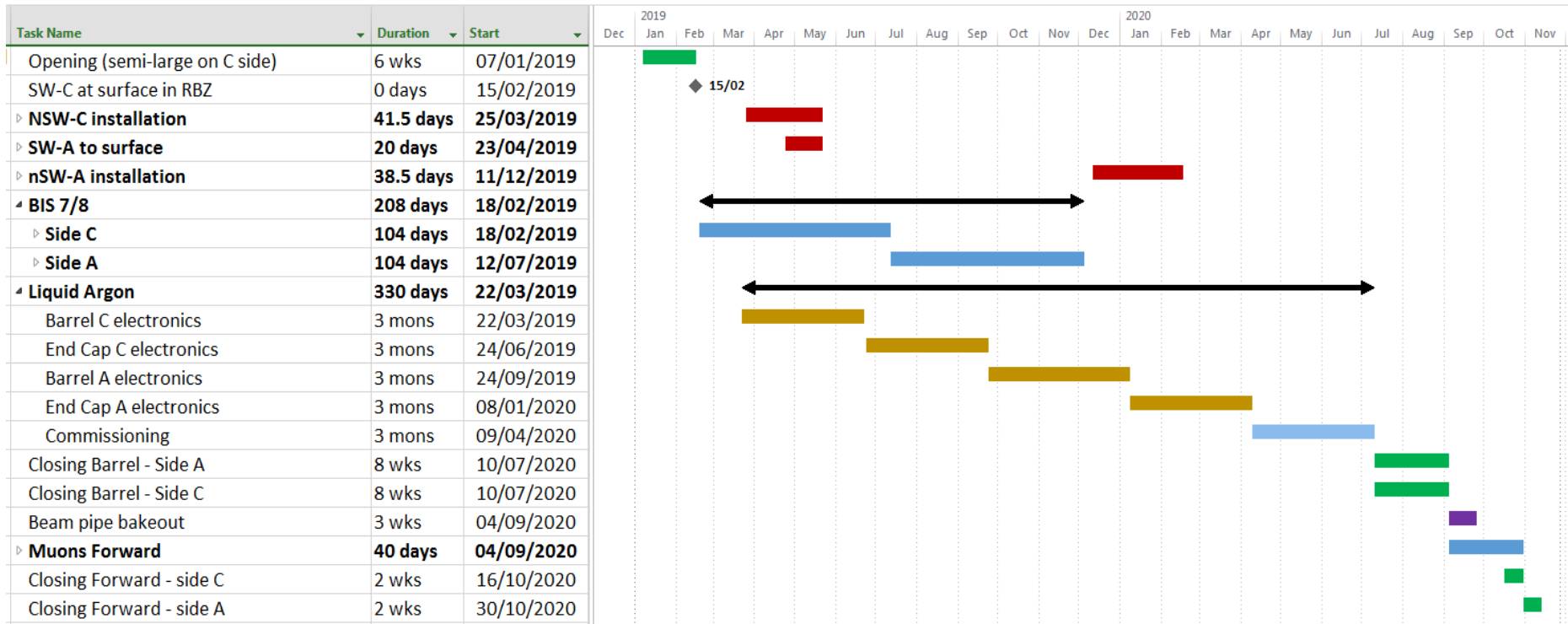
- TDAQ upgrade (Level 1 trigger, Dataflow)
- **SR1 extension is required, delivery expected by 2019**
- **UPS upgrade (1.5 MVA to 2 MVA)**
- Consolidation of central UPS distribution
- Refurbishment of EOD8 switchboard
- Independent power distribution to B. 3196
- **Cooling plant control system**
- Distribution of UX15 ventilation
- **Lift replacement**
 - The two main lifts at P1 will be replaced,
 - Temporarily lift will be installed → limited impact for ATLAS
 - PM15 at the very beginning of LS2 (Dec. 2018 – Feb. 2019)
 - PX15 at the very end of LS2 (Dec. 2020 – Feb. 2021) or eventually on the next YETS

ATLAS Main Other Activities



The schedule includes technical constraints such as:

- **End Cap Cal. activities are incompatible with Small Wheel craning**
- **BIS 7/8 installation not compatible with Small Wheel installations**
- Contingencies in the duration AND the organization between main tasks
- ALARA methodology is applied to every installation project
- **LS2 schedule is not seen as critical (relevant compared to LS1)**



ATLAS Critical Activities

- **Activities in Plan (mostly) done** (ok for EN-CV and EN-EL, but activities for MME have not yet been reported in PLAN) follow-up on-going
- **Most critical activity will be the installation of the New Small Wheel**
- **SR1 building enlargement important to be finished before LS2** not to impact the work of EN/CV during LS2
- CE and internal clean-room decision pending on purchase model (turn key or not)
 - **otherwise more support from SMB and EN required** (clean room electrical network, CV already active, etc.)
- **Possible required storage place in P1**
- Concurrent activities will be a concern (ex beam pipe dismounting/remounting and bake out, transports etc.)



CMS, LS2 upgrade scope

- It is not possible to upgrade the CMS phase I detector into the HL-LHC detector in a single 30 months shutdown
 - Large parts of the infrastructure at P5 have to be upgraded/changed
 - Parts of the upgraded infrastructure will be needed for testing/commissioning
- **Work in all coming shutdowns EYETS (2016/17), YETS(2017/18), LS2 (and then later LS3 and YETS in between)**

Main Criteria:

- Availability of the components
- ALARA
- The logistic configuration of CMS
- Possible impact of infrastructure upgrades on work at the detector
- Availability of resources
- **“5-year” detector maintenance (40-50% of activity) together with additional maintenance of services as during LS1**



CMS: upgrade scope after EYETS

New Tracker (LS3)

- Radiation tolerant - high granularity - less material
- Tracks in hardware trigger (L1)
- Coverage up to $\eta \sim 4$

Barrel ECAL (LS2 +LS3)

- Replace FE electronics
- Cool detector/APDs
- New infrastructure needed

Barrel HCAL (LS2)

- Replace HPD by SiPM
- Replace inner layers scint. tiles?

Trigger/DAQ

- L1 (hardware) with tracks and rate up ~ 750 kHz
- L1 Latency $12.5 \mu\text{s}$
- HLT output rate 7.5 kHz
- New DAQ hardware

Still in R&D

- Fast-timing for in-time pileup suppression

Muons (LS2 and LS3)

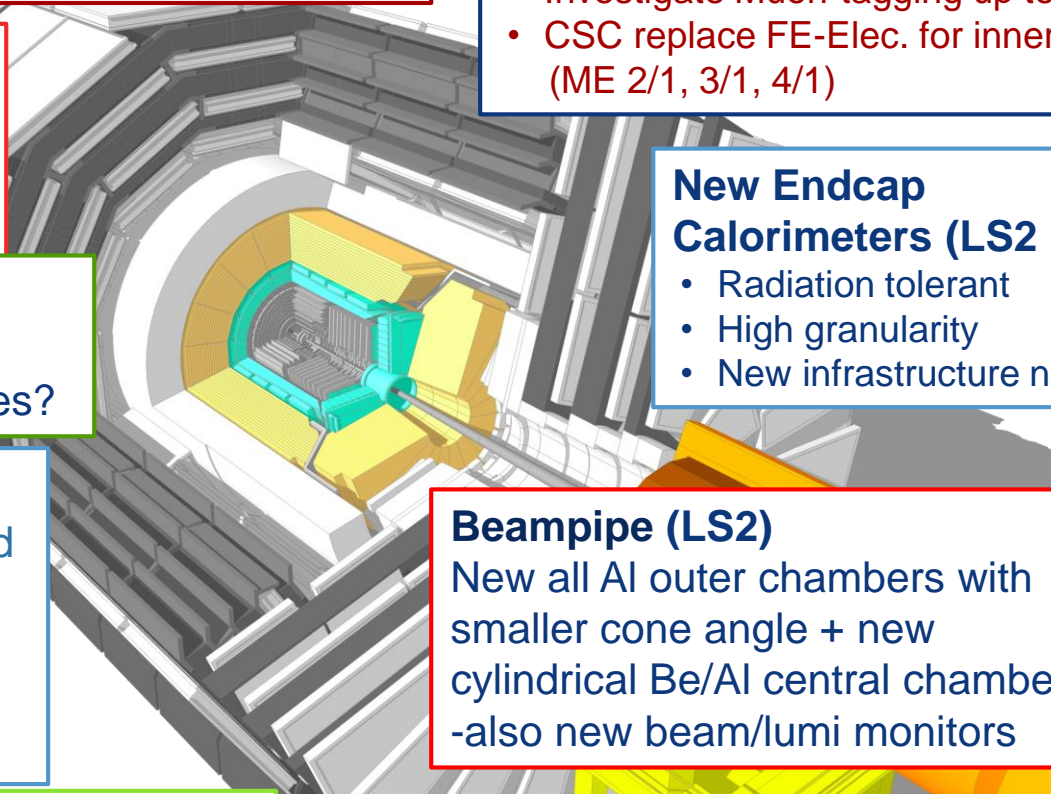
- Replace DT FE electronics
- Complete coverage in forward region (new GEM/RPC technology)
- Investigate Muon-tagging up to $\eta \sim 3$
- CSC replace FE-Elec. for inner rings (ME 2/1, 3/1, 4/1)

New Endcap Calorimeters (LS2 & LS3)

- Radiation tolerant
- High granularity
- New infrastructure needed

Beampipe (LS2)

New all Al outer chambers with smaller cone angle + new cylindrical Be/Al central chamber -also new beam/lumi monitors





CMS, Main Activities (Full Opening)

- **Many logistic configuration changes and work on the detector**
 - Upgrade readout of endcap muon stations ME2/1,3/1,4/1 (UXC,SX5)
 - New muon station GE1/1; Hadron Calorimeter Phase 1 upgrade: HB photo-transducers (if EYETS ok); Possible replacement of HE megatiles (16-17 data)
 - Install revised opening system and overhead YE1 cable gantry
- **Replace FULL beampipe chambers except FWD section & test RP shielding**
 - Phase 2 tracker needs new design of the whole pipe: **TE strong support, but financing of pre-purchases required** (before Phase 2 budget is available)
- **Major infrastructure revisions:**
 - **Underground HVAC control**, control room HVAC
 - Chilled water (**increase capacity**)
 - New cooling water production & distribution control system
 - Pneumatic control compressed air system revision.
 - Electrical distribution UPS expansion (extra 1.5MVA)
 - **Dry Gas (detector environment control) upgrade: possibly with new diesel backup**
 - Detector & rack safety systems upgrade
- **VAX/TAS region prep for HL-LHC revision in LS3**
- Surface buildings:
 - **Construction/Completion of SX5 building extension & SX5Z offices**
 - Complete SCX control room consolidation



CMS, LS2 Constraints

- **A new office building SX5Z to replace the barracks cleared for HL-LHC**
- **UXC: 2nd 20t crane bridge:**
 - Design by EN-HE with integration by CMS.
 - Quotes received within expected price range (ready to go at a few months notice)
 - Zoning/ cross-over control, radiation & field tolerance still being optimized
 - **Aiming for installation in YETS 2017-18 if possible – net benefit in LS2.**
- **Yoke opening system (Endcaps + Barrel): tendering close to final**
- **CO₂ plant for Phase-II Tracker and HGC**
 - conflict for USC space between cooling and electronics
 - check viability of displacing laser barracks below USCCR
 - structural reinforcement design & power/services routings
 - **highly advisable to do this in LS2 (example of Phase1 pix)**
- **Data-Centre bldg and UPS barn footprint**
 - CERN directorate/HSE



CMS, \leq LS2 and Urgent

- **Phase-II Beampipe (2020 installation):**
 - mandatory in LS2 (ALARA for LS3); requires freezing design very soon; strong preference for a unique solution working for LHC & HL-LHC
- **SX5X (1200m² building for workshops and storage of key tooling) must be ready by end of LS2 to set up the ECAL refurbishment & the endcap calorimeter new build for LS3**

(existing with brass absorber will be replaced by stainless steel)
- **Primary services required for LS3 - > can some be shifted to \leq LS2:**
 - Cooling, electrical distribution, dry gas...
 - **Some upgrades planned for LS3 are in conflict with HL-LHC surface construction/commissioning**
 - Need urgently clarification with CERN Technical groups
- During Run2:
 - **Replace PM54 elevator** (outside technical stops)
 - (Surface “battery barn” for UPS upgrades - on hold awaiting HSE decision)
 - **YETS 2017-18: Install 2nd UXC crane**

LHCb, LS2 upgrade scope

Motivation:

Limited by the detector, but not by the LHC

- Upgrade to extend Physics reach
- Exploit advances in detector technology
- Better utilize LHC capabilities

Goal:

recorded luminosity $\geq 50 \text{ nb}^{-1}$

- $L \sim 2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$
- Displaced Vertex Trigger, 40MHz readout

Strategy:

- ➔ Replacing almost all front-end electronics and several detector parts.
- ➔ Without Hardware Trigger
- ➔ Fully Software Trigger
- ➔ Electronic readout almost completely exchanged

LHCb, LS2 upgrade scope



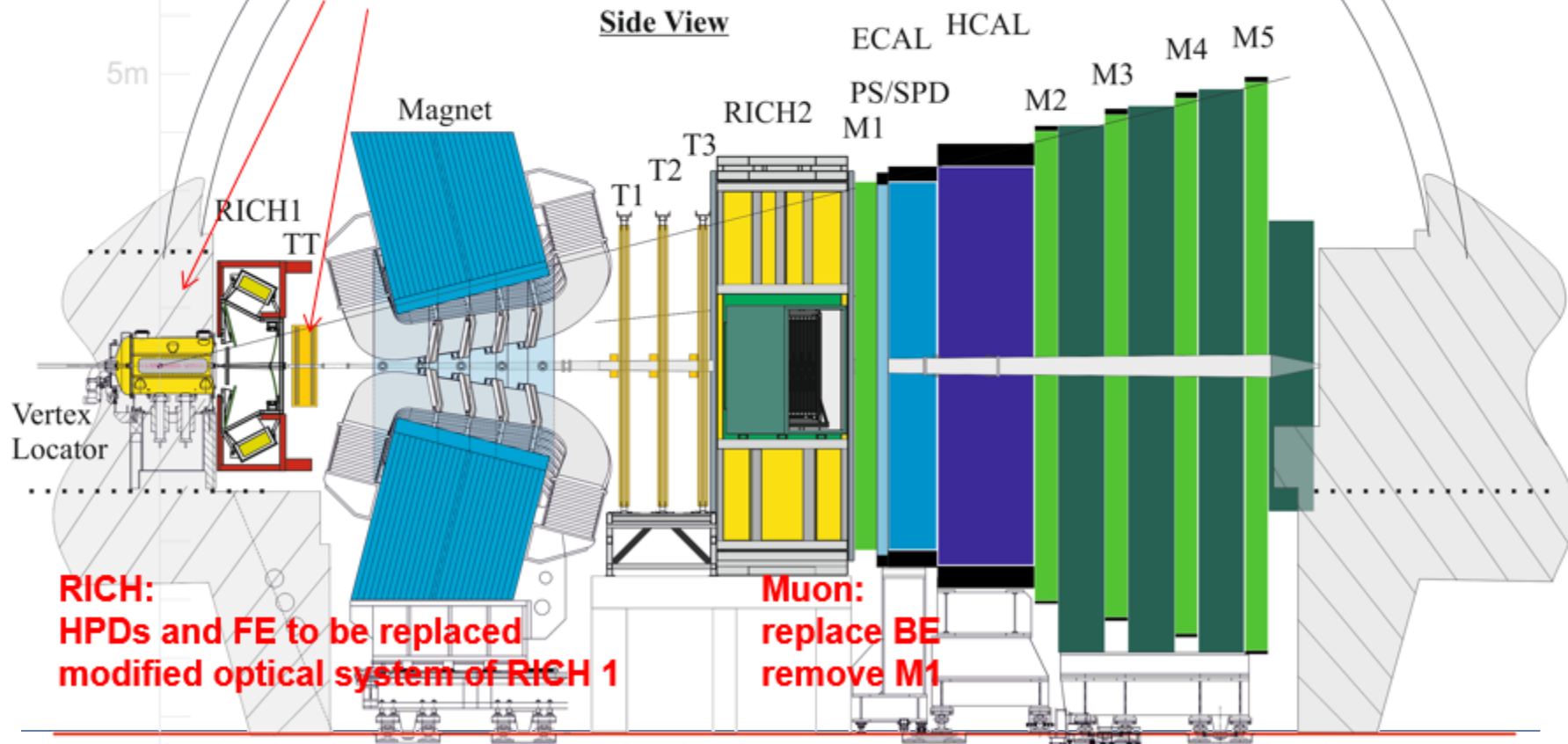
Outer Tracker/ Inner Tracker:
Replace with SciFi Tracker
Add shielding behind RICH

Replace read-out boards and DAQ network

Velo & TT:
Silicon sensors to be replaced

Calo:
replace FE
remove PS/SPD/Lead wall

Side View



RICH:
HPDs and FE to be replaced
modified optical system of RICH 1

Muon:
replace BE
remove M1

New detectors and r/o electronics

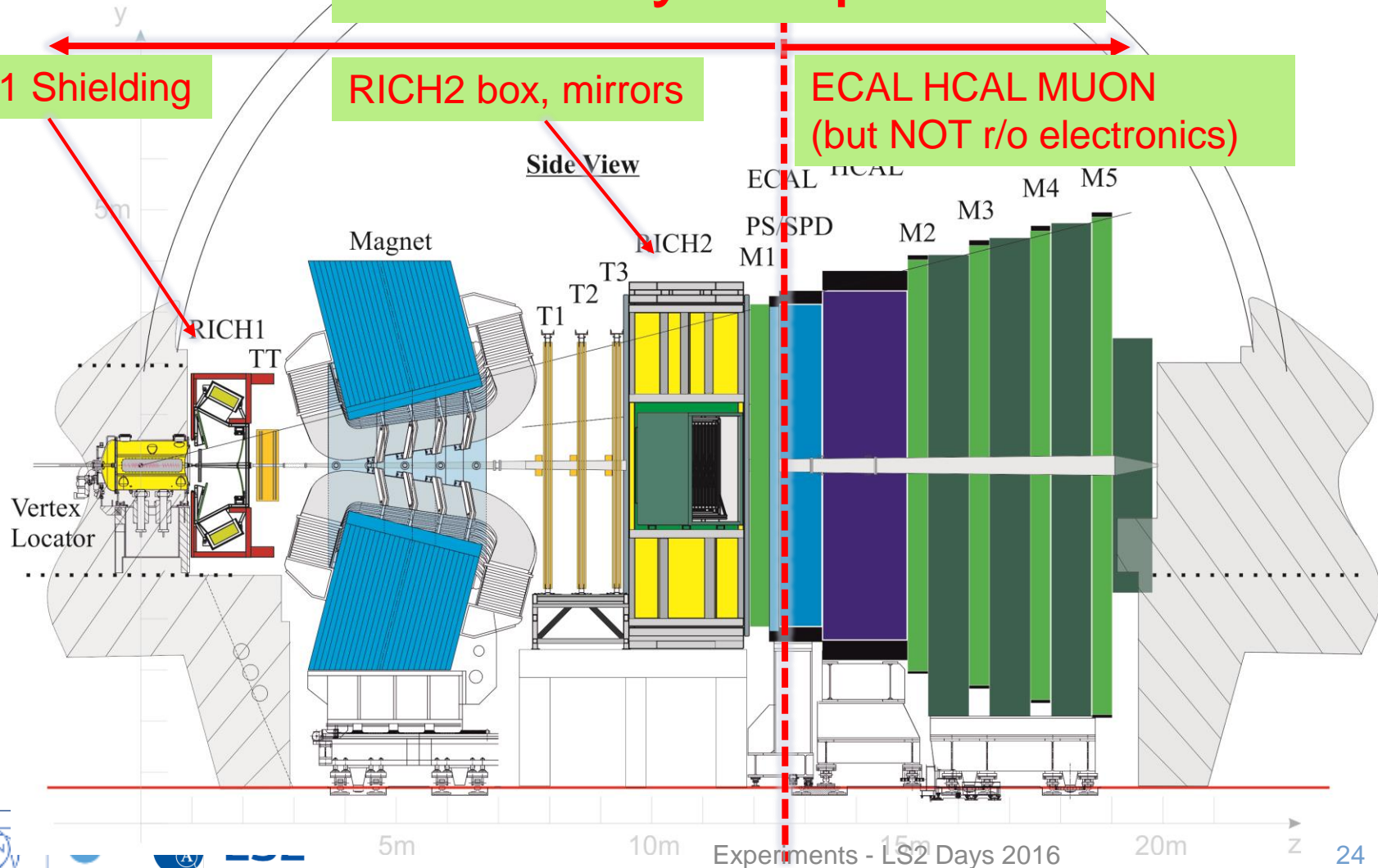
New r/o electronics

What stays in place?

RICH1 Shielding

RICH2 box, mirrors

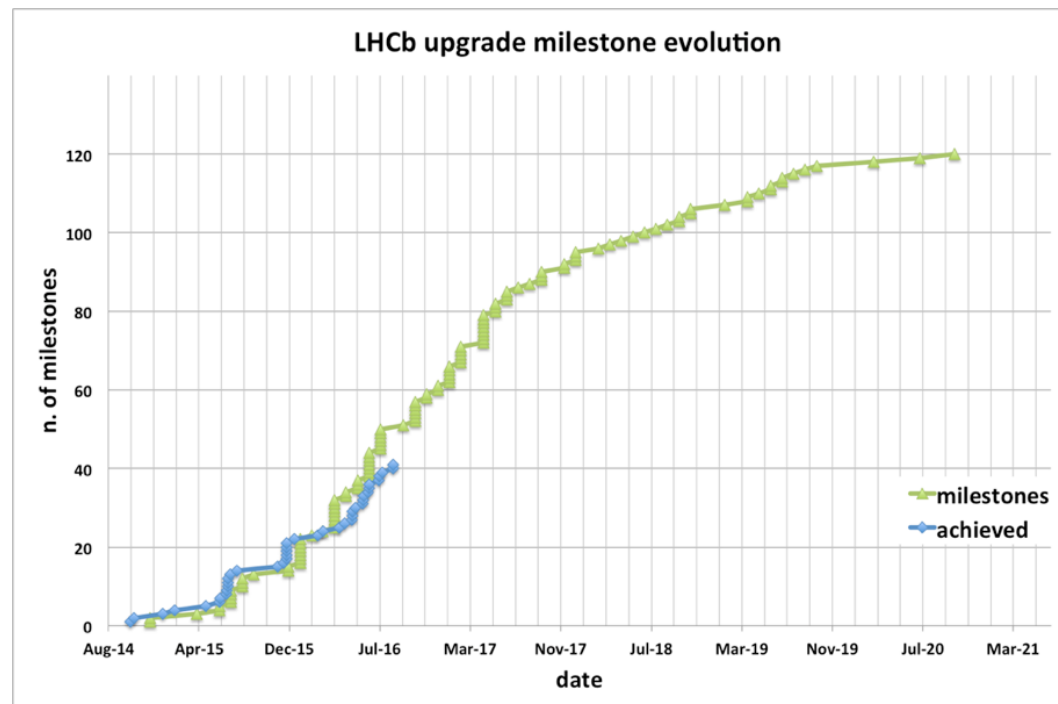
ECAL HCAL MUON
(but NOT r/o electronics)



LHCb Upgrade I construction on track



- **Prototypes exist for most major elements**
 - Engineering Design / Production Readiness Reviews done or being conducted
- **Crucial productions started (SciFi, ASICS, RICH mechanics)**
- First large production items delivered (MaPMTs, fibres for SciFi)
- **Internal upgrade comprehensive review early 2017**
 - Review critical aspects
 - Installation preparation
- **Construction project on milestone schedule**
- Milestones include construction
- Major industrial orders placed



LHCb Critical Activities



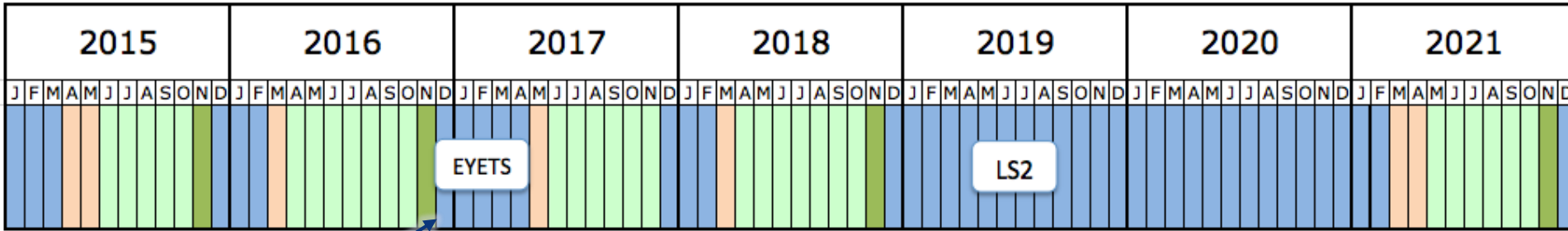
- **Quick opening of detector and start of dismantling (BP removal)**
- **Detector installation - most critical path:** strong correlations between UT/RICH1/VELO/BEAM PIPE
- Infrastructure
 - **storage** at point 8: fast removal of equipment from cavern required; additional storage required for the shielding wall.
 - **survey:** will be needed most of the time, or on short notice.
 - **transport:** some activities might need support from the transport even after normal working hours, in order to complete certain tasks
 - **storage** outside of point 8 during LS2 and some month after (activated and non activated), all information had been sent to Miguel as requested
- **LS2 Phase-I: Dismantling of services (e.g, shielding wall)**

LHCb Critical Activities



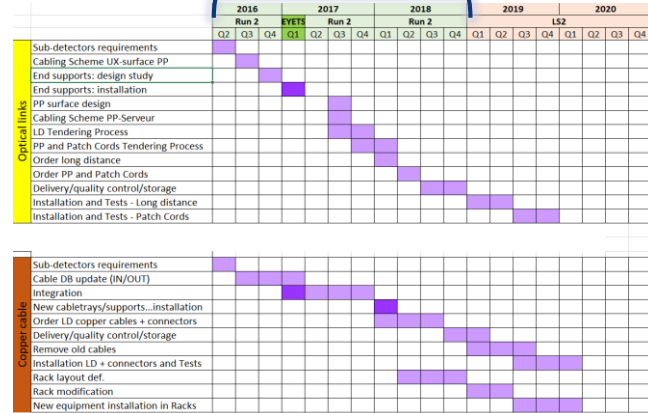
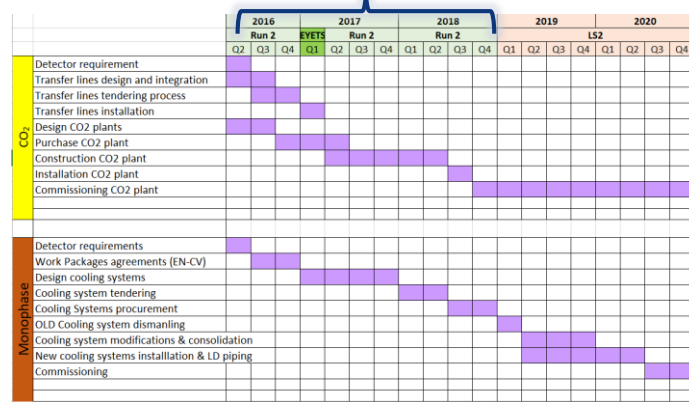
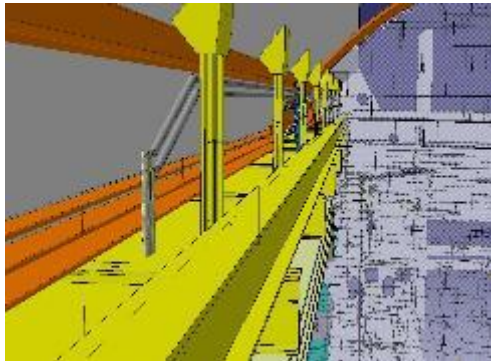
- Detector installation:
 - Detector assembling in surface facilities (SciFi, UT, VELO)
-> **Requires cooling and DAQ**
 - Tests & Survey
 - -> then descent and installation in the pit
- **Closing & Commissioning**
 - Final connection between detectors and services
 - Beam Pipe installation and Bake-out (section 1-4)
 - Closing LHCb detectors
 - Final survey and alignment of detectors
 - Commissioning
- **Success relies on strong involvement of Institutes + CERN**

Infrastructure & Services

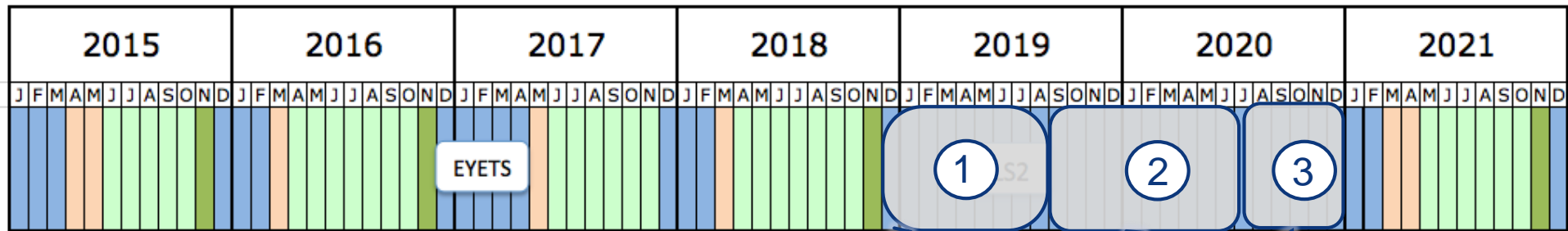


CO2 transfer lines (VELO-UT cooling)

Cooling plants, pipes, optical links, copper cables: specs, design, integration, procurement and installation



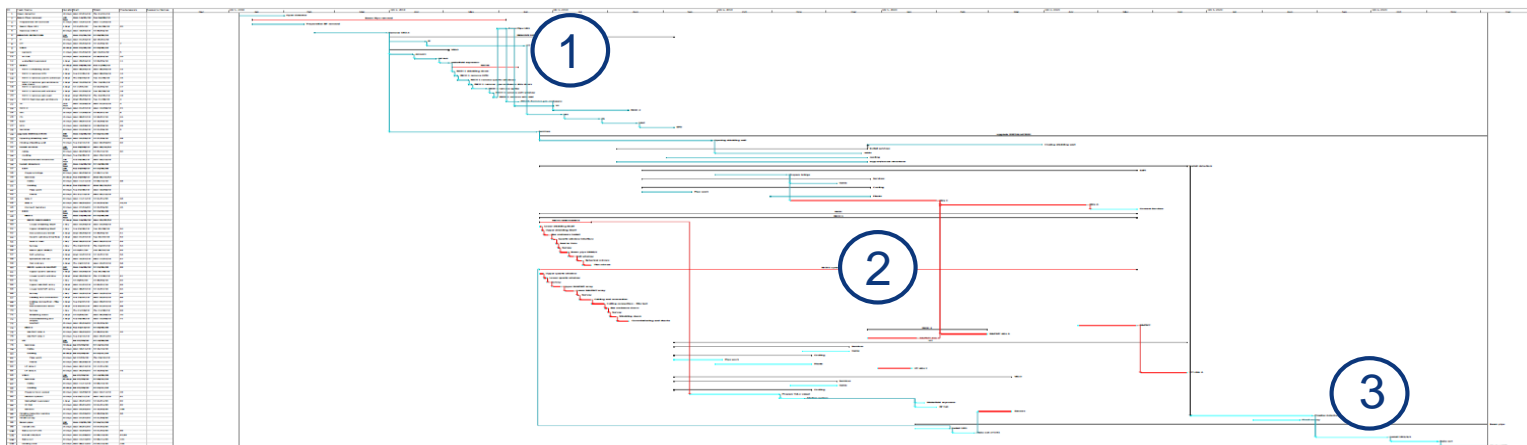
LS2 schedule: 3 phase



Dec19-Aug19
Open Experiment +
Dismantling

Sept19-Jul20
Install detectors
services

Jul20 Nov20
close Experiment
Survey
Recommissioning



Experiments - LS2 Days 2016

Common Services & Support

- **EN – Engineering Department**
 - Survey (detector assembly and positioning)
 - EL (power, copper cables, optical links)
 - CV (Detector and Data Center Cooling)
 - Handling,
 - Safety Coordination,
 - EA support
 - ...
- **TE – Technology Department**
 - Vacuum Chamber and Equipment
 - ...
- **HSE – Radioprotection**
 - Radioprotection
 - ...

Common Constraints

- **Technical and Planning follow-up**
 - 'contact persons' in the experiment for each subject: CV, EL, vacuum, etc, who stay in close **contact with the colleagues in the corresponding groups in the technical sector**
 - scheduling and coordination with other activities/resources passes through the established **EAM (experimental area management team)** of the experiments
- **Safety coordination**
 - Groups from different departments are working together on specific projects – **responsibility/support for safety?**
 - Discussion already during last LS2 days
- **Working detector environment & Radio Protection**
 - Most cases, no dead time taken into account for radiation cooling time
 - Protection of personnel – risk assessment prior any destructive work
 - Logistic – waste sorting – waste disposal

Going Further

- Status in PLAN already very good and detailed iterations between service groups and experiments ongoing
 - **Important to focus on critical activities, with an iteration in the coming weeks/months and a regular follow-up**
- Planning based on master schedule frame and facility coordinators implement detailed versions – **follow-up required!**
- In LS1 the experiments have taken over several responsibilities, which were before partly followed by the technical sector
 - at least for LHCb, during **LS2 this coordination is not possible due to missing resources to coordinate between groups** from the T Sectors (as partly done in LS1)
 - Overall support: can one improve (not necessarily the quality, but the **quantity**) of support?

Continued iterations (all levels) and close planning required!

Non-LHC Experiments and Experimental Areas

EYETS Main Activities

North Area

- **TCC2/TDC2**
 - Crane maintenance BA80 surface, TCC2 537 et 544
 - Maintenance UPS, sprinkler, fire detection, extinguisher
 - Maintenance CV
 - **Collimators replacement**
- **EHN1, EHN2, ECN3**
 - Buffer zone for the target areas to be built (2017)
 - **Gas detection system in EHN1 (consolidation and GIF++)**
 - Electrical consolidation for EHN1 (consolidation and NP)
 - Lighting maintenance gallery
 - **SBA equipment maintenance**
 - Cabling
 - Area 182 and 164 installation for EHN1 NP
 - **XTDV installation (GIF, end H2, end H4)**
 - XCHV replacement (K12)
 - Squid T10 works (K12)

EYETS Main Activities

HiRadMat

- **He exhaust line installation**
- Tank TJ7 shielding consolidation
- **Beam instrumentation**

AD

- **ALPHA/ASACUSA extension**
- **ELENA electron cooler installation**
- **ELENA vacuum commissioning**
- AD ring: BHN33 magnets refurbishment

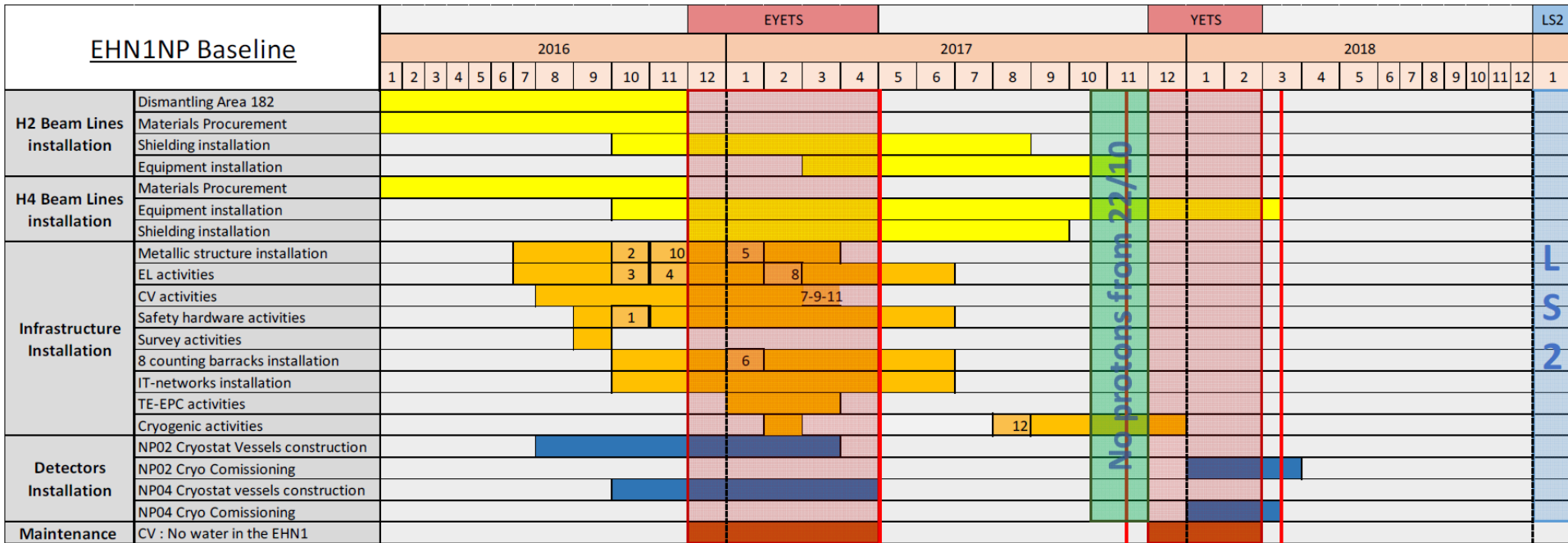
AWAKE

- Electron acceleration phase installation (electron source, electron beam line, detectors, services, etc...)

North Area Consolidation

- **Focus on urgent consolidation items:**
 - Power Converter exchange for SM2/Compass (EYETS 2016-2017)
 - TDC2/TCC2:
 - Irradiated cabling campaign (LS2)
 - Magnet cooling circuit (LS2)
 - EN-CV: chilled water circuit, AHU, cooling tower and stations refurbishment; TCC2/TDC2 control system renewal (2017/18)
 - EN-EA: renovation of ~40 collimators until end of LS2
 - GS-ASE will consolidate the underground gallery access system in EHN1 (YETS 2015-2016 + EYETS 2016)
 - EHN1 extension involves some consolidation of the general infrastructure (EN-EL, EN-CV, EN-HE)
 - **Additional activities currently under study (focus on LS2-3 reliable operation and User requirements)**

NA and EHN1 Extension <LS2



Access to NP04 pit (Quay installation)

H2 commissioning with beam

H4 commissioning with beam

No protons from 22/10

- 1 : All PPE and PPX doors (mechanics)
- 2 : All building doors (mechanics)
- 3 : Lights
- 4 : Cable trays in the trenches
- 5 : Access system including IMPACT (susy) after IT installation & cable campaign
- 6 : Baracks installed

- 7 : Building ventilation
- 8 : Electricity in the barracks
- 9 : Water cooling in 2 baracks for computing
- 10 : Mechanical platforms to reach the top of the detectors
- 11 : LAr extraction in the pits
- 12 : Cryogenics areas ready for installation

Several activities on critical path for 2018 operation, challenging for experiment assembly and infrastructure

NA consolidation : EN-CV infrastructure

- YETS 2015-2016:
 - Ventilation units in the NA PC rooms (BA81)
 - Chilled water (BA82)
 - Chilled water coils in AHU's (BA82)
- EYETS 2016-2017:
 - Chilled water circuits in EHN1
 - Ventilation units in the NA PC rooms (BA82)
 - AHU consolidation in NA surface buildings & BA80, 81 and 82
- YETS 2017-2018
 - **Cooling towers control**
 - **Chilled water circuits in TT85**
- **LS2**
 - **Chilled water circuits in TT81 and TT82**



NA Consolidation: TDC2/TCC2

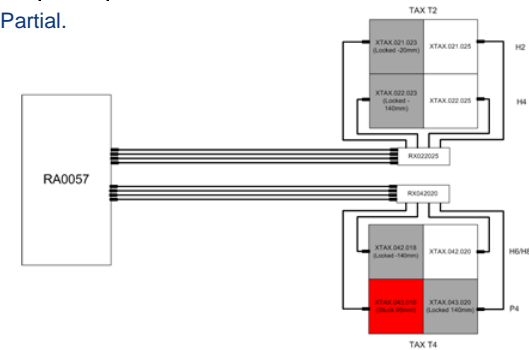
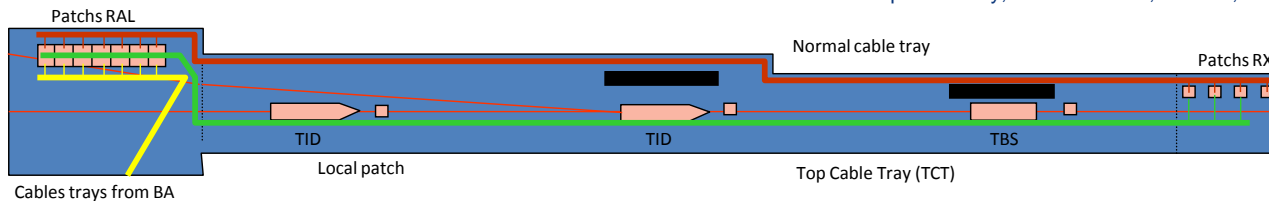
- Irradiated cabling campaign (end of LS2, 2020)**

- Replace irradiated cables, avoid unnecessary cable length, **eliminate cable with PVC if possible**
- Only signal and control cables (not DC cables) between patch RAL and Patch RX
- 700 cables = 100 km in TCC2/TDC2 for the time being
- End user to fill a DIC if additional request

Areas	1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09
TS1	All					All								TCT						
TS2	ZS/MST/ MSE			All		ZS/MST/V ac				Exc TCT										Exc TCT
TCC2			All								AA		R							
TDC2			All								All									
TS4										Part										
TS6	ZS/MST/ MSE	Exc TCT	TCT			Exc TCT			Vac exc TCT	TCT						Rem. ZS, Inst MKE				
TT60							All													
TCC6							All													
TNC			All																	



TCT: Top cable tray, AA: Almost All, R: Rest, Part: Partial.



Courtesy J-C. Guillaume

NA consolidation - Collimation

- Support needed from:
 - Survey (EN-ACE)
 - Controls (EN-STI)
 - Transport (EN-HE)
 - Radioprotection (DGS-RP)
- Schedule:
 - TCC2: 7 units in EYETS
 - **Transfer lines, TT81 to 85**
 - **20 units in LS2**



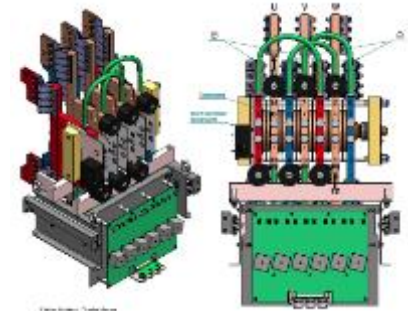
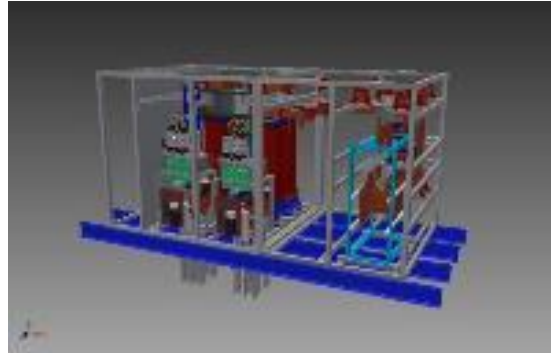
XCSV or H: Collimator Slit
Vertical or Horizontal:
25 units



XCHV: Collimator twin
Vertical+Horizontal:
19 units

SM2 / COMPASS (M2) - EYETS

Old NR41-001 power converter replaced by a new one during EYETS16-17



Technical specification: EDMS1513983

The old NR41-001 will be kept as a backup

SPS Thyristor Bridges (ARCEL)

Oil transformer replacement by SPS dry transformer (TMC)



5000A/600V
Water cooling
RegFGC3

	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17
Transformer installation	█	█	█				
Finishing Electronic, cables...	█	█	█				
Finishing Documentation	█	█	█				
Cubicle installation				█			
EN-EL installation				█	█	█	
Cooling installation				█	█		
Power Converter construction				█	█	█	
Electronic reception				█	█	█	
Electronic FGC3 commissioning						█	█
Power converter commissioning						█	█

Other: EHN2: SUSI; ECN3: vacuum valves to isolate GTK

NA-CONS Items in PLAN

ID	Title	Group	Responsible	Type	Priority	Group contribution	Comments
11006	Maintenance cooling supply TCC2	TE-MSC	P. Catherine	Preventive maintenance	4. Approved projects	EN-CV, EN-STI, HSE-RP	25% of resources missing
11005	General maintenance North Area/TCC2	TE-MSC	P. Catherine	Preventive maintenance	4. Approved projects		
11004	Test and Inspection North Area / TCC2	TE-MSC	P. Catherine	Inspection	4. Approved projects	BE-OP	
10778	Install - Red Telephones & Hard. Safety Alarm insfr. (MMD, CSAM) - SHIP (?)	BE-ICS	S. Grau	New	1. Safety	EN-EL, HSE-SEE, IT-CS	25% not yet validated, 60% of resources missing
10773	Renovation - Fixed Gas-ODH Det. - SGGAZ- 00146-MX62 - EHN2-Z. 9 - by new SYNTEL EHN2 loop	BE-ICS	S. Grau	Upgrade	4a. Approved project if budgeted	EN-EL, HSE-SEE	
10772	Renovation - Fixed Gas-ODH Det. - EHN1 et Z. Nord Infrastructure - by new SYNTEL	BE-ICS	S. Grau	Upgrade	4a. Approved project if budgeted	EN-EL, HSE-SEE	
10761	Install - Fixed ODH Detection - Extension Hall EHN1 - SYNTEL Deported conn. box + Detectors + Actions	BE-ICS	S. Grau	New	4. Approved projects	EN-EA, EN-EL, HSE-SEE, IT-CS	
10760	Install - Fixed Gas-ODH Detection - GIF - SYNTEL Deported conn. box + Detectors + Actions	BE-ICS	S. Grau	New	1. Safety	EN-EA-EC, EN-EL, HSE-SEE, IT-CS	
10749	Renovation - Fire Detection & Evacuation - SFDIN-00278 - N.VEGA - Zone 13 (TDC2-TCC2-BA80)- by new CASSIOPE	BE-ICS	S. Grau	Consolidation	1. Safety	EN-EL, HSE-SEE	33% of resources missing
10748	Renovation - Fire Detection & Evacuation - SFDIN-00268- N.VEGA Zone 9 (ECN3-BA82-EHN2) - by new CASSIOPE	BE-ICS	S. Grau	Consolidation	1. Safety	EN-EL, HSE-SEE	33% of resources missing
10734	Install - Fire detection & Evacuation - Extension Hall EHN1	BE-ICS	S. Grau	Upgrade	1. Safety	EN-EL, HSE-SEE	
10726	Renovation - Beam Imminent Warning & Evacuation system - SPS North Area - Powering , sirens, BGLA, cables	BE-ICS	S. Grau	Upgrade	1. Safety	EN-EL, HSE-SEE	25% of resources missing
10370	Supply new converter for Compass SM2 Spectrometer in North Area	TE-EPC	X. Genillon	Consolidation	4. Approved projects	BE-OP, EN-CV, EN-EL, EN-HE-HH, SMB-SE, TE-MSC	
10230	Renovations in the ENH1 area (Roofs, etc.)	SMB-SE	F. Magnin	Consolidation	4a. Approved project if budgeted		
10178	GCS NA62 PLC upgrade (1PLC)	BE-ICS	E. B. Vinuela	Upgrade	4a. Approved project if budgeted		

First status ok, but some activities missing or to be updated!

EA/NA Other Activities

- **COMPASS**

- YETS: Transform to Drell-Yan layout
- Modify absorber shielding?
- 2017, YETS: CEDAR upgrade
- Improve thermal insulation and airconditioning in EHN2

- **NA62**

- EYETS: Install two vacuum valves to isolate each GTK
- CEDAR commissioning for Hydrogen (pending test this year)

- **PBC** recommendation and new experiments

- **Few studies possible in \leq LS2 scope (contact with working groups established)**
 - E.g, for DM search install fixed (water-cooled) dump (after K12-BEND3) and remove two quads to make space

AD LS2 Activities and Requirements

- **AD transfer lines dismantling / ELENA's TL installation** (PLAN insertion on-going)
- All experiments require simultaneous **availability of infrastructure / services, for periods of 1-2 months** minimum
- BHN magnets repair (exact number not known yet)
- **IHe / IN₂ fixed distribution line installation ?**
- ALPHA control room upgrade
- BASE exp area enlargement
- AEGIS removal to new experimental area, ECR pending
- Consequently: redeployment of **ASACUSA laser and control rooms**, addition of storage area over the laser room
- **Experimental setup modifications** (ALPHA G, ASACUSA 2nd BL)

AD ELENA LS2 Activities

- **Installation of new low-energy beam lines for all experimental areas (03/19 – 05/20)**
- Commissioning using the Ion source.
- Re-location of **AEGIS zone to new area** near ELENA ring, includes modification of ASACUSA laser hut
- N.B.: **ELENA machine development can be done during LS2 using local ion source**, need services. Periods to be defined based on commissioning experience
- **ALPHA & ASACUSA control rooms to barracks outside AD hall**
- **BASE: need services (power, He delivery) throughout LS2** (but can survive short periods using battery back-up power)
- **Gbar: needs a number of 1-2 month periods with all services available**
- **ALPHA/AEGIS: need stable conditions with services available during 2nd half of LS2** rather than 1st half
- N.B. **All users need to be warned well ahead of any stop of services** (Cooling water, El., He) and major work in the hall. We should also aim to plan services stops to coincide with each other

AD Consolidation LS2 Activities

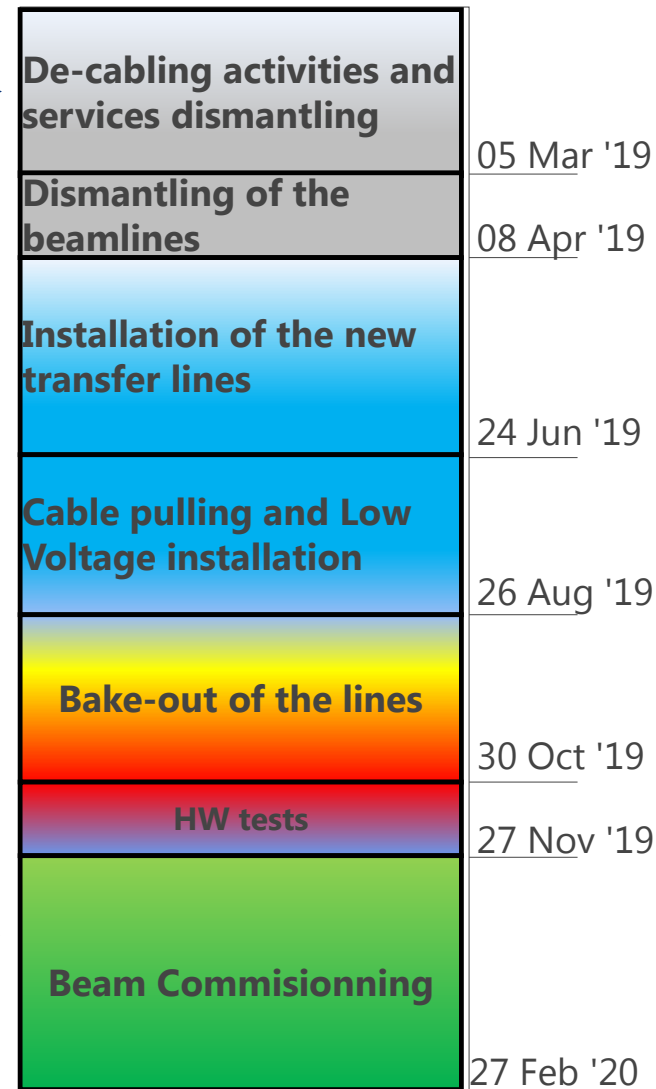
- AD Target area renovation: see talk by M.Calviani
- Current plan for AD Ring and related equipment includes:
 - BE/BI: Installation of **new electron cooler**
 - BE/RF: C02, replace existing cavity with Finemet
 - BE/RF: C02, new DSP Low-Level (TBC)
 - BE/RF: C10, Refurbishment of **TH116 valves, Thales will confirm feasibility**
 - TE/EPC: New capacitor discharge converters for transfer lines
 - BE/RF: Stochastic cooling, Renovation of power amplifiers (TBC)
 - EN/CV: AD hall cooling/ventilation upgrade (TBC)
 - etc.

Connection of ELENA

Start ASAP in LS2 to maximize commissioning time

- EN-EL : ~ 2 months, TE-MSD : ~ 2wks →
- EN-HE : ~ 1 month (Supervision from TE-MSD, TE-VSD, EN-MME) →
- EN-HE : ~ 2,5 months, EN-ACE-SU : ~1,25month, EN-MME : ~1,5month, TE-VSD : ~1,75month (Supervision from TE-ABT) →
- EN-EL-FC : ~ 2 months, EN-EL-BT : ~ 3wks →
- TE-VSD : ~2,5months →
- 4 weeks for hardware commissioning : TE-ABT, TE-EPC →
- Beam commissioning with the H+/- Source: BE-OP : ~3months →

Start : 01/01/2019



Finish : 13/02/2020

On-going implementation in PLAN

Target Area: Frontends

- The two existing Frontends (**GPS & HRS**) will come to **the end of their expected lifetime during the LS2 period.**
- LS2 will provide a significant cool down period to **minimise collective dose rates**
- The opportunity will be taken to **improve on design features and upgrades**
 - Beam instrumentation
 - Extraction electrode controls
 - Local cable replacement
 - Beam line modification

Main groups involved:

EN-STI-RBS/ECE

TE-VSC

EN-ACE-SU

TE-EPC

DGS-RP

Assembly and installation to be done mainly by

EN-STI-RBS

Projection

2016: Review of design

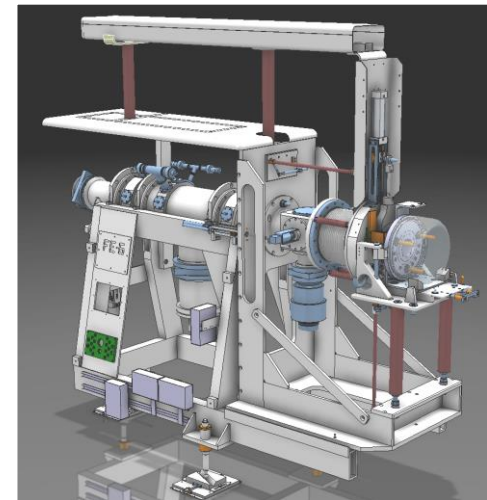
2017: Procurement

2018: assembly

2019: testing

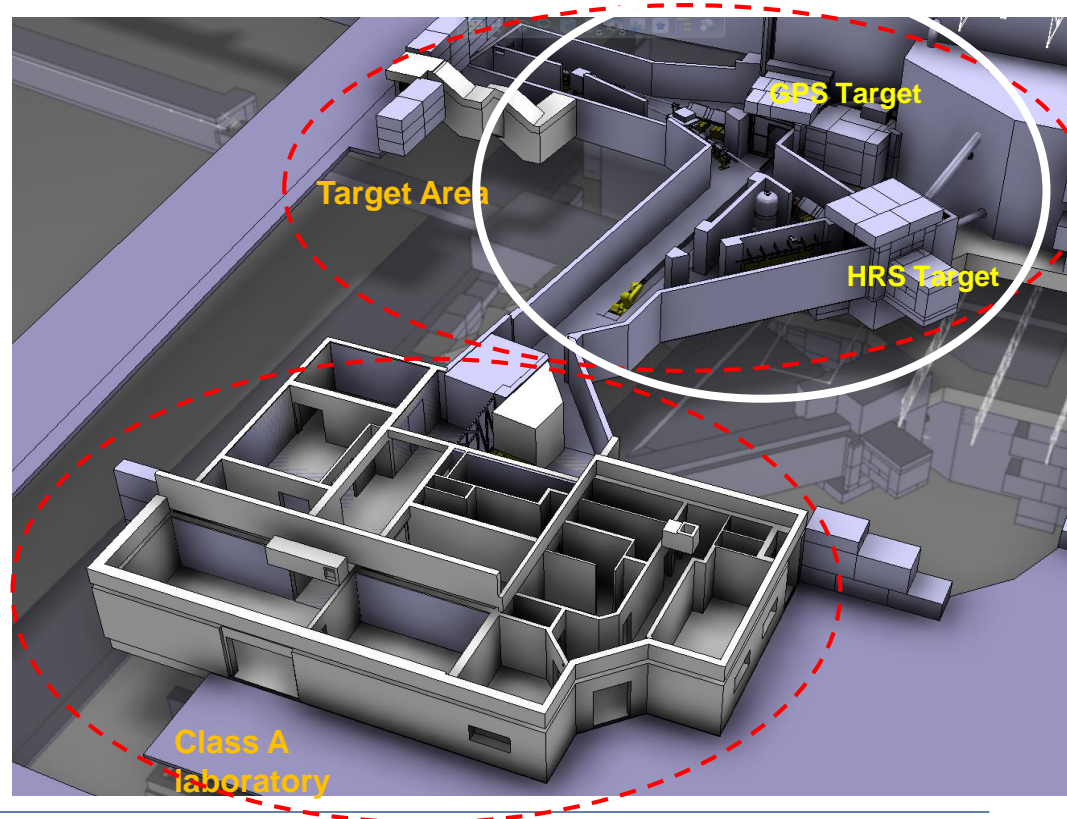
2020: installation 1er semester

2020: Testing 2eme semester



Target Area: Ventilation

- **Refurbishment of target area ventilation system and its controls** (managed by EN-CV)
- No open source exposure during CV work (i.e. opening of beam lines)
 - Will impact new Frontend installation
 - Possibly impact target changes.



Experiment Hall: Beam line alignment

Eliminate irregularities in beam line alignment to **improve transmission of secondary beams to experiments**

Proposed to the ISOLDE Collaboration Committee and agreed two weeks ago

Some experiments have little margin for manoeuvre

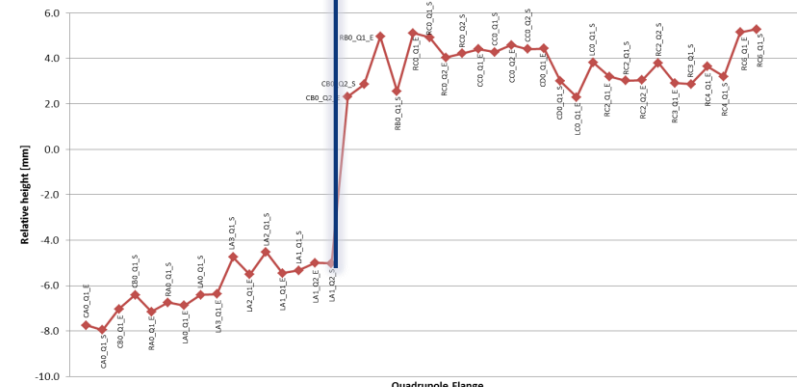
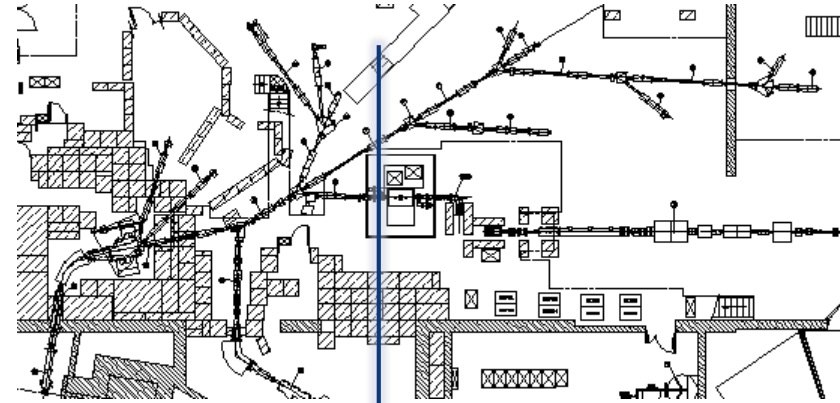
Main groups involved: EN-SU, TE-VSC

Preferred schedule:

- **1st semester of 2020 to maximize radioactive cooling in secondary zones**

Survey support requested for 1 or 2 experiments by users

Does not impact REX/HIE alignment



10mm step in vertical direction

HIE-ISOLDE Cryogenics

- **Preventive maintenance** of the cryogenic system including major overhauling of rotating machinery
- Cryo operation: setup of the automatic controls for transient modes
- **(Potential) consolidation of cryo plant and/or of cryogenic distribution system** [study + IEFC iteration]
- Potential new project: **installation of a LN₂ auxiliary cooling system:**
 - pre-cooler system including an He/N₂ heat exchanger
 - a helium circulator
 - a LN₂ dewar
 - and the associated control system
- **Services which need to be available for the system**
 - Cooling water
 - Electrical power
 - Compressed air
- Installation of Liquid/Gas Helium phase separator on the cryogenic distribution line (tbc)

HIE-ISOLDE RF

- CM1 (if not done before): solenoid short circuit on current leads and rinsing
- CM2 (if not done before): repair of vacuum/He leak
- CM3: replace existing cavities with better performing ones in case of insufficient cryogenic power for operating with 4 cryomodules (tbc)
 - **Refurbishment of a CM is resource intensive (clean room technicians, RF technicians/engineers, vacuum, transport and survey) and possibly interferes with LHC and HL-LHC crab cavity requirements**
- **HIE-LINAC-BI: to be validated by BE/BI**
 - Upgrade or installation of additional beam diagnostics (emittance meter, etc...)
- **REX consolidation:**
 - RF cavities
 - LLRF and power RF systems
 - Vacuum
 - Beam instrumentation
 - Warm magnets and interlocks

Operations during LS2

At present, ISOLDE is the only facility in Europe providing a wide variety of radioactive ion beams for the nuclear physics community. **LS2 implies an important 2 year break in the European nuclear physics program...but:**

- **The ISOLDE Facility can operate in stand-alone mode** (if services are available)
- Produce stable beam for beam transport exercises to experiments and testing of new FEs: **much needed for HIE-ISOLDE and following beam line re-alignment**

“Winter Physics”

- Produce radioactive **ion beams from imported long-lived sources**
 - Eg. ${}^7\text{Be}$, ${}^{44}\text{Ti}$ as done in the past
- Produce radioactive ion beams **from previously irradiated ISOLDE target units**
 - After irradiation at room temperature, the targets are heated to release long-lived species
- **It's important to know options** (even for a few months in 2019 or on ‘best effort’) in order to **allow going through official approval channels** for each experiment (including INTC/RB) - there will be a lot of happy and keen users.

Starting up in mid-2020 is very important (OP included).

- We will have a completely re-aligned machine and new FE's.
- Also HIE will be in much need of dedicated stable beam time.

Operations during LS2

Proposed schedule

- **Requires all services as during normal operation**
- BI, controls, CV, vacuum etc
- **Requires all services as during normal operation with the exception of ventilation**
 - Minimum RP requirements

Winter physics

Little activity at ISOLDE due to radioactive cool down



Start and end dates to be defined



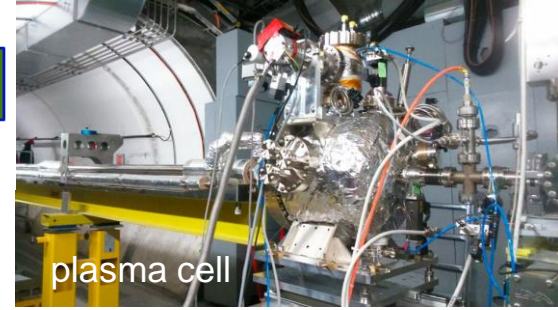
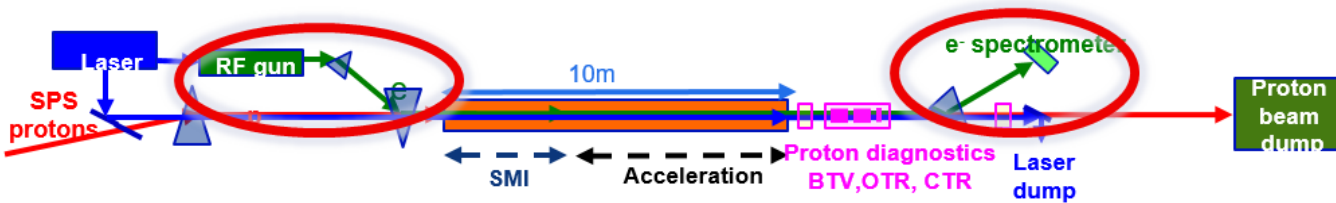
Cold check out

Stable beam exercises
Testing of FEs

AWAKE

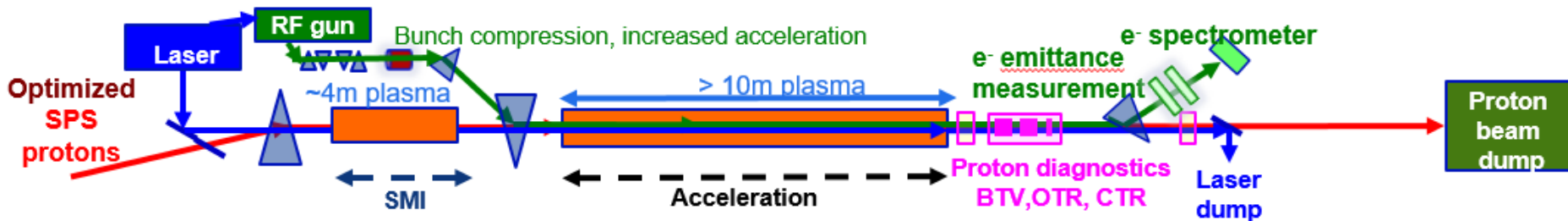


- During **EYETS 2016/17: AWAKE Run 1**: electron acceleration phase installation (electron source, electron beam line, detectors, services, etc...)



- **LS2: Design Study for AWAKE Run 2 (>LS2)**
 → **Prepare proposal by end 2017**

- Works required during **LS2 defined by end 2017** (e.g. beam line modifications, 2 plasma cells, services, CNGS target area removal, etc...)
- In addition, **operation of facility during LS2** foreseen (electron, laser beam, experimental equipment...)



LS2 activities:

With the expected LIU intensities and emittances after LS2, it is required reviewing and potentially upgrading:

- **Intercepting beam instrumentation**
- **Vacuum window**
- **Dump and window**
- **Patch cabling from TNC to TT61**

Preparation & Studies to be performed

HiRadMat Upgrade list (Other)

- **Beam sigma measurement** at experiment for full intensity/density range (required until early 2017)
- Technical **infrastructure for cryogenic experiments** (2017)
- General target (common design) containment for destructive/survival tests as facility service
- Common (and larger) scanning table for experiments
- Common monitoring/DAQ as facility service and support
- **Hot cell for PIE (option with PSI exists)**
- increase beam availability by decoupling HiRadMat from LHC injection: upgrade power converters of extraction line (during LS2, TE/EPC, 400-800 kChF)

see EDMS 1709921 for details

Summary (non-LHC Experiments)

- **Significant number of activities** – Coordination to be maintained and even further improved
- **Importance of consolidation projects** (see also Sebastien's and Marco's talks) -> close activity follow-up required
- **Several areas/experiments concerned about the availability of services (and resources), thus operation during LS2** – for data taking, etc.: EA (CLOUD), AD (most of the experiments), ISOLDE/HIE-ISOLDE, AWAKE
- **North-Area: consolidation activities focus on 'urgent' activities in view of LS2 and beyond**
 - Strong focus for 2017 required
- **PBC working groups** possibly triggering study projects



ENGINEERING
DEPARTMENT