Feasibility and implication of installation of the string test in SM18 with a slope

M. Bajko WP16

Open technical issues under discussions

Integartion

- With SLOPE or not (no request from CRG nor from magnets and Vac)
- Tooling : for Sc link and DFX installation
- Which set up point 1 or 5? Paolo Integration? The most complex one
- String should validate installation and dismounting procedures

Cryogenics:

- Need of a quench buffer, 10 g/s recovery line at warm, operational pressure 20 bars
- Which cooling (point 1 or point 5)
- Do we have spare DFX or we use a standard one?
- V_{He} in a cold mass = 25 l/ m? Herve?

Magnets

- Machine cycles…see with ABP
- Training till Inom? Iultimate?
- Provoked quenches with QHs to check propagation, QH delays
- Tracking test (measurements during ramp?)
- Thermal cycle?

Alignment

- Monitoring also during operation the position of the magnets (installation, cool down, warm up)

Vacuum

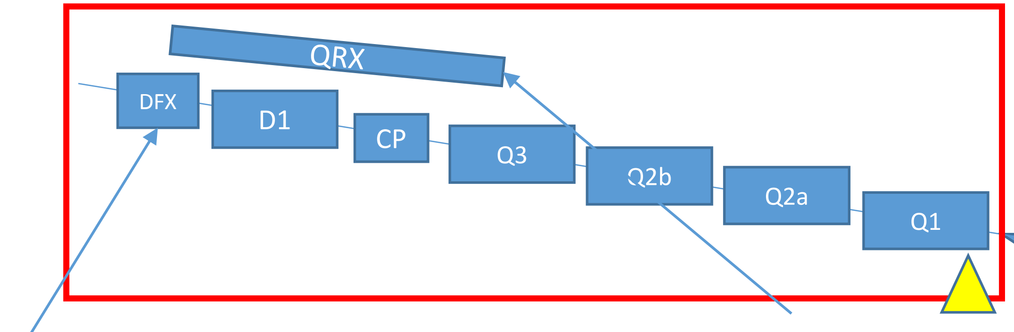
- Beam screen? With dedicated instrumentation? Chaufrettes?
- **De we have counted in the budget the beam screens? 700 kCHF extra cost?WP12?**we would need for Q1 proto (166mm) and D1(6mm dipole) proto , we have for the series but we need to instrument at least one (6 mm quad).

Integration slide1

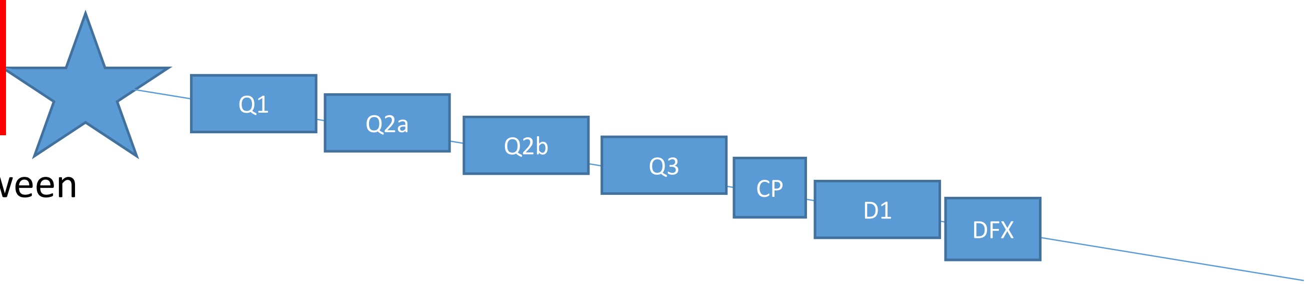
Integartion

- With SLOPE or not (no request from CRG nor from magnets and Vac)
- Tooling : for Sc link and DFX installation
- Which set up point 1 or 5? Paolo Integration? The most complex one
- String should validate installation and dismounting procedures

We have to choose between:
P1 or P5
Where P1L = P5R, and P1R= P5L



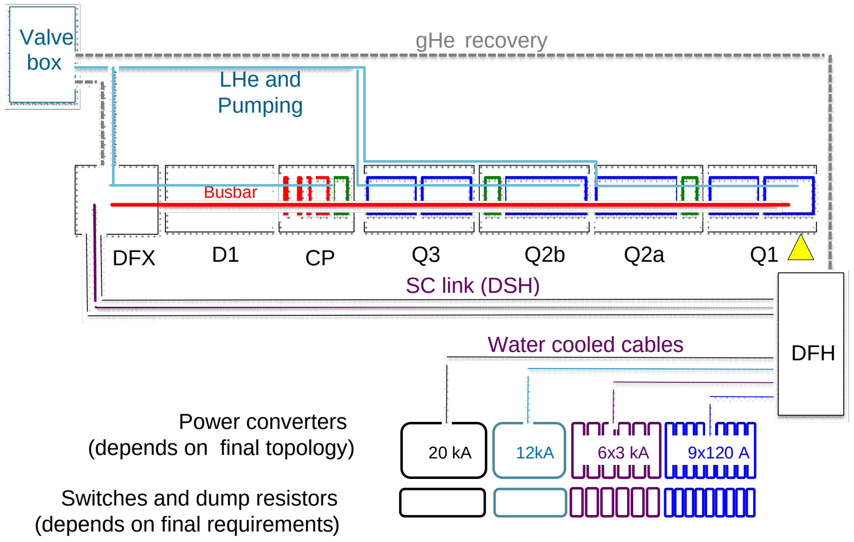
P5



Using the argument of the SM18 set-up the choice is: P5L or P1L
Using the argument of complexity is : P5L

Proximity of existing cryogenic installations

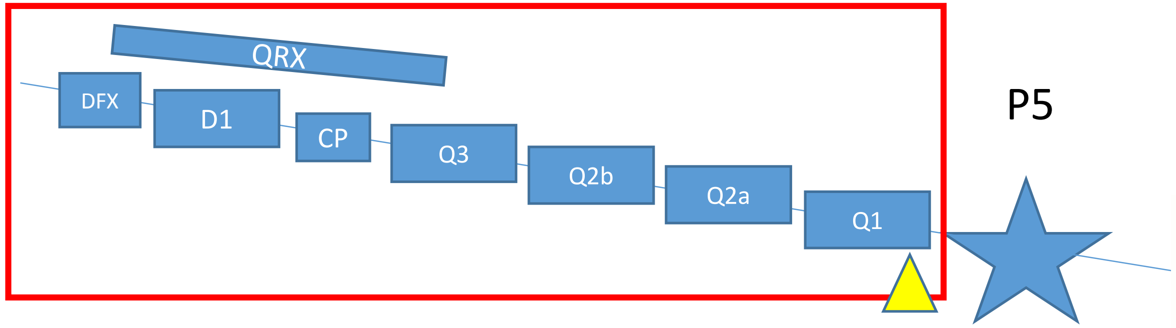
Position of the cryo line between the wall and magnets



P5L is the most complicated and coherent set up with the Sm18 installations and the tunnel is the smallest .
We plan to reproduce the space allowed in that place of the tunnel for the interventions

Integration slide 2

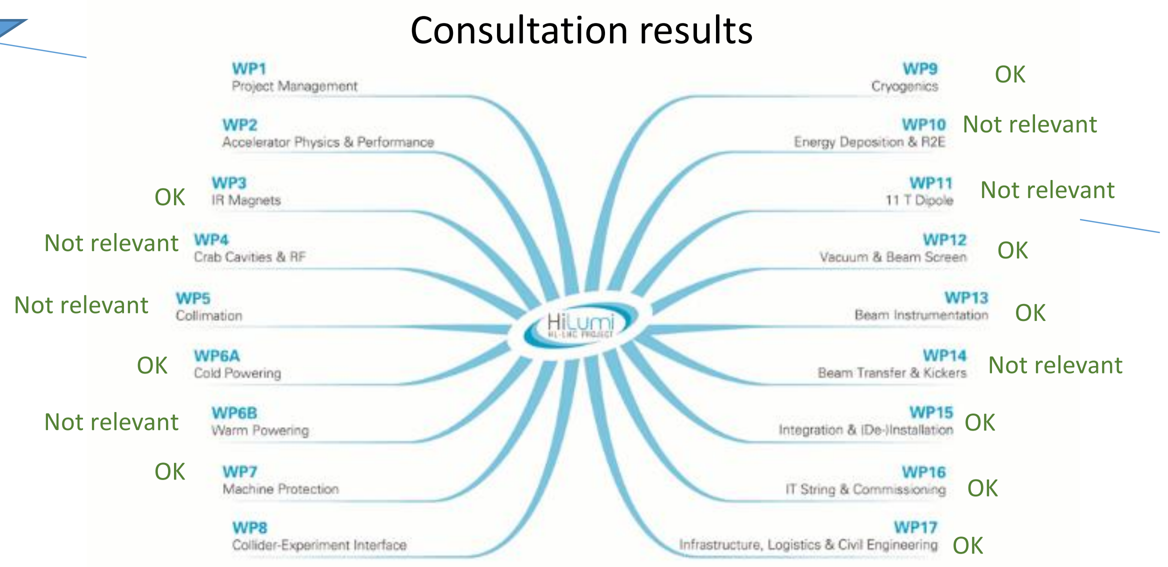
<u>Integartion</u>
- With SLOPE or not (no request from CRG nor from magnets and Vac)
- Tooling : for Sc link and DFX installation
- Which set up point 1 or 5? Paolo Integration? The most complex one
- String should validate installation and dismounting procedures



***P5L** is the most complicated and coherent set up with the Sm18 installations and the tunnel is the smallest .*

We plan to reproduce the space allowed in that place of the tunnel for the interventions

There is no clear show stopper in SM18 to simulate the SLOPE but we did not get till today REQUEST for doing it.



TODAY we do not consider to implement a SLOP for the IT STRING.

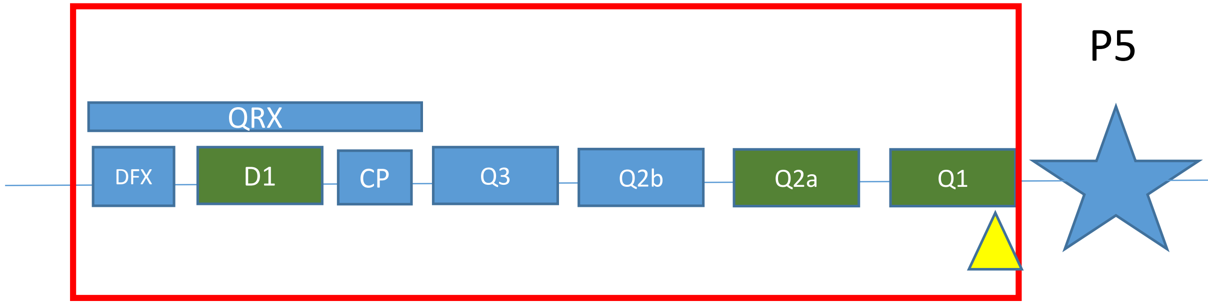
Integration slide 3

Integartion

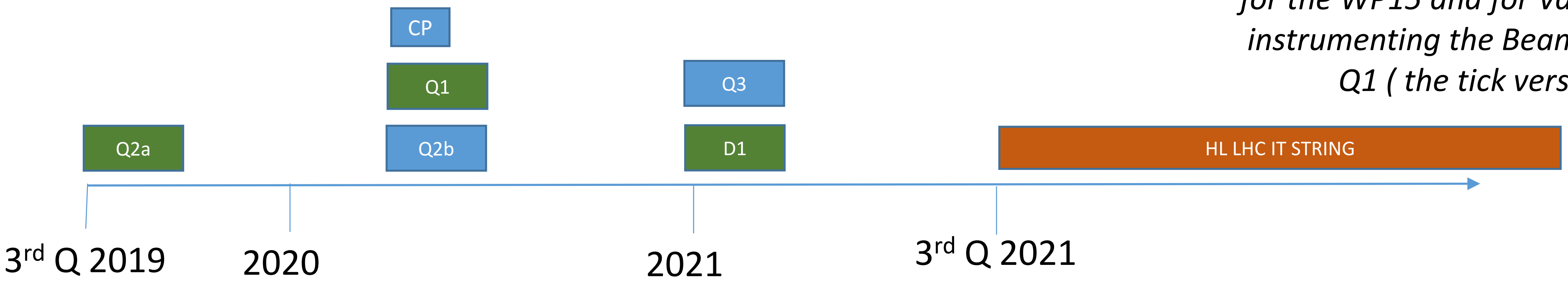
- With SLOPE or not (no request from CRG nor from magnets and Vac)
- Tooling : for Sc link and DFX installation
- Which set up point 1 or 5? Paolo Integration? The most complex one
- String should validate installation and dismounting procedures

Magnets ordered by arrival option 1

- Q2a prototype 1st-3rd Q 2019
- Q2b series 2nd Q 2020
- Q1 prototype 2nd Q 2020
- CP series 2nd Q 2020
- D1 prototype 1st Q 2021
- Q3 series 2nd Q 2021



In principle more difficult the installation and have more interest for the WP15 and for Vac as allows instrumenting the Beam screen of Q1 (the tick version)



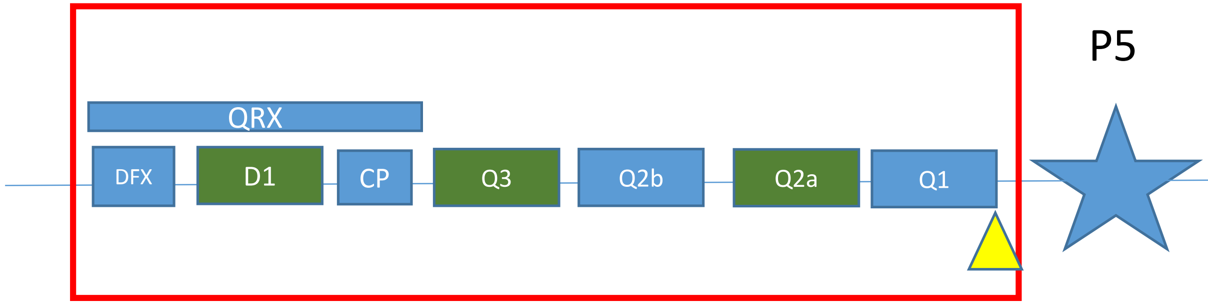
Integration slide 4

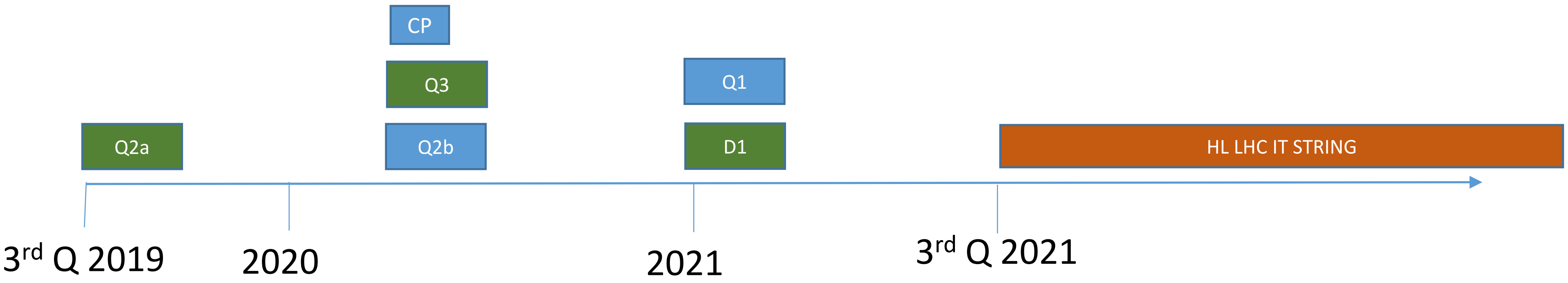
Integartion

- With SLOPE or not (no request from CRG nor from magnets and Vac)
- Tooling : for Sc link and DFX installation
- Which set up point 1 or 5? Paolo Integration? The most complex one
- String should validate installation and dismounting procedures

Magnets ordered by arrival option 2

- Q2a prototype 1st-3rd Q 2019
- Q2b series 2nd Q 2020
- Q3 prototype 2nd Q 2020
- CP series 2nd Q 2020
- D1 prototype 1st Q 2021
- Q1 series 2nd Q 2021





Cryogenics

Cryogenics:

- Need of a quench buffer, 10 g/s recovery line at warm, operational pressure 20 bars
- Which cooling (point 1 or point 5)
- Do we have spare DFX or we use a standard one?
- V_{He} in a cold mass = 25 l/ m? Herve?

***P5L** is the most complicated and coherent set up with the Sm18 installations and the tunnel is the smallest .*

We plan to reproduce the space allowed in that place of the tunnel for the interventions

Antonio Perin is working on the cryogenics. Together with MSC-TF and P. Gayet we are evaluating the pumping capacity for SM18 . *The last conclusion made by L. Serio (with SM18 UPG) was that no need of additional pumping.*

Magnets

Magnets

- Machine cycles…see with ABP
- Training till Inom? Iultimate?
- Provoked quenches with QHs to check propagation, QH delays
- Tracking test (measurements during ramp?)
- Thermal cycle?

I_{nom} is what we have considered thill now.
In the phase of HWC of the STRING 120 quenches were estimated to be done till I nom.
An other 50 quenches are planned to do with the goal of "special test" not done in the shadow of the HWC.

Hardware Commissioning | Special Tests | Hardware Commissioning | Special Tests

magnet name	energy @ nominal [MJ]	nr of quenches aftre 1st cool down					nr of quenches aftre Thermal Cycle				
		LOW 10%Inom	MEDIUM 40%Inom	HIGH 75%Inom	NOMINAL Inom	NOMINAL STUDIES Inom	LOW 10%Inom	MEDIUM 40%Inom	HIGH 75%Inom	NOMINAL Inom	NOMINAL STUDIES Inom
2 xMQXFA (Q1)	9.82	10	8	8	4	8	10	2	2	2	4
MQXFB (Q2a)	8.37	10	4	4	2	4	10	2	2	1	2
MCBXFb(Q2a)	0.1	5	5	5	2	5	5	1	1	1	2
MQXFB (Q2b)	8.37	10	4	4	2	4	10	2	2	1	2
MCBXFb(Q2b)	0.12	5	5	5	2	5	5	1	1	1	2
2 xMQXFA (Q3)	9.82	10	8	8	4	8	10	2	2	2	4
D1	2.15	5	3	3	1	3	5	1	1	1	1
MCBXFA	0.22	5	5	5	2	5	5	1	1	1	2
HO	0.1	9	9	9	0	9	9	4	4	0	4
DSH		0	0	0	1	0	0	0	0	0	0
bus bar		0	0	0	0	0	0	0	0	0	0
DHL											
total in the string	39.07	69	51	51	20	51	69	16	16	10	23
total nr of quenches		173					65				

The Current level has a non-negligible consequence on the energy deposition into the cold mass + extraction and so on the pumping capacity affecting finally also the planning

***1 TC** is planned*

Vacuum

<u>Vacuum</u>

- Beam screen? With dedicated instrumentation? Chaufrettes?
- **De we have counted in the budget the beam screens? 700 kCHF extra cost?WP12?**we would need for Q1 proto (166mm) and D1(6mm dipole) proto , we have for the series but we need to instrument at least one (6 mm quad).

Beam Screens will be installed

Following the magnets availability and the needs in testing all type of beam screens we have:
3 instrumented: Q1 proto, D1 proto and Q2a or Q2b proto

Planning (Draft version)

Font	Schedule	Schedule	Tasks	Insert	Insert	Properties	Editing

Oct '20 · Dec '20 · Feb '21 · Apr '21 · Jun '21 · Aug '21 · Oct '21 · Dec '21 · Feb '22 · Apr '22 · Jun '22 · Aug '22 · Oct '22 · Dec '2

INFRASTRUCTURE	MAGNET INSTALLATION	COOLING	HWC	STUDIES	TC	HWC aftre TC	S	WARMING
Tue 01/09/20 - Mon 28/12/20	Tue 29/12/20 - Mon 17/05/21	Fri 21/05/21 -	Thu 22/07/21 - Mon 31/01/22	Tue 01/02/2				

Task Name	Duration
INFRASTRUCTURE	85 days
MAGNET INSTALLATION	100 days
COOLING	44 days
HWC	138 days
STUDIES	50 days
TC	76 days
HWC aftre TC	61 days
STUDIES aftre TC	10 days
WARMING	32 days

Qtr 2, 2020 · Qtr 3, 2020 · Qtr 4, 2020 · Qtr 1, 2021 · Qtr 2, 2021 · Qtr 3, 2021 · Qtr

Jun · Jul · Aug · Sep · Oct · Nov · Dec · Jan · Feb · Mar · Apr · May · Jun · Jul · Aug · Sep · Oct · Nov · De

INFRASTRUCTURE

MAGNET INSTALLATION

COOLING

HWC

STUDIES

TC

HWC aftre TC

STUDIES aftre TC

WARMING

magnet name	energy @ nominal [MJ]	nr of quenches aftre 1st cool d LOW 10%Inom	MEDIUM 40%Inom	HIGH 75%Inom	NOMINAL Inom	...wn NOMINAL STUDIES Inom
2 xMQXFA (Q1)	9.82	10	8	8	4	8
MQXFB (Q2a)	8.37	10	4	4	2	4
MCBXFb(Q2a)	0.1	5	5	5	2	5
MQXFB (Q2b)	8.37	10	4	4	2	4
MCBXFb(Q2b)	0.12	5	5	5	2	5
2 xMQXFA (Q3)	9.82	10	8	8	4	8
D1	2.15	5	3	3	1	3
MCBXFA	0.22	5	5	5	2	5
HO	0.1	9	9	9	0	9
DSH		0	0	0	1	0
bus bar		0	0	0	0	0
DHL						
total in the string	39.07	69	51	51	20	51
total nr of quenches			173			

magnet name	energy @ nominal [MJ]	nr of quenches aftre Thermal LOW 10%Inom	MEDIUM 40%Inom	HIGH 75%Inom	NOMINAL Inom	Cycle NOMINAL STUDIES Inom
2 xMQXFA (Q1)	9.82	10	2	2	2	4
MQXFB (Q2a)	8.37	10	2	2	1	2
MCBXFb(Q2a)	0.1	5	1	1	1	2
MQXFB (Q2b)	8.37	10	2	2	1	2
MCBXFb(Q2b)	0.12	5	1	1	1	2
2 xMQXFA (Q3)	9.82	10	2	2	2	4
D1	2.15	5	1	1	1	1
MCBXFA	0.22	5	1	1	1	2
HO	0.1	9	4	4	0	4
DSH		0	0	0	0	0
bus bar		0	0	0	0	0
DHL						
total in the string	39.07	69	16	16	10	23
total nr of quenches			65			

SUMMARY

Today we do ***NOT*** consider to implement a ***SLOP*** for the ***IT STRING***.

P5L

is the most complicated and coherent set up
with the Sm18 installations

We plan to make ***1 TC*** *and approximately*
200 quenches up to a

maximum of $\boldsymbol{I_{nominal}}$