MDI and Integration
Status and Future Plans

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ALCPG ILD Meeting
Albuquerque
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ILD Mechanical Concept - as in LoI

- platform for push-pull
- 3 barrel yoke rings, 2 endcaps
- central yoke ring carries cryostat with coil and barrel calorimeters
- endcap yoke carries endcap calorimeters
- TPC and SET suspended from cryostat
- Inner silicon detectors in support structure (CFRP) supported from TPC
- QD0 magnet and forward calorimeters carried by pillar, suspended from coil cryostat with tie-rods
Bi-lateral Discussions

- Interface Doc.
- Functional Specifications
- Technical Solution #1 (Platform)
- Technical Solution #2 (Rollers)
- Technical Solution #3 (QD0 supp.)
- Technical Solution #n (Pacmen)

Today

Tomorrow

IR / MDI

Technical Specifications

One day
Bi-lateral Discussions

Interface Doc.

Functional Specifications

Today

SiD

ILD

Tomorrow

Technical Solution #1 (Platform)

Technical Solution #2 (Rollers)

Technical Solution #3 (QD0 supp.)

Technical Solution #n (Pacmen)

IR / MDI

Technical Specifications

One day
SiD-ILD-BDS Discussions

Alain Hervé spent two months this summer at SLAC to discuss with SiD and ILC-BDS people. Klaus Sinram joined them for two weeks:

• Ways to get to a common IR hall design where
  • ILD moves on a platform
  • SiD does not

• Common push-pull system
• Common shielding („pacman“) design
• Implications on the interface with the beam delivery system
  • Final focus magnets supports and alignment

• Impressive progress in a relative short time!
Possible Common Pacman Design

A. Hervé:

Possible Common Solution

19 m (was 18.6 in ILD, Matthieu)

ILD

SiD

Interface pieces born by each experiment
Common Hall Design Study
Common Hall Design Study
Common Hall Design Study
Common Hall Design Study
How to Proceed

• All agree that it would be easier if both experiments would choose the same push-pull vehicle: platform or not
• It needs to be studied which solution would be better in terms of vibration issues
• This is important especially for the support of the QD0 magnets
• Need to study the full stack:
  • Ground → Platform → Support → Experiment → QD0 Support

• KEK colleagues volunteered to model ILD and also CMS (for comparison) for FEM analysis
• CERN colleagues will measure vibrations around CMS (ground, floor, tunnel-to-tunnel)
• KEK colleagues will measure vibrations at KEK-B and ND280

• Try to optimise the QD0 support using the results
**QD0 Support Vibration Analysis**

**Calculation results:** *Vertical direction*

**ATF-2004Feb10-17:00UD**

- **CERN-Data**
  - Integrated amplitude at 5Hz: Larger than 50nm (ATF, CERN High)
  - Much smaller than 50nm (CERN small, Reference)

**H. Yamaoka**
Coherency measurement at KEKB-tunnel

**Measurement: A**
How is the coherency between the position-A and B?
These two points keep coherency??

**Servo Accelerometer MG-102** (Tokkyokiki Corp.)

- **Size**: 40 x 40 x 50mm
- **Max. input**: ±2G
- **Resolution**: 1/10^6 G
- **Acc**: 0.1 ~ 400Hz
- **Acc. 60dB = 1gal/V**

Belle detector ~1300 tonnes
Results

P.S.D. at position-B.

- Perpendicular to beam line
  - Microseismic
  - Resonance of soil

- Beam direction
- Vertical direction

Coherency between position-A/B.

⇒ It seems that there is no coherency between two positions. Except for the frequency of microseismic (0.0Hz) and resonance of soil (~3Hz).
ND280 Measurements

- Natural frequency after fixed to the bracket is increased to ~1Hz (NS, UD).
- P.S.D. is reduced because natural frequency is increased.
- Support stiffness is increased.
- It is not so big different but it's efficient to use the support-brackets.

It helps to fix the detector to the floor.
CMS Measurements:

- On top of barrel yoke ring
- On top of endcap ring
- On top of HF tower
- At the extremity of the Rotating Shielding (pacman)
- On and around the plug

- All w.r.t. the local ground vibration

- Measurements on the cryostat are also important

- Results expected soon
• Learn how to implement the ILD CAD model kept by Matthieu Joré into the ILC EDMS system
• Discussed strategies on how to share models efficiently
• Global ILD CAD model will define working space for subdetectors
• Detailed models and specifications will be linked in EDMS

• EDMS access is only really useful for experts (needs training etc.)
• Webpage interface for all in ILD will be done, e.g. on www.ilcild.org
  • Access to all released documents via EDMS-Direct

• Support from DESY experts (Lars Hagge et al.) available
ILD CAD in ILC-EDMS
Opening on the Beam (- or not)?

• Present design foresees opening of the detector on the beam:
  • Partially split endcap yoke allows \( \sim1\) m wide access space between coil and endcap calorimeters
  • Allows for limited maintenance in the beam position(?)
  • Every major work would be done in the parking position - push pull!

• But:
  • A real engineering challenge which puts hard boundary conditions on many other things
CMS Experience: it is not trivial to access a 1m wide space several meters above the floor (beam height is at 9m).

- Small size cradle elevator (used for small interventions):
  - Needed place between endcap and barrel: 1.6 m
  - The overall size on floor of engine is 1.3 m
- Crane truck (allowing heavier operation up to ≈full height):
  - 1.5 m on floor, 2 m needed for motion

+ On surface:
  - Scaffolding
  - Fixed and moveable
QD0 Support

- Movable yoke endcap makes QD0 support complicated
- QD0 supported by pillar outside of the detector and suspended on tie rods from the cryostat
- Monitored by MONALISA, placed on actuators for alignment
- Vibration issues are under study
• MONALISA requires vacuum pipes for laser beams attached to QD0
• Need to be disconnected remotely controlled when the endcap is opened
• Needs a lot of engineering work

Case of Monalisa:
Final Doublet Stability and in-detector Interferometry
• 4 entries on one side,
• 2 on the other side,
• Lines going under the detector

• It is an interferometric metrology system for continuous monitoring of position critical accelerator components
• Consists of a fixed network of evacuated interferometric distance meters with nanometre type resolutions over O(10m)

See David Urner’s talk at LCSW08
More CMS Experience

- Endcap deformations are in the order of 15mm
  - Will be better at ILD
- Ground deformations during movements can reach 5mm at a scale of 2m.
- Time for closing of the endcap is in the order of 1.5 days (sic!)
  - Has not been done very often so far. Learning-curve effects are expected
- Moving 3000t pieces in a delicate environment (beam pipe is 1mm) is not trivial and needs thorough engineering

[Diagram]

- Bending up to 17 mm
- Then the needed gap between barrel and Calo nose is to be >20 mm
- The longitudinal movement of the nose because of magnetic field is here of 17 mm

- Vertical deformation ≈3 mrad, i.e. 45 mm at 15 m
- Possible lateral misalignment : 13 mm

During the closing of endcaps, the position is controled by laser monitoring (4 points) / beam tube
To Open or Not to Open (on the beam)

• From the engineering point of view it would be much simpler to do maintenance on the detector only in the parking position
  • Push-pull will bring the detector to the parking position in one day

• Question to all of us:
  • What do we really gain if we design the detector for the opening of the end-cap on the beam?

• Keep in mind:
  • Access space is VERY limited
  • Only limited access to TPC endplate, barrel and endcap calorimeters
  • No access to inner detector (VTX, SIT, FTD, etc.)
  • CMS experience: opening time for the endcaps could be in the order of one day!
  • „When people are moving heavy pieces in these conditions (...), they become extra careful as any accident has dramatic implications.“ (A. Hervé)
  • Engineering resources are EXTREMELY rare in ILD. If we spend many on the endcap we might miss them somewhere else

• Questions to be answered:
  • What maintenance could be done on your subdetector during this limited access?
  • How much luminosity would we loose if we wait with the maintenance until we pull out?
  • What is the lumi-loss risk with the more complicated opening scenario?
To open or not?

• Suggestion: collect arguments now and try to have a structured discussion at the ILD workshop in Paris

• Comments received so far:
  • „Keep it simple, we can get more sophisticated when the machine has been approved.“
  • „Think about the potential problems now so that they will not hit us later“
  • „Do not mix maintenance procedures with push-pull issues. Maintenance is ILD-internal, while push-pull involves the other detector as well.“

• Please continue to send comments and be prepared for Paris
Yellow: most urgent tasks from the global integration viewpoint
Summary

• We are still in the process of understanding what really needs to be done at the timescale of 2012
• ALCPG meeting should be a starting point for discussion on stabilities with BDS and SiD
• Relations of tasks is getting clearer
• Milestones have not been defined yet, first draft expected for ILD workshop in Paris
• Resources are very limited - need to concentrate on really important items
• Plan to have an MDI/Integration pre-meeting for the ILD workshop
  • Preferably one full day right in advance of the workshop, depends on availabilities of rooms, etc. Catherine Clerc volunteered to organise.