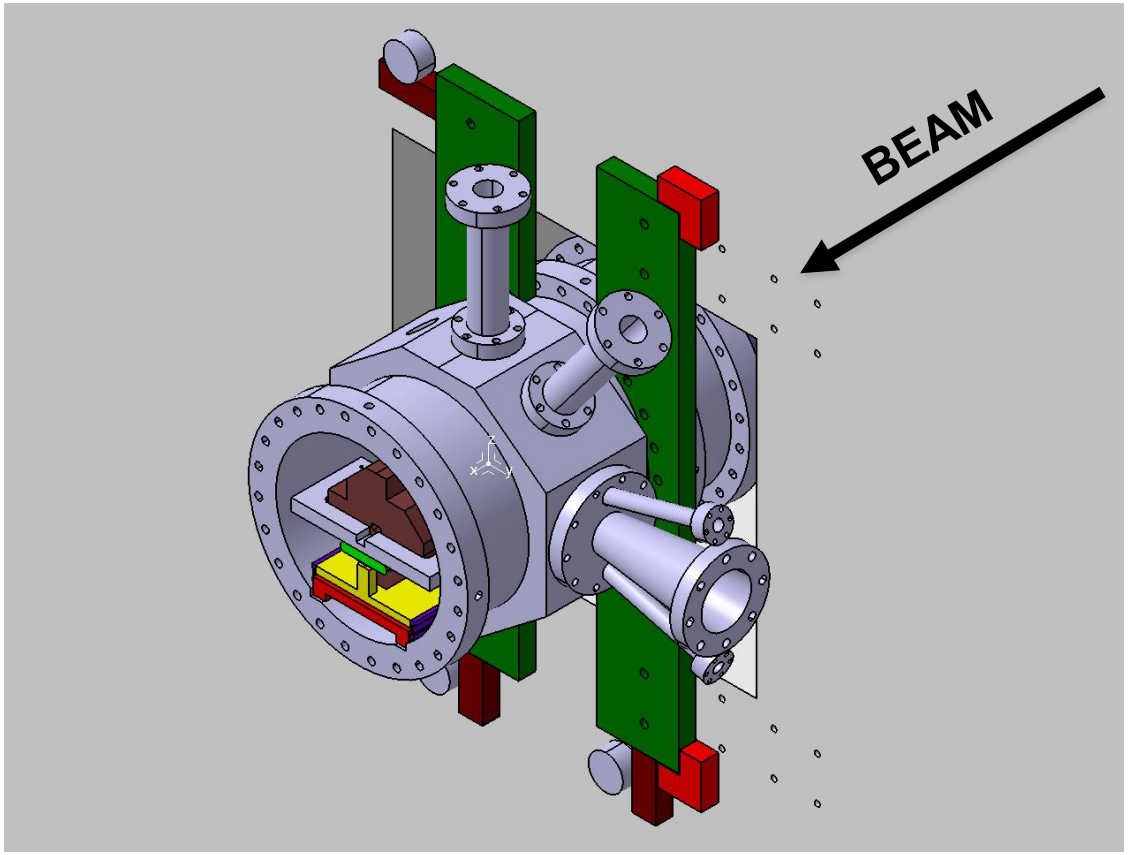
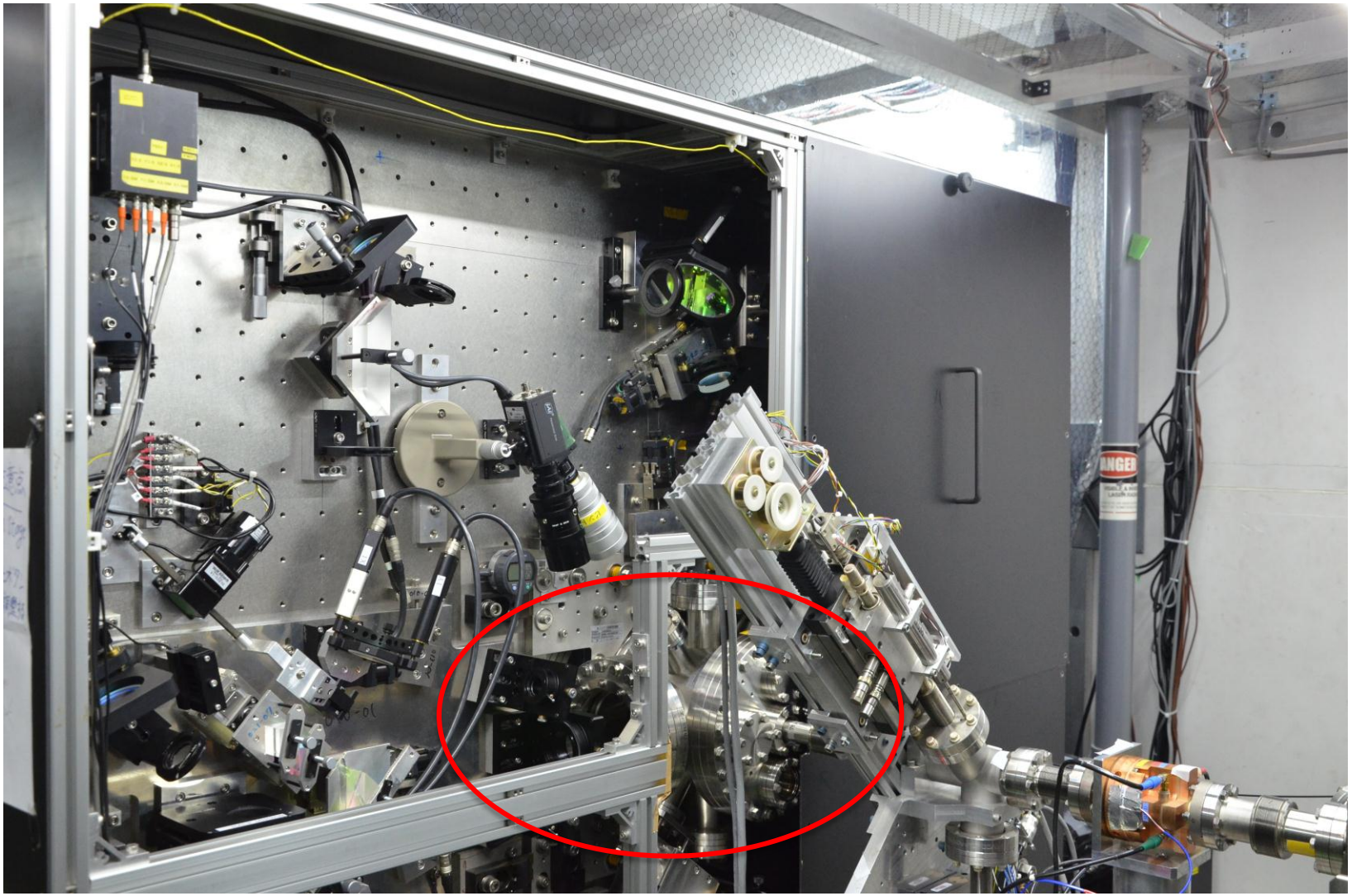
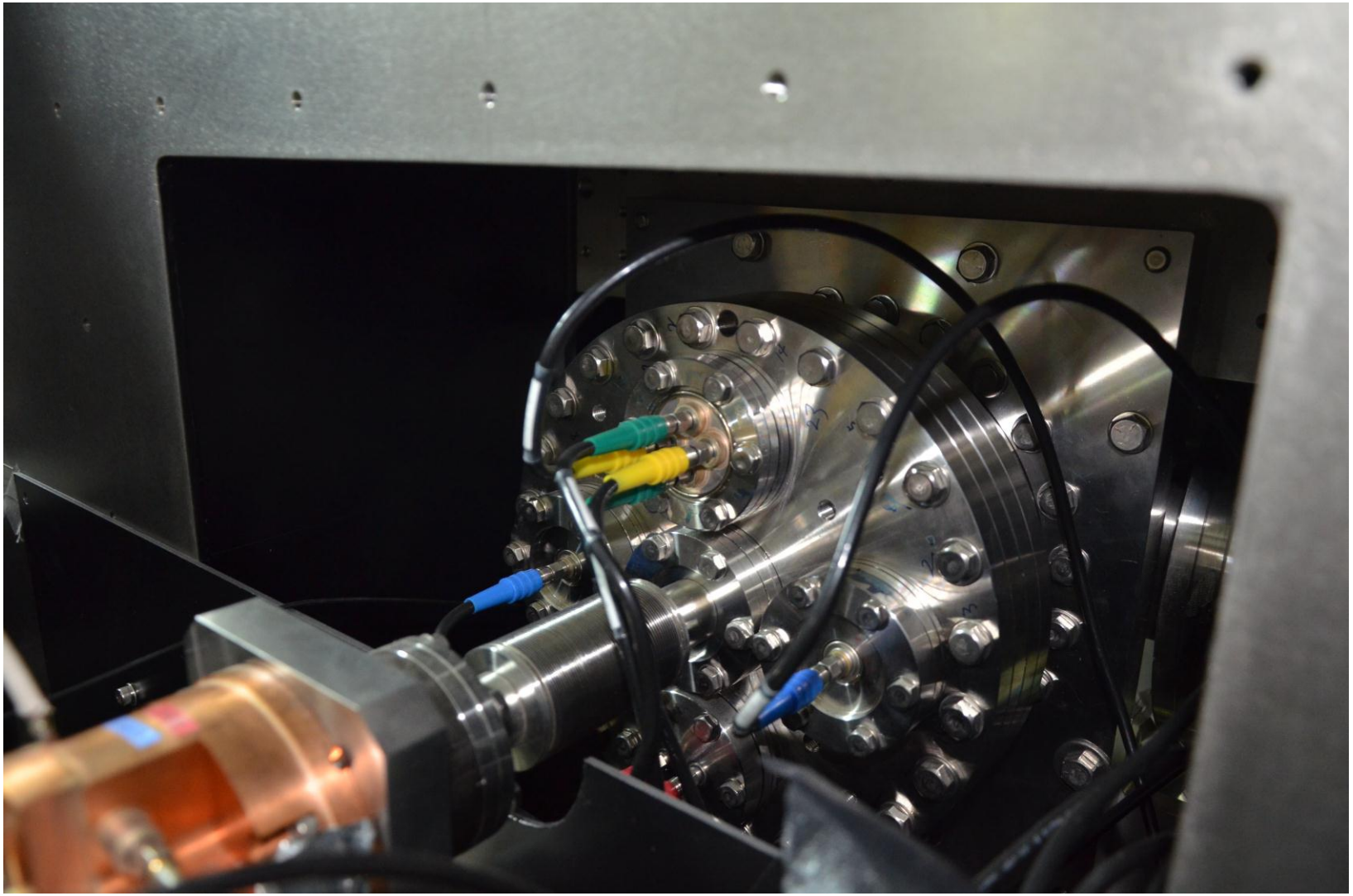
ATF2 IP Chamber Mechanical developments



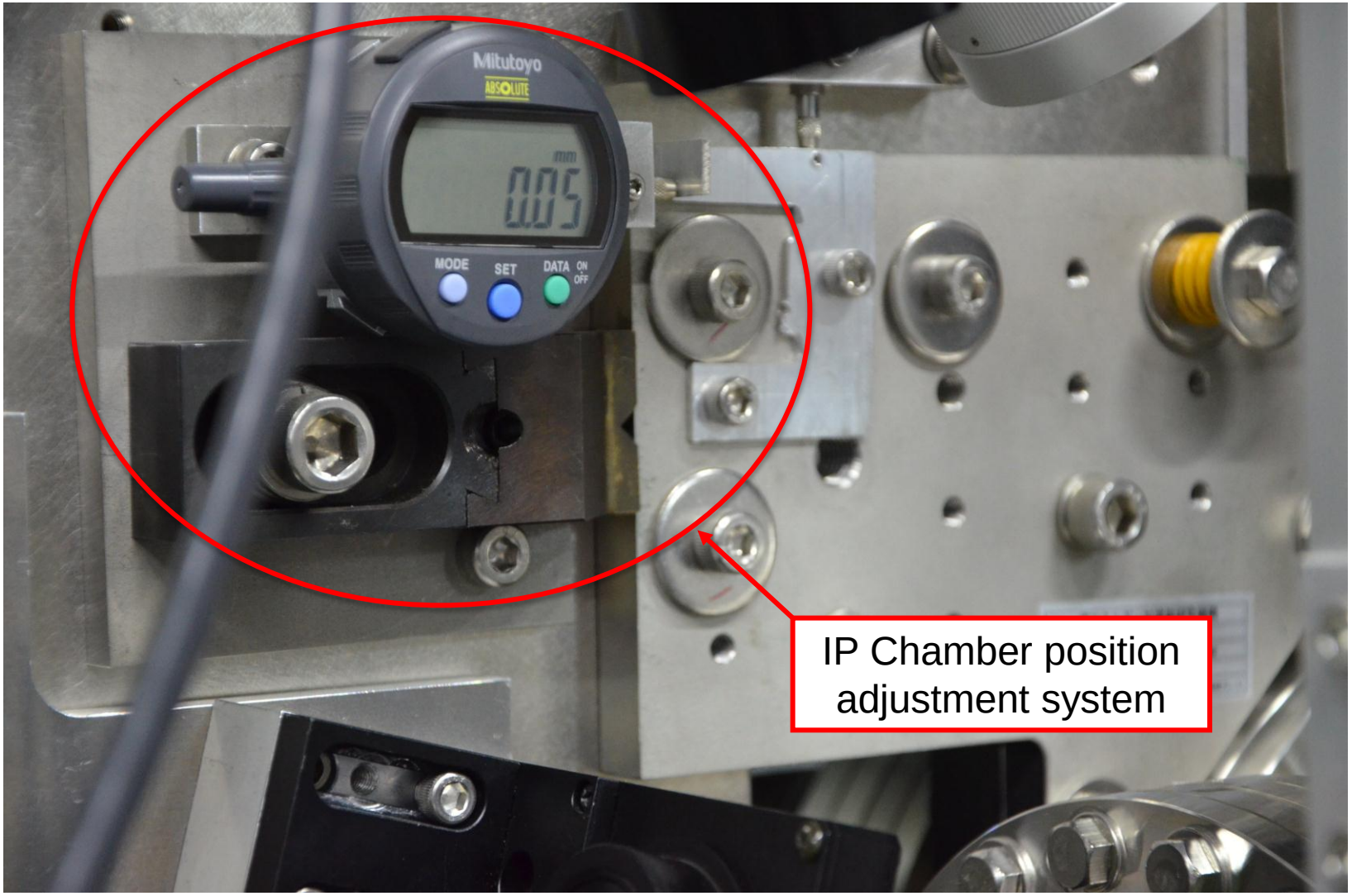
LAL-IN2P3-CNRS and Paris-Sud Orsay University
Frédéric BOGARD, Sandry WALLON – 19 march 2011



"FFTB" IP Chamber re-used at ATF2-KEK - Downstream side
… Too small to place 3 BPMs

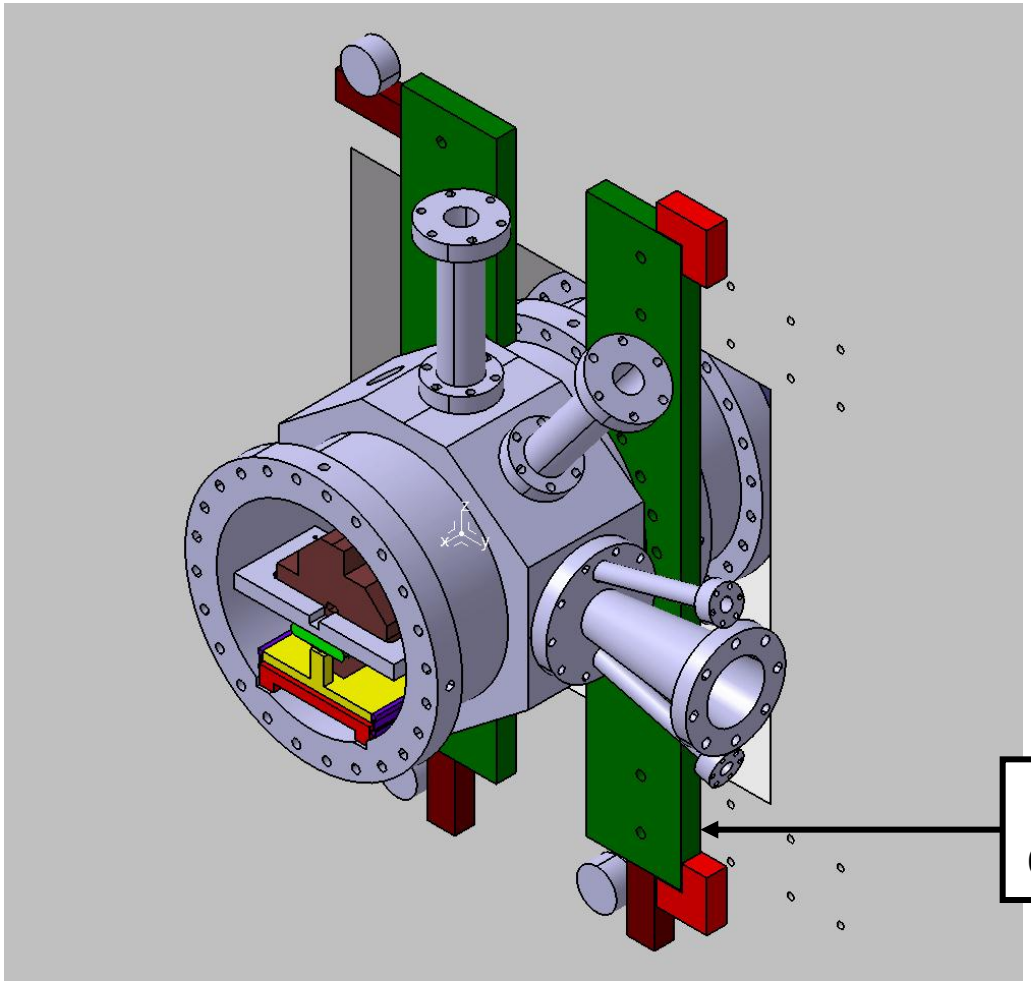


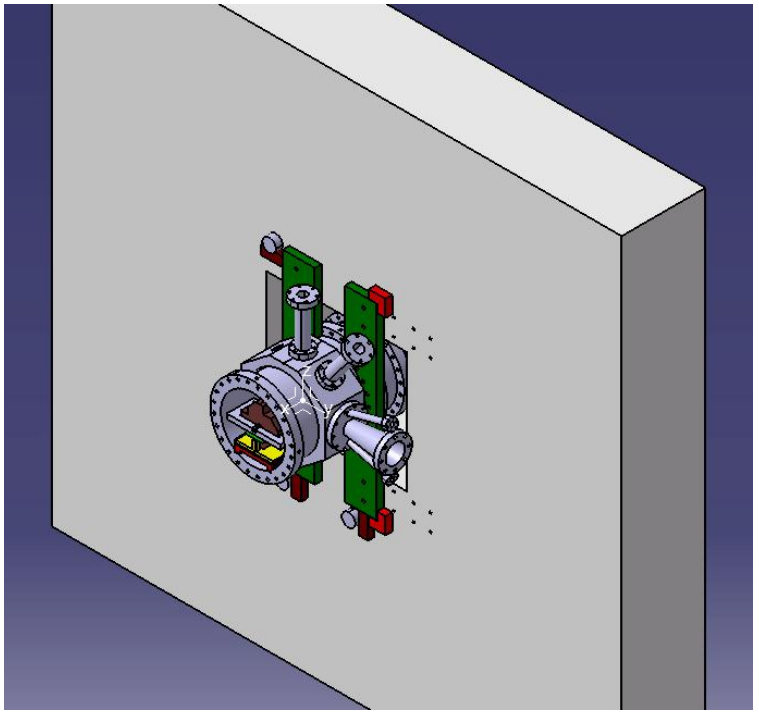
“FFTB” IP Chamber at AFT2-KEK - Upstream side



“FFTB” IP Chamber at AFT2-KEK - Downstream side

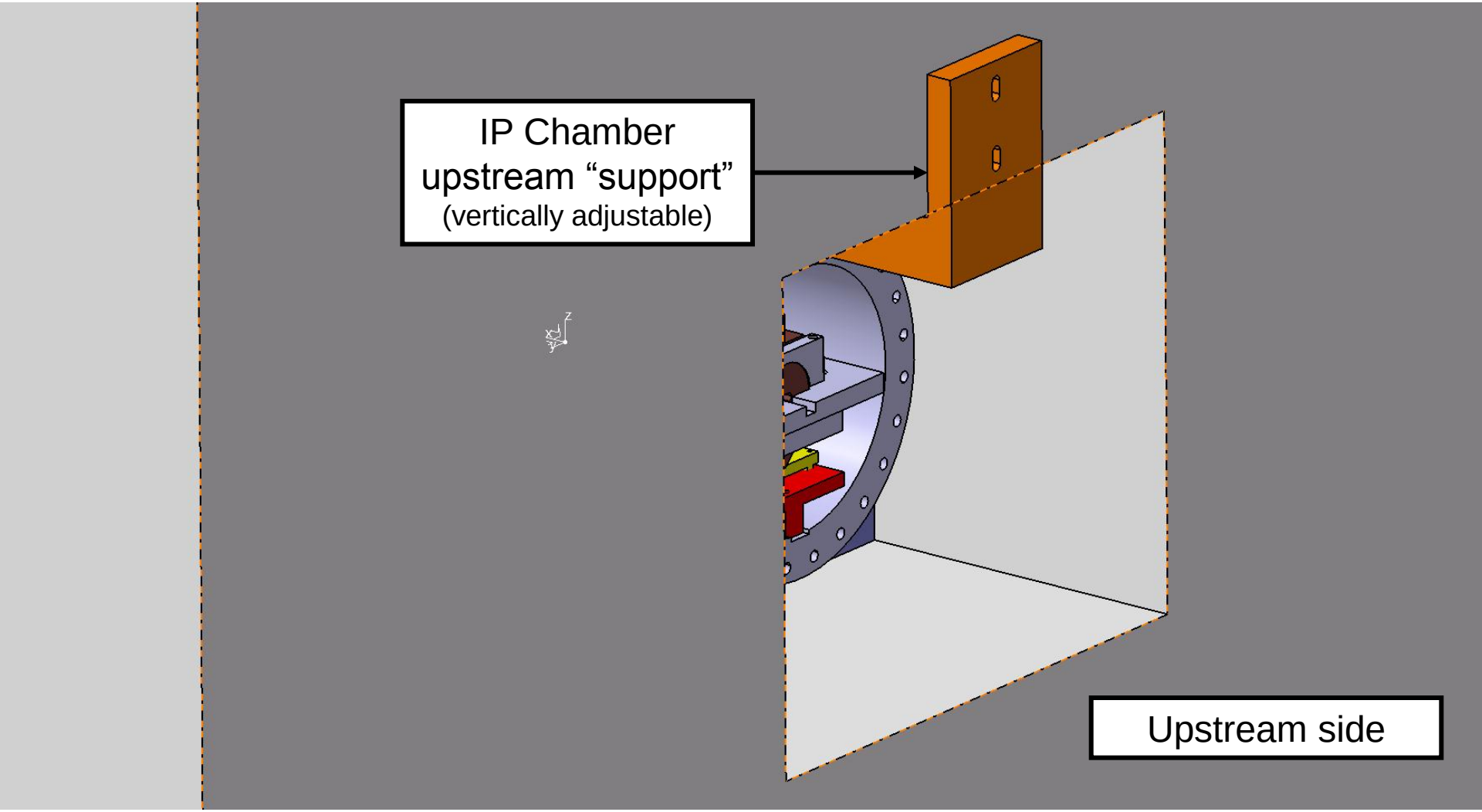
New IP chamber for 3 BPMs



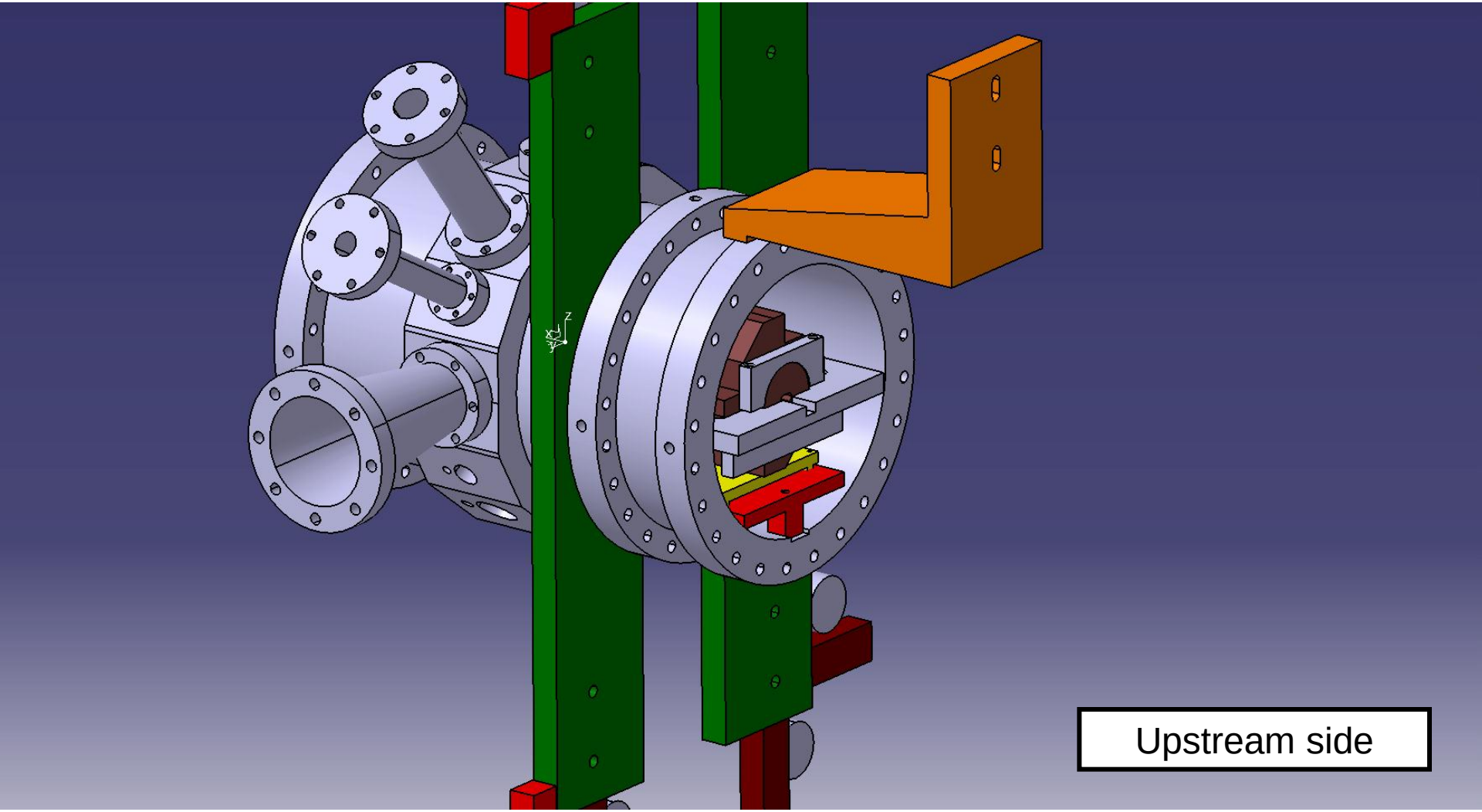


IP Chamber downstream fixture

Downstream side



Upstream support reduces optical table deformation (both side of sandwich structure “take” the bending moment.)



Detail of upstream support

External alignment devices

Holes for targets to enable surveyor measurements
(4 holes per flange)

→ External references bring IP Chamber axis, vertical and horizontal planes

2 Shims holders

Downstream side

4 External (manual) movers to adjust IP-Chamber position

External alignment process

Request :

- External pre-alignment for laser interferometer : 100 μm to few hundred

External alignment process

Coarse adjustment :

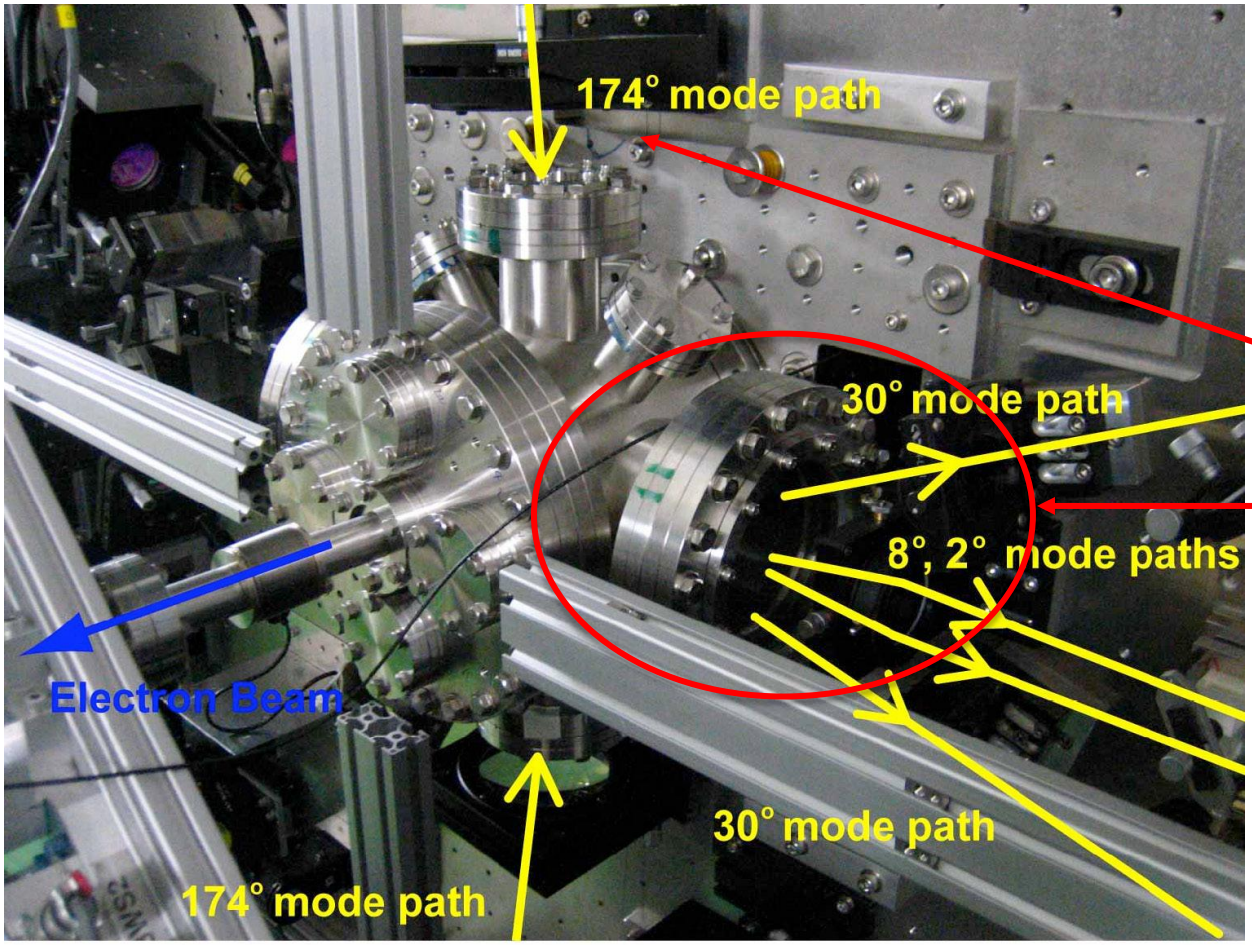
- External targets placed on IP Chamber' holes (3 flanges, 4 holes per flange)
- Measurements performed with laser tracker / theodolite
- Adjustment thanks to external movers and shims (shims to be placed into "shims holders")

→ Accuracy depends on laser tracker / theodolite precision

Fine adjustment :

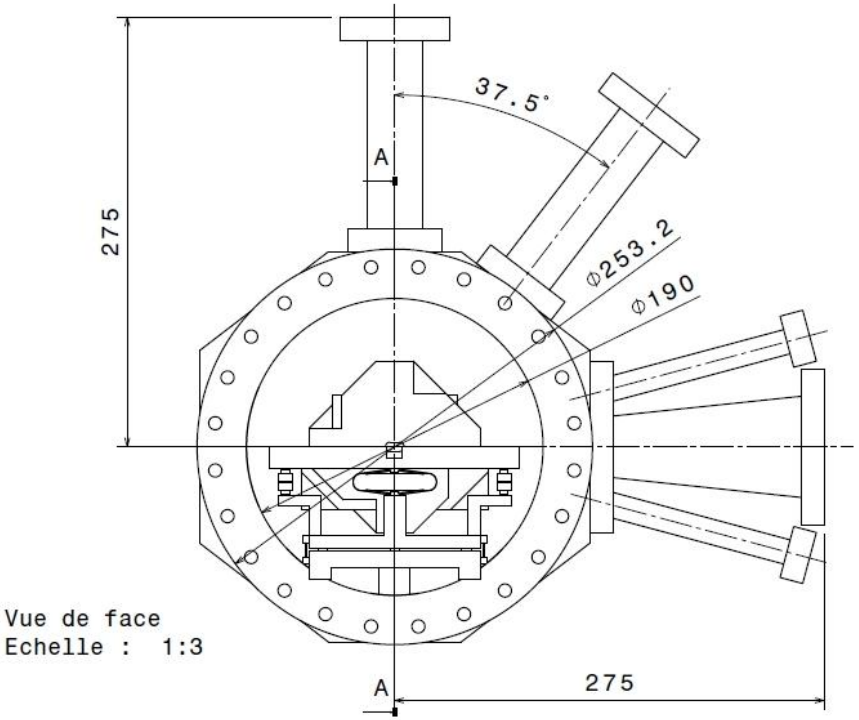
- BPMs position known with regard to holes (for external targets) thanks to tridim measurements done at workshop (accuracy : 5 μm)
- Measurements performed with beam
- Adjustment thanks to external movers

IP Chamber interfaces and dimensions

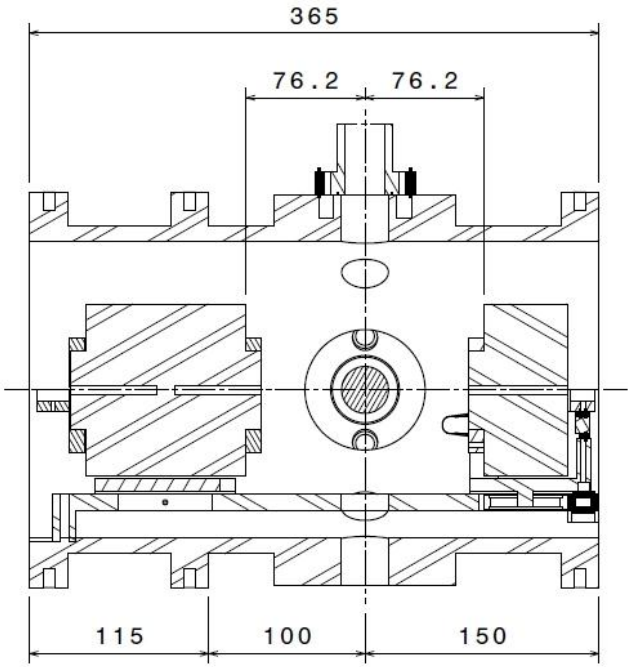


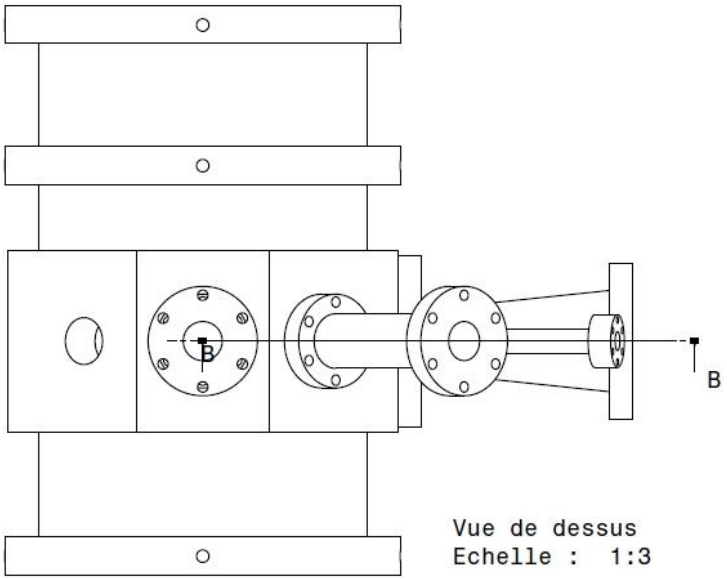
FFTB design to be improved :
- Reduce “windows to lens” distance
- Window orthogonal to 30° mode beam laser

Some angles to match



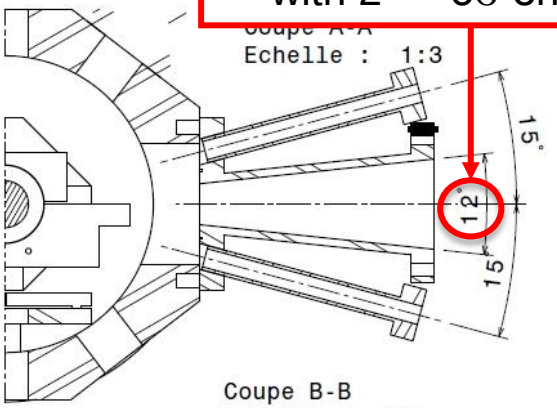
Vue de face
Echelle : 1:3





Vue de dessus
Echelle : 1:3

Allow 4° beam laser axis with 2 ° "5σ envelop"



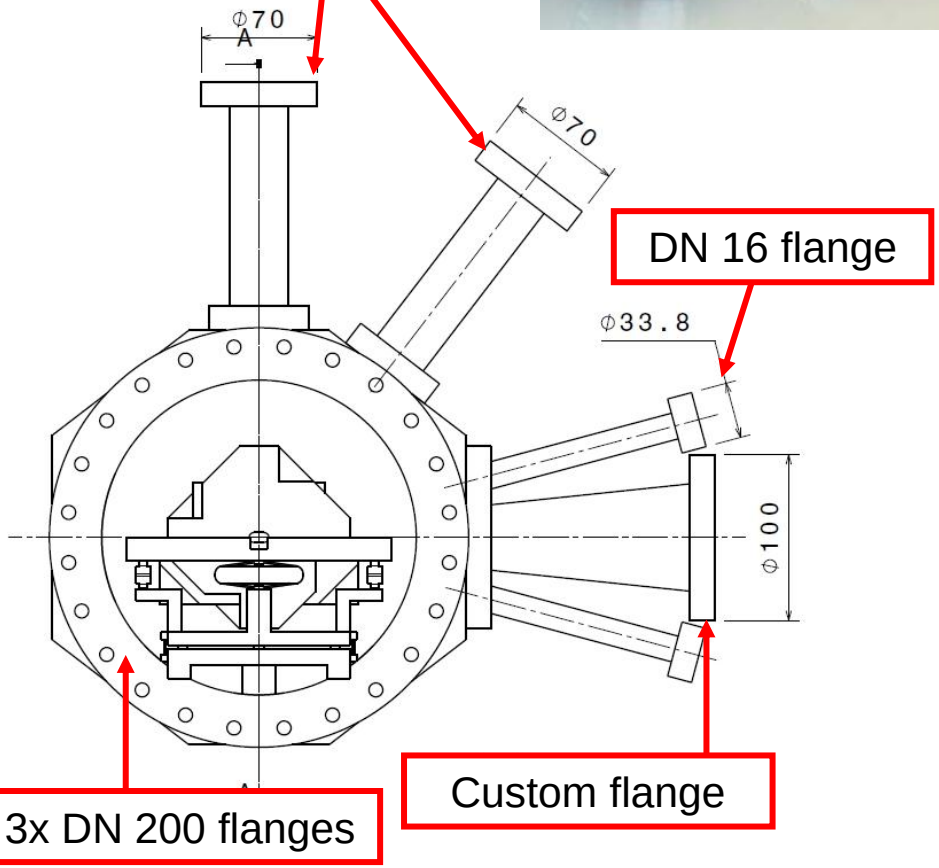
Coupe B-B
Echelle : 1:3

IP Chamber assy layout

- Angles & main dimensions

Metal (SS)
insert detail

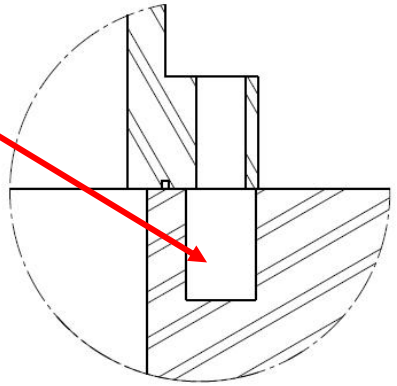
DN 40 flanges



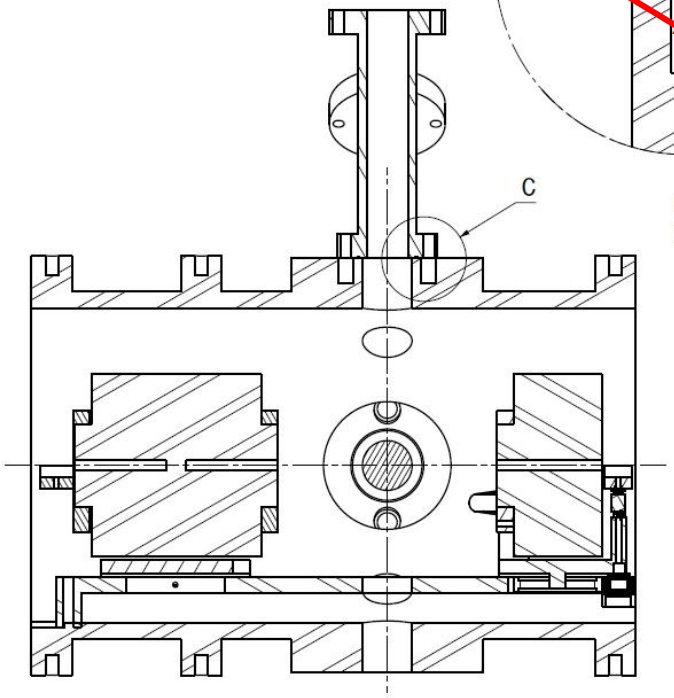
DN 16 flange

Custom flange

3x DN 200 flanges



Détail C
Echelle : 3:2



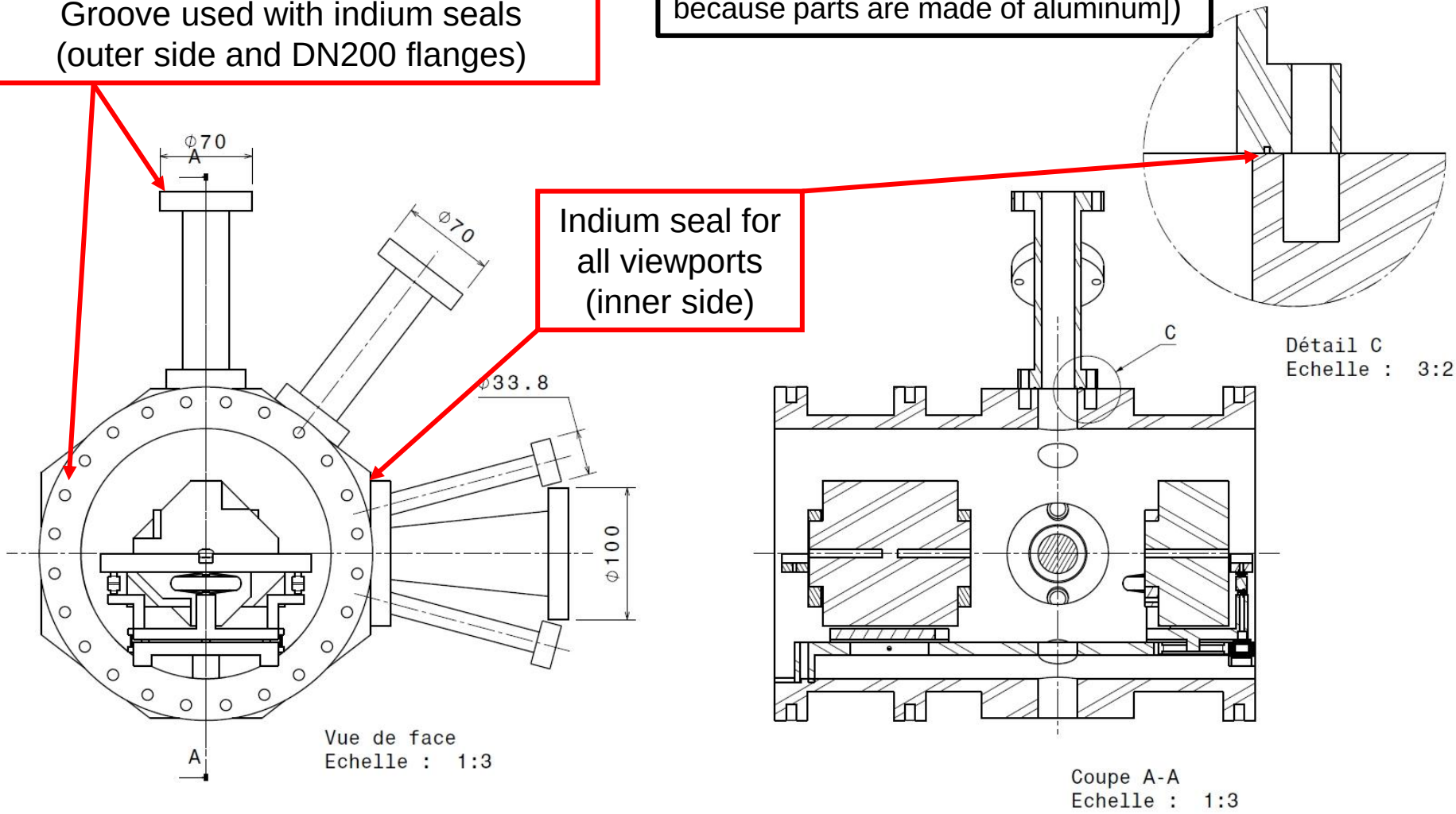
Coupe A-A
Echelle : 1:3

IP Chamber assy layout - Flanges interfaces

→ We advice indium seals (helicoflex seals need surface hardening such as anodization or metal coating [outgassing issue because parts are made of aluminum])

Flat surface used with helicoflex seals
OR
Groove used with indium seals
(outer side and DN200 flanges)

Indium seal for all viewports (inner side)



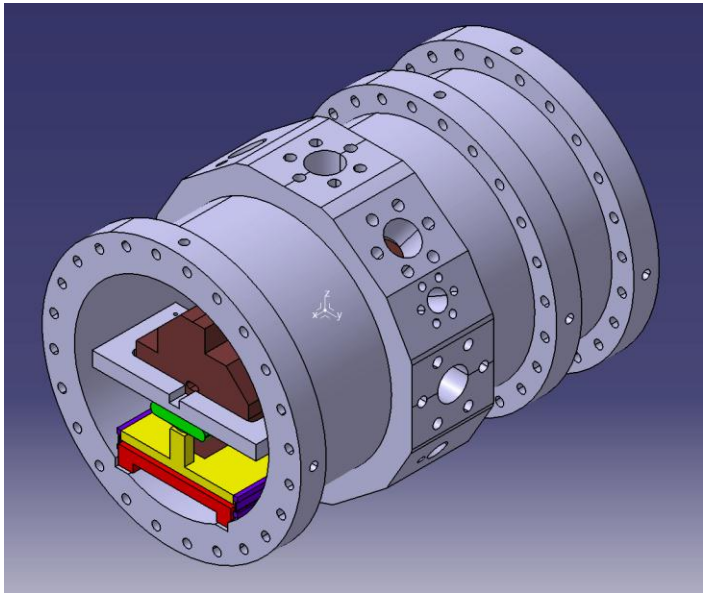
IP Chamber assy layout - Seals

Electrical connections

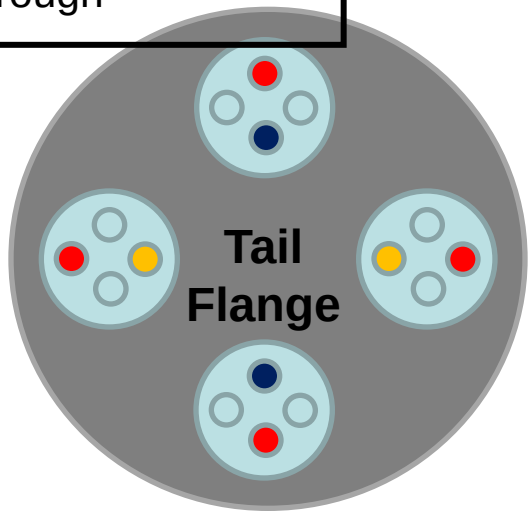
Movers wires inside IP Chamber

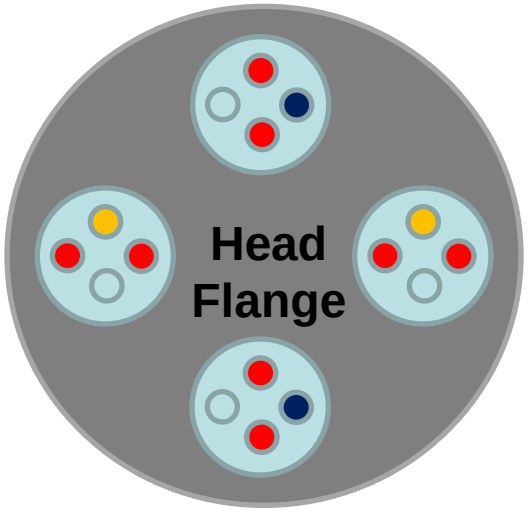
Per BPM positioning system:
- 4+1 or 4x2 PTFE wires (power supply)
- 4x4 PTFE wires (strain gauges)

Wires : 30 cm long to be crimped to feedthrough



<Flanges for Chamber>

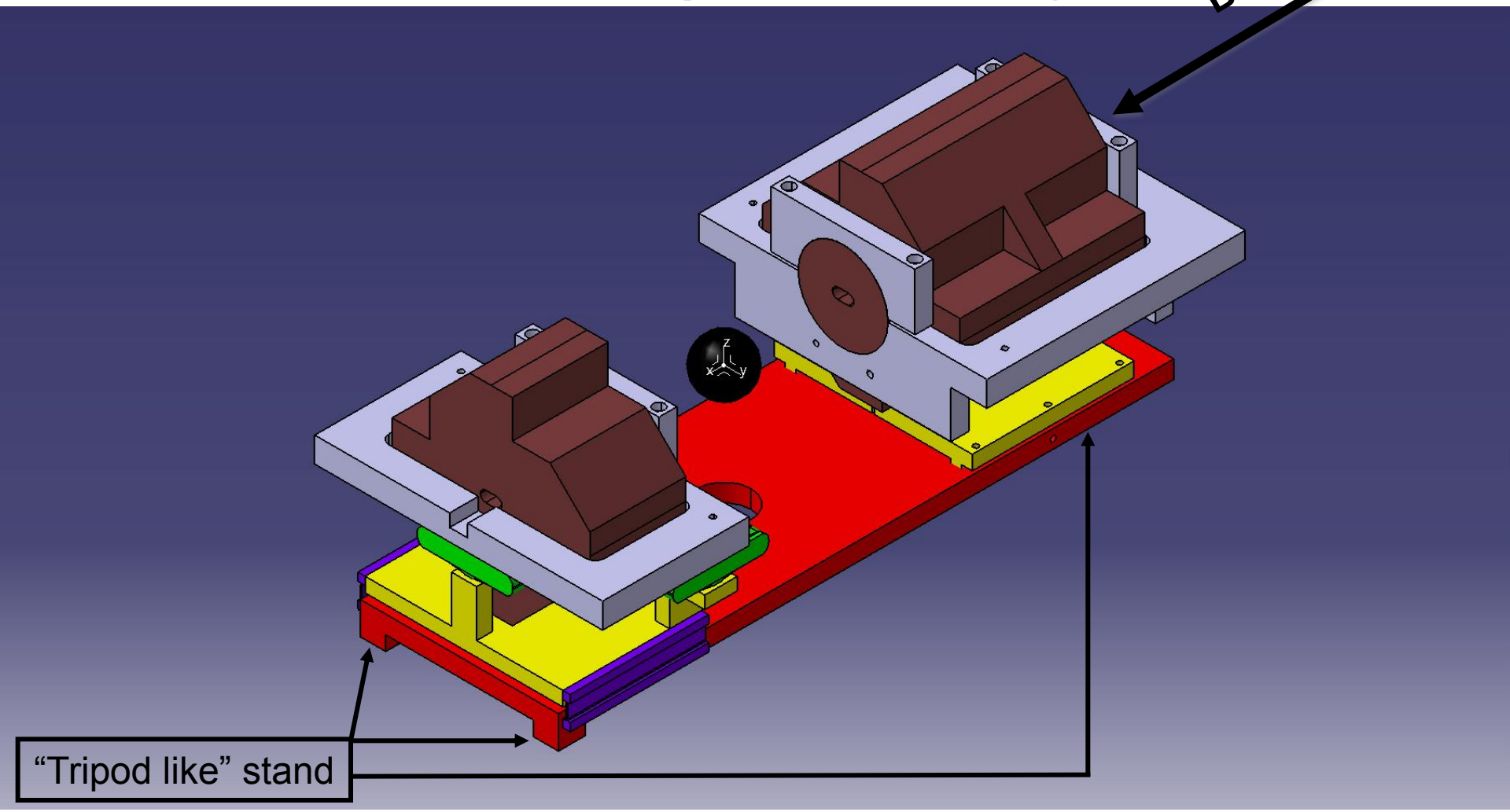




- Red dot: BPM cables
- Blue dot: Mover cables
- Yellow dot: Temperature cables

SiWon pics

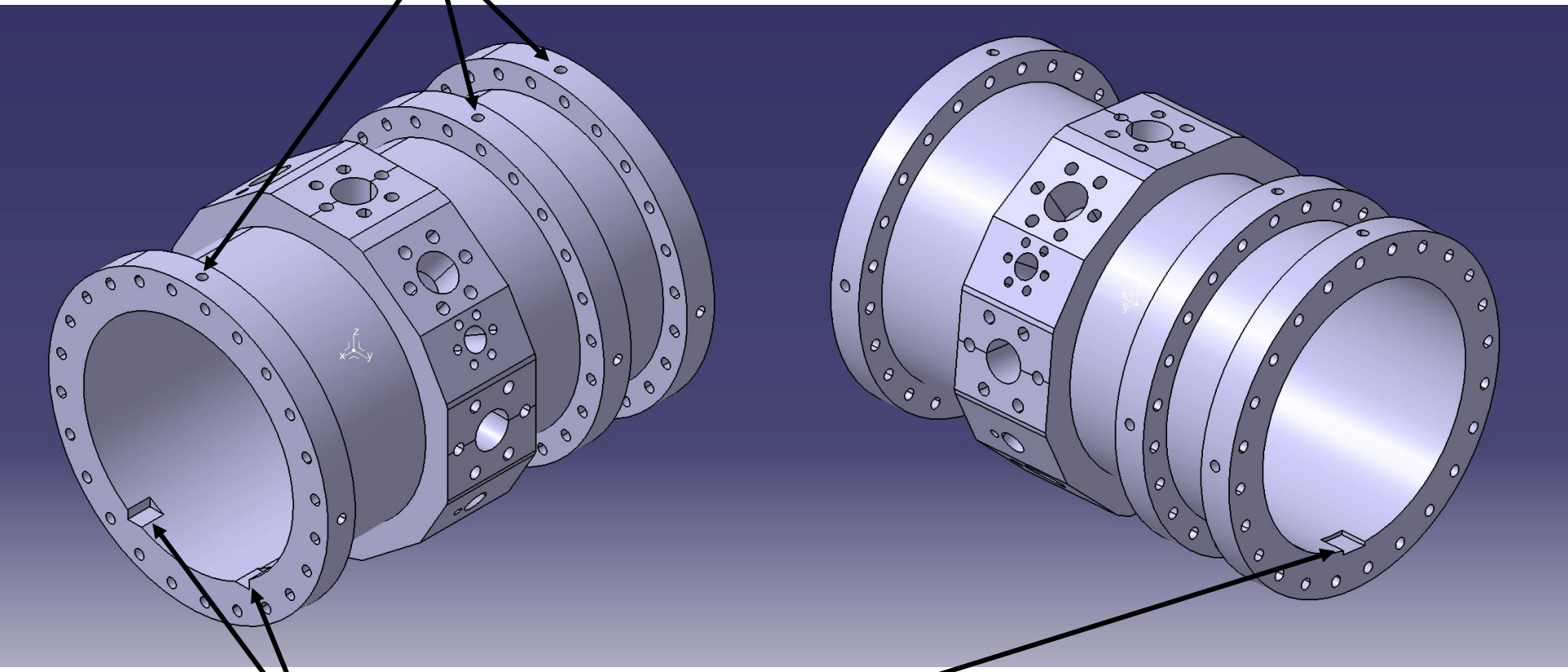
BPMs positioning



BPMs assy to be mounted in IP Chamber vessel

External references for targets - 4 holes per flange)

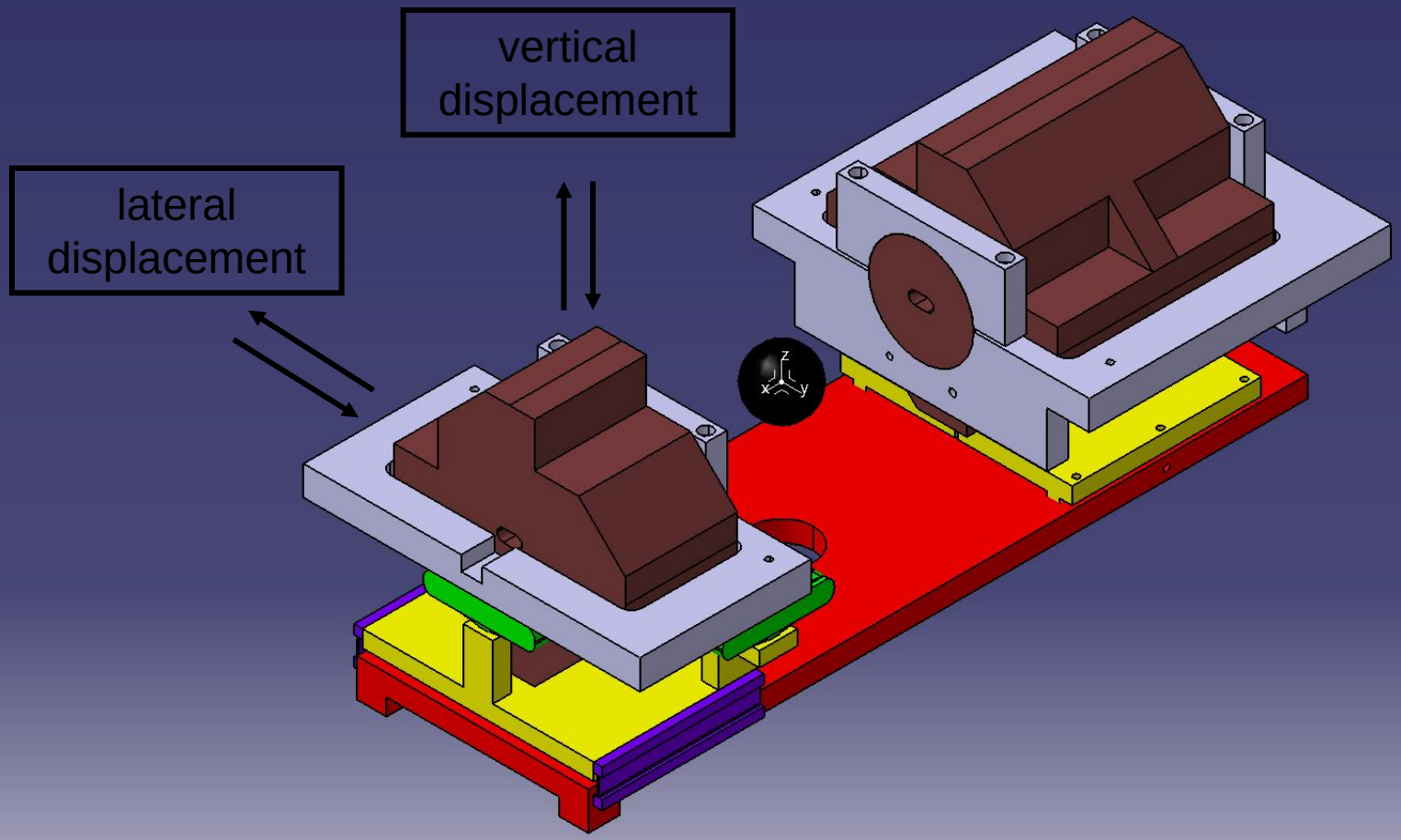
→ Internal references are known with regard to ext. ref.



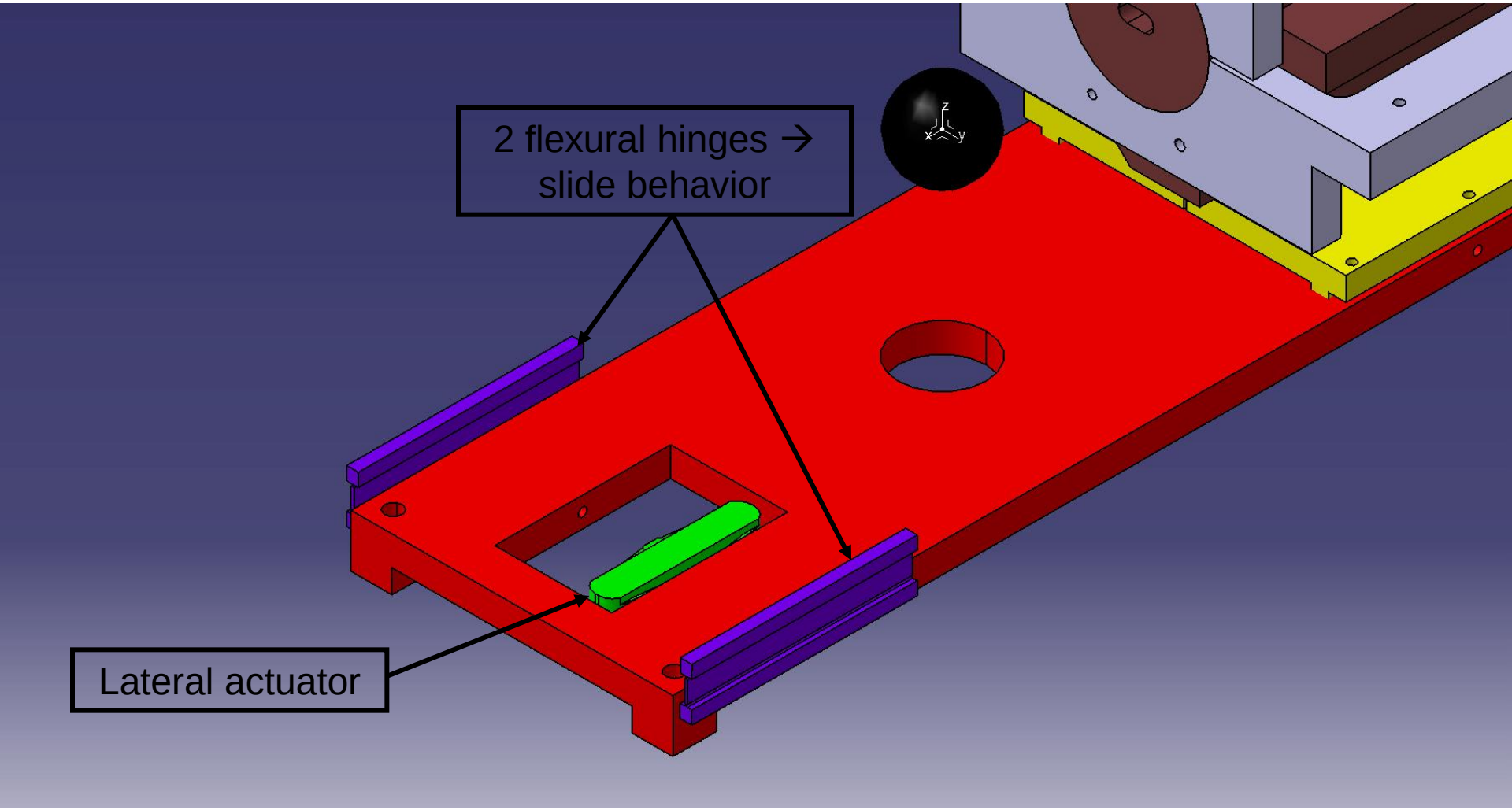
Internal references to receive BPMs assy

IP Chamber vessel

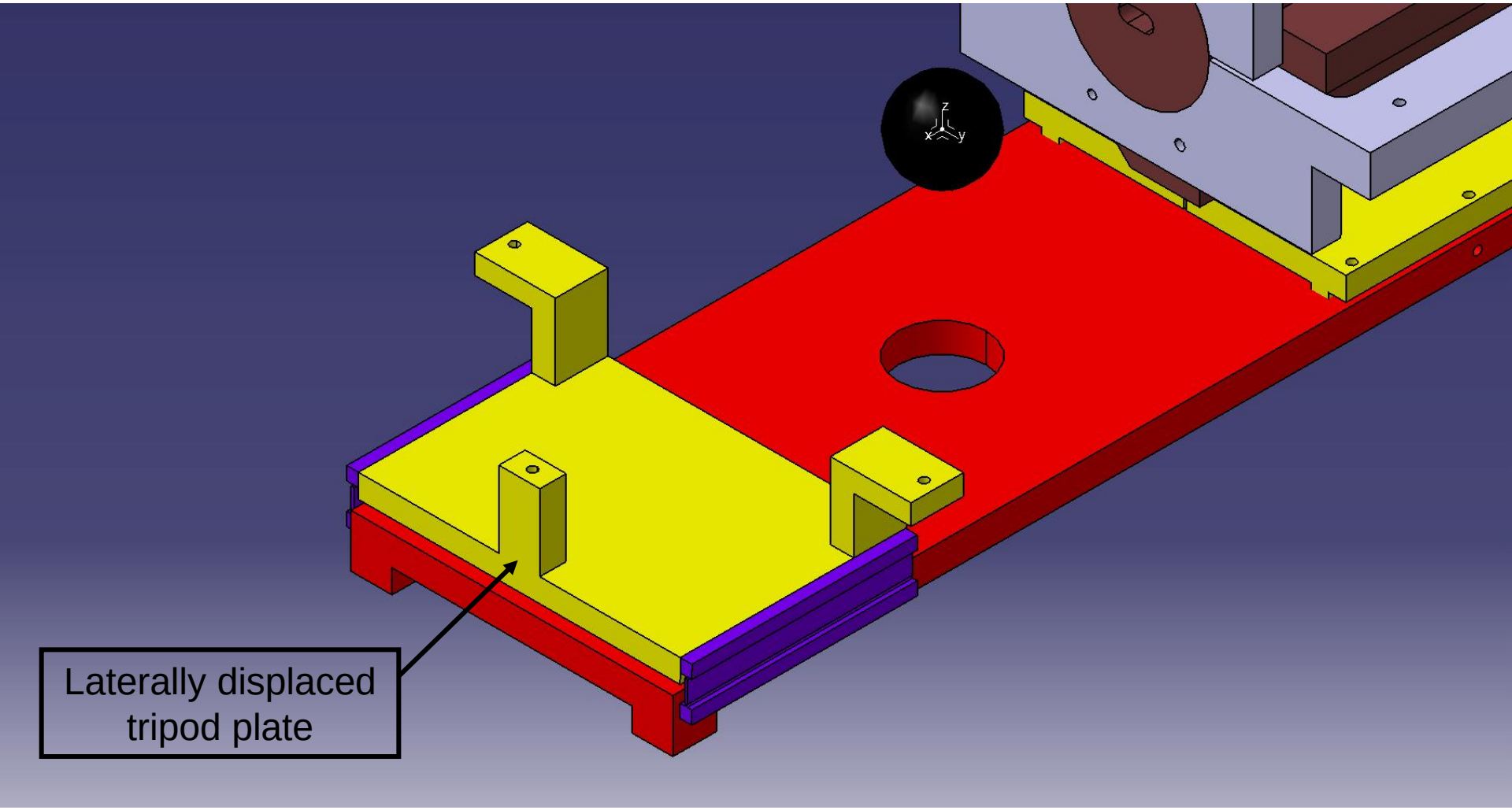
BPM3 displacements



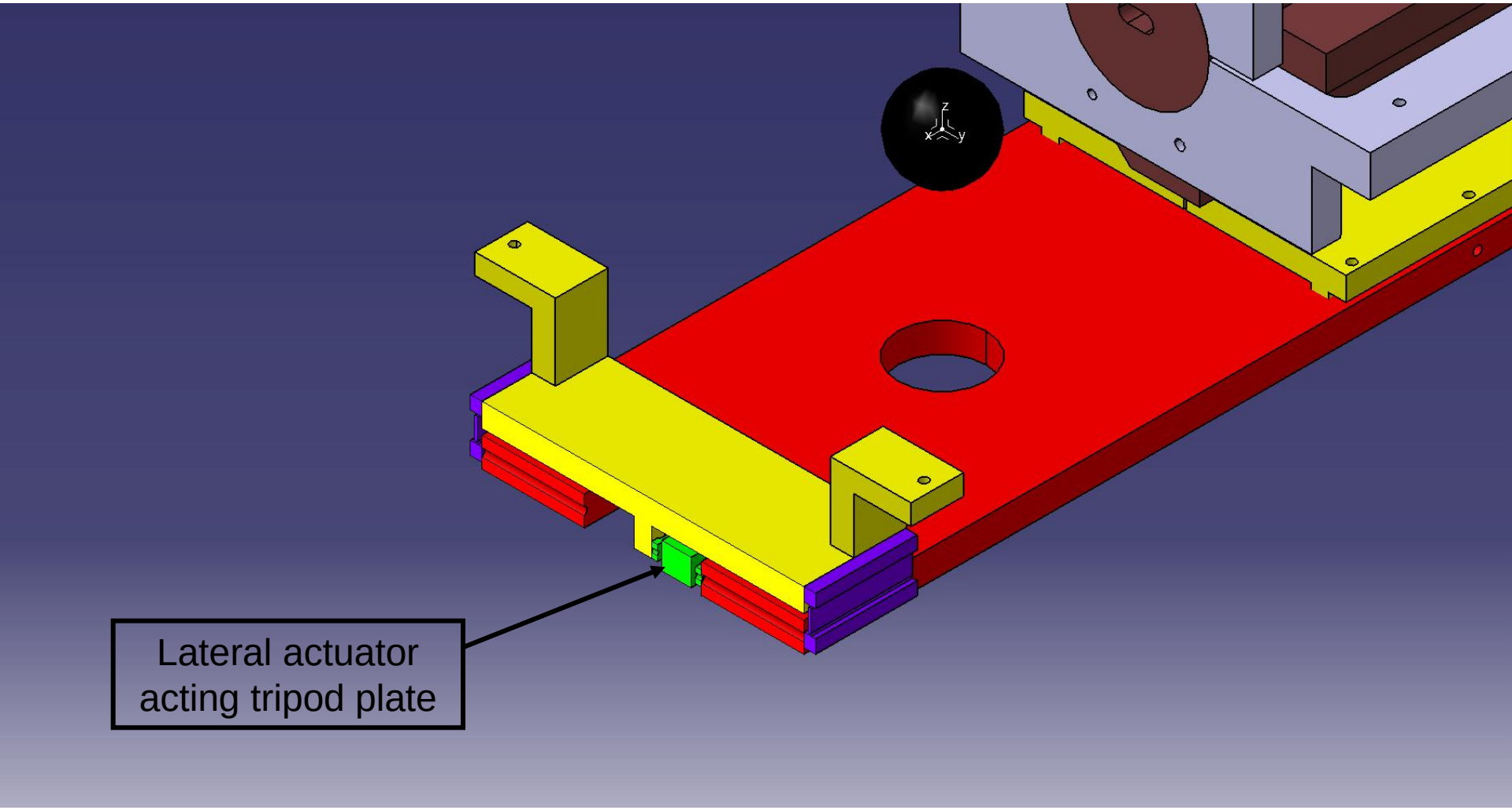
BPMs assy



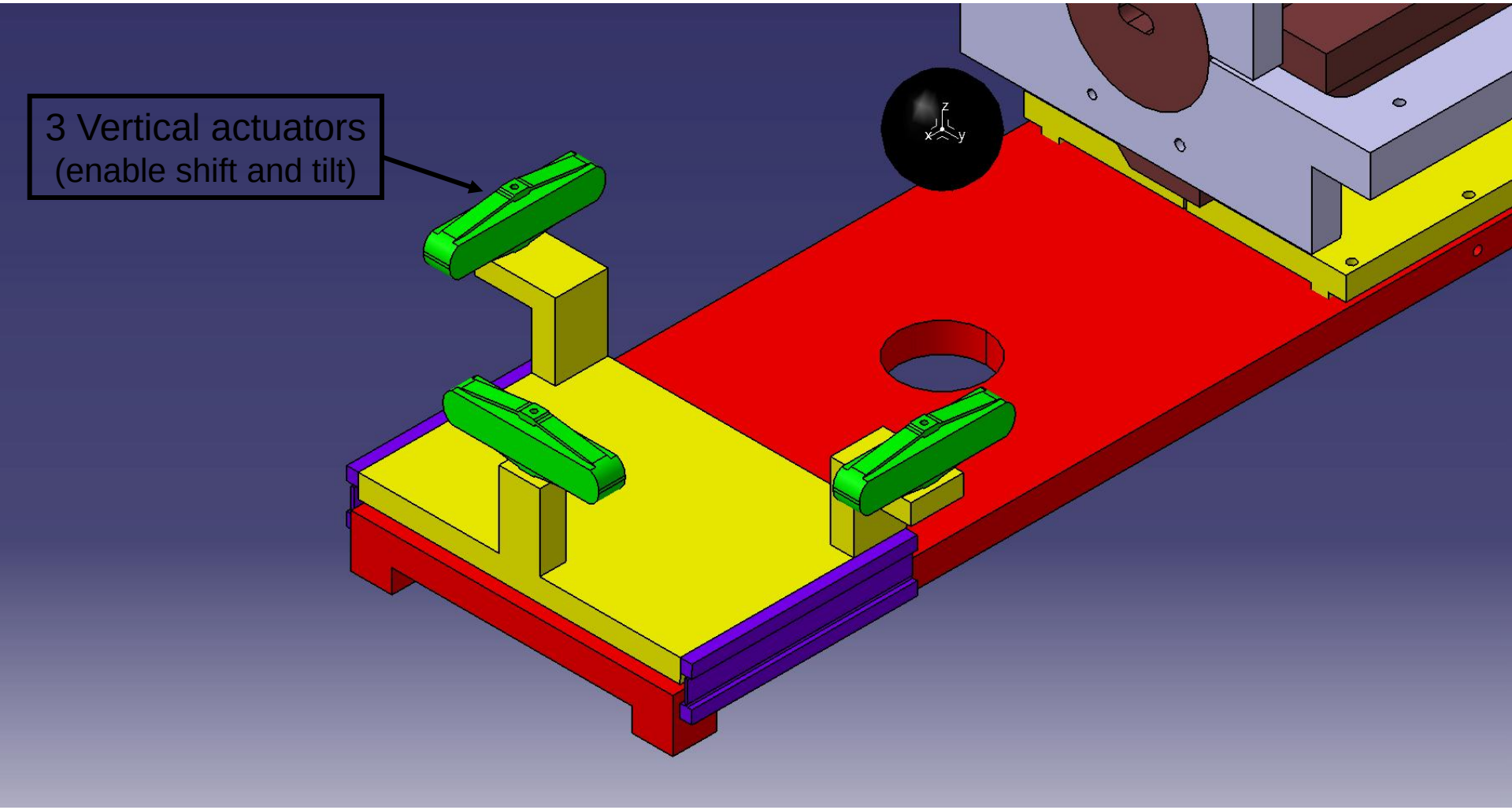
Lateral displacement -1



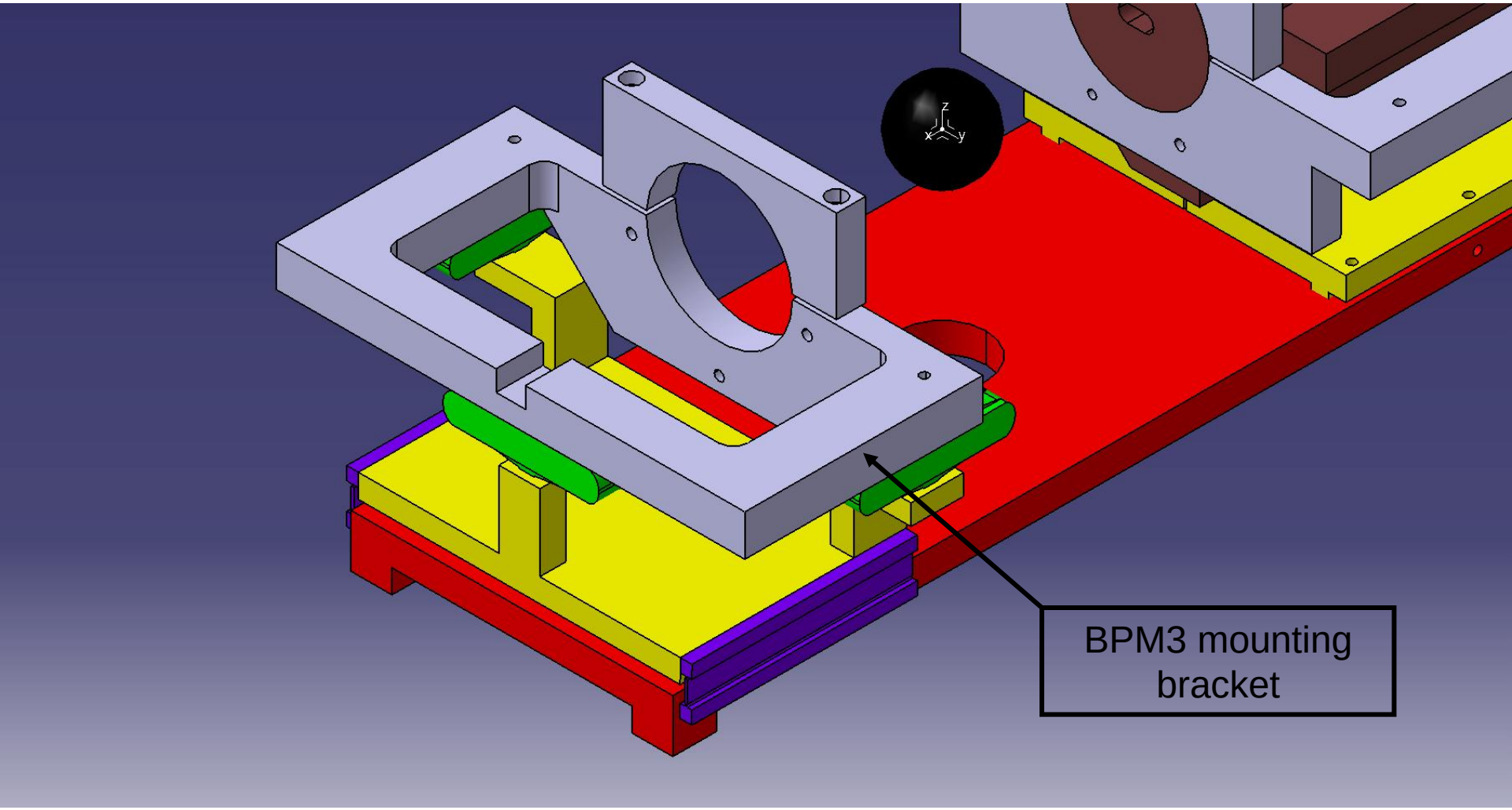
Lateral displacement -2



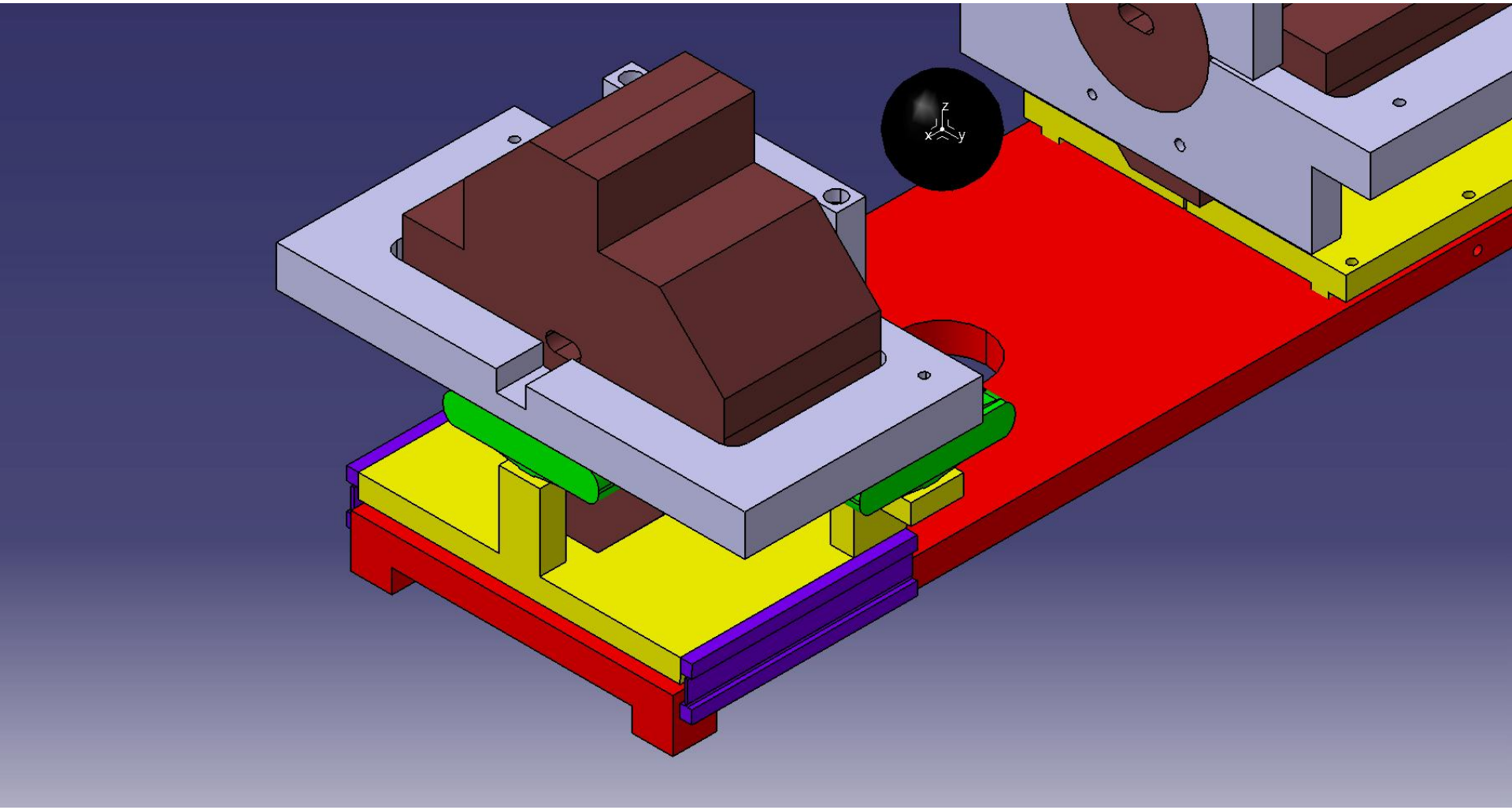
Lateral displacement -3



Vertical displacement -1



Vertical displacement -2



Vertical displacement -3

BPM3 displacements with piezo actuators

Piezo actuators (Cedrat APA 200 M) :

- Stroke : 230 μm
- Integrated feedback (strain gauge sensor)
- Actuator resolution : 2.3 nm
- Resolution (actuator + position sensor + controller) : 23 nm (1/10000 of stroke = strain gauge resolution)
- Accuracy : 230 nm (1/1000 of stroke – close loop including actuator, a sensor position and a controller are necessary to remove the hysteresis)

→ Enable BPM 3 vertical & lateral disp., roll and pitch adjustments

BPM1&2 displacements

Actuators for BPM1&2 will be provided later

(Actuators can be temporary replaced by shims)

How/why to use BPMs displacements

Stroke → BPMs alignment with regard to beam

Accuracy → Calibration

Resolution → BPMs resolution checking ?

Actuators in open loop mode (2.3 nm resolution) ?

How to improve piezo actuator

- Stroke : N/A
- Resolution of 23 nm (strain gauge “resolution”) : use of capacitive position sensor (for example external sensor with resolution < 1 nm, i.e. outside the close loop system)
- Accuracy of 230 nm : use of special controller, capacitive position sensor (inside the close loop system)

Material and weight

MATERIAL

- IP Chamber vessel and extension viewports : aluminum alloy 5083
- Other parts : FORTAL (high stability aluminum alloy)

→ Aluminum alloy brings weight reduction and good machinability

WEIGHTS

- IP Chamber : 13 kg
- Set of 9 viewports extensions : 3 kg
- BPMs positioning parts : 2 kg
- BPMs : 1 + 2 kg
- Screws, washers, nuts : not calculated

Total Weight : ~21 kg

Schedule

- Delivery at LAL of KNU' BPMs : end of 3/2012
- Delivery at LAL of 4 piezo actuators with electronic for BPM 3 : end of 3/2012
- Piezo actuators tests : 4/2012
  - Dimensional tolerances, stroke…
  - Outgassing
- Order piezo actuators and electronic for BPM1&2 (budget?) : 6/2012
- Manufacturing (with breaks) at LAPP : 4 to 8/2012
- IP Chamber and parts checking : 9/2012
- Assembly process test : 10/2012
- Delivery at KEK : 11-12/2012

Extra slide 1

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1 / 1 125% Rechercher

CEDRAT TECHNOLOGIES

TECHNICAL DATA SHEET | **APA200M** | **v3.3**

CEDRAT
TECHNOLOGIES
15 chemin de Malacher
ZIRST
38246 MEYLAN Cedex
France

Tel. : +33 4 76 90 50 45
Fax : +33 4 56 38 08 30
http://www.cedrat.com
actuator@cedrat.com

TABLE OF STANDARD PROPERTIES OF USE AND MEASUREMENT

The properties defined in the table below, are set up according to the technical conditions of use and measurement. These properties are warranted within their variation range and in compliance with the standard technical conditions of use.

Properties APA200M	Standard technical conditions	Unit	Nominal values	Min. values	Max. values
Notes		-	-	-	-
Max. no load displacement	Quasistatic excitation, blocked-free	µm	230	207	299
Blocked force	Quasistatic excitation, blocked-free	N	73	58	88
Stiffness	Quasistatic excitation, blocked-free	N/µm	0,32	0,25	0,35
Resonance frequency (free-free)	Harmonic excitation, blocked-free, on the admittance curve	Hz	4600	3910	5060
Response time (free-free)		ms	0,11	0,10	0,13
Resonance frequency (blocked-free)	Harmonic excitation, free-free, on the admittance curve	Hz	900	765	990
Response time (blocked-free)		ms	0,56	0,50	0,64
Capacitance	Quasistatic excitation, free-free, on the admittance curve	µF	3,15	2,84	4,10
Max. no load displacement at resonance	Max. harmonic excitation, free-free	µm p-p	155	124	186
Max. voltage at resonance	Max. harmonic excitation, free-free	Vrms	9,00	7,20	10,80
Force limit (0-pk)	Max. harmonic excitation, free-free	N	27,38	21,90	30,11
Resolution	Quasistatic excitation	nm	2,30	-	-
Height (in actuation direction)		mm	17,00	16,80	17,20
Length		mm	55,00	54,90	55,10
Width (excl. wedge & wires)		mm	5,00	4,95	5,05
Width (incl. wedge & wires)		mm	9,00	8,00	10,50
Mass		g	15,7	-	-
Standard mechanical interface	2 flat surfaces 5*5 mm² with M2.5 threaded hole	-	-	-	-
Standard electrical interface	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	-	-	-	-

PROPERTIES STANDARD TECHNICAL CONDITIONS OF USE AND MEASUREMENT

Free-free : The actuator is not fixed
Blocked-free : The actuator is fixed to a mechanical support assumed infinitely stiff

Extra slide 2

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1 / 1 125% Rechercher

Max. voltage at resonance	Max. harmonic excitation, free-free	Vrms	9,00	7,20	10,80
Force limit (0-pk)	Max. harmonic excitation, free-free	N	27,38	21,90	30,11
Resolution	Quasistatic excitation	nm	2,30	-	-
Height (in actuation direction)		mm	17,00	16,80	17,20
Length		mm	55,00	54,90	55,10
Width (excl. wedge & wires)		mm	5,00	4,95	5,05
Width (incl. wedge & wires)		mm	9,00	8,00	10,50
Mass		g	15,7	-	-
Standard mechanical interface	2 flat surfaces 5*5 mm² with M2.5 threaded hole	-	-	-	-
Standard electrical interface	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	-	-	-	-

➢ **PROPERTIES STANDARD TECHNICAL CONDITIONS OF USE AND MEASUREMENT**

Free-free	:	The actuator is not fixed
Blocked-free	:	The actuator is fixed to a mechanical support assumed infinitely stiff
Quasistatic excitation	:	AC voltage between –20 and 150 V at 1 Hz
Harmonic excitation	:	Voltage of 0.5 Vrms, sinusoidal mode from 0 to 100 kHz
Max. harmonic excitation	:	Voltage defined by the measurement of max. displacement, sinus at resonance frequency
Displacement measurement	:	Laser interferometer, capacitive displacement sensor
Admittance measurement	:	HP 4194 A or Cypher C60 electrical impedance analyser
Environment	:	Ambient temperature (15-25°C) and dry air (Humidity < 50 % rH)

Any technical conditions of use, different from those defined above, can lead to temporary or definitive alterations of properties. Thank you to contact CEDRAT TECHNOLOGIES before using actuators under non standard technical conditions.

➢ **FACTORY TESTS CARRIED OUT**

☒ Test 1 : Electrical admittance vs. Frequency, free-free
☒ Test 2 : Displacement vs. input voltage

➢ **EXTRA FACTORY TESTS**

☐ Test 3 : Gain and linearity of the sensor
☐ Test 4 : Step response in closed loop
☐ Test 5 : Stability in closed loop

➢ **MECHANICAL INTERFACE**

☒ [FI] Flat Interface
☐ [SV] Specific version
☒ [H] Flat Interface with hole
☒ [FF] Free-free Interface
☒ [TH] Flat Interface with threaded hole
☒ [SI] Specific interface

➢ **AVAILABLE OPTIONS**

☒ [SG] Strain gauges
☐ [ECS] Eddy current displacement sensor
☒ [NM] Non-magnetic
☒ [VAC] Vacuum