Report from Mini-Workshop on Infrastructure and CFS for Detectors

16.05.2017 KEK

Karsten Buesser

ILD Group Meeting
06.06.2017

Mini-Workshop

- Fourth installment of a successful series:
  - 1st workshop: 31.8./1.9.2015
  - 2nd workshop: 15./16.03.2016
  - 3rd workshop: 30.9.2016
  - 4th workshop: 16.5.2017
- Supported by E-JADE
- Main topics this time:
  - Staging for machine and detectors
  - Anti-DID engineering
  - Infrastructure at IP and main campus
  - Detector engineering

Staging Discussions

Why Staging?

- Staging is being discussed for the ILC project
  - Goal: reduce the initial cost of the project by O(30-40%)
  - Reduce the initial cms energy to 250 GeV
  - Clear upgrade plan to 500 GeV (with costs and timeline)
    - details under discussion (initial tunnel length, etc.)
- What about the detectors?
  - Detector costs are not part of the project cost, but also given in the TDR
    - but still they are significant: O(300-400) MILCU per detector
    - detector costs are traditionally treated differently than project cost
      - financed via collaborations
      - but in the end (partially) by the same funding agencies
  - We should not talk too loudly about detector staging now…
  - But we should prepare for implications of the machine staging to the detectors!

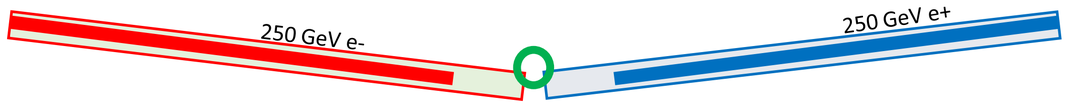
Machine Staging

- Different scenarios under study
  - initial energy 250-350 GeV
  - short tunnel
  - long tunnel
    - fully prepared
    - only „empty hole“
  - …
- Envisaged initial cost reduction
  - 30-40%

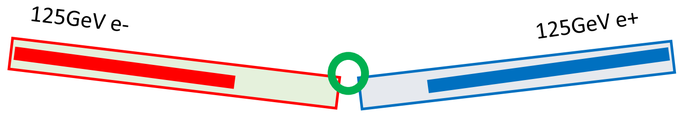
staging option name （given by S. Michizono, 02052017）

350GeV option were added

500GeV **TDR:**



250 GeV **Option C:**

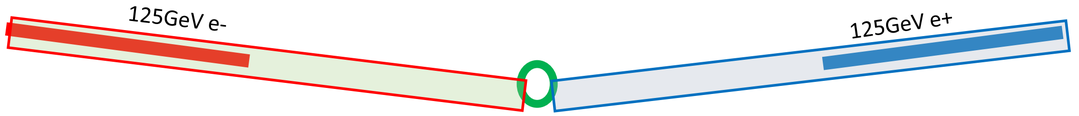


Option D:

350GeV Option D':

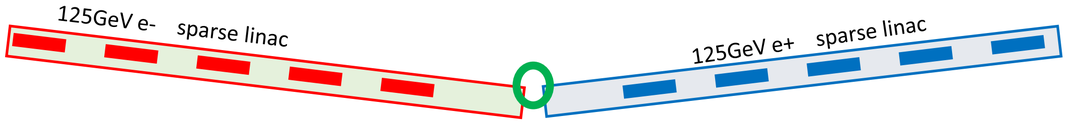
Option E:

350GeV Option E':



Option F:

350GeV Option F':



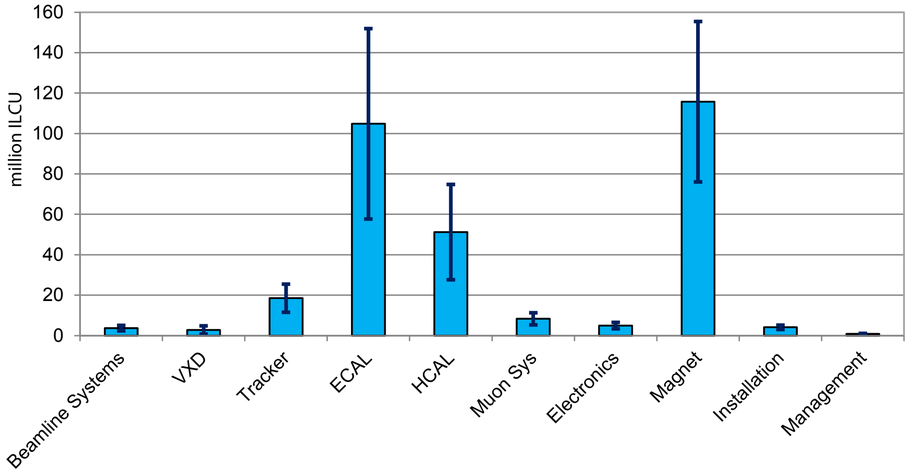
Staging for Detectors

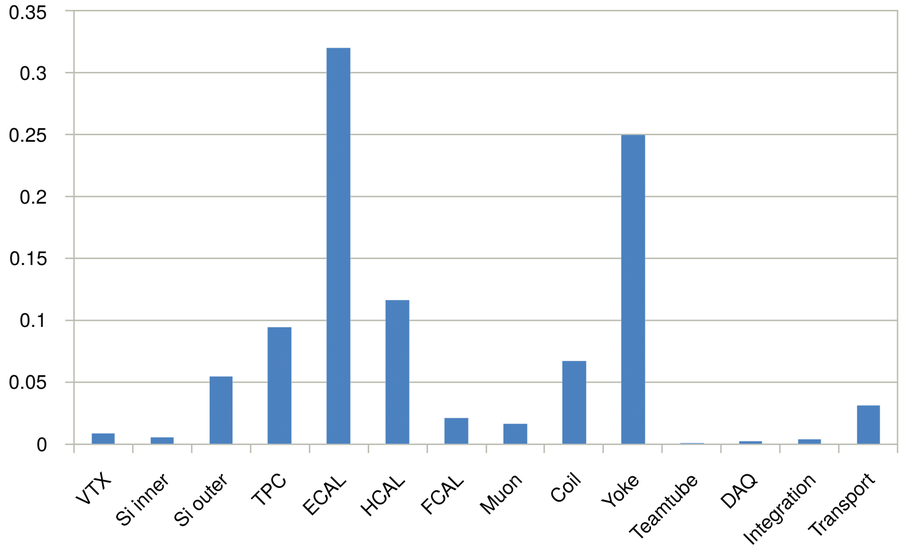
- Is there a way to save money in an energy staging scenario for the detectors?
- Two cases:
  - either there will be an initial detector that is designed for energies of 250 GeV and below that will be replaced or supplemented by another high-energy detector
    - essentially no upgrade to the existing detector, but replacement
  - or a multi-purpose detector with an initial 250 GeV design that will be extended to 500 GeV (or 1 TeV) later

- Related question (though not necessarily related to energy staging):
  - One or two detectors in the first stage?

Detector Cost

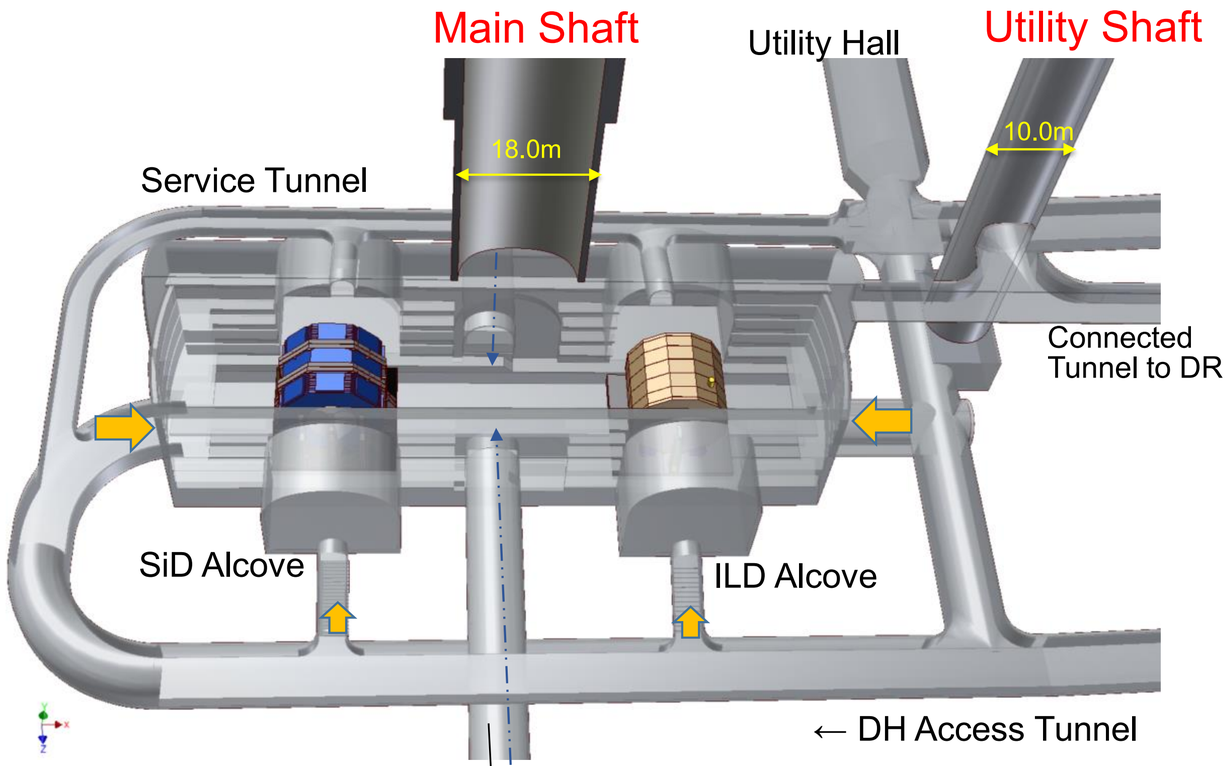
- The big cost drivers are ECAL and Coil/Yoke
  - Together O(60-70%) of the total cost per detector
- Coil and Yoke will most probably never be changed in the detectors
  - this means that any detector that should also be able to run at high energies (up to 1 TeV) cannot save on this in a 250 GeV stage
- Can the ECAL thickness be reduced (or less sampling)?
  - needs detailed studies, but I guess this would have a quite significant impact on the photon energy resolution
- Reduction of the tracking system outer radius?
  - Yes, this should help: see difference between SiD and ILD!
  - ILD study on smaller detector model on-going
- Other sub-detectors?
  - Possibly savings, studies required, total cost volume is small
- What about a dedicated 250 GeV detector?
  - Needs to be studied… could be smaller, maybe cheaper
  - but you would need the high-energy detector in the next energy phase anyhow…





One or Two?

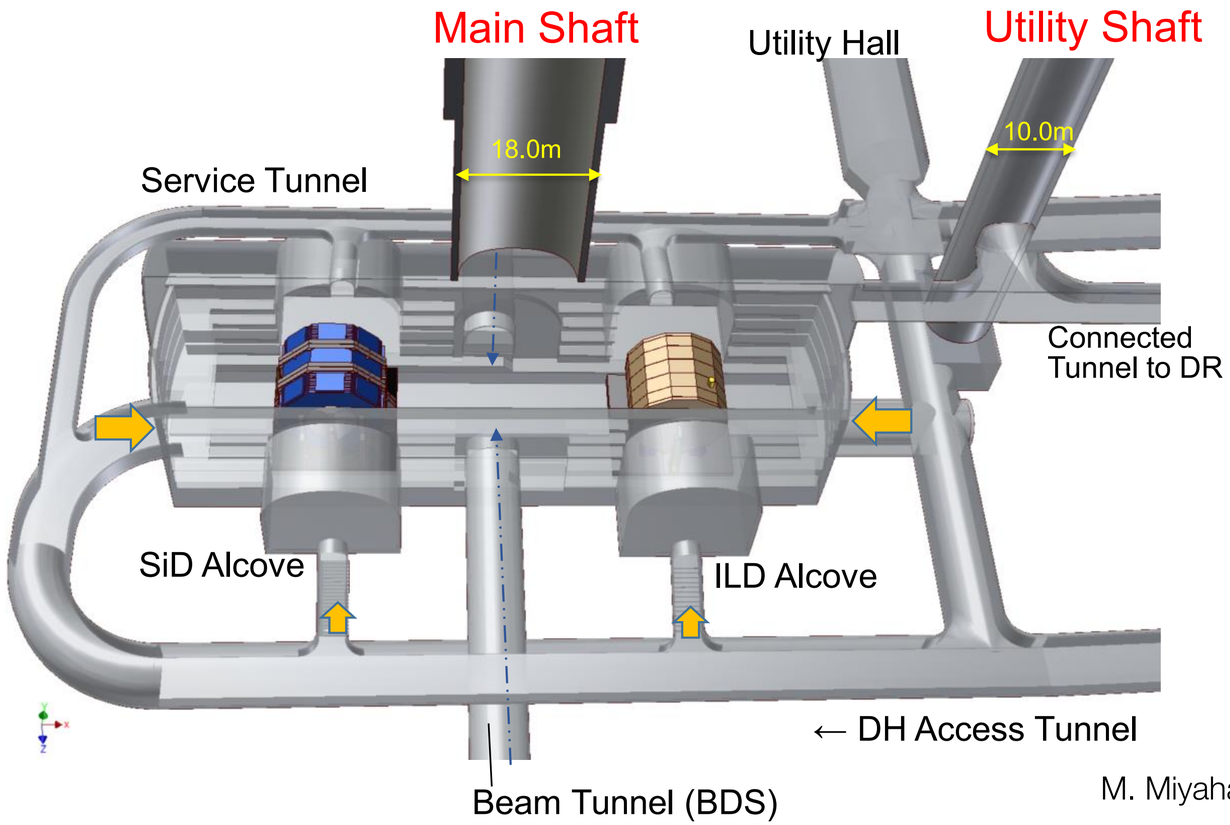
- Often discussed (since Snowmass 2005)
  - one or two detectors?
- This question is not directly related to energy staging of the machine!
  - It has been discussed for many years for the 500 GeV machine
- It could turn into an energy staging question:
  - start with one detector optimised for 250 GeV
  - add a second detector optimised for higher energies later



M. Miyahara

One or Two?

- Infrastructure savings for only one detector:
  - reduce underground volume
  - reduce surface areas
  - reduce services
- Push-pull?
  - you still would need a mechanism to get the detector from the parking position to the beam to allow for commissioning of the beam while maintenance is done on the detector
- Again: this is not directly related to staging! It is related to the question about one vs two detectors that has been answered in the TDR!



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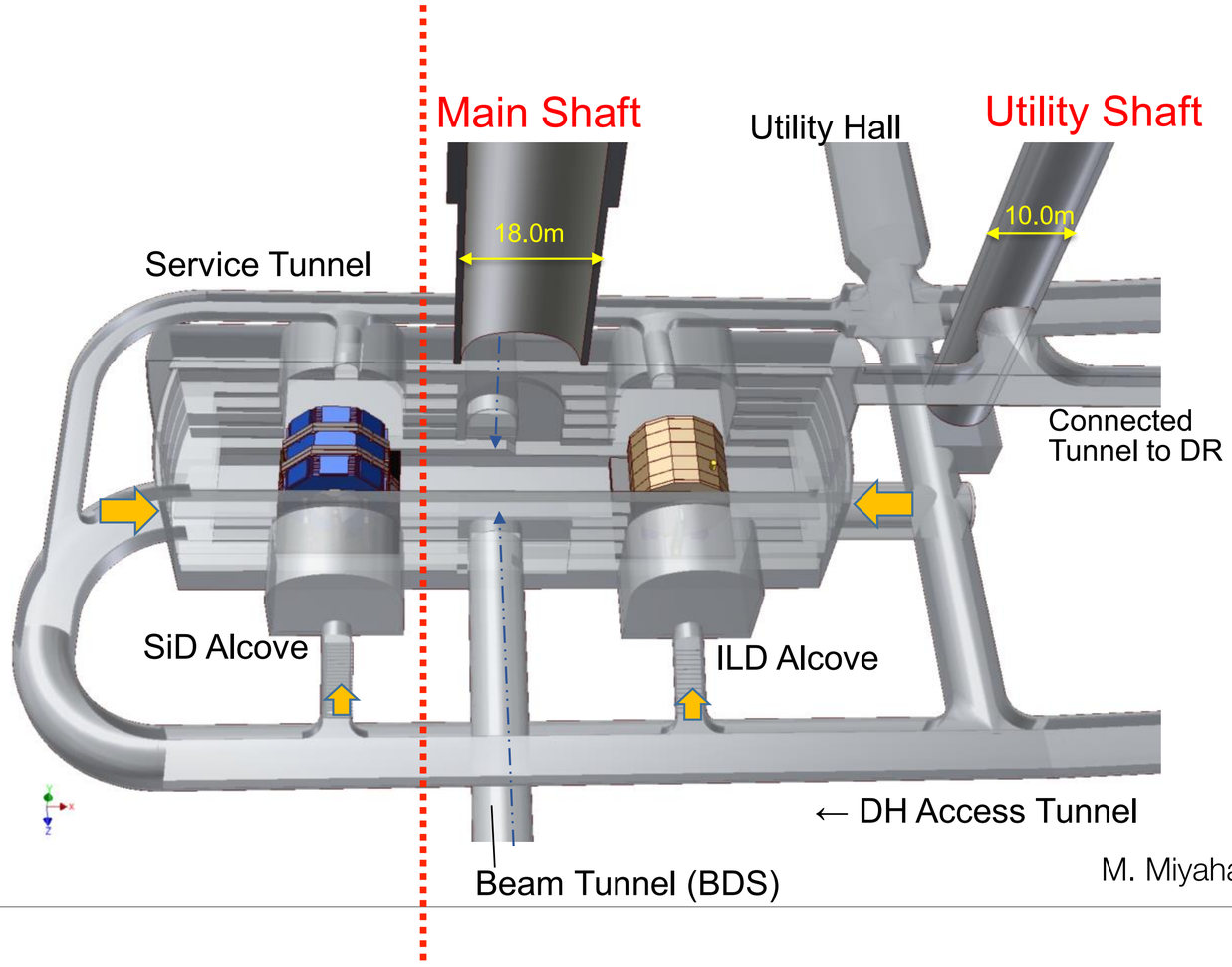
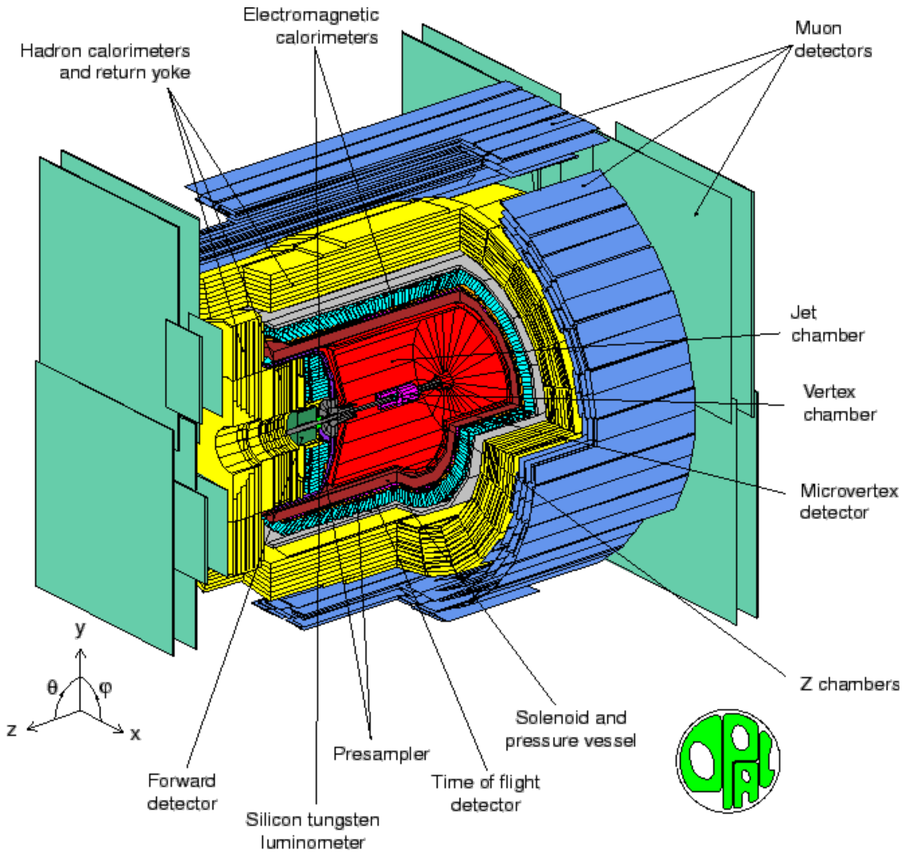


M. Miyahara

A Dedicated 250 GeV Detector?

- A dedicated 250 GeV detector could be cheaper:
  - smaller radius
  - lower B-field
  - smaller yoke
- But: this requires a detailed physics study!
- And in the end it will still be a device with costs of several 100 MEUR…
- And it will NOT be able to run at higher energies and reach the physics goals
  - not attractive for international collaborators!
- The high-energy detector needs to be built anyhow for the later stages

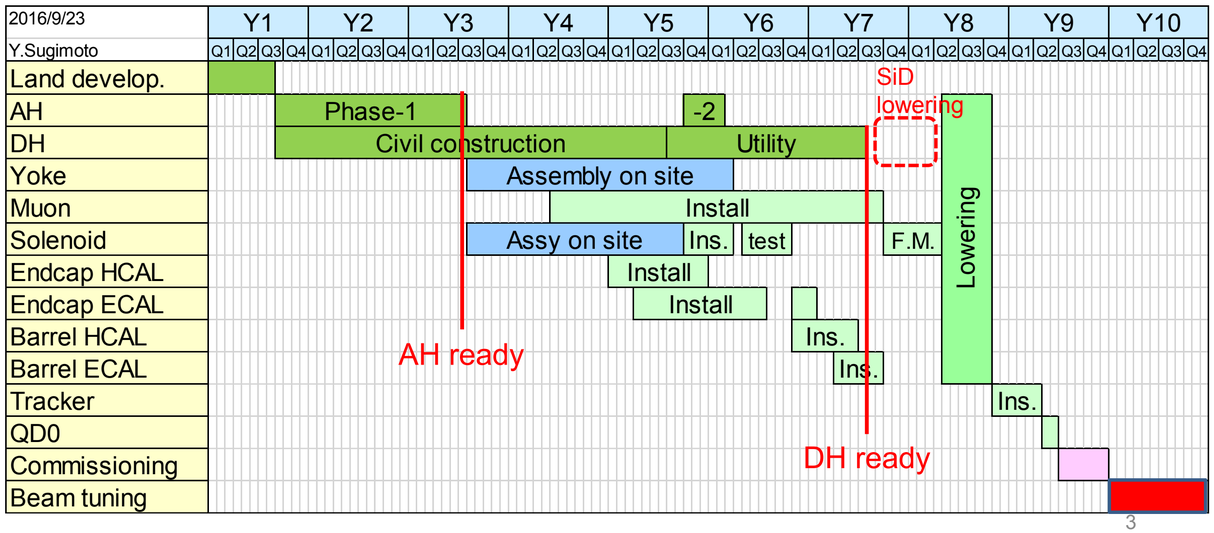


Timing

- How can the detectors adapt to a reduced construction time of the staged machine?
  - need to save 6-12 months? Timeline for staged accelerator not clear yet!

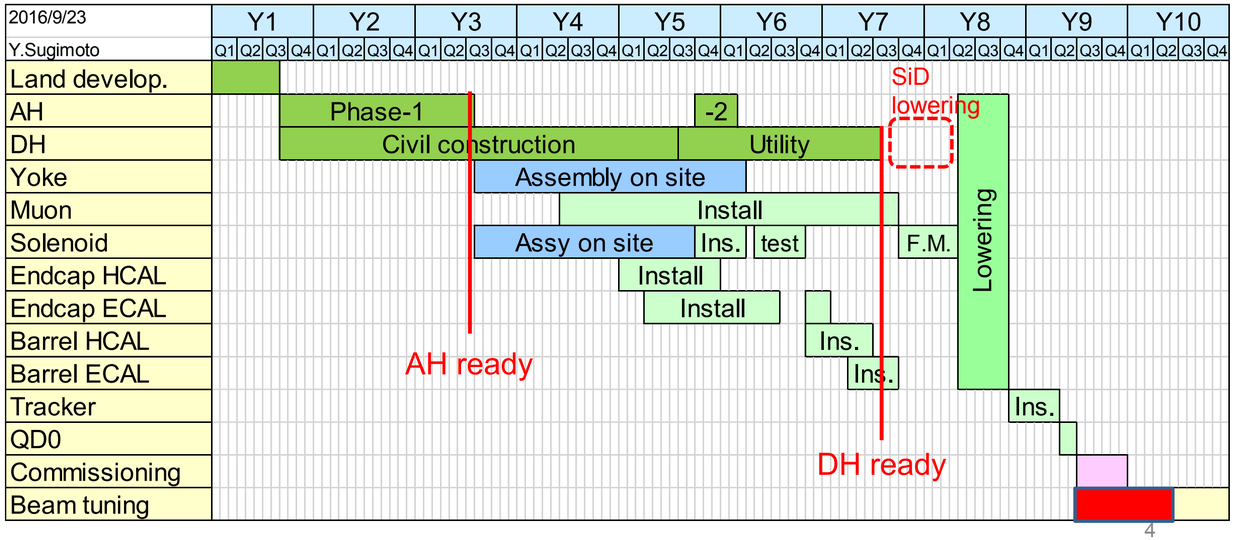
Original schedule

- ILD will get ready before beam commissioning in Y10



0.5 year earlier commissioning

- If occasional access to the detector during beam commissioning is possible, 0.5 year earlier beam commissioning is acceptable

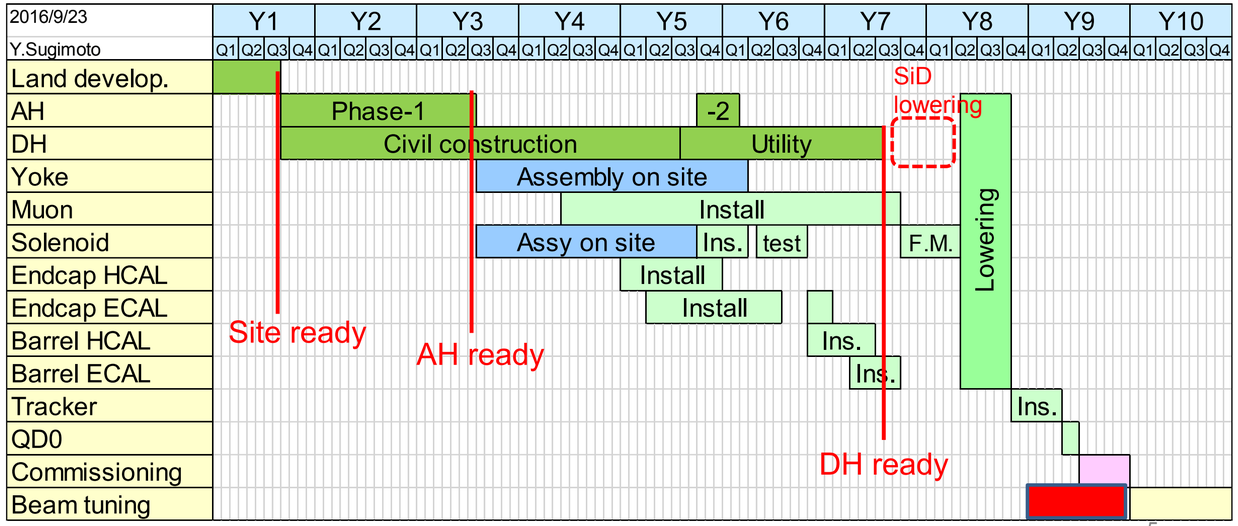


Y. Sugimoto

Timing

1 year earlier commissioning

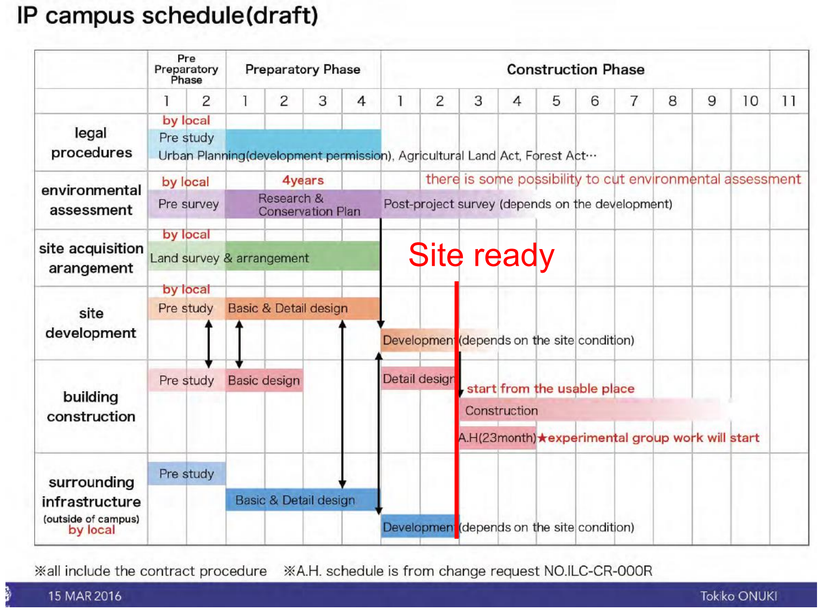
- If the beam line is shielded (by SiD?) by the end of Y8, 1 year earlier beam commissioning is acceptable



5

Critical path

- There is no way to shorten the detector construction period after DH completion
- If land development is delayed by 1.5 y, completion of DH construction and ILD assembly would be delayed by 1.5 y (Accelerator construction will be also delayed)



From slide by Tokiko Onuki

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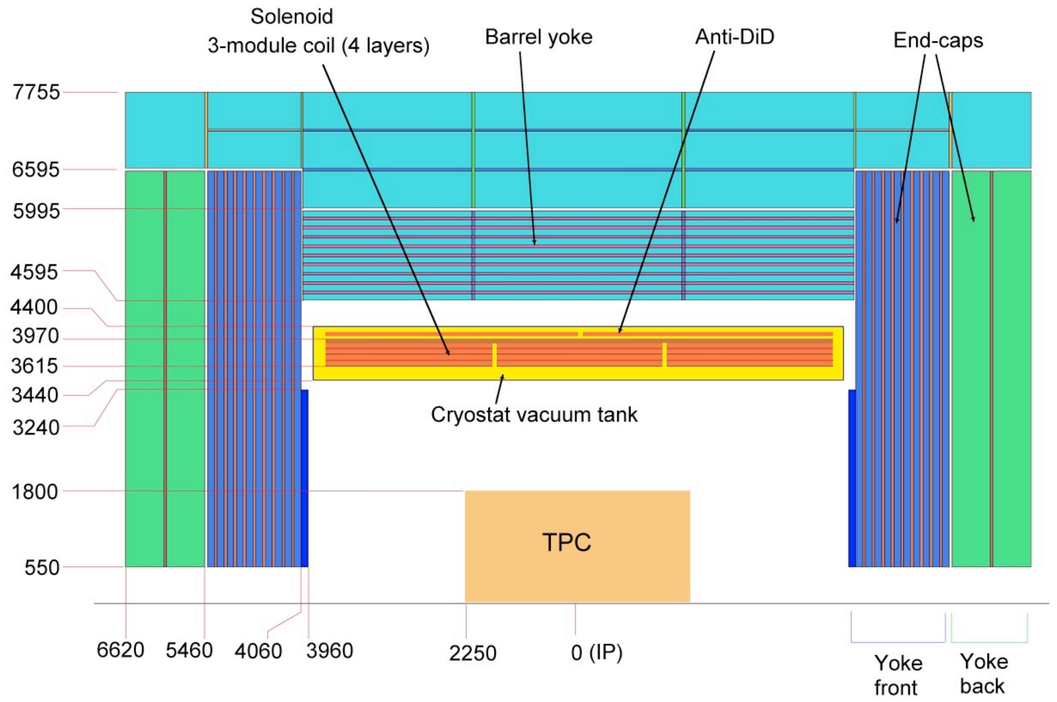
Anti-DID

Solenoid and Anti-DID

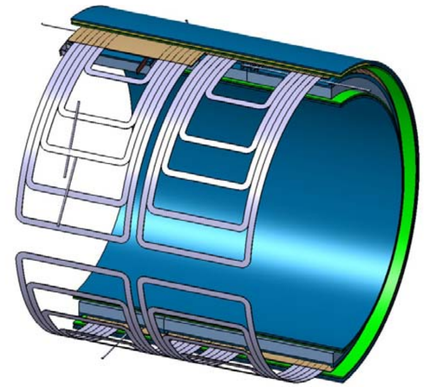
Coil and Yoke Cross-Section ILC TDR/DBD



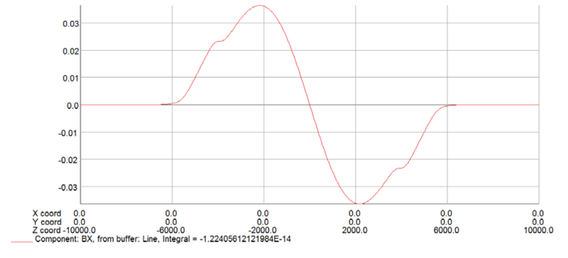
Conceptual Design - BDB Version 1

Requirement:

> Max field Bx 0.035 T at z = 3m

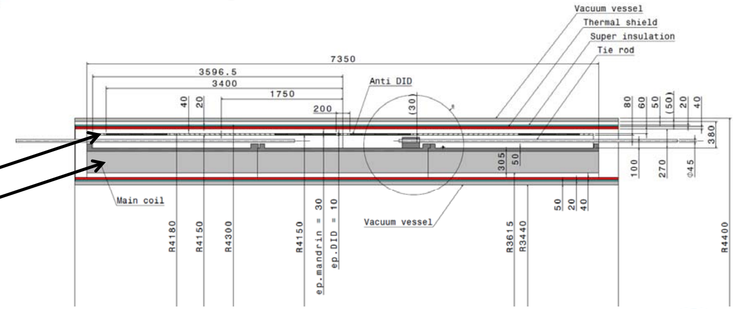


Dipolar Field



Saclay group
Magnet note
LC-DET-2012-081

Integration in Cold Mass

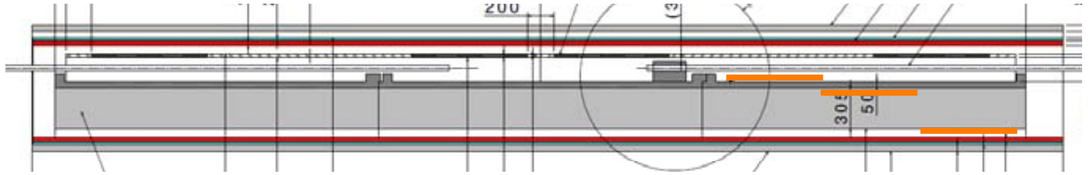


Anti DID
Main Coil

Anti-DID Production

- How to integrate Anti-DID and Solenoid?
  - three solenoid modules
  - two Anti-DID modules

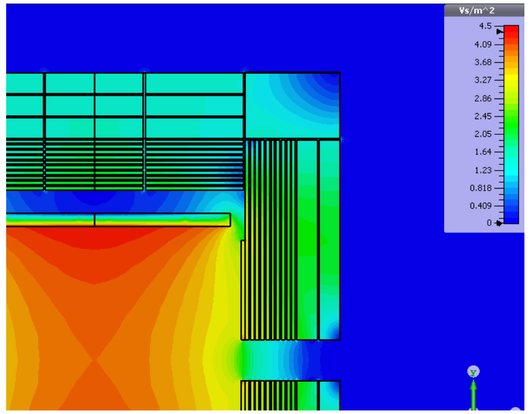
Different Anti-DID Production Geometry



1.
2.
3.

Location of direct wind anti-DID conductor

1. Outside solenoid support cylinder
   - In conflict with cooling tubes, current leads and tie-rods
   - Low magnetic field, low forces
   - Would require new, additional winding machine
2. Between support cylinder and solenoid
   - Reduced cooling contact between solenoid conductor and support
   - Transfer of forces during quench
   - Still low magnetic field and forces
   - Could use modified main winding machine
3. Between support cylinder and solenoid
   - Still low magnetic field and forces
   - Could use modified main winding machine



Meeting at CERN with CMS magnet experts
(B.Parker. H.Gerwig, B.Cure Dec. 2016)

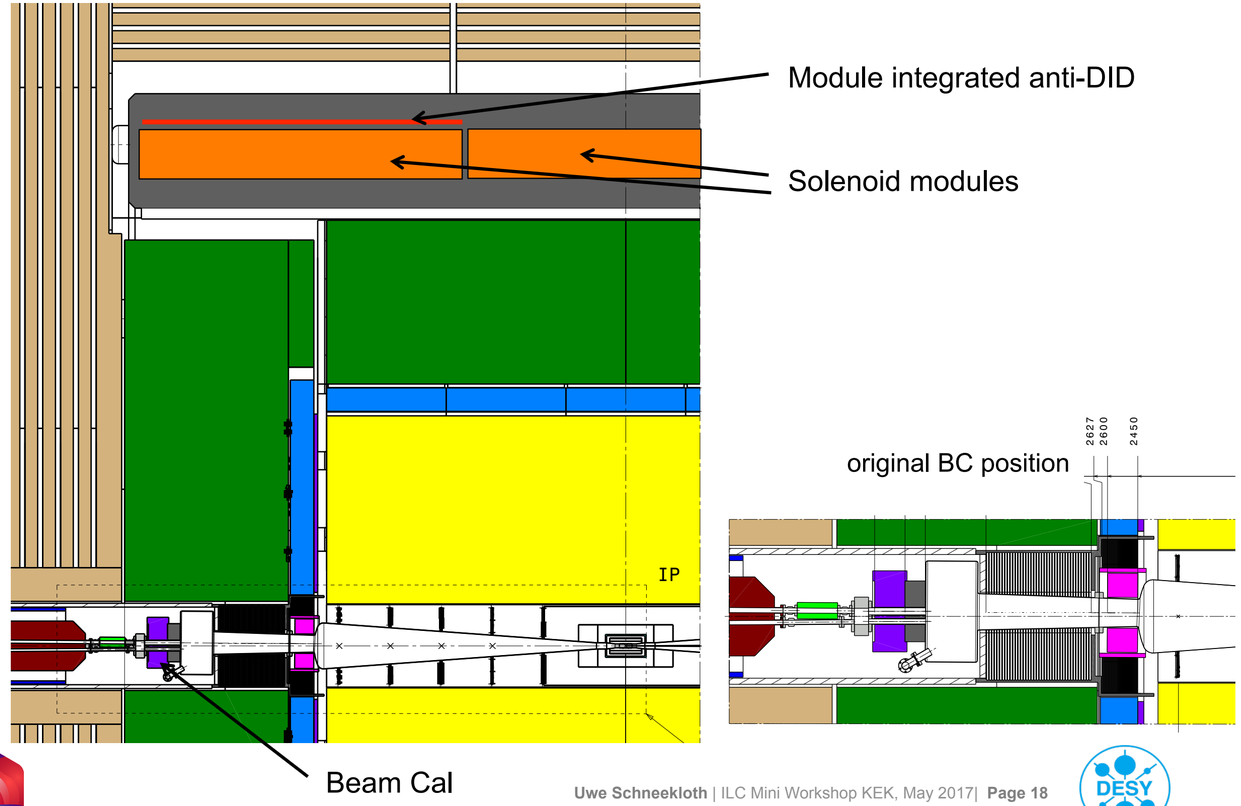
Propose

> Anti-DID between solenoid and support (2.)
> Conductor in grooves cut into support cylinder
> Use dipole winding

New BNL Design

- Only two Anti-DID modules

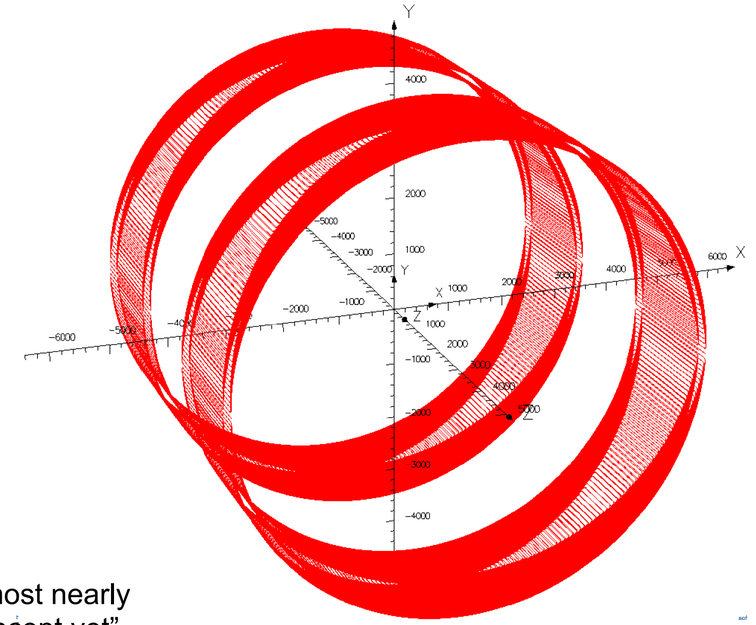
Solenoid – Beam Cal



New Concept – B.Parker

Slide B. Pa

ILD anti-DID Coil Using the Two Outer Solenoid Sections

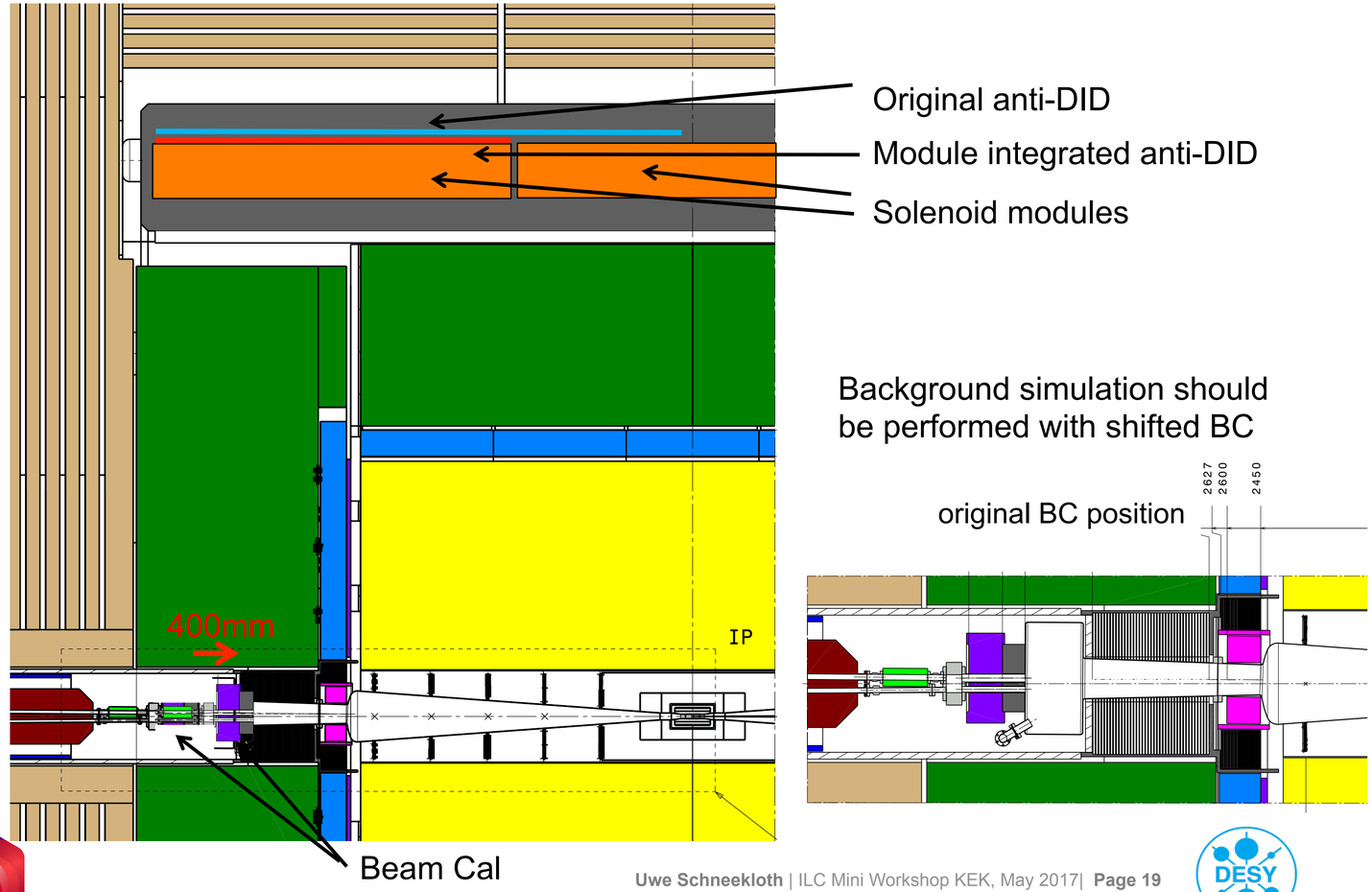


Brett: " the most nearly buildable concept yet"

New Forward Region Geometry

- BeamCal has been moved by 40cm!
- Anti-DID field shape needs to be checked
- Background simulations required!

Solenoid – Shifted Beam Cal (l* 4m)

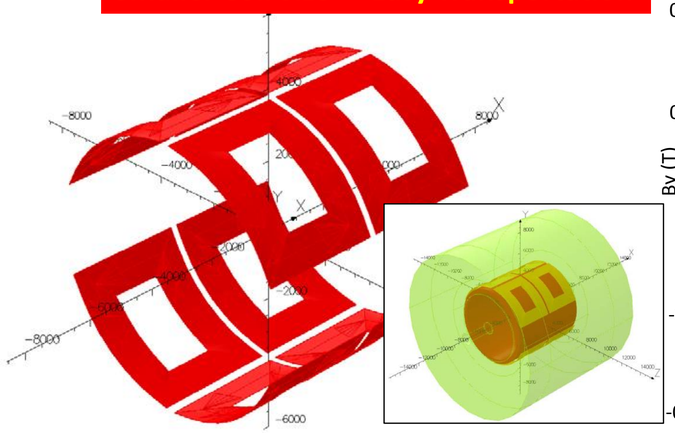


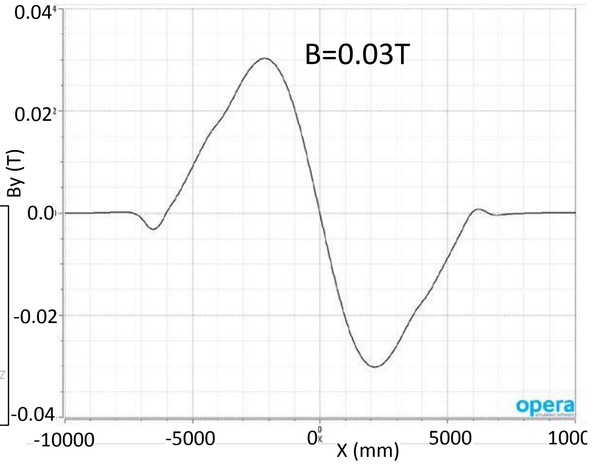
Hitachi-Design for Anti-DID

Circumferential divided Anti-DID

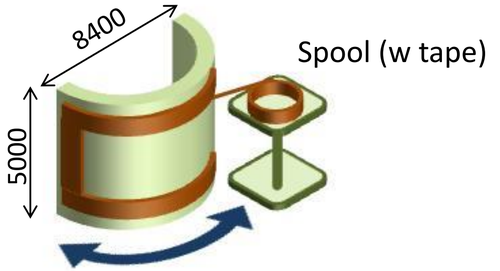
Curved S. I. R. (mm)	3760	Thickness Turn No.	2
Curved O.R. (mm)	3768	Width Turn No.	150
Straight L. (mm)	1200	Current (A)	1067
Winding W. (mm)	1000	Current Density (A/mm^2)	40
Winding T. (mm)	8	Iron Yoke I.R. (mm)	4595
Conductor (mm^2)	6.67 × 4	Iron Yoke O.R. (mm)	7755
Elevation Angle of Straight S. (deg)	30	Iron Yoke L. (mm)	13240

Smaller Coil Size -> Easy Transportation

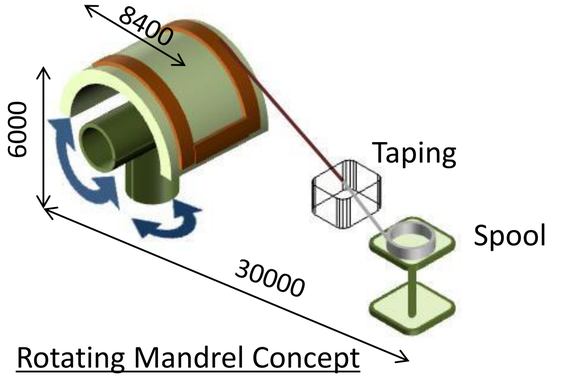




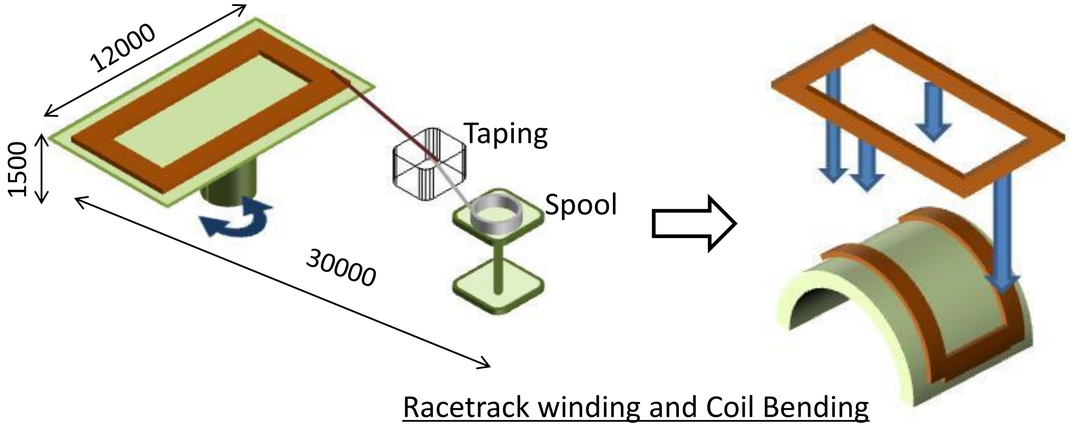
Fabrication Methods of Anti-DID



Moving Spool Concept



Rotating Mandrel Concept



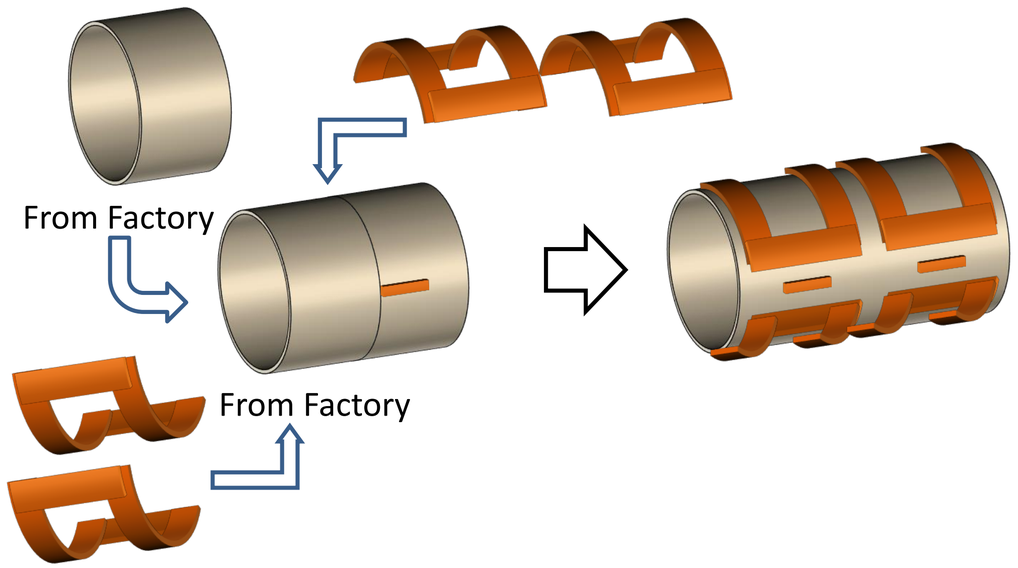
Racetrack winding and Coil Bending

Hitachi-Design for Anti-DID

- Industrial study - need to compare with BNL design

Setting Anti-DID on Solenoid

Anti-DID Coils are Directly fastened on Solenoid Shell



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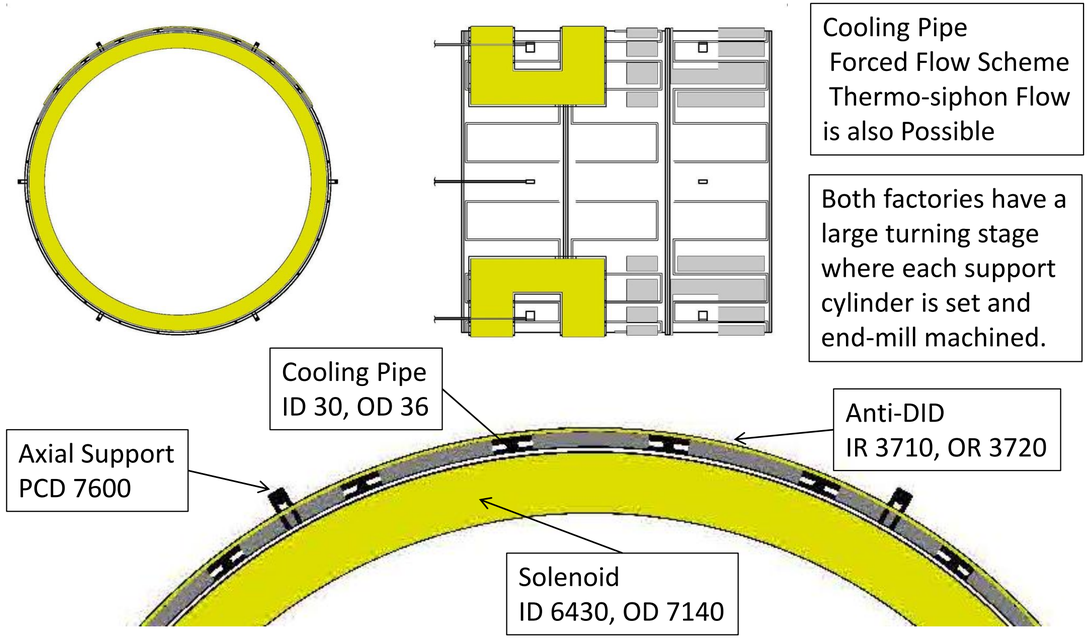

Local Infrastructure Issues

IP Campus and Main Campus

- Nice progress has been shown by Tokiko Onuki for new IP geography
  - all details still secret, so I can show no drawings…. ;-(
  - Non disclosure agreements between KEK and DESY in preparation
- New IP location should be finalised before summer
- Then selection of location for main campus (the international ILC lab campus) should be started
  - Evaluation planned with a broader panel
  - Plan to be ready before a possible „green light“ comes

- Staging discussions might have an impact
  - need to fight for surface and underground space now!

Summary

- A very successful series of mini-workshops on infrastructure and CFS for detectors has been established
- Concentrated this time on:
  - Staging of detectors
  - Anti-DID engineering
  - IP and main campus infrastructure
  - Detector engineering
- A lot is ongoing in Japan before and behind the scenes!

- Plan the next mini-workshop to discuss implications of IP decision
  - proposed to attach it timely to CALICE collaboration meeting (September 25-27 in Tokyo)
    - date tentatively fixed to September 28 (full day)
    - at KEK

Waiting for Green Light in Japan…
TOKYU
歩行者優先
三菱東京UFJ銀行
JOYSOUND