



BE-BI Activities during the LS2 period

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Scope and contents

- **Scope**
 - Overview of BI activities in the LS2 frame
 - LIU and HL-LHC covered in specific talks
 - Using examples to show potential issues
 - Mainly LHC and injectors
 - Focus on tunnel installations where interfaces are critical
- **Contents**
 - The timeframe:
 - Looking back to LS1
 - EYETS 16-17
 - BI activities and contributions in PLAN through LS2
 - Summary of potential issues
 - Conclusions

Looking back to LS1

Machine Complex	In-Vacuum Beam Instruments		Non-Vacuum Beam Instruments	
	Total in place	Removed	Total in place	Removed
PS	457	87	159	159
SPS	496	63	410	30
LHC	1220	73	3993	2300
Total	2173	223	4562	2489

- Typical activities
 - Participation in CERN-wide projects (eg, SMACC, LSS1 cabling, layout changes)
 - Consolidation and maintenance of instruments (eg, impedance issues in LHC-BSRTM, fatigue lifetime in LHC-BWS)
 - New or replacement instruments (eg, SPS-BWSRE, LHC-BGV)
 - Controls upgrades to LHC electronics and software

EYETS 16-17

Facility	IMPACTs for EYETS	PLAN lines
PS	40 (-7)	18
SPS	12 (-3)	4
LHC	39 (-2)	7
Totals	91 (-12)	29

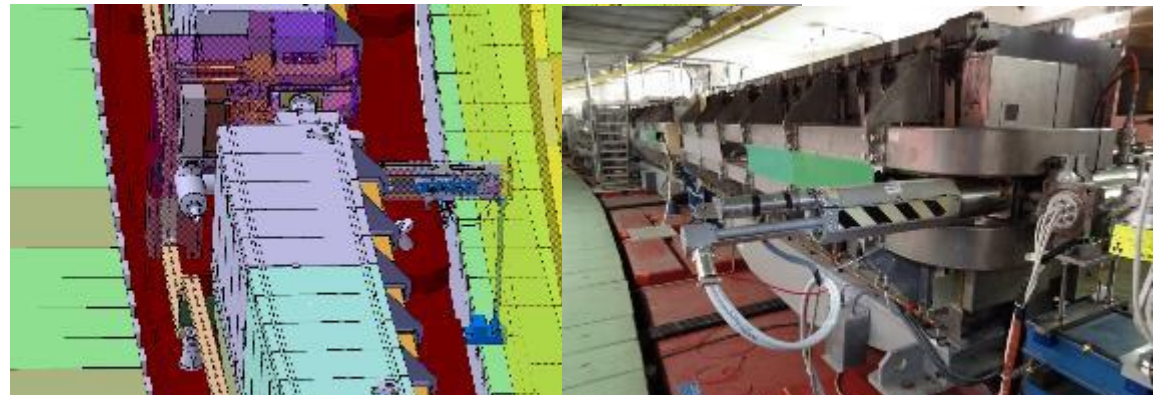
- BI organisation for EYETS
 - BI Shutdown coordinator for each facility
 - Regular group-wide preparation and follow-up meetings are in progress
- Closely following planned interventions where some uncertainty is seen (currently 12 out of 91 interventions)
 - Criticality in manufacture or vacuum acceptance
 - Discussion on approval (ECR, schedule) or necessity
- Coordinators report back to respective planning coordination meetings
- Bring-forward installations wherever possible
 - Eg, PS-BLMs, BTVs in PSB injection are now in EYETS
- PLAN only represents 30% of BI activities in EYETS
 - Typically maintenance, operational changes, late requests, do not appear

Examples of uncertainties for EYETS 16-17

- Beam-Gas Ionisation Monitor (BGI) in the LHC
 - Used for beam size measurements, principally for ions
 - Impedance heating is strongly suspected
 - **Decision will be taken after the ion run** as to whether to remove in EYETS (VSC are making replacement chambers)
- Secondary emission grids (SEM) in the PS ring
 - Vacuum and operational issues found with existing, old (30+ year) monitors in SS 48,52,54
 - Consolidation-funded replacement has been designed and is under manufacture
 - Issues during integration led to delays in launching production, so **uncertainty as to readiness** for EYETS



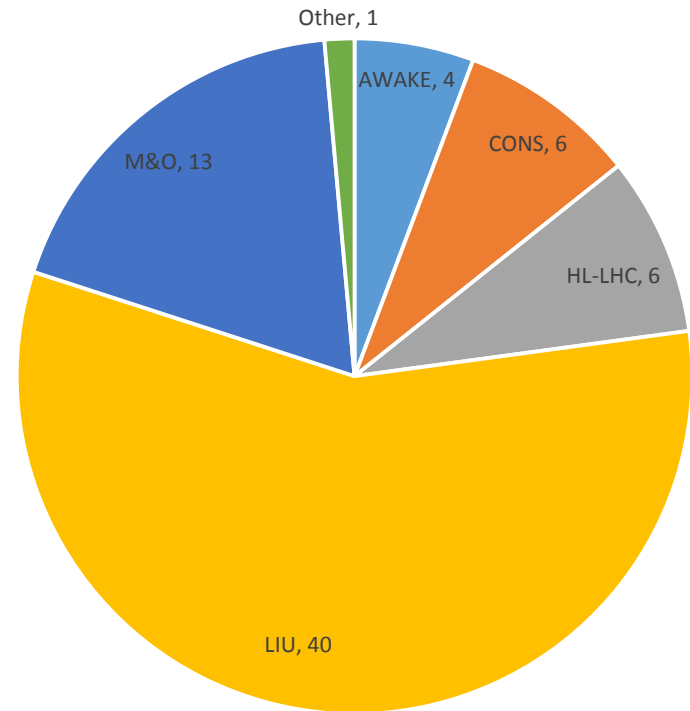
Beam-Gas Ionisation (BGI) monitor in the LHC



New (left) and existing (right) Secondary Emission grids in PS sector 54

BI Activities in PLAN

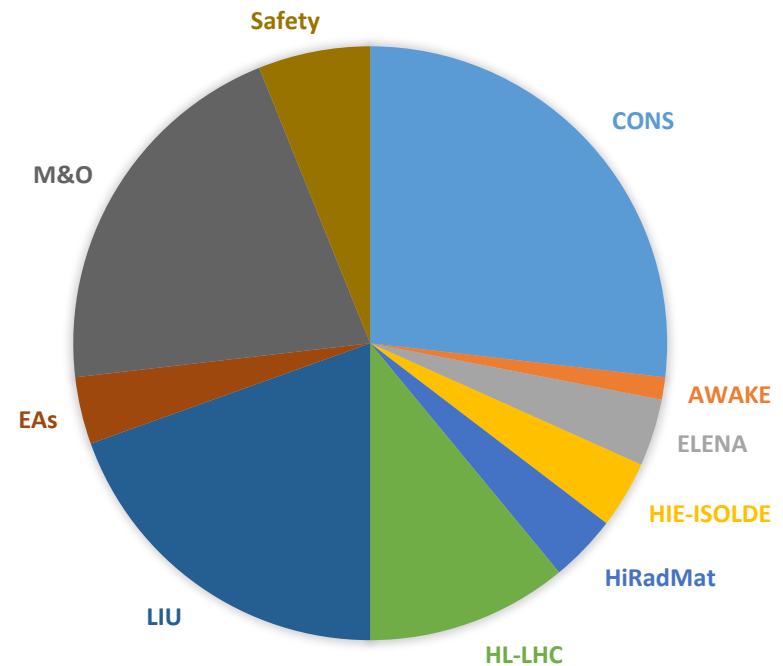
- Currently total of 70 activities upto 2020
 - LIU the main client
 - This will evolve towards LS2
- BI mainly requests contributions from
 - EN-MME, EN-EL, TE-VSC, HSE-RP, BE-ABP, EN-ACE, EN-HE
- Significant volume of activity also comes via 'contributions' to other activities



BI activities in PLAN, showing number by project (total = 70)

BI Contributions in PLAN

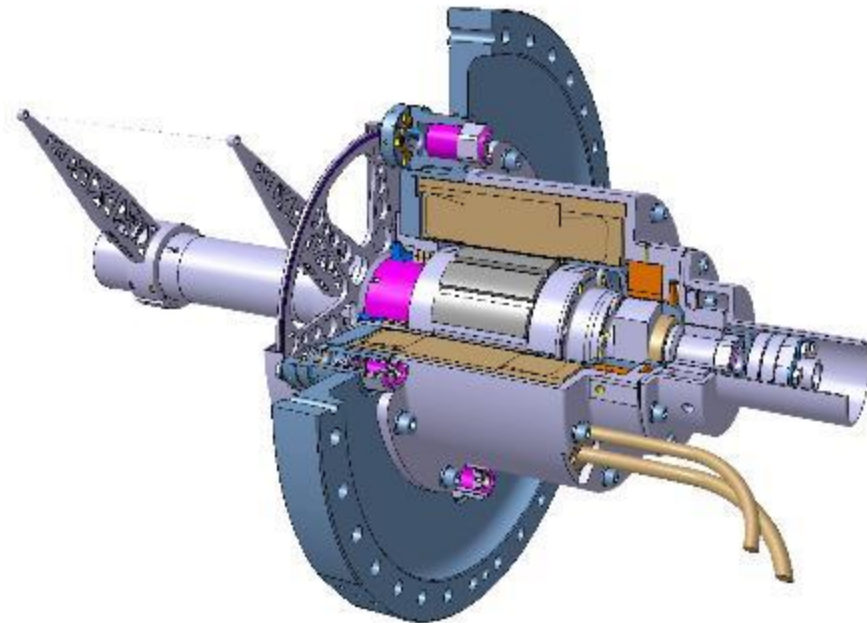
- 82 total requests for BI contributions from other groups
 - Broad range of projects
 - Wide range in level of detail
 - Significant contributions to East Area renovation and North Area neutrinos during LS2 period



BI contributions in PLAN, by project (total = 82)

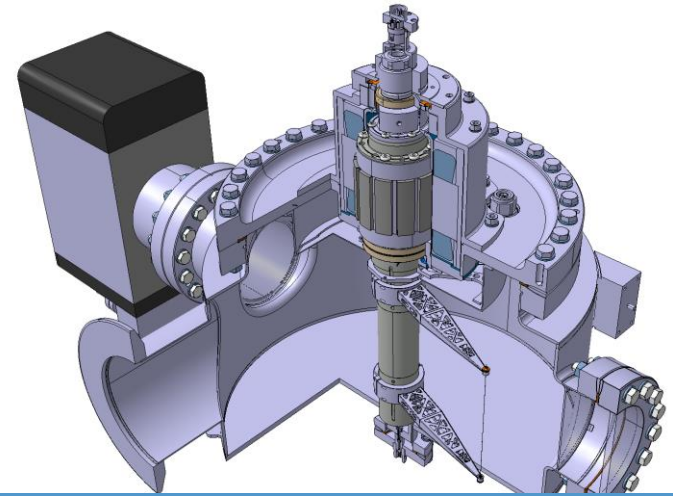
New wire scanners for LIU

- Overview
 - Wire scanners give beam profile measurements, key for optimising machine performance
 - Small, intense, HL-LHC beams mean a new, fast scanning, micron-precision instrument is required for the High-Lumi era
- Requirements
 - Ultra-high vacuum, precision mechanics with associated control and acquisition system
 - Some **22 instruments and 21 vacuum tanks needed for LS2** with more expected later
 - UHV feedthroughs, laser optics, electro-mechanics

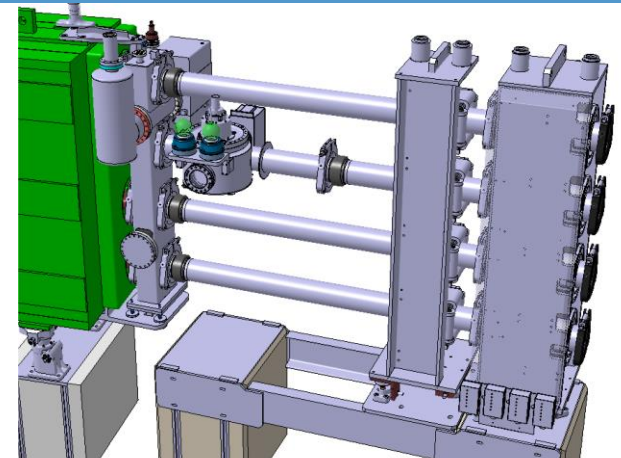


Integration of prototype wire scanner in the PSB during EYETS

- Design and qualification
 - Design and production with EN-MME and qualification with TE-VSC, BE-ABP and BE-RF
 - SPS prototype installed LS1
 - PSB prototype for EYETS
 - PS prototype for YETS 17-18
- Series installation for LS2
 - Production, assembly and test of a series of 21 with variants
 - **Limits of MME capacity** already under discussion
 - Assembly and test space requested to LIU



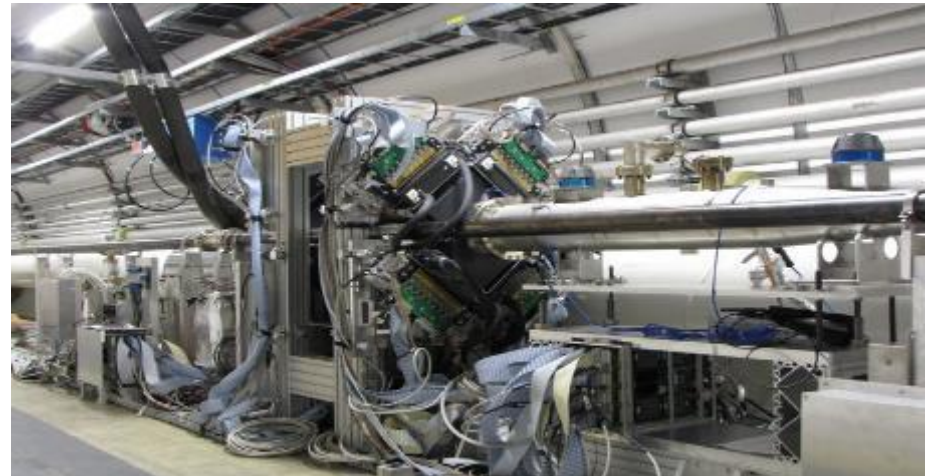
Wire scanner integrated in PSB vacuum tank with pump



Wire scanner tank integrated in PSB for EYETS

Beam Gas Vertex Detector (BGV) for HL-LHC

- Overview
 - Non-destructive beam size measurement at high energy
 - New concept, based on HEP detector technology (LHCb) to reconstruct beam-gas tracks
 - Collaboration between CERN, EPFL (CH), RWTH (DE)
- Requirements
 - Precision mechanics, Silicon trackers and associated electronics
 - Prototype progressively installed since LS1.
 - Operational instrument under development for LS3
 - Decision not yet taken for a second installation in LS2, pending operational tests



BGV demonstrator, installed in the LHC

Potential issues

- Interfaces with other groups
 - Close collaboration with MME and VSC, however, we already see **bottlenecks in production** with MME for LS2 deadlines. We will need to maximise external contracting where possible
 - Co-activity between installation and commissioning was an issue at the end of LS1. This should be considered in the scheduling with some more margin in the global schedule and plan for earlier installation for some key items
 - There is a need for **agreed vacuum acceptance specifications** for the different machines to avoiding bottlenecks occurring late in the production path
- Resources
 - Additional resources are already foreseen for shutdowns (FSU and Russian BLM collaboration)
 - Resources from projects (LIU, HL-LHC) are planned for preparation, test and commissioning
 - Additional resources from EN-ACE to more closely integrate the schedule are also planned

Potential issues

- Uncertainties on workload for LS2
 - Some 5 FTE of **unforeseen activities** arrived during the LS1 (LHC-BQS, PS-SEM etc)
 - **New operational requests** will arrive between now and LS2 (eg, BLMs)
- Storage and logistics
 - **Additional lab space** has been requested for LIU instrument assembly
 - Removal and repair of radioactive instruments from the injectors will put strain on **BI radioactive workspace** and **CERN radioactive workshops**
- Safety
 - BI will have many interventions with WDP and radioactive transports, so we already work closely with RP
 - **Streamlining of the workflow** for radioactive transports (number of signatures, confidentiality of EDH documents..) will help to avoid schedule issues during the shutdown

Conclusions

- Activities for LIU and HL-LHC are well defined and closely followed-up with the projects (schedules and resources)
 - There are many critical LIU milestones in each shutdown from EYETS and through LS2
 - Options to advance work to earlier shutdowns have been fully exploited but some work may be moved to YETS 17-18.
 - The year-long cycle time of PLAN mean it does not fully reflect BI activities
- Smaller projects, M&O and consolidation represent a major fraction of BI activities
 - Workload here is less predictable and will change upto and through LS2
 - It is imperative that some slack is maintained in terms of planning and resources to cope with this (often high-priority) work
- We request a significant workload from other groups (in particular MME, VSC, EL, MPE, CO) but communications are good and improvements from LS1 have been implemented
 - More details are available in working documents shared at a group level
- Help from ACE and LS2 project management are essential for:
 - Managing schedules for the same resources across the different machines
 - Coordinating co-activities due to re-commissioning whilst shutdown still in progress in 'downstream' machines

