Summary of Machine Detector Interface

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International Linear Collider Workshop 2010
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Summary of SiD MDI

By **Philip Burrows, JAI, Oxford Univ.**

- **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**

Summary of ILD MDI

By **Matthieu Jore, LAL, IN2P3**

- **Important steps have been made :**
  - **Better understanding of the QD0 support and the vacuum**
  - **A first idea of a push pull scenario and mechanism**
  - **Integration of both detectors in the hall seems possible even if their philosophy is different**

- **BUT the common effort between detectors concepts and BDS people have to be reinforced in the hottest topics :**
  - **IR Hall design**
  - **Engineering studies on the push pull mechanism including the platform design**
  - **Supporting QD0** ***(Do we need a common solution with SiD?)***
  - **Etc….**

MDI engineering issues for the CLIC Detector

By H. Gerwig, CERN

- Stable and precise support of QD0
- Beampipe sectorisation, Vacuum valves, pumps & access
- Kicker & BPM and its electronics
- Crossing angle and split beam pipe
- Opening of the detector
- Push-pull, moving platform, connection tunnel/cavern
- Alignment issues
- Self-shielding detector, safety
- Experimental cavern, access, services, cranes, safety

Satisfy all the requirements in a way that it just works fine!

Vibration Issues

The mechanical stability requirements of the QD0 are set by the capture range of the IP fast feedback, as written in the "Functional Requirements" document, ILC-Note-2009-050

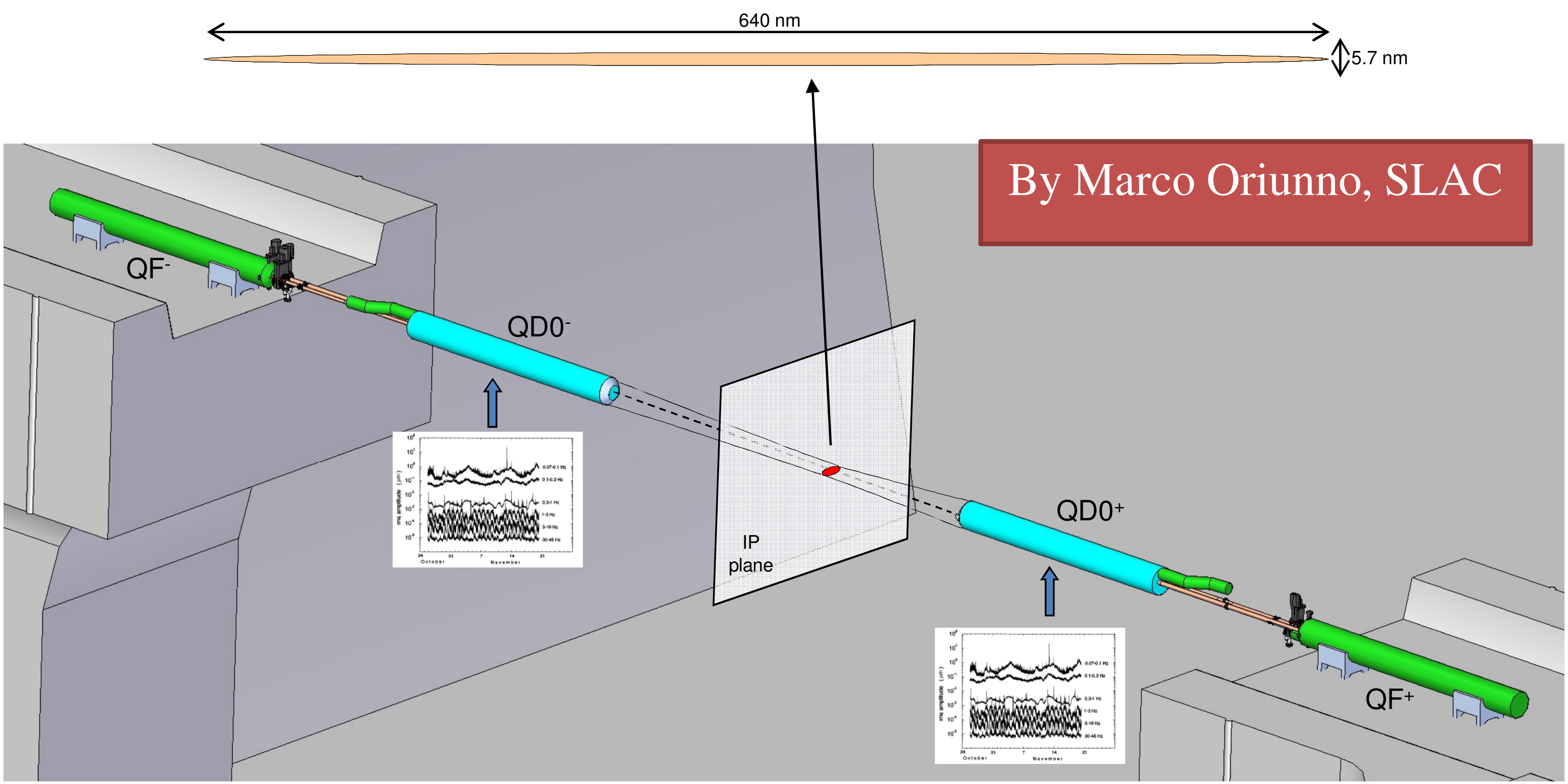
" The QD0 mechanical alignment accuracy and stability after beam-based alignment and the QD0 vibration stability requirement are set by the capture range and response characteristics of the inter-bunch feedback system.

- **QD0 alignment accuracy**: ± 200 nm and 0.1 μrad from a line determined by QF1s, stable over the 200 ms time interval between bunch trains

- **QD0 vibration stability**: Δ(QD0(e+)-QD0(e-)) < 50 nm within 1ms long bunch train "

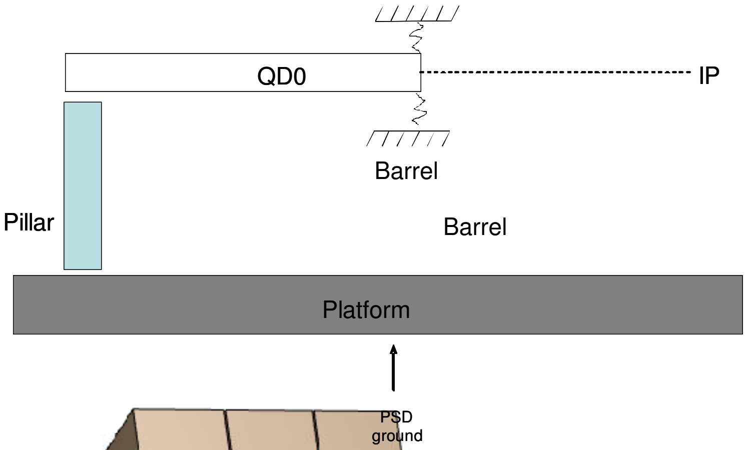
Vibration Studies for SiD

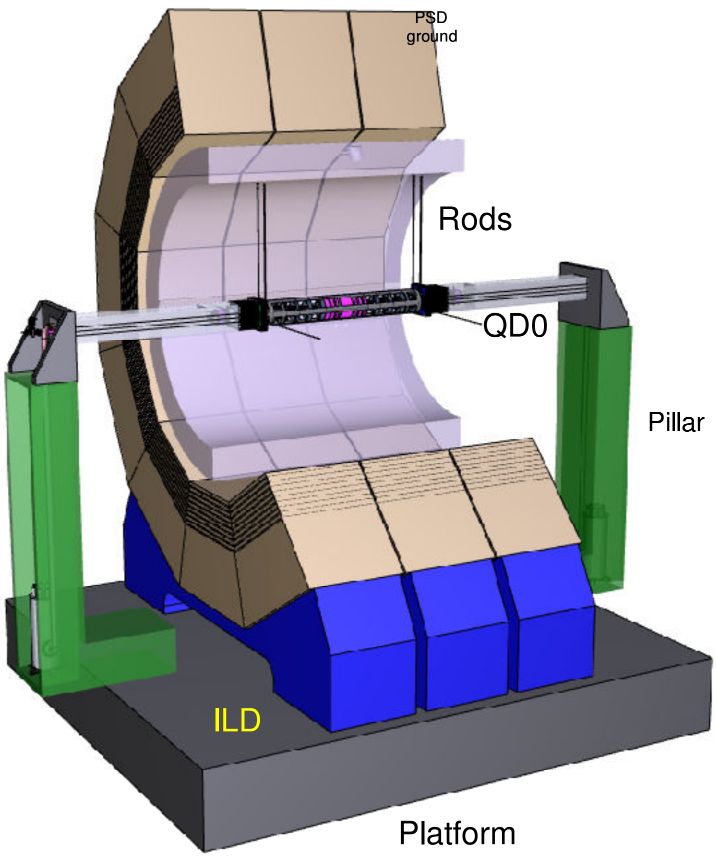
- **Sub-nanometric stability of the focusing system is required to maintain the luminosity to within a few percent of the design value.**
- **Ground motion is a source of vibrations which would continuously misaligning the focusing elements.**
- **The design of the support of the QD0 is a fundamental issue**

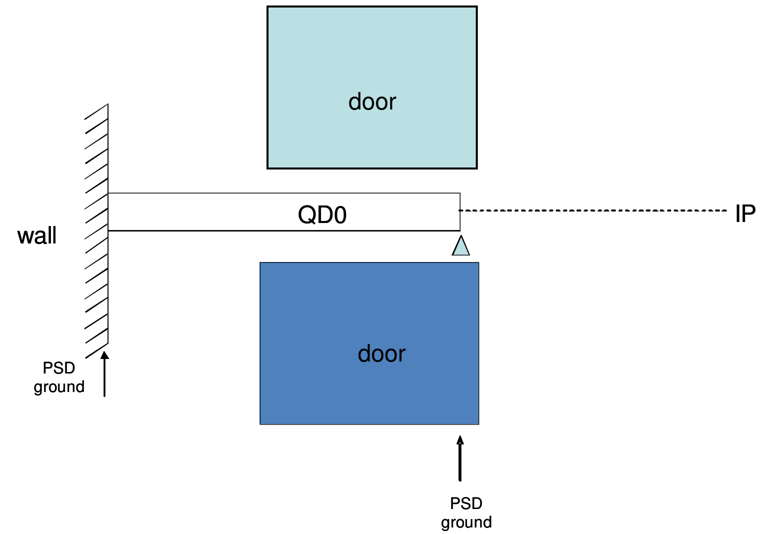


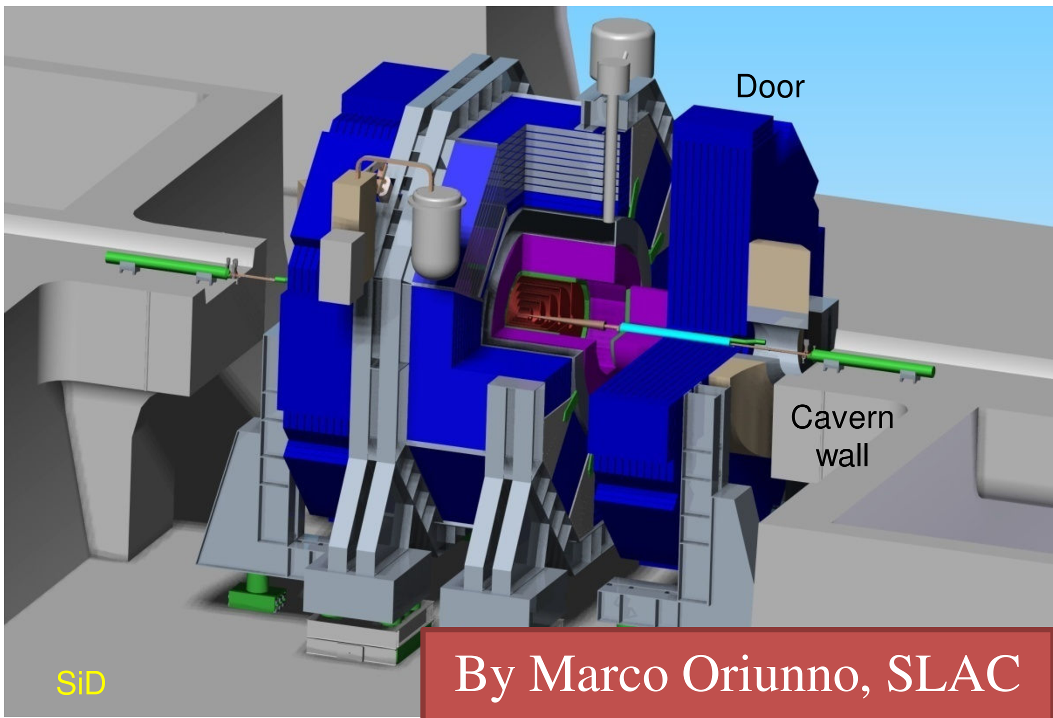
By Marco Oriunno, SLAC

QD0 supports for ILD and SiD









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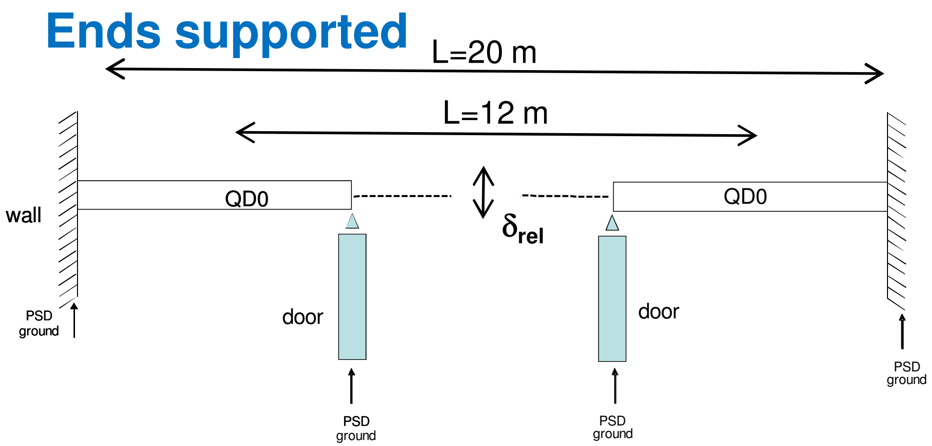
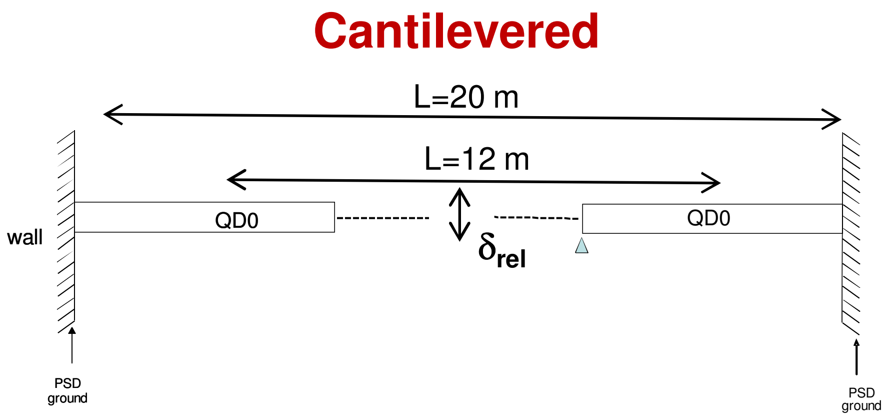
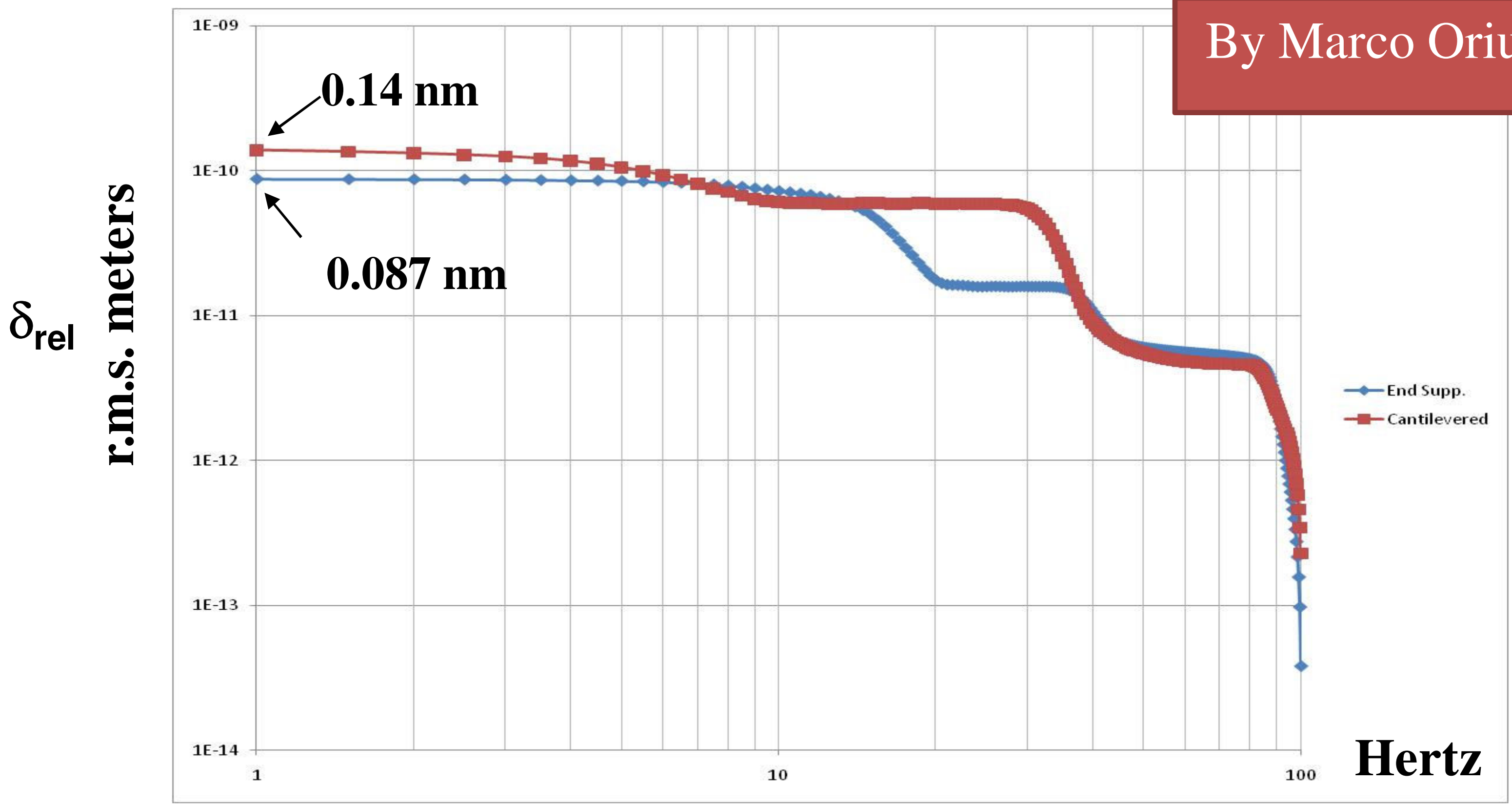
Comparison of Relative Displacement





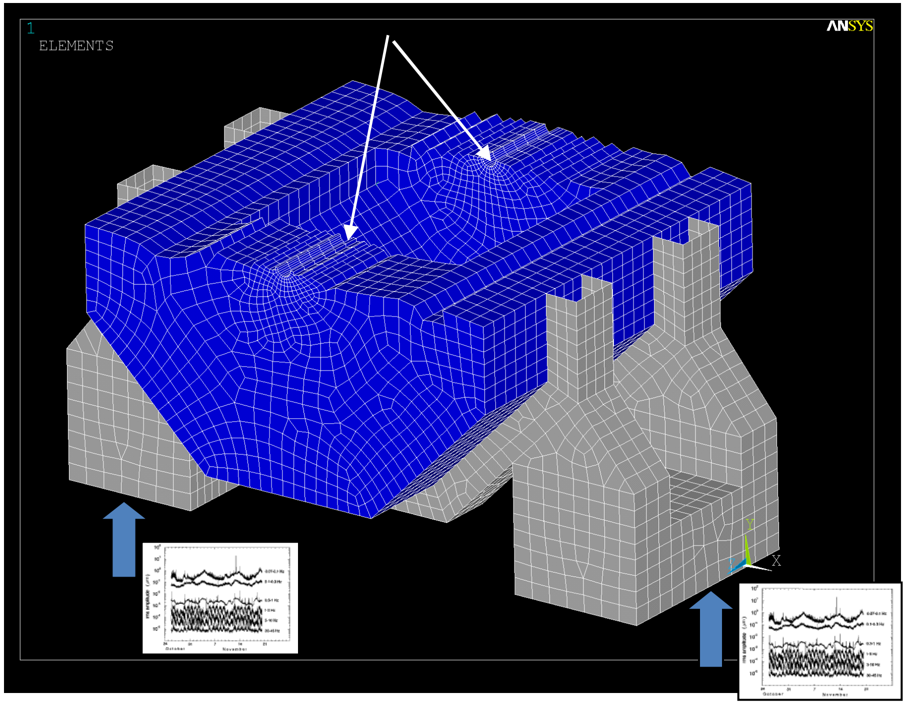


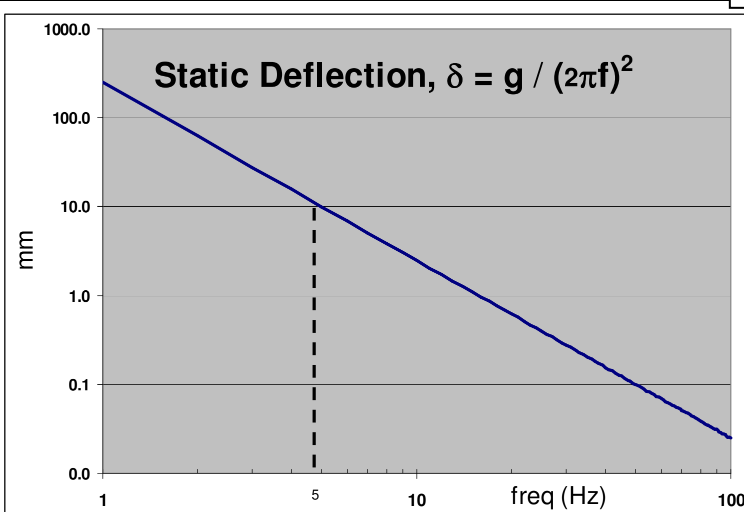
By Marco Oriunno, SLAC

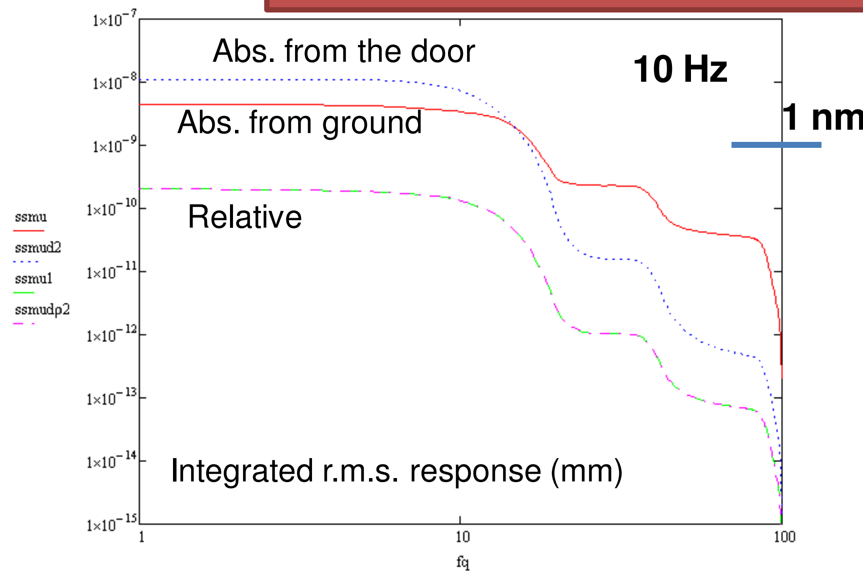
Harmonic Analysis

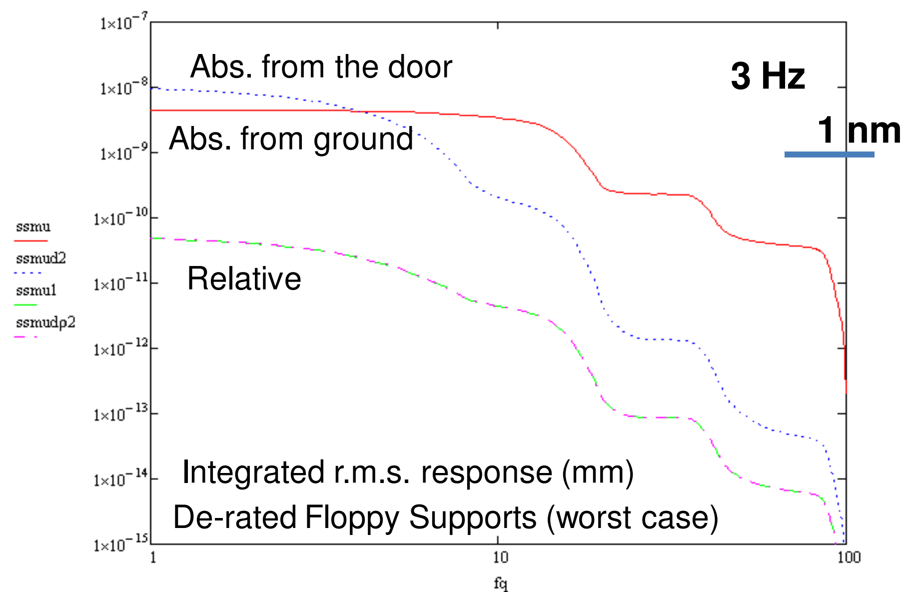
By Marco Oriunno, SLAC

Frequency Response Function









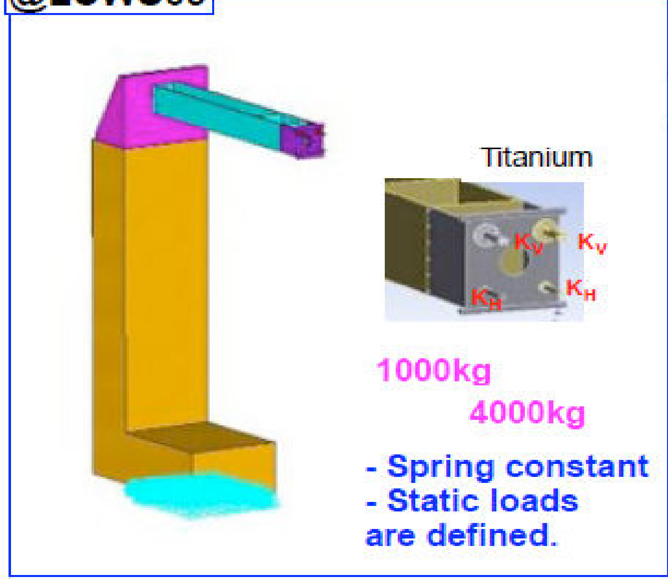
Vibration Studies for ILD

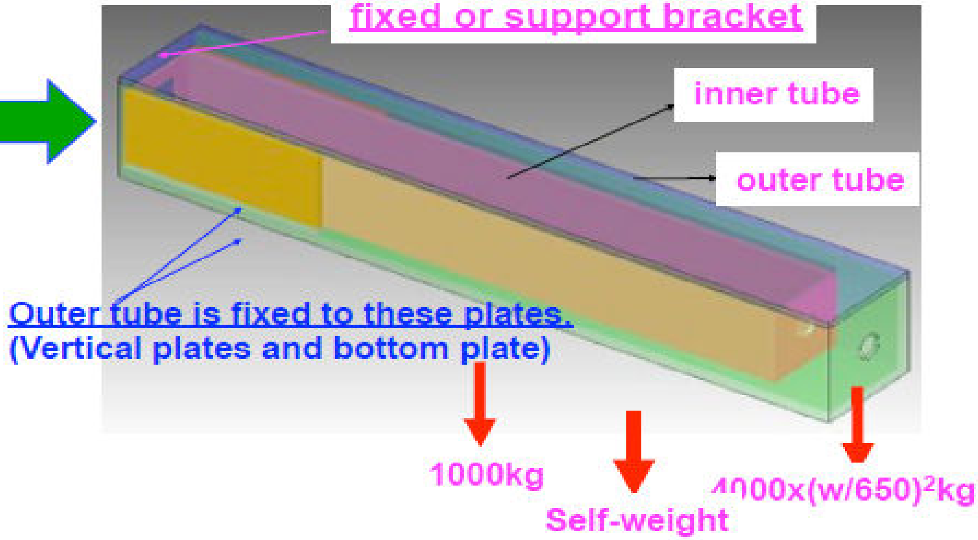
By Hiroshi Yamaoka, KEK

1) Design of Supporting Structure

Stiff support structure was changed from single tube to double tube

@LCWS09





Allowable Amplitude: < 50nm(V)
(Above 5Hz) < 300nm(H)

→ Integ. amplitude in cases of ATF and CERN high-noise are larger than 50nm at f > 5Hz. (ATF/KEKB and CERN have GM integrated amplitude of ~ 20nm at f > 5Hz.)

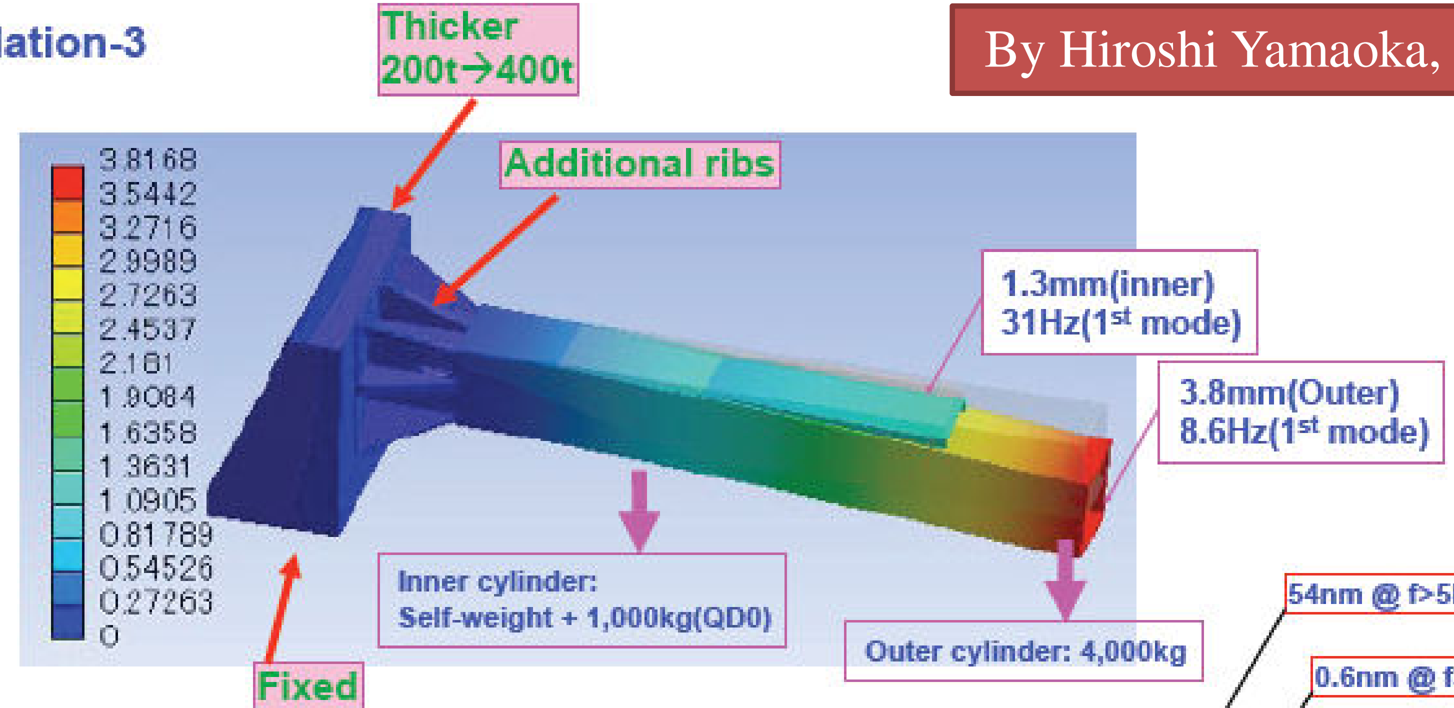
→ Double tube is proposed.

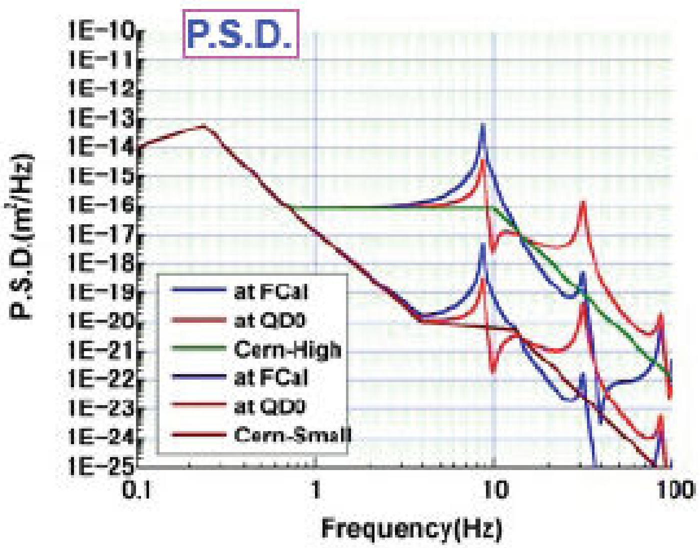
- Support tube consists of double square tube.
- Outer tube supports FCAL.
- Inner tube supports QD0.

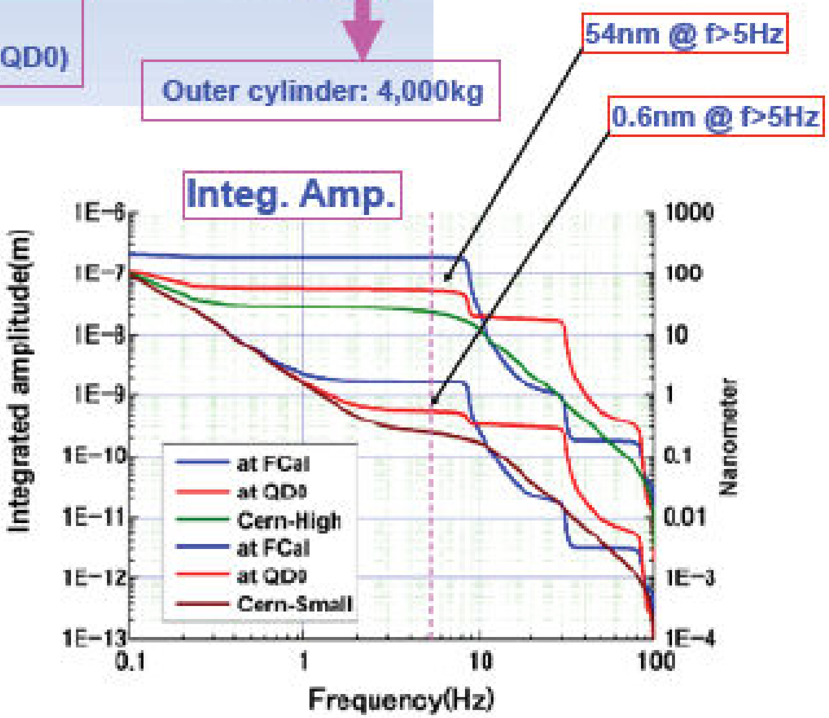
2) Calculation

By Hiroshi Yamaoka, KEK

Calculation-3

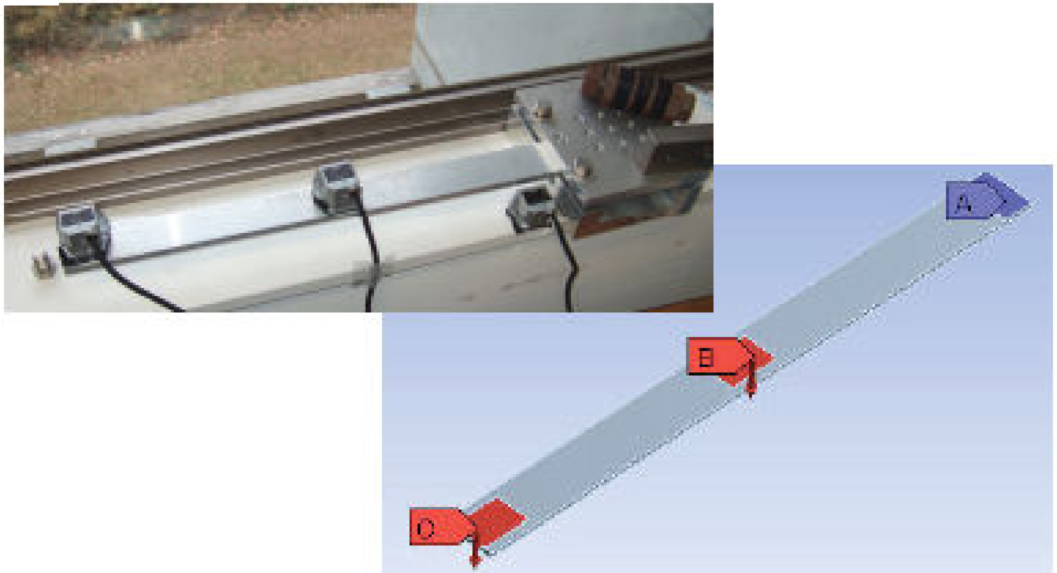


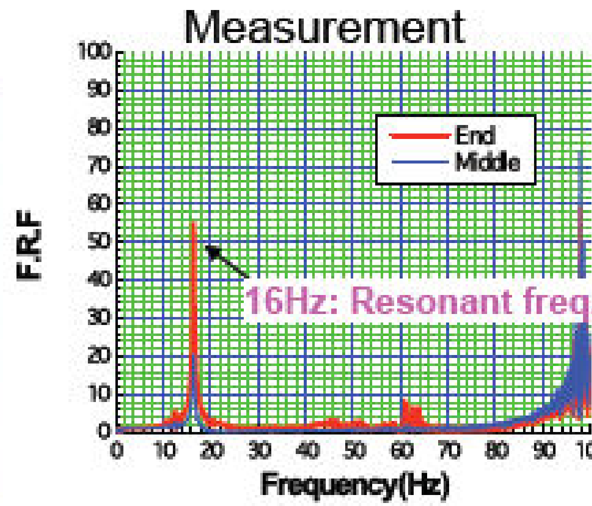


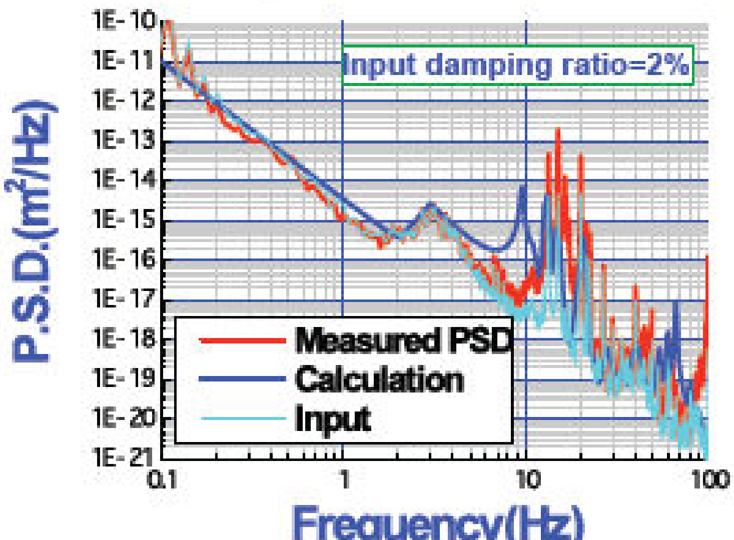


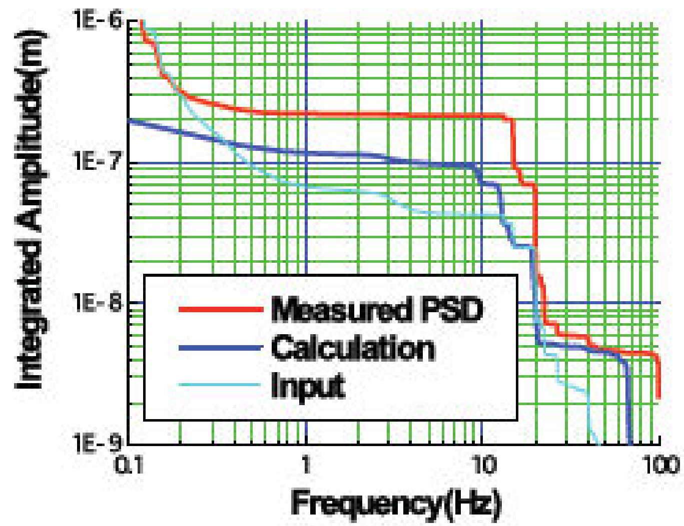
3) Consistency check between calculations and measurements

By Hiroshi Yamaoka, KEK









➔ - 1st mode of resonant frequency is ~6Hz different.
- Amplitude is ~100nm different.

i.e. not perfect fixing

Vibration Issues at CLIC

By **H. Gerwig, CERN**

1) Limit vibration by construction !

- **Abandon opening on IP** thus making the QD0 support short (L^3)
- Use **a two-in-one support tube** scheme (idea of H. Yamaoka)
- Tune tube's **eigenfrequency** (train repetition rate - 50Hz)
- Avoid cooling liquids (permanent magnet)
- **Keep** also the end-caps **compact** in Z (with endcoils)
- **Reduce to the max. gap** between detector & tunnel (no pacman)
- Support QD0 from a **passive low frequency pre-isolator** in the tunnel

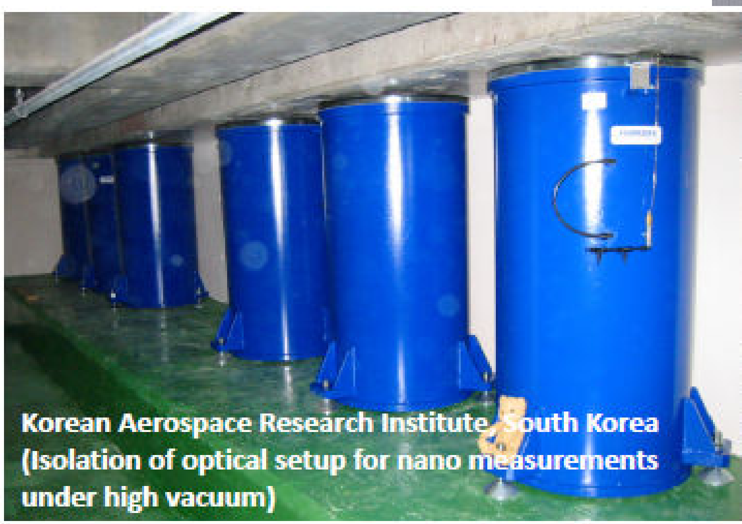
2) Limit vibration by active intervention

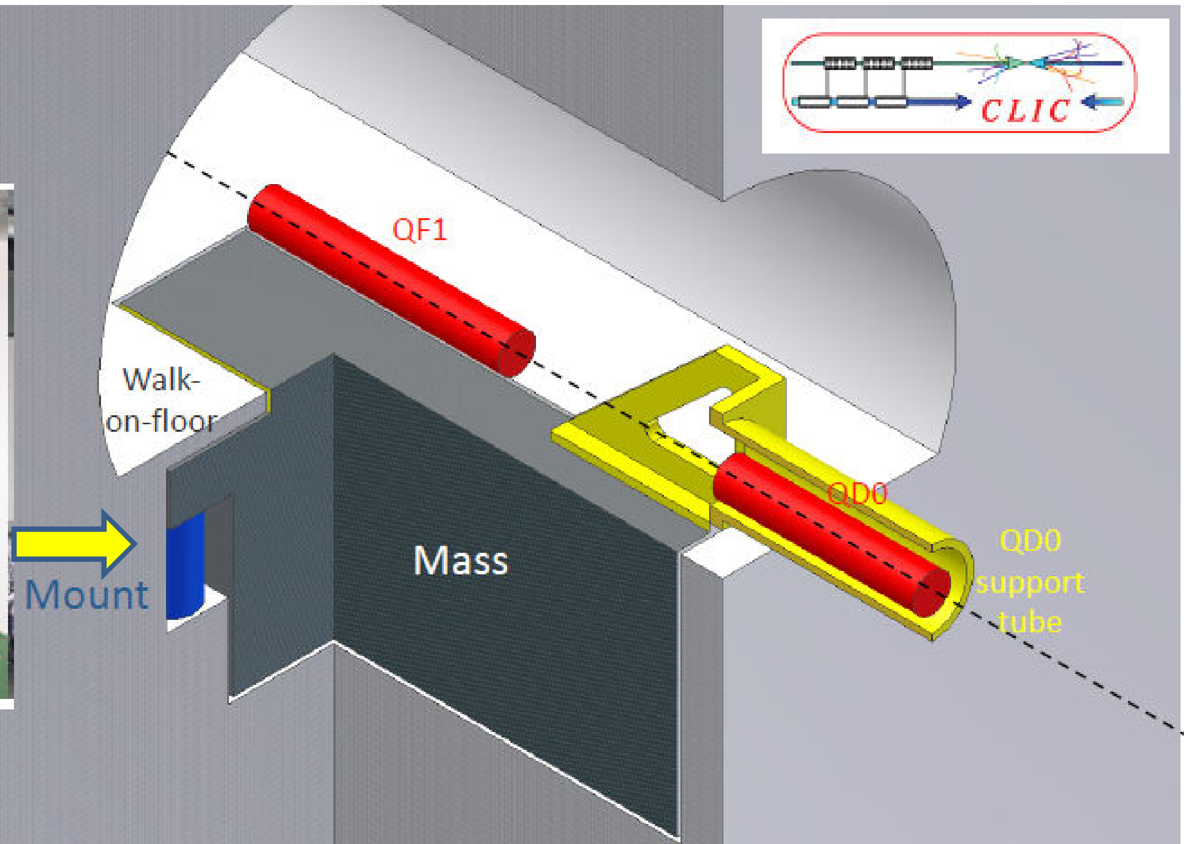
- **Active stabilisation with piezo - actuators**
- **BPM – beam kicker feedback loop**

Proposing a pre-isolator system with Low natural frequency (around 1 Hz) and Large mass (50 to 200 ton)

By H. Gerwig, CERN

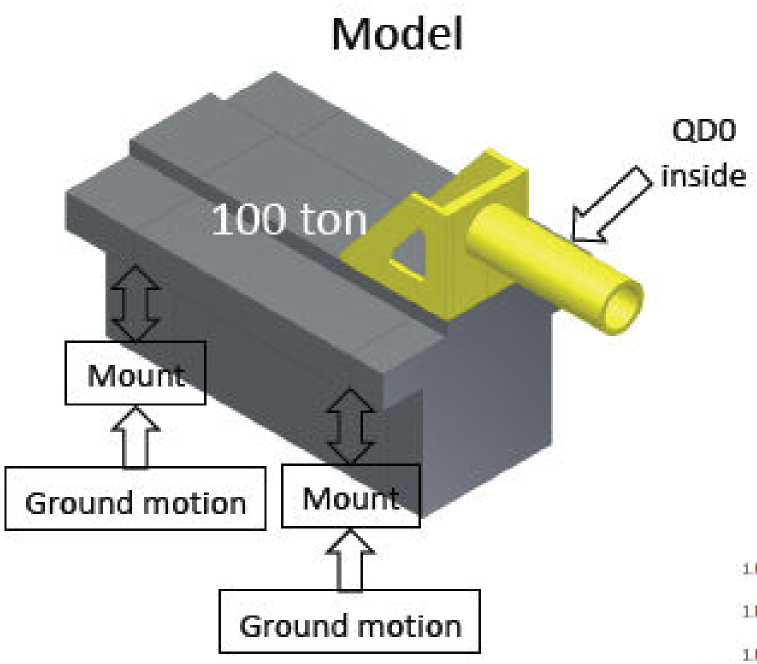
This system will act as a low-pass filter for ground motion that is able to withstand external disturbances (air flow, acoustic pressure, etc.)

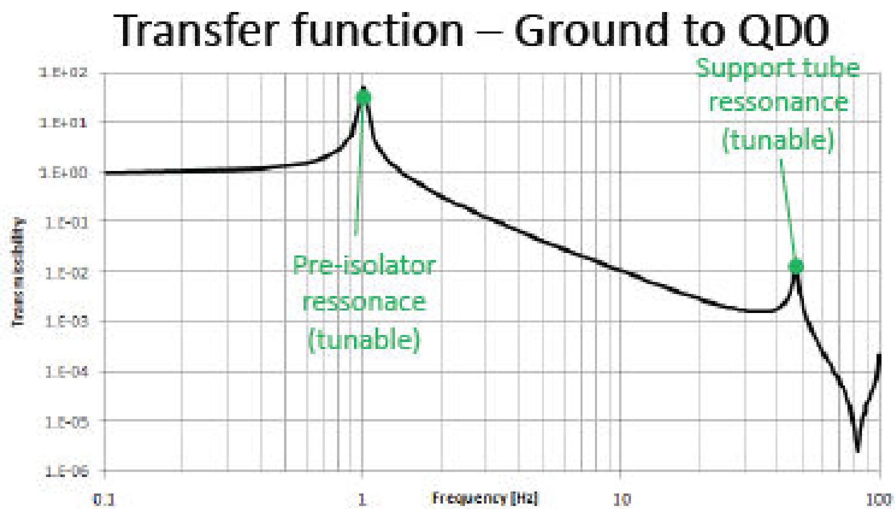




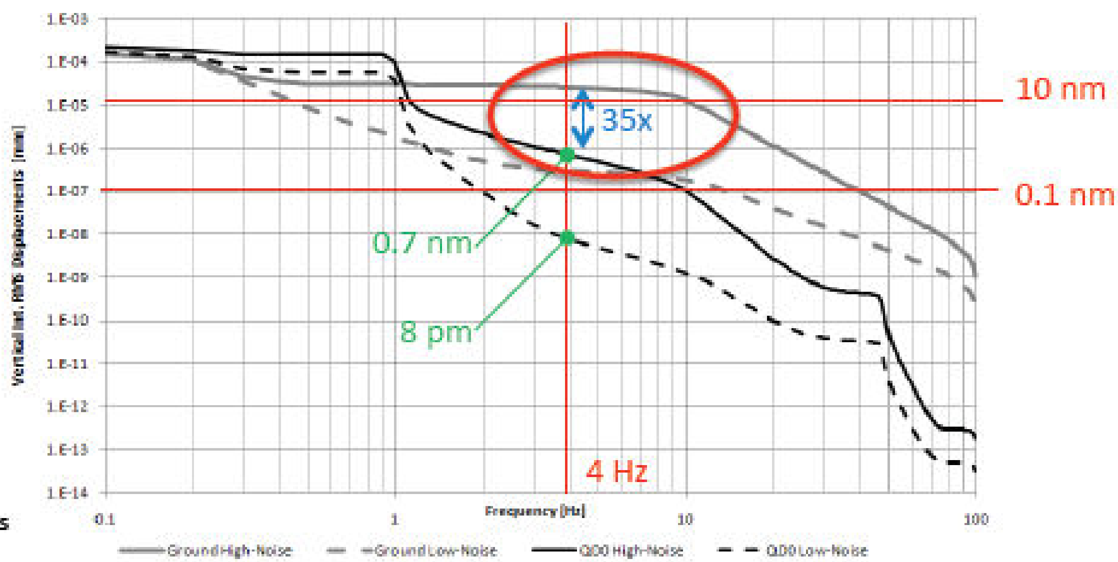
FEM Simulations of gain

By **H. Gerwig, CERN**



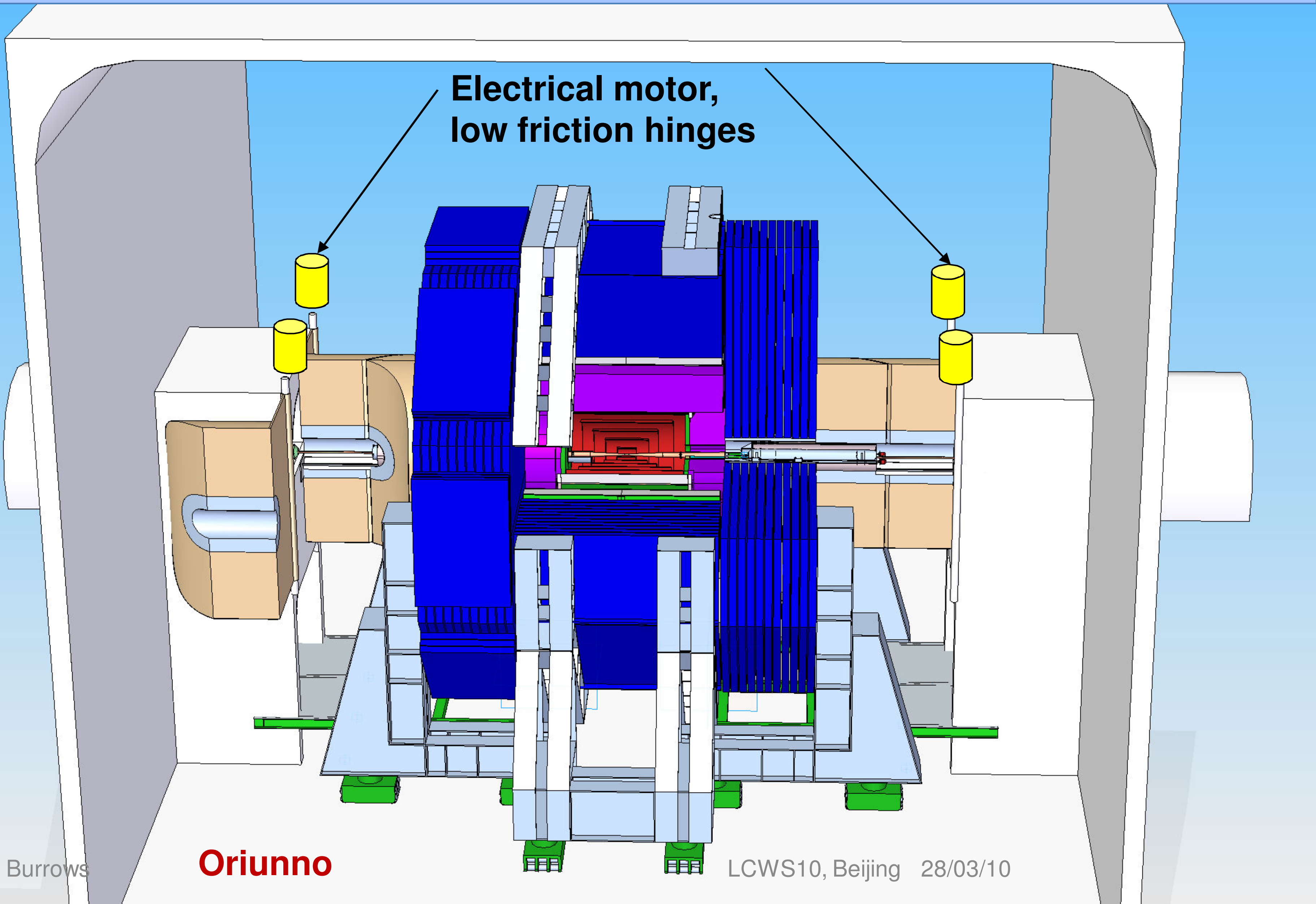


Integrated R.M.S. displacements @QD0 (vertical)



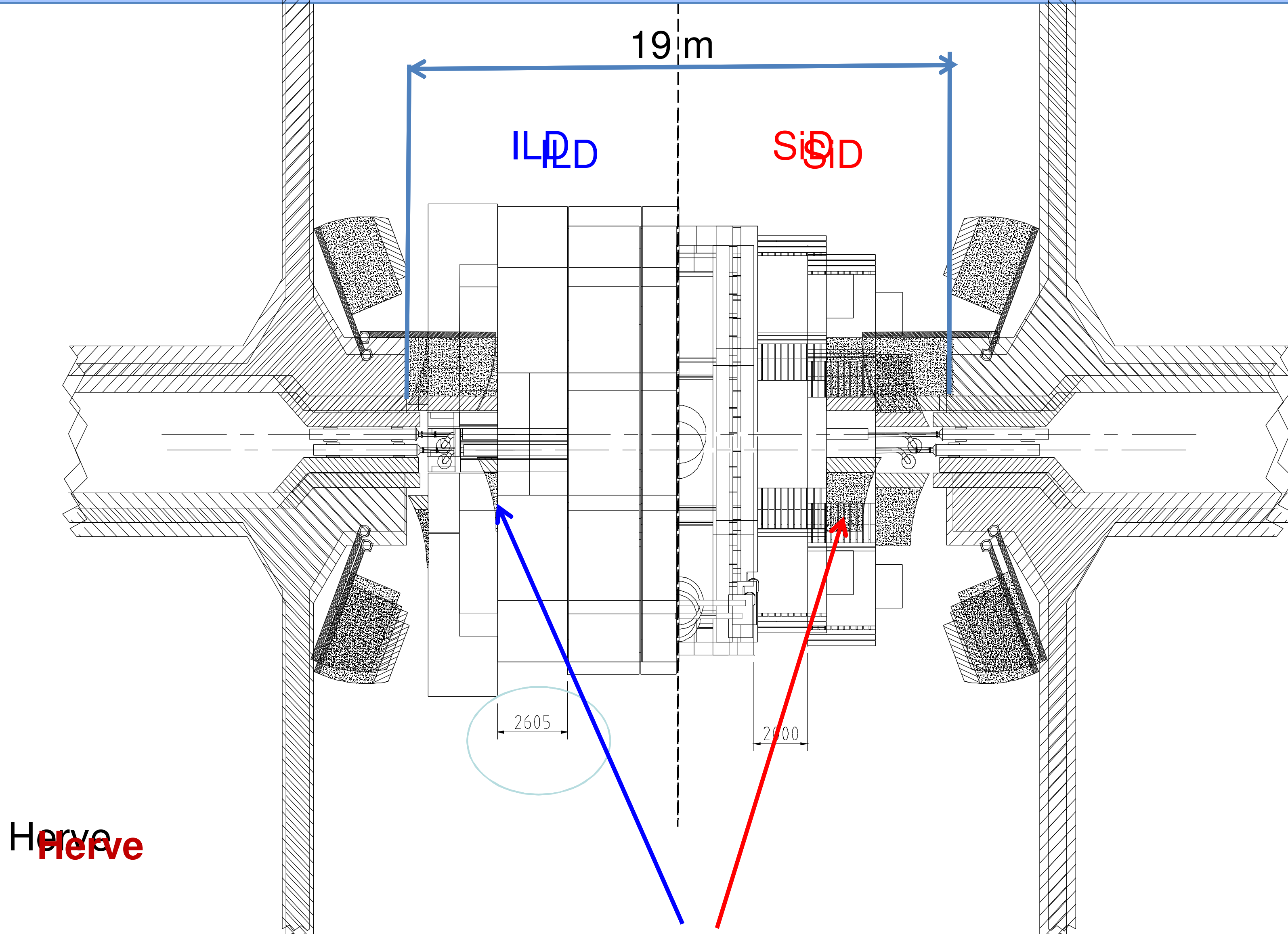
*Input ground motion from: C. Collette, ILC-CLIC LET Beam Dynamics Workshop (23-25 June 2009)

Shielding between detector and tunnel



Oriunno

SiD / ILD compatible PACman



Interface pieces carried by each experiment

Radiation Protection studies for SiD

By Mario Santana, SLAC

Monte Carlo tools and methods

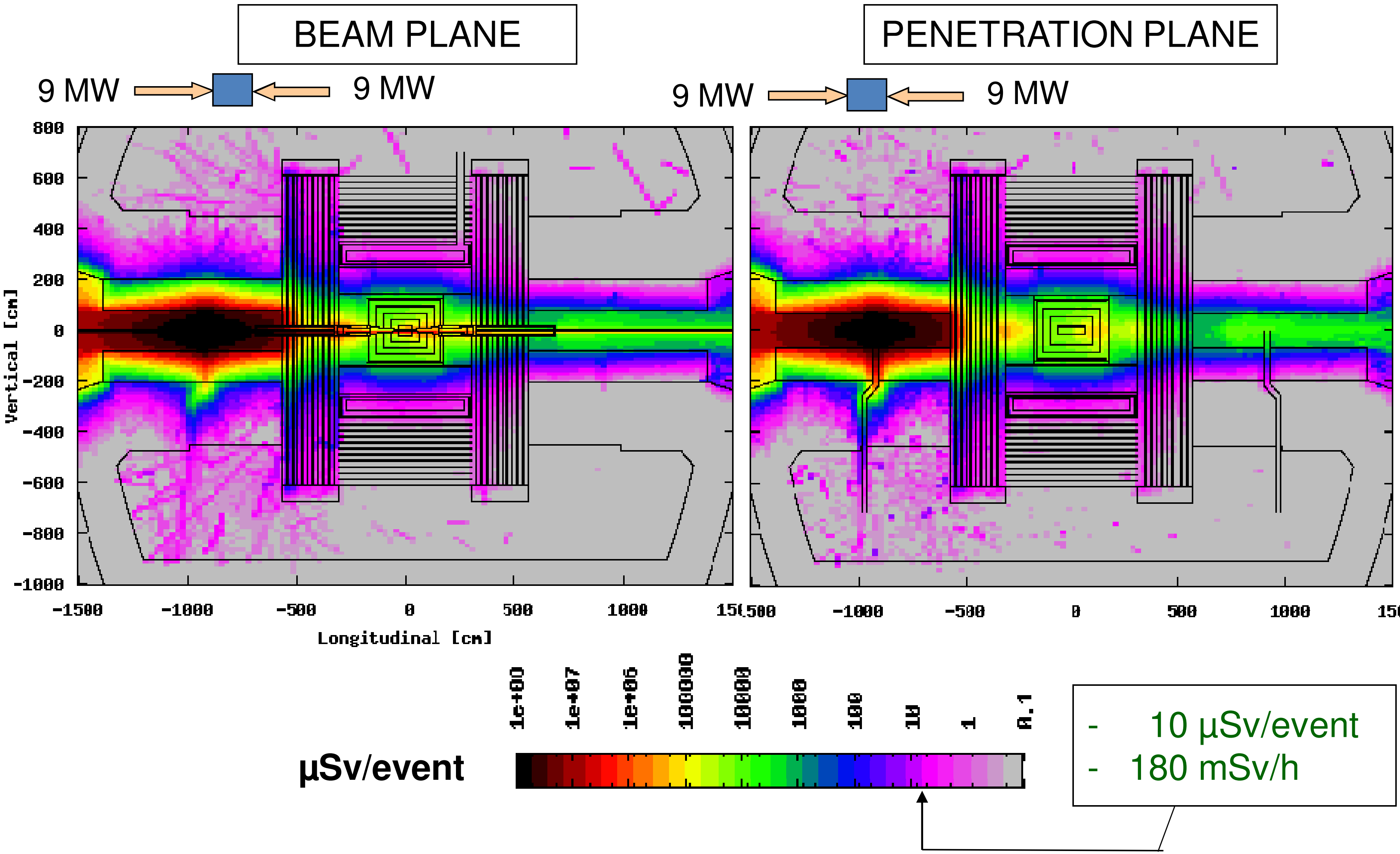
- FLUKA Intra Nuclear cascade code
- Deq99 fluence to dose conversion routine
- FLAIR GUI
- PARALLEL simulations at SLAC farm: about 76000 CPU-hour

Beam and accident conditions

- 500 GeV / beam and 9 MW / beam
- Typical accidents:
  - Beam1 AND beam2 hit thick target at IP-14 m
    - Weakness cavern-pacman interface?
  - Beam1 AND beam2 hit thick target at IP-9 m
    - Pacman is sufficiently thick? Weakness in penetration.
  - Beam1 hits tungsten mask at IP-3 m (unsteered)
    - SiD is sufficiently shielded?
- Beam aborted after one train = up to 3.6 MJ

20 R.L. Cu target in IP-9 m. Large pacman.

By Mario Santana, SLAC



Provisional conclusions for SiD

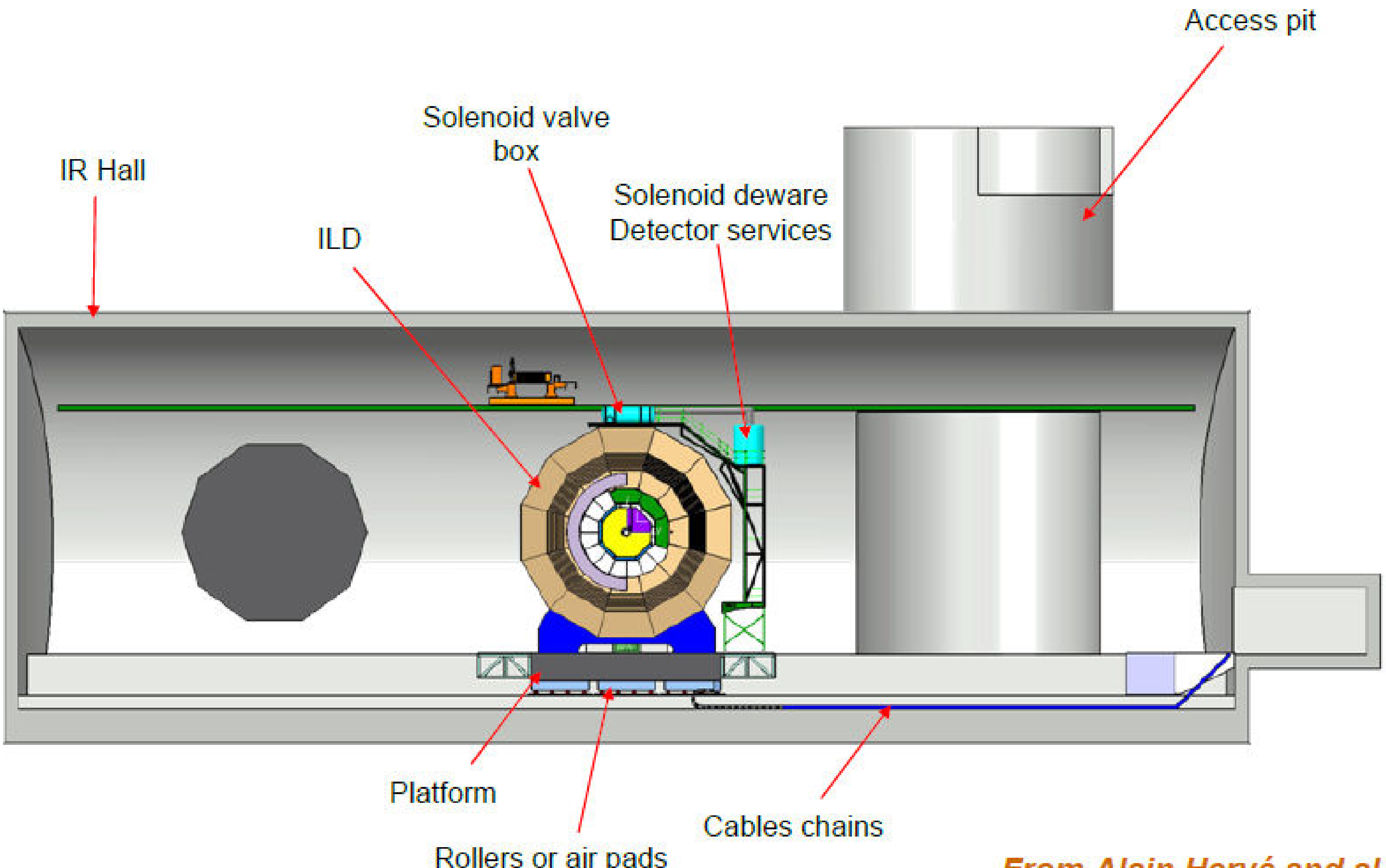
By Mario Santana, SLAC

- **Small pacman and pacman-cavern interface are sufficient in terms of *dose per event*.**
- **However, the *dose rates* for the small pacman are very high:**
  - **Proven mechanisms should be installed to:**
    - **avoid these accidents to occur**
    - **shut off beam after 1 train (200 mS)**
  - **Possible Debates**
- **The large pacman complies with all criteria.**
- **The penetrations in the pacman don't require local shielding.**
- **The shielding of the detector may be insufficient to comply with dose rate limit. Exclusion area?**
- **More studies ongoing (mis-steering…)**

Detector Motion

- **Main issues:**
- **Height difference (~1.7 m)**
- **Preferred detector support mechanism**
  - **- SiD: legs**
  - **- ILD: platform**
- **Preferred detector motion mechanism**
- **Interface to machine tunnel**
- **…**

ILD on Platform in IR Hall

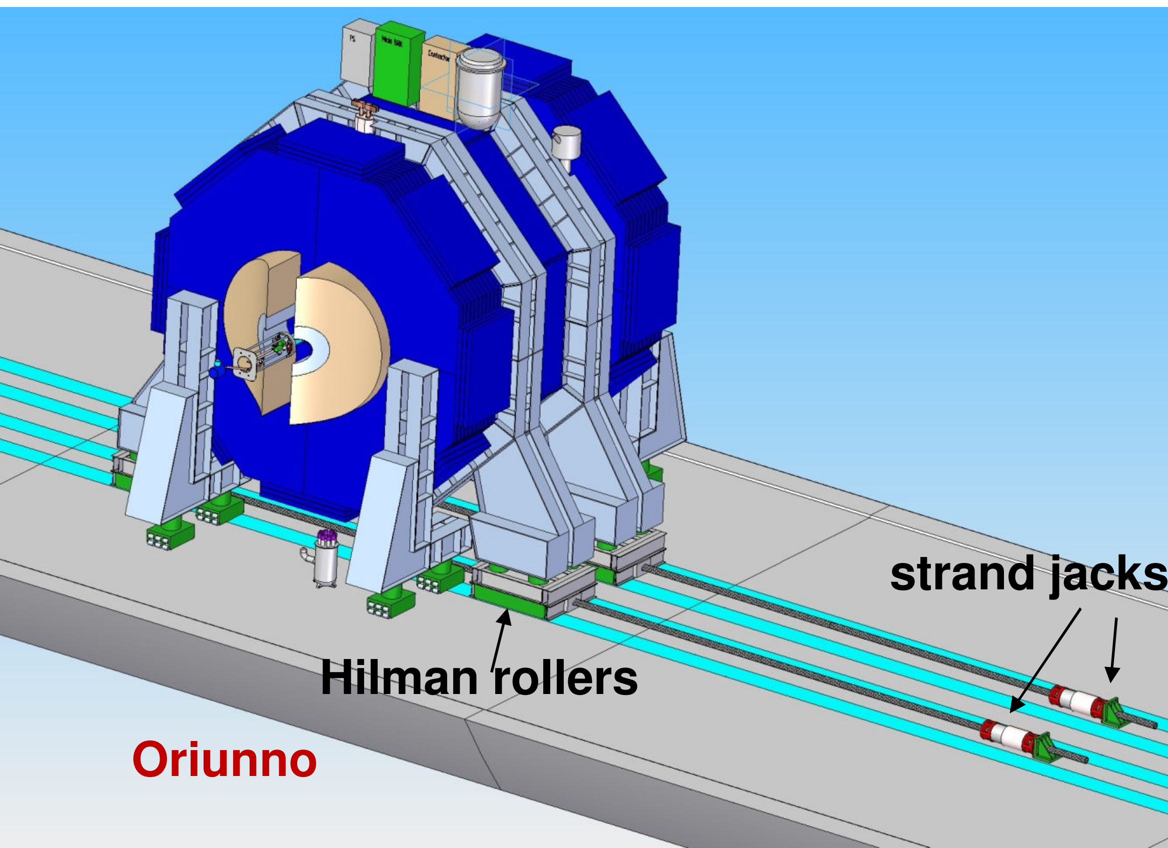


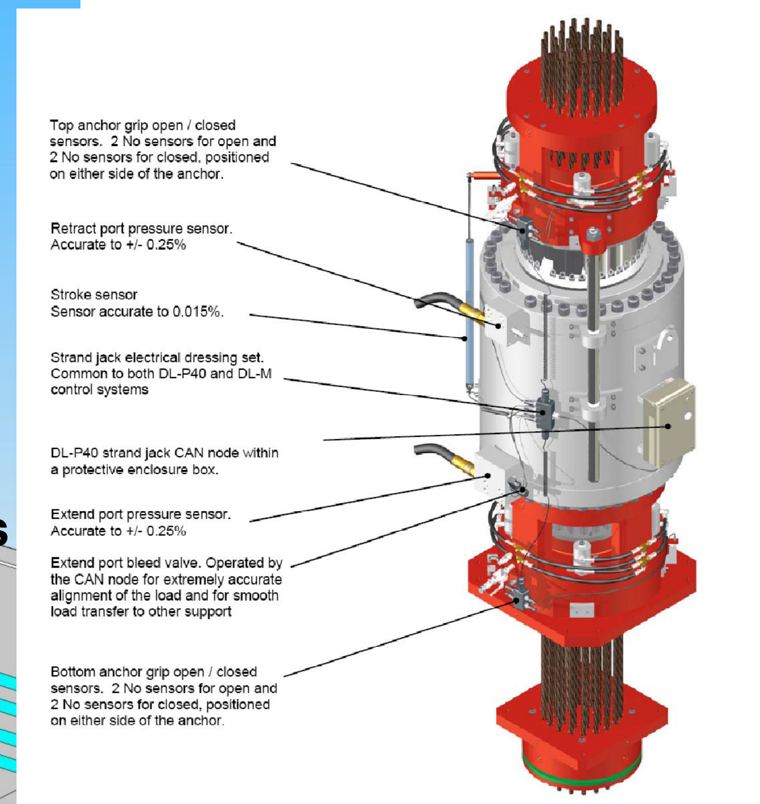
From Alain Hervé and al.

Push pull mechanism for SiD

By Philip Burrows, JAI, Oxford Univ.

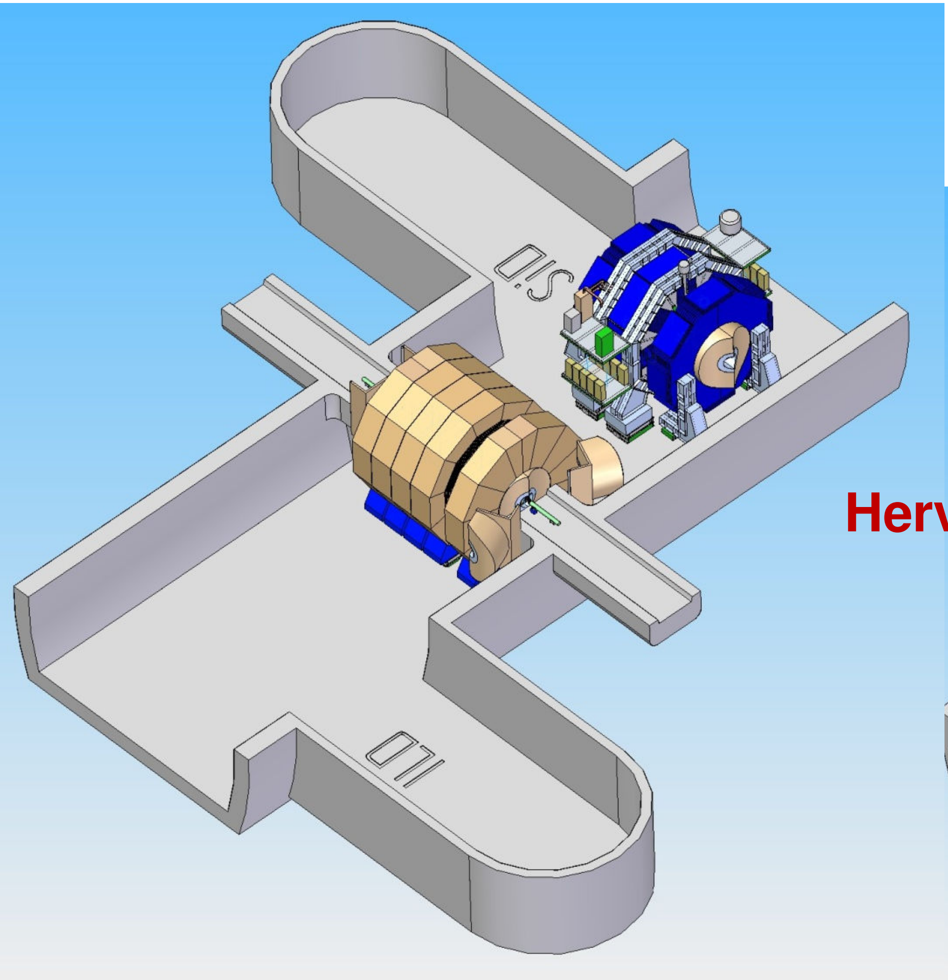
- Move on hardened steel rails, grouted and locked to the floor
- Rail sets for transverse motion (push pull) and door opening in both the beamline and garage positions will be needed
- Hilman roller supports, strand jacks provide locomotion
- If ILC is built in a seismically active location, provision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



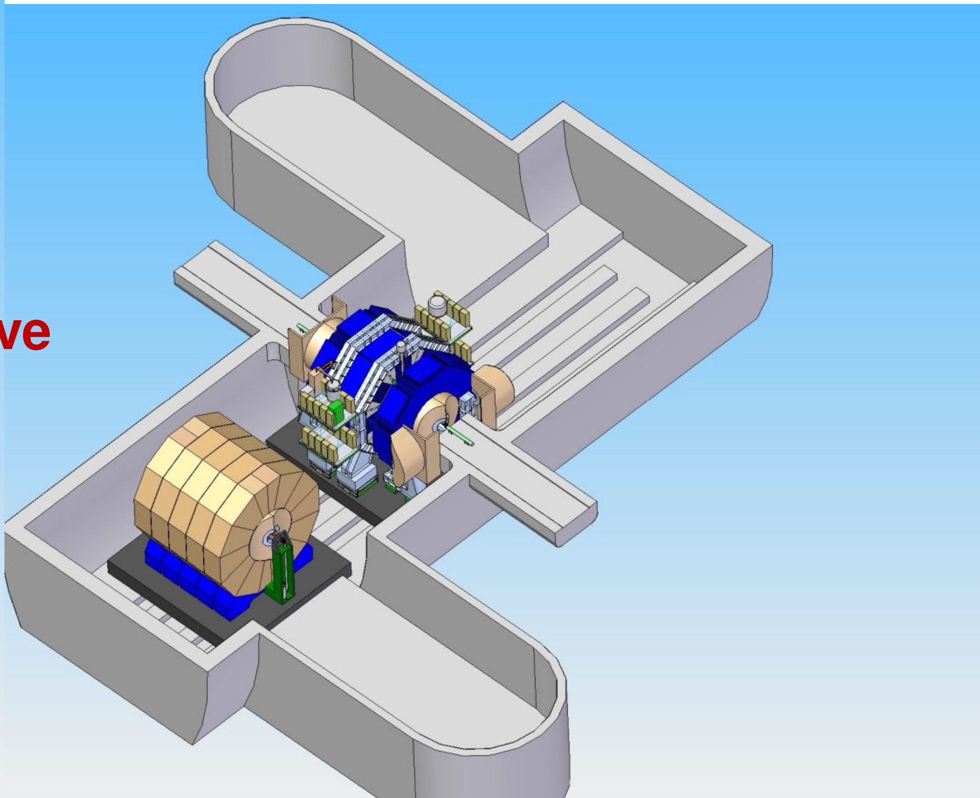


Both detectors on platform or legs?

By Philip Burrows, JAI, Oxford Univ.

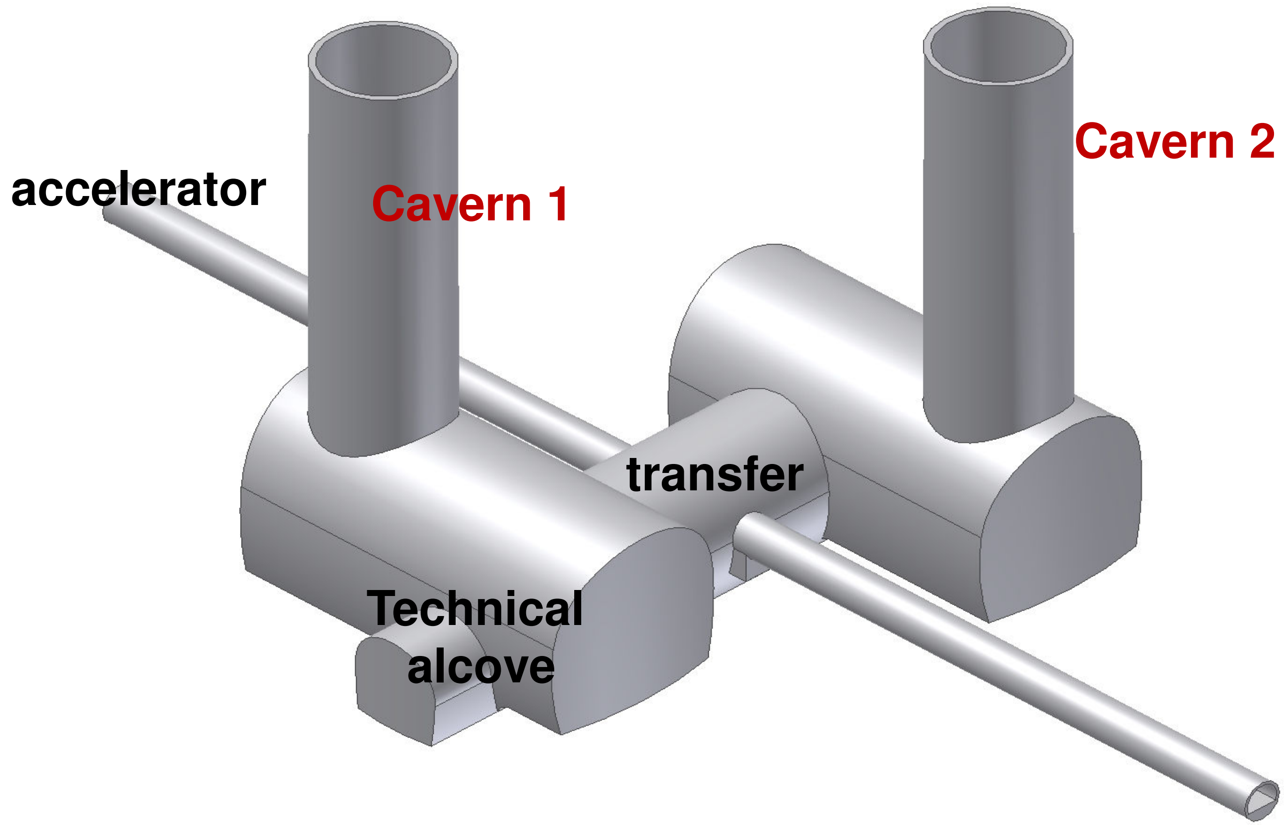


Herve



Proposed Experimental Area

– no pacman shielding – instead chicanes between endcap/tunnel
– Very smooth end-wall of tunnel
– Longer experiment adapts via end-coils to shorter experiment
– Radiation shielding1 is a ring chicane on the endcap
– Radiation shielding2 is a sliding concrete wall integrated into cavern
– Provision of 2 x 75 m^3 volumes in the tunnel to house a possible massive pre-isolator of up to 200 tons each



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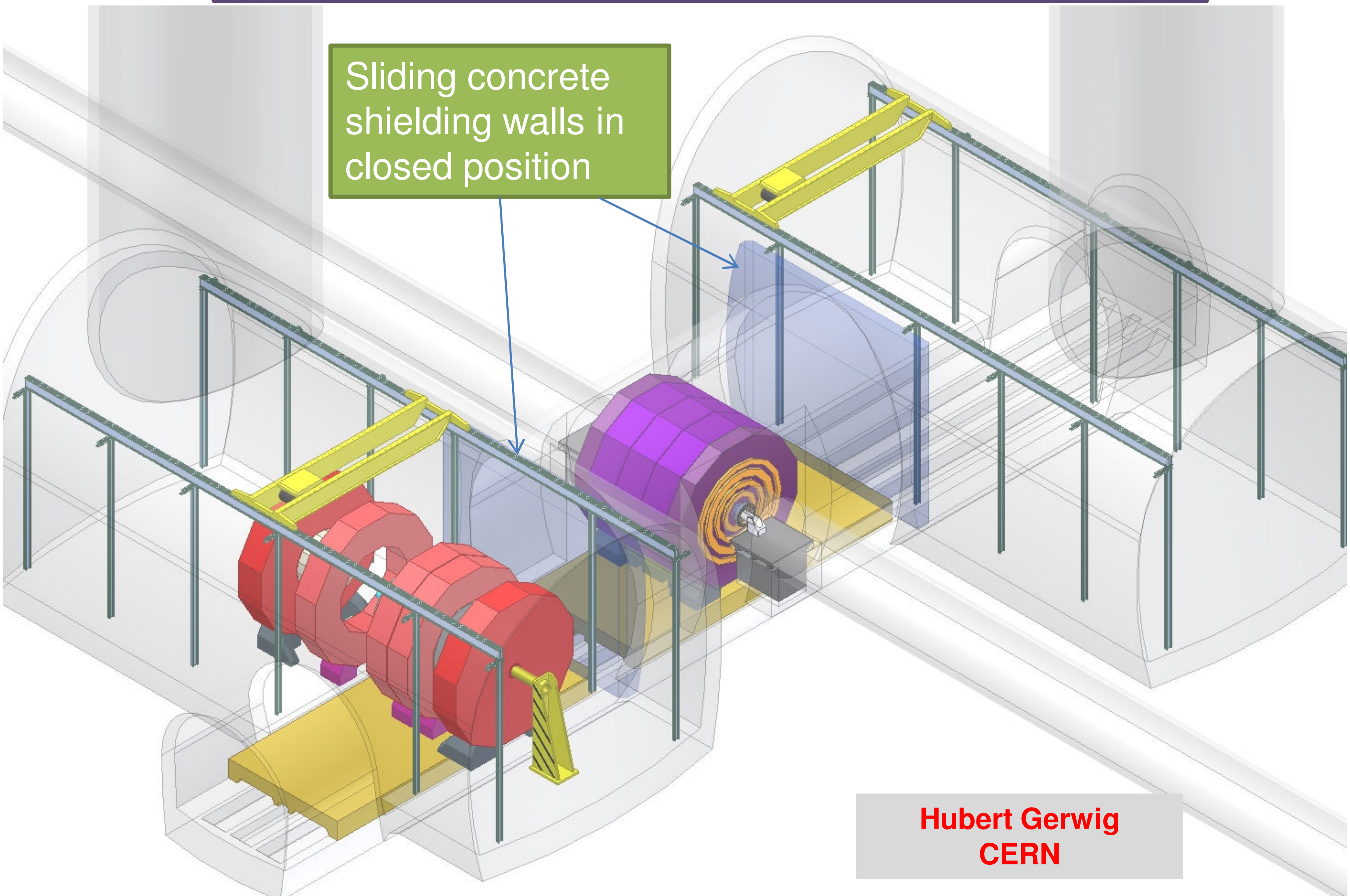
CERN

Experimental Area (looking inside)

Experiment 2 sliding on IP, shielding walls closed



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Other "MDI" Topics Not Discussed

- **Vacuum studies at ILD (M. Jore)**
- **Simulation of beam-beam background at CLIC (A. Sailer)**
- **Testbeam Measurements with a Prototype Cherenkov Detector (D. Kaefer)**
- **IP feedback prototype status and engineering considerations for implemention in the MDI (P. Burrows)**
- **What could we learn at ATF2 concerning ILC backgrounds (G. Hayg)**
- **Status of Beamcal Readout Chip (A. Abusleme, T. Markiewicz)**
- **SI sensor Radiation Testing (T. Markiewicz, B. Schumm)**
- **SID Field Maps for Various Iron Configurations (T. Markiewicz, W. Craddock)**
- **Luminosity Measurement at ILC (I. Bozovic-Jelisavcic)**
- **……**