Vacuum aspects of Q1-TAXS area

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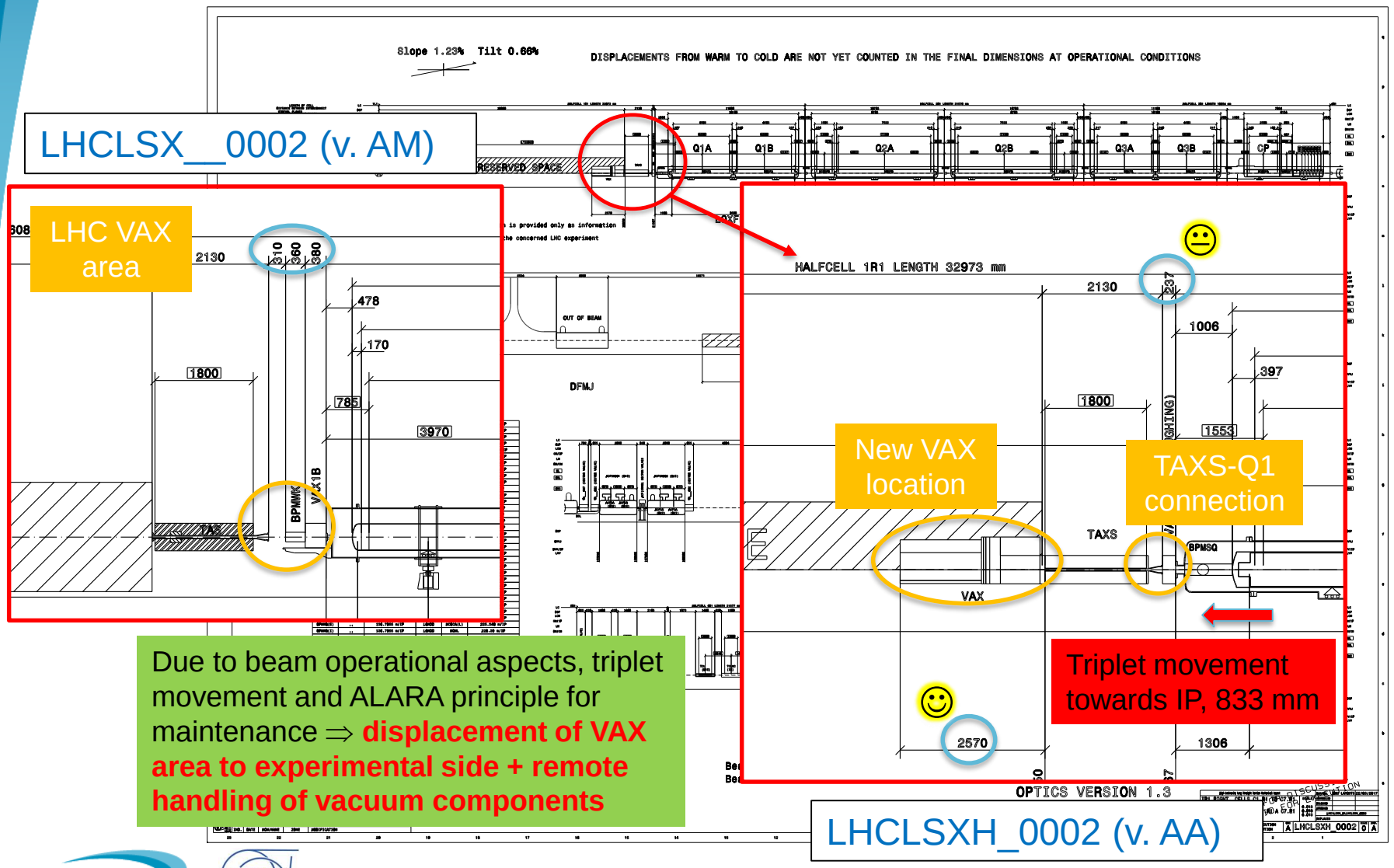
Outline

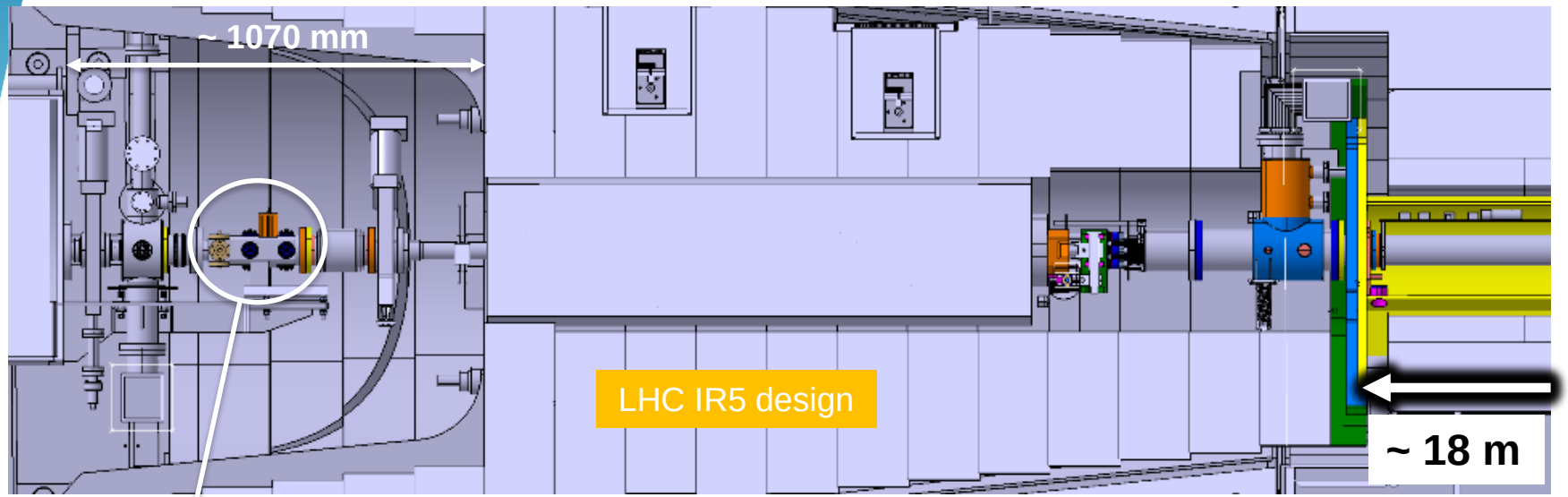
- From LHC to HL-LHC
- Q1-TAXS vacuum assembly configurations
- TAXS-experiment connection
- Q1-TAXS connection
- Summary

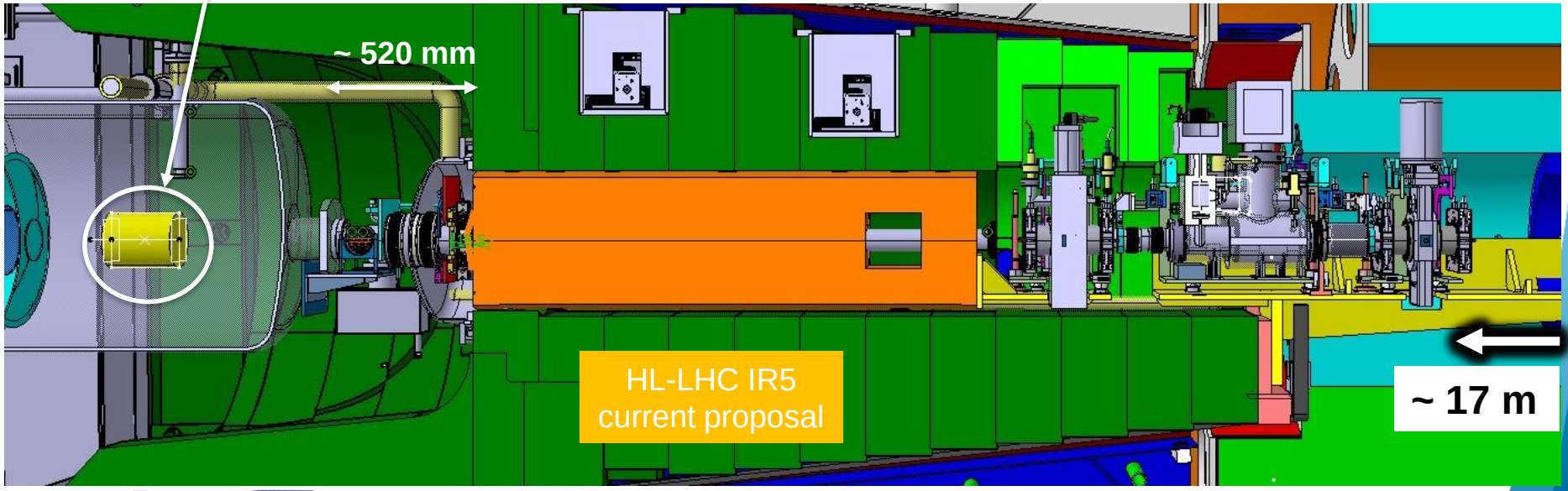
From LHC to HL-LHC



Due to beam operational aspects, triplet movement and ALARA principle for maintenance ⇒ **displacement of VAX area to experimental side + remote handling of vacuum components**

From LHC to HL-LHC (IR5 VAX area)





HL-LHC beam aperture and TAXS alignment tolerances

- 34 mm in **LHC**
- 54 mm as first proposal for **HL-LHC**

Optical Element	Distance from IP [m]	Average beam separation [mm]	Maximum beam size [4][mm], A	Mechanical aperture separation [mm]	Min. aperture [mm], B	aperture [mm], C	Alignment and ground motion [mm], D
End TAXS	20.85	0	<56.8(hv)	n/a	60[1] (hv)	60[1] Circle	3.2
End D1 (MBXF)	80.917	4.39	<112.1(hv)	n/a	115.3 (hv)	119.7, 110.7 (45°) Octagonal	3.2
Start TAXN	127.135	148	<80.6(hv)	148			
(MCBY)							4.4
							4.4

TAXS: extraction from HL-LHC TDR

Vacuum chamber to alignment fiducial tolerance	[mm]	± 0.6
Supports range of motion		± 30 mm at installation, 10.0 mm horiz. and vert. Stops in z (beam axis) at operation.

	Cold bore		Beam screen						
	Inner diameter	Thickness	Nominal aperture* H(V)+/-45 °	Vertical tolerance		Horizontal tolerance		Cooling tube Nb * OD * thickness	Shielding maximum height
				Shape	Positioning**	Shape	Positioning**		
Q1	136.7 H8	4 0/+0.5	99.7; 99.7	+/-1.15	-1.23/0.15	+/-1.1	+/- 0.65	4 * 16 * 1	16
Q2a			119.7; 110.7	+/-1.15	-1.05/+0.11	+/-1.1	+/- 0.65	4 * 10 * 1	6
Q2b									

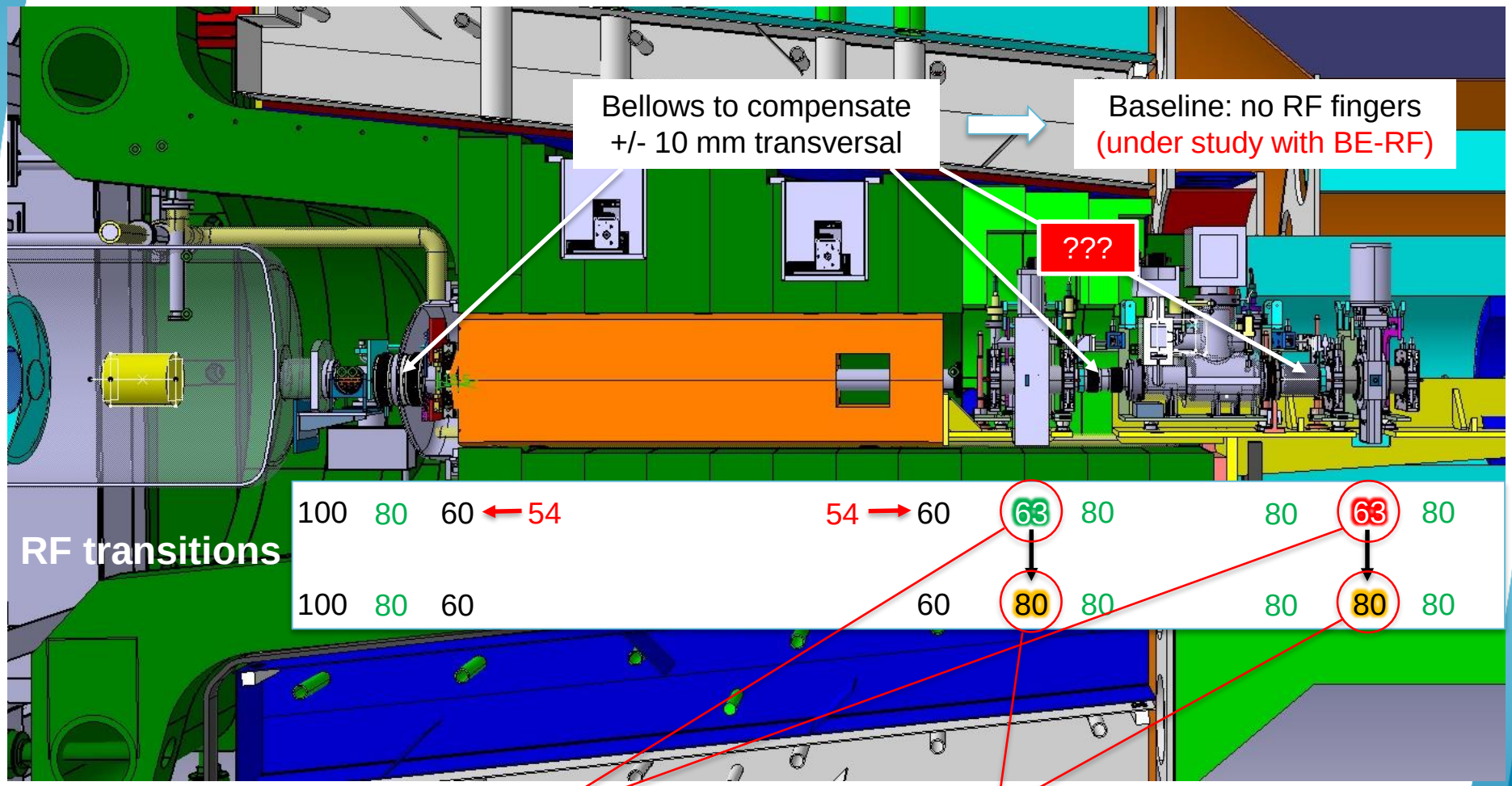
C. Garion 15/11/2016

protection
(2) Transition from 188mm to 194mm occurs on the CWT
(3) In D2 cold mass the beam pipes will be parallel
(4) The beam size is take from the average beam separation and not the mechanical aperture separation

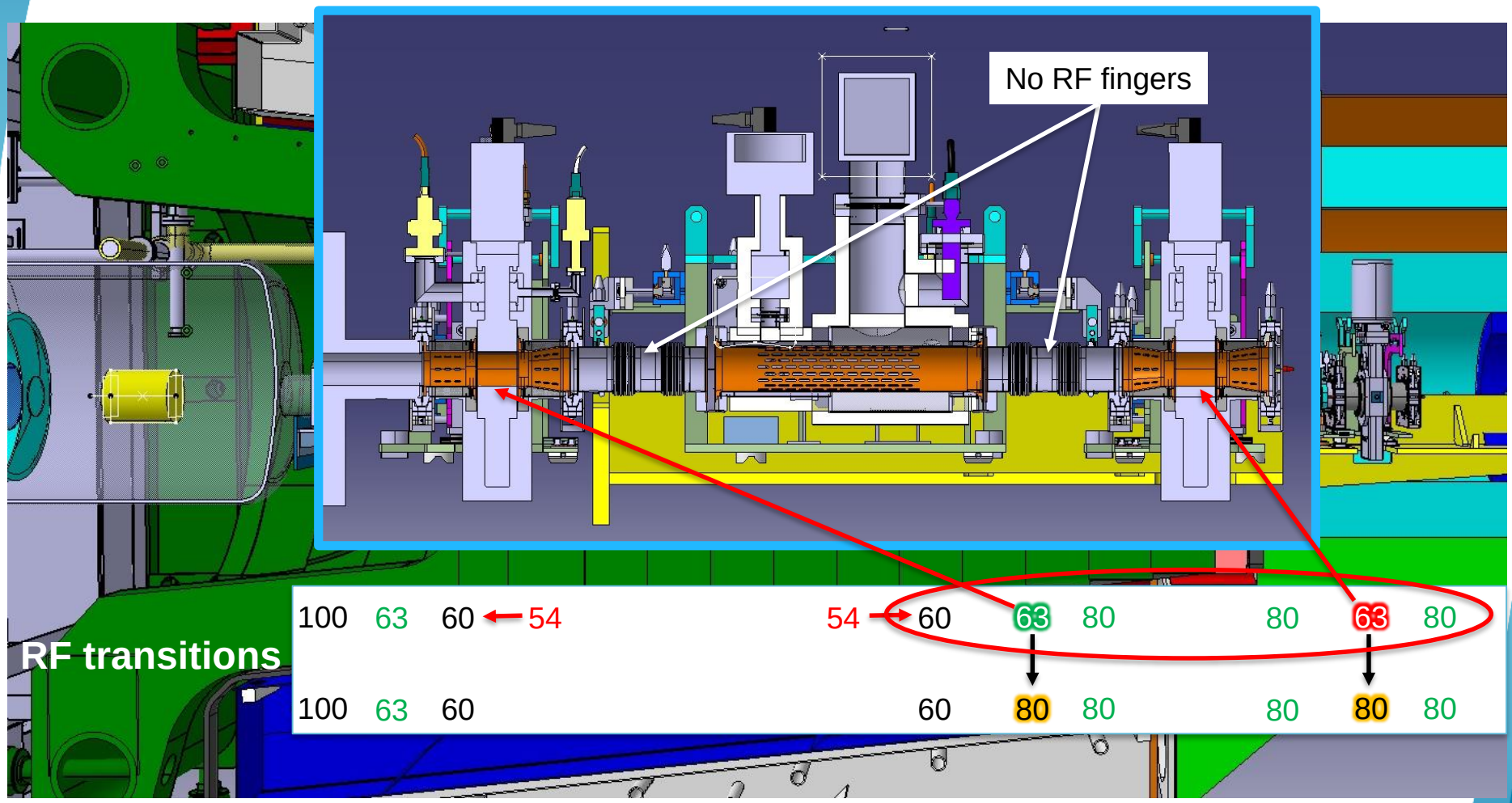
R. De Maria 26/04/2017

WP2 computation:
A=B-D
B=C-3.3
D=3.3+3.2

HL-LHC (HL-LHC IR5 VAX area)

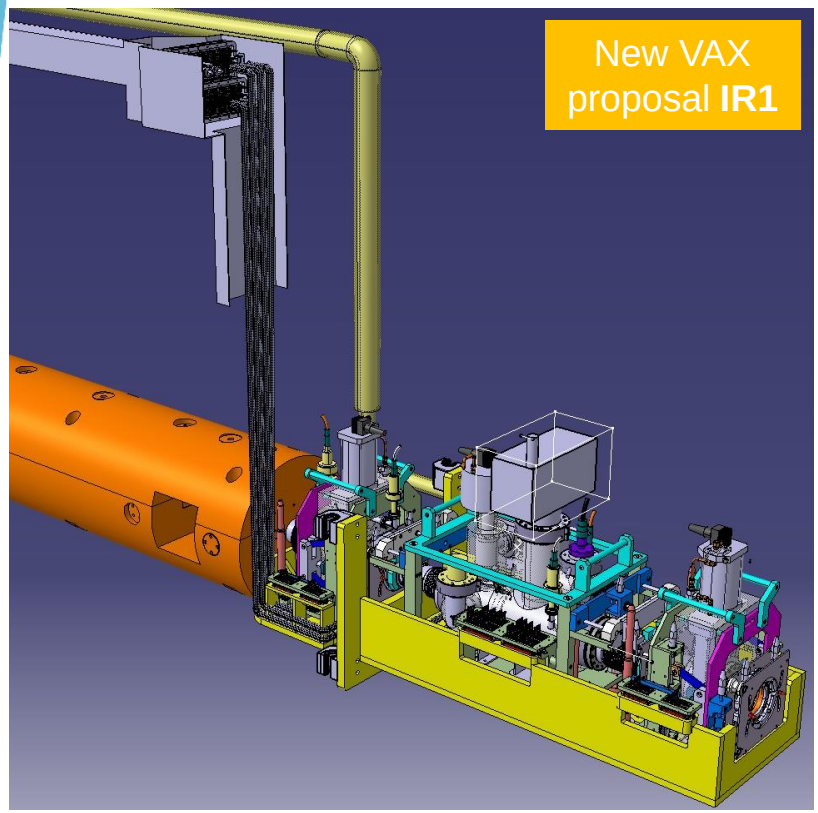


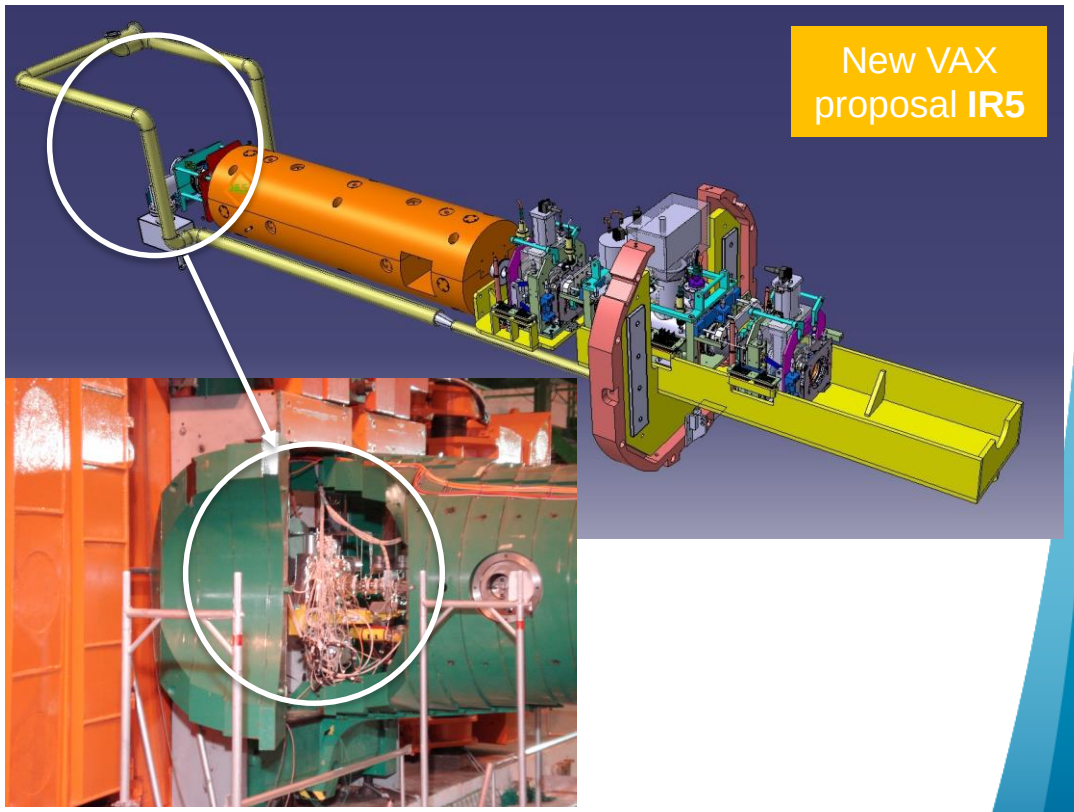
HL-LHC (HL-LHC IR5 VAX area)



HL-LHC VAX areas. IR1 vs. IR5

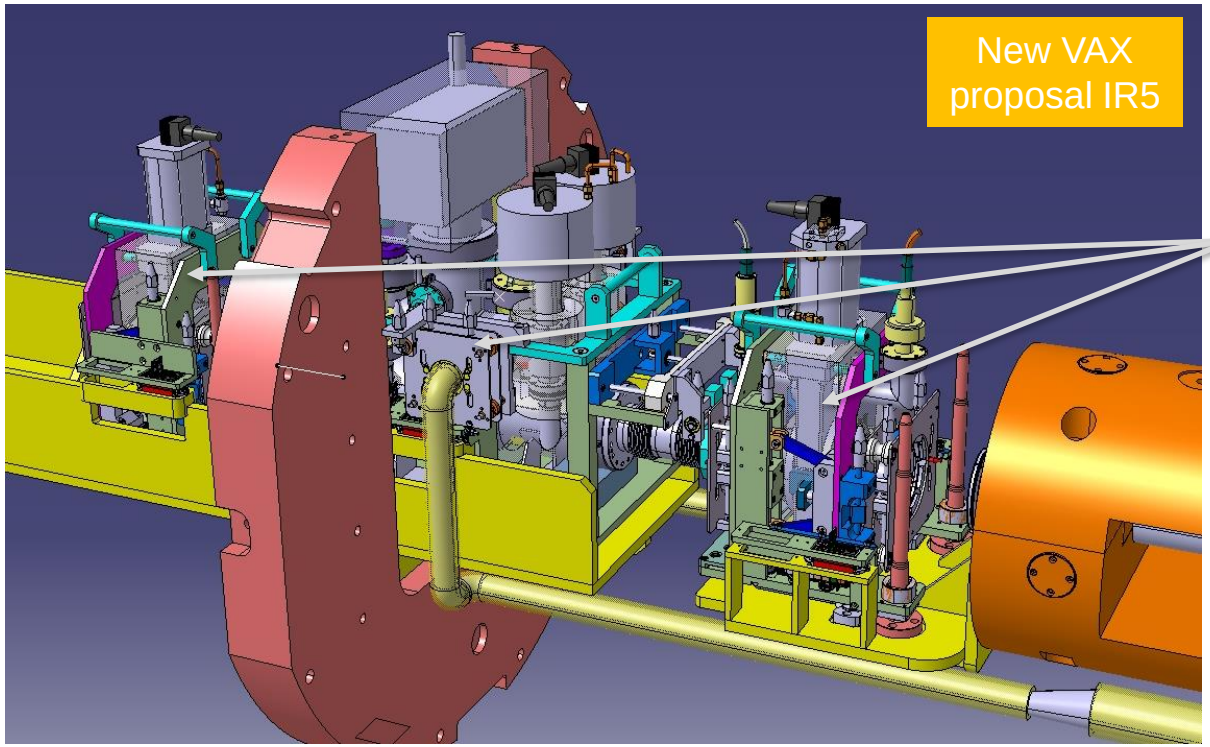
- Interfaces and alignment principles are similar and compatible but not the same, as some basic differences are present
  - Different support configurations (yellow structures in pictures)
  - Different dismantling scenarios
- Cabling and piping needs are similar, but routing constraints are different ⇒ different solutions and approaches
  - IR5: pumping/venting lines cross TAXS and 'free maintenance area' ⇒ **REDUNDANCY**





New VAX area in IR1 and 5 (TAXS-experiment connection)

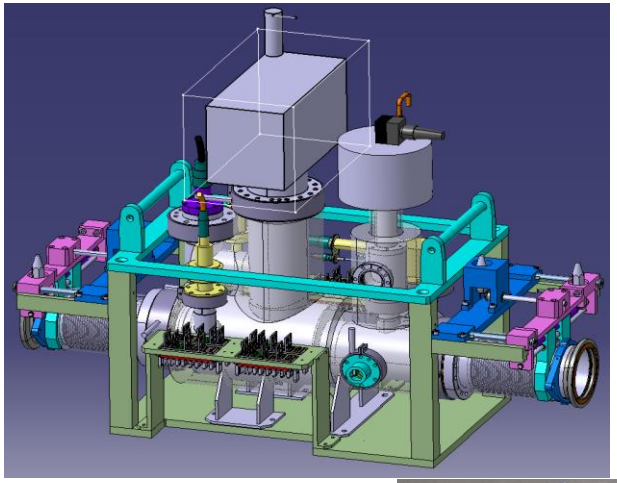
- Need of sectorization to decouple experiment's vacuum from machine vacuum
- Instrumentation in front of Q1 moved to the experiment's cavern to reduce radiation to the personnel: robustness, remote handling and tooling are required
- Installation in LS3 during TAS exchange
- The impact on the experimental vacuum beam pipe is under study ⇒ some studies to be ready for LS2
- Objective: unique diam. 80 mm aperture along all the VAX vacuum components

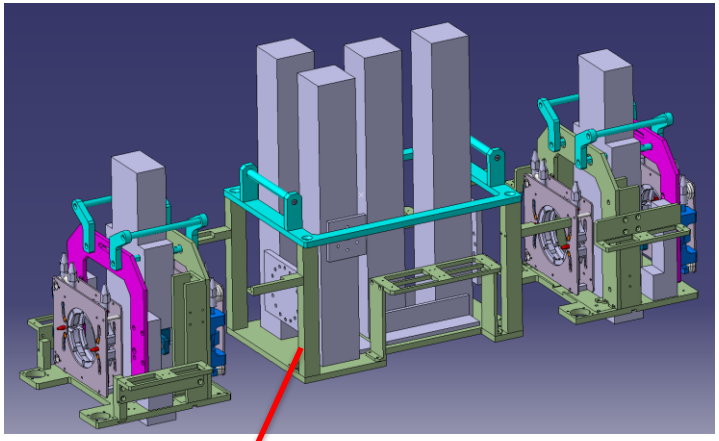


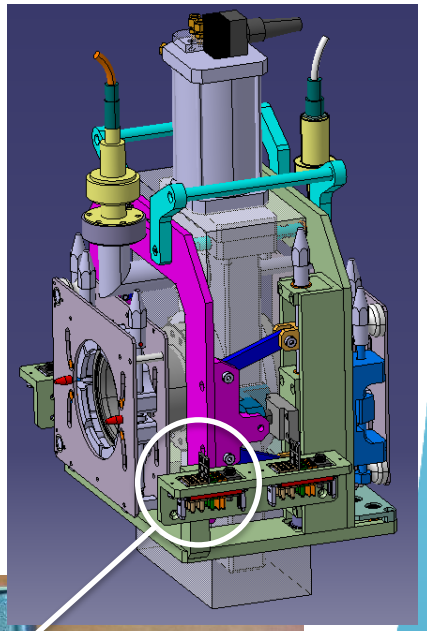
3 independent modules per IR and side:
- 2 valve modules
- 1 VAX module

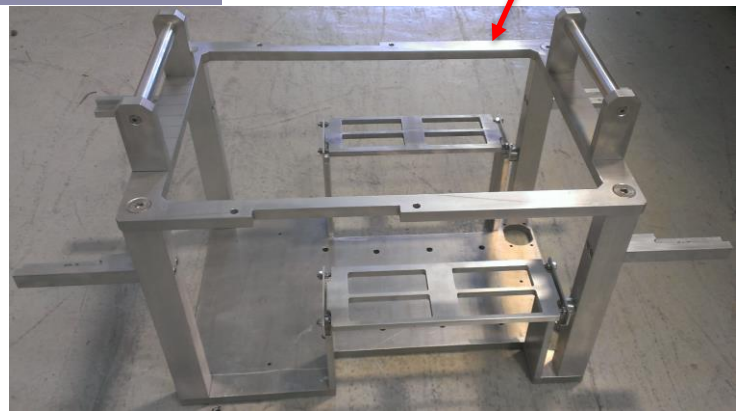
TAXS-experiment connection modules

- Use of ‘known’ reliable solutions whenever possible (e.g. DN100 ‘collimator type’ quick flanges)
- Remote handling and mechanism principles and solutions to be the same for all modules
  - Prototyping phase to be started (some structural supports already prototyped)
- All-metal valves to be the same in all cases
  - New HL-LHC 80 mm aperture valve under study with the supplier



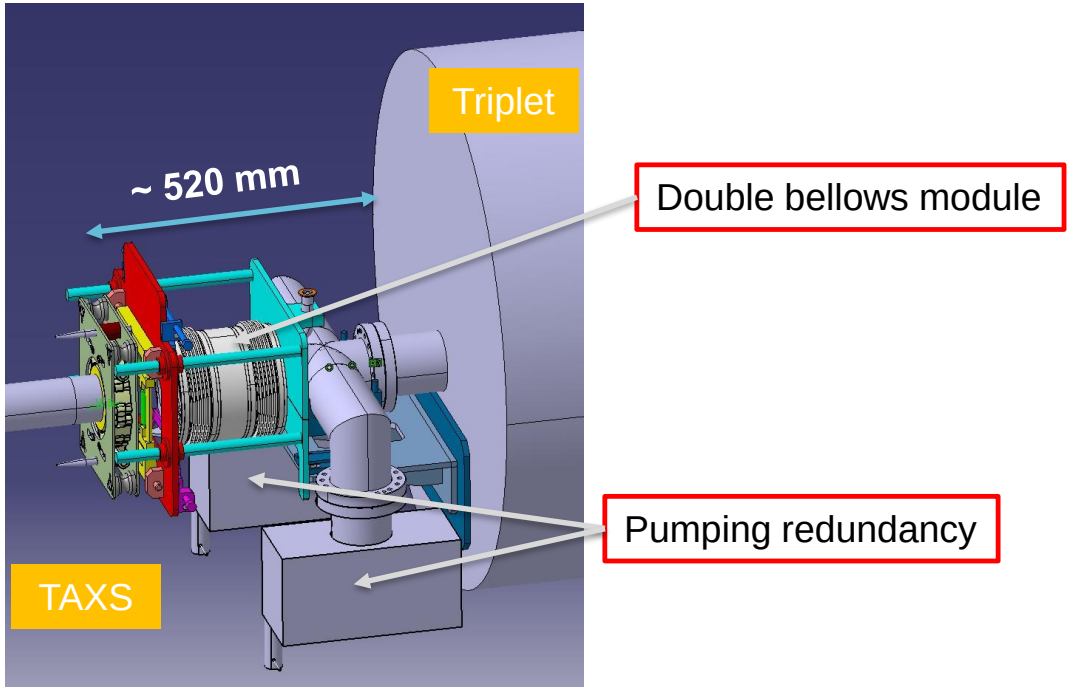






Q1-TAXS connection

- Pumping and bellows to decouple room temperature TAXS from cryogenic temperature triplet
- Unbaked a-C coated TAXS
- Considered as a free maintenance area: vacuum components to be reduced at maximum; high quality and robustness are required
- Installation in LS3 during TAS exchange
- Risk analysis to drive the final connection concept ⇒ few alternatives due to confined space, bad accessibility, high radiation levels and exceptional potential interventions



Summary

- TAXS-Experiments & Q1-TAXS areas studies are coordinated by WP8
- TAXS-experiment area more evolved than Q1-TAXS area
  - Prototyping phase is to be started for remote handling aspects (TAXS-exp.)
  - All envelope, integration and routing studies are well advanced (TAXS-exp.) for both IR1 and IR5
  - There is a baseline layout (for both IR1 and IR5) which still requires some studies and developments (new valve aperture, bellows with or w/o RF fingers, Q1-TAXS connection concept, etc.)
- Specs. and some studies to be finished by 2017 for LS2 works (TAXS-exp.)
- Risk analysis and final connection concept studies to be re-launched soon (Q1-TAXS)

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HL-LHC PROJECT

Thanks for your attention

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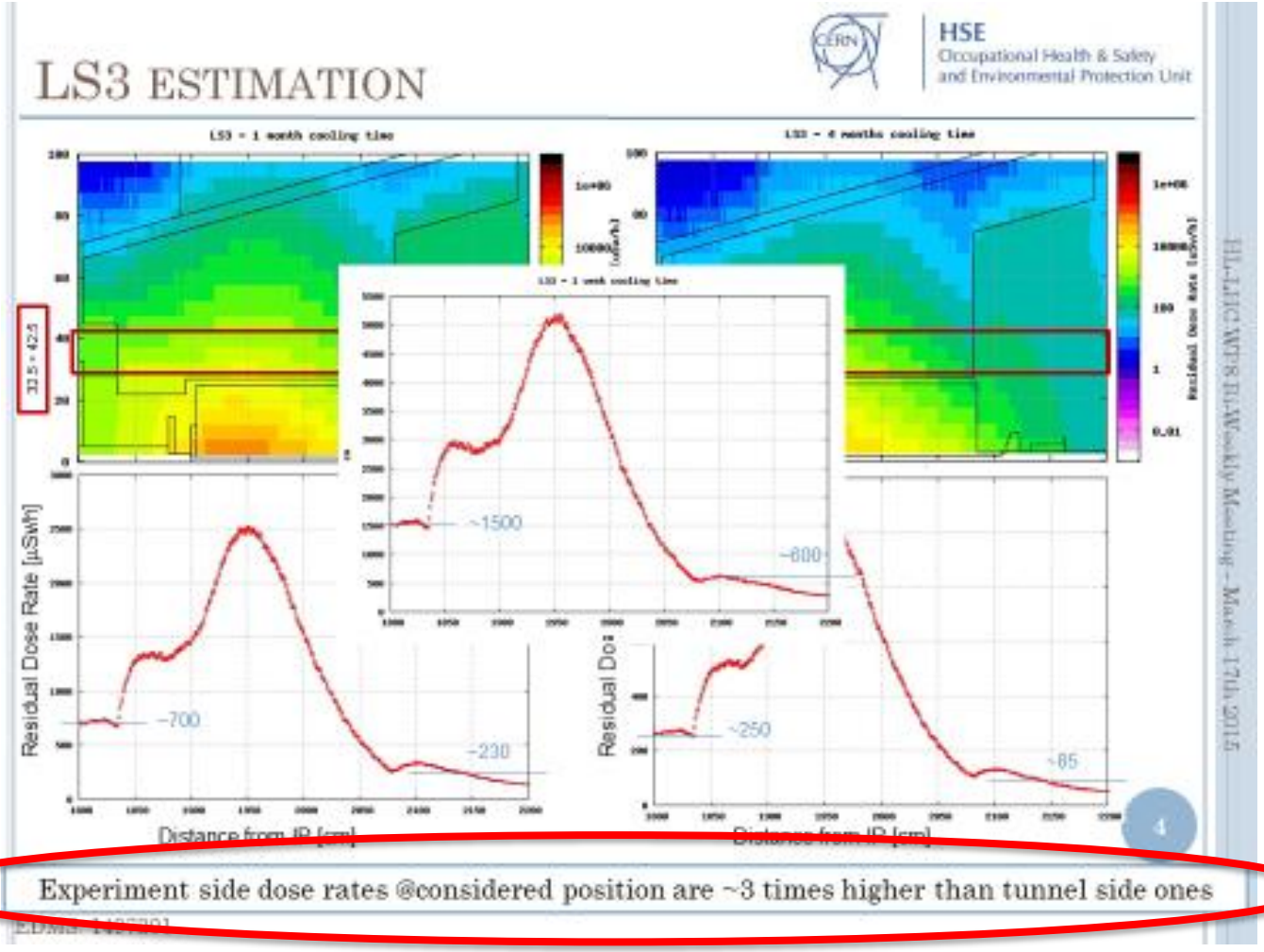
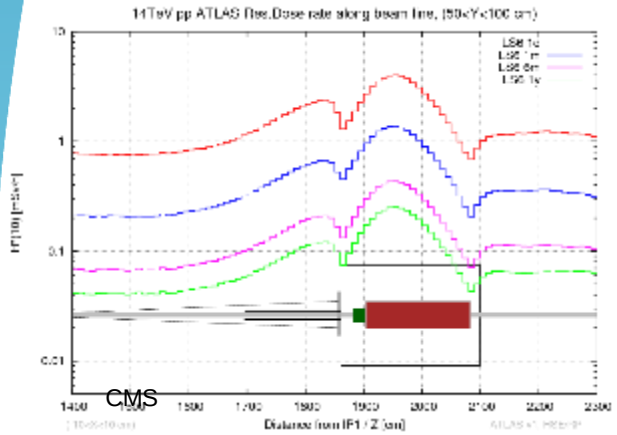
Back-up slides

Radiation dose map: TAS LHC side vs TAS experiment side

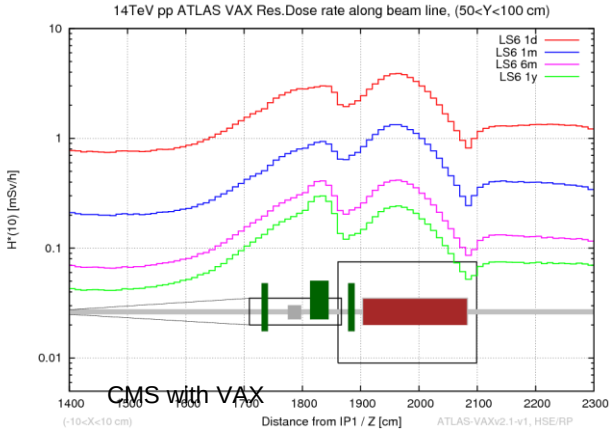


H*(10) in mSv/h, along beam line (50–100 cm)

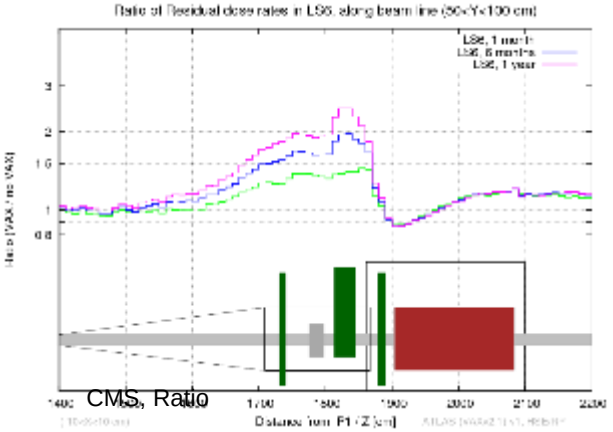
ATLAS



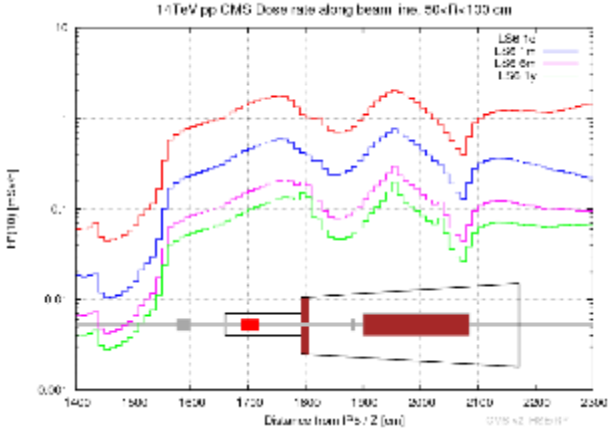
ATLAS with VAX



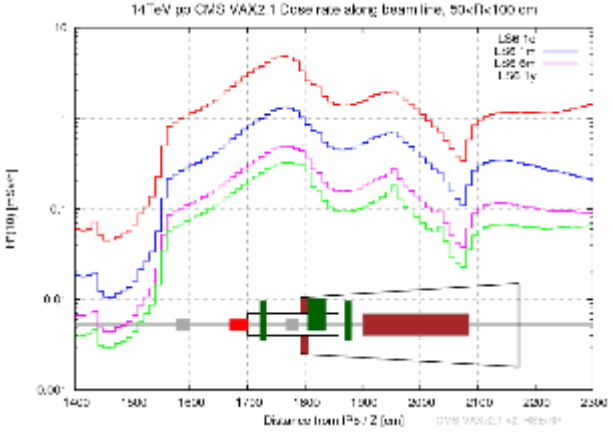
ATLAS, Ratio



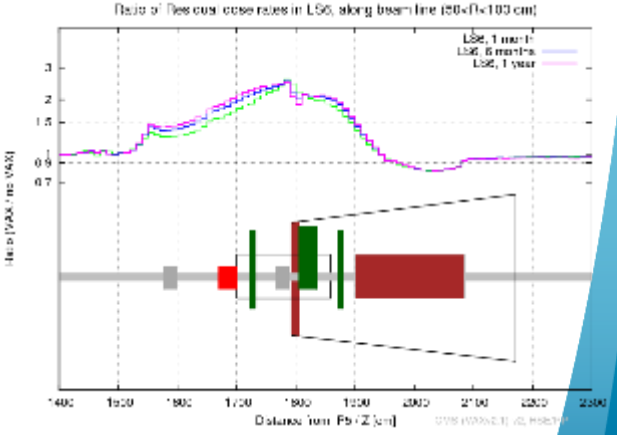
CMS



CMS with VAX



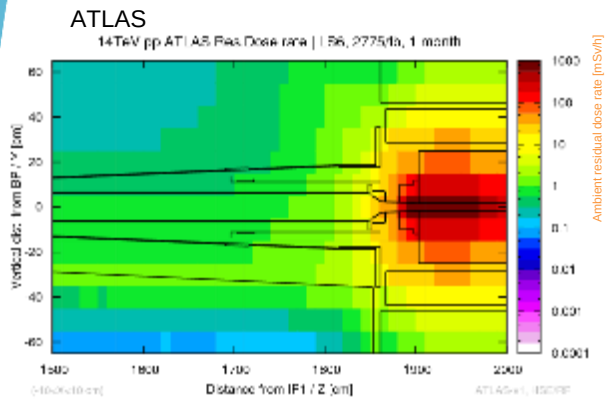
CMS, Ratio

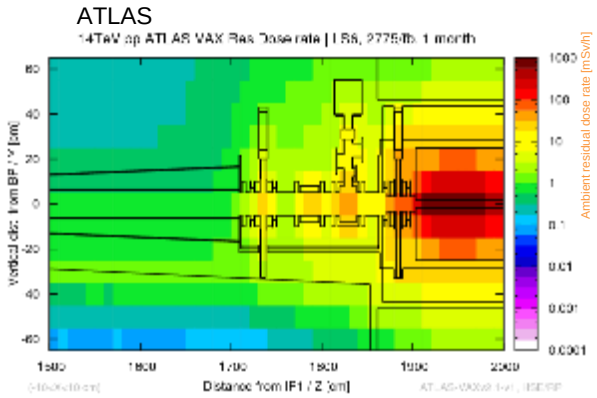


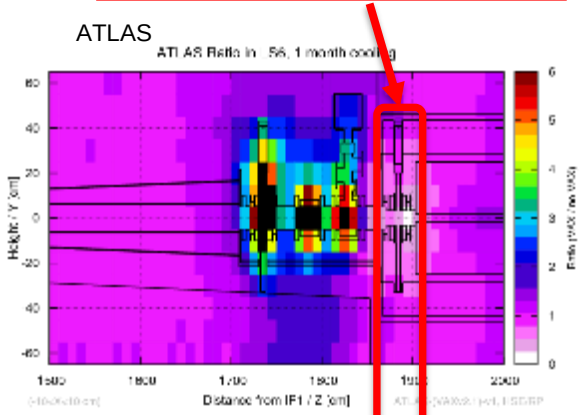
H*(10) in mSv/h, LS6 1 months cooling

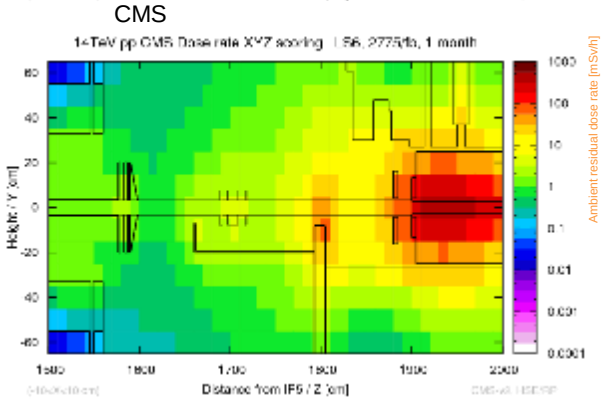
Minor impact in ATLAS

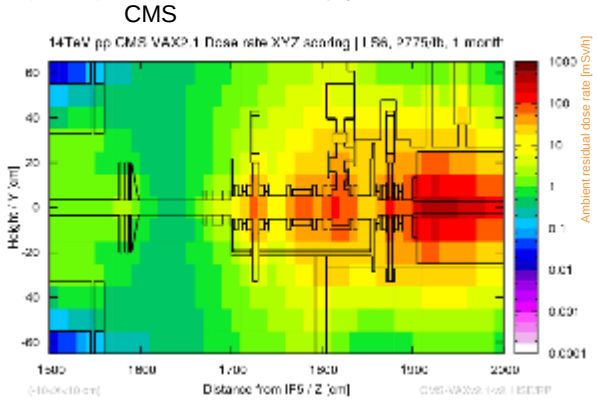
1st valve: dose rate dominated by TAXS

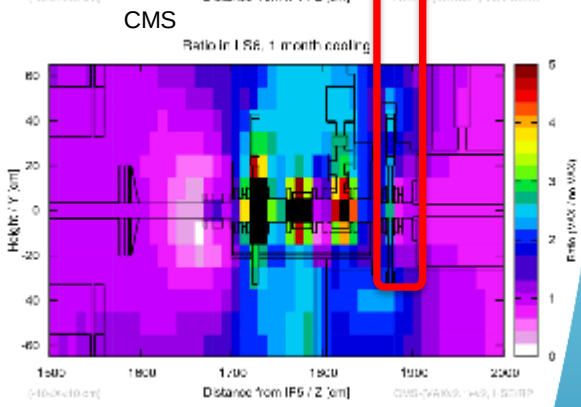






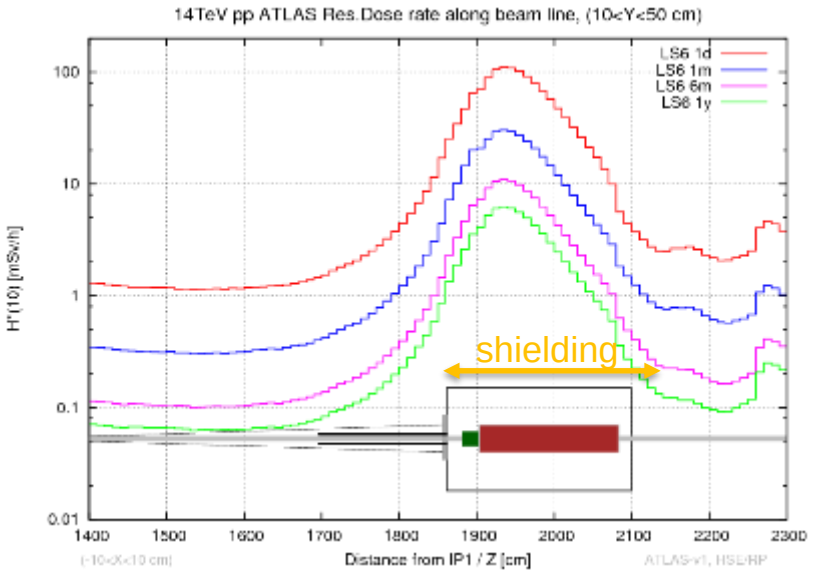


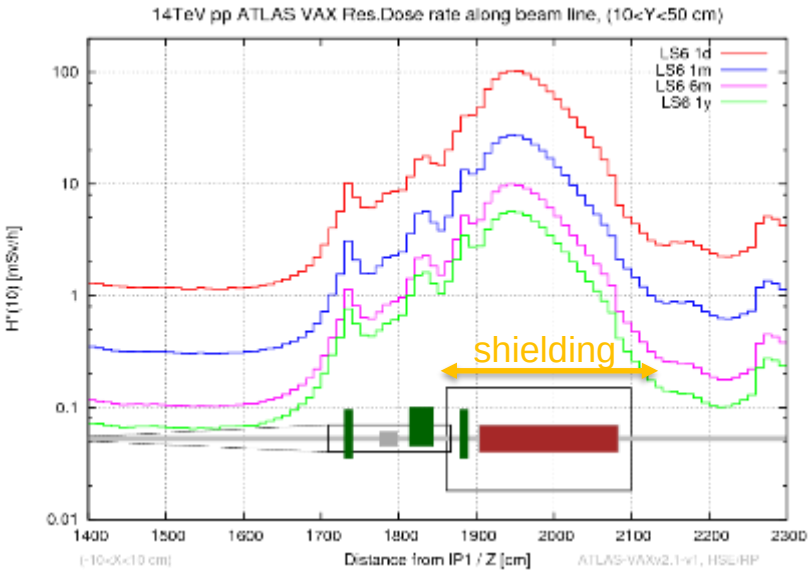




Some more impact in CMS

H*(10) in mSv/h along beam line (ATLAS)





Average dose rate 30 cm from beam line with Forward shielding open…

…and with VAX installed.