General comments: more editing efforts are required to make this chapter more coherent. The current version is merely collection of sections written by individuals with their own writing style. Section 4.3 on Mechanics, cooling and services is well written but the other sections require more editing work. There are also inconsistent parameters and assumptions in this chapter. For example, the radius of the first layer is stated as 11.06 mm (4.1.2), 11.1 mm (Table 4.2) and 11 mm (4.3.1.1).

L2437- 2450 Requirements on the vertex detector are unnecessarily repeated in this short introduction.

Section 4.1.1 It might be better not to mix the requirements on the vertex detector and the pixel sensor. For example, the 40 mW/cm^2 is more a requirement on the sensor but not on the vertex detector (or state as the sensitive area of the vertex detector). I would also suggest to change the order of introducing the requirements. It would be better to state first the spatial resolution and material budget (determined by tracking/vertex that are driven by physics requirements), followed by timing and power consumption.

L2467 Why comparing the collision frequency with ALICE? It does not help to justify your detector performance requirements with this single parameter. You may state directly the stringent requirements that are anyway explained later.

L2469 I would suggest to use “sensor” rather than “chip” throughout the chapter.

L2469-2470 “To balance power efficiency and timing performance”? The power consumption limit is set by the air-cooling capability and the low material budget requirement. I would suggest to remove the starting phrase.

L2474 Better to change “between 3 to 5 um” to “better than 5 um” or “close to 3 um”. And make this statement consistent throughout the chapter.

L2491 “high occupancy” might not impose challenge on readout electronics. Better to change “high occupancy” to “huge number of readout channels and high volume of data output”?

Table 4.1, remove the words of “Baseline”, “Overall” in the caption.

4.1.2 “Detector layout”, the introduction part is not written in a logical way. It might be better to start with the general description of the “baseline” layout with four curved layers followed by two double-sided layers, and specify the detector coverage. The discussion on the feasibility of the stitching technology shall be minimized or moved to the technology discussion section.

L2520 What is the purpose of this sentence “The intrinsic single-point … of 5 um.”? It is not directly related with the detector layout.

L2522 “Stitching plan” 🡪 “Stitching design”? It might be better to delete the sentence “On a 300 mm wafer, … the baseline scheme.” There have been enough words to stress the necessity of adopting the stitching technology.

L2528 “Three layouts” (easily confused with the detector layout), “A/B/C regions” might be rephrased as “three types of stitched sensors”, “Type A/B/C” …

Figure 4.1 in the caption, there is no need to state the process feature size. Using “Bent stitched sensors” and “planar CMOS sensors” should be sufficient. Different names of the two sensor designs are used and they must be made consistent.

Table 4.2 It is difficult to understand the column of “height” if the reader is not familiar with the detector layout concept. Would it be possible to change it to “tilt angle”?

Figure 4.3 It might be better to remove “The A and B regions … dash-dot lines, respectively.” As suggested above, it shall be better to use Type A/B/C stitched sensors rather than A/B/C regions.

Figure 4.4 This figure does not contain much information other than telling there would be a mechanical gap when assembling detector layers with multiple stitched sensors along the z-direction. Better to be removed.

L2546 remove “(Cabon Fibre-Reinforced Polymer)”

L2548 remove “in base-line layout” from the section title. Double-sided are used in both baseline and backup design with slightly different geometric configuration for different layers.

L2551 change to “sensor is glued to the flex that conducts power and transmits the signal.” (?) to avoid confusion

L2560 remove “for baseline and backup layout” from the section title

Figure 4.5 It is better to make these two plots as stacked histograms illustrating the material contribution from the beam pipe to the outer most layer.

Figure 4.6 This plot is rather misleading. The thickest CFPR appears to be marginal in the composition. A pie chart of contributions from individual components to the total material budget shall be more interesting.

Table 4.3 the unit of radiation length (X\_0) is missing.

4.1.3 Background estimation

L2573 – 2582 This part needs to simplified. The basic message will be “several neighboring pixels will be fired when a charged particle transverses a pixel sensor” and “detector occupancy” is calculated within a specified time window.

Table 4.4 suggest to round up the numbers to two digits.

L2599 “bunch crossing” -> “bunch spacing”. The occupancy calculation could be tricky. The dead time of the front-end electronics could be much longer than the bunch spacing. This requires more discussion with the sensor designers. Numbers in Table 4.5 need to be re-visited.

Line 2601 The data rates are subject to the pixel sensor design and data packaging. It does not give much information when listing these numbers here.

Section 4.2 Sensors and electronics design

“proposed” and “planned” are frequently used in this section. Please consider removing those words and describe right away the designs.

L2609-2610 Be careful with the statement “state-of-the-art”. This is properly only true for the HEP community.

L2615-2630 In this subsection “sensor technology review”, only experiments/detectors are reviewed but not the pixel sensors! It would be better to mentioned the achieved performance and important features, as well as their impacts on the technology development of those MAPS sensors.

Similar comments on Table 4.6, to compare the sensors but not the detector systems!

L2666 This subsection is to introduce the function blocks and arrangement. There is no need to put down the data readout rate.

Table 4.7 the dimensions are less important information for readers and are anyway subject to future optimization. It would be better to delete this table.

L2707 The analysis of the power consumption can be move to the dedicated section 4.2.2.4. Stating on the importance of IBIAS setting should be sufficient.

L2729 The detection efficiency should be mostly decided by the charge collection efficiency of the electrode, together with the resolving capability of the front-end electronics in case of pileup signals. The peripheral readout circuits shall be designed to read out the signals close to 100%.

L2732 remove “in our estimation”

L2747 this legacy clock of “40 MHz” is not consistent with the targeted 43.33 MHz in other places.

L2762 Do those quoted hit rates match the numbers derived from the background estimation described earlier? Pie charts of the power consumptions of different function blocks could help readers understand better the design considerations.

L2765-2780 these lines contain scattering information. It is better to rewrite this part and focus on the most important auxiliary functions.

Figure 4.13 You may change “×8”to “×10” to match the number in the text that reflects the largest number in the ladder design.

Table 4.8 and 4.9, the unit should be “mW/cm^2”

4.2.3. Backend electrons 🡪 on-detector electronics?

There is not sufficient information regarding the on-detector electronics other than describing flex PCB. Please consider strengthen this part.

The mechanics part is general well written and pleasant to read. A few minor comments:

L2838 when describing the detector layers, it might be better to follow the tradition, and change the direction from the inner most to the outer most.

4.3.2. Cooling

Is thermal isolation/encapsulation considered for the design? Beam pipe and the silicon tracker can operate at different temperatures from the vertex detector. There might be impacts on the cooling effectiveness.

Table 4.1.1 Where does the number “190 W” come from? There is no easy way to derive this number based on the assumed 40 mW/cm^2 in the sensitive area. It is noted that large power density of 485 mW/cm^2 is required for LEB (in Table 4.10) and multiple modules are to be used in several layers. Are those heat spots implemented in the analysis?

What are the expected alignment precisions for assembly, track-based alignment and real-time monitoring, respectively? Numbers are needed.

4.4.2 Track-based alignment

Are cosmic rays considered for the tracker alignment? At electron-positron machines, the events are so clean that there might not be sufficient number of tracks to achieve good alignment precision within a reasonable period of collision time. It would be even more challenging if too many distorting modes have to be considered.

4.5.2 MAPS

L3066-3068 better to remove these lines

L3102 Not sure about the statement of “introduces a bias …”. And the statement of “higher threshold … smaller cluster size … and ultimately worsens the intrinsic resolution” is not fully supported by the results presented in Figure 2.33 (b).

L3114 DUT B with “a larger charge collection area” but its efficiency “drops significantly at high thresholds compared to DUT A”? A large charge collection area means high charge collection efficiency which should lead to a high detection efficiency.

L3160-3166 There is no need to repeat the vertex design. Please consider deleting these sentences.

L3177 This bending test only concerns the mechanical properties of the sensor. But other electrical properties and signal integrity are more important. It would be better to weaken the statement of “without damage”. This suggestion also applies to the caption of Figure 4.25.

L3187 rephrase the sentence “Ideally, for all trajectories, …. outcome” or delete it.

Figure 4.26 “its errors”, what exactly the errors?

4.6.2 Resolution

What are the charge particles used in the simulation, muons, pions or electrons?

L3217 Not sure about the statement “of tracks even at high momentum”. The resolution at high momentum is mostly driven by the spatial resolution and structure design, but less by the material budget which sets the difference between to layouts.

Figure 4.27 (right) It is difficult to understand the similar performance achieved with the tow layouts at 20 degree at low momentum, which should be mostly affected by material effects.