# IDAG Comments by Sandro Palestini

Comments on SiD draft of DBD document
S. Palestini, 20/10/2012

General remarks: document is rather complete and well written in many chapters. However some topics would deserve more detail - maybe more study (e.g., material budget due to services in the vertex and tracking systems), and other topics are substantially missing (e.g., alignment issues).
The detector choices that remain open (e.g.: the pixels sensors, the active elements in the hadronic calorimeter) are generally discussed at a level of detail that appears suitable for this document. Of course we should understand the reasons and the implications of keeping such choices still open.
One option that is not presented is the possibility of choosing non PFA-oriented calorimetry for specific regions of SiD, which instead was under discussion time ago.
The document is still missing the physics performance studies performed with the benchmark processes
A list of comments, which sometimes address the content and in others the presentation, is shown below.

Overview chapter:

1. Page 15: the pixel size in the vertex/barrel are quote here as 20 x 20 microns, in the following page 16 a goal of 10x10 microns is mentioned: the context is different, but some doubts may be left with the reader.
2. Page 17: momentum resolution is quoted only for the tracking resolution (and alignment) term; it is made clear later that over a wide momentum range the resolution is limited by the multiple-scattering term, despite the impressive "lightness" of the vertex and tracking detector. It might be better to mention the multiple scattering term already in this page.
3. Page 18: some performance figures (e.g. jet energy resolution, 2-jets invariant mass) might be mentioned in this section, in analogy with what done above for tracking. (It is also true that similar figures are not present in the section on the vertex detector.)

Chapter on vertex detector:

1. Page 22: Figure 2.1.1: a larger figure, maybe with a few dimension explicitly quoted, would be preferable. This comment could be made for several figures.
2. Page 30: Table 2.4.1 refers only to the barrel, is the situation is similar in the disks?
3. Page 32: I was expecting to find more details on the cables, on the routing of services, and in general on the passive material that contributes to the material budget in the vertex and tracking detectors. This is important because the goal is very ambitious – and nevertheless the multiple scattering is relevant over a wide range of particle momentum. (The authors acknowledge this point in page 34.)
4. Issues of alignment are not discussed in this chapter.

Chapter on main tracking

1. Page 43: Figure 3.2.3: the angle theta must be the complement to the polar angle.
2. Page 45: the main excitation frequency of power pulsing is 5 Hz, but I wonder if the interval of ~1 ms between pulsing-up and pulsing-down generates a significant component at ~ 1Khz. Still this might not be a problem if the mechanics resonates at frequencies f_m such that 5 Hz << f_m << 1 kHz.
3. Page 51: the comment on the need of accurate modeling of services can be repeated for the chapter on main tracking.
4. Alignment issues are not discussed. It would be interesting to describe, maybe without an excessive detail, the main aspects of it: accuracy in assembly and positioning, monitoring devices, used of tracks. Is an alignment error included in the term "a" of equation (3.4.1)?

Calorimetry

1. Page 55: among the goals of calorimetry, I was expecting to find some performance figure for PFA explicitly stated (e.g.: WW vs. ZZ identification in 4 jets events, or maybe repeating 3 % or better energy resolution as mentioned in the introduction on page 53.
2. Page 56: in the first section, after saying that 17%/sqrt(E) , consider adding on the expectations for response uniformity (the constant term). This is understood to be good because of detector design, and some comments on the sensor are made below, in page 64, section 4.2.5, although the expected gain uniformity of the sensors is not mentioned explicitly.
3. Page 56: mechanical aspects, like planarity tolerance on the plates and the mechanical assembly scheme are rather challenging. Is ILD making plans for similar requirements and assembly procedures?
4. Figure 4.2.1: some of the details present in the text are not visible in the picture.
5. Page 88: sections on "Calorimeter Performance" and "1 TeV issues" are empty. Is the performance of PFA going to be described here?
6. Alternative approaches to calorimetry, namely systems with multiple read-outs for high performance calorimetry (electromagnetic+hadronic) were discussed in the past, as options for specific areas of the SiD. This subject is not mentioned at all in the DBD document.

Muon system

1. Page 96: the reader might notice that that RPC are described as glass-based when they are an option for DHCAL, while Bakelite plates are suggested as an option for the Muon system. Not a real criticism, but looks somewhat odd.
   H.Band: It is not completely arbitrary, but different choices on what aspect of the design was most important.
   We could use either material for both detectors.

Glass is significantly heavier than bakelite for the same thickness (2mm) and more brittle.
Given the large area chambers needed for the muon system Bakelite would be easier to construct and install.
Probably cheaper too. The downside is the potential aging problems which
as far as I know have been mitigated at LHC.

The glass RPCs have better aging characteristics. When used in a thinner design (1.2 mm) the stiffness is an advantage. I don't think the Argonne group has fully solved how they would build a glass RPC calorimeter from roughly 1m by 1m squares (or smaller), but they seem convinced that it can be done. Here the choice was on the safest technology.

Magnet system (Altogether, a well detailed chapter)

1. Page 105: Figure 6.3.1: the caption might help the non-expert clarifying the units in the ANSYS plot, like it is done for Figure 6.2.1

Engineering, integration and MD interface

1. Page 122-123: the short paragraph on the push-pull operation seems one of the shortest in the chapter. The subject is relevant, and would deserve more space.
2. Page 123-124: speaking of the beampipe design, a drawing of the envelope of the trajectories of e+e- from beamstrahlung might be an interesting addition.
3. Page 128-129: speaking of ground motion, vibrations and transfer functions, and Intratrain Feedback system, it might be interesting to quote the frequency range, besides the rms motion amplitudes.

Forward system

1. Page 138: The equation for the number of Bhabha per bunch-crossing must have something missing, otherwise it suggests order of thousands events per bunch crossing.
   B. Schumm :True - the factor of 8 came from the integral alone, and did not include the pre-factor including the overall cross section scale, the lum, and the bunch-crossing rate. The new factor that replaces "8" is 6x10^{-6}.
2. Page 138: Theta_min is used in the formula, then as equal for 20 mrad (where it probably refers to the beamstrahlung envelope and not to LumiCal), then as equal to 3 mrad (that is the BeamCal, not LumiCal) after referring to systematic (geometric) errors. Please revise for consistency. Consider also starting the paragraphs below on BeamCal with a new section number.
   B. Schumm :Yes - this was confused. Theta_min is now only used for the fiducial-region boundary, and is always 46 mrad. I didn't agree with the statement about the new section number: it all belongs in section 8.1.1 on overall design criteria.
3. Page 145 and following: The discussion of "stau" pair production as example of the relevance of BeamCal for vetoing two-photon background is interesting. However, as it is presented in chapter 8 it seems somewhat out of the style of the document, since other cases of this type are not discussed in the previous chapters, and the reader is expecting to see them collected together as physics studies. You might consider moving this case to that chapter – when it exists - and just refer to it in chapter 8.
   B.Schumm, M. Stanitzki: Done as suggested

Simulation and reconstruction

1. Page 159: Definition of "voxel": geometrically, is it intended as the smallest unit (i.e.: pixel, or strip, or pad)?
2. Page 161, near the bottom: it does not appear clear the way in which "the primary vertex constraint is [normally] used in the reconstruction of secondary vertices".
   The primary vertex is used in the reconstruction of secondary vertices. Normally, the primary vertex is fit with a constraint. The text has been clarified.
3. Page 164: consider adding a few words to explain the definition of rms90 for the general reader.
   Done

Benchmarking

1. Many sections are missing: starting with jet finding algorithm, and going over the benchmark processes: top Yukawa coupling, Higgs branching fractions, Beam polarization and triple gauge coupling, top cross-section and asymmetry.