



Pre-alignment voluntarily displacement

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INPUT

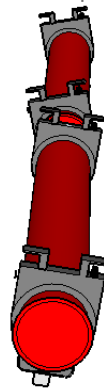
- **Safety layers constraints :**

After the interconnections, the bellows can accept :

- 1 mm of translation



- 1 mrad of torsion



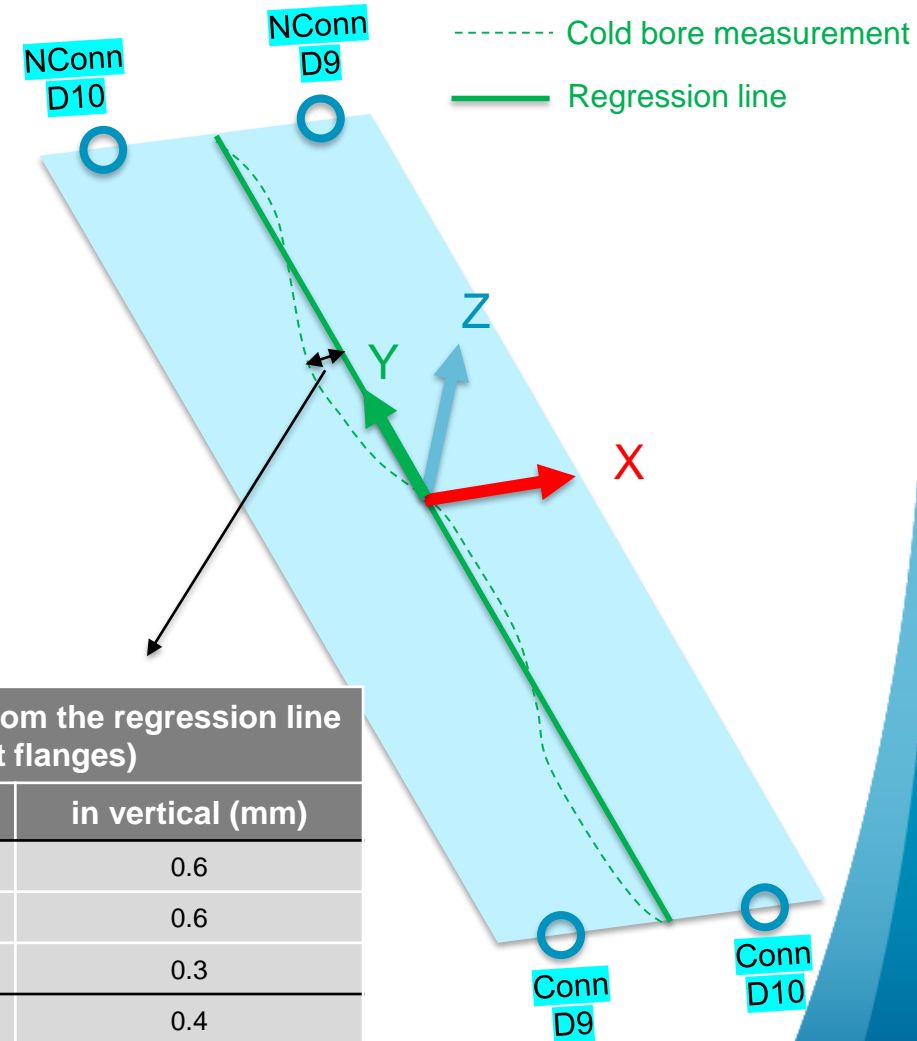
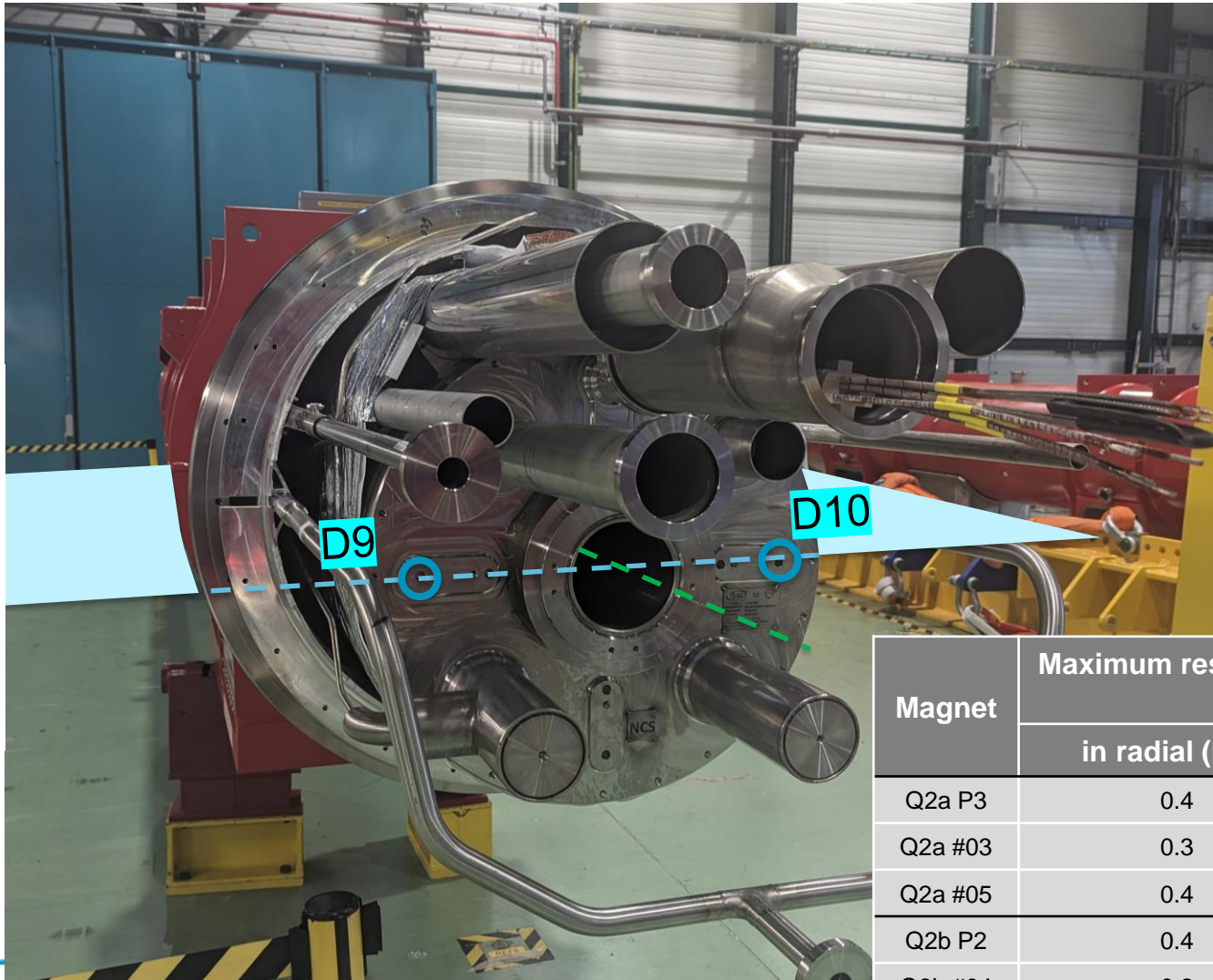
- **Range :**

- FRAS range : +/- 2.5 mm
- Jack range : +/-10 mm

- **Baseline :** When the interconnection is complete, the jacks should be positioned within the mid-range

Mechanical Coordinate system

- Primary axis : Y : Regression line corresponding to the mechanical cold bore axis (determined from mechanical mole)
- Secondary axis : Z : Normal vector of the plane [Conn-D9, Conn-D10, NConn-D9, NConn-D10]
- Origin : Projection of the central cold feet on Y axis

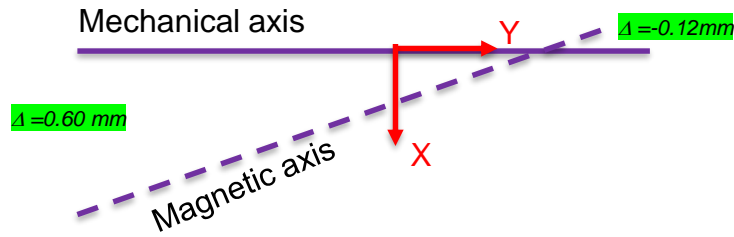


Magnet	Maximum residual from the regression line (except flanges)	
	in radial (mm)	in vertical (mm)
Q2a P3	0.4	0.6
Q2a #03	0.3	0.6
Q2a #05	0.4	0.3
Q2b P2	0.4	0.4
Q2b #04	0.2	0.3
Q3 #01	0.5	0.5

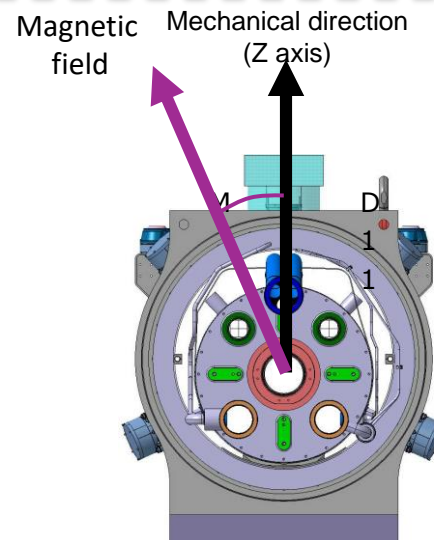
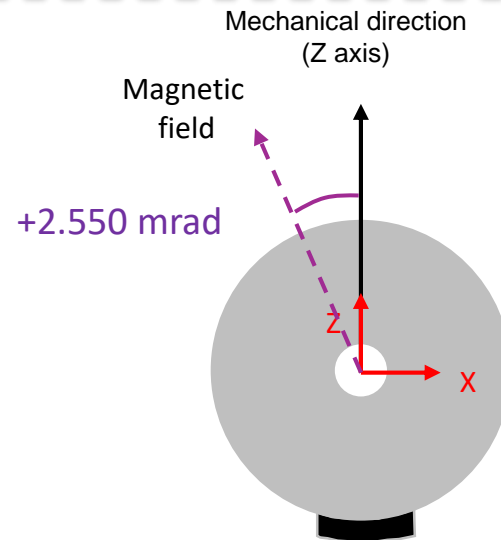
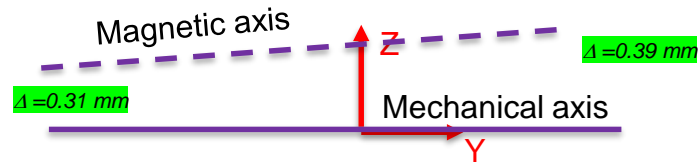
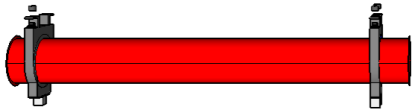
Delta Mechanical and Magnetic (axis and magnetic field)

Q3 #01

Top view



Side view

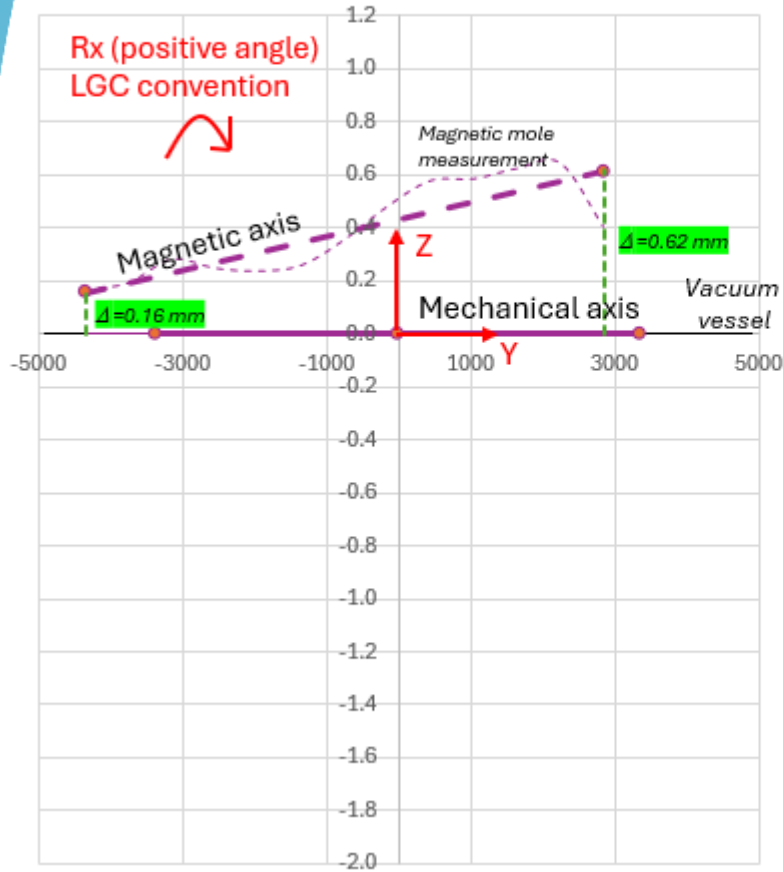


This rotation also occurs between the end cover and the magnetic axis. All the auxiliary lines are installed with respect to the Z-axis.

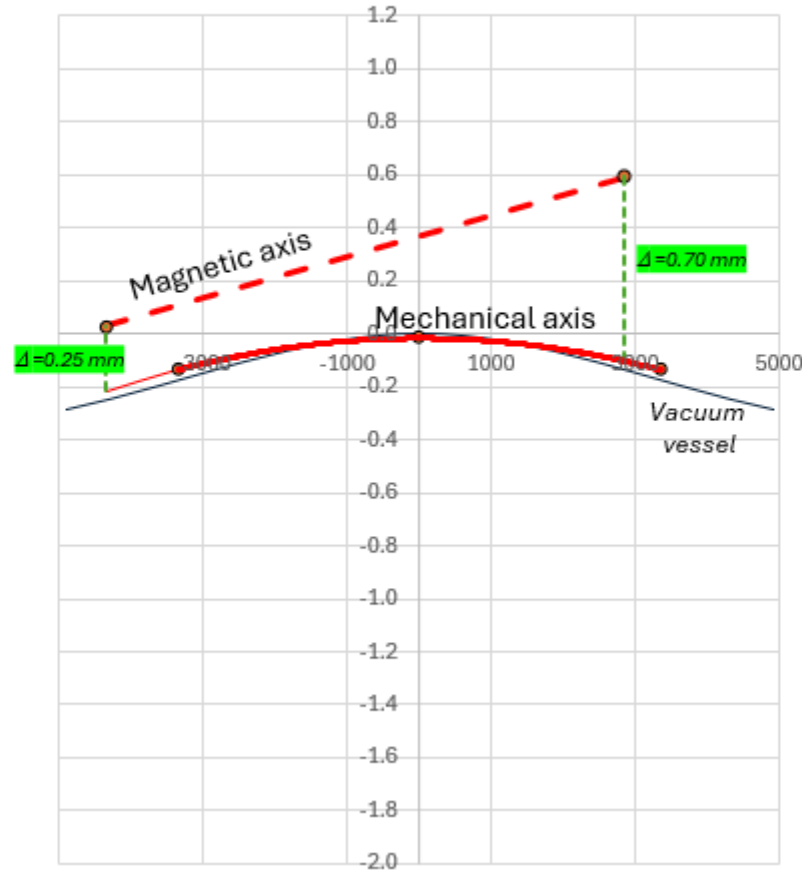
Delta Mechanical and Magnetic (Constant at warm and at cold)

Example : Q2#P3 in vertical

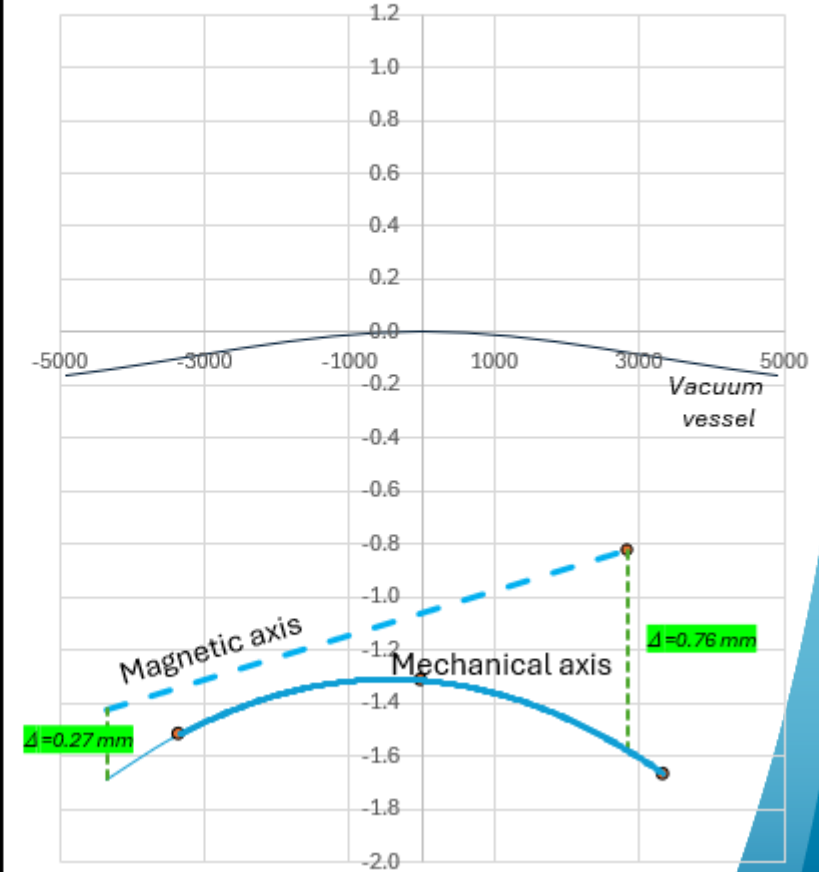
Fiducialisation : SMI2/B180 measurement
Vertical measurement



WARM Ambient pressure : SM18
Vertical measurement

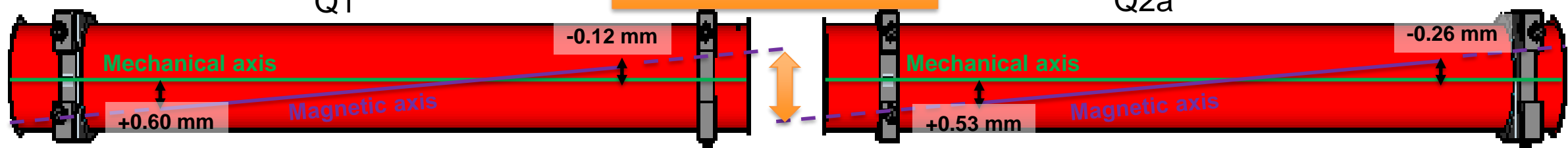


COLD : SM18
Vertical measurement

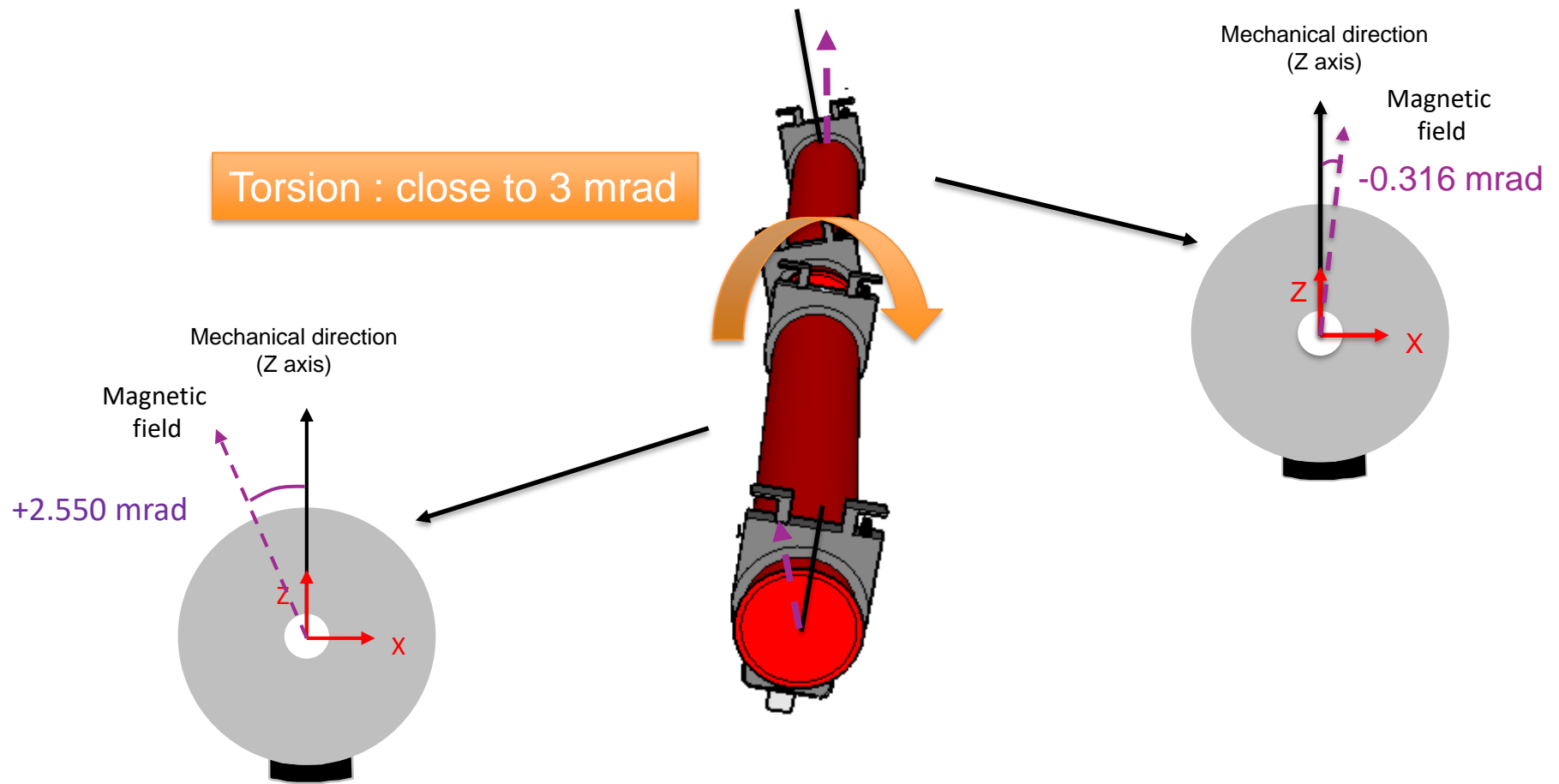


Mechanical or magnetic axis ?

Top view



Torsion : close to 3 mrad



How to manage the different coordinate system ?

R-fiducialisation

= R-mechanical axis (cold mass at warm)

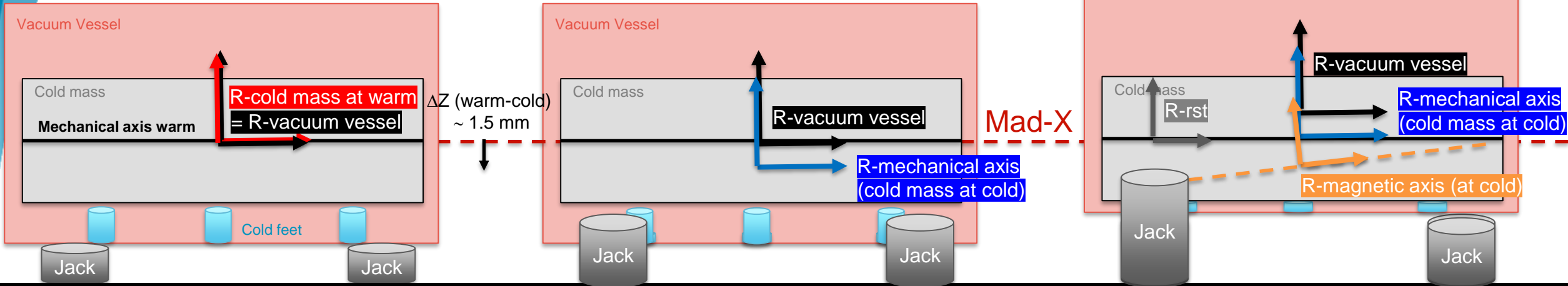
= R-vacuum vessel

R-vacuum vessel R-mechanical axis (warm)

R-mechanical axis (cold)

R-magnetic axis (at cold)

R-rst



floor

For cold element	R-vacuum vessel = R-mechanical axis (warm)	R-mechanical axis (cold)	R-magnetic axis (at cold)	R-rst
Tx (radial)		FSI or Tx = 0	Tx = ...	Tx = 0
Ty (longitudinal)		FSI or Ty = 0	Ty = 0	Ty = ...
Tz (vertical)		FSI or Tz = -1.5 mm	Tz = ...	Tz = 0
Rx (pitch)		FSI or Rx = 0	Rx = ...	Rx = 0
Ry (roll)		FSI or Ry = 0	Ry = ...	Ry = 0
Rz (Yaw)		FSI or Rz = 0	Rz = ...	Rz = 0 or 180 °
Scale		FSI or Scale = ...	Scale = 1	Scale = 1

↓
FSI or Constant

↓
Constant

↓
Constant

Open discussion

- Before the interconnection phase, the elements should be installed in their nominal positions
- The **longitudinal shift** from Mad-X (R-rst) to the fixed cold foot of each component should be implemented
- The **warm-cold delta** should be taken into account prior to interconnection.
- The **mechanical-magnetic delta** should be taken into account prior to interconnection.
- The **direction of magnetic field** should be taken into account prior to interconnection.

→ How to manage the deltas ?

→ By longitudinal shift → **Longitudinal shift from R-magnetic axis at cold to Rrst**

→ By vertical shift → **Warm-cold delta (anticipation)** → **Be careful not to apply it twice (shift + FSI)**

→ By bump : Three bumps exist :

→ Bump : Beam Base alignment

→ Bump : Optimization displacements (aperture) → **mechanical-magnetic delta (MAB validation)**

→ Bump : Mechanical constraints

This implementation is not yet done on geode → On going

→ String Test ?

→ 100% magnetic ?

**Thank you
for your attention**