Mini-revue des activités SU pour HL-LHC
HL-LHC Work Package 8 (WP8) TAXS
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HL-LHC WP8 working group

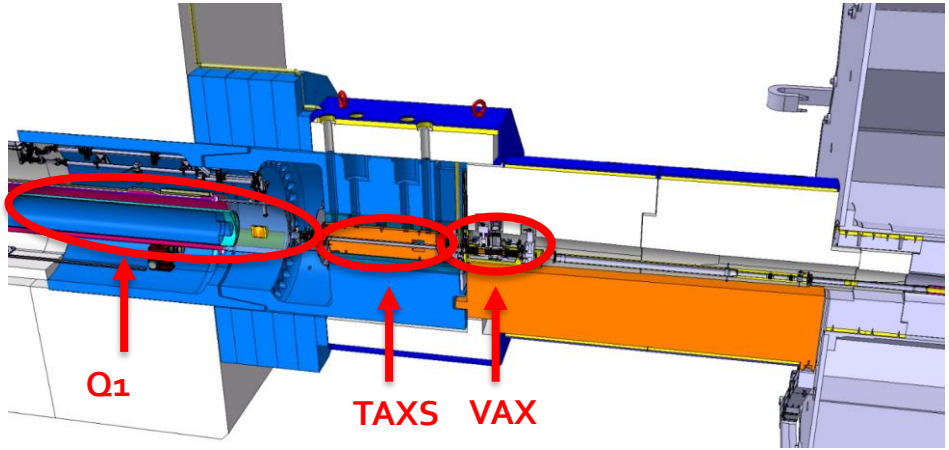
- WP8 working group Collider Experiment Interface:
- Chairman of the working group: *Francisco Sanchez Galan*

The hardware and equipment involved in the machine-experiment interface for HL-LHC operation include:

- The **experimental beam pipes**, covering in particular the part around the interaction region but more widely the design, **handling and operation procedures for the vacuum sector at Q1-TAXS left-and Q1-TAXS-right**.
- The passive absorbers for charged (**TAXS**) and neutral (**TAXN**) particles designed to primarily protect the nearby superconducting magnets from the radiation coming out from the interaction region, and simultaneously provide a background reduction to the experiments for beam interactions in the collimators and beam gas.
- The modifications of forward **shielding structures in the experimental caverns**, in particular the part that is close to the LHC machine tunnels which are designed to **minimize the background radiation in the detectors and to protect personnel from the highly activated elements during access and maintenance activities**.

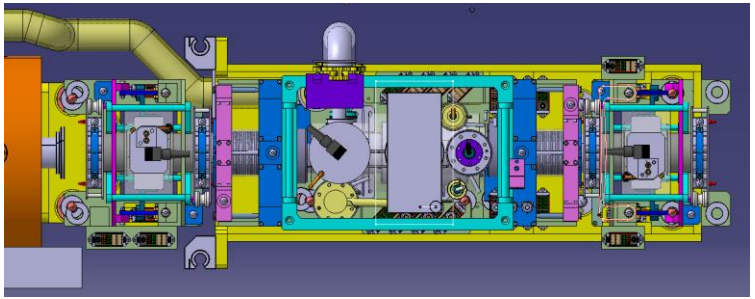
Introduction

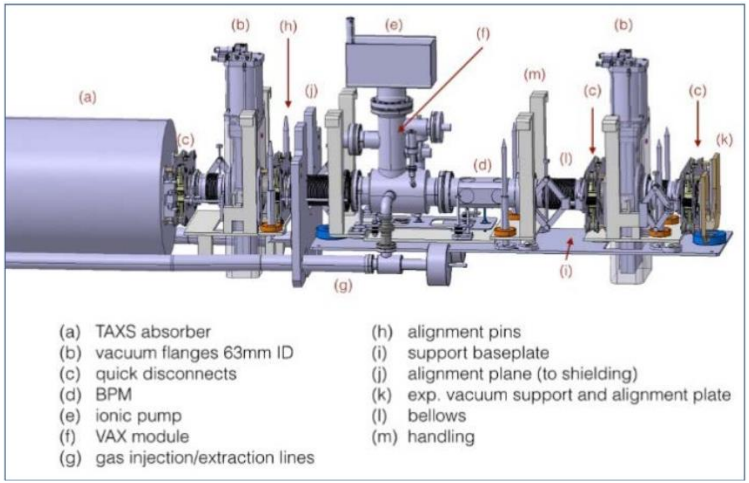
- Where are the TAXS in ATLAS and CMS?
  - Passive absorbers next to each Q1 in ATLAS and CMS
- Why survey is concerned?
  - Precise alignment of TAS and beampipes from Q1 to Q1 (aperture)
  - Special targets due to high radiation level and shielding
- VAX equipment moves from machine side to experiment?
  - Alignment of VAX
  - Change of VJ/VT-alignment



VAX layout for ATLAS

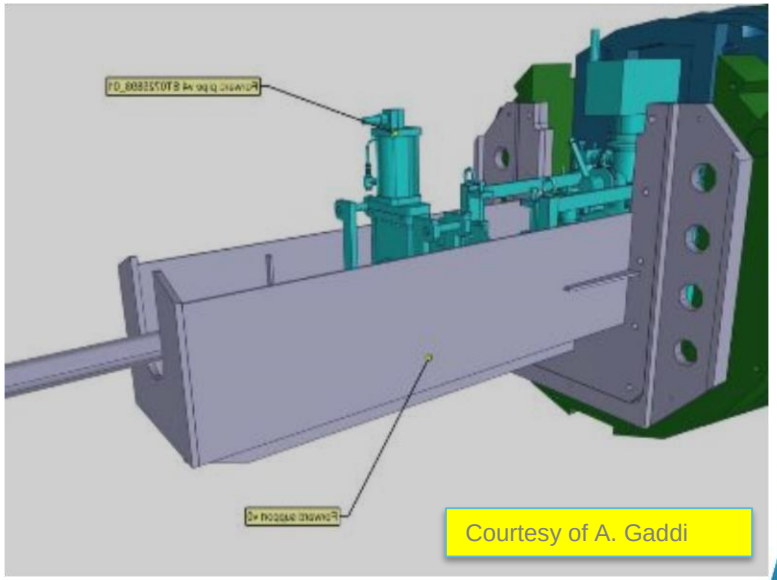
- Different conflicts with ATLAS forward shielding
- Modification of shielding in LS2
  - JFC1 (A+C)
  - JFC2 (A+C)
  - JTT (A+C)
- Support box to be aligned
- Permanent targets mandatory for remote controlled measurement
- New strategies for VJ and VT alignment to be developed





VAX layout for CMS

- **Exception:**
- ***Installation of support box and partly new beam pipes for CMS in LS2 (without complete VAX)***
- Design close to completion: VAX modules, services re-routed. Shielding modifications agreed, ongoing integration with TE-VSC for LS2 modifications.



Actual baseline for TAXS

Baseline for future TAS alignment:

- Same concept as so far (limited mechanical choice); 2x vertical, 2x horizontal
- Permanent targets for laser tracker (non-magnetic)
- TAXS get Z-stoppers => no alignment in beam direction
- Demanded accuracy for adjustment 0.5 mm at 1 sigma (unchanged)

For ATLAS:

- Alignment based on 4x long bars (2 parts) for ATLAS (points outside second layer of shielding called JFS)
  - As so far but with more rigid bars and different connection system

For CMS:

- Alignment based on 4x short, rigid bars for CMS (points outside first layer of shielding called FIN)

The initial idea (of Ilias Ephtymiopoulos) to have an online monitoring system for the TAS has been abandoned!

Actual VAX alignment strategy

- Initial relative alignment of VAX components and fiducialisation in surface
- Initial alignment based on laser tracker with permanent targets in cavern
- VAX components can be exchanged individually using plug-in interfaces (no alignment works expected from SU)
- Eventually regular measurement of box as long-term monitoring (once/year), but without mechanical alignment using permanent targets (no access required)

Important remarks:

- High level of radiation in VAX region next to the TAXS
- Expected diameter of valves 80 mm with respect to 54/60 mm diameter for the TAS
  - Available clearance limits constraints for the alignment of VAX

2017 activities for TAXS in WP8:

- Removal & installation scenario
- Detailed design Q1
- VAX Proof of principle
- LS2 activities approval CMS
- LS2 activities approval ATLAS.
- Handling JTT, VAX modules
- ***Alignment***

Progress of WP8 on alignment issues is considered to be at 35%

- Discussion of alignment advances slowly as some important decision had priority:
  - ***The VAX doesn't contain a BPM***

    => alignment tolerance gets larger
  - ***Installation of VAX on experiment side has a proof of concept***

    => changes procedure for experimental beam pipe alignment
  - ***Study of radiation level outside experimental shielding***

    => drives decision for manual or remote controlled system

Activities for alignment in WP8:

Task list for the alignment preparation for TAXS (CMS and ATLAS):

- Participation in the design of TAXS bars/tubes and supports for survey targets
- Integration of fiducials on TAXS bars in designs
- Get radiation level following last FLUKA model for ATLAS on JFS shielding (probably < 10µSv/h) for LS6 after 8 weeks cooling time
- Purchase of non-magnetic targets for laser tracker (budget?) for TAXS
- Purchase of non-magnetic targets for laser tracker (budget?) for beam pipes

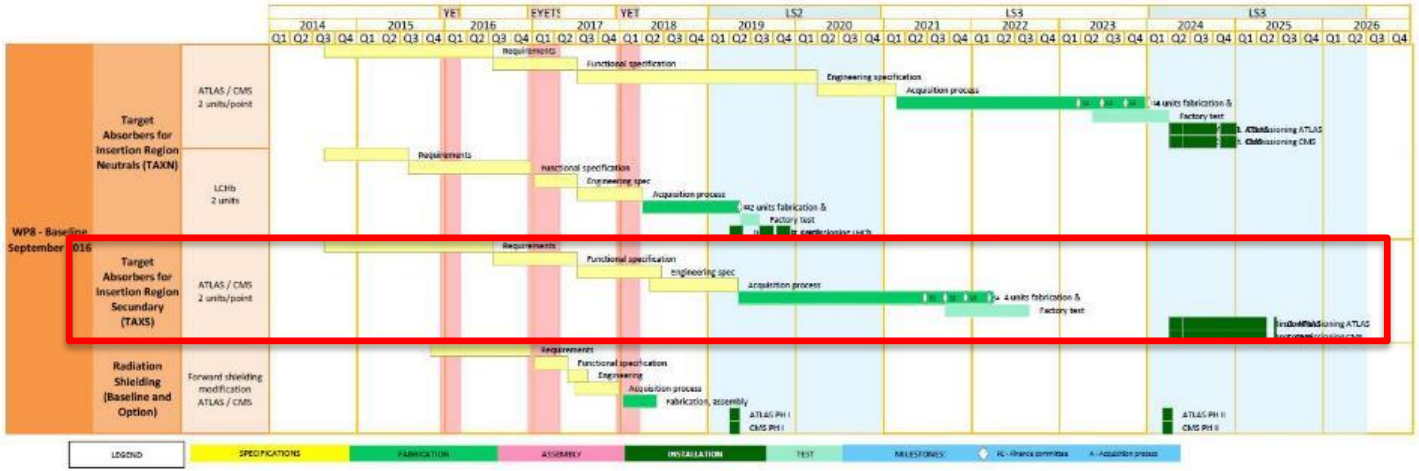
Task list for the alignment preparation for VAX:

- Integration of fiducials on support boxes for VAX in CMS and ATLAS
- Definition of measurement configuration for VAX and beam pipe measurement
- Clarify the necessary fiducialisations for the different VAX components if still needed as there is no BPM anymore in the VAX
- Alignment accuracies for the VAX and beam pipe equipment

Schedule of working group

General mile stones for Target Absorbers for insertion region Secondary (TAXS):

- Requirements (2014-2016)
  - Functional specifications (2016-2017)
    - Engineering specifications (2017-2018)
      - Acquisition process and fabrication (2018-2022)
        - Installation in LS3 (2024-2025)



Schedule for TAXS

- Exceptions:
- ***Installation of support box for vacuum equipment for CMS in LS2 (without VAX)***
- ***Installation of new CMS beam pipe parts in LS2***
- ***ATLAS shielding modifications partly in LS2***

Requirements Definition
Development Stage
Fabrication, Assembly & Verification
Installation-Commissioning

TAXS could be an
in-kind contribution

WP	PBS Element Description	2016		2017		2018		2019		2020		2021		2022		2023		2024		2025		2026	
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
WP8	ATLAS Target Absorber For Insertion Region Neutral																						
WP8	CMS Target Absorber For Insertion Region Neutral																						
WP8	LHCb Target Absorber For Insertion Region Neutral																						
WP8	ATLAS Target Absorber For Insertion Region Secondary																						
WP8	CMS Target Absorber For Insertion Region Secondary																						

Remark from C&S review

Experiment Interface: At high luminosity conditions significant activation by debris from the collisions is expected at absorbers in the interaction regions. Possible dose rates of several 10mSv/h were mentioned. At this level remote handling of critical components is required. The implications of remote handling are possibly underestimated by the project. The complex space situation for cable routing and other installations requires good coordination in the detector area.

Main question for survey:

- **Which operations can be done manually?**
- **Which operations need a remote controlled intervention due to the dose rate?**

Baseline for TAXS survey is:

- **Manual adjustment (outside shielding for ATLAS) and measurement at distance.**
- **Motorized adjustment is considered as too risky from maintenance point of view (never adjusted in CMS).**

Non-solved issues

- Beam pipe alignments have to be completely re-discussed for ATLAS and CMS for Hi-Lumi configuration

- Revision of all beam pipe alignment targets, procedures and techniques for ATLAS and CMS are necessary

Keywords for new strategies:

- Permanent targets
- Radiation hard, non-magnetic
- Remote controlled measurement
- Remote controlled alignment
- Visibility, accessibility, ALARA

It will be more challenging to find acceptable survey solutions for the different beam pipe sections of CMS and ATLAS than for the TAXS and VAX equipment!

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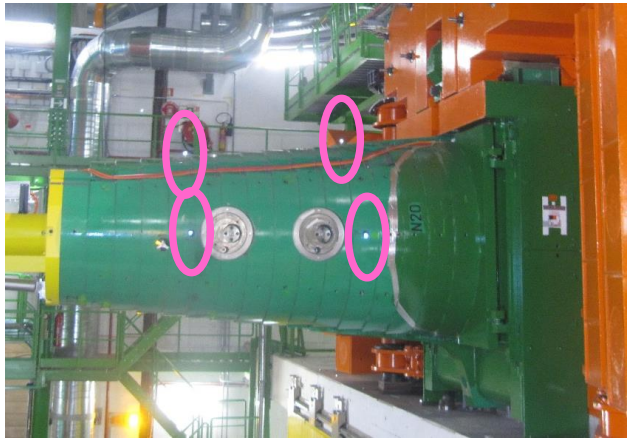
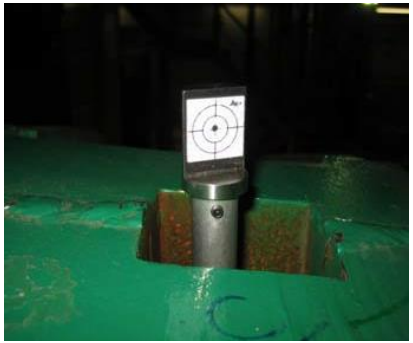
Actual CMS TAS concept

- TAS alignment based on bars attached to TAS and traversing the FIN shielding (green)
- Single parts of bars stay permanently
  - 1st fix part inside FIN
  - Retro-targets are mounted as targets
- Rotating shielding needs to be open for measurement
- Z-coordinates of 2 top points determine vertical alignment
- X-coordinates of 2 side points determine radial alignment
- Manual intervention with constraints on configuration, planning, access, exposure



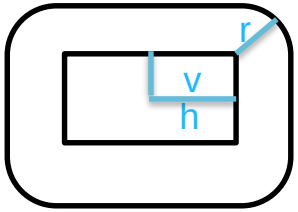


Actual ATLAS TAS concept

- TAS alignment based on bars attached to TAS and traversing the JFC and JFS shielding
- Bars are made of two parts
  - 1st part fix inside TX1STM
  - 2nd part removable in JFS and supports the targets
- 2nd part needs to be (dis-)mounted for opening/closing
- Z-coordinates of 2 top points determine vertical alignment
- X-coordinates of 2 side points determine radial alignment
- Alignment in single configuration possible (experiment closed, shafts open, cherry-picker available)
- Regular manual intervention with constraints on configuration, planning, access, exposure

Survey-fiducialization tolerances

	Ground motion			Fiducializaton		
	r [mm]	h [mm]	v [mm]	r [mm]	h [mm]	v [mm]
TAXS (*)	2.0	0	0	0	0.5	0.5
Triplets	0.6	0	0	0	1.0	1.0
BPMs	0	0	0	2.5	0	0
TAXN (*)	0.84	0.36	0	0	1.0	1.0
D1	0.6	0.36	0	0	1.0	1.0
D2/Q4/Q5	0.84	0.36	0	0	0.9	0.6



All values need to be re-discussed in detail!

Values from J. Jeanneret, LHC rep 1007.
To be re-validated by Survey, WP3, WP8 teams.
Values for experimental beam pipe under discussions.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