Push-Pull for 4th

"Anything you can do, I can do better."

- "Annie, Get Your Gun", Broadway

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Fundamental differences between 4th and SiD/ILD

- Mass is 1/10 of ILD. This makes everything in the IR easier.
- Energizing the solenoid(s) does not result is huge forces on iron masses, FF elements, or mechanical distortion of the detector
- MONALISA requirements easily met
- Open detector allows spatial alignment monitoring even during the push/pull movement

Push-Pull time-and-motion study: not done. However,

- We plan active alignment, both mechanical and electrical, as tested in the FFTB (see 4th LoI).

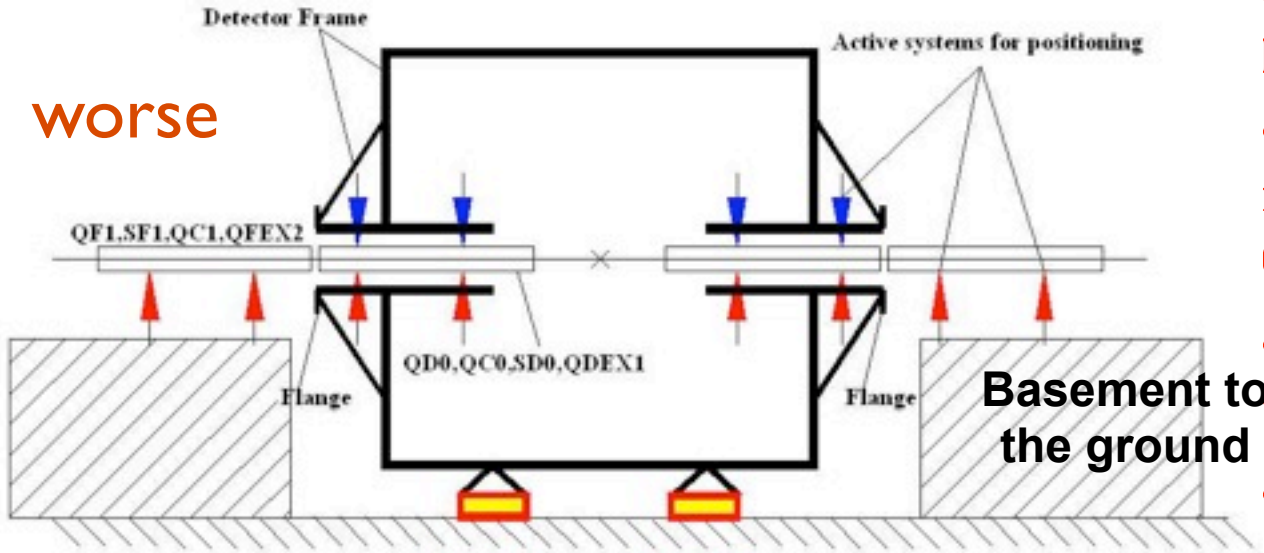
- We believe the vibration of frame and quads can be reduced to the level required for the passive and active systems to take over.

- A platform allows even quicker motion than expected for Hilman rollers (i.e., less than one week for complete push-pull)

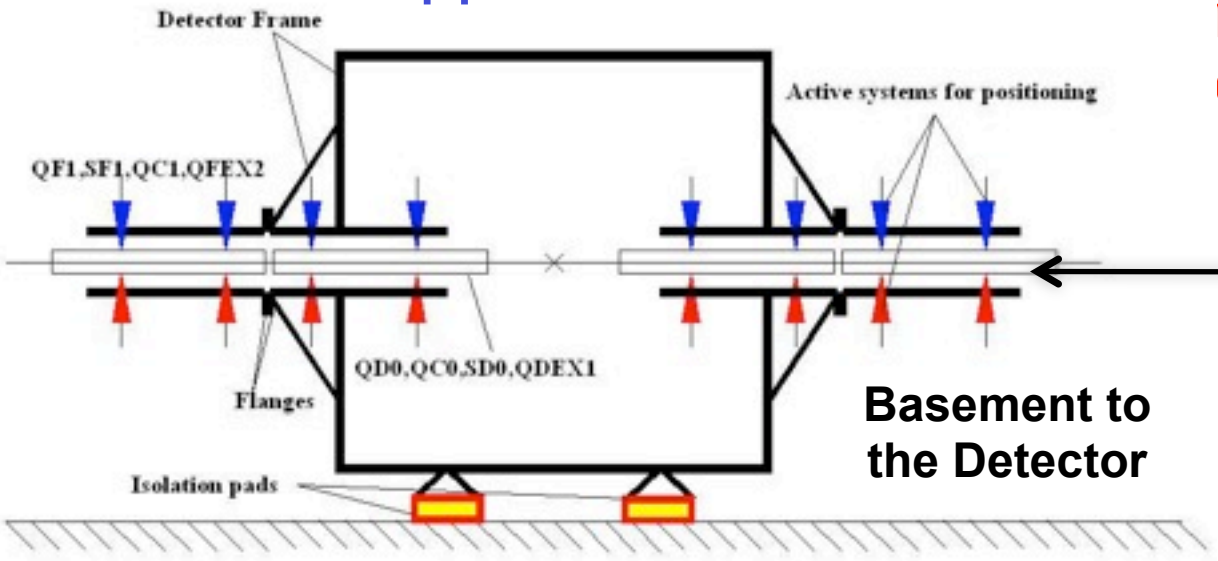
All cables and cryo lines remain connected (huge benefit of a platform). The cable volume is small (~200K channels, reduced by zero-suppression).

CONCEPTS OF FF OPTICS INSTALLATION

worse



better – 4th approach



Active systems for positioning include:

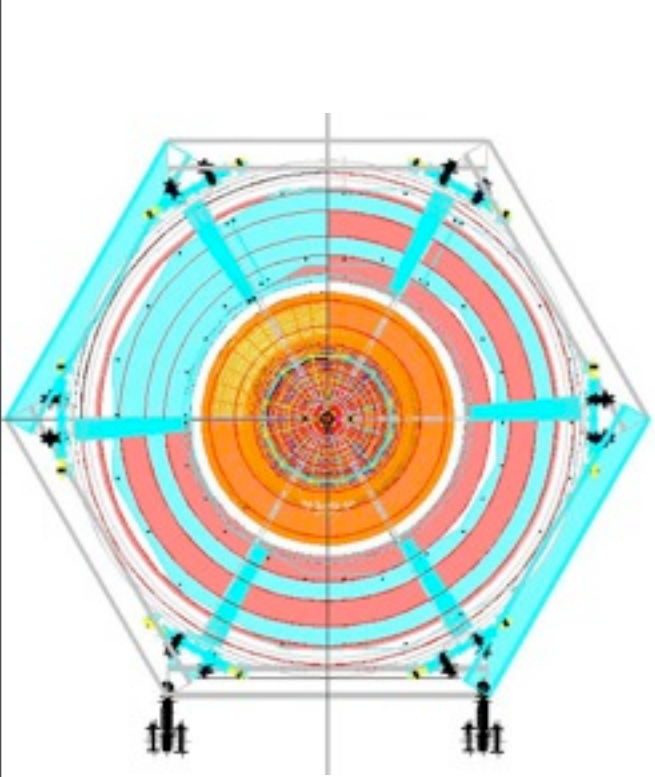
- Stepping motor-driven micro-positioning movers (tested at FFTB);
- Piezoelectric fast movers with active feedback;
- Dipole windings in each quadrupole for equivalent shift of quadrupole axis in both transverse directions (tested at FFTB).

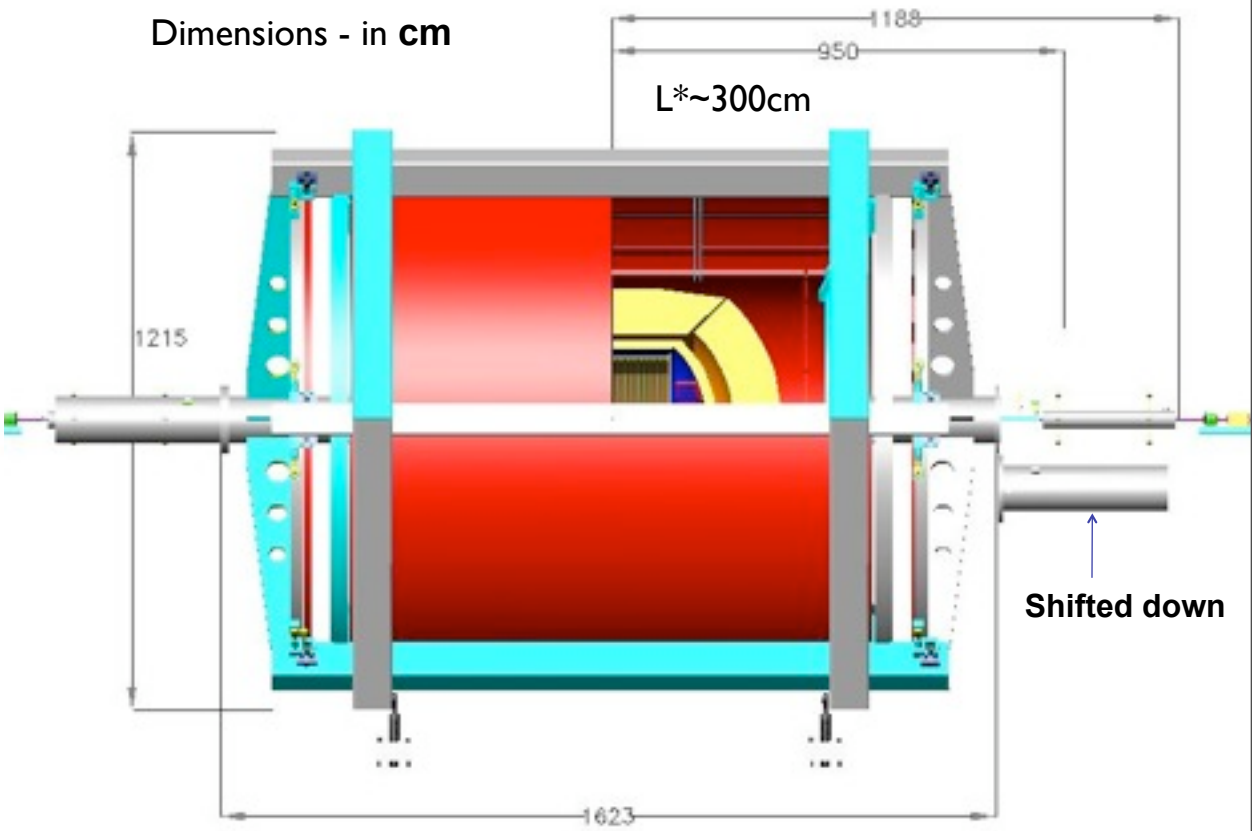
Attachment of cryostat with QF1 to the detector frame could be done after positioning detector in place

DETECTOR CARRIES FINAL FOCUS OPTICS. MORE DETAILED VIEW

Total stored energy~2.77 GJ

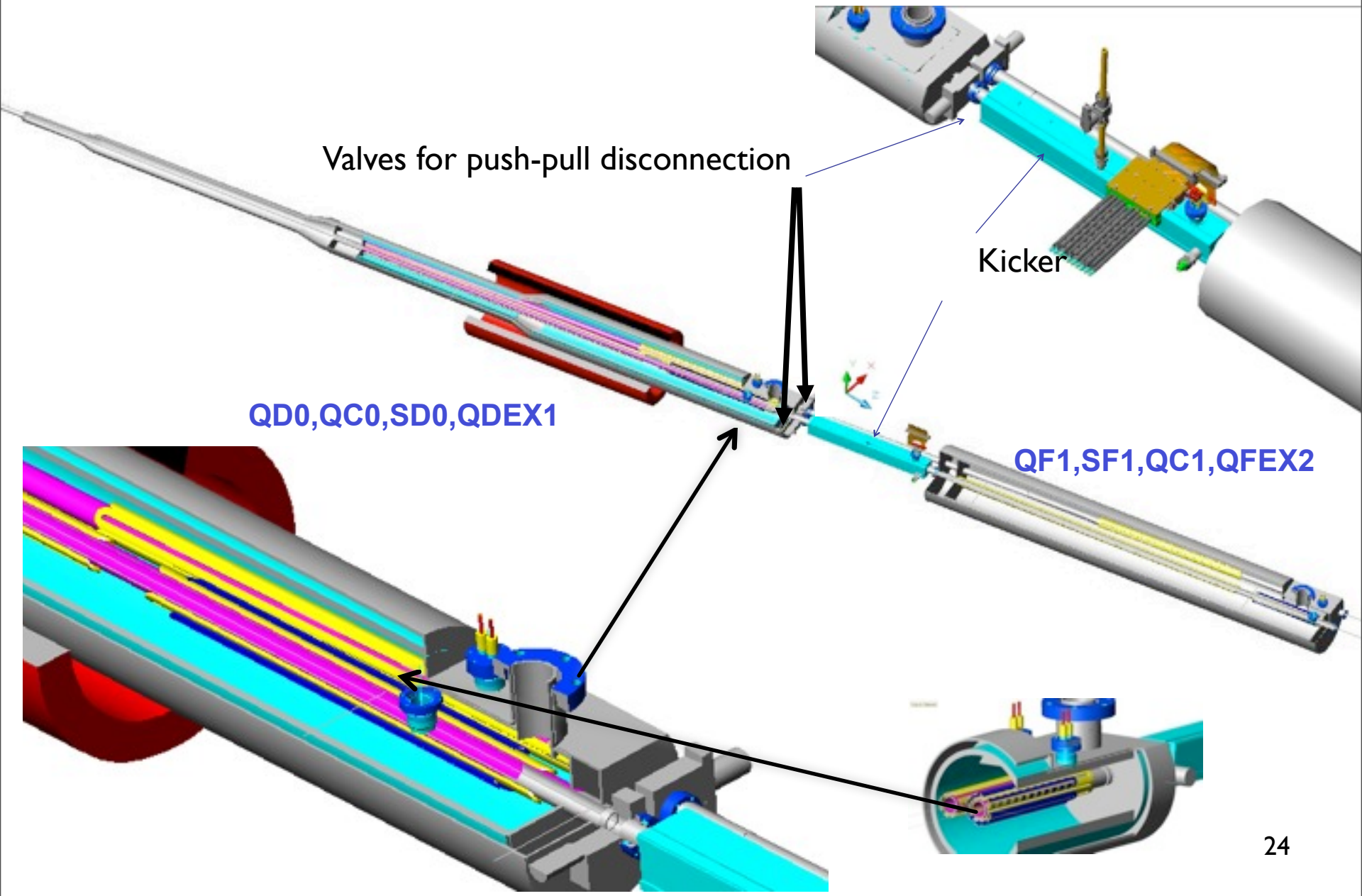
FF optics has trimming possibilities-mechanical and magnetic



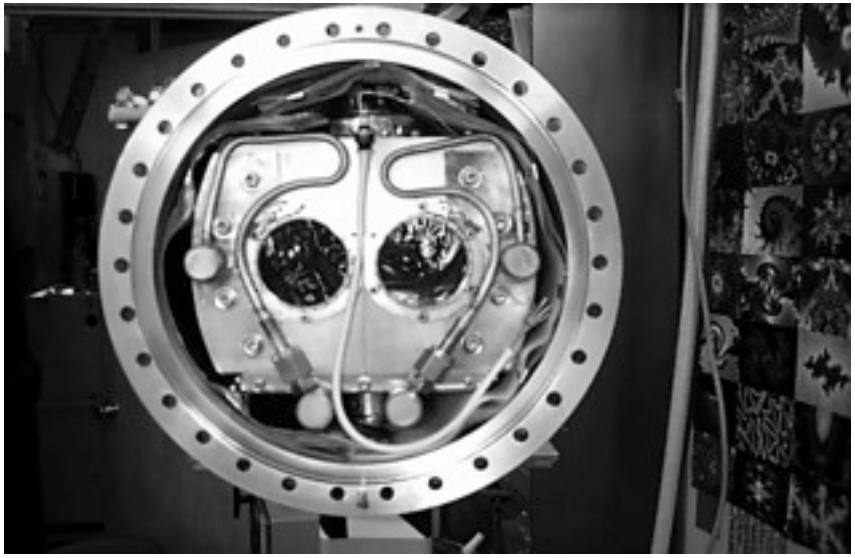


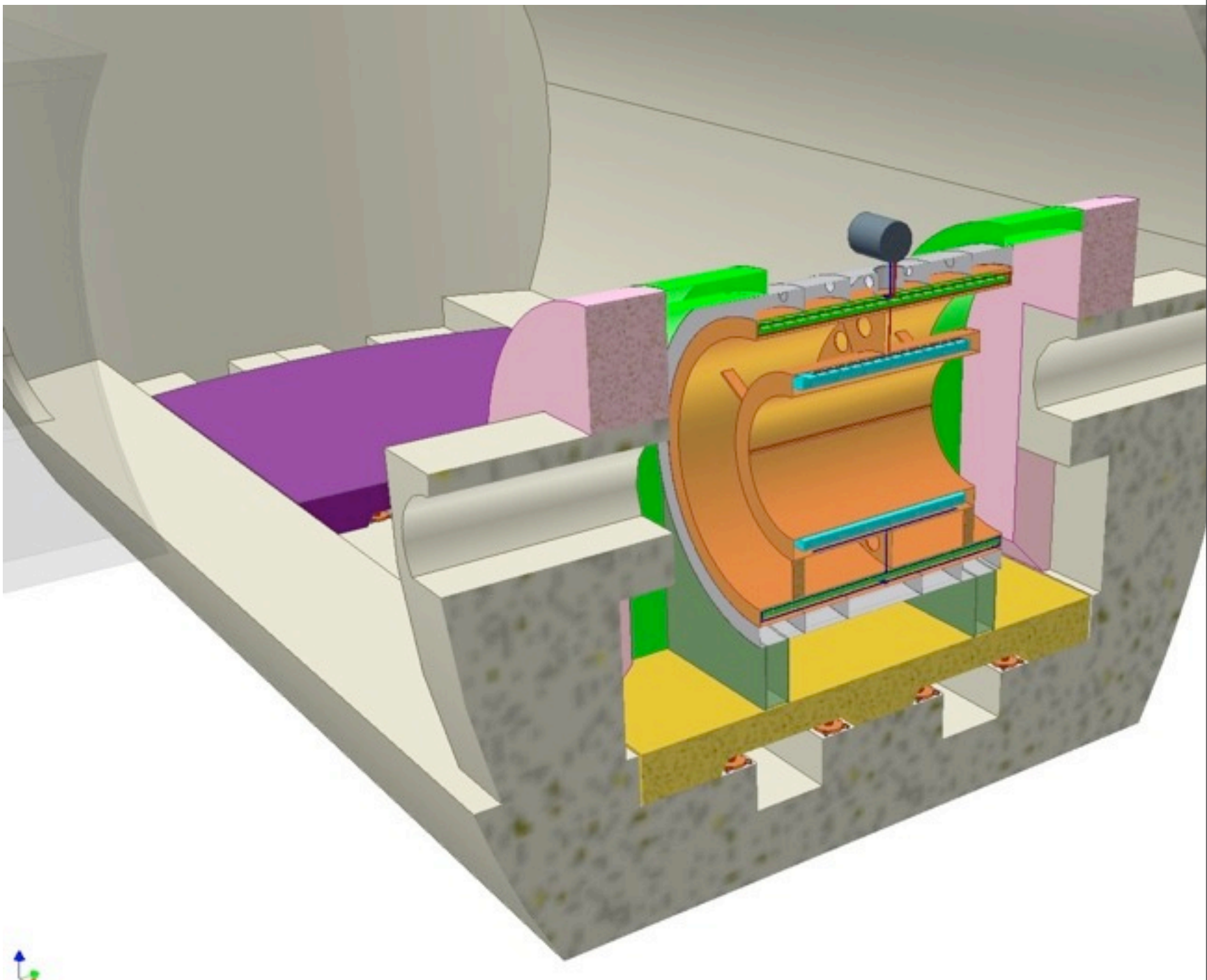
Thanks to the absence of iron all elements are visible from single point, even during a move. This whole unit moves as one light-weight frame.

FINAL DOUBLET (IN/OUT), SEXTUPOLES FOR 14 mrad CROSSING ANGLE

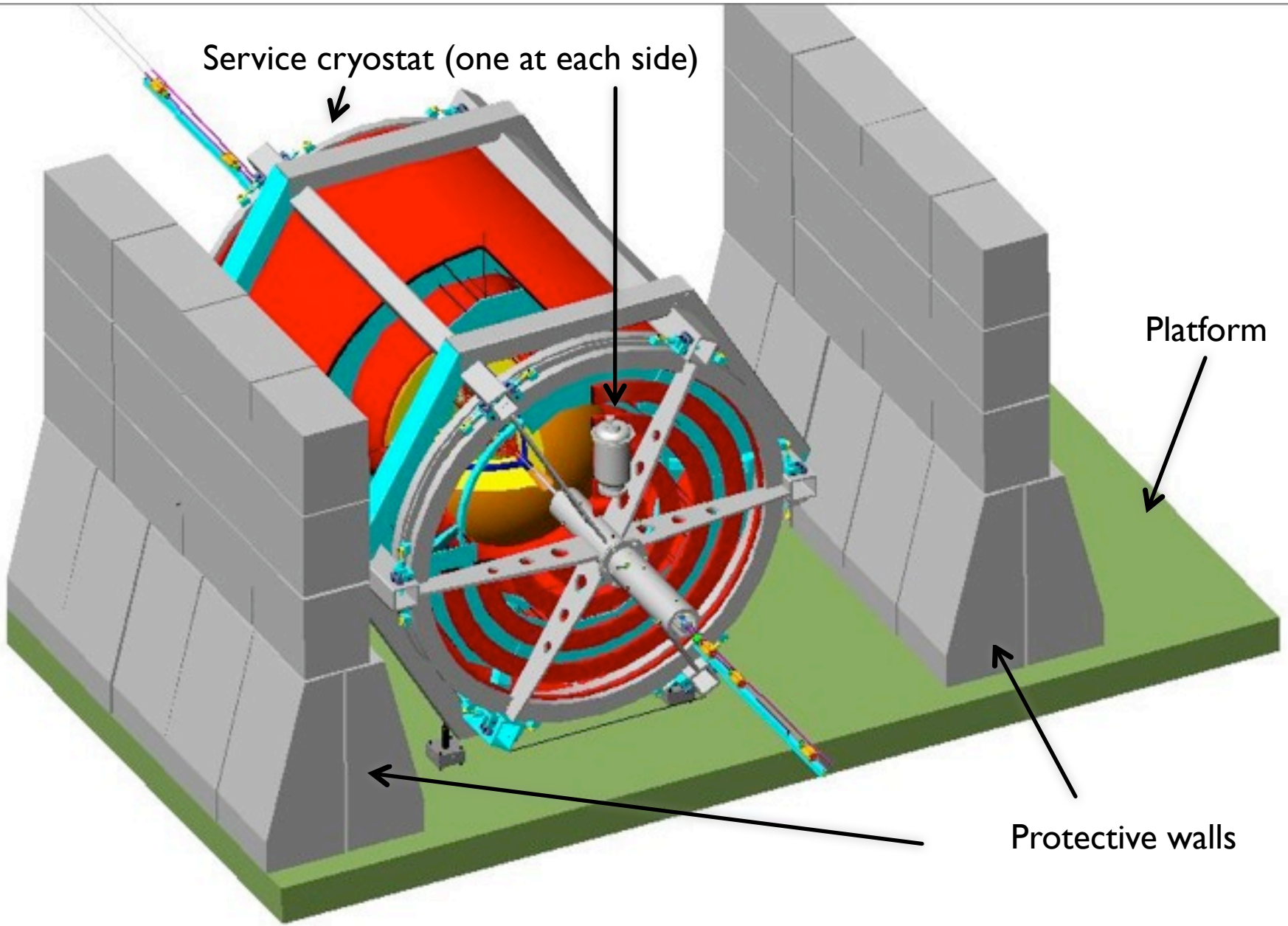


- Active systems move the lenses centroids in transverse plane using dipole mechanical movers +windings in lenses;
- Windings used for generation of Skew-quadrupole fields;
- Cancellation of influence of deformations induced by ponderomotive forces;
- Cancellation of influence of ground motion;
- Cancellation of influence of detector field on beam and spin dynamics





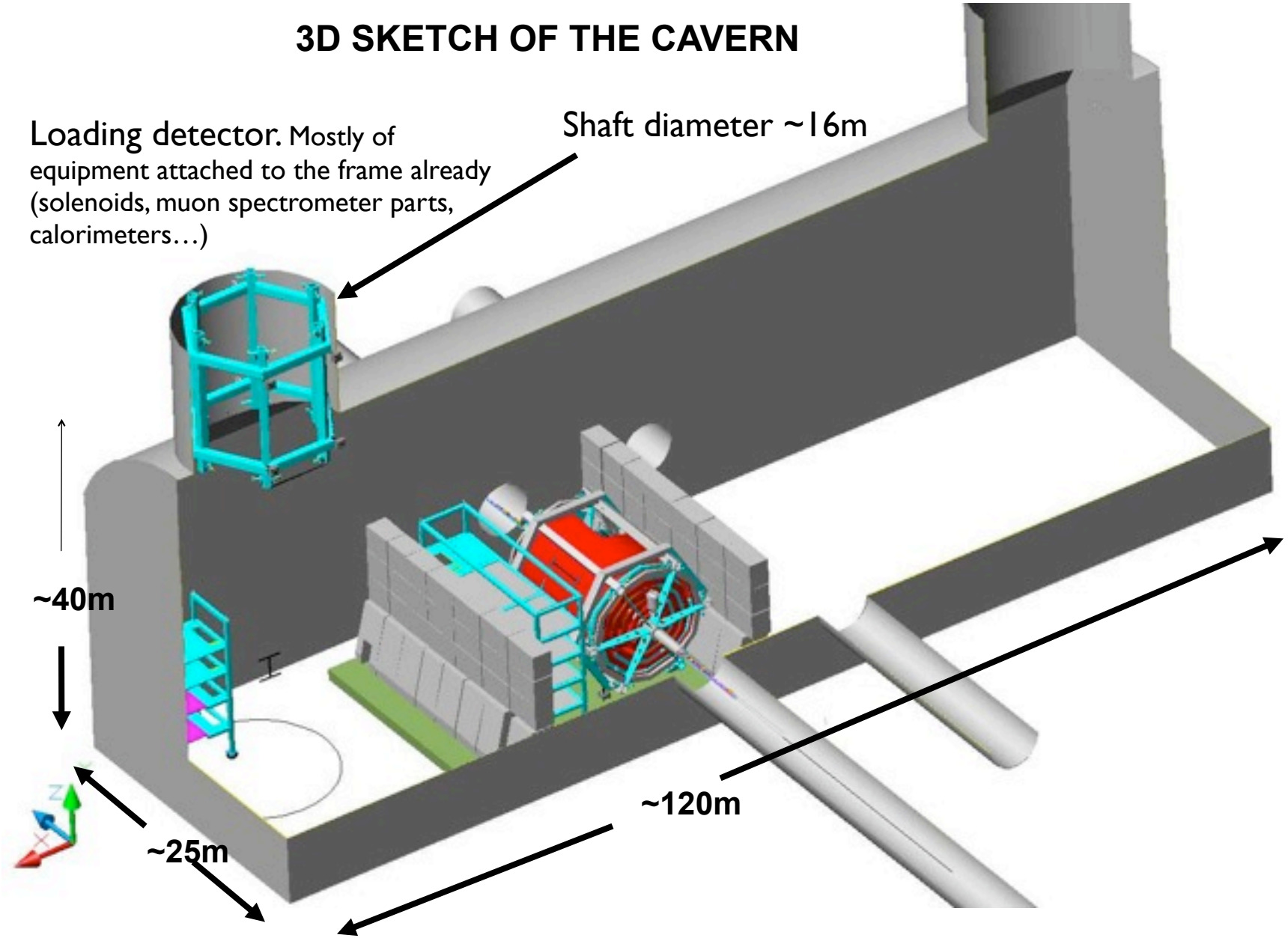
INSTALLATION ON A PLATFORM WILL SPEED UP PUSH-PULL ACTION



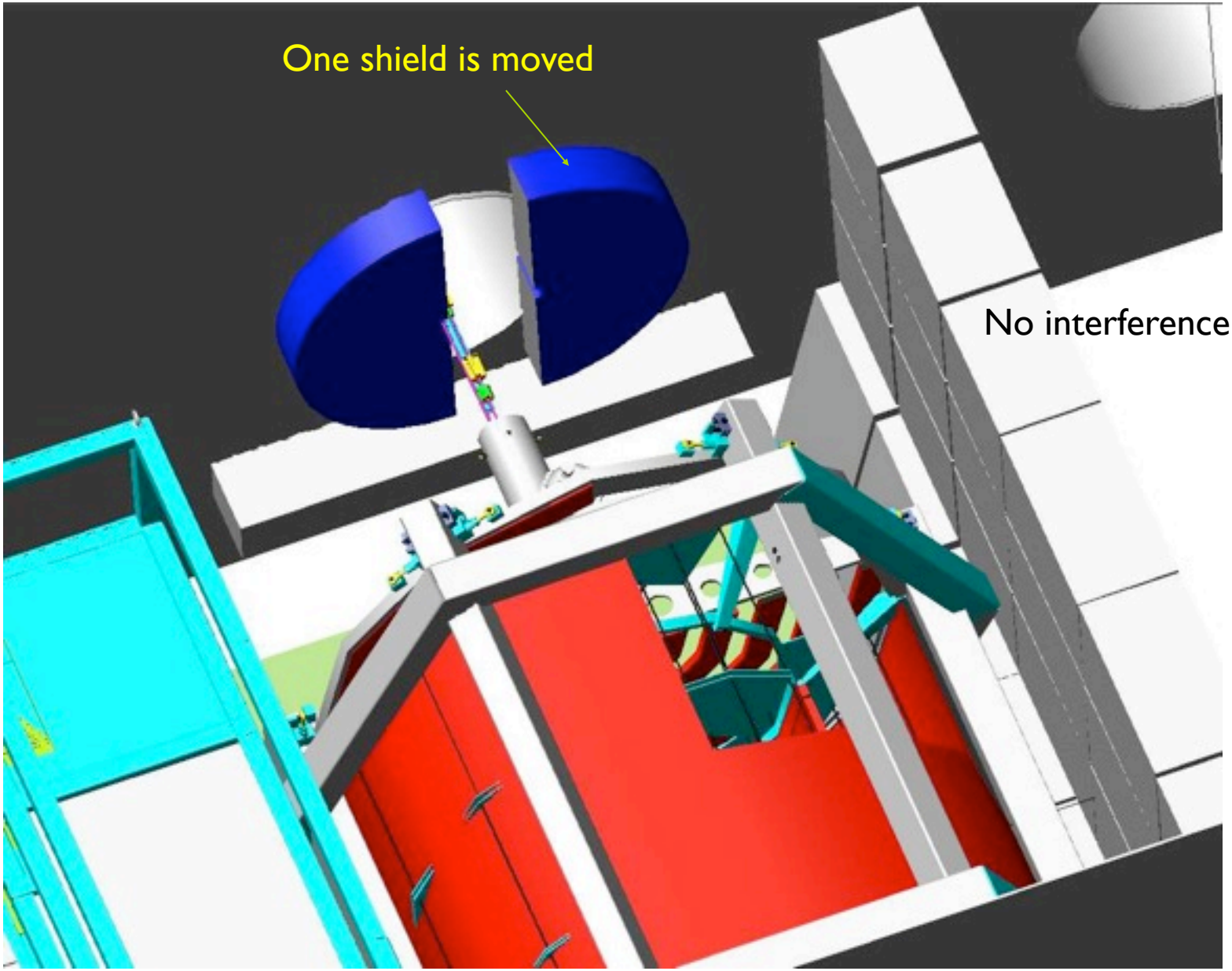
3D SKETCH OF THE CAVERN

Loading detector. Mostly of equipment attached to the frame already (solenoids, muon spectrometer parts, calorimeters…)

Shaft diameter ~16m



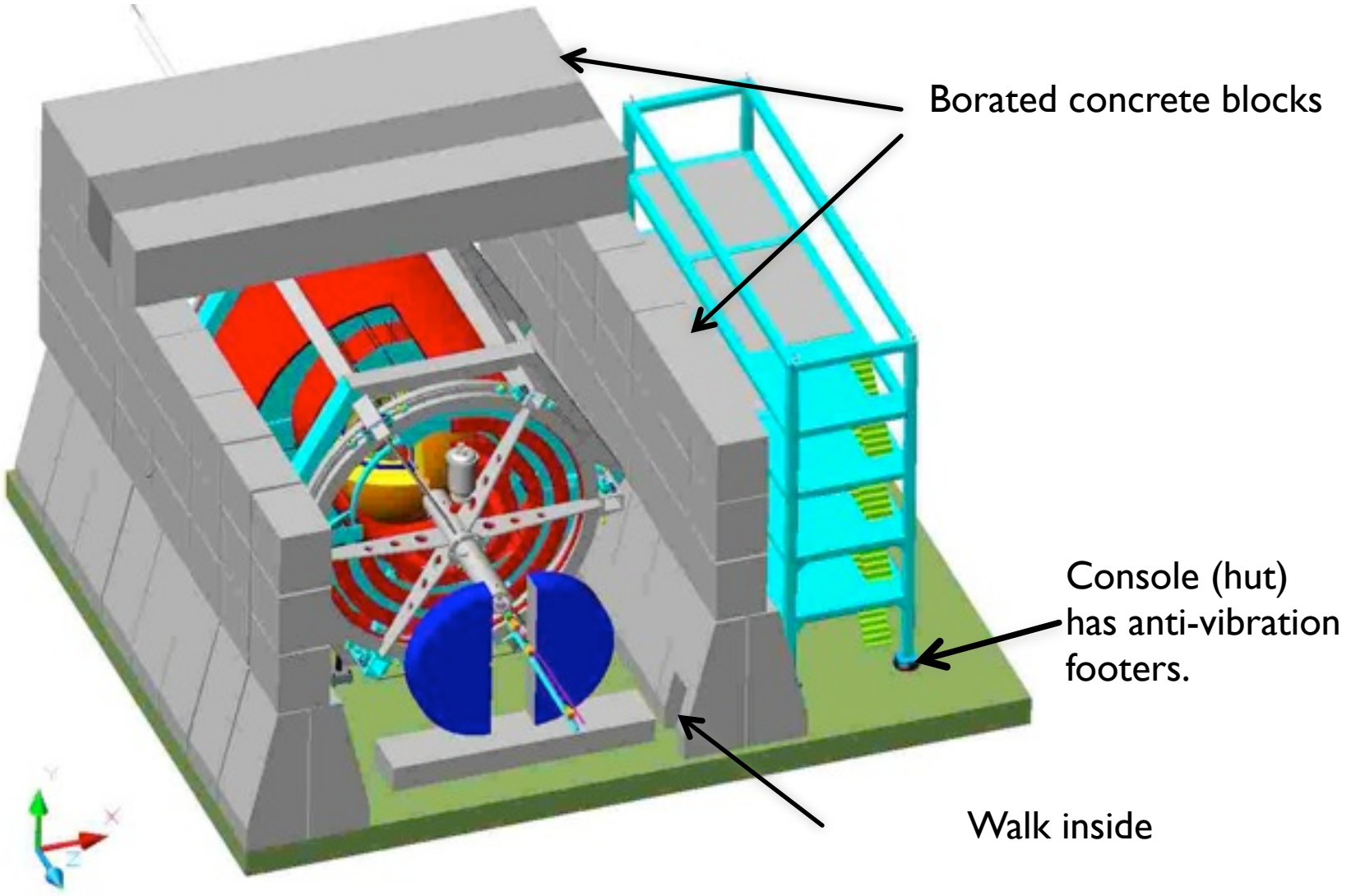
Tunnel shields at the cave entrances (Pacmans) not shown (next slide)



No interference with detector

So called PACMAN-type cover (shields on hinges) require more space and limiting movement freedom

The hut with electronics could be installed behind the wall



Detector protected by inexpensive shield; Boron Carbide interlace for protection against slow neutrons could be incorporated into protective wall.

CONCLUSIONS

- 4th-concept allows easy motion in cavern for push-pull operation;
- Elements of FF optics mounted on detector frame allow better protection against ground motion; active system against vibrations;
- Engineering stage for coil design must be continued toward practical tests of concept.