# List of Issues/Tasks for ILD MDI/Integration

## 1. IR Issues/Tasks

### 1.1 IR design optimization with engineering studies

- beam pipes, pumps, wakefields
- innermost radius of VTX and B-field
- outer radius of support tube and inner radius of TPC
- calorimeters, pair monitor and beam instrument

### 1.2 Background estimation

- pairs v.s. B-field, (anti-)DID
- muons v.s. muon spoilers, collimation depth
- synchrotron radiations v.s. collimation depth, masks
- neutrons from pairs, extraction line and dump v.s. mask

### 1.3 Relevant parameters for IR optimization

The relevant parameters are listed in a following table, where differences will be studied and tried to be understood.

| | GLD and GLDc | | LDC |
|---|---|---|---|
| machine parameter set | 1TeV, HiLum-1 | | nominal? |
| L* (m) | 4.5 | same in GLDc | 4.3 |
| B (Tesla) | 3 | 3.5 in GLDc | 4 |
| $R_{Be}$ (cm) | 1.5 | z < 5cm | 1.4 |
| $R_{VTX}$ (cm) | 2.0 | FPCCD | 1.6 |
| VTX angular acceptance | ¦cos¦<0.95 | 3 super-layers | ¦cos¦<0.952 |
| $R_{FCAL}$ (cm) | 8 | z = 2.3m | 7.6 |
| $R_{BCAL}$ (cm) | 1 and 1.8 | z = 4.3m | 1.3 |
| support tube | cantilever 70cm dia. | 10cm$^{t}$ W-tube | cantilever 58cm dia. |

Some parameters do not have the same meaning in GLD and LDC. For example $R_{in}$ for TPC is the limit between TPC and SIT for LDC, in the case of GLD it is the inner radius of the sensitive part of the TPC, with the same definition LDC would be 36cm. We should first agree on definitions.

Common parameters have been suggested by the detector optimization working group as listed below.

| Detector concept | | | GLD | LDC | GLD' | LDC' |
|---|---|---|---|---|---|---|
| TPC | | $R_{in}$ (m) | 0.45 | 0.3 | 0.45 | 0.3 |
| | | $R_{out}$ (m) | 2.0 | 1.58 | 1.8 | 1.8 |
| | | $Z_{max}$ (m)* | 2.5 | 2.25 | 2.35 | 2.35 |
| Barrel | ECAL | $R_{in}$ (m)** | 2.1 | 1.6 | 1.85 | 1.82 |
| | | Material | Sci/W | Si-W | Sci/W | Si-W |
| | HCAL | Material | Sci/W | Sci/Fe,Gas/Fe | Sci/W | Sci/Fe,Gas/Fe |
| Endcap | ECAL | $Z_{min}$ (m)*** | 2.8 | 2.39 | 2.55 | 2.55 |
| B-field (T) | | | 3 | 4 | 3.5 | 3.5 |
| VTX | | inner layer (mm) | 20 | 16 | 18 | 18 |

* GLD $Z_{max}$ = 2.3 + 0.2m for TPC readout which has been included in LDC.

** LDC has less radial space between TPC and ECAL.

*** Fixed ECAL $Z_{min}$ is proposed for well-defined TPC endplate region.

## 1.4 Beam pipe design

1. Vertex chamber
   B-field, pair background, collimation depth ( synchrotron radiation profile at IP) and neutrons with BCAL as mask
2. In front of FCAL
   Precise luminosity measurement with ;
   - Beryllium or Aluminum straight pipe
     smearing effect to be studied
   - Right angular SUS pipe
     wake-field and minimum thickness for mechanical strength
3. Pump
   Background should be studied including electro-hadronic production in addition to bremmstrahlung process between beam and residual gas.
   - P > 10nTorr for no baking, no pump
   - P > 1nTorr for no baking with NEG pumps

## 1.5 Outer radius of support tube

1. QD0 and SD0
   - compact superconducting magnets ( B.Parker's design, 39cm dia.)
   - compact permanent magnets ( Y.Iwashita's design )
   - anti-solenoid
     installed in the same cryostat by B.Parker's design
   - support structure with fine adjustment
     dynamic range of ±1mm and nanometer accuracy?
2. Thickness of tungsten tube
   - LDC does not have a W tube anymore, the W is on the HCAL.

    - GLD : minimum value for backgrounds in endcap CAL and Muon chambers
    - CFRP tube which has less Young's modulus than tungsten
    - Mechanical strength for supporting QD0,FCAL,BCAL and LHCAL
3. Tracking in intermediate trackers between TPC and VTX
    - 4 layers for self-tracking capability in GLD
    - 2 layers for linkage in LDC

# 2. Detector Integration Issues/Tasks

## 2.1 Detector and its assembly on surface

- CMS-style assembly
    - coil support in the central ring, where the barrel part is divided into three rings
    - mechanical strength
    - B-field uniformity and leakage field

## 2.2 Iron structure

- deformation due to B-field
  thickness of iron yoke : 2.7, 2.8 and 2.15m for GLD, GLDc and LDC
- global shape : dodeca-, dodeca- and octa-gon for GLD, GLDc and LDC
- field uniformity and leakage magnetic field
  tolerances ?
- split of end-Yoke ?

## 2.3 Solenoid and cryostat design

- feasibility of (anti-)DID in terms of engineering, cryogenics and B-field uniformity etc.
- how to wind coils and where ?

## 2.4 How to support inner detectors and QD0

- mechanical feasibility of cantilever system
- diameter of endcap hole

## 2.5 Opening, closing procedures

- requirement of experimental hall size and crane capacity
  GLDc : 31m x 120m x 33m (height) and crane of 100 tonnes
  Crane size largely affects the size of experimental hall.
- max 6m for detector endcap door opening in GLDc

## 2.6 Underground hall requirements

- where to put electronic trailers, need for service caverns
- temperature, humidity stability, the gradient

- utility ( power, cooling water, gases, cables etc.)
- safety for fire, earth quake

# 3. Push-Pull Issues/Tasks

## 3.1 Re-commissioning machine operation

Re-commissioning process has been identified by T. Okugi (KEK) as listed below;

1. initial alignment less than 1mm ( long, 3 mm )
2. Beam Based Alignment (BBA) of QD0 relative to upstream beam line
3. IP position scan for collision between 2 beams
   the major task and the most time consuming item !
4. Luminosity scan by changing SD0 transverse position
5. beam size tuning by sextupole (SD0, SF1) -knob

He suggested movers each for QD0,SD0 as well as QF1,SF1 .

## 3.2 Alignment of VTX and QD0

1mm displacement could happen. Is it tolerable ?
Or, fine adjustment system is needed in VTX ?

## 3.3 Slow settlement ( 100μm/month is tolerable ?)

Is it tolerable ?

## 3.4 Radiation, shielding around beam line

We could ask experts, e.g. T. Sanami (KEK), for estimation of self-shielding property of ILD .

## 3.5 Cryogenics system for solenoid, QD0

What, how and where ?

## 3.6 Commissioning during assembling/survicing detectors

stability, safety in the interference

## 3.7 Large platform scheme

H. Yamamoto suggested it in terms of stability and reproducibility.