



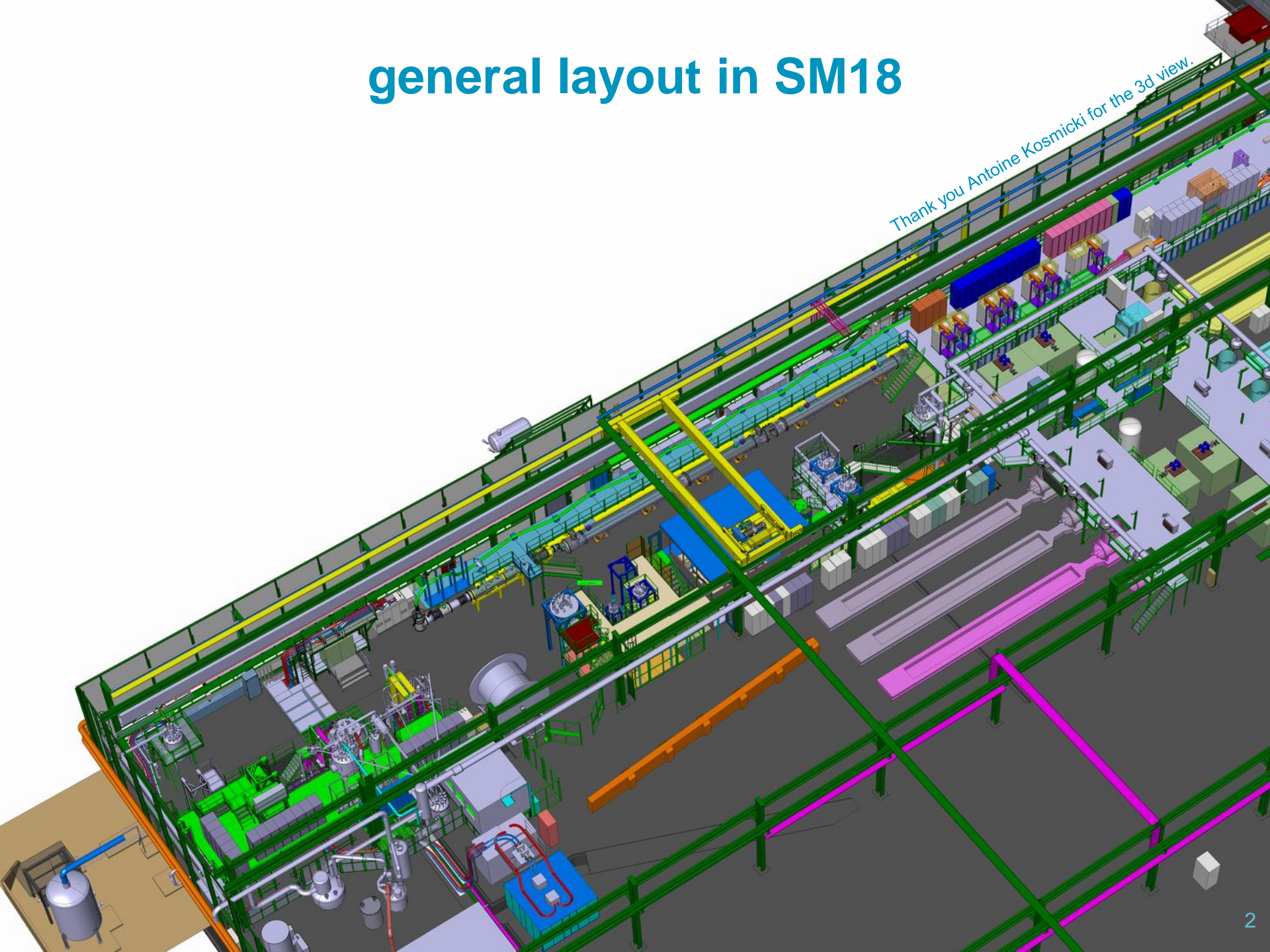
# What is foreseen on string test

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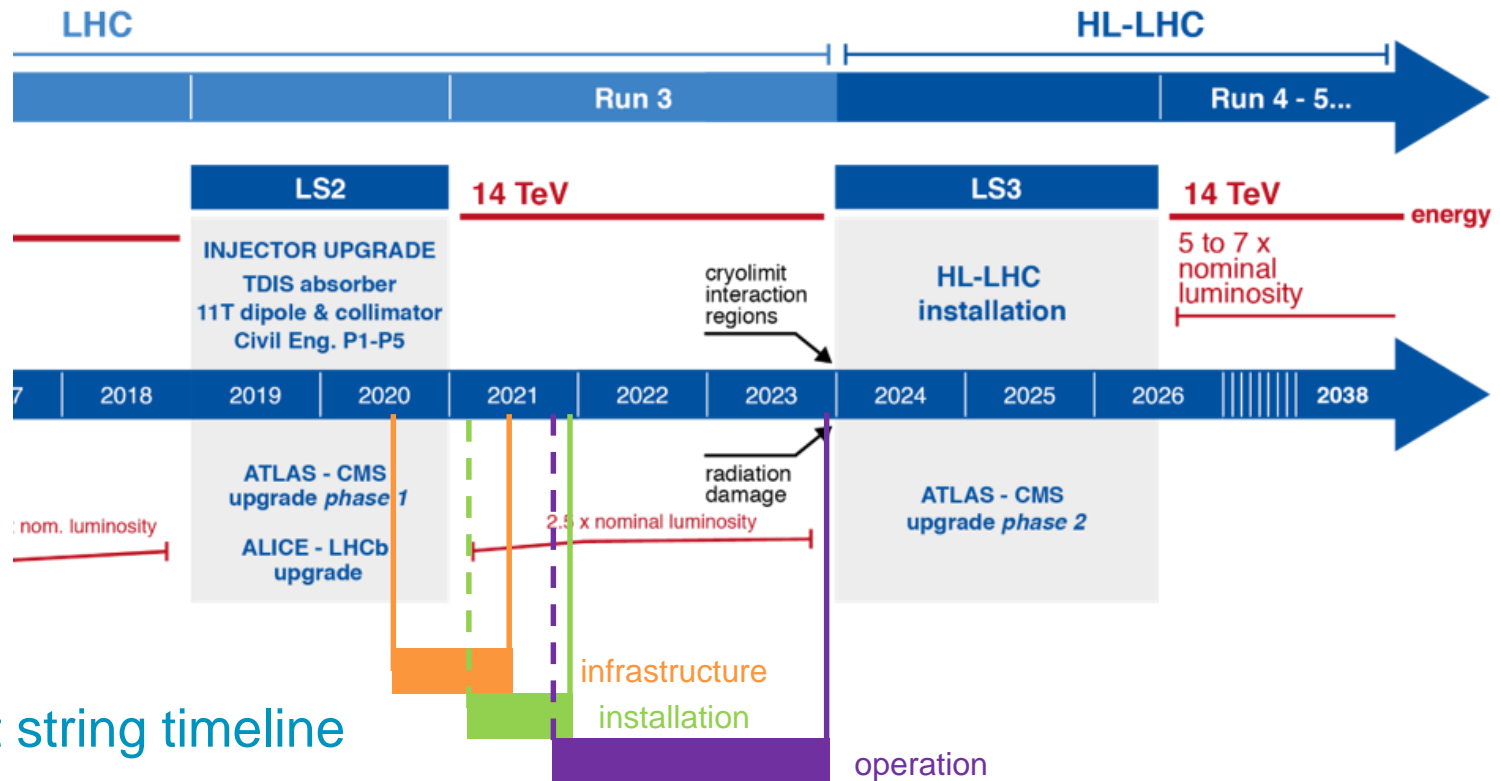


# general layout in SM18

Thank you Antoine Kosmicki for the 3d view.



# timeline & scope



test string timeline

The scope of the string test is to evaluate complete systems and their interaction with systems of other work packages, e.g. interconnection forces, vacuum forces, cold-warm relations.

# WP15.4 contribution

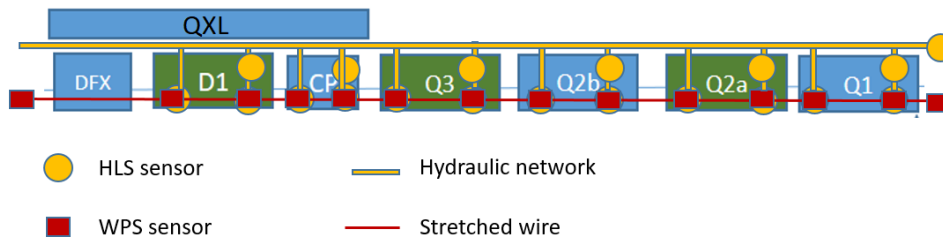
- Fiducialisation (covered during manufacturing)
- Complete process of “standard measurements” for installation  
Geodetic network, QXL, jacks, alignment cryostats before interconnection
- Validation of systems: integration and technical solution  
Installation, operation and validation of the continuous position determination systems
- Full Remote Alignment Operation  
First time operation of Full Remote Alignment system; study impact on other systems (e.g. deformable RF bridges)
- Maintenance during operation  
Maintenance scenarios for Work and Dose Planning time estimation (radio protection) and cryogenic access constraints due to helium spill risk (similar to LHC today)
- Provide data for other work packages<sup>(\*)</sup>
  - Movements during quenches, pump down, cool down
  - Optional: vibration measurements



# continuous position determination systems

To determine the position of the cryostats

- 14 WPS for radial and vertical
- 18 HLS for vertical and roll
- 6 MT-FSI lines for longitudinal position
- 4 MT-FSI inclinometers



To adjust the position of the cryostats

- 18 motorized jacks

To monitor the position of the cold mass inside the cryostat in Q1, Q2a, Q2b and Q3

- 48 MT-FSI lines



# measurements of WP15.4 on string installation

- Alignment (continuous position determination sensors, external)
  - micrometric relative movements between cryostats
  - overall position of the components in the SM18 geodetic network
- Motorized jacks
  - micrometric relative movements
  - backlash behaviour under true load and stroke
- Internal monitoring
  - validate measurements under string conditions with interaction between components
  - follow movements / deformations of interconnected cold masses during thermal cycles

# installation layout

The Inner Triplet string test is a mock-up with HL-LHC components, thus some will reflect

- **true installation**

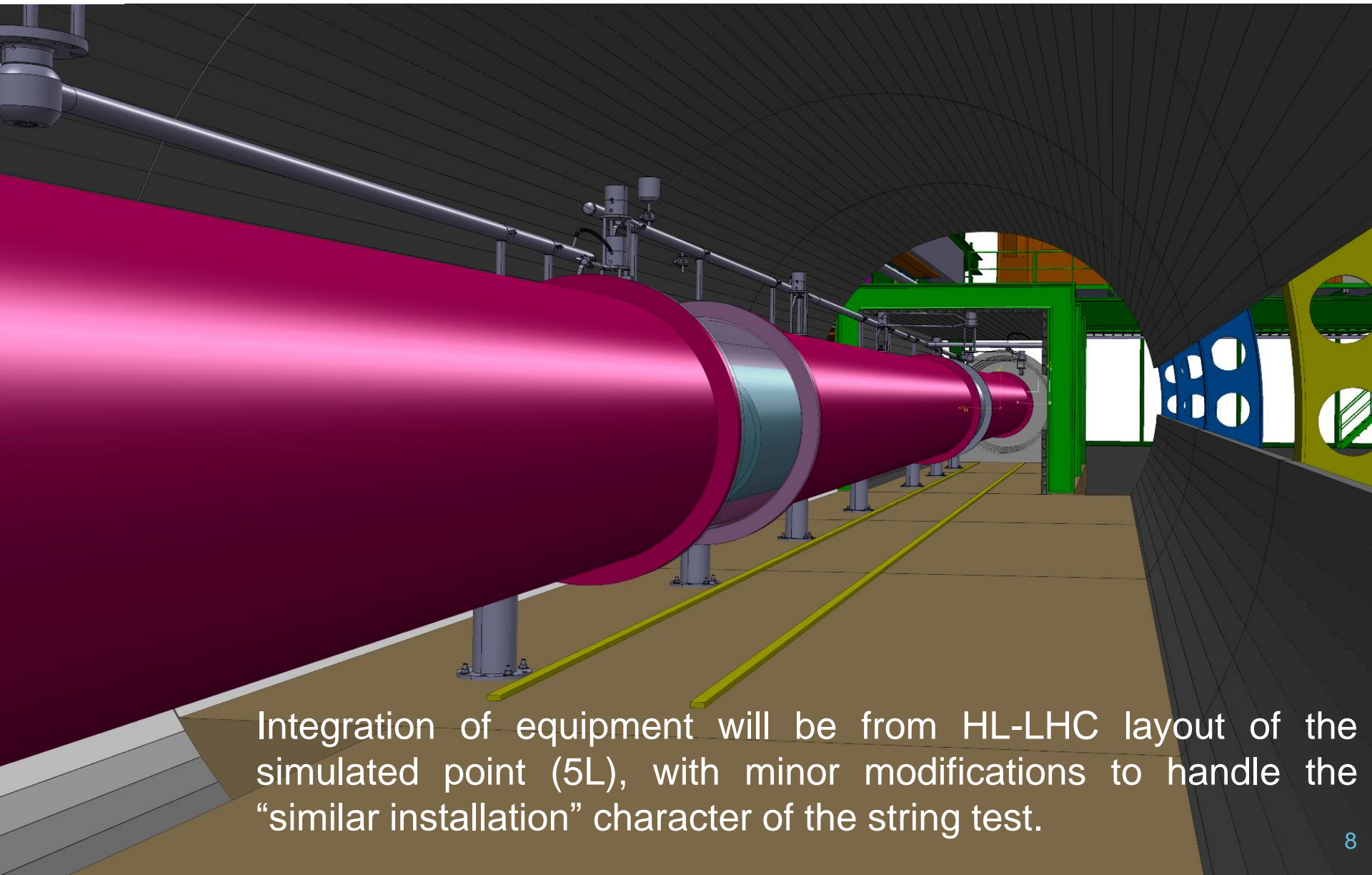
of internal monitoring, HLS and WPS systems on cryostat, inclinometers allowing **full evaluation** of the behaviour from Q1 to D1

- **similar installation of**

- Main hydraulic network of HLS, e.g. horizontal vs. slope installation;
- Supporting of main hydraulic network, e.g. vibrations;
- WPS wire protection;
- Different vibration and electromagnetic interferences possible should have **no influence on test setup**

Reuse as much as possible in later HL-LHC installation.

# integration status



Integration of equipment will be from HL-LHC layout of the simulated point (5L), with minor modifications to handle the “similar installation” character of the string test.



# summary

## HL-LHC string test

- is the only opportunity to check the alignment systems performance in a real environment before the installation in HL-LHC.
- It will offer a fantastic analysis of the behaviour of interlinked cold masses and cryostats under different states allowing to validate simulations and assumptions.
- It will allow to account and validate the impact of the interconnections on the single magnet kinematic.
- From the schedule point of view, it provides a very important intermediary milestone before the LS3.
- It offers a real size training and a very good opportunity to have a better understanding of other systems and their impact on the measurement systems.

The experience will not be the same in case of tests on stand alone components or if test need to be performed in the tunnel (time and risk mitigation).