SiD MDI Introduction

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Thanks to: Marco Oriunno,

Tom Markiewicz, Karsten Buesser

Outline

- **Introduction and reminder:**
  - **detector assembly procedure**
  - **push-pull scheme**
- **SiD / ILD push-pull issues:**
  - **detector support and motion scheme**
- **PACman shielding**
- **Conclusion**

Introduction

- **SiD complies with MDI functional requirements document:**

ILC-Note-2009-050
March 2009
Version 4, 2009-03-19

Functional Requirements on the Design of the Detectors and the Interaction Region of an e^+e^- Linear Collider with a Push-Pull Arrangement of Detectors

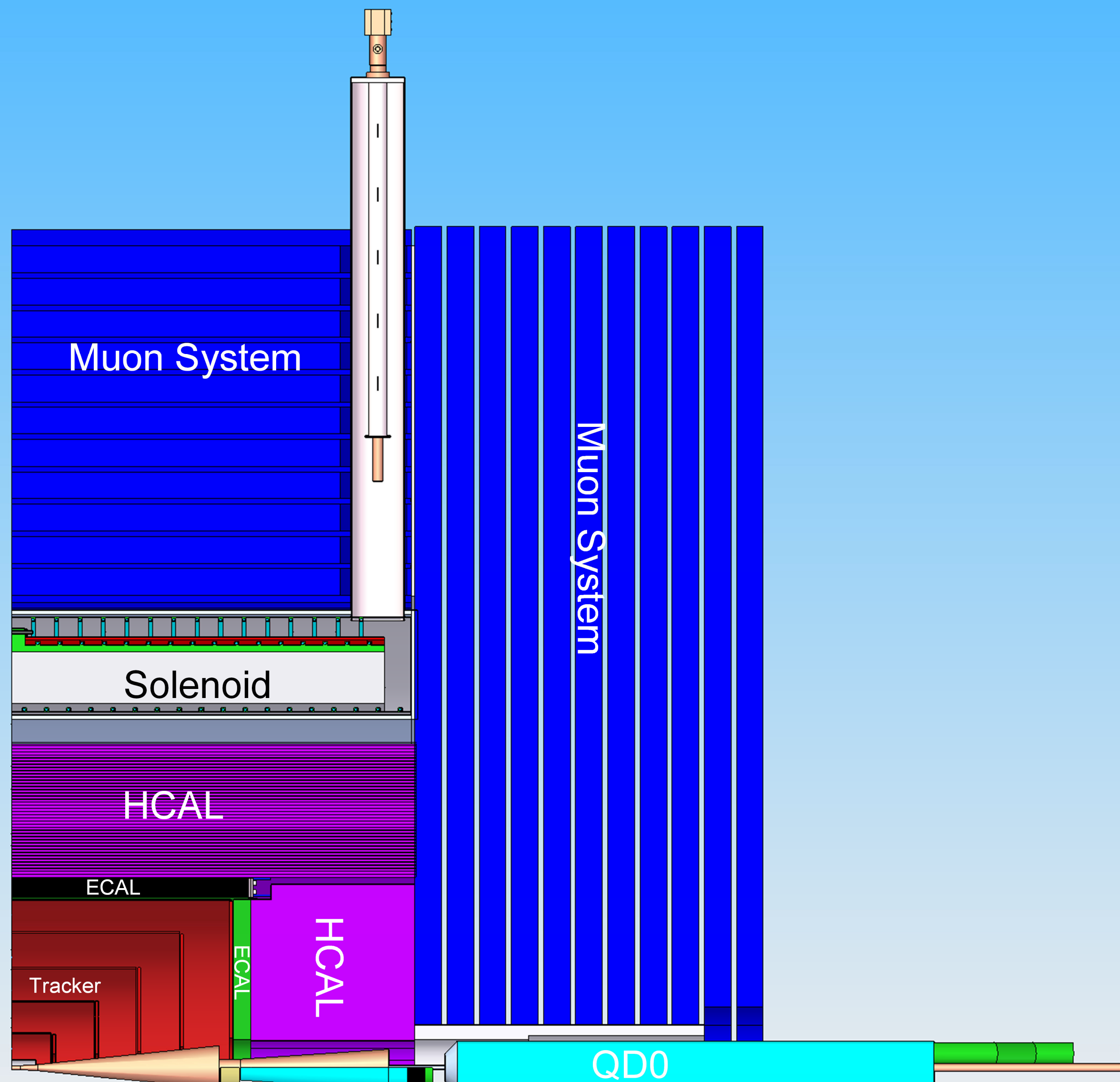
B.Parker (BNL), A.Mikhailichenko (Cornell Univ.), K.Buesser (DESY), J.Hauptman (Iowa State Univ.), T.Tauchi (KEK), P.Burrows (Oxford Univ.), T.Markiewicz, M.Oriunno, A.Seryi (SLAC)

Abstract
The Interaction Region of the International Linear Collider [1] is based on two experimental detectors working in a push-pull mode. A time efficient implementation of this model sets specific requirements and challenges for many detector and machine systems, in particular the IR magnets, the cryogenics and the alignment system, the beamline shielding, the detector design and the overall integration. This paper attempts to separate the functional requirements of a push pull interaction region and machine detector interface from any particular conceptual or technical solution that might have been proposed to date by either the ILC Beam Delivery Group or any of the three detector concepts [2]. As such, we hope that it provides a set of ground rules for interpreting and evaluating the MDI parts of the proposed detector concept's Letters of Intent, due March 2009. The authors of the present paper are the leaders of the IR Integration Working Group within Global Design Effort Beam Delivery System and the representatives from each detector concept submitting the Letters Of Intent.

- **Participate in MDI Common Task Group (Oriunno, Burrows)**

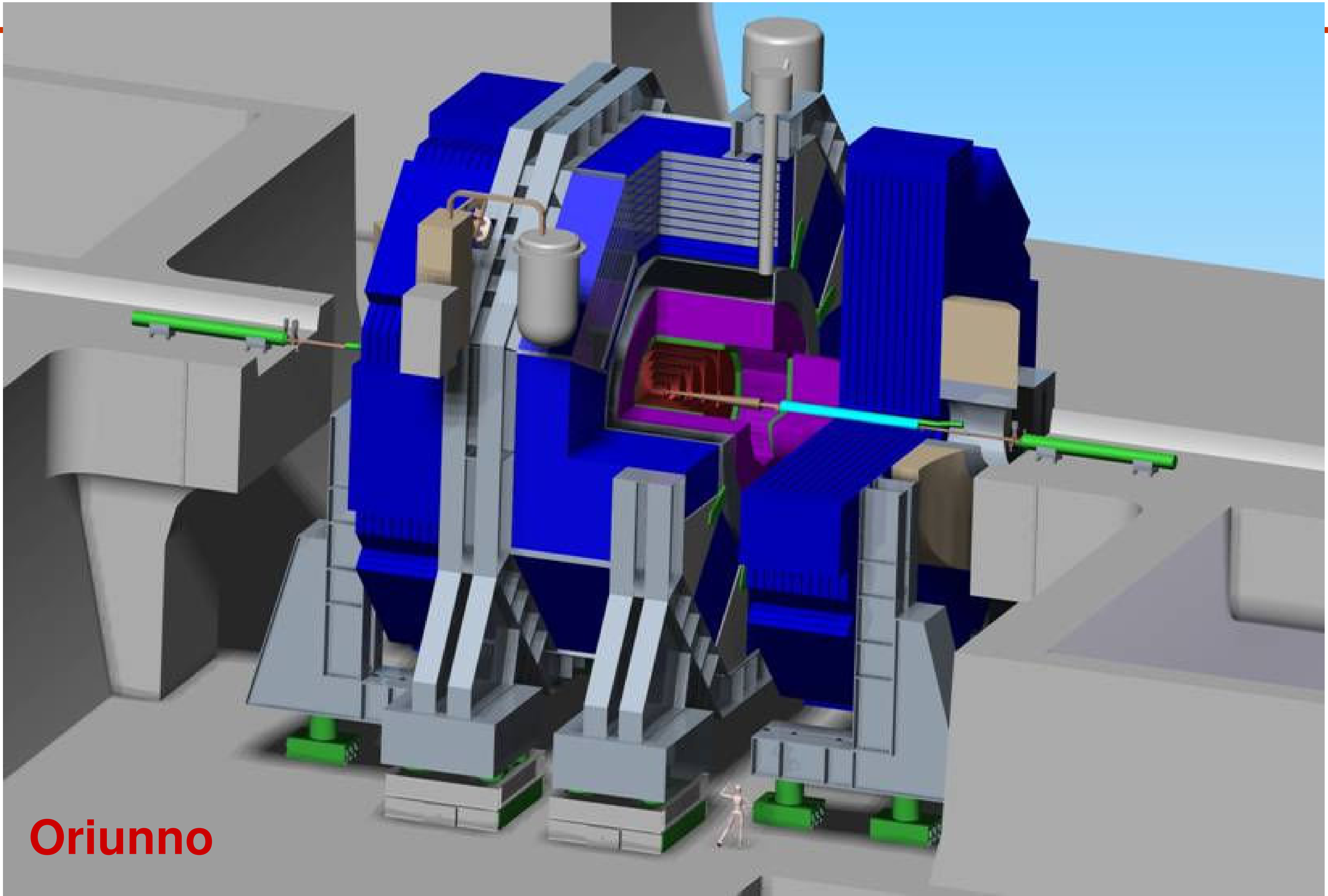
- **Working closely with ILD colleagues on relevant push-pull detector interface issues**

Detector (quadrant view)



Oriunno

Detector (on beamline)



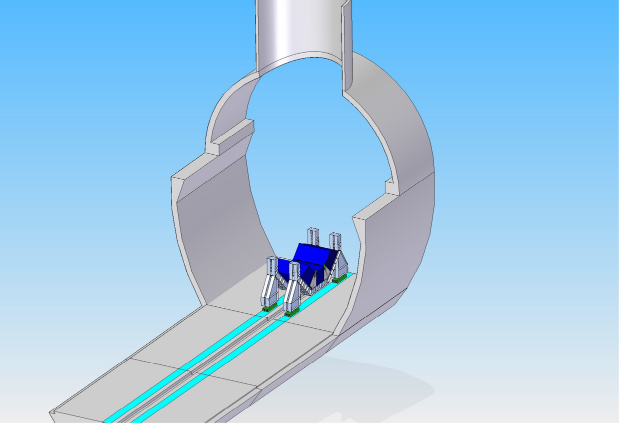
Detector assembly considerations

- Iron built in sub modules with a mass suitable for transportation, and bolted together at the ILC
- Solenoid fabricated by industry
- VXD, ECAL, and HCAL modules built outside and transported to ILC site
- Detailed assembly strategy depends on site:

  ‘shallow’ vs. ‘deep’
- Shape of an underground hall and the capacity for underground bridge cranes may depend on the site geology
- Optimal strategy will depend on ILC construction schedule

Possible detector assembly (1)
(underground site)

1. Underground assembly of iron flux return barrel
2. Barrel Octants lowered in pre-assembled pieces of 400t max.
3. Solenoid lowered and inserted in the flux return barrel.
4. Doors preassembled on surface and lowered in one piece of 2400t max.
5. Doors closed around flux return barrel
6. Complete iron+solenoid moved to garage position, hooked up to cryogenics and commissioned
7. Doors move leaving access to the barrel for insertion of HCAL (380t), ECAL (60t) and tracker (2t)
8. Doors close around fully assembled barrel
9. SiD moved into garage position, hooked up to cryogenics



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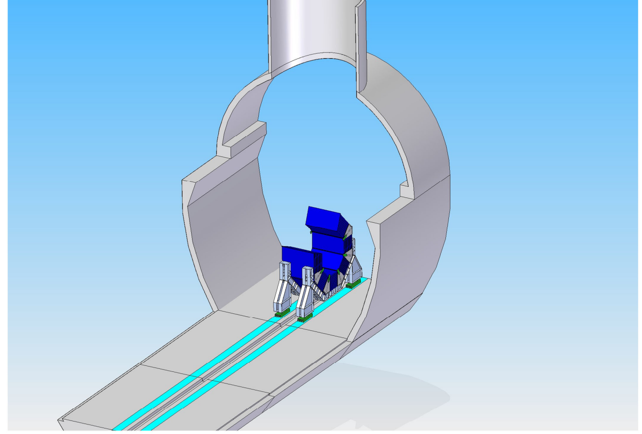

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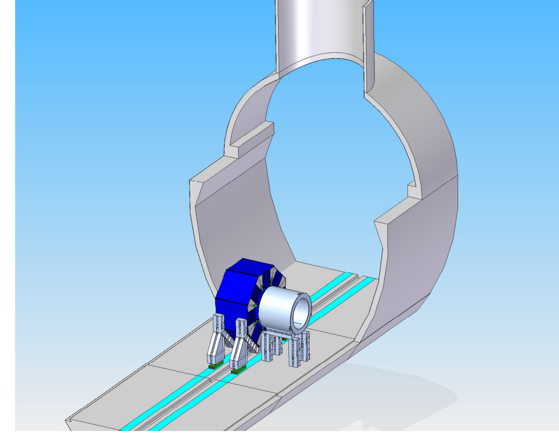

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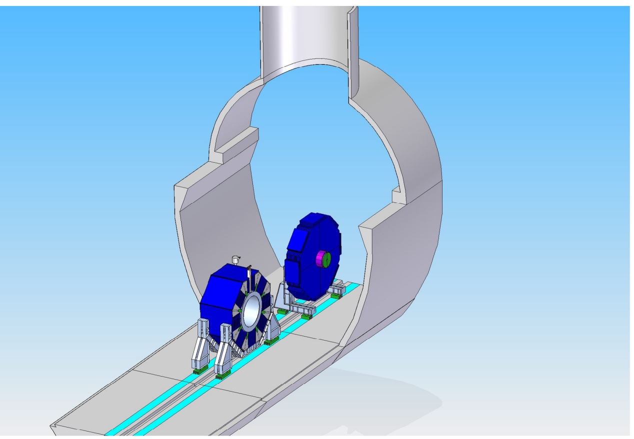

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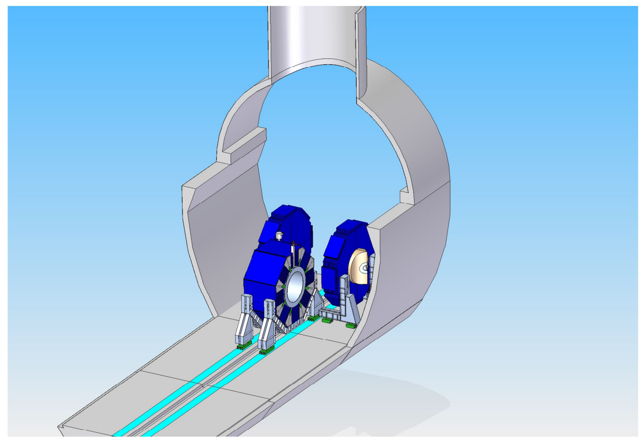

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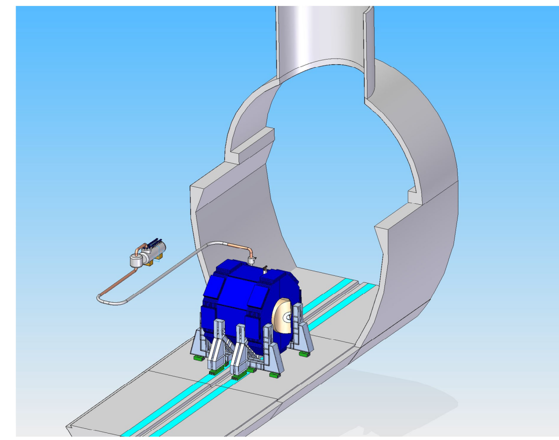

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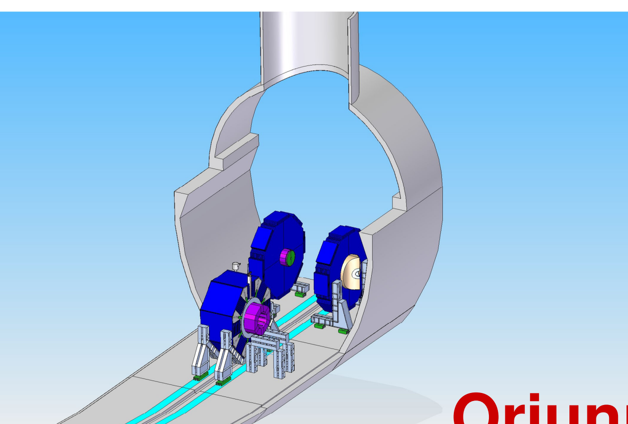

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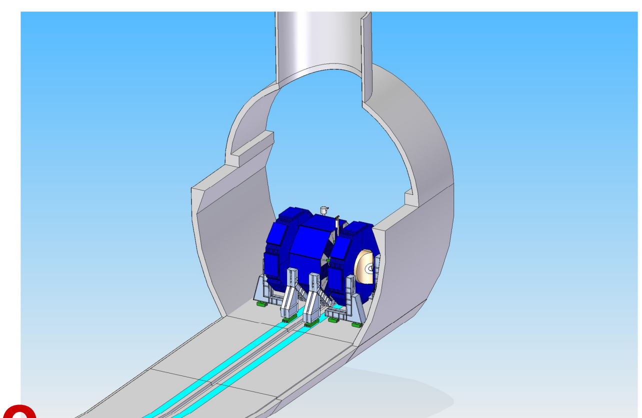
Oriunno



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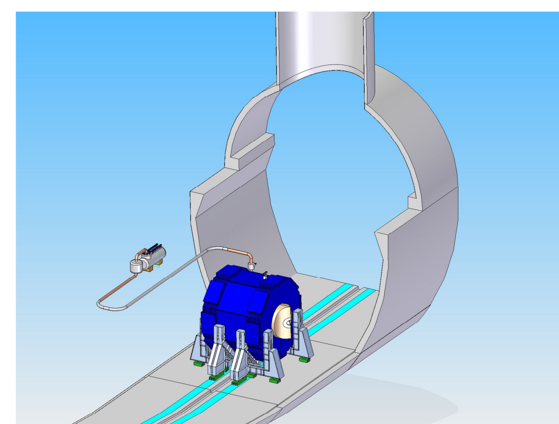

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Possible detector assembly (2)

- Assembly on IR floor with a 300 to 400t bridge crane
- Possible alternative: two approximately 200t cranes on the same rails, one nominally for each experiment, with occasional coordinated use of both cranes
- Dedicated tooling for insertion of barrel detectors into solenoid

- Complete barrel assembly weighs approximately 4kt
- Surface assembly and lowering with a substantial gantry crane is possible

Detector positioning

Accurate positioning critical for push-pull model

General concept:

SiD moves into beam position as a single large unit, carrying end doors with the barrel

Detector moves on multi-roller supports, each with an integrated drive: steel structure minimally stressed

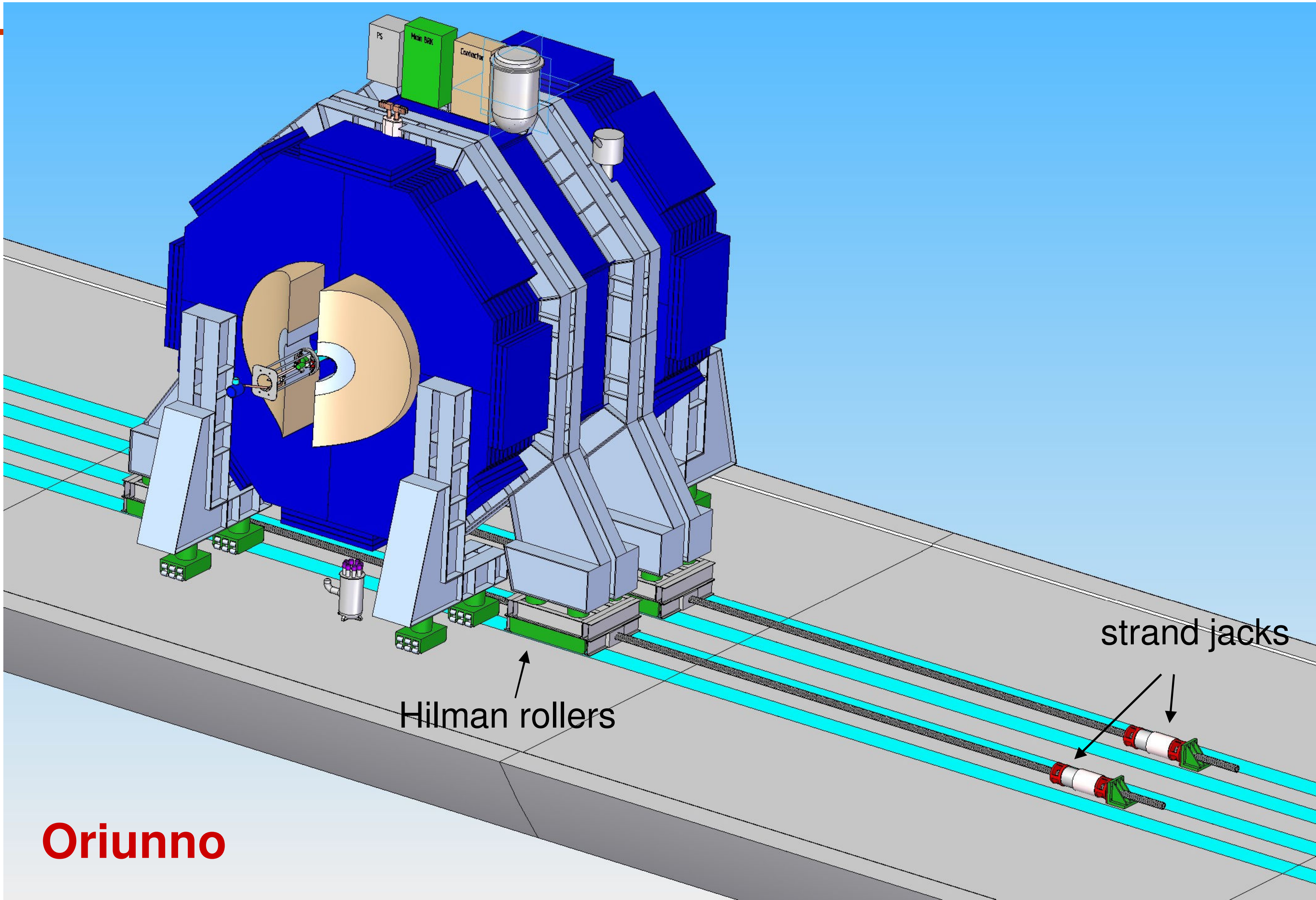
Smooth acceleration + deceleration: max. speed 1 - 5 mm/sec

Permanent mechanical stops

→ Position accuracy +- 1 mm

Acceptable for positioning of iron structure, muon system, solenoid, calorimetry and outer tracker

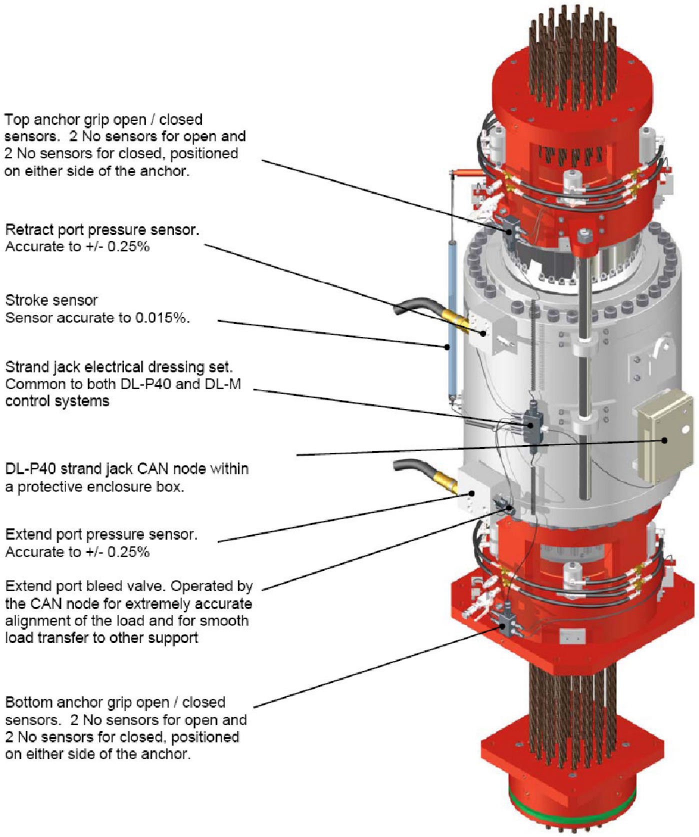
Detector motion: concept

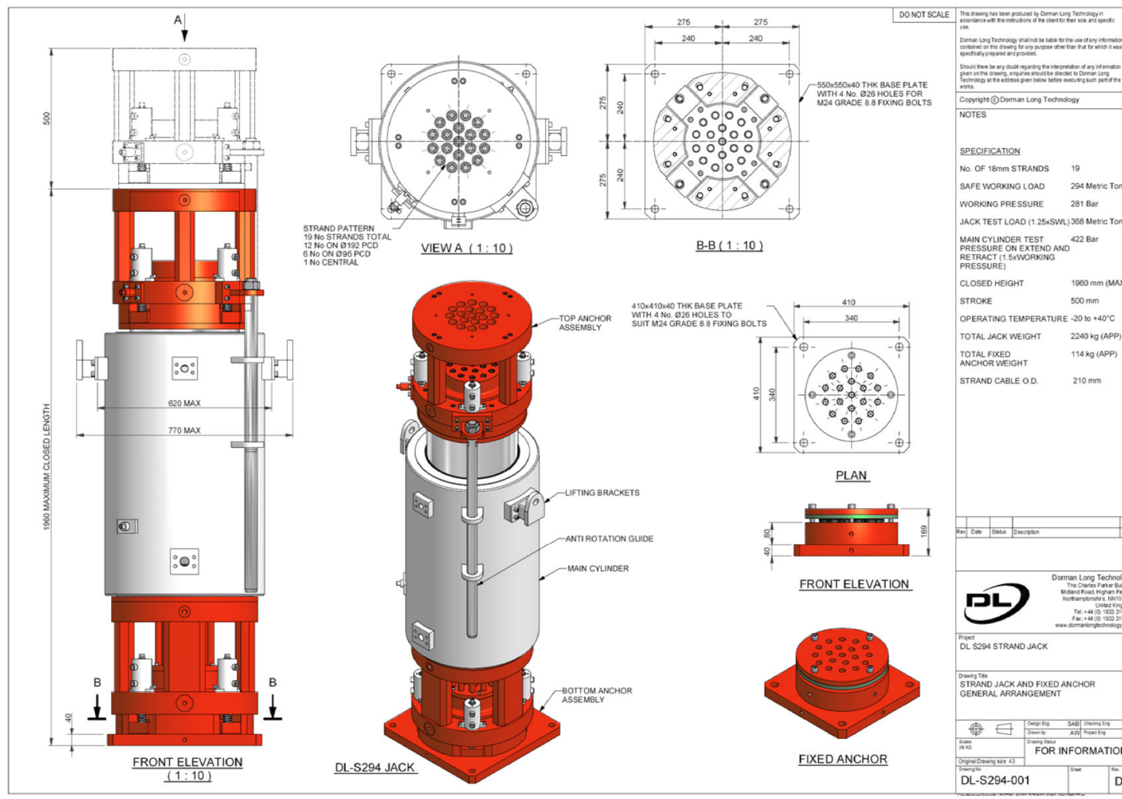


Detector motion

- Move on hardened steel rails, grouted and locked to the floor
- Rail sets for transverse motion (push pull) and door opening in both the beamline and garage positions will be needed
- Hilman roller supports, strand jacks provide locomotion
- If ILC is built in a seismically active location, provision may be needed for locking SiD down in both the beamline and garage positions

Strand jacks (c. 500t capacity)





DL-S294 strand jack

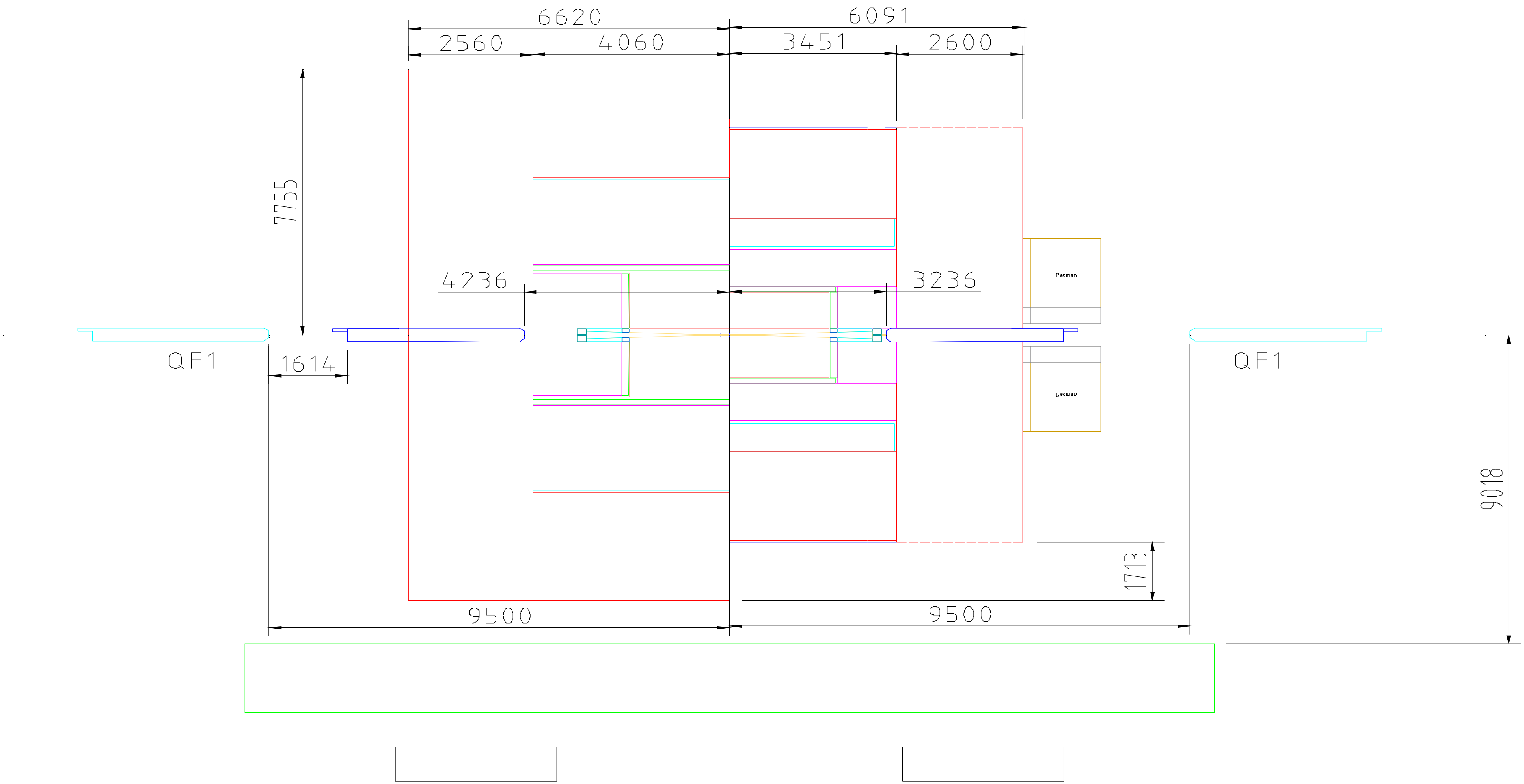
Philip Burrows

Push-pull compatibility with ILD

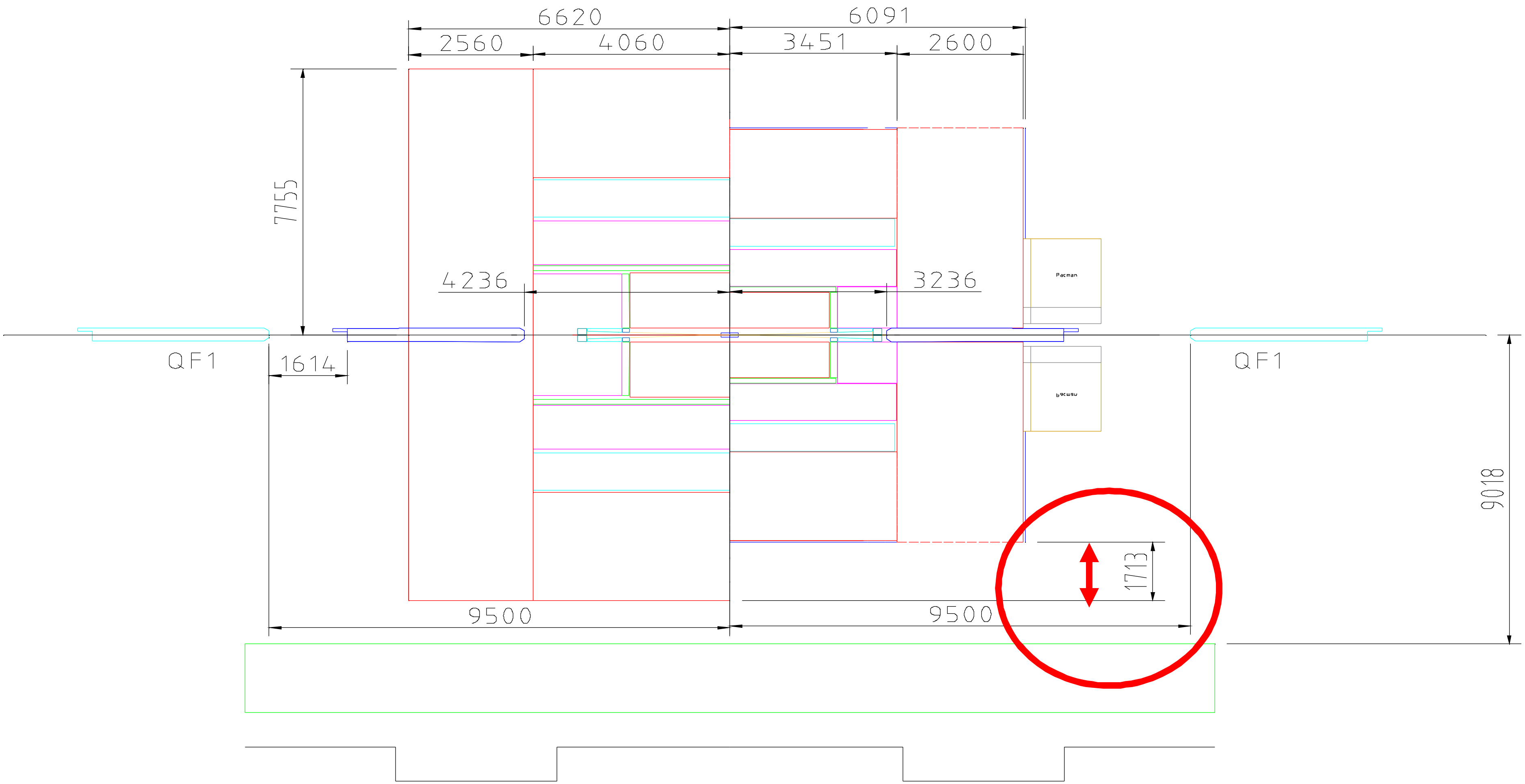
Main issues:

- Height difference
- Preferred detector support mechanism
- Preferred detector motion mechanism
- Interface to machine tunnel
- …

Detector heights

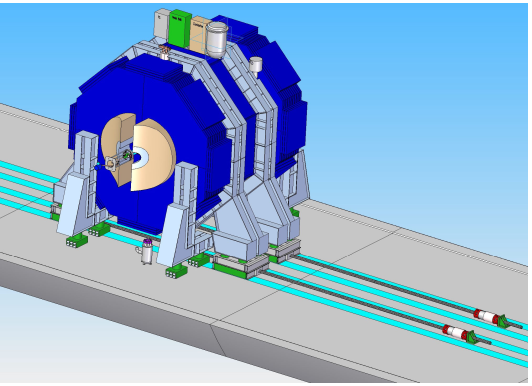


Detector heights

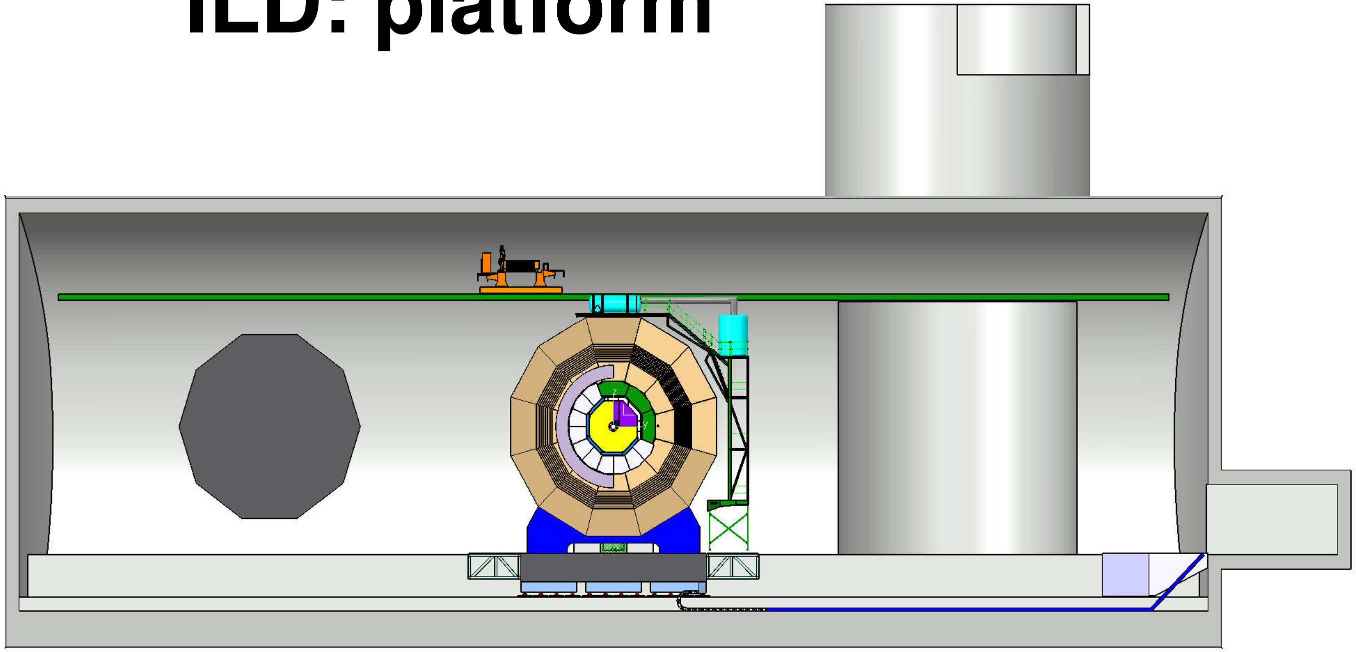


Detector support mechanism

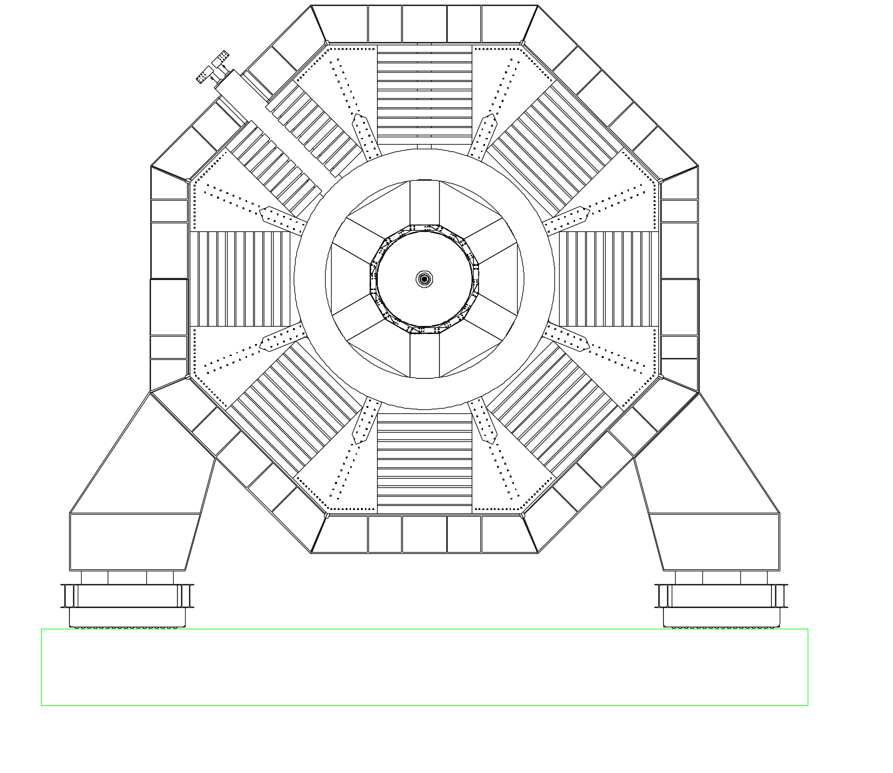
SiD: legs

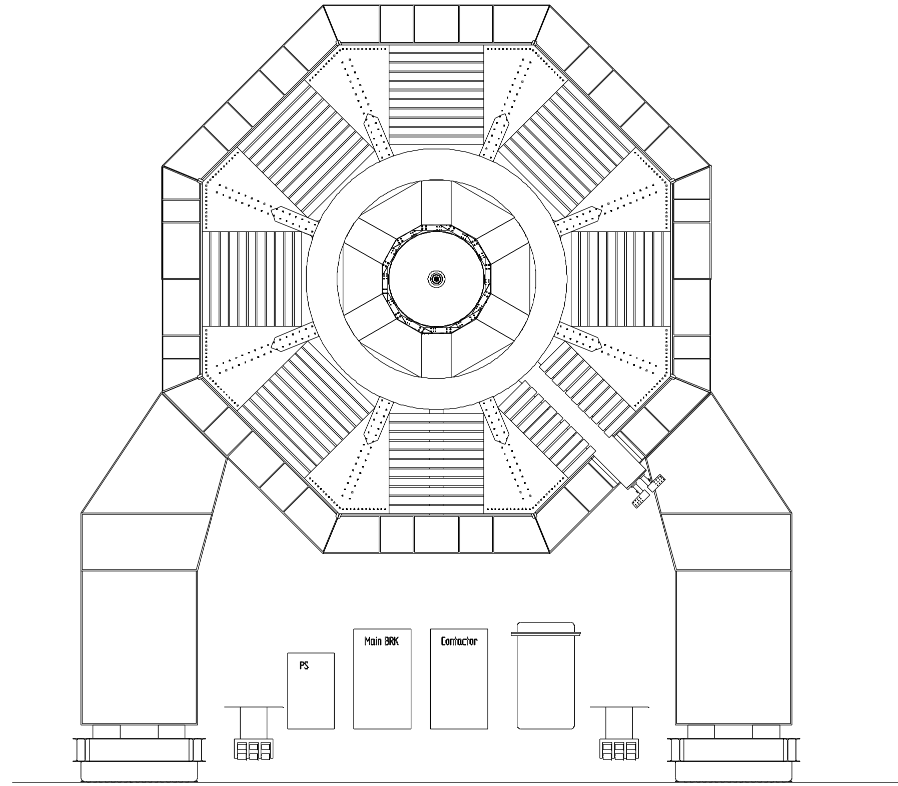


ILD: platform



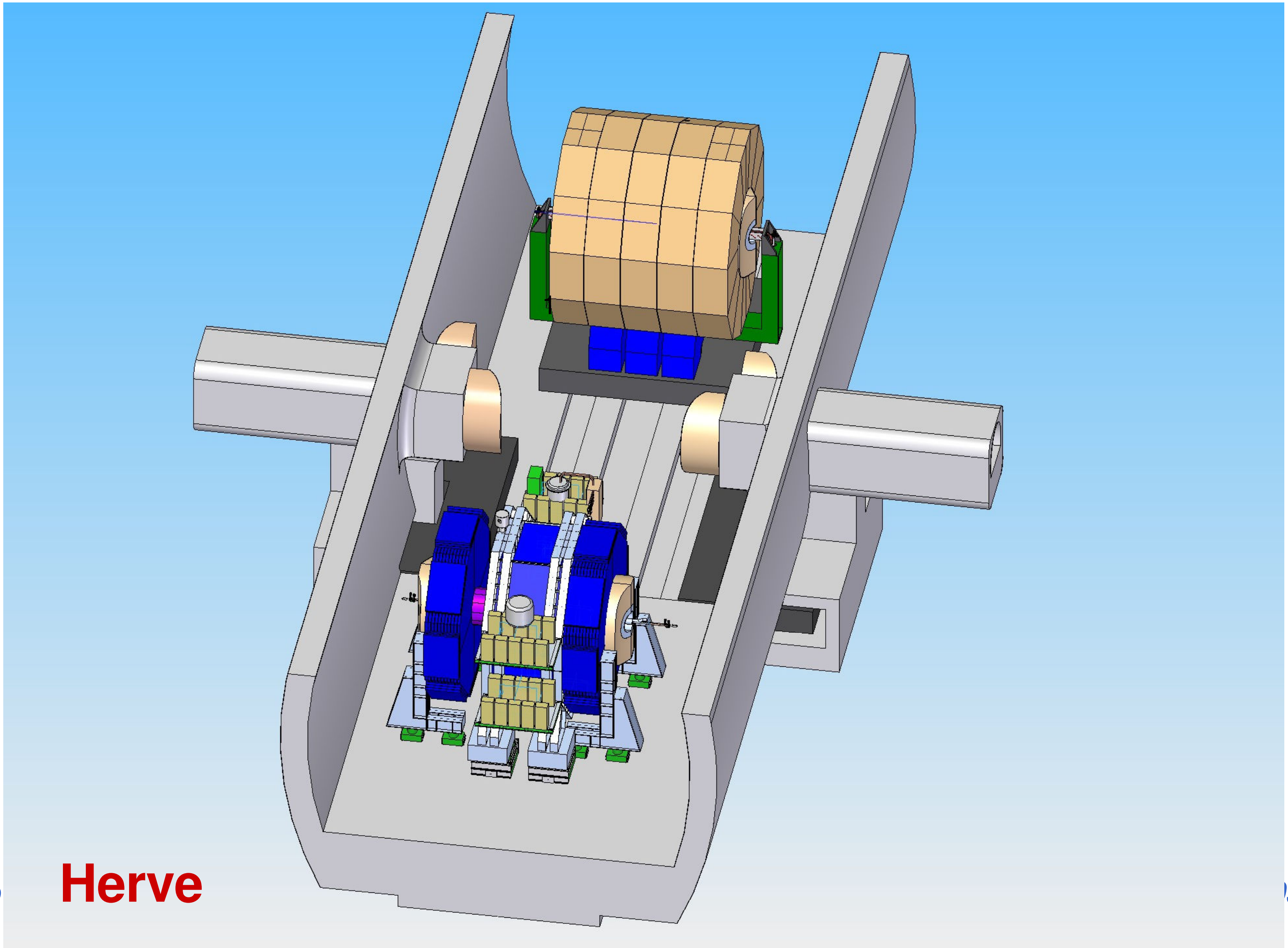
1) Lengthen SiD's legs?





→ increased exposure to vibrations?

2) Half platforms in lateral alcoves



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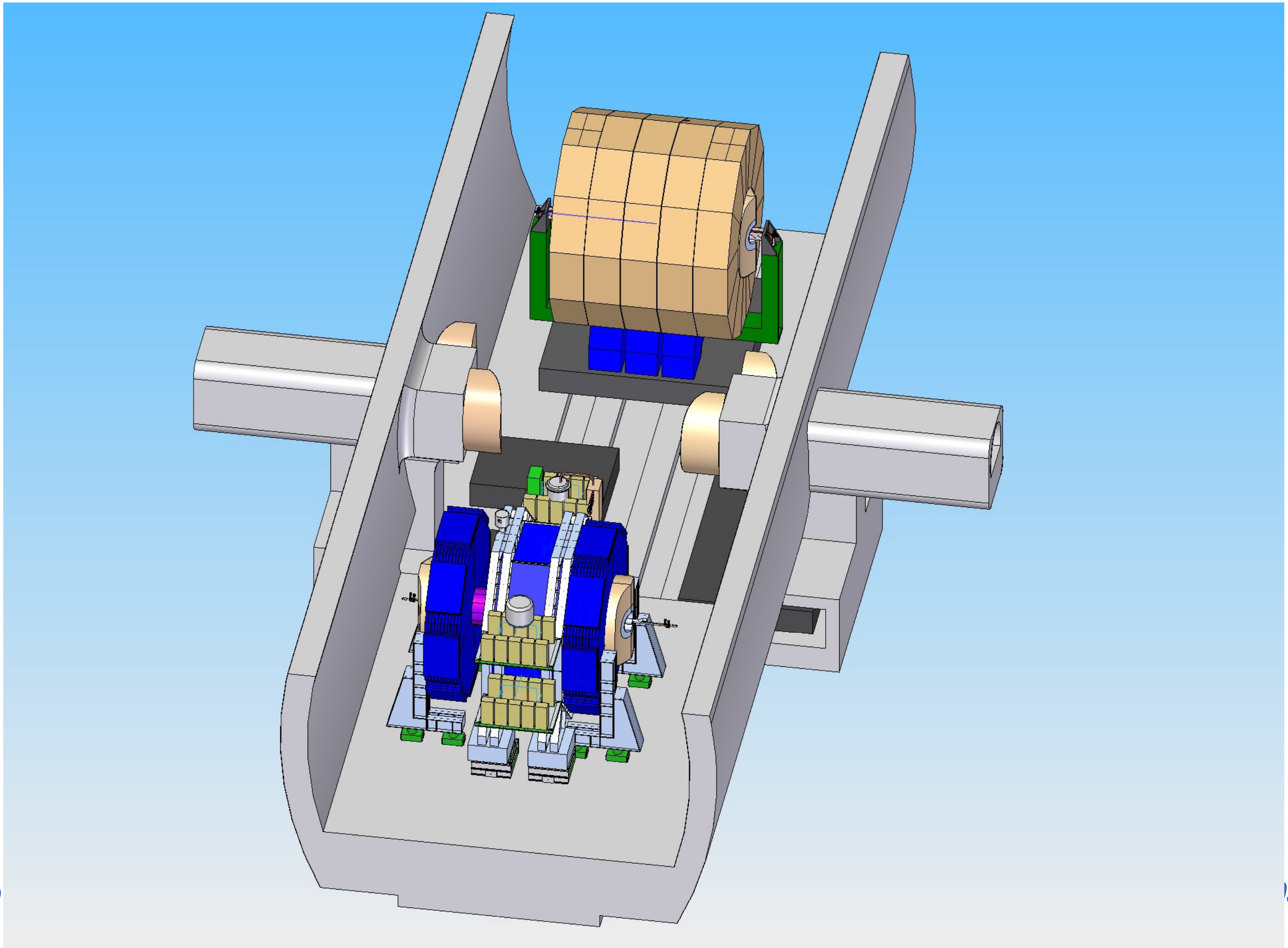

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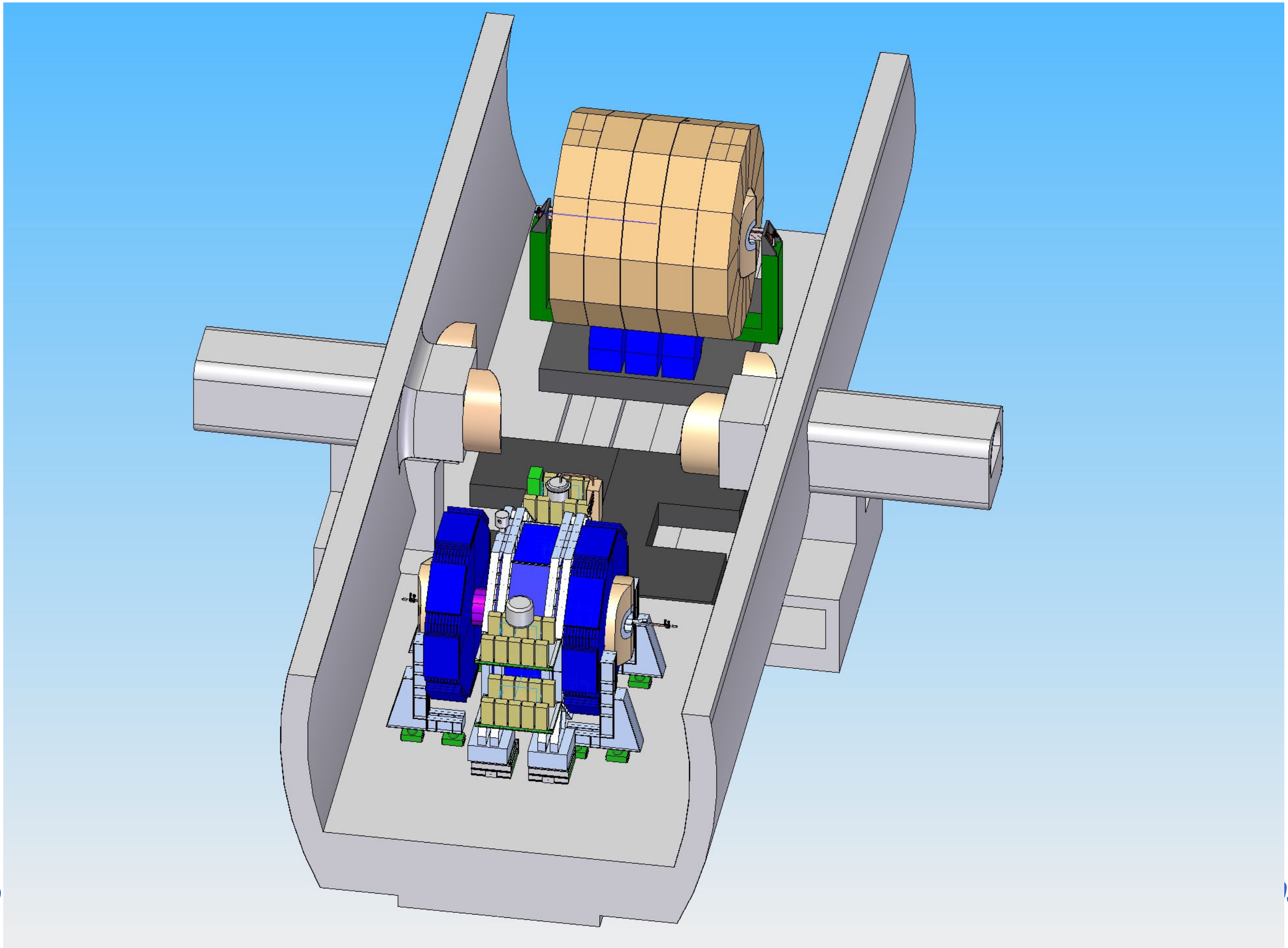

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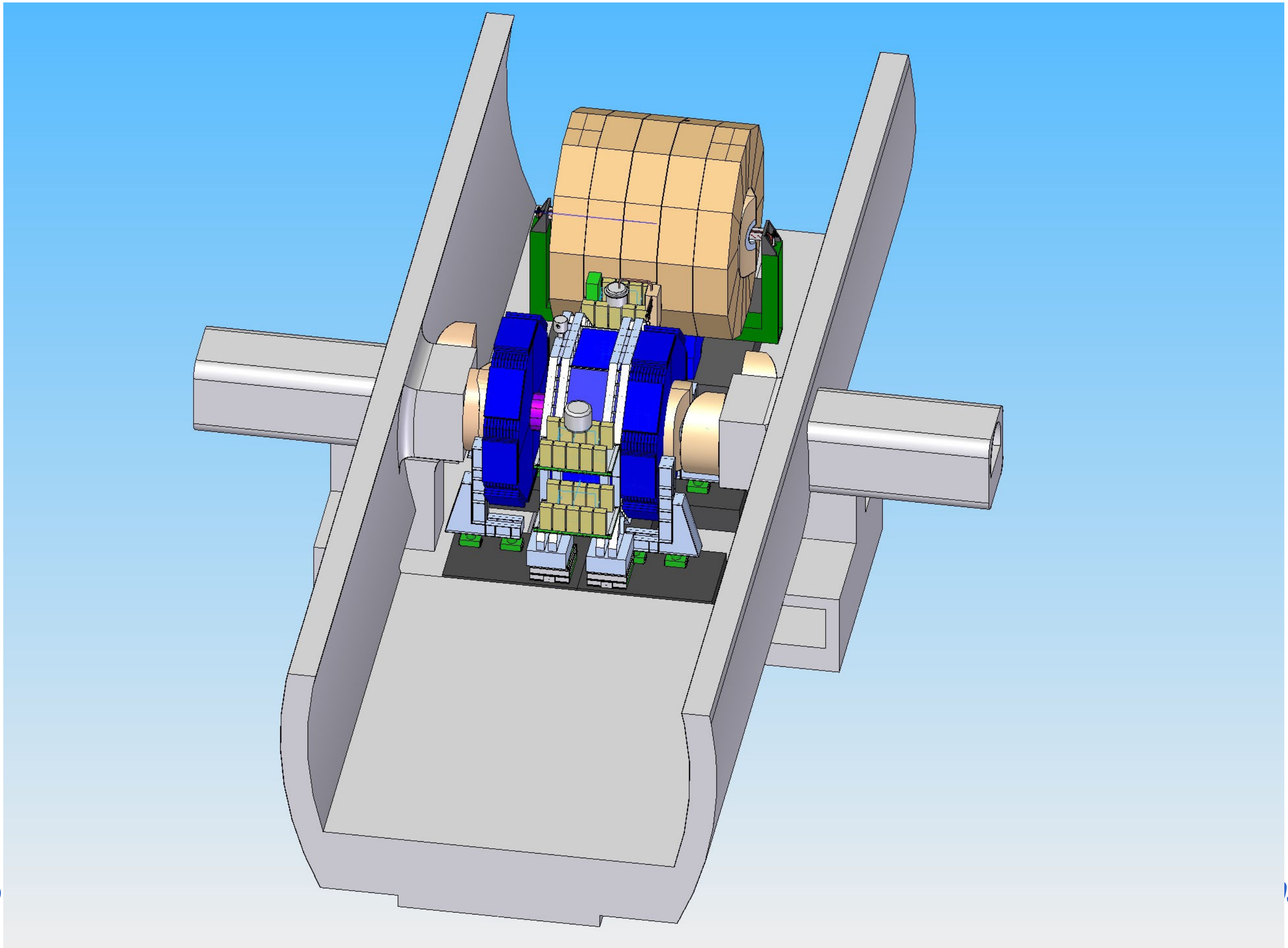

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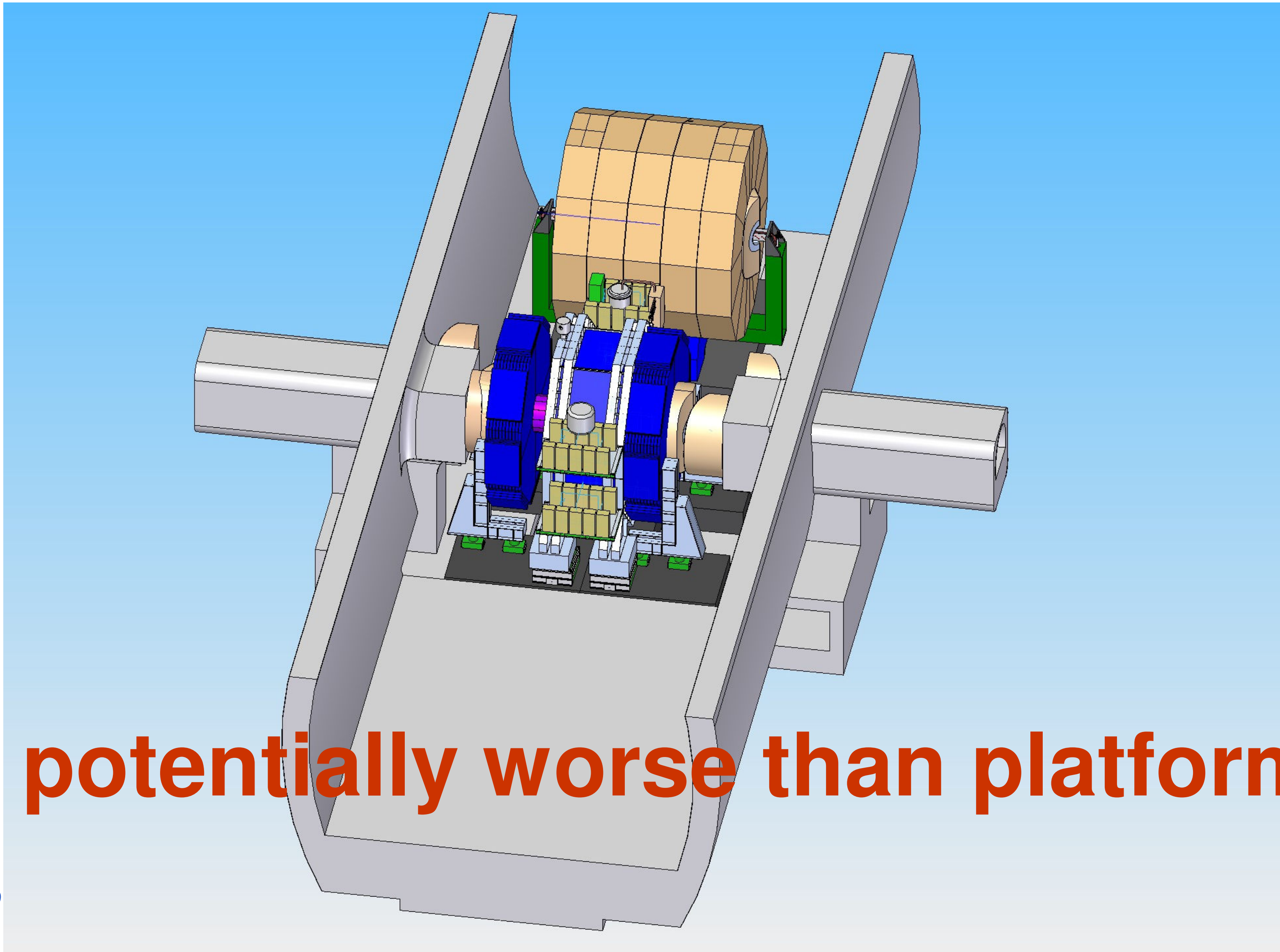
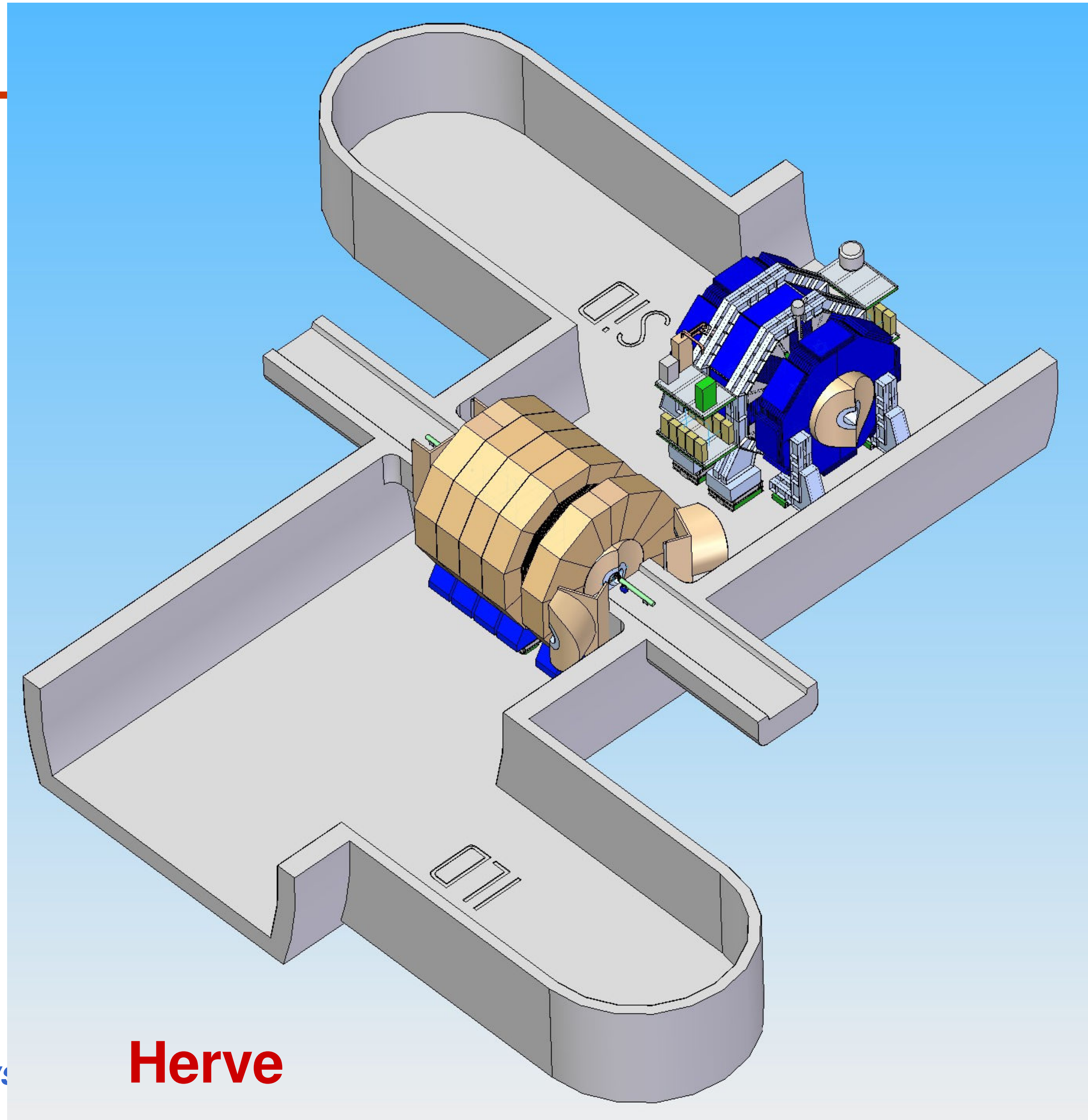
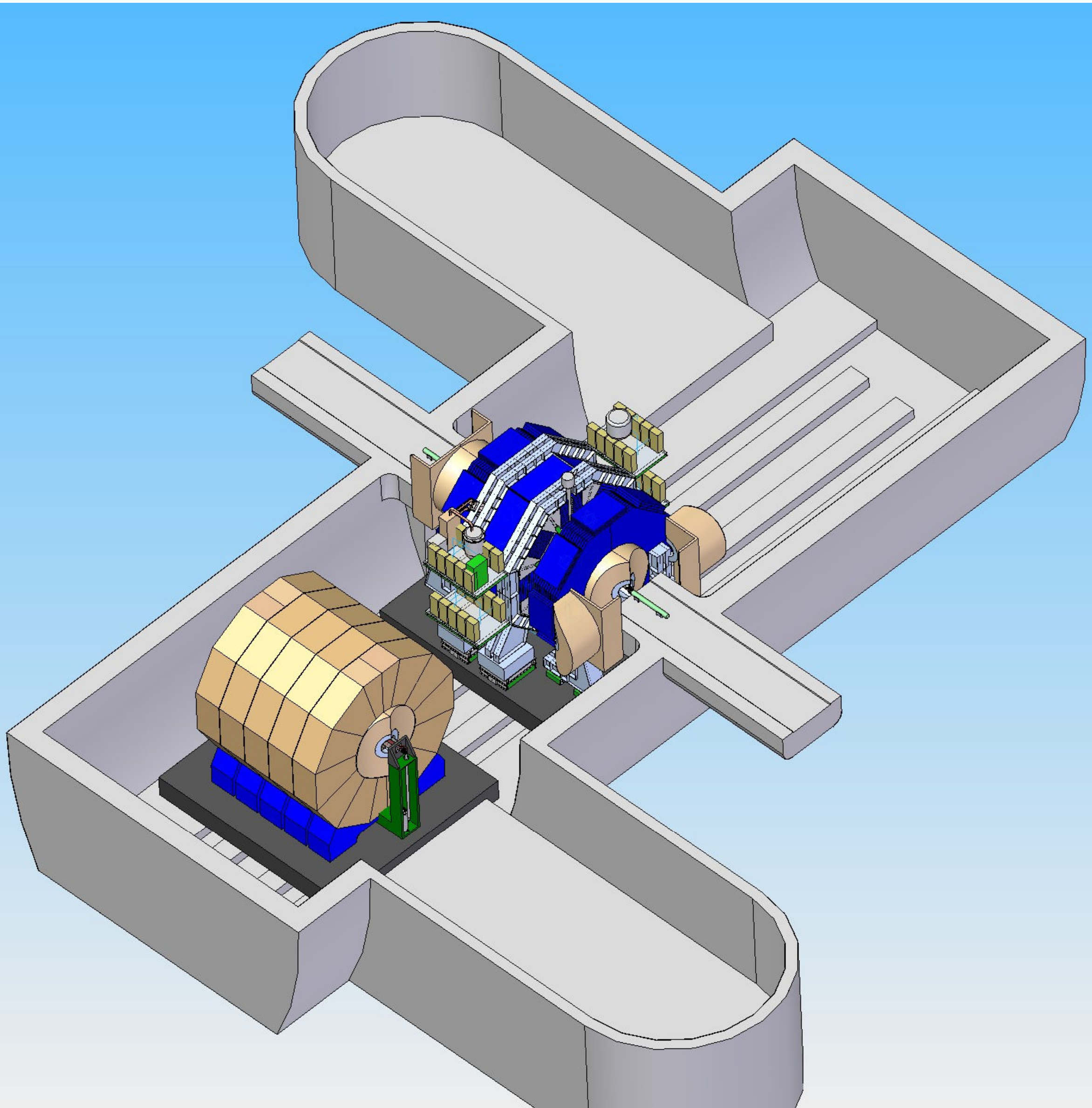


→ potentially worse than platform?

3) Both detectors on legs?



4) Both detectors on platform?



Herve

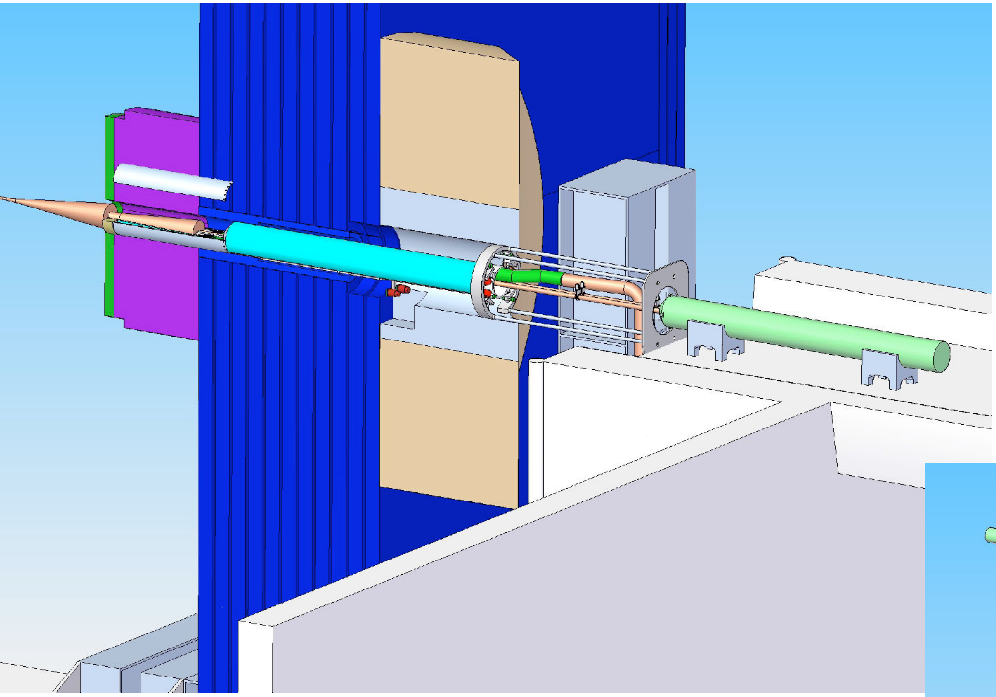
Issue for quantitative study

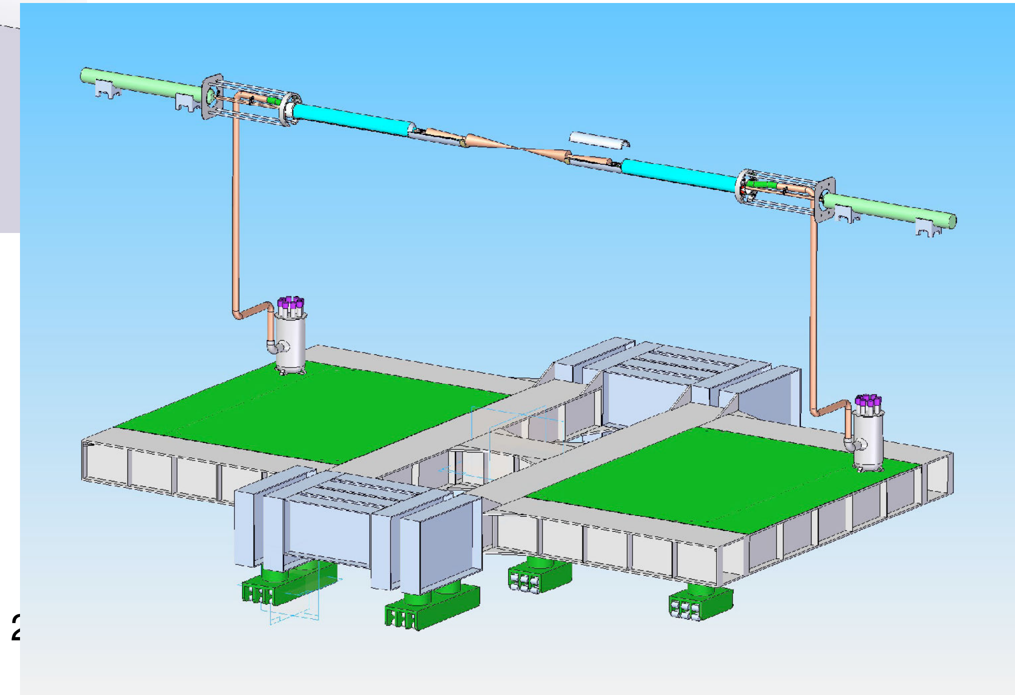
What are merits of platform vs. no platform in terms of minimising the detector and QD0 susceptibility to ground vibrations?

Detector: with / without platform

QD0 support: from pillar, from detector door …

QD0 support





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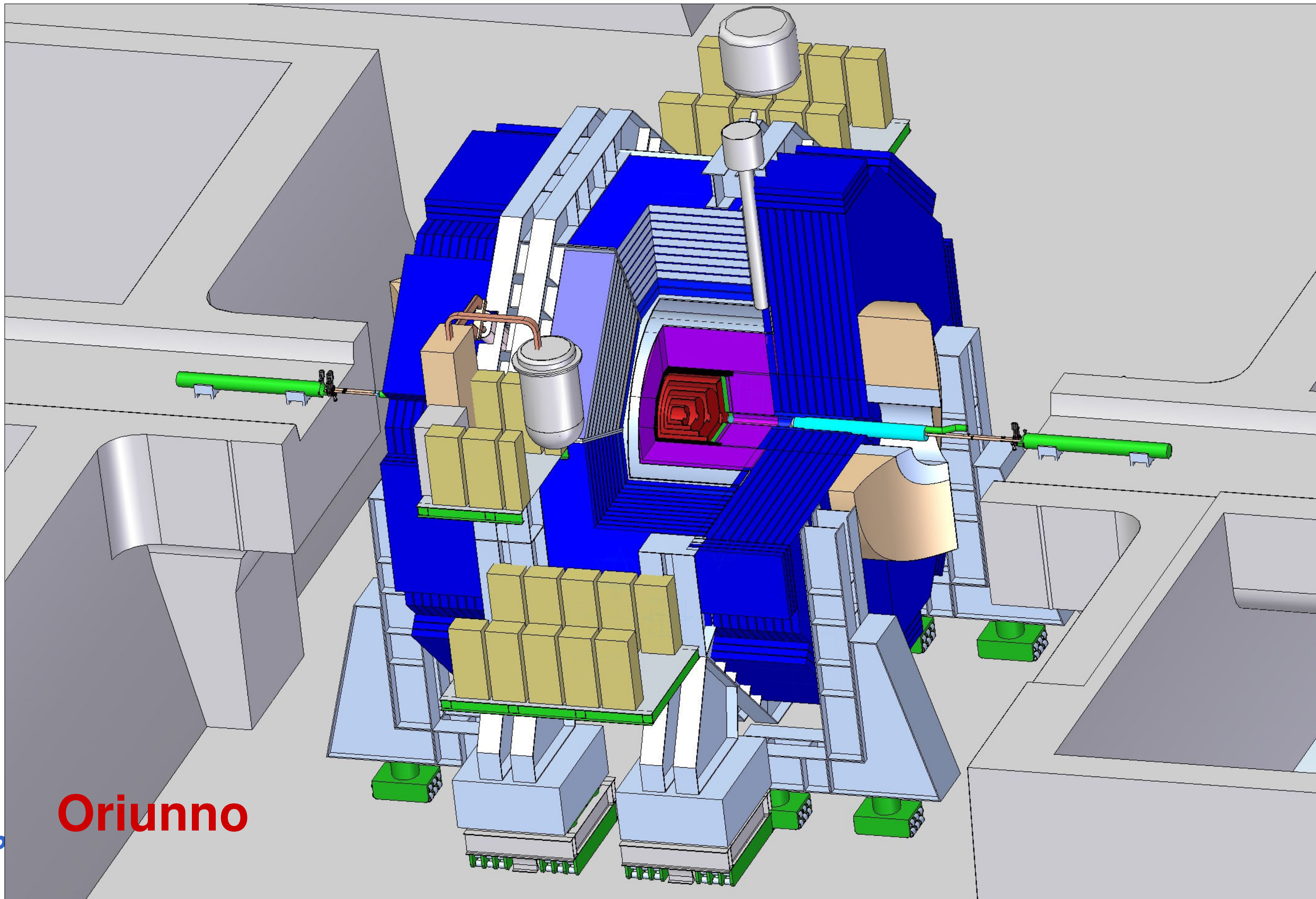
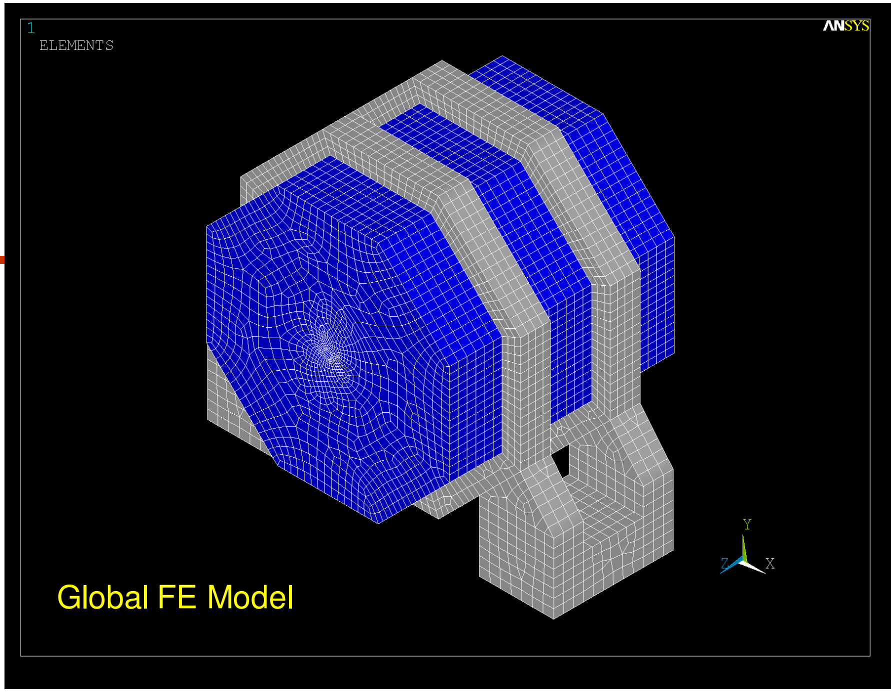
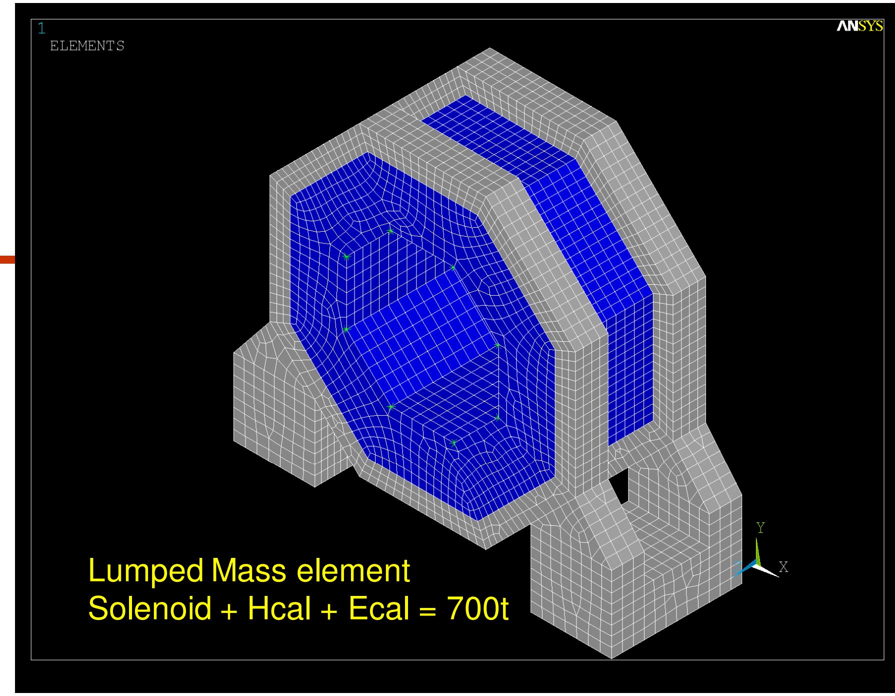
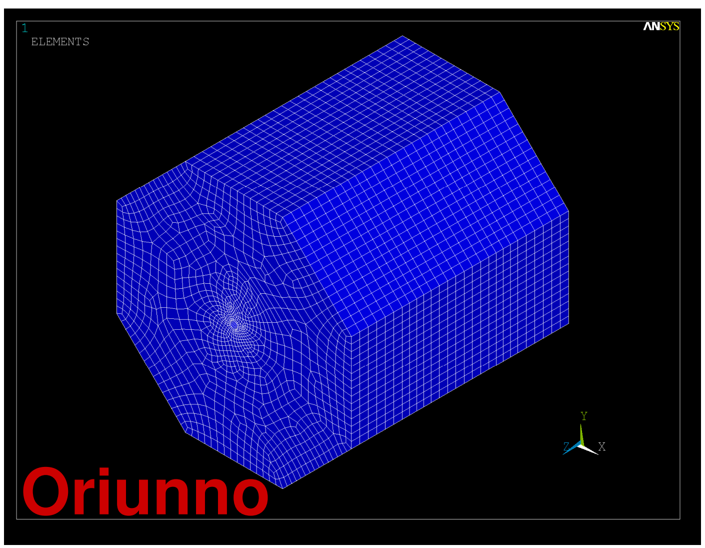
SiD on legs

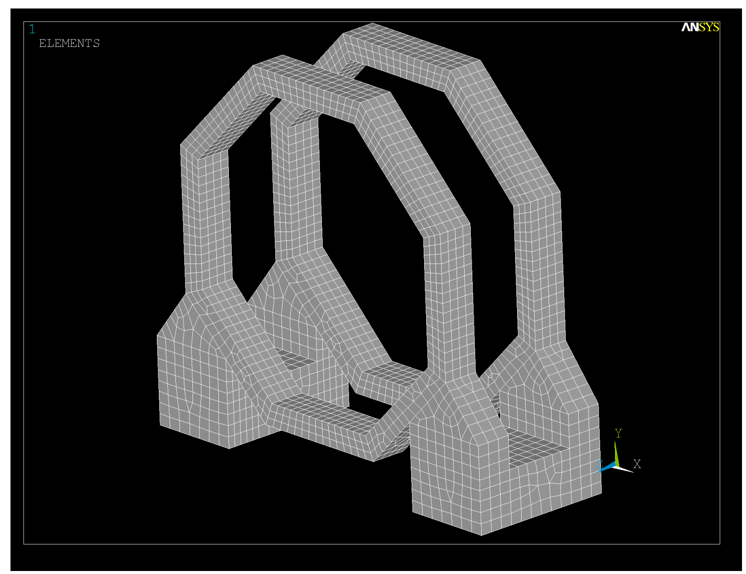






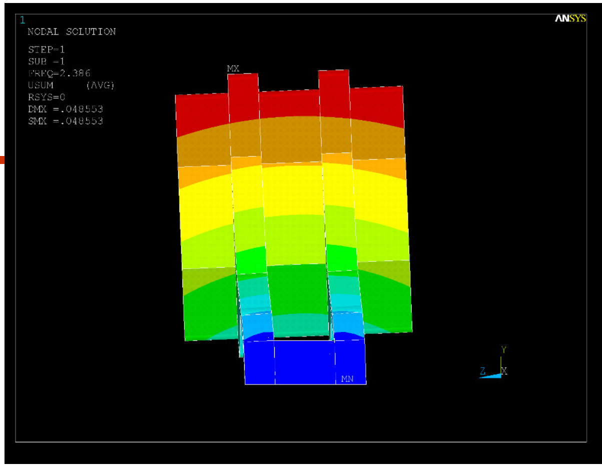


3D Solid Elements for the Iron Yoke, 9000 t

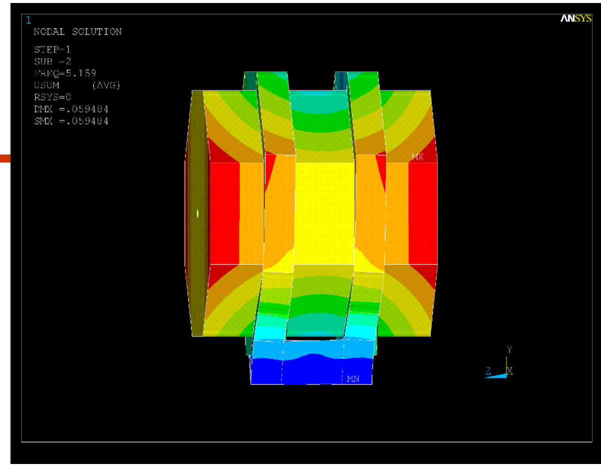


3D Shell Elements for the Arch, thickness 50mm

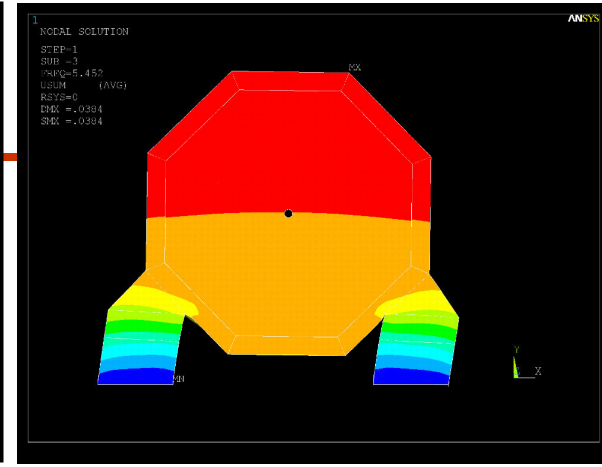
Free Vibration Modes



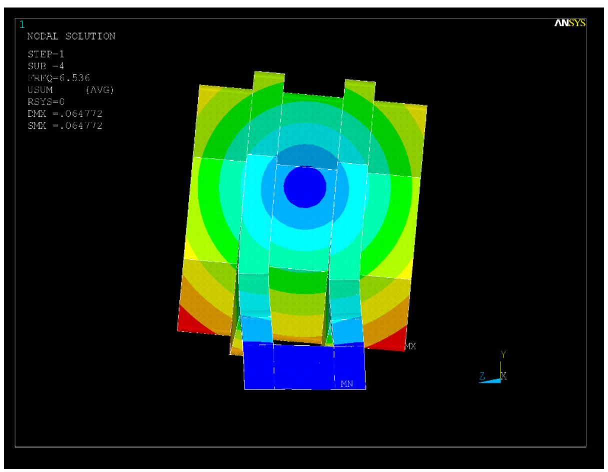
1st Mode, 2.38 Hz



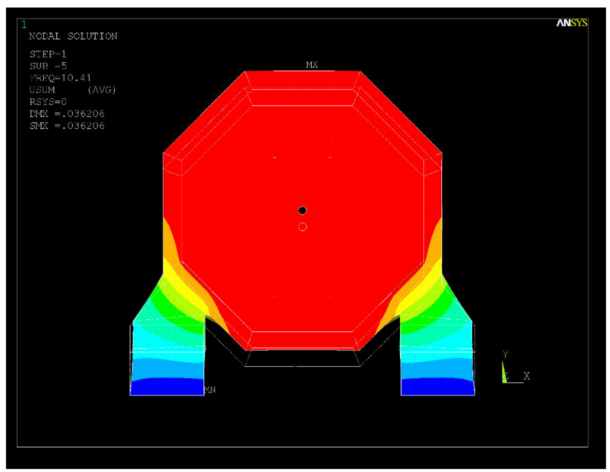
2nd Mode, 5.15 Hz



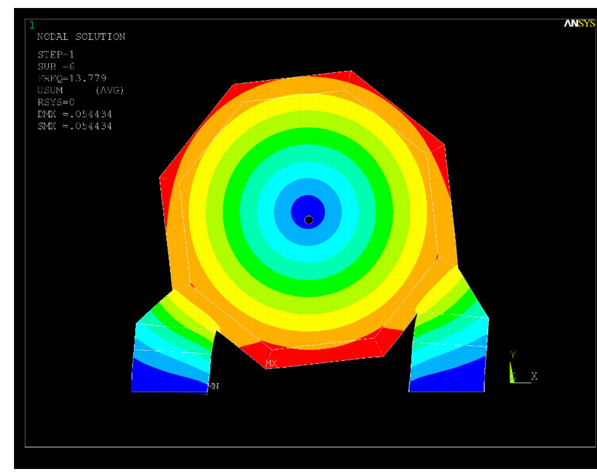
3rd Mode, 5.45 Hz



4th Mode, 6.53 Hz



5th Mode, 10.42 Hz



6th Mode, 13.7 Hz

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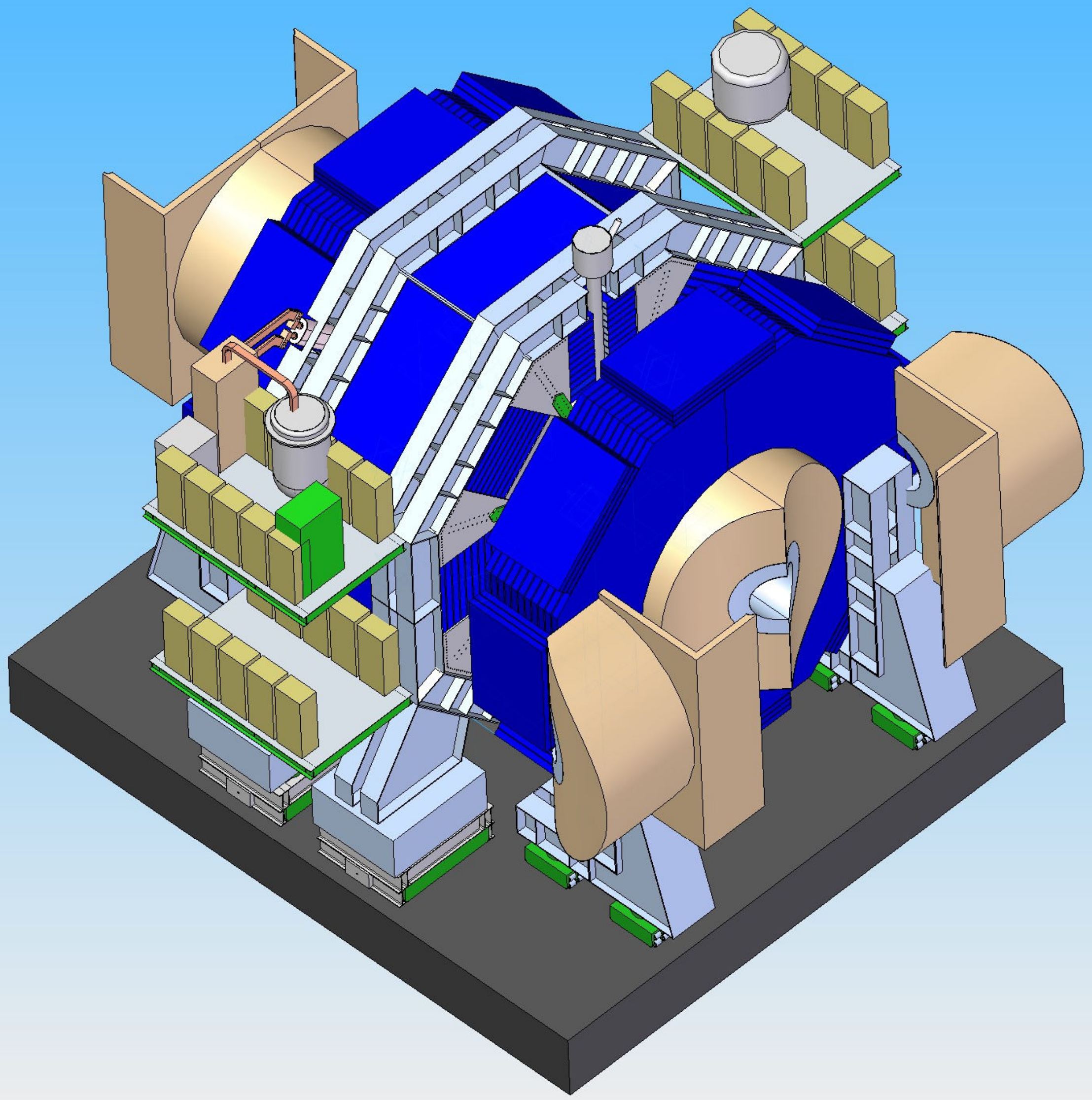
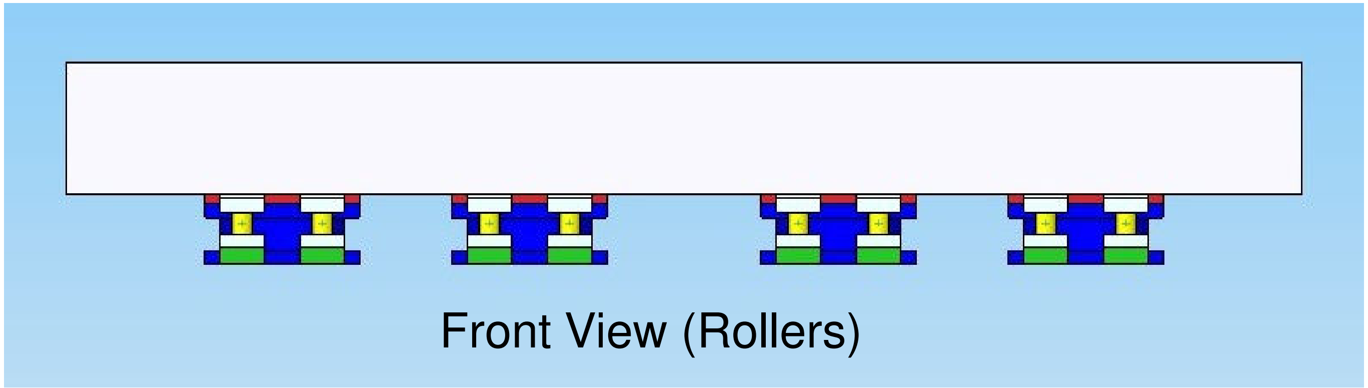
Vertical motion

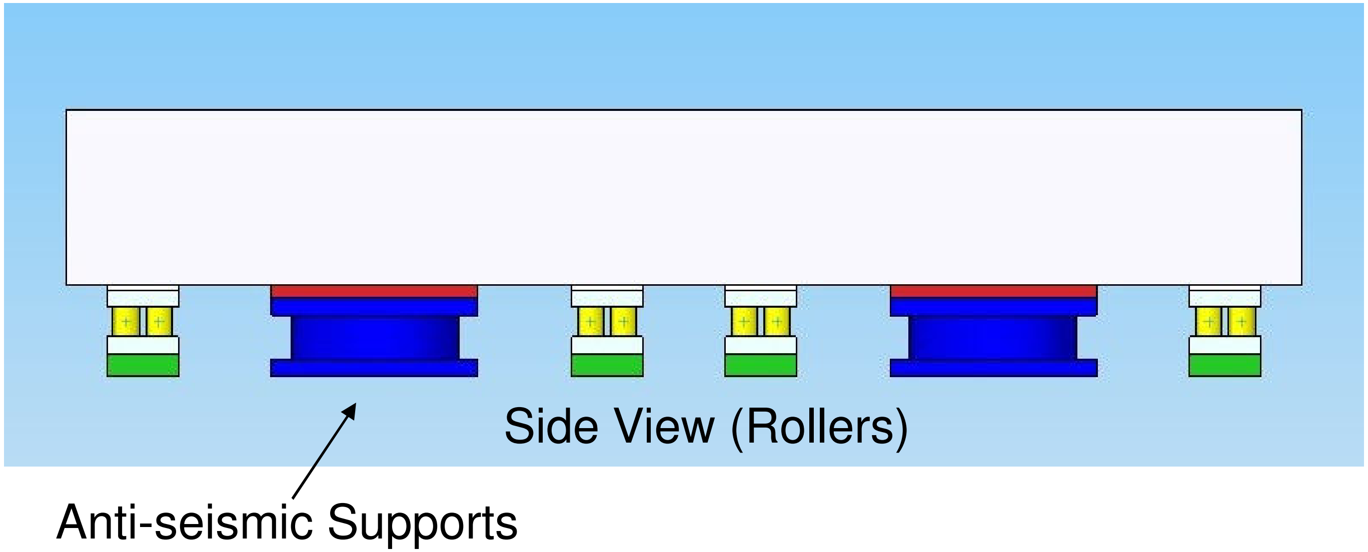
SiD on platform



Oriunno

Platform concept





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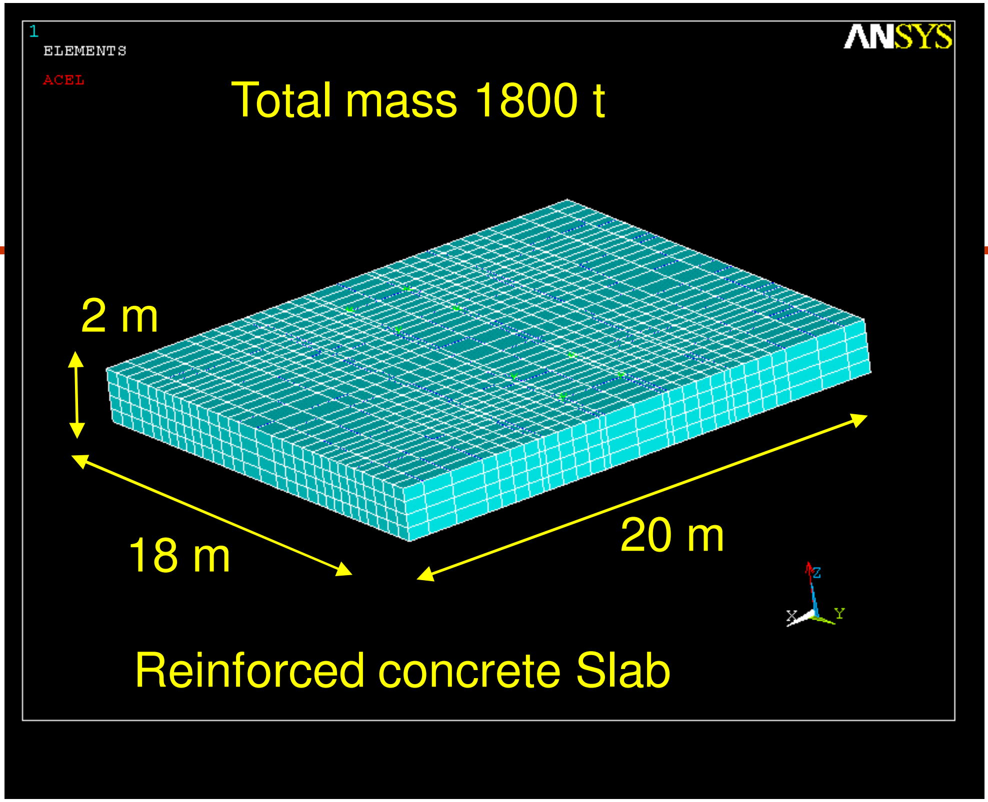
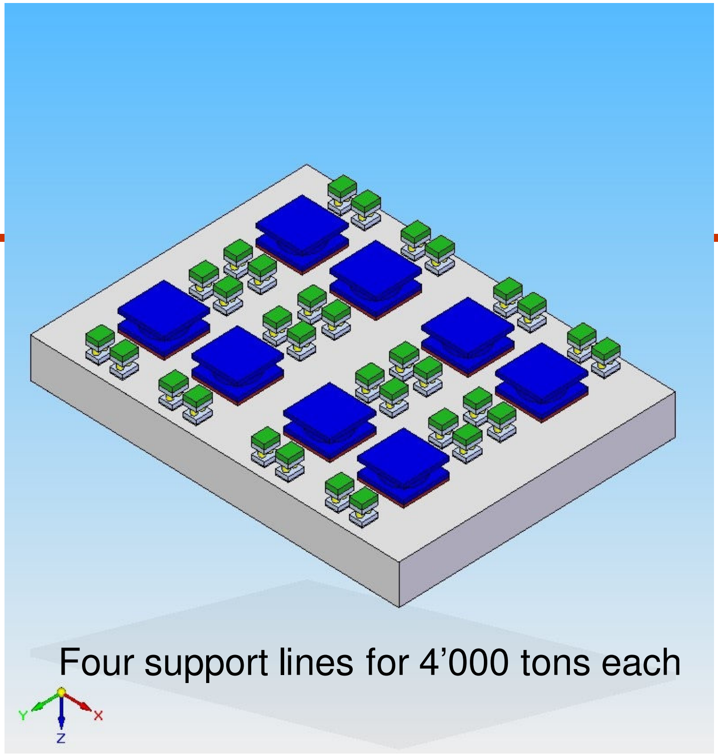
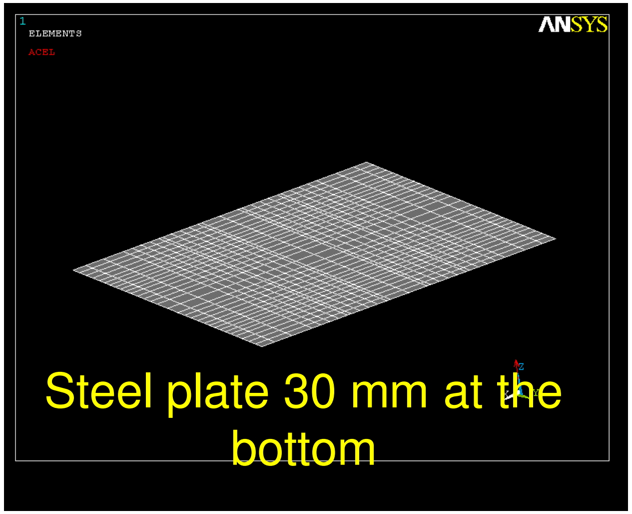
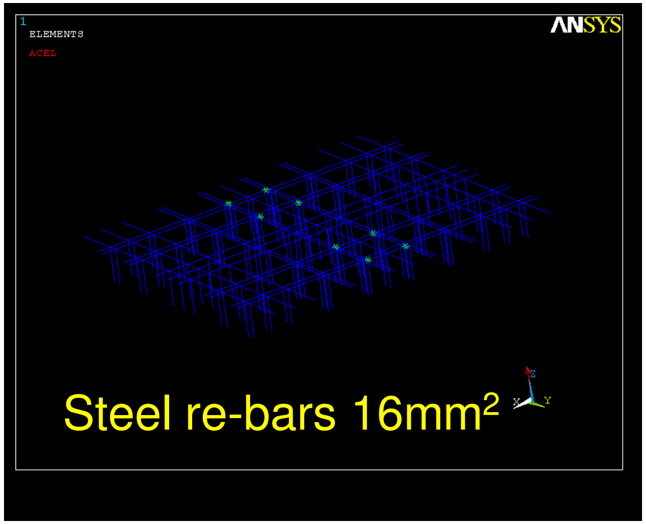


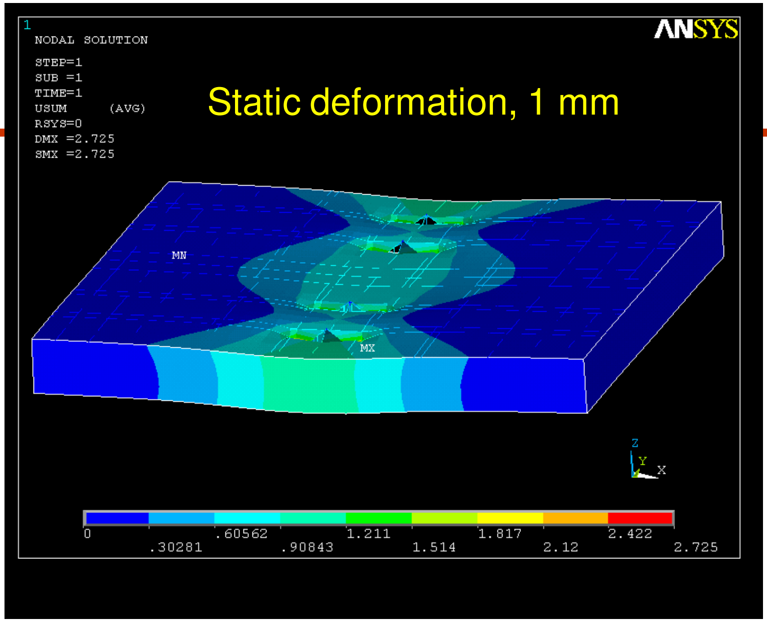


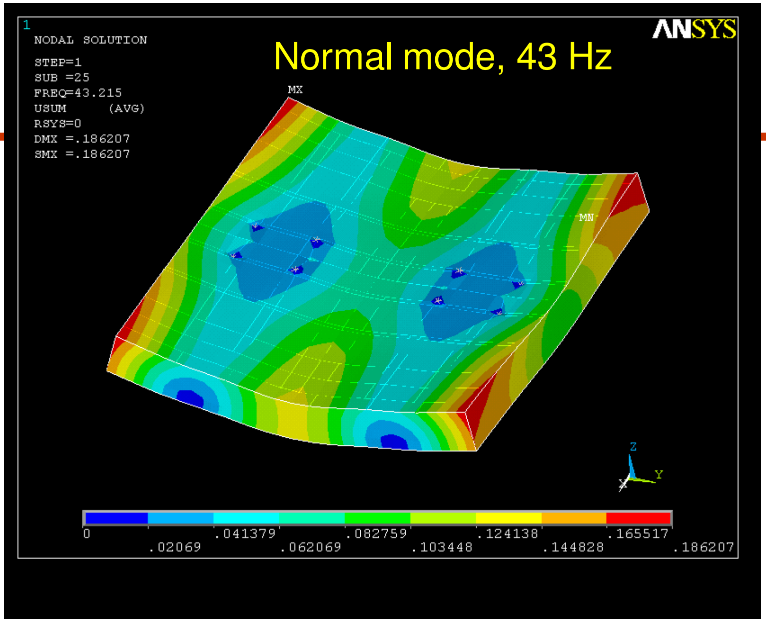


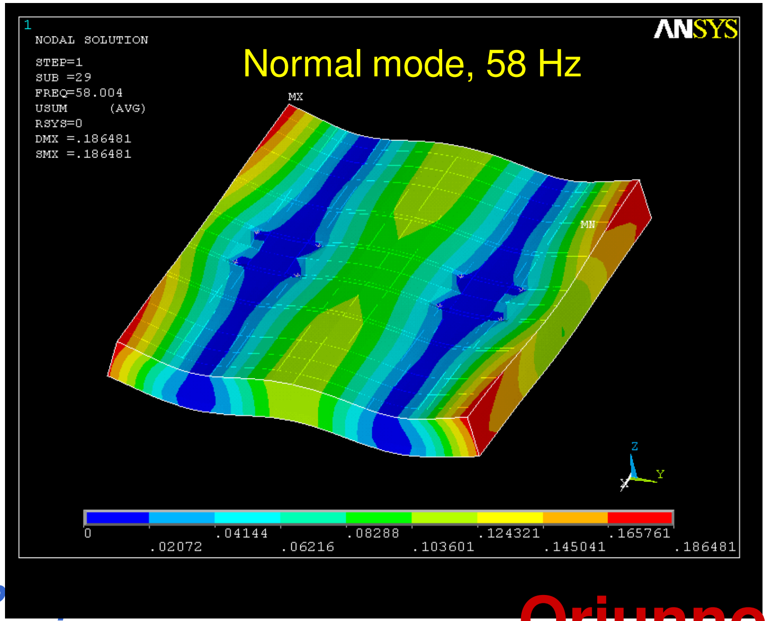


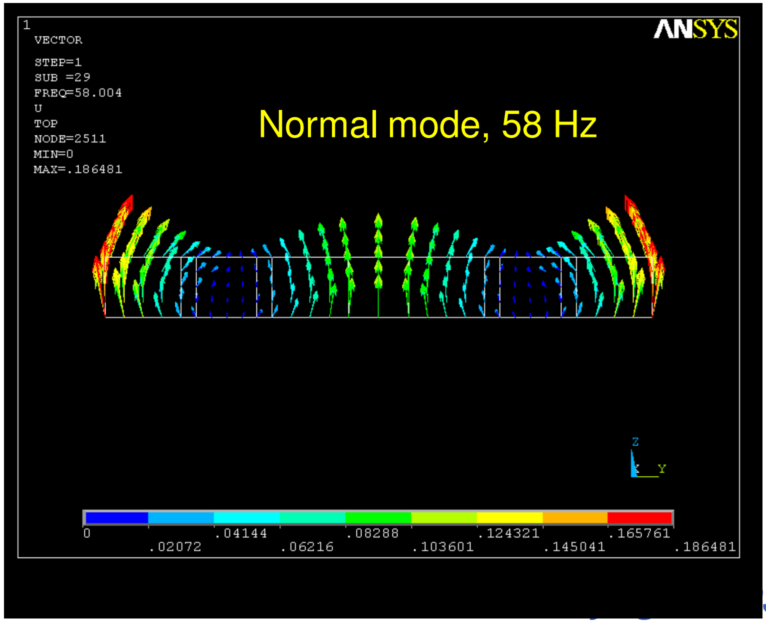
10kt Anti-seismic supports

Vibration Modes









Vibrational update

BDS / MDI joint session on vibration and stability issues Monday 29 March 09.00:

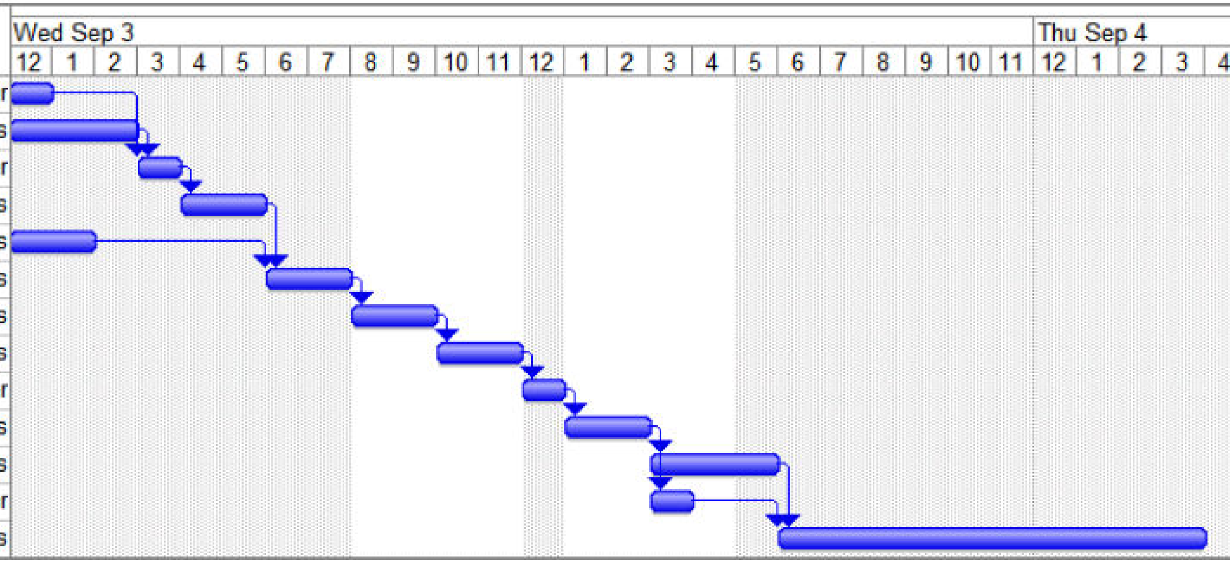
- **Marco Oriunno: SiD vibration studies**
- **Toshiaki Tauchi: vibration studies at KEK**

Push-pull: SiD position

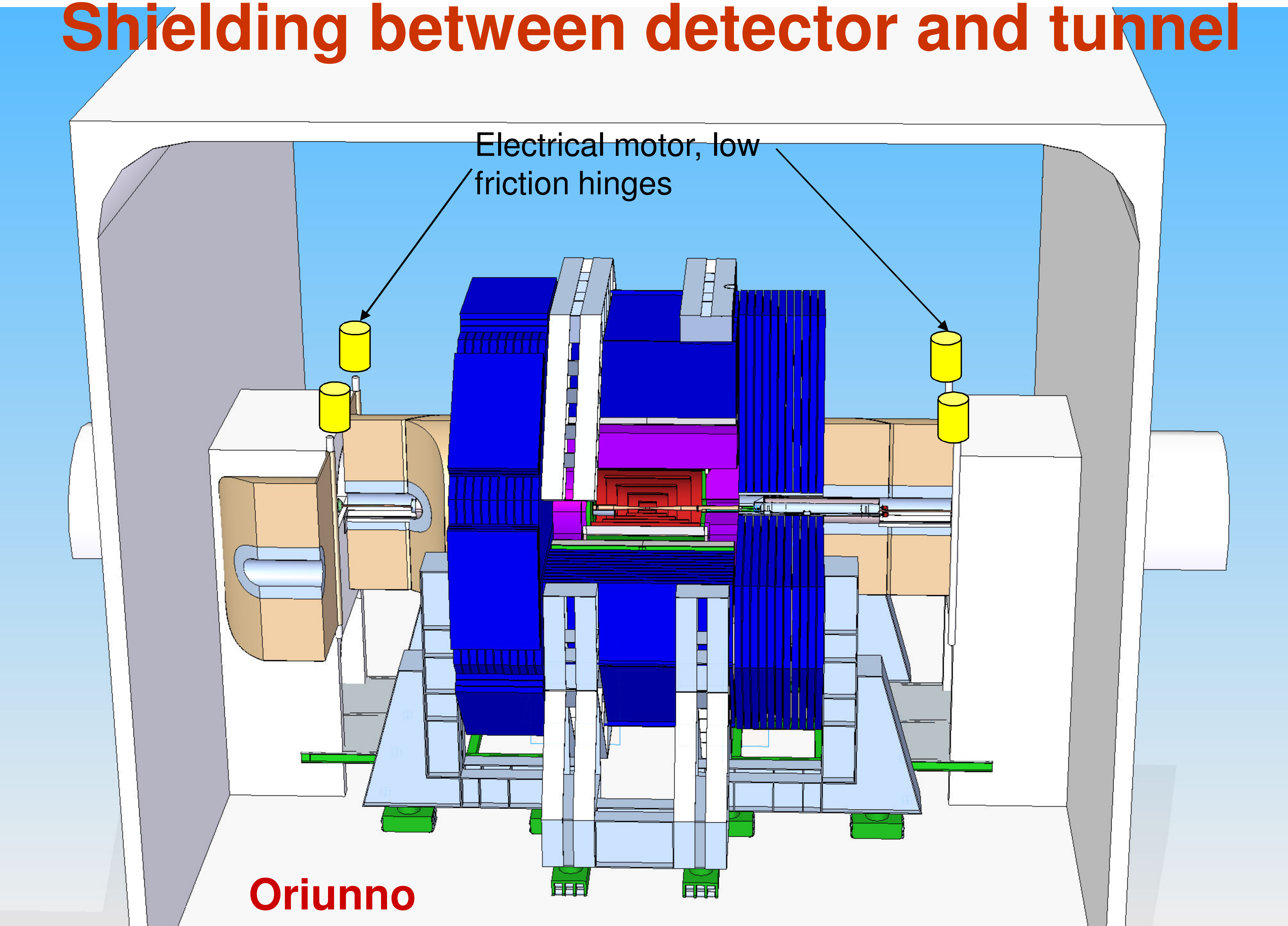
- With proper engineering considerations push-pull can be made to work
- Need well defined algorithm for scheduling swaps
- Machine luminosity must be shared equitably
- Period between swaps should be of order 1 month:
  - neither detector can gain significant lumi advantage in 1 period
- Switch-over time << running period

Push-pull sequence

ID	Task Name	Duration
1	Secure ILC Beams	1 hr
2	De-energize magnets	3 hrs
3	Open Beamline Shielding	1 hr
4	Disconnect Beamlines	2 hrs
5	Checkout Detetctor Transport system	2 hrs
6	Transport Detector 20 m	2 hrs
7	Transport other detector on beamline	2 hrs
8	Connect beamline	2 hrs
9	Close Beamline shielding	1 hr
10	Check gross detector alignment & adjust if	2 hrs
11	Energize magnets	3 hrs
12	Safety Checks before beams	1 hr
13	Begin Beam Based alignment	10 hrs

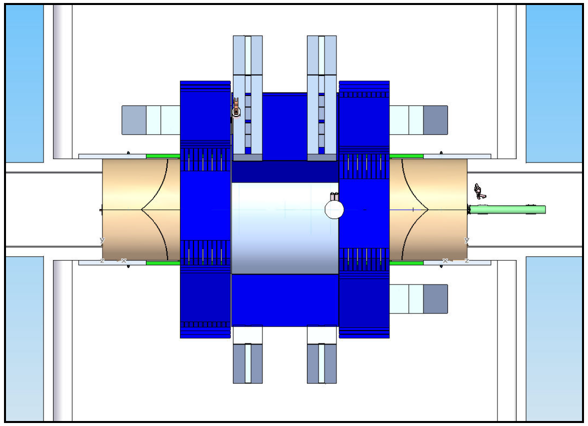


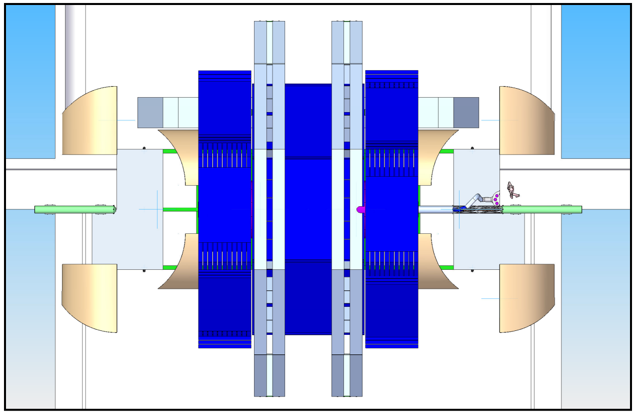
Shielding between detector and tunnel

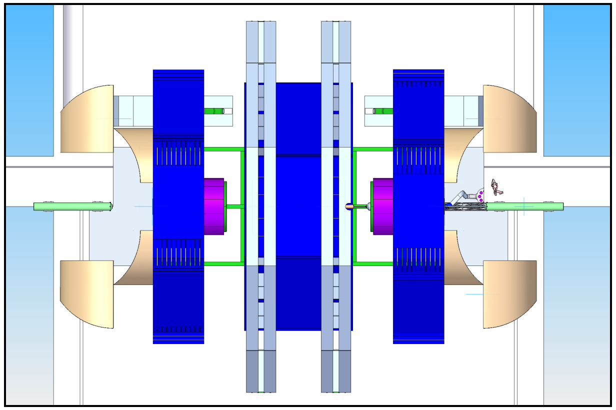


Oriunno

SiD opening on beamline

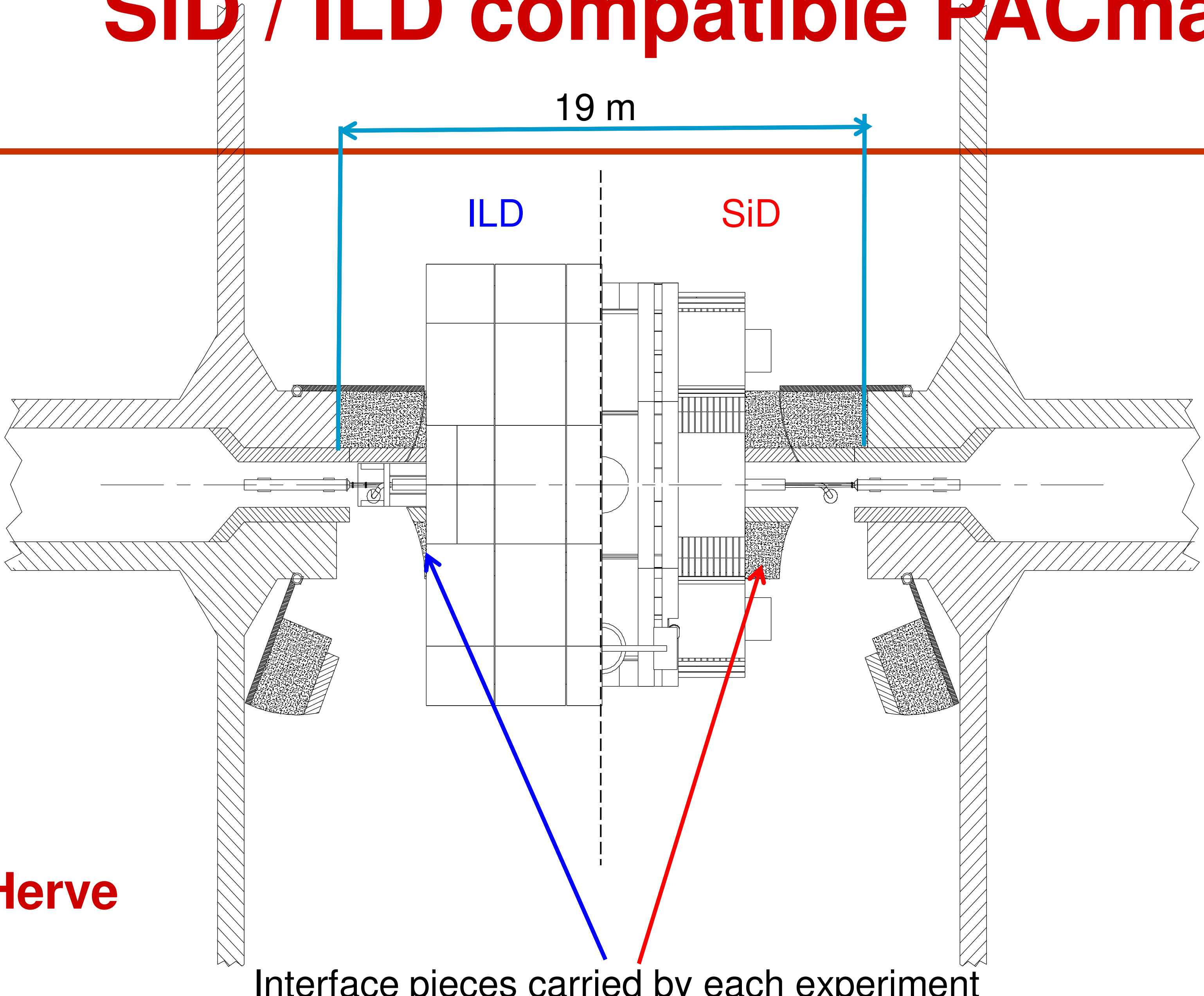






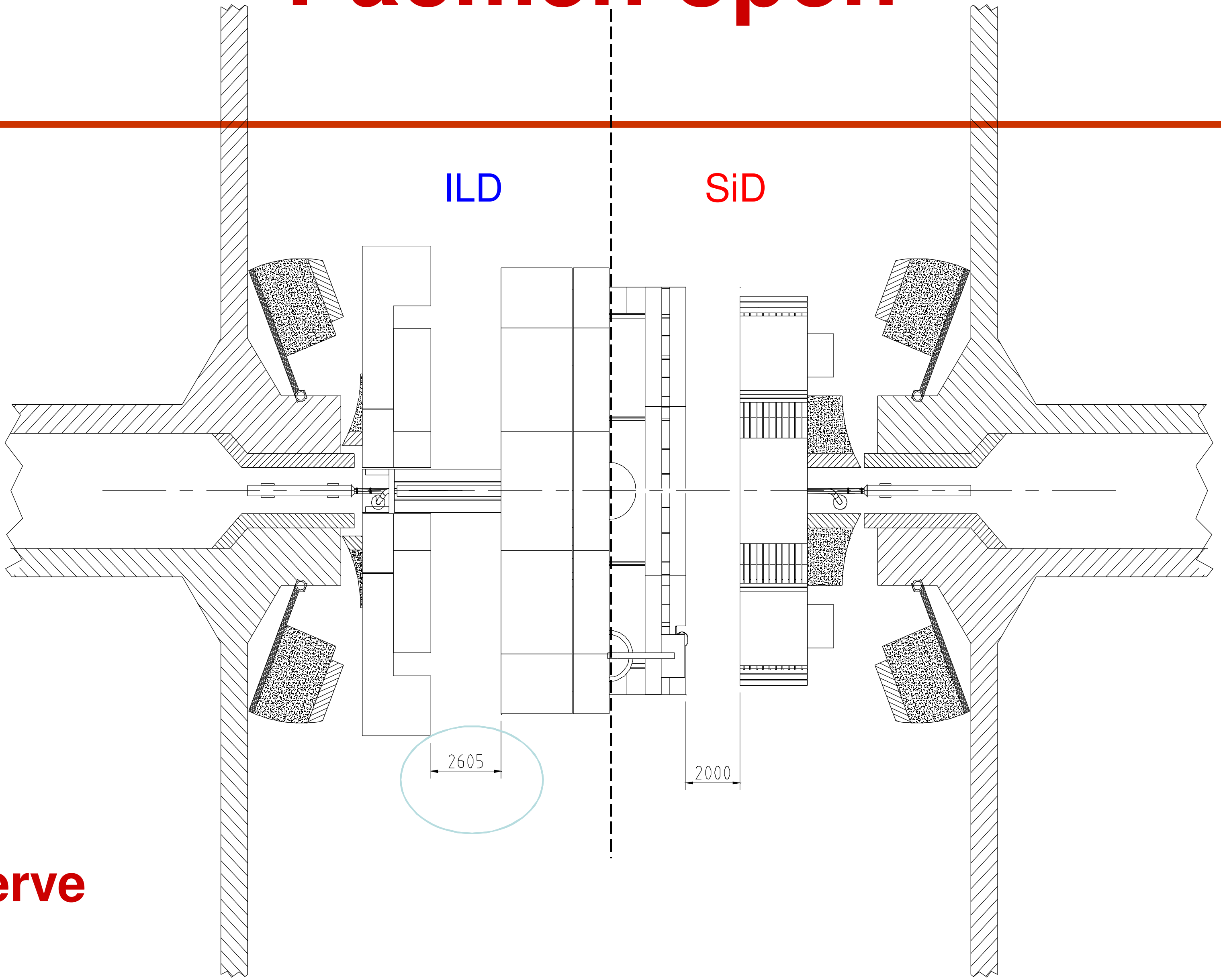
Oriunno

SiD / ILD compatible PACman



Herve

Pacmen open



Herve

Conclusions

- SiD + ILD working together to understand and solve common IR hall issues for push-pull mode of operation
- Common solution for Pacman plug shielding
- Detector support scheme being addressed quantitatively via vibration studies
- MDI concepts being adapted for CLIC

→ session on Monday

Extra material

Detector parameters

M-Tons	Stainless HCAL Radiator		Tungsten HCAL Radiator	
	Barrel	Endcap x2	Barrel	Endcap x2
EM Cal	59	19	59	19
HCAL	354	33	367	46
Coil	160		116	
Iron	2966/8= 374.5	2130/4= 532.5	1785/8= 223.125	1284
Support x 2 (each ~5%Fe)	150	110	90	65
Total to Lower	Loaded Coil=573	Assembled Door=2402	Loaded Coil=542	Assembled Door=1479
Shaft Diameter(m)	8.3m	10.4+2.0m		