



## Update on Mini TAN and D2 protection for IP8

F. Sanchez Galan on behalf of WP8,  
Special thanks to F. Cerutti, V. Baglin, P. Fessia, P. Santos  
Diaz.



29 September 2016

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- Scope, iterations
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- Conclusion

# Scope

LHCb will increase its luminosity in Run 3 for an operation at  $2 \cdot 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ )

The protection scheme at P8 is different from P1 and P5, where TAS and TAN absorbers are installed ( $1 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ )

Target:

- give protection for D2 @ Run 3
- having the lesser impact in P8 layout.



**Modifications will be done in LS2**

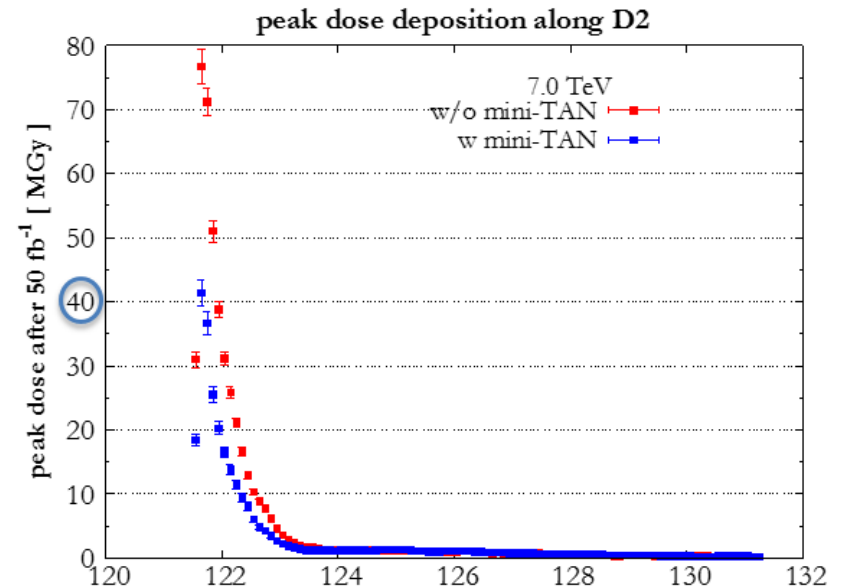
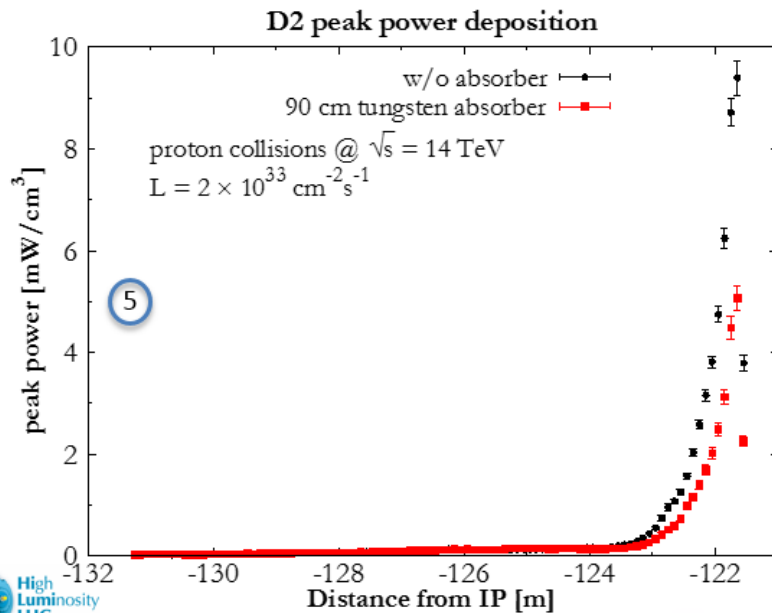
# D2 EXPOSURE [I]

@  $2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$  (power),  $50 \text{ fb}^{-1}$  (dose)

**385** urad half horizontal crossing angle

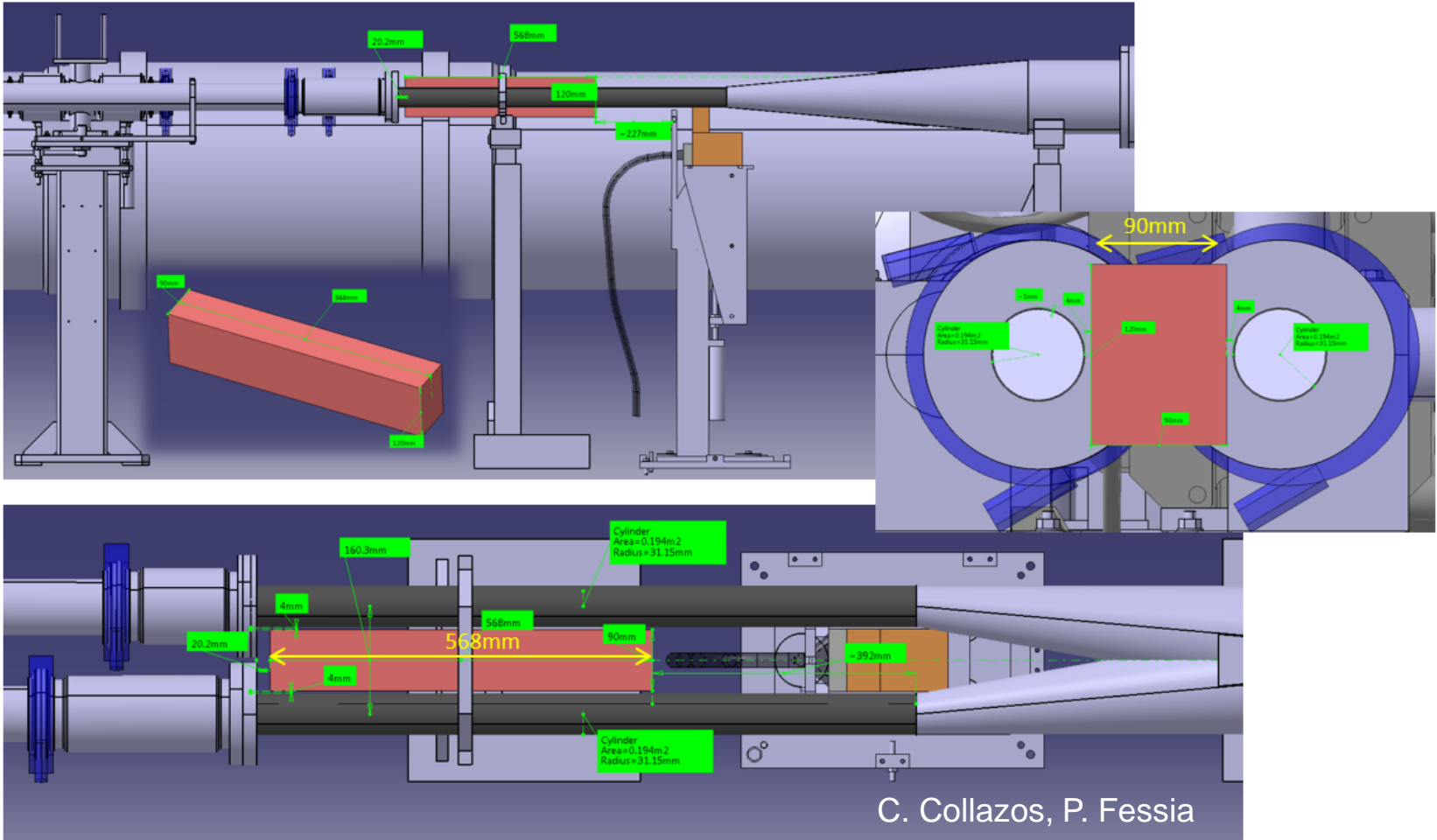
Total Power Deposited [W]

Absorber	None	W
Absorber	-	19
D2	24	8.6



# First iterations

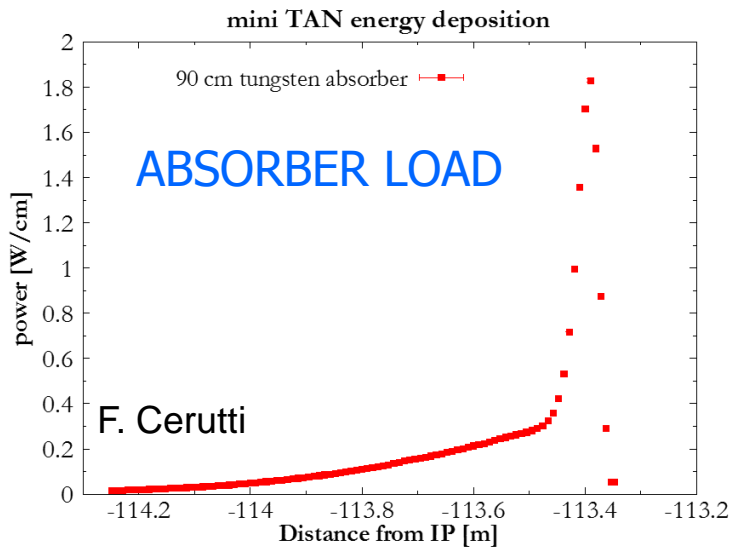
## 1. POINT 8 LEFT (8L). INTEGRATION NEUTRAL ABSORBER. C4L8



Point 8L (8L) general view. Integration neutral absorber (90x120x568mm<sup>3</sup>)

# First iterations

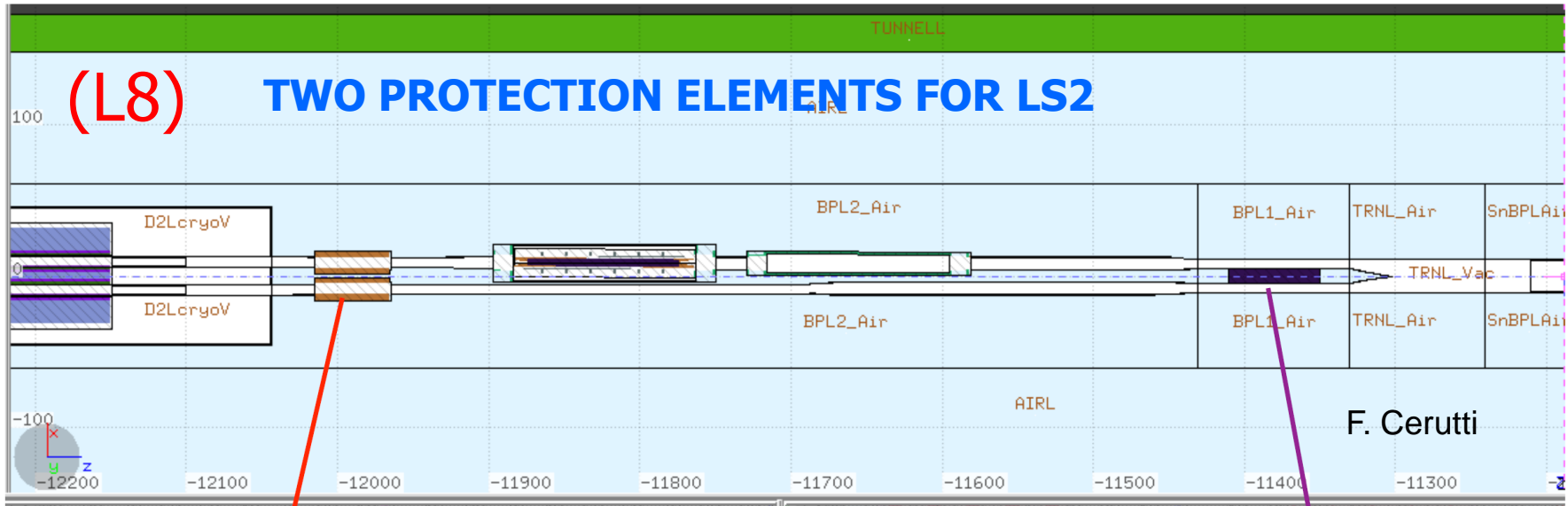
Available space in the region showed that the absorber length needed to be reduced.



Design choice was to produce a “short TAN” (2200 mm flange to flange instead of 4900), integrating the BRAN

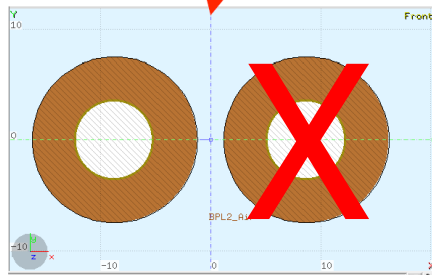


# First iterations

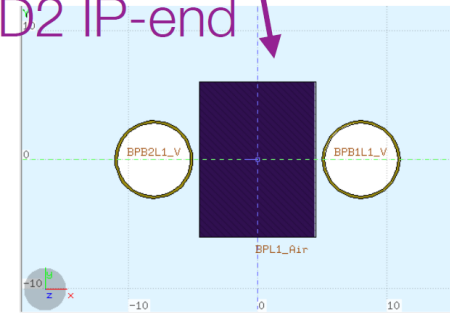


69mm ID aperture

50 cm Cu masks  
at ~1.35 m  
from D2 IP-end



9 x 12 x 60 cm<sup>3</sup>  
Inermet180 absorber at  
~ 7.5 m from D2 IP-end

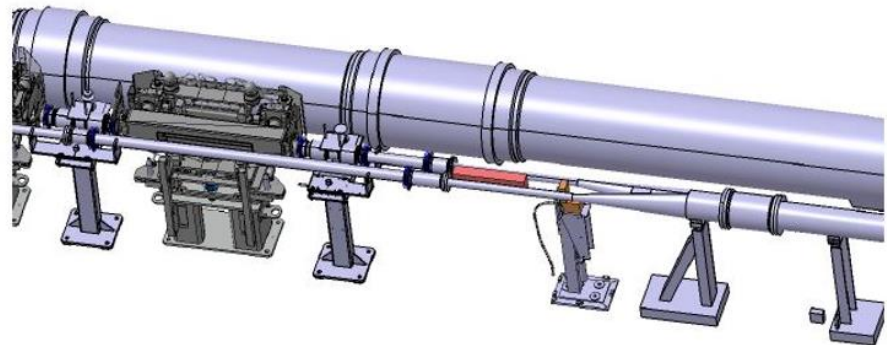


i.e. mini-TAN

# First iterations

## TAN absorbers in LHCb/P8

- Due to the large x-sing angle a “classical” TAN is not efficient for IP8. A mask in-front of D2 is more efficient
- It is wise to include a mini-TAN as well, in particular to protect the installed collimators
- we could consider a self-shielded collimator (in particular in the back part) but probably is more complicated to create yet a new element!
- **Question** : is this configuration sufficient for the future LHCb operation?

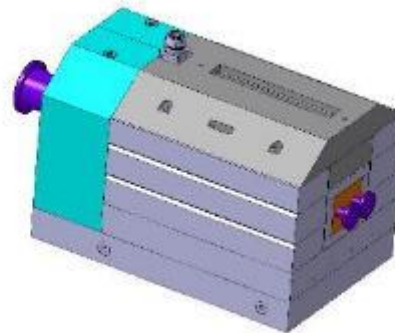




Description	WP	Period	Location
Baseline			
Installation of TAXN for LHCb	8	LS2	P8
Installation of TCDDM (Mask for D2)	8	LS2	P8

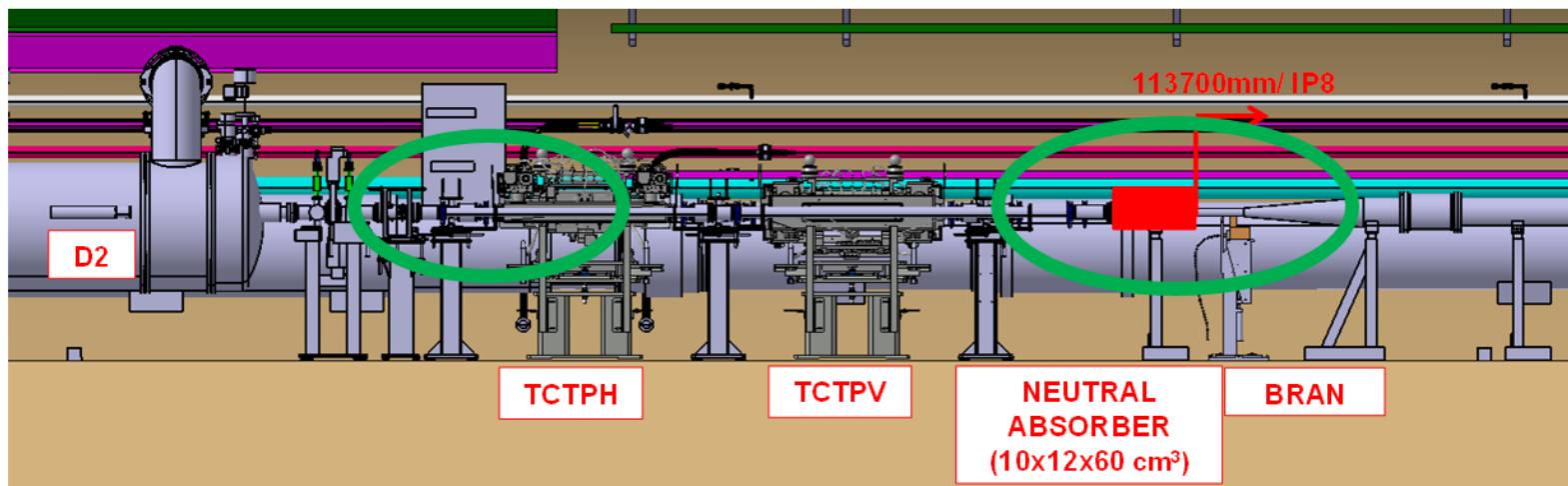
**Combination of new TAXN and TCDDM** reduce the energy deposition in the superconducting dipole D2 (by absorbing collision debris), this way reducing the risk of quenches and damage for any operational scenario. (EDMS 1562627 & 1361110).

**BRAN could be integrated in TAXN** as currently done for IR1 and IR5.



# First iterations, Chamonix 2016

## Collider-Experiment interface



### Neutral absorber

Chamonix 2014 : LS2 activity proposals	Chamonix 2016: LS2 activity proposals
Installation of a neutral absorber in front of D2 in L8	Maintained. (LHC-ECR to be done)
Installation of 2 TAXN for <u>LHCb</u> in P8	Maintained. (LHC-ECR to be done)



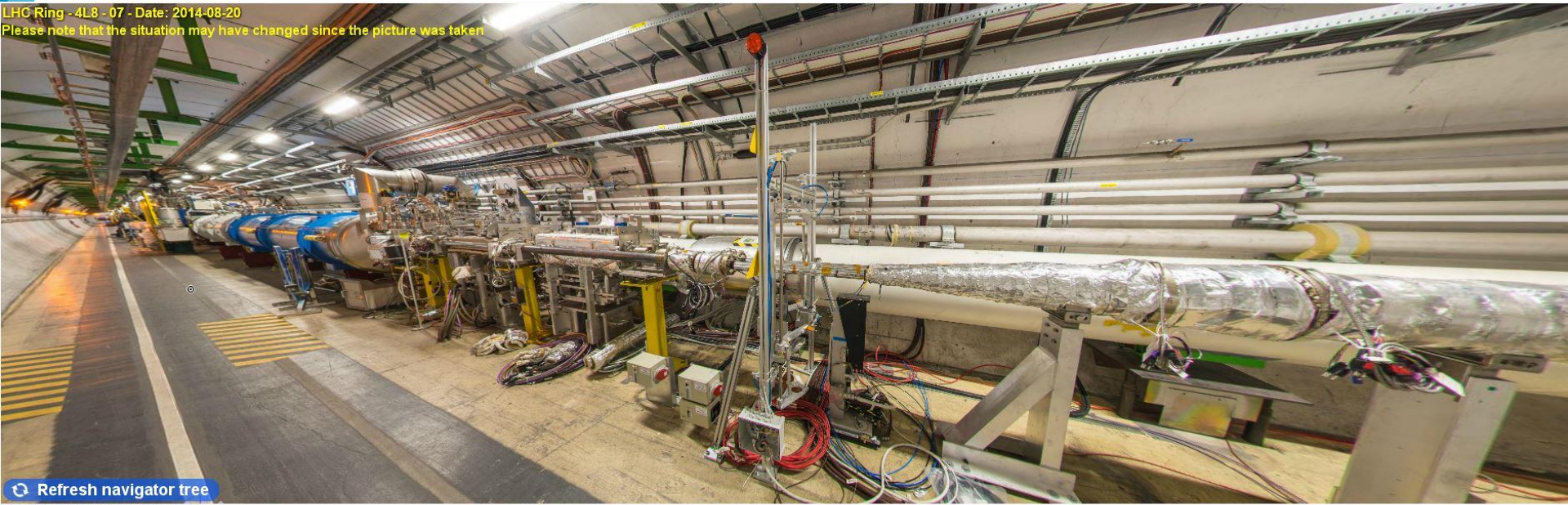
### LHC Performance Workshop

Session 8: (E)YETS and Long Shutdown 2 Strategy and Preparation. 28<sup>th</sup> January 2016 <http://indico.cern.ch/event/448109/>





LHC Ring - 4L8 - 07 - Date: 2014-08-20  
Please note that the situation may have changed since the picture was taken



[Refresh navigator tree](#)

INTERNAL Full Screen View (2014-08-20)

DOCUMENTS

EDMS Id : [454857](#) LAYOUT HALF\_CELL C2L8

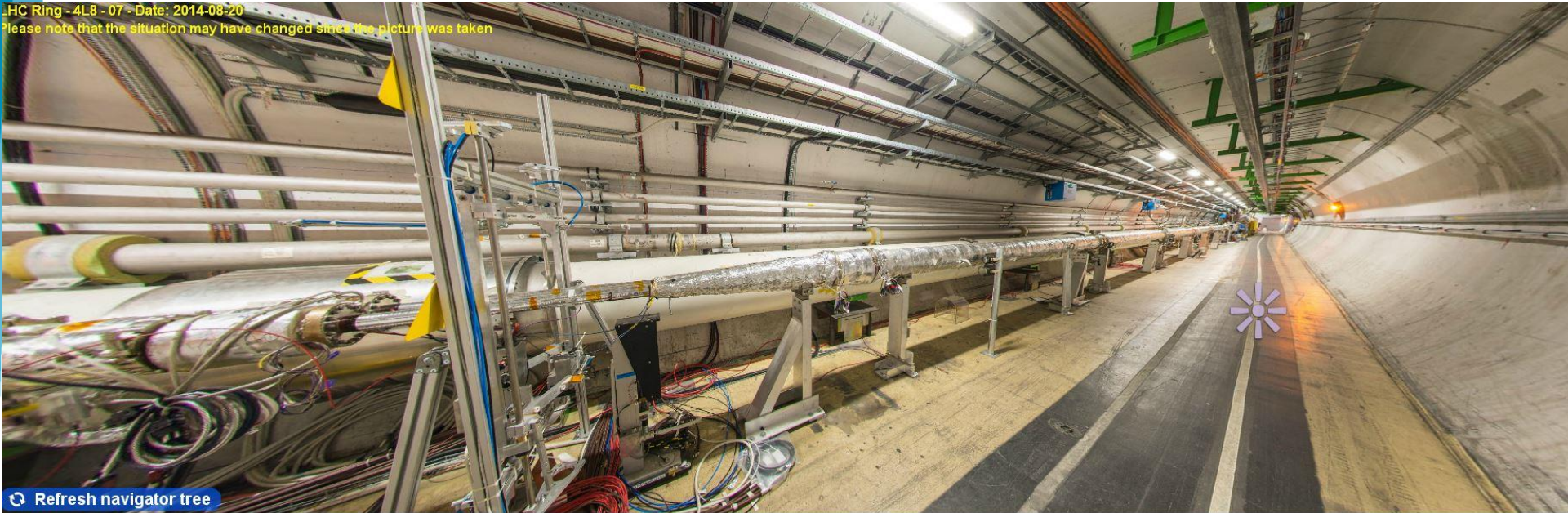
Files :  
[lhclj\\_0504-v0.plt](#)

EDMS Id : [4087307](#) LHC photo 6S 02 R1 L 8 Inv. Version 1 Released



LHC Ring - 4L8 - 07 - Date: 2014-08-20

Please note that the situation may have changed since the picture was taken



Refresh navigator tree

INTERNAL Full Screen View (2014-08-20)

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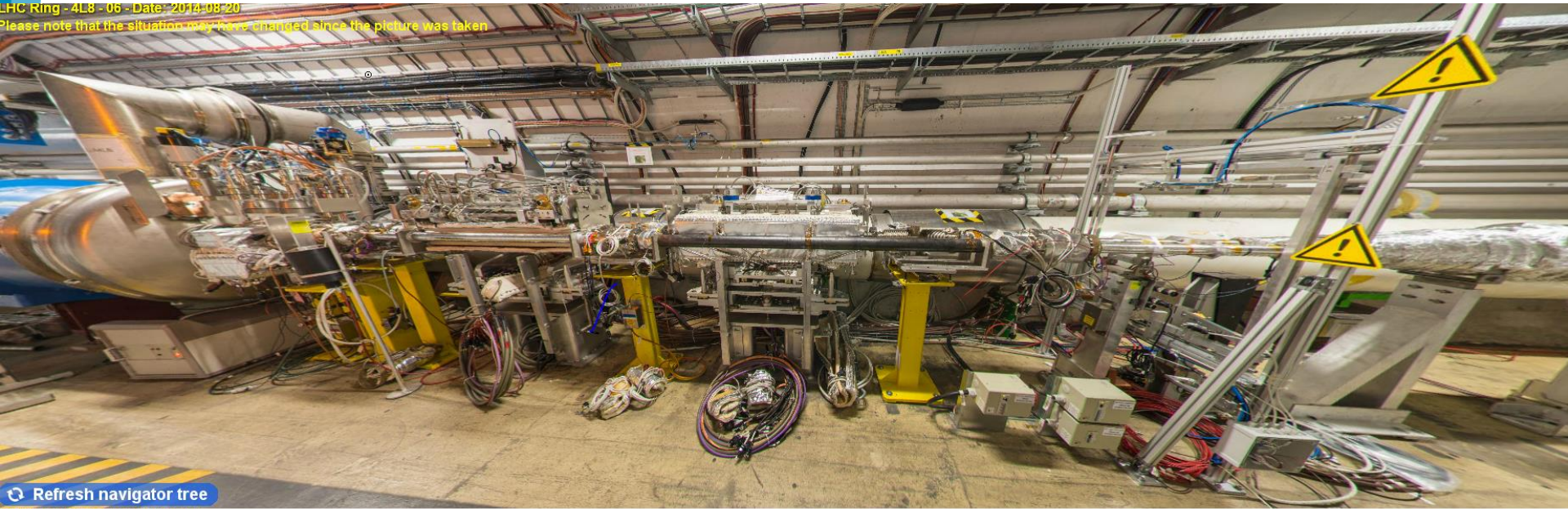
files :  
cclj\_0504-v0.plt

EDMS Id : 1087307 LHC photo: 66.Q2.B1L8.jpg Version 1 Released



LHC Ring - 4L8 - 06 - Date: 2012-08-20

Please note that the situation may have changed since the picture was taken



Refresh navigator tree

INTERNAL Full Screen View (2014-08-20)

DOCUMENTS

EDMS Id : **454857** LAYOUT HALF\_CELL C2L8

Files :  
hclj\_0504-v0.plt

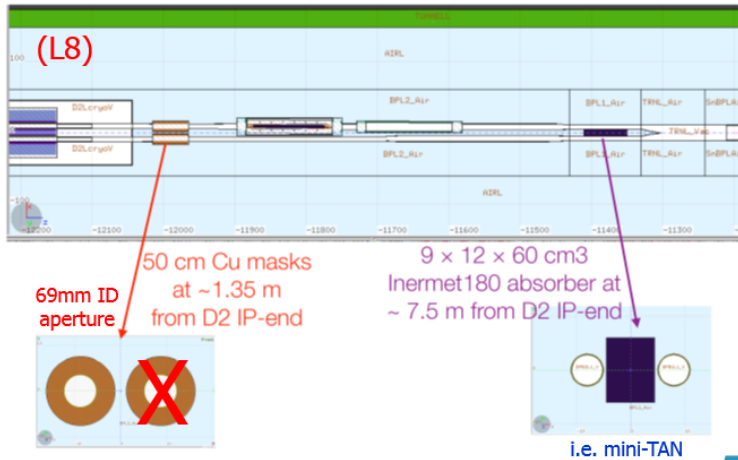
EDMS Id : **1087307** LHC photo: 66.Q2.B1L8.jpg Version 1 Released

It became clear that there's no space available for the elements, unless changing the lay-out or finding alternatives to the protection scheme.

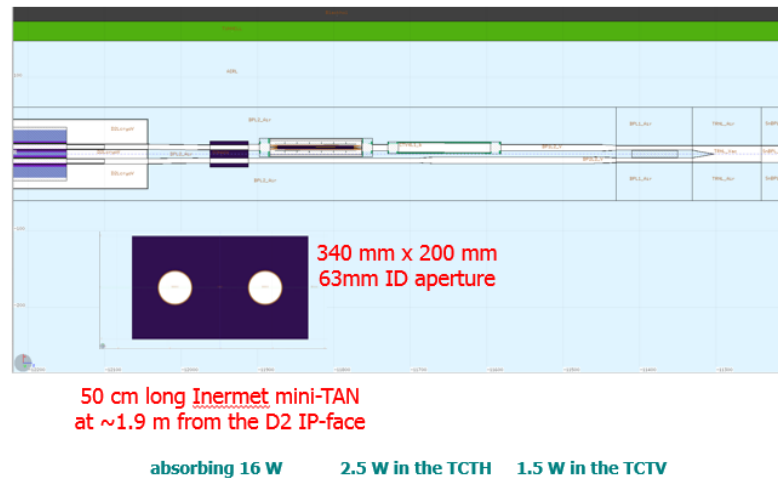
# Alternative options



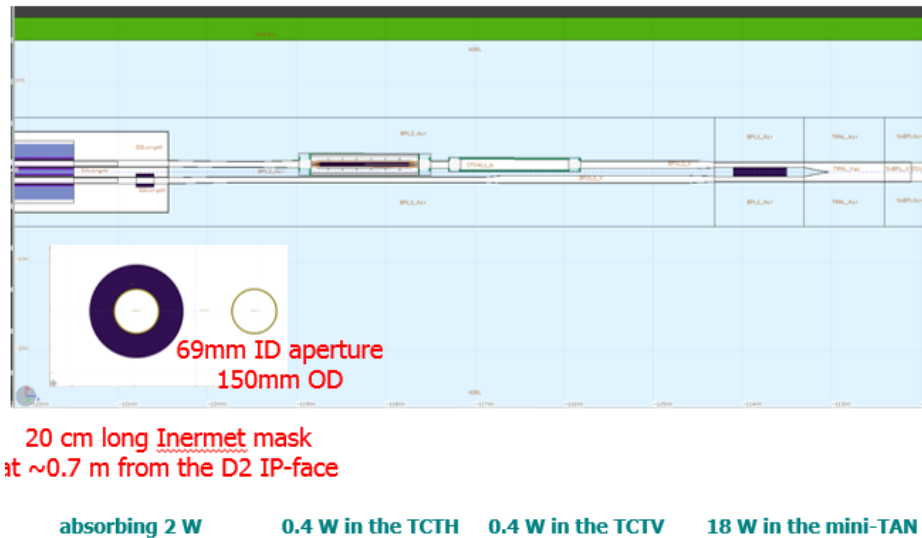
## TWO PROTECTION ELEMENTS FOR LS2



## OPTION 2: A DISPLACED mini-TAN ALONE



## OPTION 3: COLD MASK (+ FORMER mini-TAN)

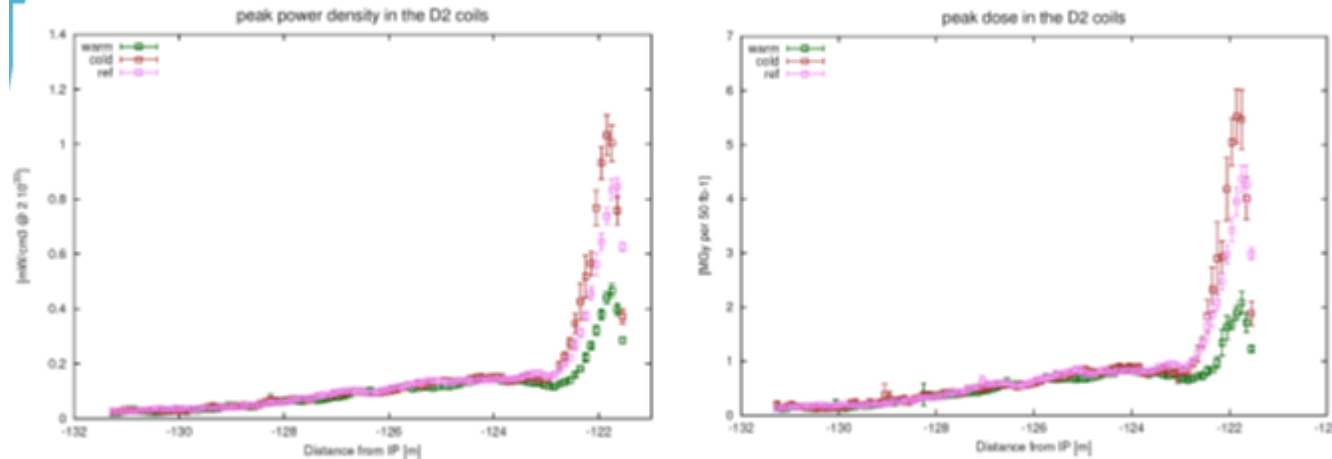


F. Cerutti



# Alternative options

## AND THE WINNER IS [I]

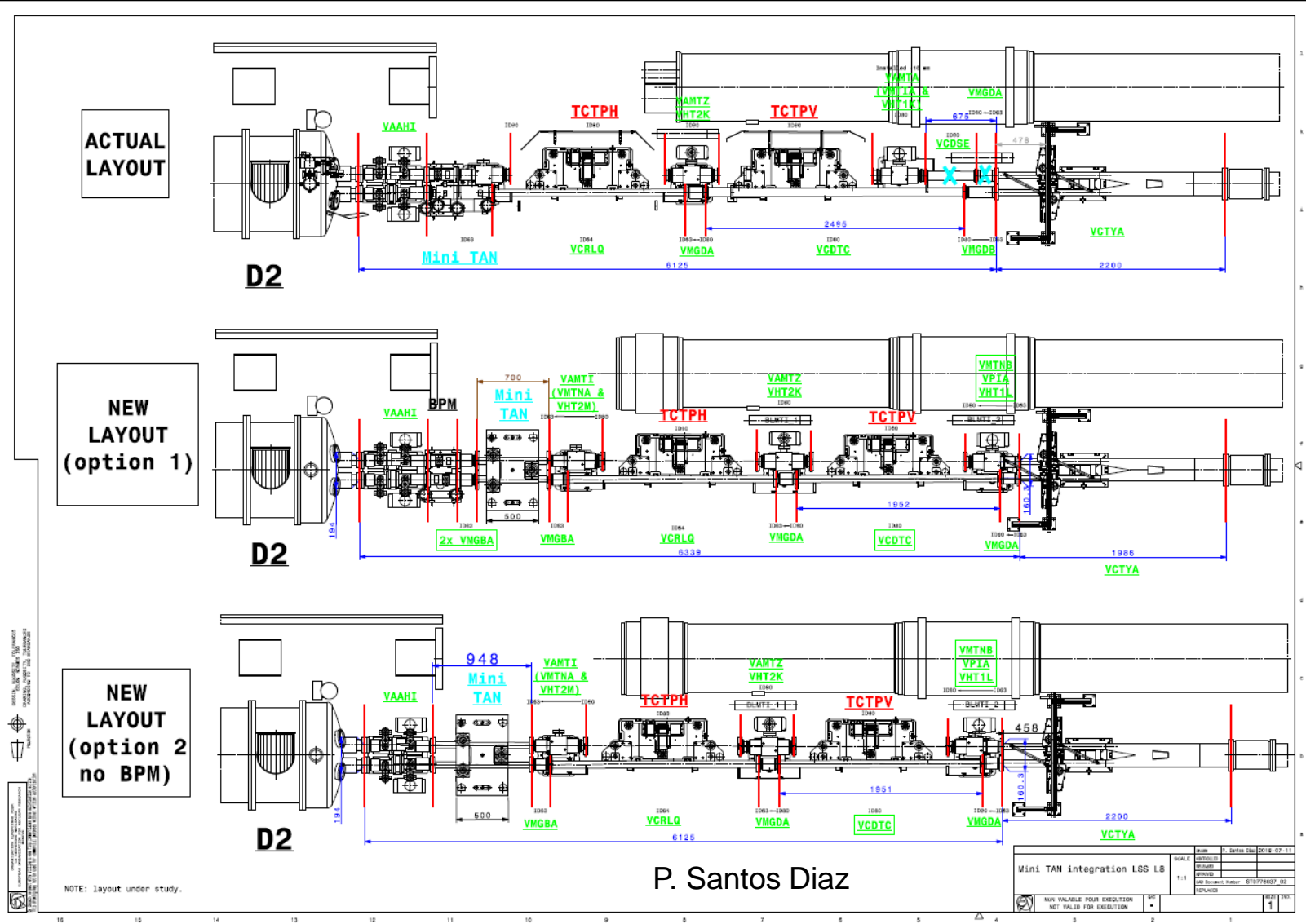


F. Cerutti

clear benefit from option 2

Decision was to integrate a mini-TAN, 500 mm absorber length in front of D2.

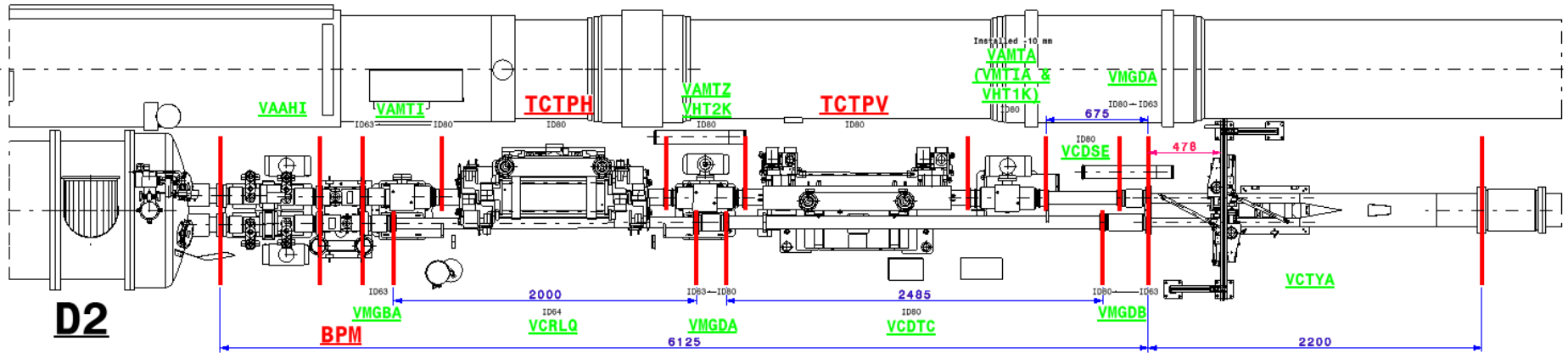
# Finding place



P. Santos Diaz

SCALE	DRAWN	DATE
1:1	P. Santos Diaz	2016-07-11





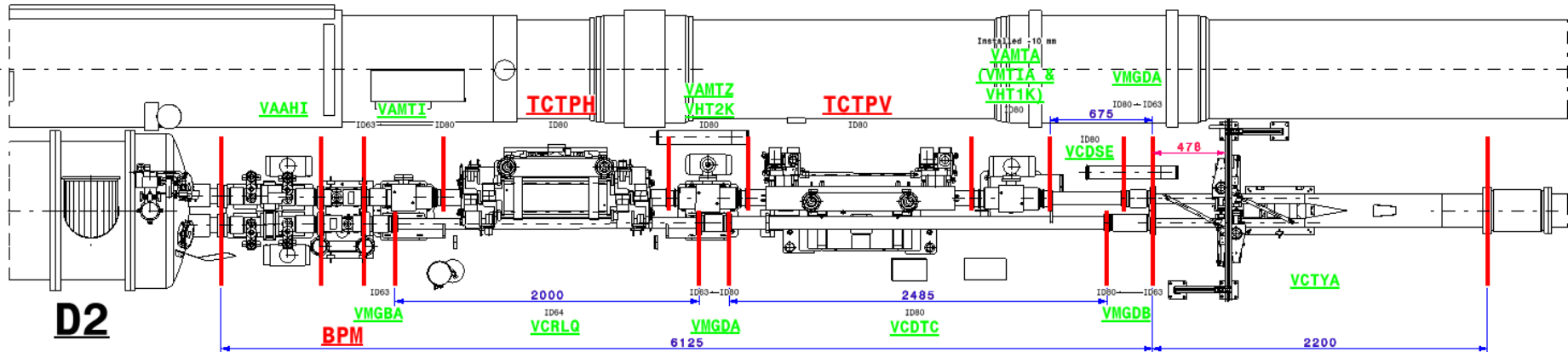
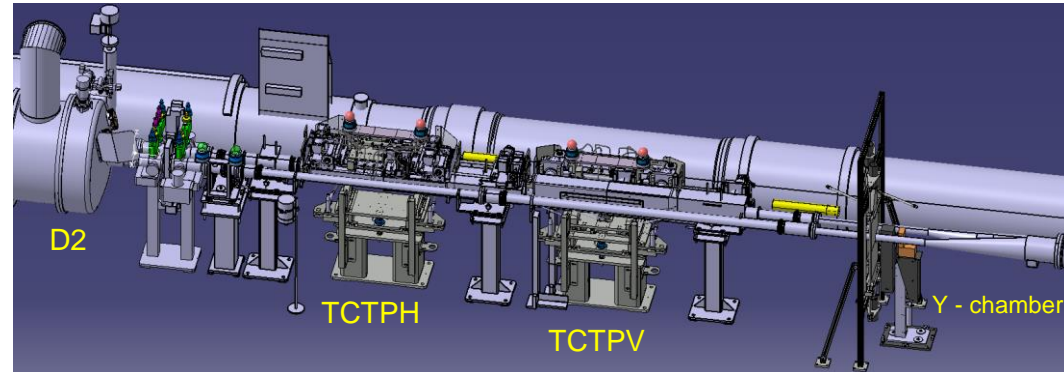
Integration of a 500 mm absorber at the requested location is only possible displacing the collimators.



Ok from optics but there's a "practical" limit in the current position: Chambers are not parallel, moving collimators towards Y-chamber reduce the distance between beam pipes.

# LHC current layout between D2 and Y chamber

- 3D and drawings are not up to date.
- Complex integration.
- Non-conform bakeout system.

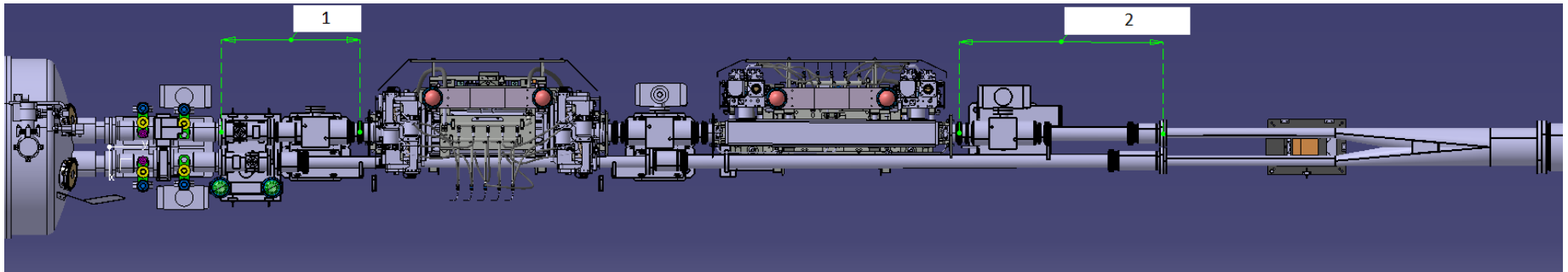


P. Santos Diaz

# Measurements in LSS8L : 14/9/2016

Measurement in-situ of the:

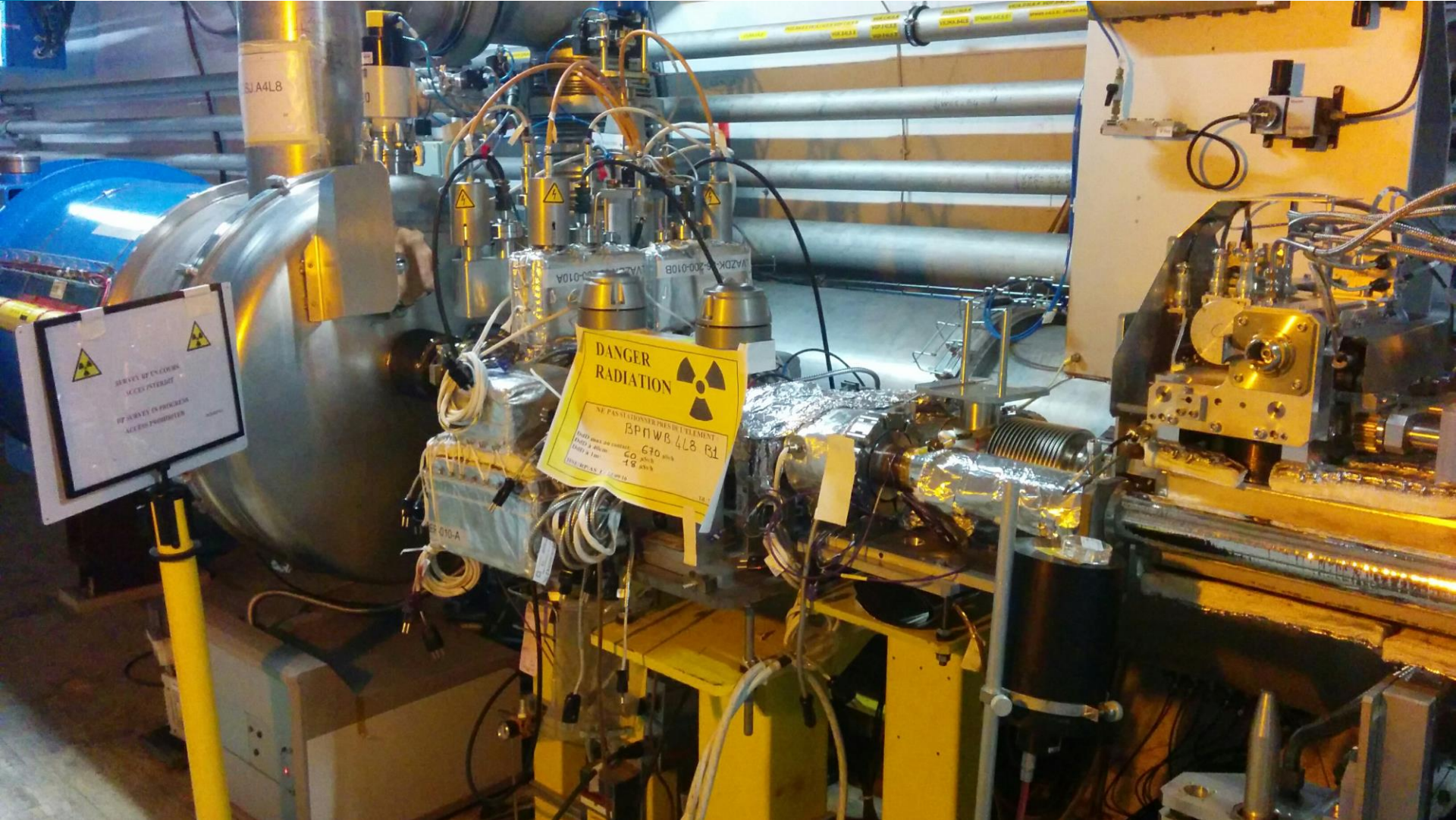
- space available measured between VAB and TCTPH (1) = 805 mm.
- distance between TCTPV and Y-chamber (2) = 1177 mm.



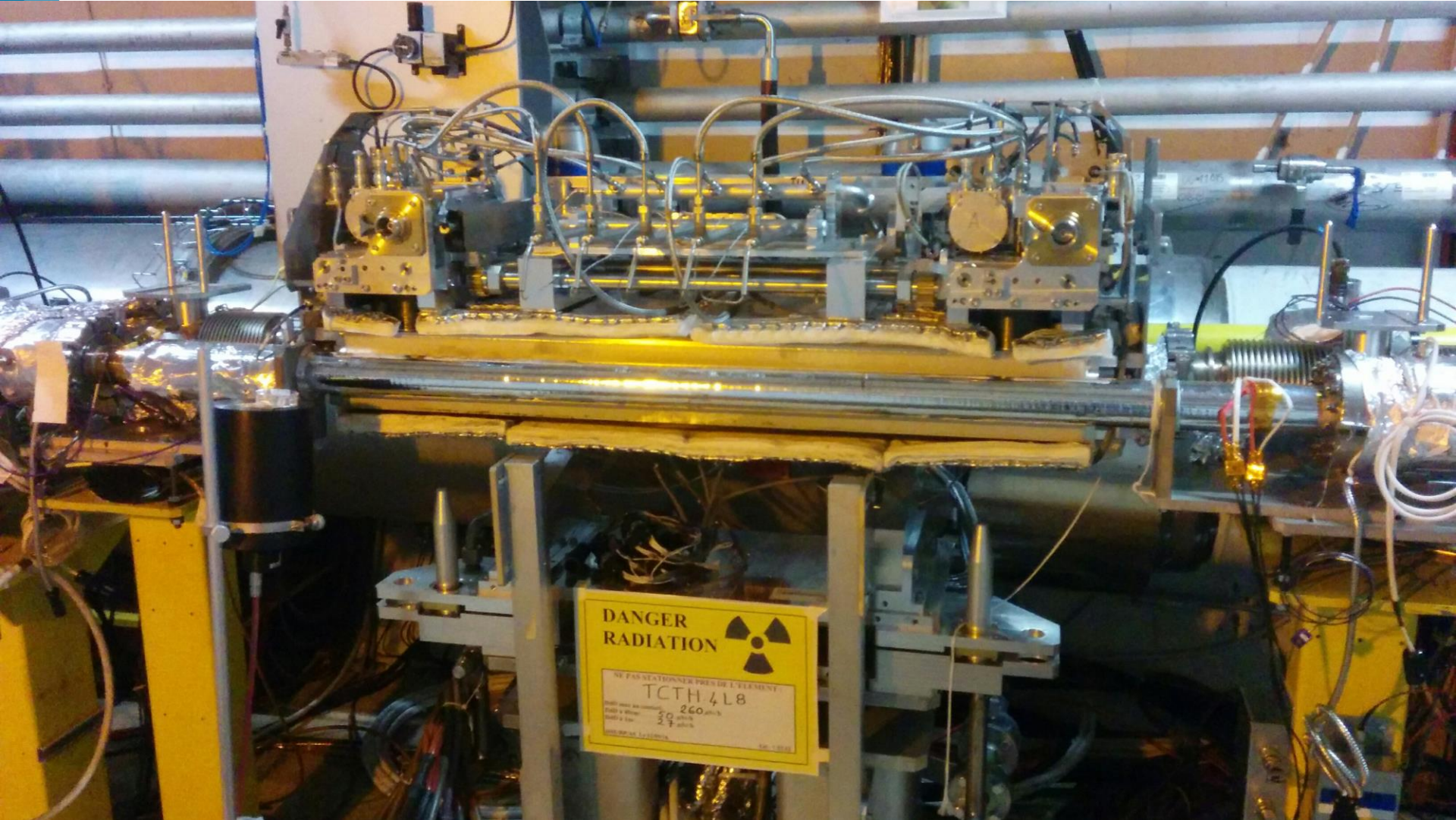
- Cross check value on the right side

P. Santos Diaz

# Measurements in LSS8L : 14/9/2016



# Measurements in LSS8L : 14/9/2016



# Measurements in LSS8L : 14/9/2016



# Measurements in LSS8L : 14/9/2016



Baseline bakeout configuration



TCTPH

TCTPH bakeout jacket (25 mm thickness)

Vacuum chamber (VC)

Vacuum chamber bakeout jacket (25 mm thickness)

Non Conform Present bakeout configuration



Only installed when bakeout is carry out

TCTPH

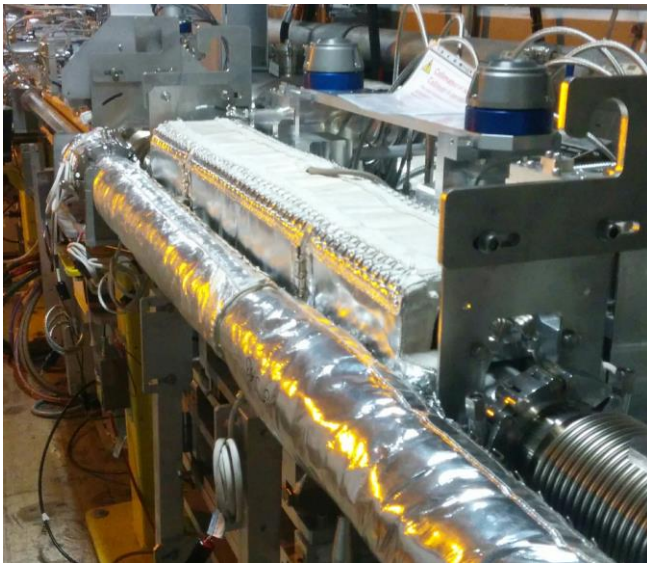
TCTPH bakeout jacket (25 mm thickness)

Vacuum chamber (VC)

Polyamide system (4 mm thickness)

Occasional insulation

## TCTPV



## TCTPH



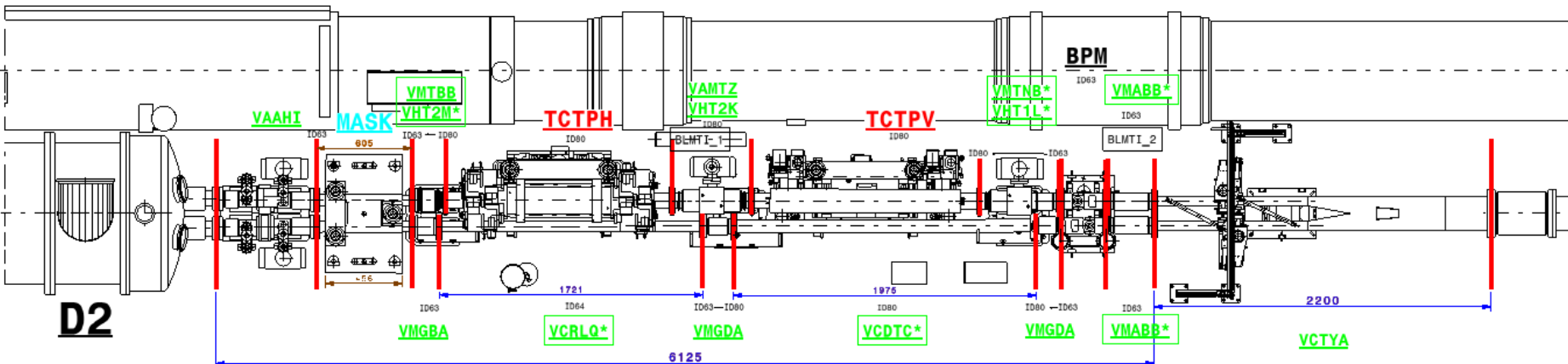
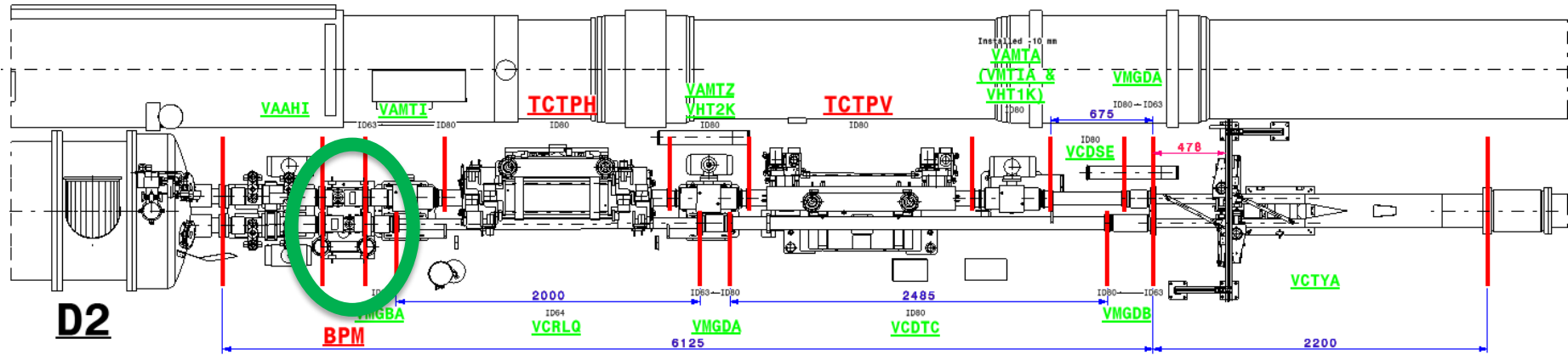


# Observations

- Due to the distance measured (~ 1mm) between the TCTPH and the vacuum chamber next to it and due to the beam merging angle, **it is not possible to displace TCTPV and TCTPH towards IP without reducing further the available space between the two components unless they are modified!**
  - not enough space to install quick connectors between the mask and the vacuum modules.
- **A new bakeout configuration is required for TCTPH and its closest vacuum chamber.** The present baseline is to bake separately the TCTPH and its closest vacuum chamber. Due to the 1 mm distance between them there is not enough space to install the bakeout jackets of both components. To improve the present configuration, an insulation cover is installed during bakeout.

P. Santos Diaz, V. Baglin

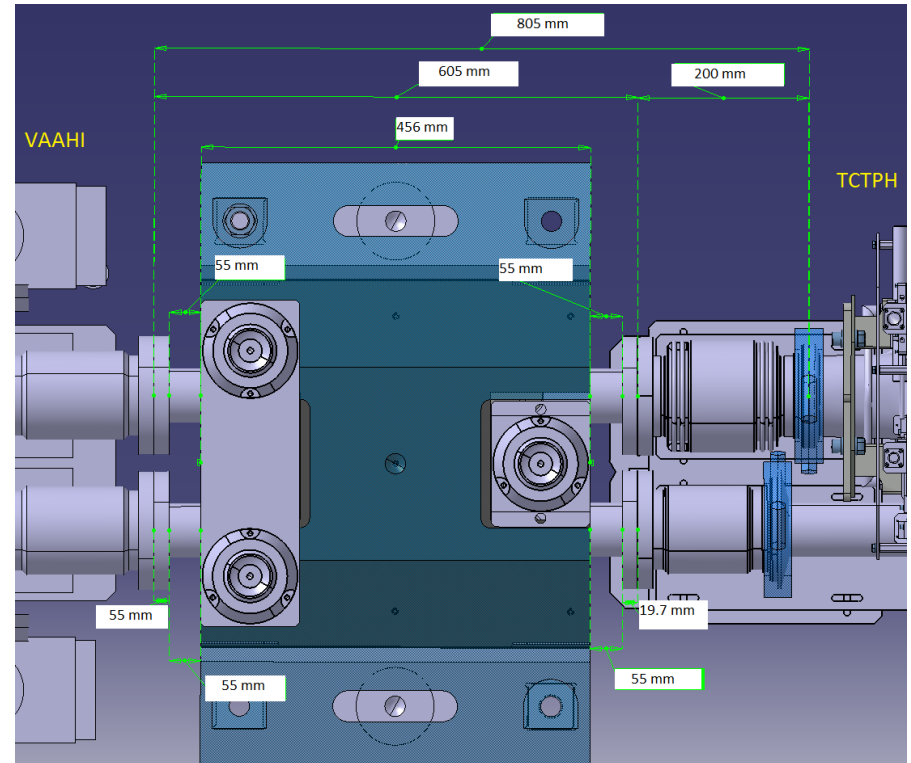
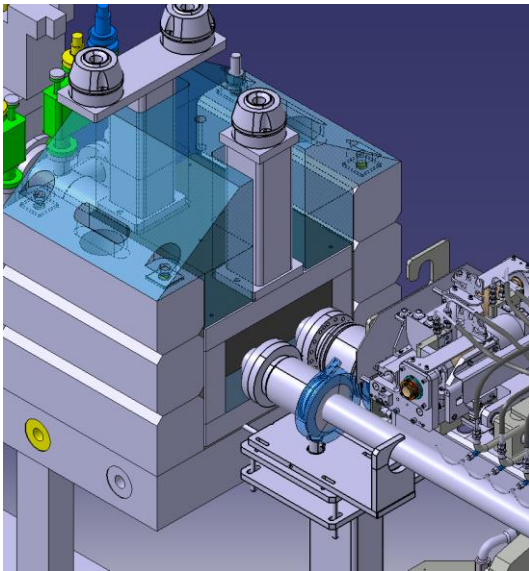
# Proposed layout



P. Santos Diaz, V. Baglin

# Proposed mask configuration

- TOTAL MASK LENGTH 456 mm.
- Bakeout system to be defined/integrated.



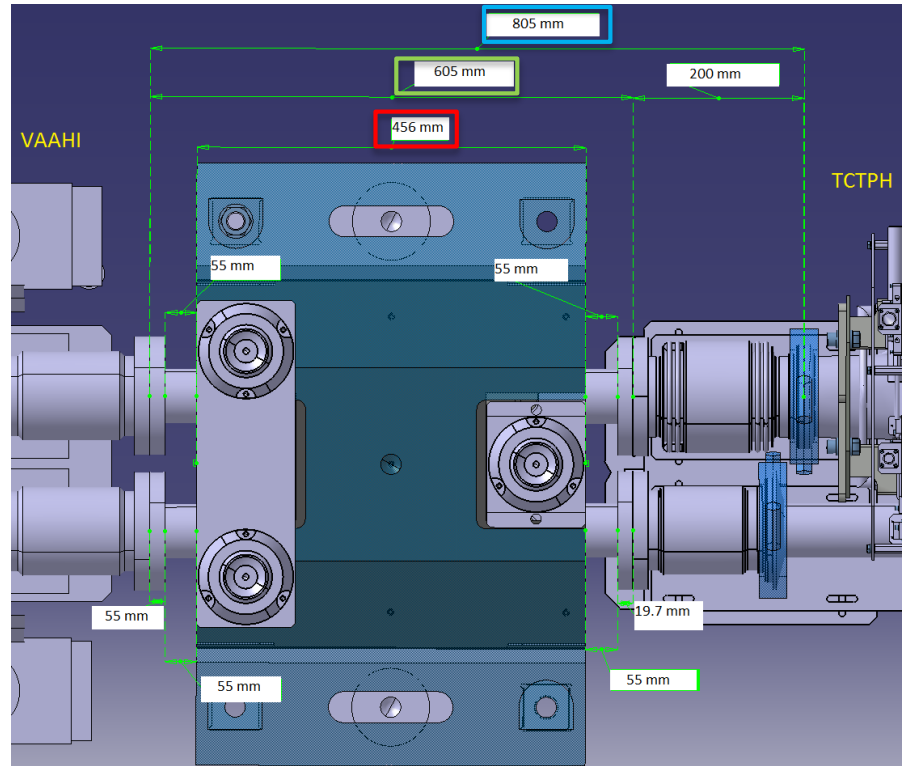
F. Sanchez Galan, 17thHL-LHC TCC, 29 sept 2016

# Mask integration

- The space available measured between VAB and TCTPH in the external beam line to install the Mask is: 520 mm (VAMTI length) + 285 mm (BPM length) = **805 mm**.
- The space for the Mask assembly is: 805 mm (space available measured) – 200 mm (VTMBB below compressed length) = **605 mm**.
- The space for Absorber block is: 605 mm – 19.7 mm\*2 (flanges thickness) – 55 mm\*2 (space required for screws installation) = **456 mm**.
- **TOTAL MASK LENGTH 456 mm.**



Valid mechanical layout from VSC point of view.



F. Sanchez Galan, 17thHL-LHC TCC, 29 sept 2016

# Proposed layout (collimators position fixed)

- **New mask with 456\* mm** shielding longitudinal length. → tbc with STI.
- VAB, TCTPV, TCTPH and Y chamber positions are fixed.
- **BPM displaced close to the Y-chamber.**
- **No chain clamps installed in both side of the mask**
- On the internal beam line the **vacuum chambers** (VCRLQ and VCDTC) **have to be shorten** to adjust them to the new external beam line configuration.
- Bakeout system in TCTPH and VCRLQ\* has to be improved.

F. Sanchez Galan, 17thHL-LHC TCC, 29 sept 2016

# Conclusions

- There will be a single absorber situated in front of D2. Absorber length: ~450 mm
- Layout finished, solution found with a minimal impact in the current LHC layout.
- No displacement of Collimators, no change of Y-chamber, BRAN or LHCb scintillators.

NOTE that Vacuum also plans to improve the bakeout system in TCTPH and VCRLQ\*



***Thanks for the support & close  
collaboration!***

***WP5, WP10, WP12, WP14, WP15. A. Rossi, P. Fessia, F.  
Cerutti, E. Thomas, V. Baglin, R. De Maria, T. Lefevre,  
P. Santos Diaz, S. Jakobsen, E. Bravin, JF Fuchs, L.  
Gentini, J.P Corso, C. Boccard, S. Redaelli, C.  
Bracco, J. Wenninger***



# Next steps

- Detailed engineering design starting, baking & survey & alignment to be included.
- Confirm design approach with RP (no quick connectors at both sides of the mask)
- Confirm protection to D2. (WP10)
- Prepare LHC ECR
- Integrate in LS2 planning
- Any other?