TDR Editing

Tuesday CEPC TDR Meeting
July 22, 2025

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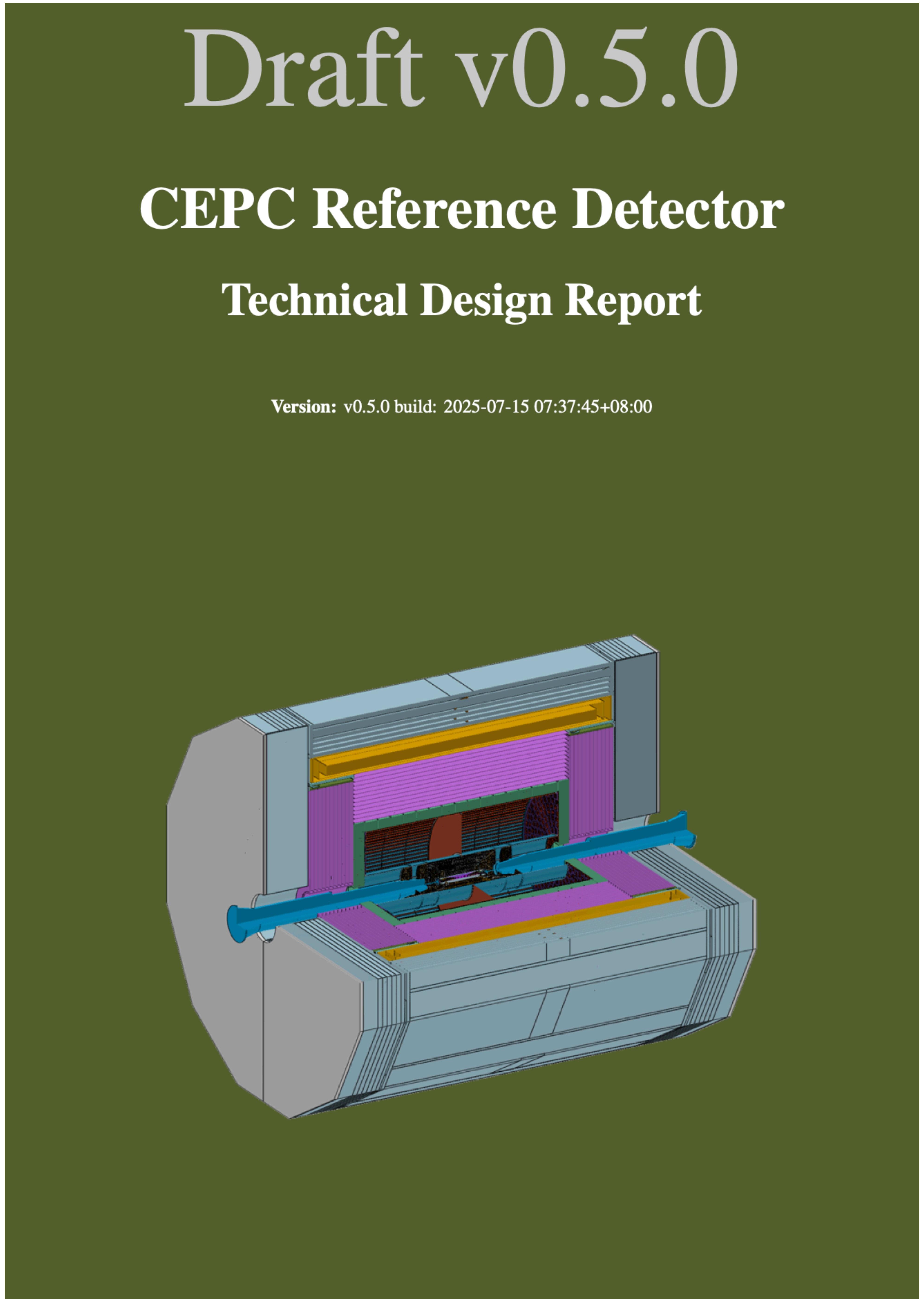
Outline

- News from IDRC
- Figures that still need update
  - Based on version 0.5.0 from Sunday morning 7:39 am
- Editing Instructions



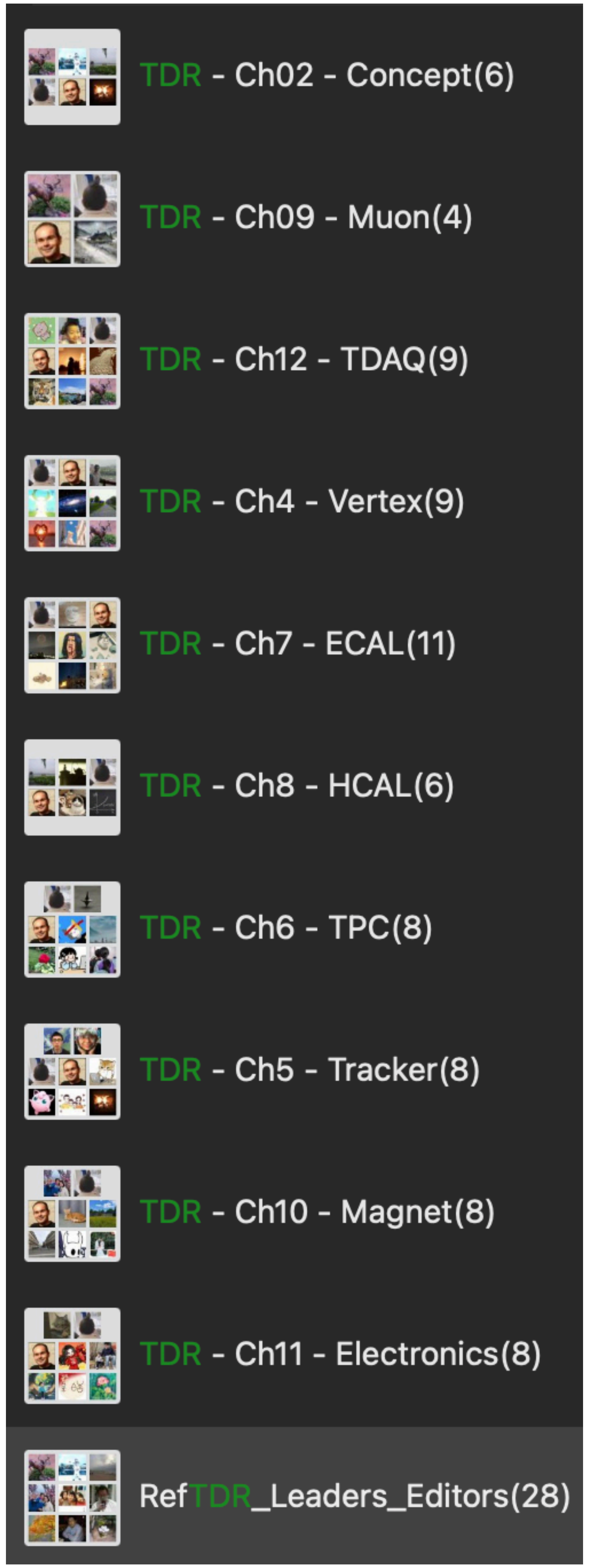
Keeping track of modifications

- **Spreadsheet monitoring the status in IHEP docs:**
  - https://docs.ihep.ac.cn/link/ARF4C648FCA57D4CF281A8E821A110229E
  - 文件名：Status of TDR.xlsx
  - 文件路径：AnyShare://ZHANG Zhaoru(zhangzr)/CEPC Det TDR/Status of TDR.xlsx

- Please fill in your input now, and **keep it updated** as we move along

- We will try to do the same!

- Provide feedback for improvements



Keeping track of modifications

Blue section of the spreadsheet is for chapter leaders

Chapter	Overall Complete	Chapter structure	Updated date	Tables (Chapter leaders)		Figures			Text		Other remaining issues
			Ready for check	Unified format	Significant digits	Change to pdf	Unified Macro	Enlarge the font size	Symbols	Glossary	
Executive summary	100%	100%		100%	100%		100%	100%	100%		
1 Introduction	100%	100%		100%	100%		100%	100%	100%		
2 Concept of CEPC Reference Detector	90%	100%		90%	90%	90%		90%			
3 MDI and Luminosity Measurement	90%	100%		100%	100%	100%	80%	90%	100%	100%	
4 Vertex Detector	95%	90%		100%	100%	100%	100%	100%	100%	100%	will take another photo for the mockup c
5 Silicon Trackers	100%	100%		100%	100%	100%	100%	100%	100%	100%	
6 Pixelated Time Projection Chamber	95%	100%	25-Jun	100%	100%	100%		80%	95%	95%	
7 Electromagnetic calorimeter	95%	98%	21-Jul	95%	95%	98%	100%	95%	95%	98%	Changes to address IDRC latest feedbac
8 Hadronic calorimeter	90%	90%	4-Jul	100%	100%	100%	100%	100%	90%		rewrite some part of HCAL with the sugg
9 Muon Detector	95%	100%	2-Jul	100%	100%	100%	100%	95%	100%	100%	
10 Detector magnet system	100%	100%	19-Jul	100%	100%	100%	100%	100%	100%	100%	
11 Readout Electronics	100%	100%		100%	100%	100%		100%	100%	100%	-
12 Trigger and Data Acquisition	100%	100%	16-Jul	100%	100%	100%	100%	100%	100%	100%	
13 Offline software and computing	98%	100%	21-Jul	100%	100%	100%	100%	100%	95%	95%	
14 Mechanics and integration	95%	95%	30-Jul	100%	100%	100%	100%	100%	100%	100%	Adding the section of cabling and servic
15 Detector and physics performance	95%	100%	21-Jul	100%	95%	100%	100%	100%	100%		WW fusion analysis needs to be updated

Update status using “blue” color so that we can know it is up to date

News from IDRC

- New comments from IDRC sent to everyone last Wednesday:
  - Feedback for: Tracker, Calorimeter, Muon Detector, Mechanics, (TPC had been communicated earlier)
- Yesterday, got further input from IDRC:
  - Feedback for: Electronics, Trigger/DAQ, Magnet

New IDRC	**Started implementing**	**Date plan to finish**
Si-Tracker		
TPC	Y	today
ECAL	Y	1 week
HCAL	Y	3-days — 1 week
Muon	Y	2 days
Mechanics	Y	1 week, cabling
Electronics	Y	Done
Trigger/DAQ		3 days
Magnet		Done, today

Figures for update

Not an exhaustive list, but a rather comprehensive one

If other Figures have similar problems, please still correct them

Chapter 1

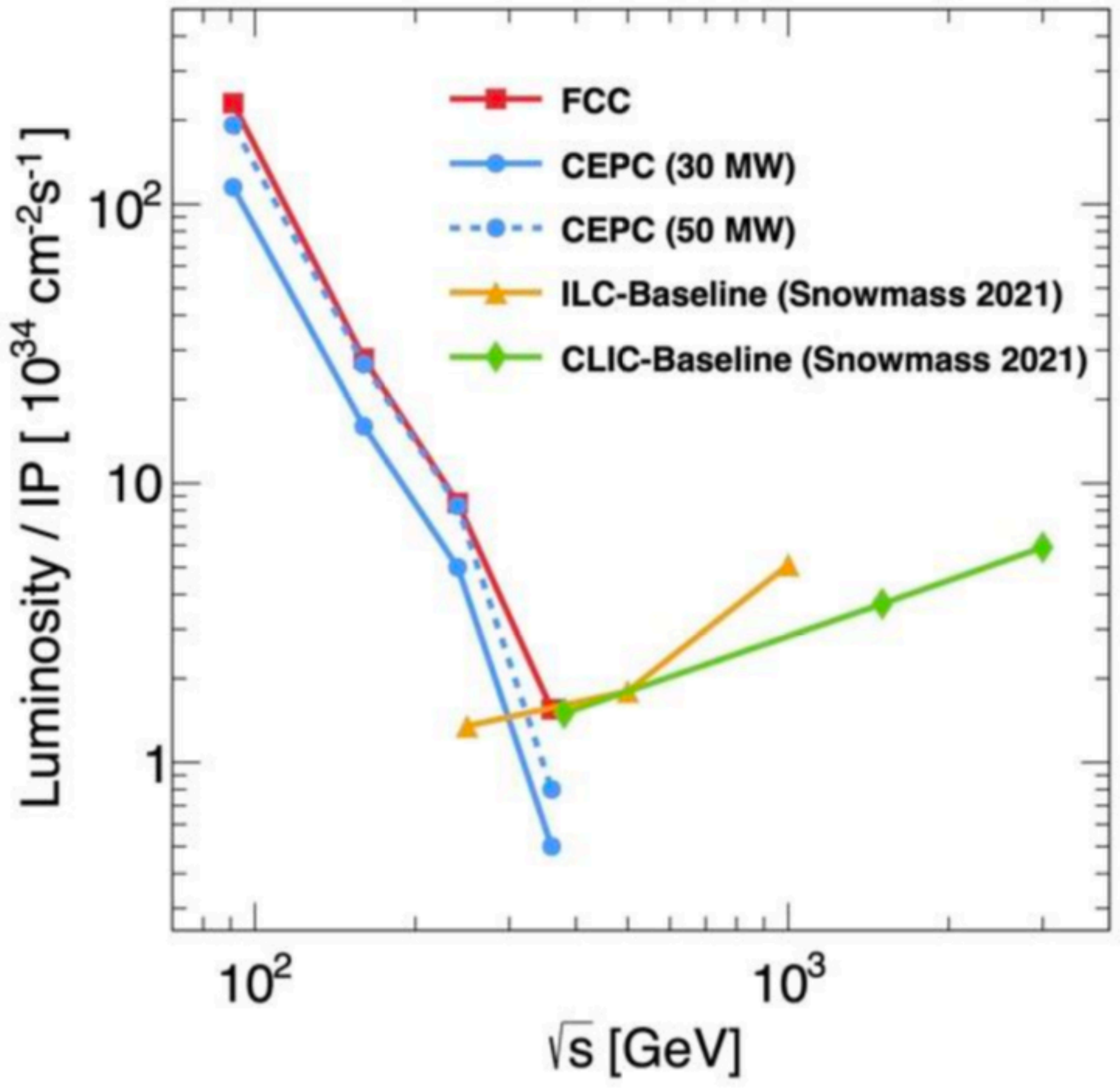


Figure 1.1: Comparison of luminosity per interaction point (L/IP) and collision energy ($\sqrt{s}$) for future collider proposals: FCC, CEPC (30 MW and 50 MW configurations), ILC, and CLIC (Snowmass 2021 baseline designs). Luminosity is normalized to $10^{34}\text{cm}^{-2}s^{-1}$.

- Still in PNG format → bad quality display → needs to be in pdf
- Caption: no need to define **L/IP** (not used in the plot), should only define **IP**
- Check if should be updated relative to Venice outcome → Manqi will send to Gang

Chapter 2

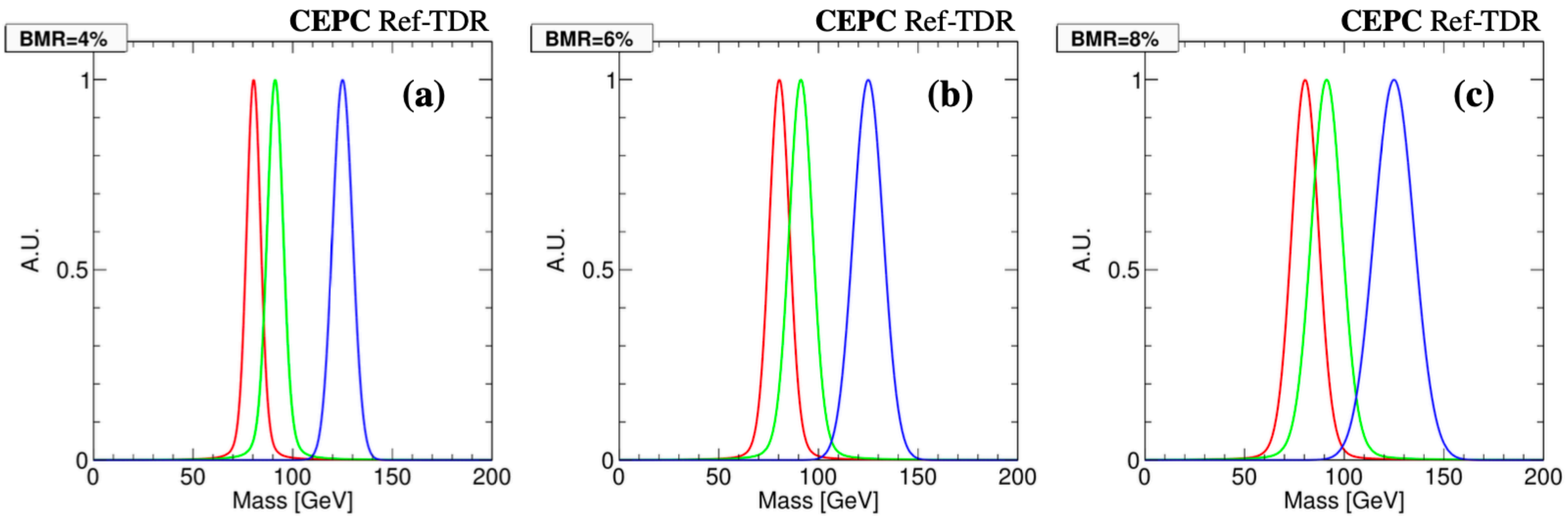


Figure 2.1: Separation of W, Z and Higgs bosons in their hadronic decays with different BMR: (a) 4%, (b) 6% and (c) 8%, respectively.

- Acceptable, but it is better to define (a), (b) and (c) in the Latex, instead of inside of the plot.
  - Usually this is what is done for publications and would allow for a more professional coherent format of the full document
  - Prefer to fix this, unless the plots are not easy to remake

Chapter 2

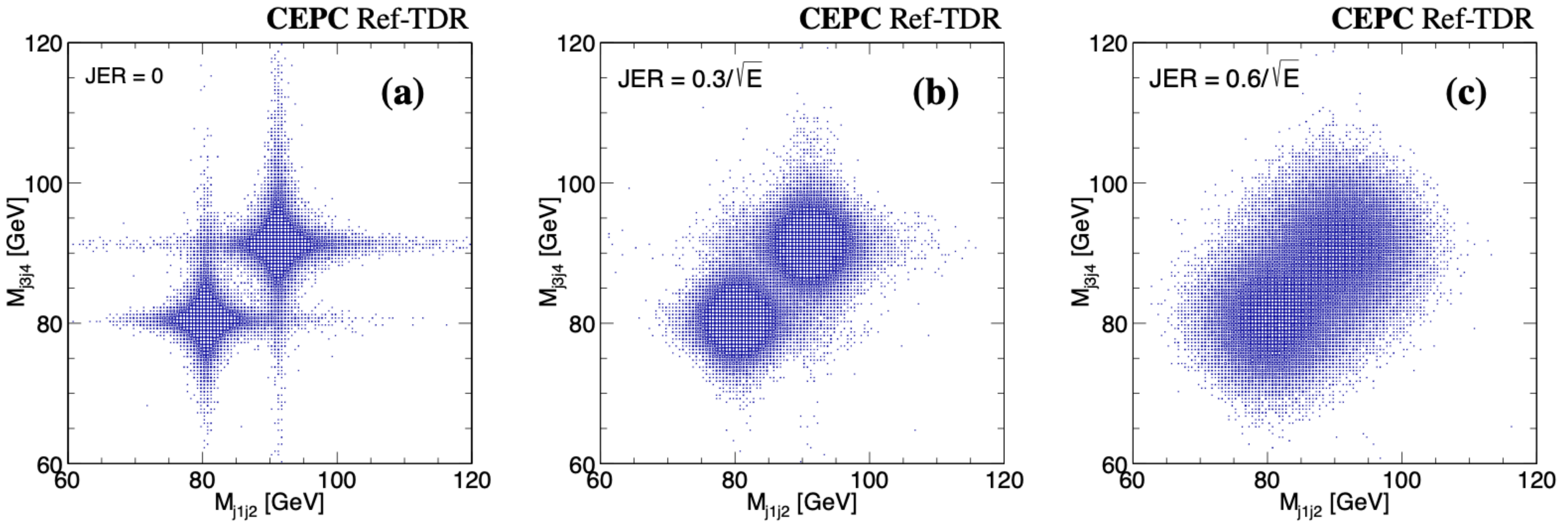


Figure 2.2: Separation of W and Z bosons in their hadronic decays with different jet energy resolutions: (a) $0\%/\sqrt{E}$, (b) $30\%/\sqrt{E}$, (c) $60\%/\sqrt{E}$. A jet energy resolution of $30\%/\sqrt{E}$ is required to well separate the hadronic decays of W and Z bosons.

- Acceptable, but it is better to define (a), (b) and (c) in the Latex, instead of inside of the plot.
  - Usually this is what is done for publications and would allow for a more professional coherent format of the full document
  - Prefer to fix this, unless the plots are not easy to remake

Chapter 2

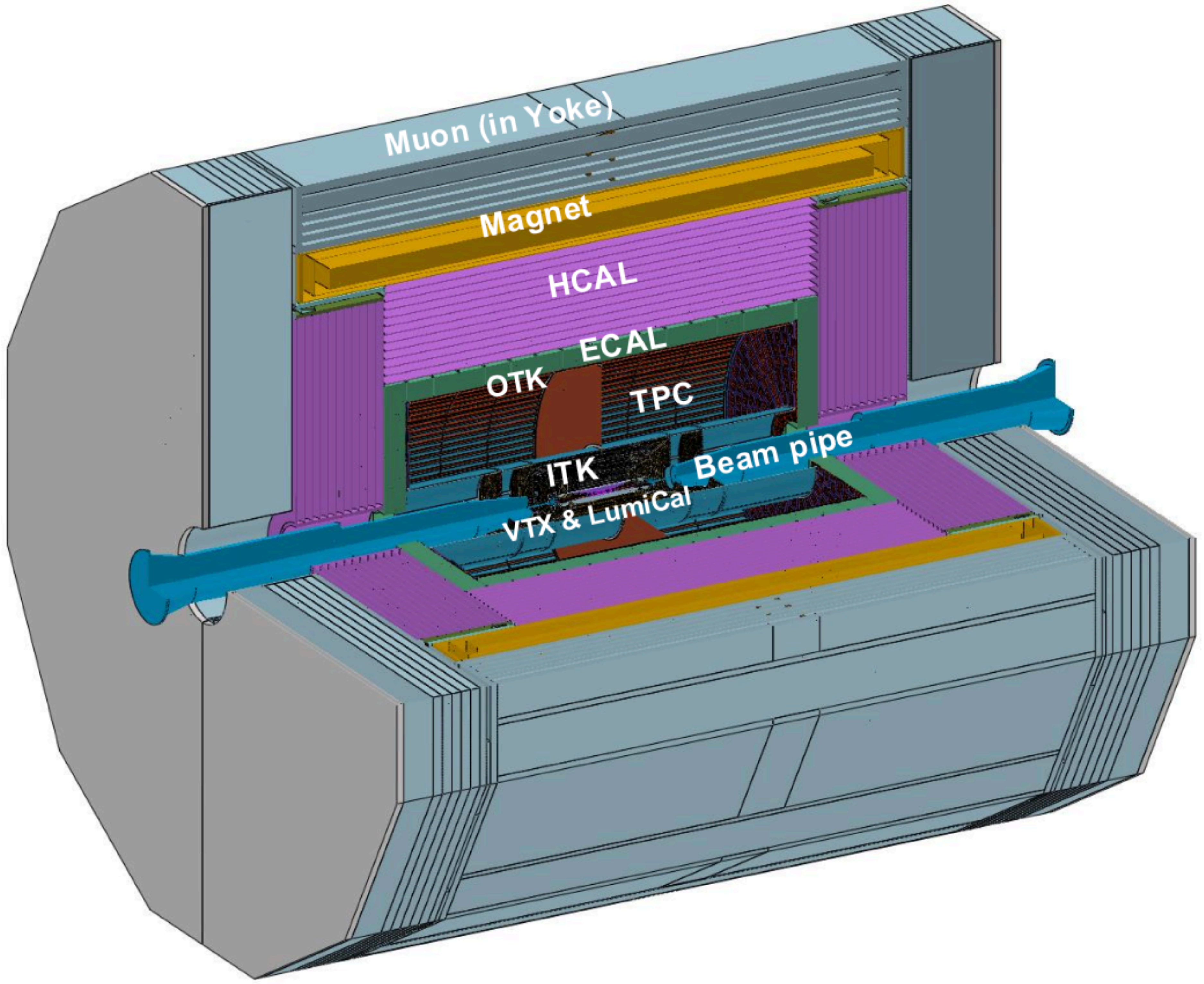


Figure 2.3: Schematic diagram of the reference detector design, illustrating its core subsystems. From the innermost to outermost, it includes a silicon vertex, a inner silicon tracker, a TPC tracker, an outer silicon tracker, Electromagnetic CALorimeter (ECAL), Hadronic Calorimeter (HCAL), superconducting solenoid, return yoke with a muon detector, and a dedicated calorimeter for luminosity monitoring which is mounted next to the beampine,

- Update to latest version from mechanics, which does not have the paraffin layer outside of the iron yoke

Chapter 3

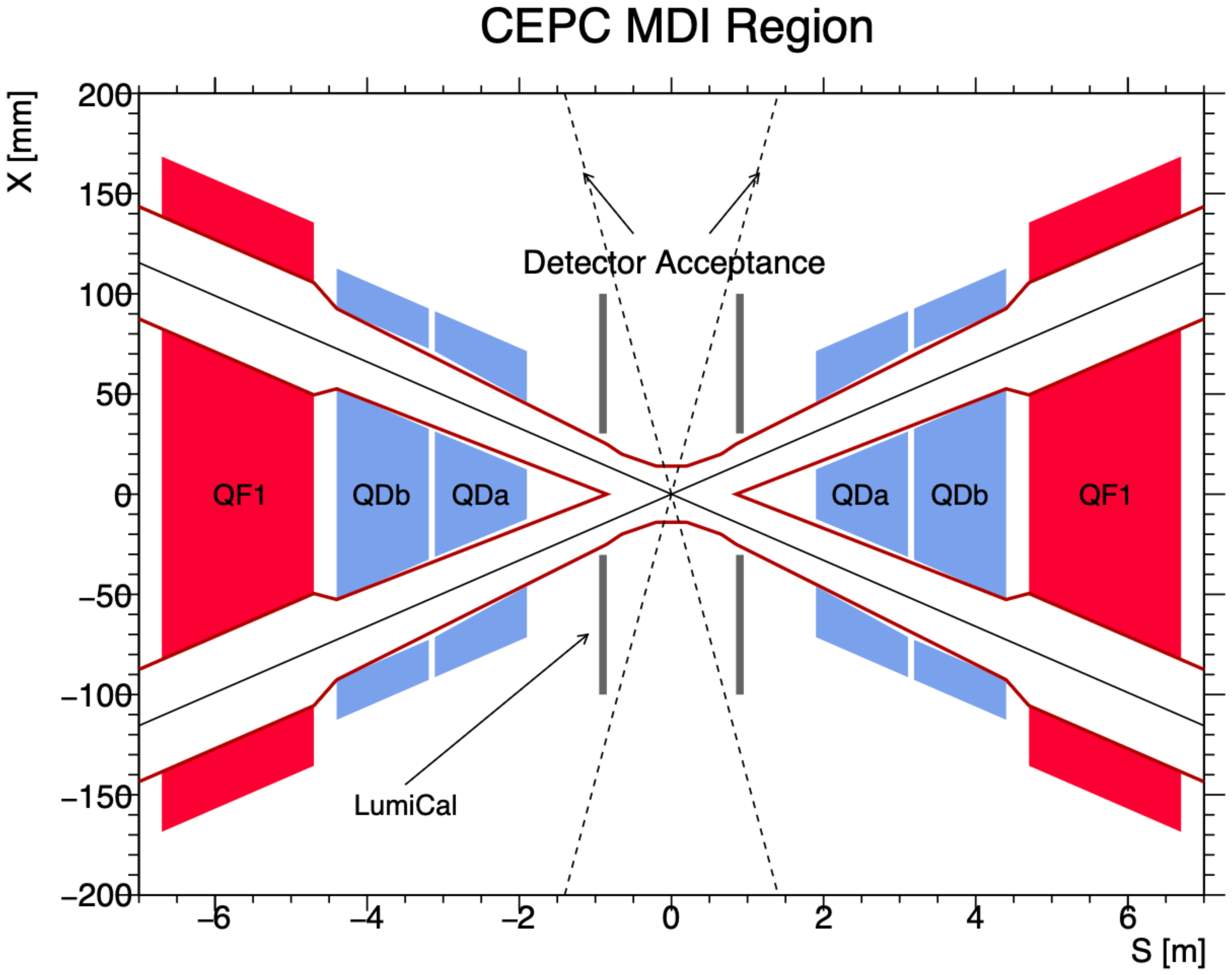


Figure 3.1: Layout of the CEPC interaction region, which is beyond the detector acceptance of $|\cos\theta| = 0.99$.

- The large top title is not needed, also the figure does not show the FULL MDI region, only the parts outside the detector acceptance, so there is NO detector in this picture
- Caption should explain and define what is being displayed QF? QD? ..... The section is now starting with this figure without any definitions.

Chapter 3

- Acceptable, but the font size could have been increased, which would have allowed for a smaller Figure overall
  - Last week, these figures were side by side. Instead of increasing the font, we made the figure gigantic
  - Currently, the font is still relatively small but it is readable
- It should be made more clear that top figure is deformation and the bottom is stress

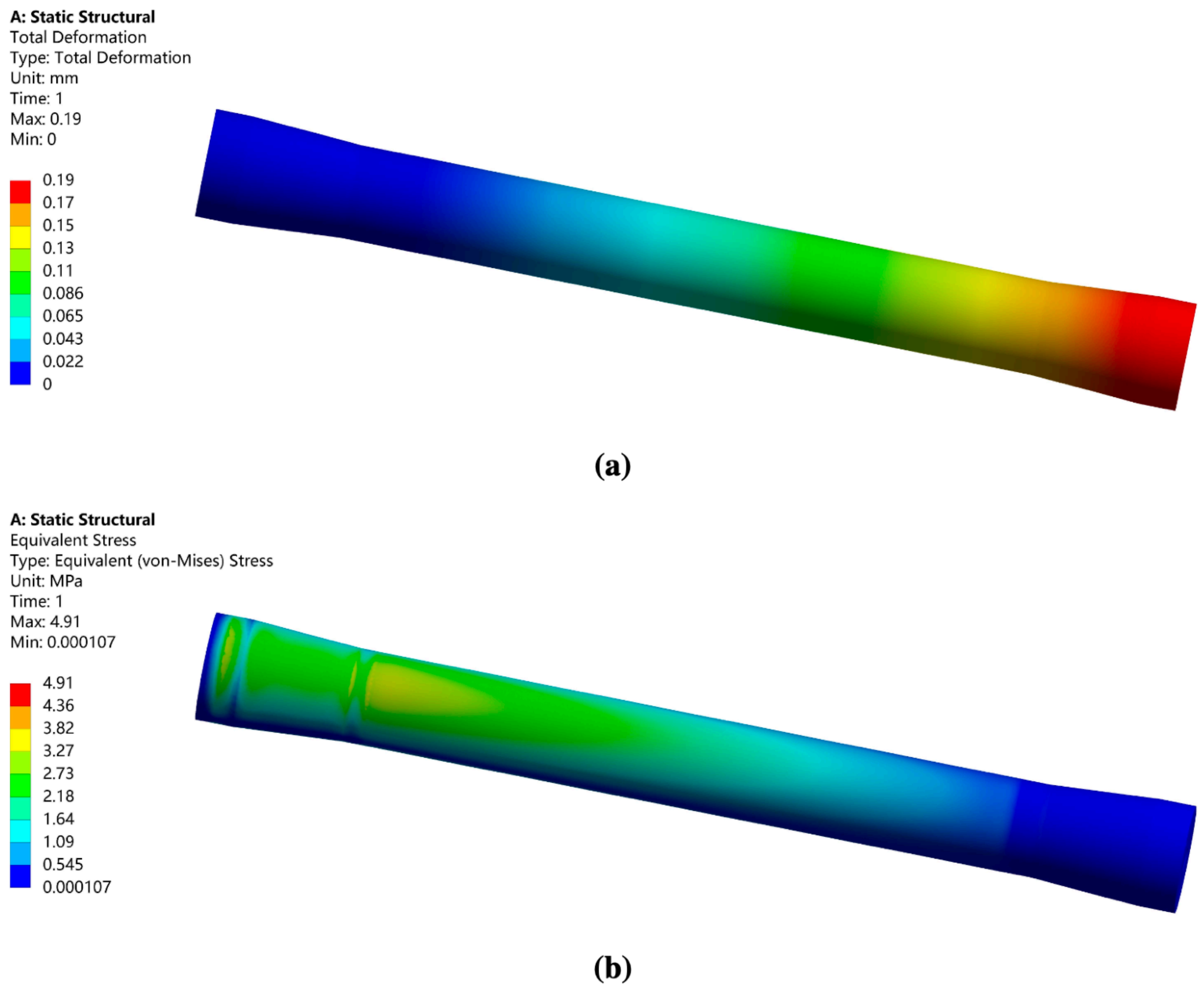


Figure 3.5: Stress analysis of the beam pipe when one end is fixed and the other end is cantilevered. a) The maximum deformation of the beam pipe occurs at the end flange, measuring 0.36 mm. And b) the maximum stress at the outer beryllium pipe is 13.77 MPa.

Suggested Caption:

Static structural analysis of the beam pipe when one end is fixed and the other end is **cantilevered**. a) Total deformation of beam beam pipe, with maximum deformation of 0.36 mm at the fixed end flange; b) Equivalent stress (von-mises), showing the maximum stress at the outer beryllium pipe to be 13.77 MPa.

NOTE, these numbers do NOT agree with the figure

Chapter 3

- Acceptable, similar comments as previous Figure
  - Caption should be modified accordingly to indicate what is the (a) Figure, and the (b) Figure
  - Caption number and numbers in the figures' scale DO NOT match

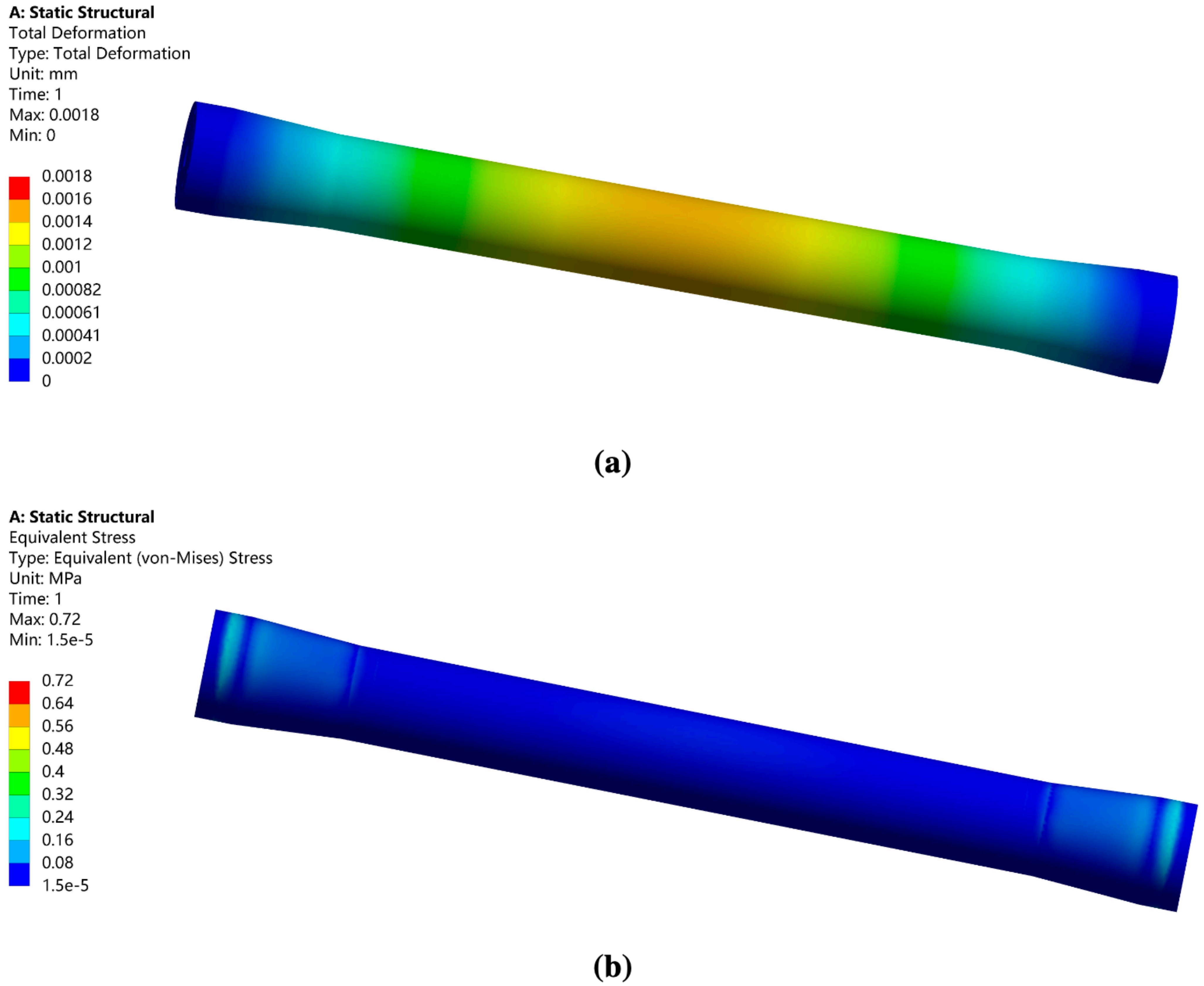


Figure 3.6: Stress analysis of the beam pipe when both ends are fixed. a) The maximum deformation of the beam pipe occurs at the middle of the extending aluminum pipe, measuring 0.19 mm. And b) the maximum stress is at the connection between the end flange and the extending aluminum pipe and reaches 15.57 MPa.

NOTE, caption numbers do NOT agree with the figure

Chapter 3

- Reduce the empty space between the figures and the (a), (b) labels, and between figures.
- Caption does not mention in what conditions this temperature distribution is observed. Need to be included.
- (Figure updated since last week's meeting)

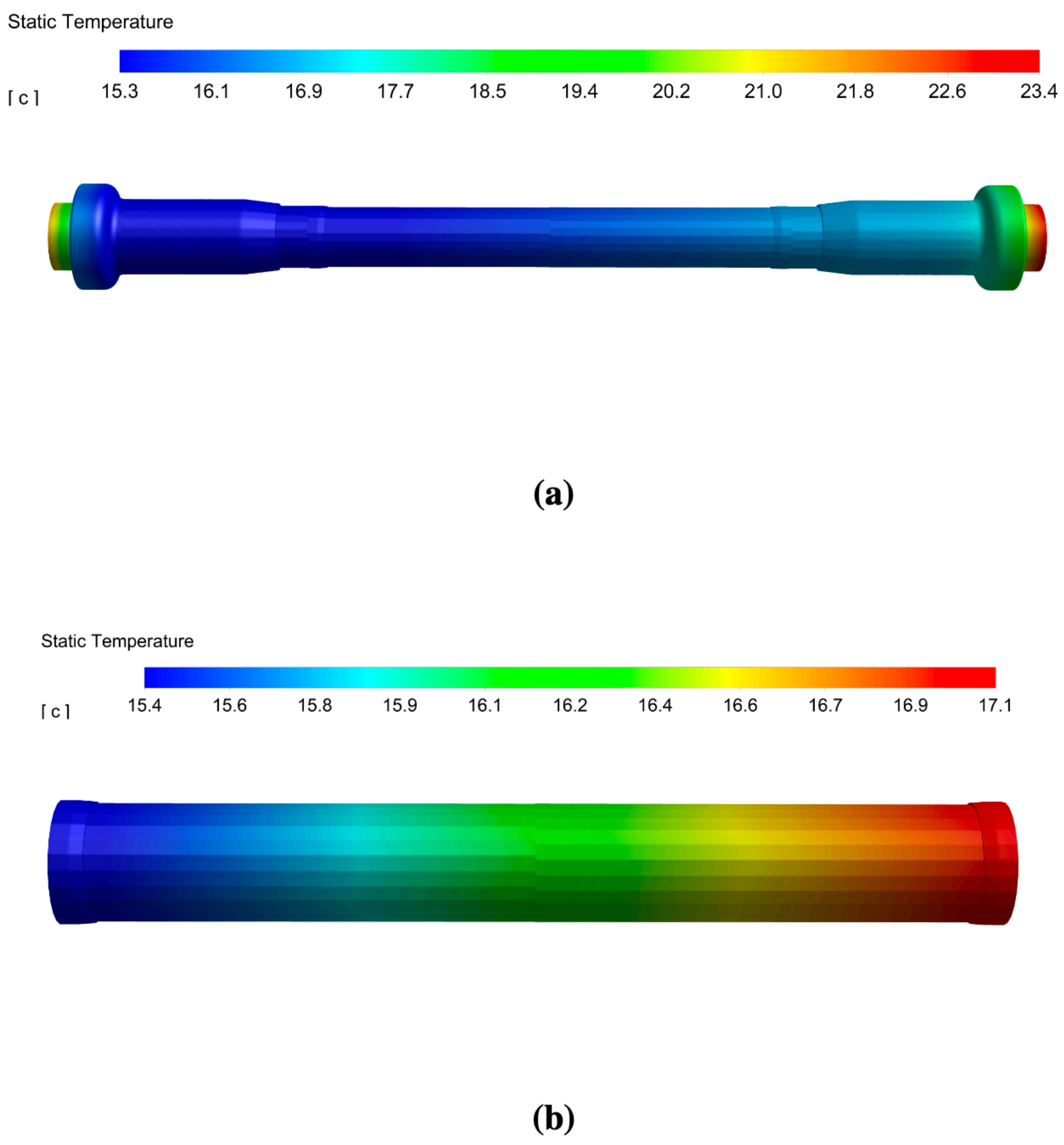


Figure 3.7: Temperature distribution of the central beryllium pipe. a) shows the inner beryllium pipe with a maximum temperature of 23.4 °C, while b) shows the outer beryllium pipe with a maximum temperature of 17.1 °C.

Figure 3.7: Temperature distribution of the central beryllium pipe when water cooled. a) Shows the inner beryllium pipe with a maximum temperature of 23.4○C, while b) shows the outer beryllium pipe with a maximum temperature of 17.1○C.

Chapter 3

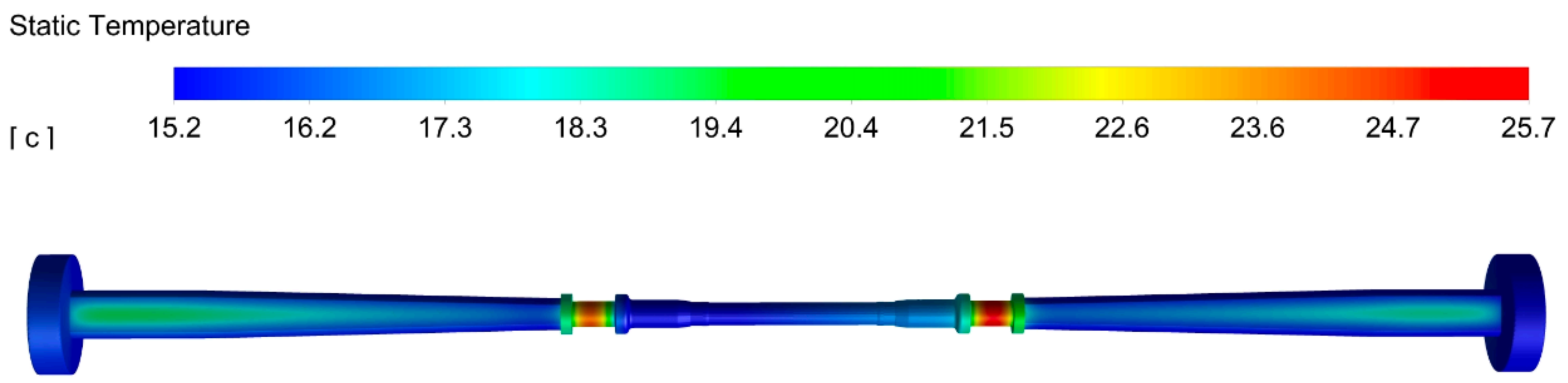


Figure 3.8: Temperature distribution of the beam pipe. The maximum temperature of the beam pipe reaches 25.7 °C at the junction between the cooling outlet end of the central beryllium pipe and the extending aluminum pipe.

- Reduce the blank empty space between the figures and caption

Chapter 3

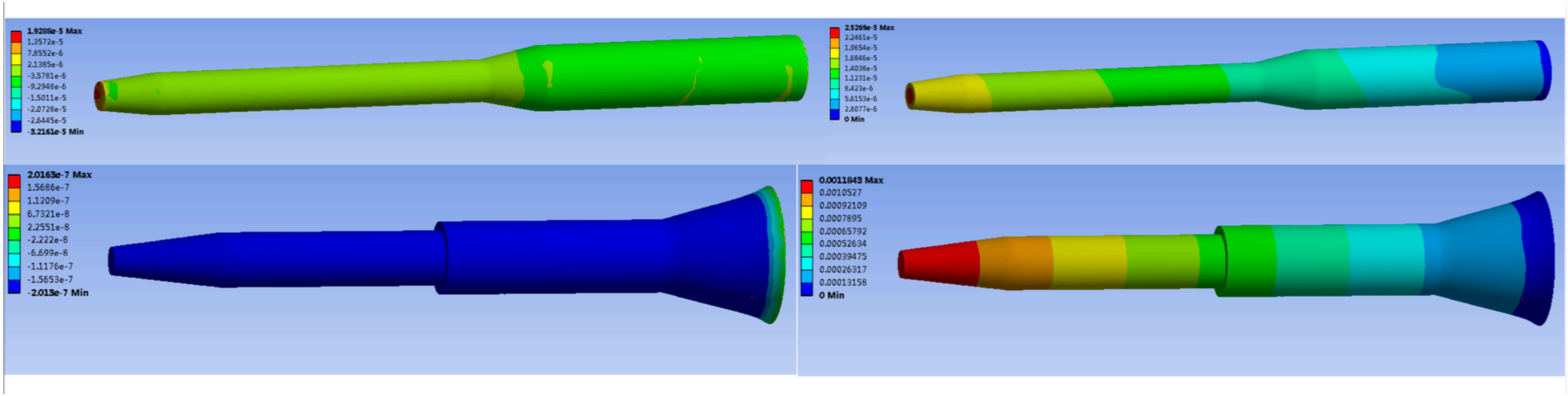


Figure 3.9: Stress analysis of the cryomodule.

- Font is too small to be readable → increase
- Add sub-figures (a), (b), (c) , (d)
- Explain what we are seeing in these 4 figures

Chapter 3

- Angle not Angel … Angels are in heaven :-)
- Explain why the energy cut-off and give a value for it

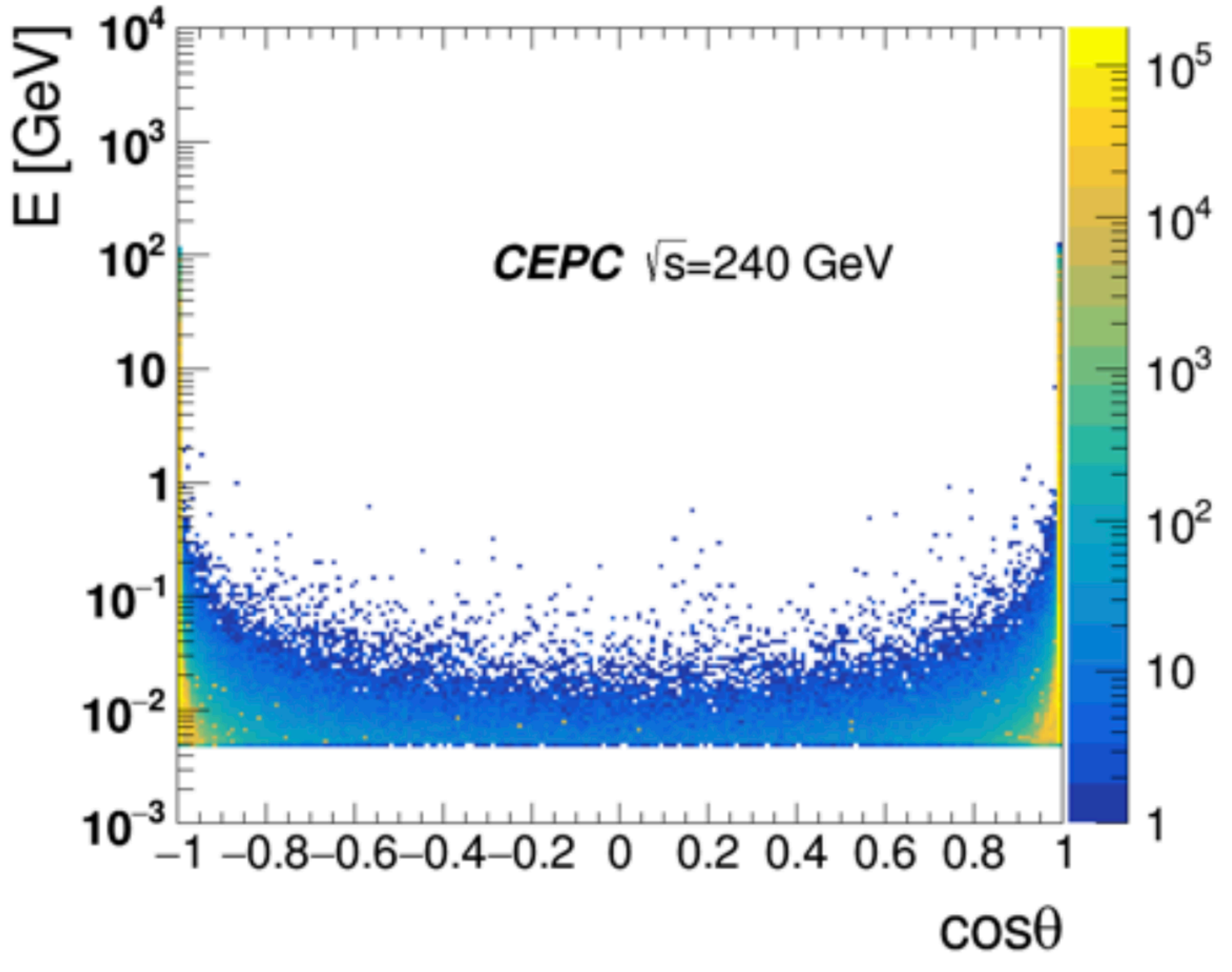


Figure 3.10: The energy and polar angel distribution of particles out of the pair production at the ZH operation mode.

Better caption

Figure 3.10: Energy and polar-angle distribution of particles from pair production beam-induced background during ZH operation mode.

Chapter 3

- Plot ok, but **caption** needs improvements
- Don't make excessive use of acronyms. Captions should be informative to the reader.
  - TSK, BGS, MDC…
- Data/MC is already a "ratio"… no need to explicitly mention it!
  - No point of using again Data/MC in caption. Should be explicit. Data/MC is jargon

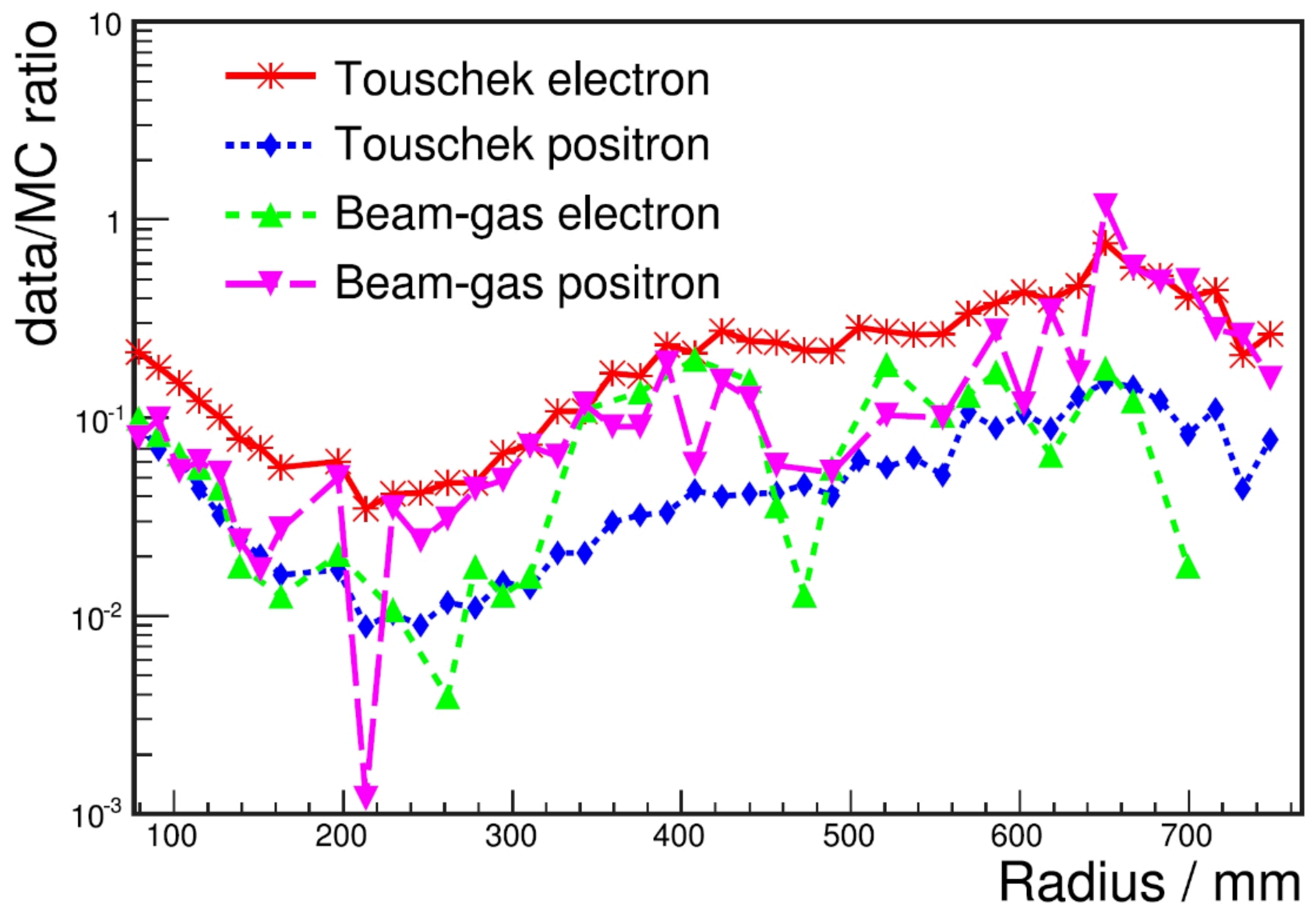


Figure 3.11: Data/MC ratios for both electron and positron beams are plotted for TSK and BGS backgrounds at different MDC layers (taken from Ref. [18]).

Better caption

Figure 3.11: Data to Monte Carlo ratios for both electron and positron beams are shown for Touscheck and beam-gas scattering, at different radial layers of the Main Drift Chamber (MDC) in BES III (taken from Ref. [18]).

Chapter 3

- Plot does not follow the recommended forma
  - Font is too small compared to the size of the plot
  - Plot is unnecessarily large
- All those acronyms should be mentioned in the caption for clarity (BGC, BTH, BGB, TSC)
- Caption does not explain plot clearly

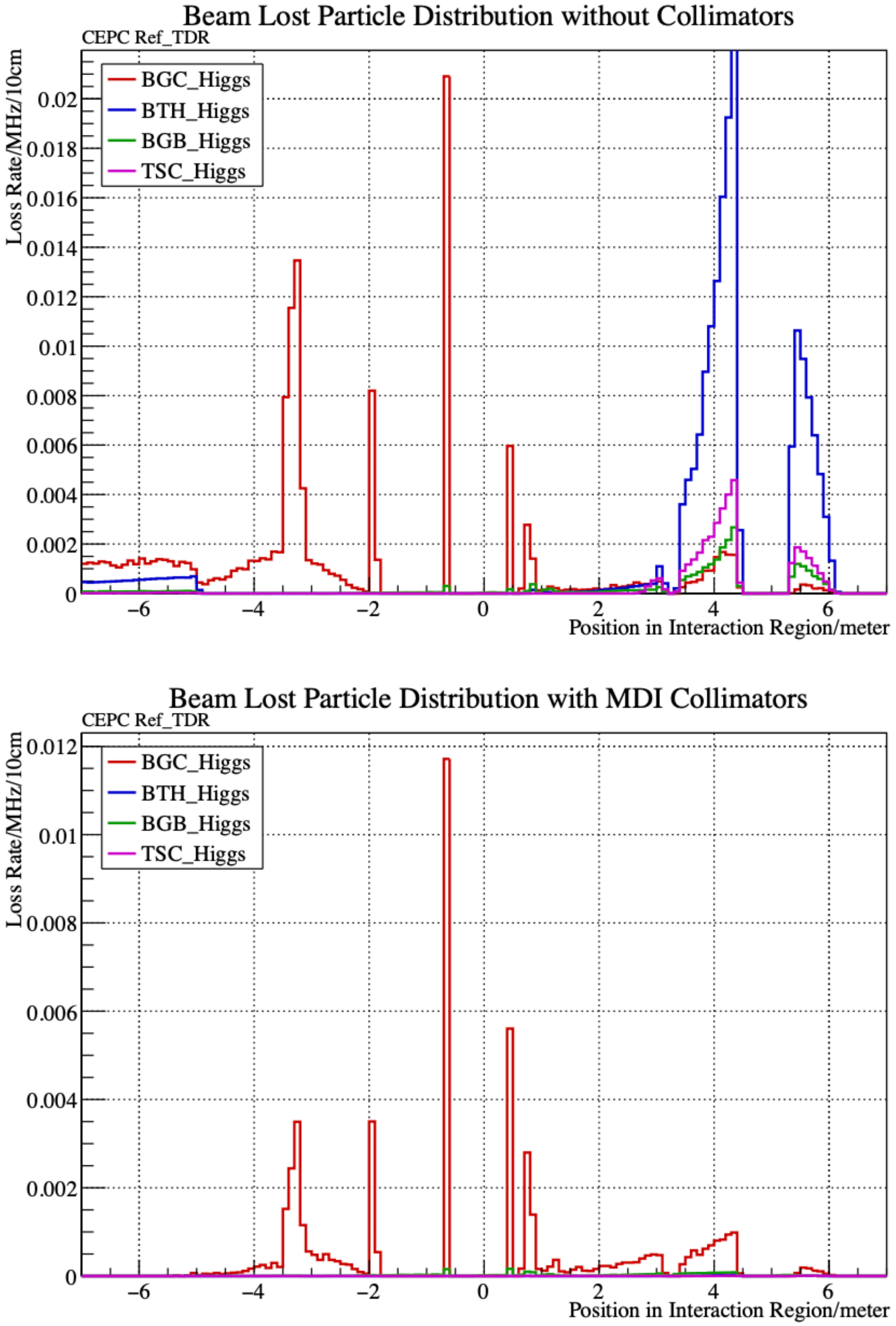


Figure 3.12: The effectiveness of the IR collimators when operating in the *H* mode. The beam loss rates due to different beam backgrounds are plotted before (upper) and after (lower) the implementation of the collimators.

Chapter 3

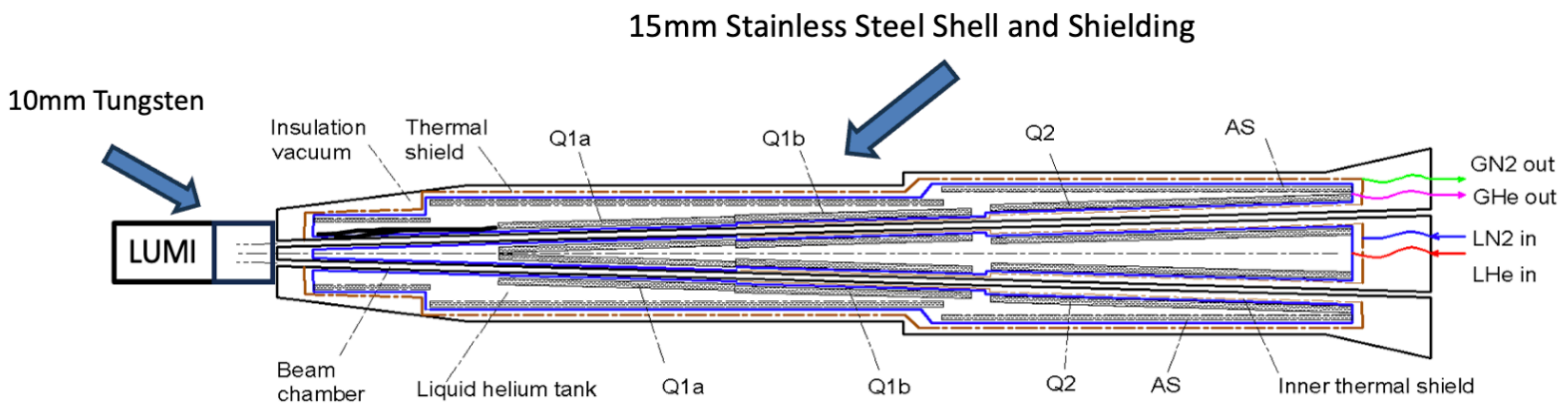


Figure 3.13: Illustration of the shielding surrounding the IR cryomodule. A 10 mm tungsten serves as the outer shell of the LumiCal and IP BPM, while a 15 mm stainless steel shell is introduced as the shielding.

- There are many symbols in this figure that are not defined. They need to be defined in the caption
- What is LUMI?

Chapter 3

- Plot titles not clear. What does LUM mean in this context? "Dose" is jargon
- Missing sub-figure labels (a) (b)
- Caption should clearly state of figure (a) and (b)
-

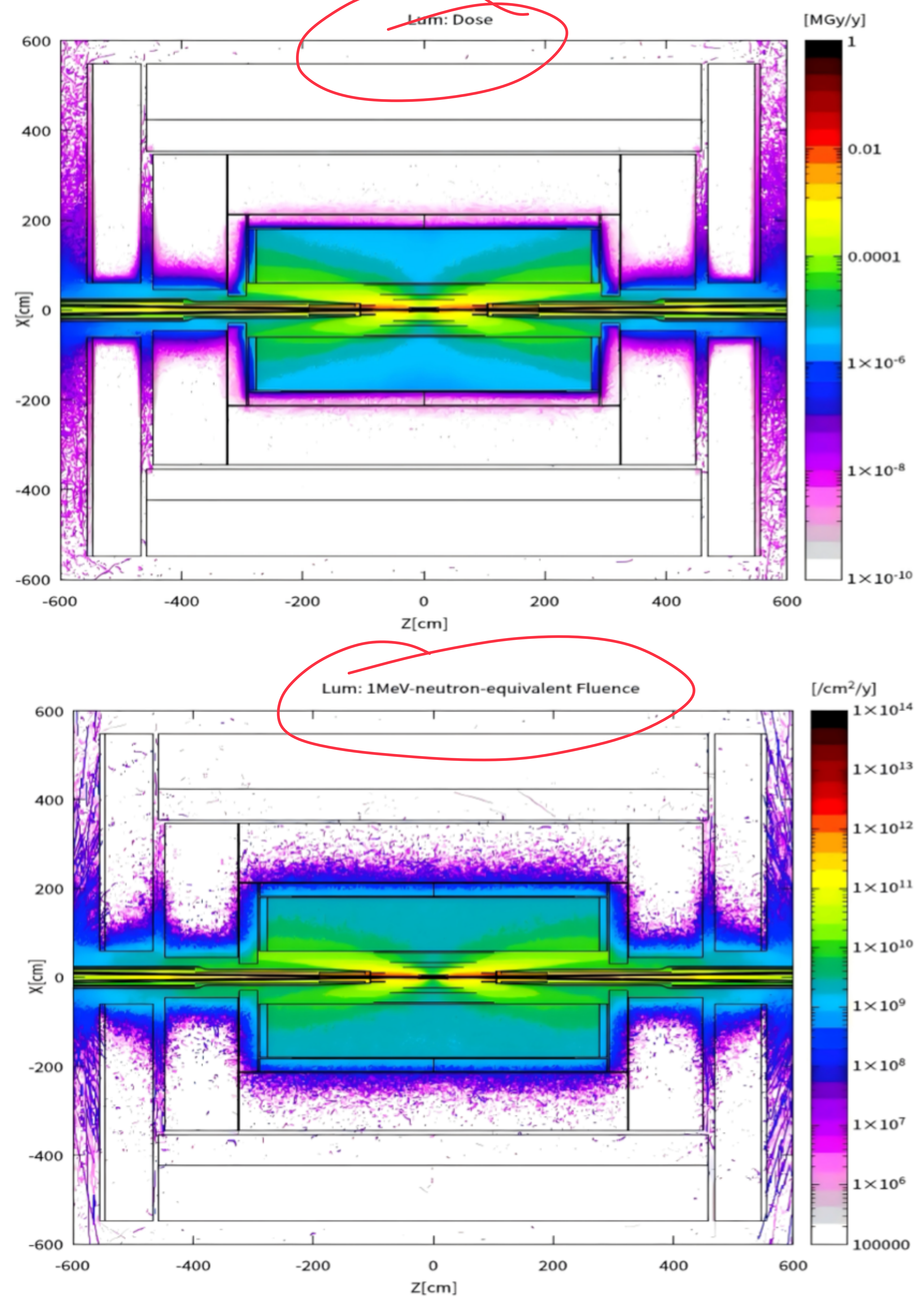


Figure 3.14: The TID and NIEL distributions caused by pair production for the CEPC detector. The highest TID reaches 0.2 MGy per year, while the highest level of NIEL is on the order of 10^{13} 1 MeV n_{eq} cm^{-2} per year.

Chapter 3

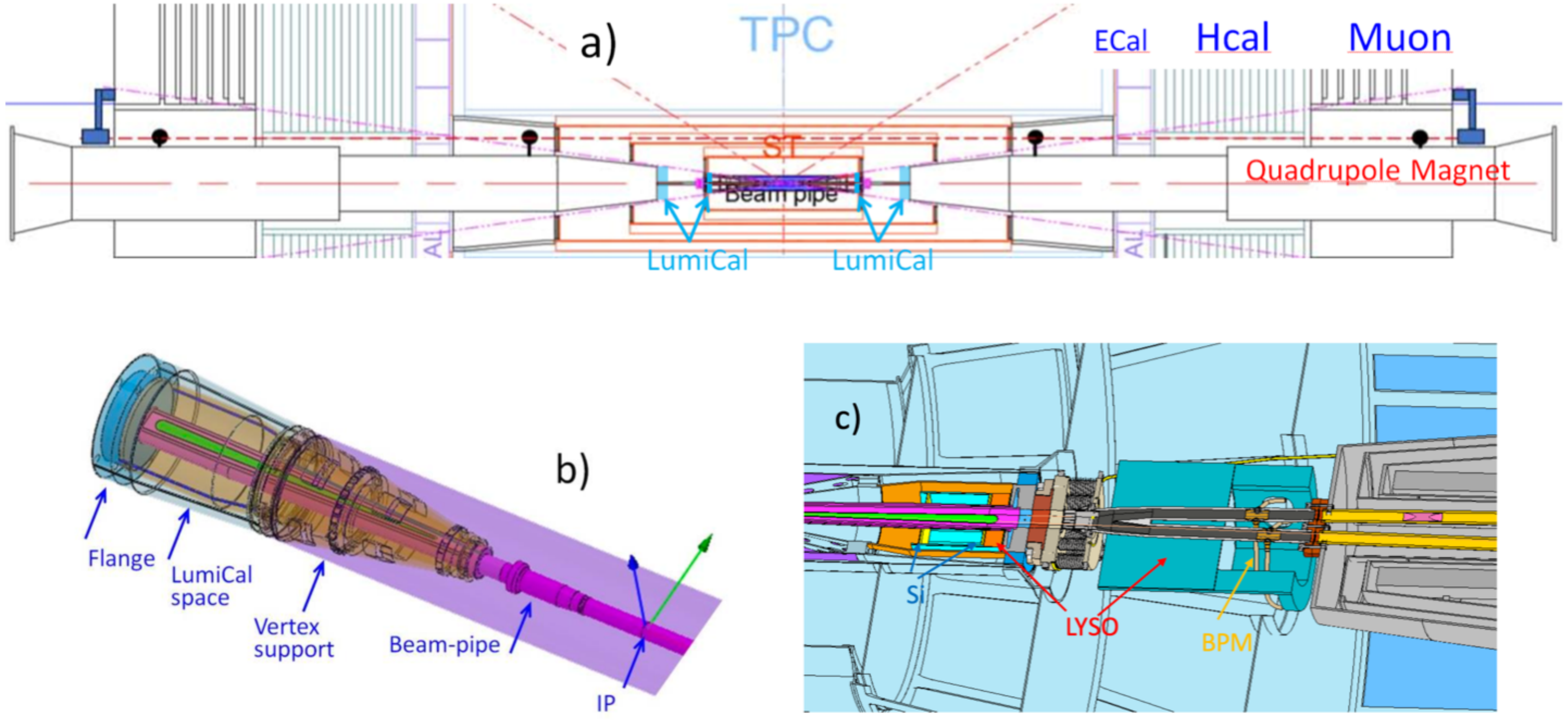


Figure 3.15: The MDI region is illustrated in a) the yz-view across the two quadrupole magnets; b) the IP to beam-pipe flange at $|z|$ = 700 mm showing the beam-pipe (purple) vertex detector support and the volume before flange (blue) for LumiCal; c) the x-z cut view of the LumiCal before flange, the bellow, and the long crystal before the BPMs and the quadrupole magnet.

- Top figure is an overview plot of the MDI region. It should be in the overview section, not here in the luminosity detector part.
  - The word “beam pipe” is over the lines of the plot, not easily readable
  - (b) plot needs to be in the overview section. It is not specific to the luminosity detector.

Chapter 3

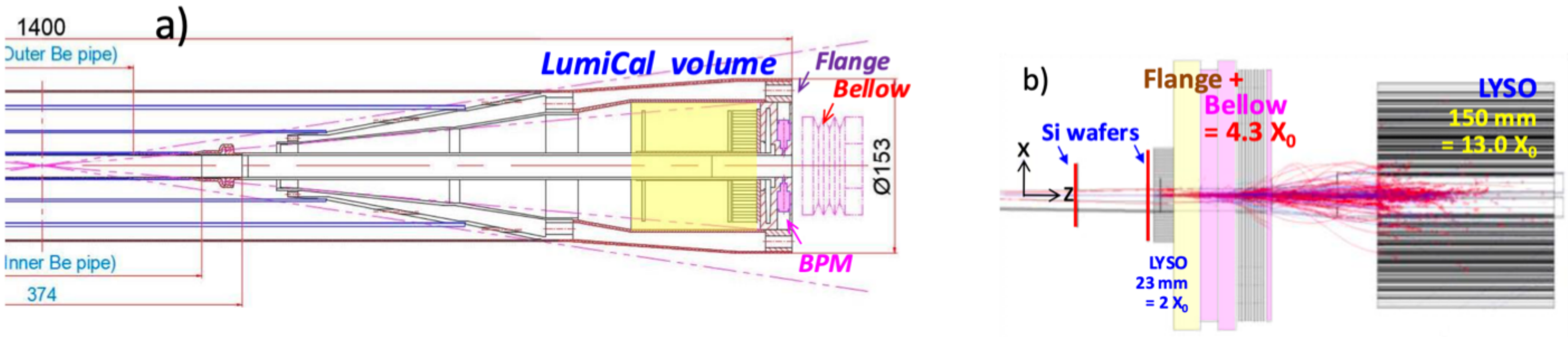


Figure 3.16: The LumiCal volume before the flange is shown in a), where two Si-wafers are positioned before 2 X_0 LYSO bars. Inside the flanges in each side, 50 GeV electron shower illustrated. Before the flange, the Si-wafers with short LYSO crystals provide electron θ position with e/γ veto. The long LYSO behind the bellow provide beam electron identification by energy deposits. The LYSO length has assumed to be 150 mm.

- Labels (a), (b) should be done in Latex, if possible
- Some dimensions have ranges not well defined. They should be repeated anyway. Some labels are too small and cut
- (Not clear we need drawing (a) in addition to what was already included before
- Drawing style of these figures is not consistent with other mechanical figures

Chapter 3

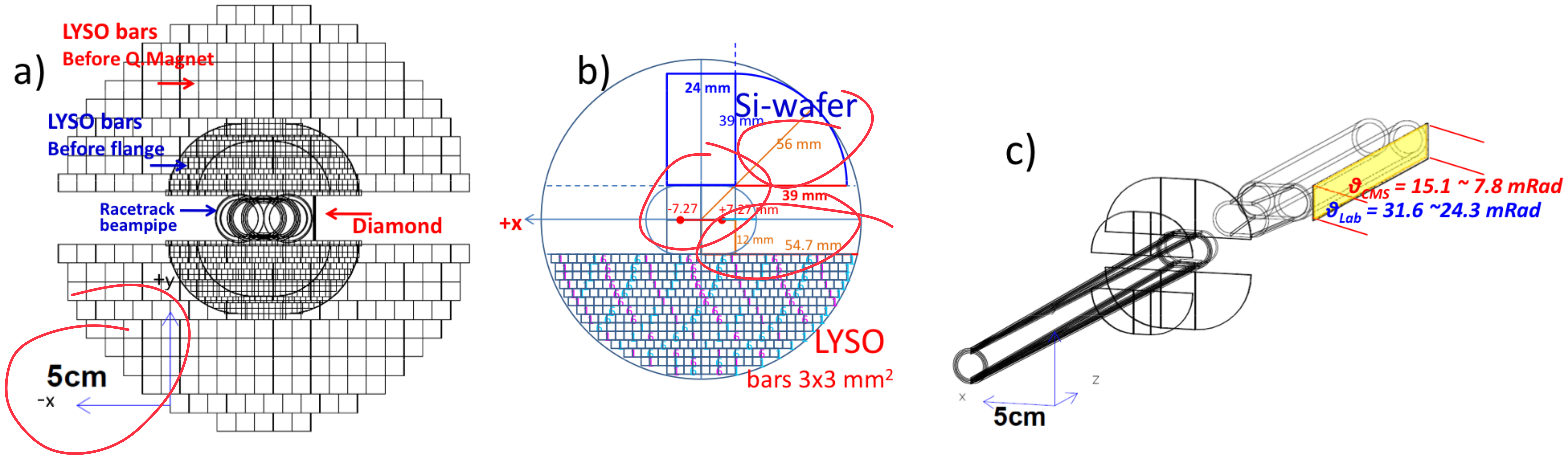


Figure 3.17: The projection of LumiCal design is illustrated in a), with the racetrack beam pipe from IP to quadrupole. The design of the second Si-wafer at $|z| = 640$ mm and the 2 X_0 of LYSO bars mounted on the flanges are plotted in b). The front LYSO bars dimension is $3 \times 3 \times 23$ mm^3. The long LYSO modules behind the bellow are segmented in $10\times10\times150$ mm^3. The fast monitoring diamond detectors in c) are positioned between the long LYSO modules on the sides of electron boosted direction, where the Bhabha electron rate is the highest.

- Labels (a), (b) should be done in Latex, if possible
- What is 5 cm on the (a) drawing?
- Some text still too small
-

Chapter 3

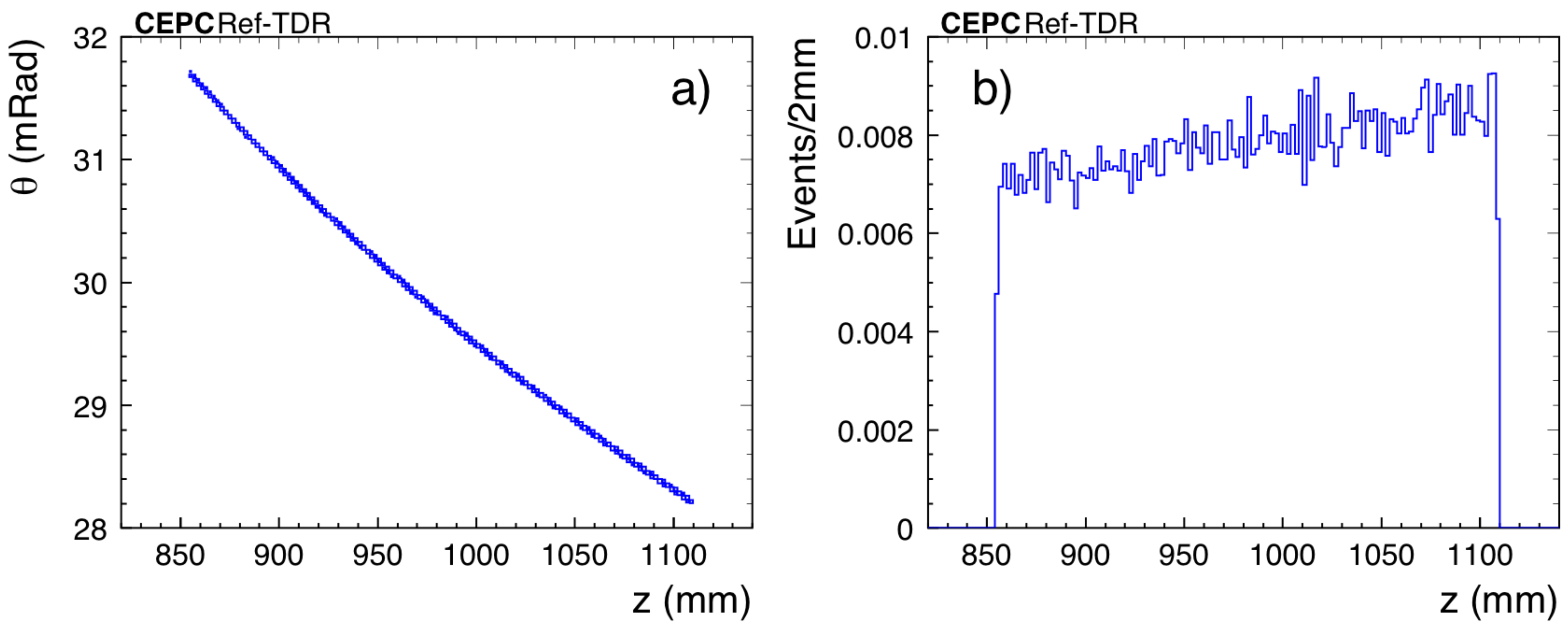


Figure 3.18: A shower passing 3 mm Cu beam-pipe for a 50 GeV electron at 10 mrad to the outgoing beam direction of 16.5 mrad. The diamond slab (24×320 mm^2) is located on the side of beam-pipe at 13 mm to beam center. The hits on diamond slab is plotted in a) for the theta versus z in laboratory frame. The event rate (normalized to 1) in z is plotted in b).

- Labels (a), (b) should be done in Latex, if possible
- Radians (rad) is capitalized in the figure axis, and not in the caption! It should not.
- Caption overdone here — We don't see a shower in these plots. Start by providing information about the plot, then give details as needed.
- The y-axis of plot (b) indicates that the number of events are normalized by the bin size. This plot is not the number of events per bin, but the "event fraction" per bin. "normalized to 1" is jargon. The plot is normalized to the total event integral, or total number of events.

Chapter 3

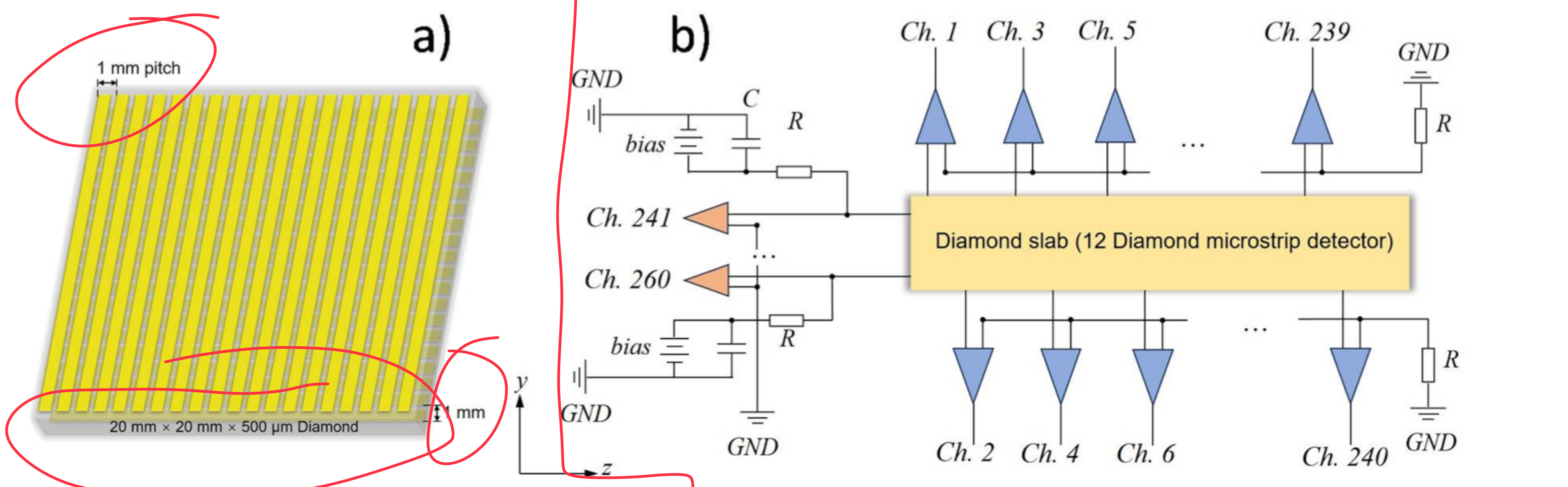


Figure 3.19: a) Schematic of the microstrip diamond sensor with orthogonal front-side and backside microstrips, featuring a 1 mm pitch; b) Illustration of the microstrip readout for a diamond slab, where the front-side microstrips (Channels 1–240) are connected to preamplifiers for measuring z-axis IP offsets, while the backside microstrips (Channels 241–260) are connected to high voltage for measuring y-axis IP offsets.

- Labels (a), (b) should be done in Latex, if possible
- Font size for the dimensions of the chip is too small. Increase it if possible, if really not possible mention it in the caption.
- Increase blank horizontal space between figures. They almost look like the same figure

Chapter 3

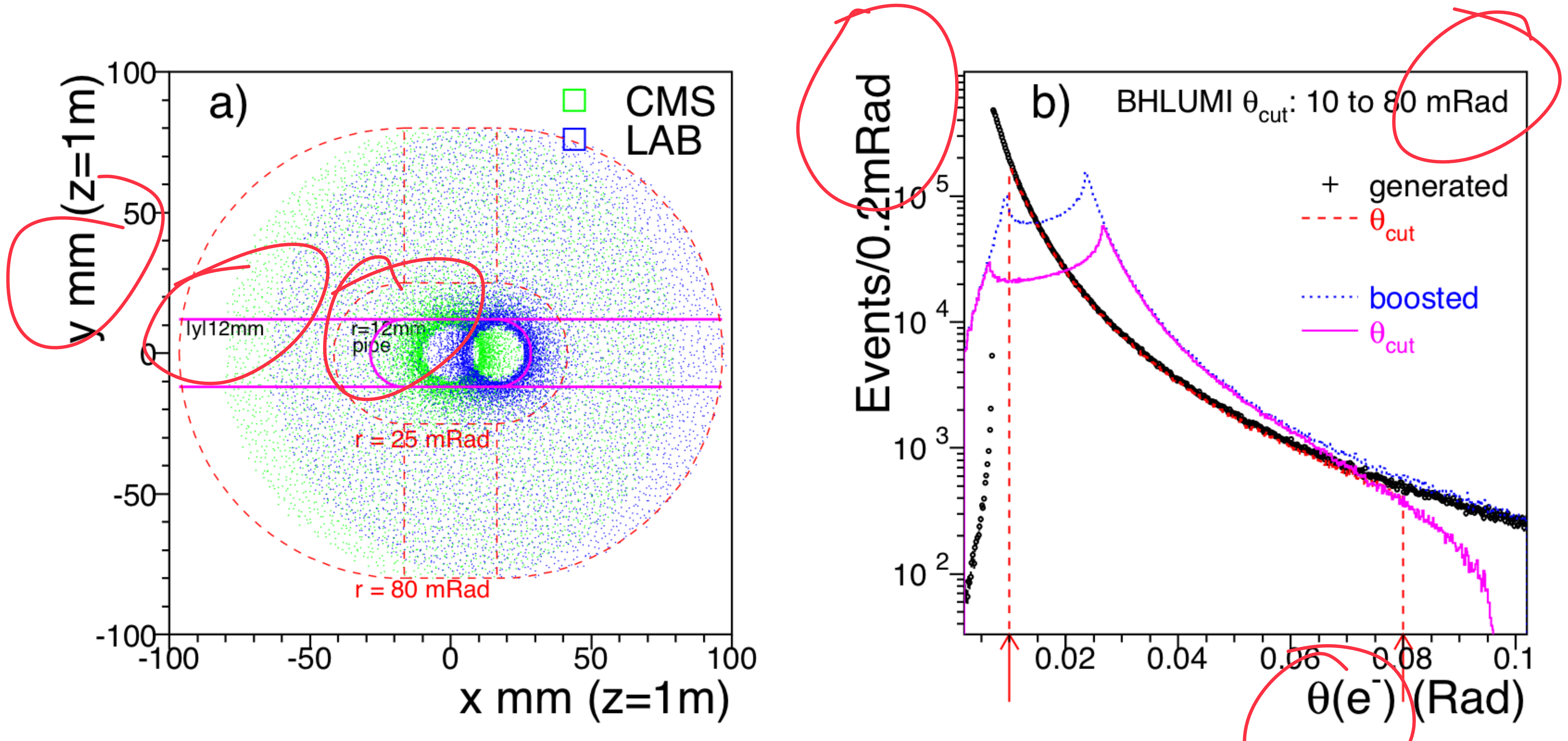


Figure 3.20: a) scattered electron distributions of BHLUMI simulations at CMS frame and after boost for the 33 mrad beam crossing at CEPC. Events are generated for $10 < \theta < 80$ mrad. The Acc0, Acc1 are selections according to the BHLUMI for LEP applications. b) the back-to-back angles of e^+ and e^- are plotted for the generated and boosted, and the Acc0 selected with and without radiative photon.

- Labels (a), (b) should be done in Latex, if possible
- Font size for the dimensions on left plot still too small
- Define what CMS stands for
- The units in the axis are not consistent. Sometimes they are within (), sometimes they are just there.
- Radians should not capitalized

Chapter 3

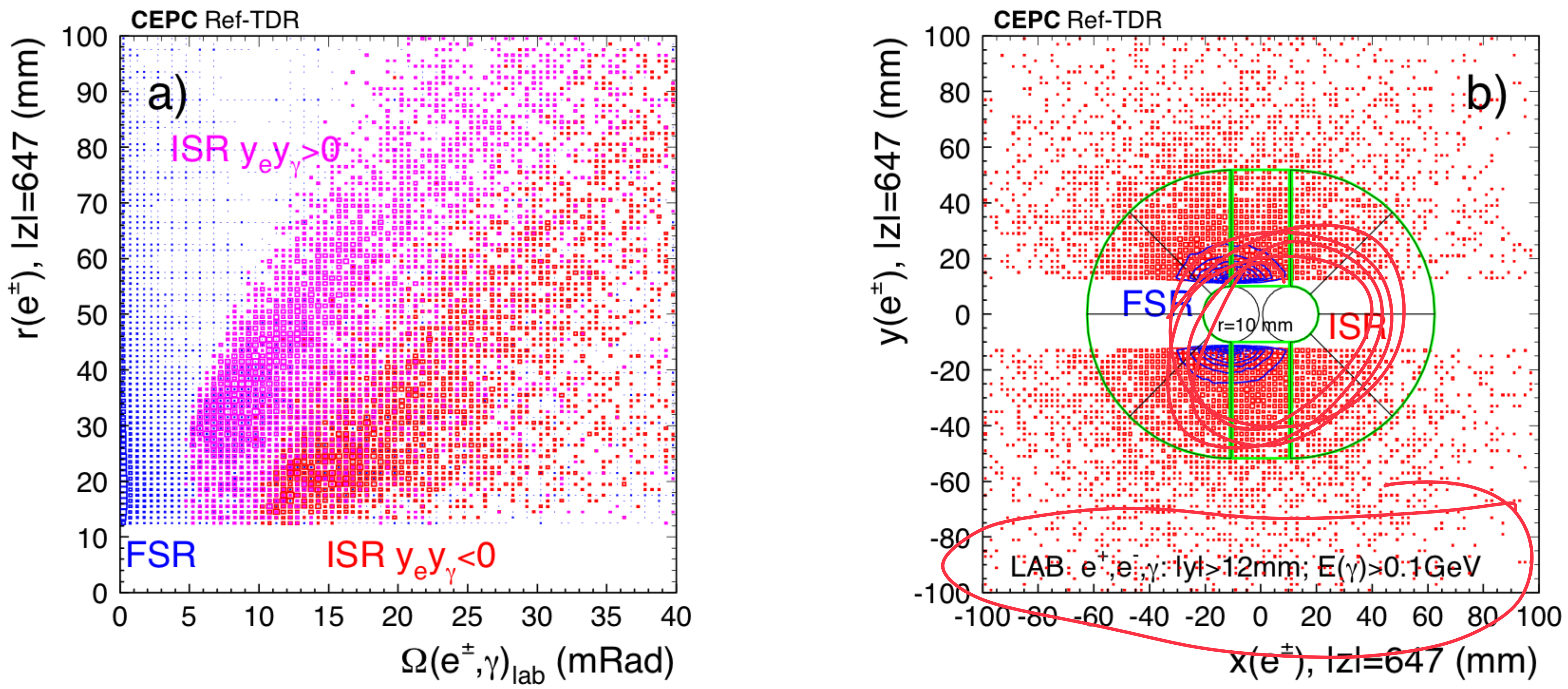


Figure 3.21: Event with radiative photon ($E_\gamma > 0.1$ GeV) are plotted for e, γ separation. a) the scattered electron position in front of LYSO is plotted for the LAB frame x-y radius vs e, γ opening angle in the same z-hemisphere. b) the electron hit positions in LAB x-y frame are shown. In case of FSR both e and γ are close beam pipe; with an ISR, e and γ are spread wider.

- Labels (a), (b) should be done in Latex, if possible
- Font size for the dimensions stil too small.
- Text should not be written over data
- LAB should not be capitalized
- Caption should explain why using this specific Z = 647 mm value

Chapter 3

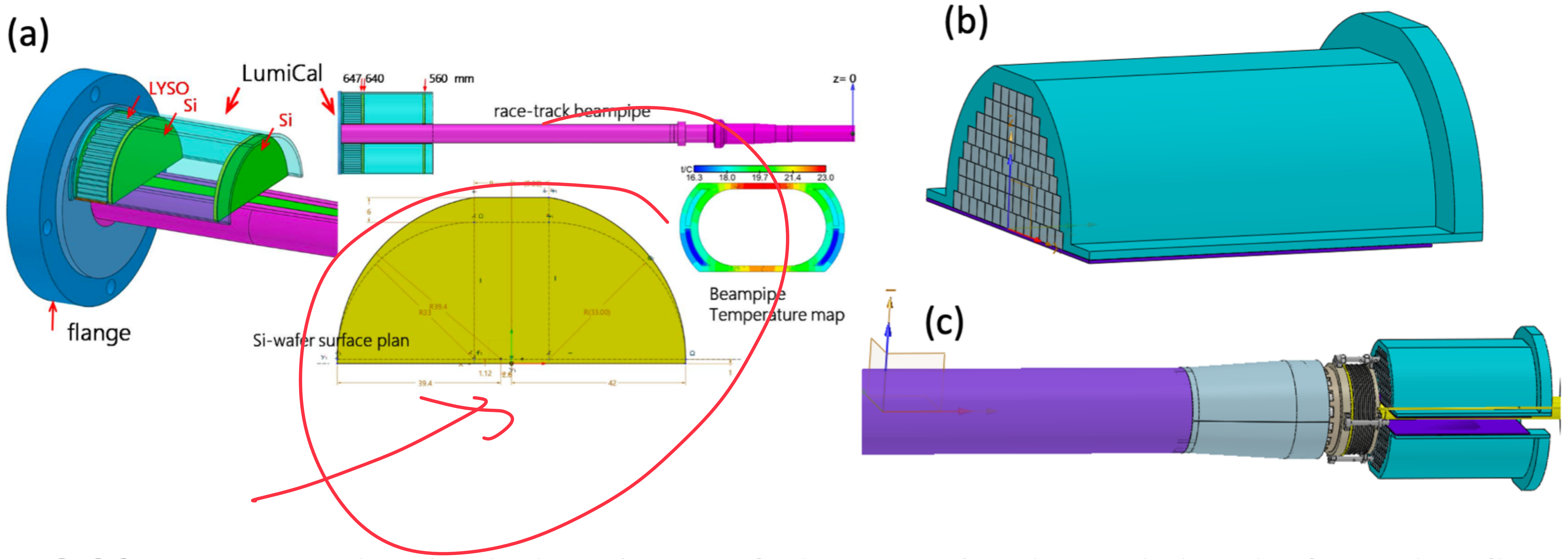


Figure 3.22: a) Mechanical drawings of the LumiCal modules before the flange of race-track beam-pipe. The two Si-wafers and $2X_0$ LYSO crystal bars are contained in half circular tubes above and below the pipe. The cooling of beam pipe has the water injected from the flange toward IP within the double Aluminum layers on the sides with the temperature map illustrated, b) Mechanical drawings of the LumiCal module beyond the flange, the $13X_0$ LYSO crystal bars covered by tungsten shell, and c) The LumiCal LYSO modules are contained in half circular tubes above and below the pipe.

- Labels (a), (b) should be done in Latex, if possible
- Some font sizes still too small, particularly for the dimensions. This was pointed out many times already, including last week.
- There is some horizontal space so the figure can be more separated and larger if needed

Chapter 3

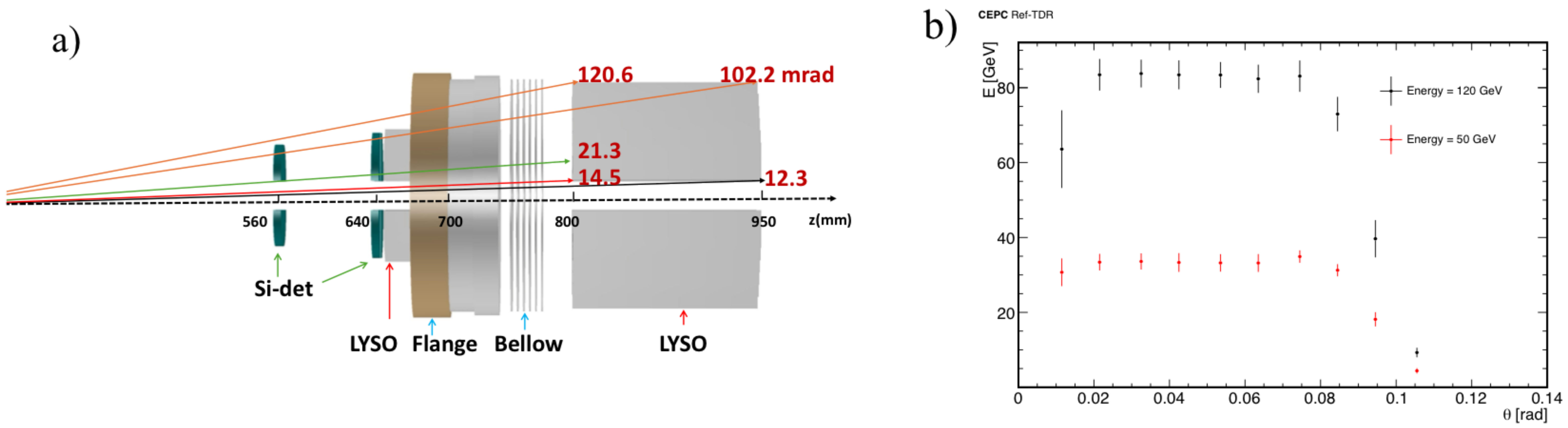


Figure 3.24: The long LYSO detector acceptance versus the electron theta is scanned along ver vertial y-axis, witht the angles illustrated in a). The sum dE/dx distributions are plotted in b) for the electron energies of 50 GeV and 120 GeV. The materials in frant include 2 X_0 short LYSO and 4.4X_0 flange and bellow, that takes away about 40 (30) % of the shower dE/dx for 50 (120) GeVelectrons, respectively. The uniform acceptance distributed from 20 to 75 mrad.

- Labels (a), (b) should be done in Latex, if possible
- Font size on the right plot is ridiculously small. It does not follow the provided template

Chapter 3

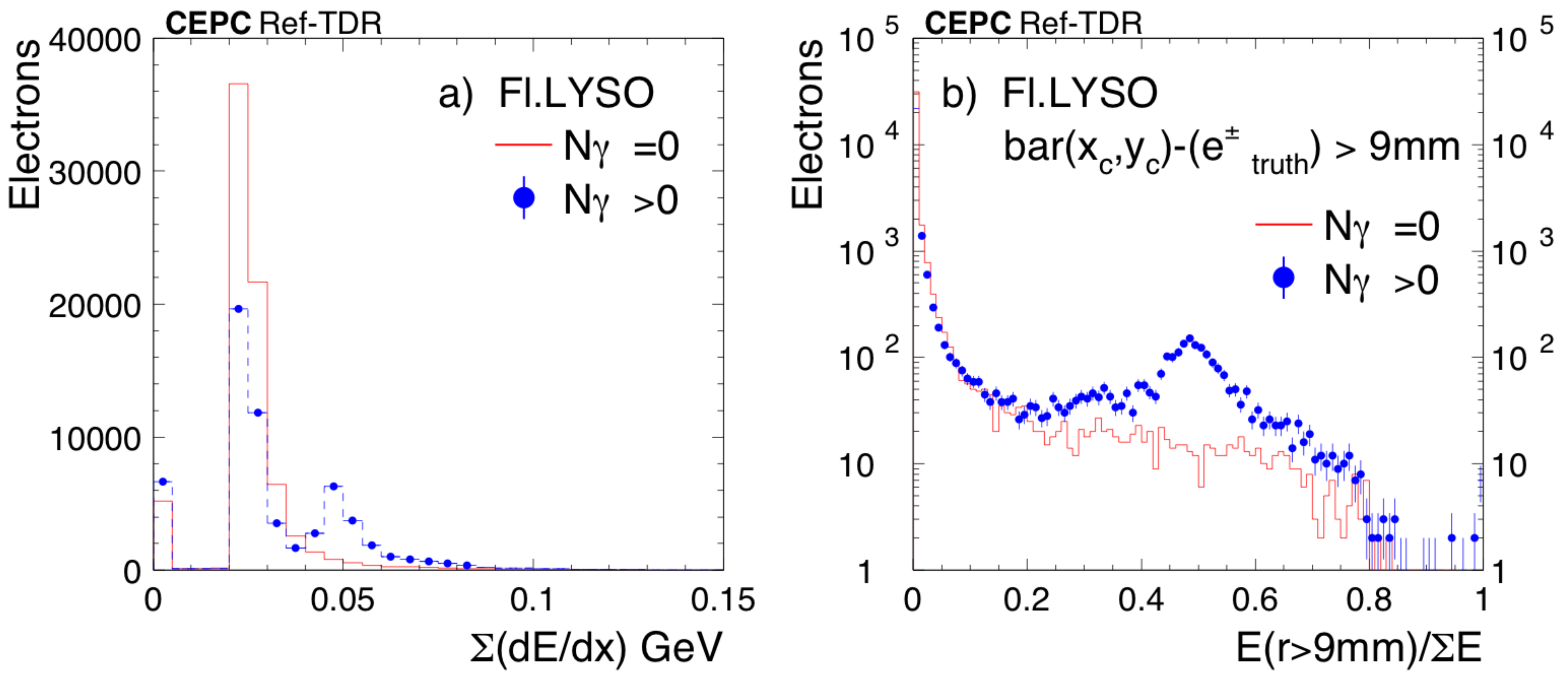


Figure 3.25: The scattered electrons of BHLUMI with projected truth directions entering LYSO at $|z| = 64.7$ mm, $|y| > 12$ mm, are simulated with GEANT. The energy deposits of electrons in a half-circle module are plotted in a). The double peak with photon could be with an FSR adjacent to the electrons. The fraction of energies in LYSO bars 9 mm off the projected electron direction is plotted in b), indicating the observable of a photon that can be identified by the LYSO bar segmentation.

- Labels (a), (b) should be done in Latex, if possible
- Text font and spacing is strange (e.g space before and after the "=" and ">" symbols should be the same. Italic should be used for variables and particle names, the same way as in the text
- What is Fl?

Chapter 3

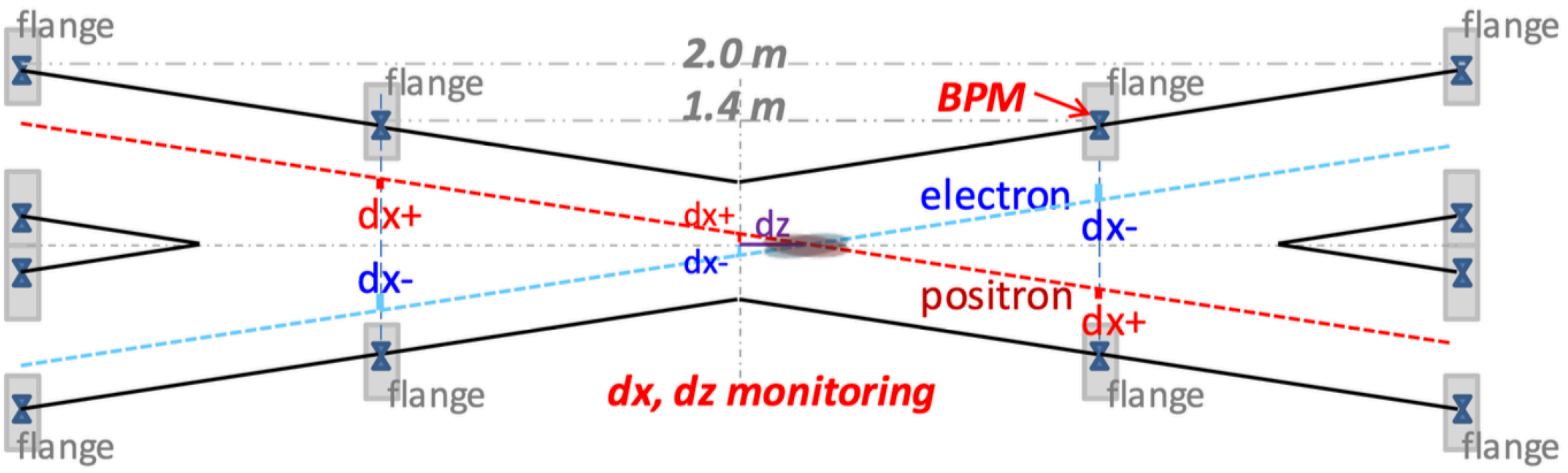


Figure 3.26: The beam currents in the interaction region are illustrated, showing the offsets to be measured with BPM.

- Text should not be written on the top of drawing elements (e.g. "flange")
- Caption is not clear enough

Chapter 3

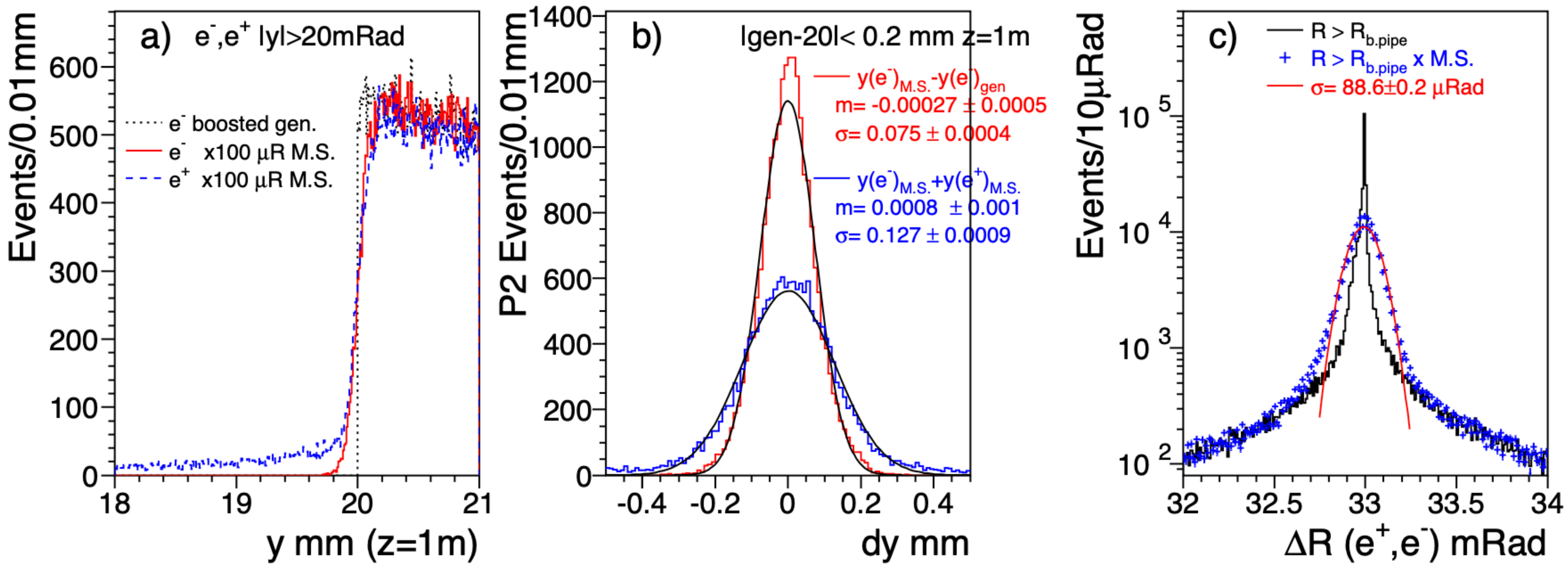


Figure 3.27: The scattered electrons (P2) and positrons (Q2) both accepted within the fiducial edges of LumiCal at $|z| = 1$ m are plotted in a) for the distribuion in $|y|$. The dotted is the BHLUMI generated P2 being cut at $|y| > 20$ mm. The multiple scattering (M.S.) smeared P2 is plotted in red solid line. The Q2 in the other z-side is plotted in blue dashed, where the tail are events having radiative photons.

- Labels (a), (b) should be done in Latex, if possible, and they should be used in the caption
- Text should stay inside the plots themselves. Not ok to have text coming out through the frame of the plot (either all inside, or all outside).
- Result of fit can be in text or table. Make sure it is really needed in this plot.
- Caption is not clear enough

Chapter 4

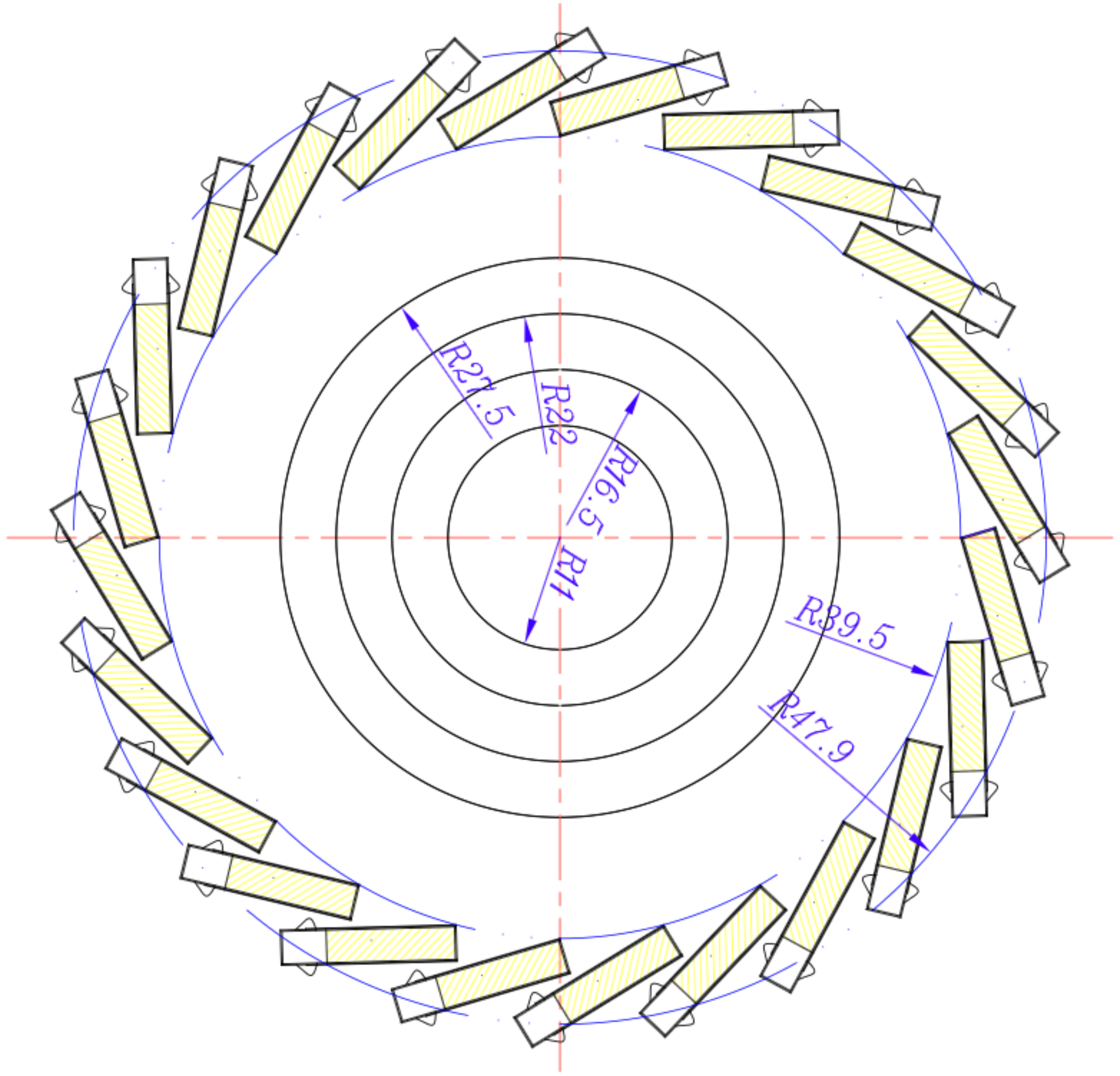


Figure 4.2: Sectional view of the VTX layout. The inner four layers are bent CIS with semi-cylindrical structure and for the 5th and 6th layers are double-layer planar CISs with ladder desgin.

- Missing units. Can just be added to the caption

Chapter 4

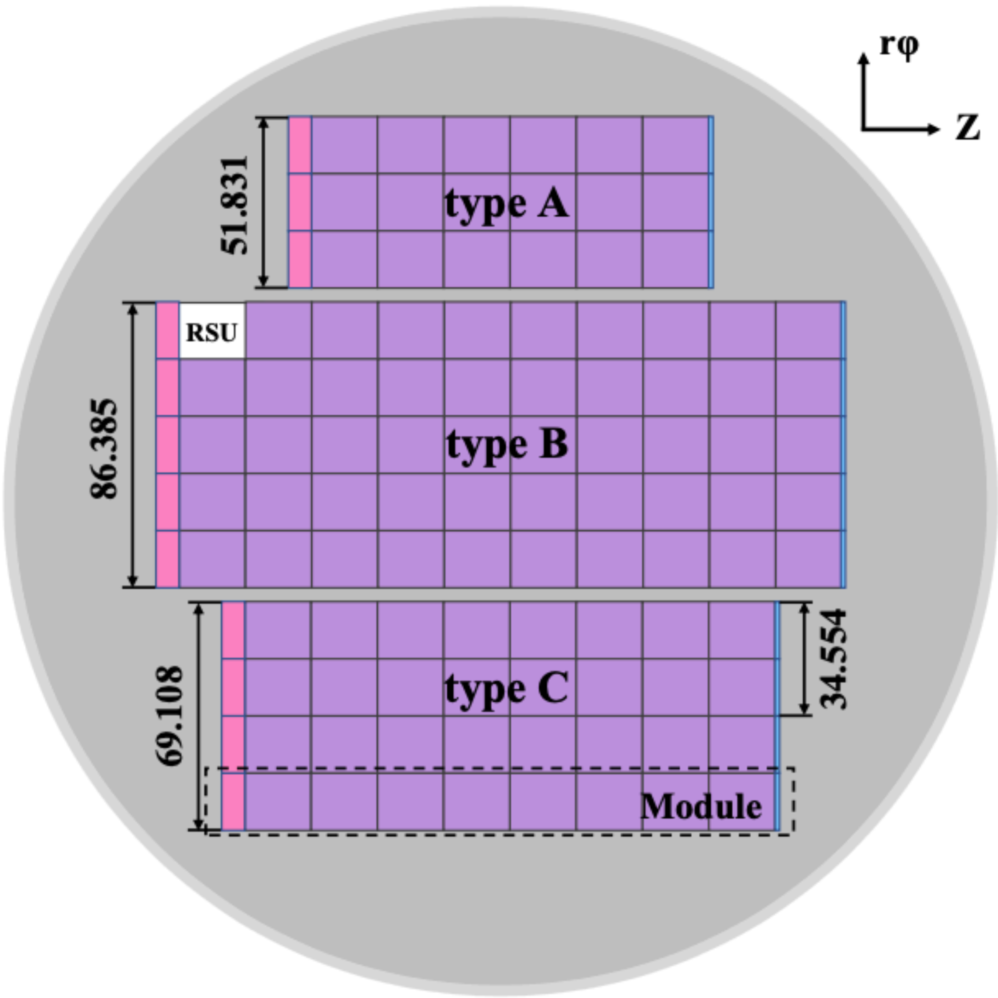
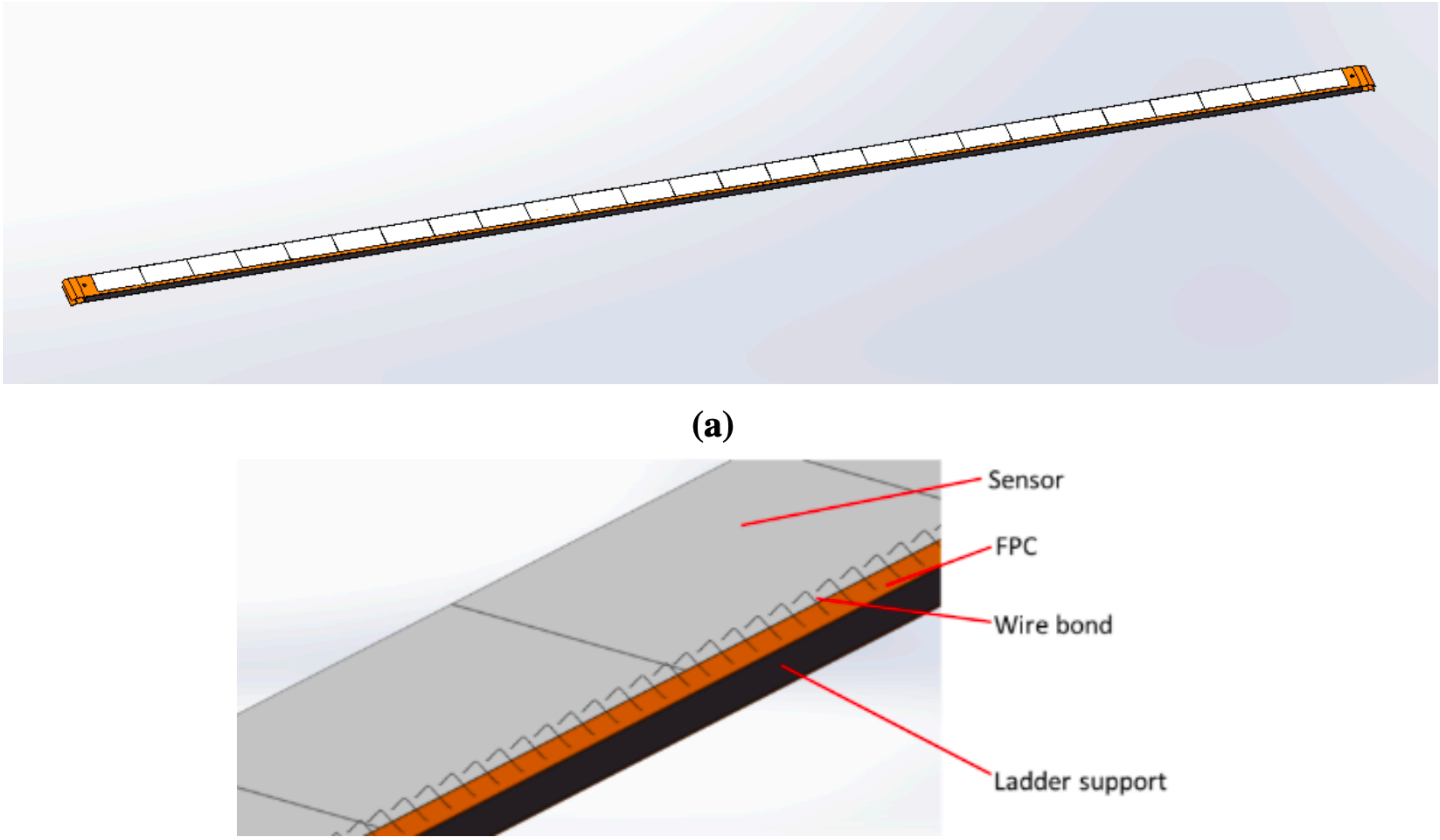


Figure 4.3: The arrangement of stitching frames on a 300 mm wafer. The purple part represents the RSUs, the pink represents the Left-end Readout Block (LRB), and the blue represents the Right-end Power Block (RPB). The short-dashed line area represents a module consisting of several RSUs, one LRB, and one RPB. To meet the requirements of each layer of the vertex detector, the type A/B/C sensors are designed with different lengths and widths. The type A and B sensors are used to make one of the sensors for CVTX 2 and CVTX 4, respectively. The full type C sensor can be used for one of the sensors for CVTX 3. The type C sensor can be divided into four modules along the vertical direction. Using two modules of the type C sensor can make a sensor for CVTX 1.

- Good, but also missing units. Units can be just added to the caption

Chapter 4



(a)

(b)

Figure 4.5: ladder structure. (a) The ladder assembly. (b) Local details of the ladder.

- Caption too short, clearly not written by the same person that wrote the captions of prior Figures.
  - These are not sentences (no verb), better to use ";" instead of "."
  - **Example caption**: A ladder is composed of 26 chips glued to an FPC mounted on a carbon fiber support: (a) the full ladder assembly; (b) ladder detail showing sensors wire bonded to FPC.
- Remove the grey color background from these figures. Usually figures in publications do not have this

Chapter 4

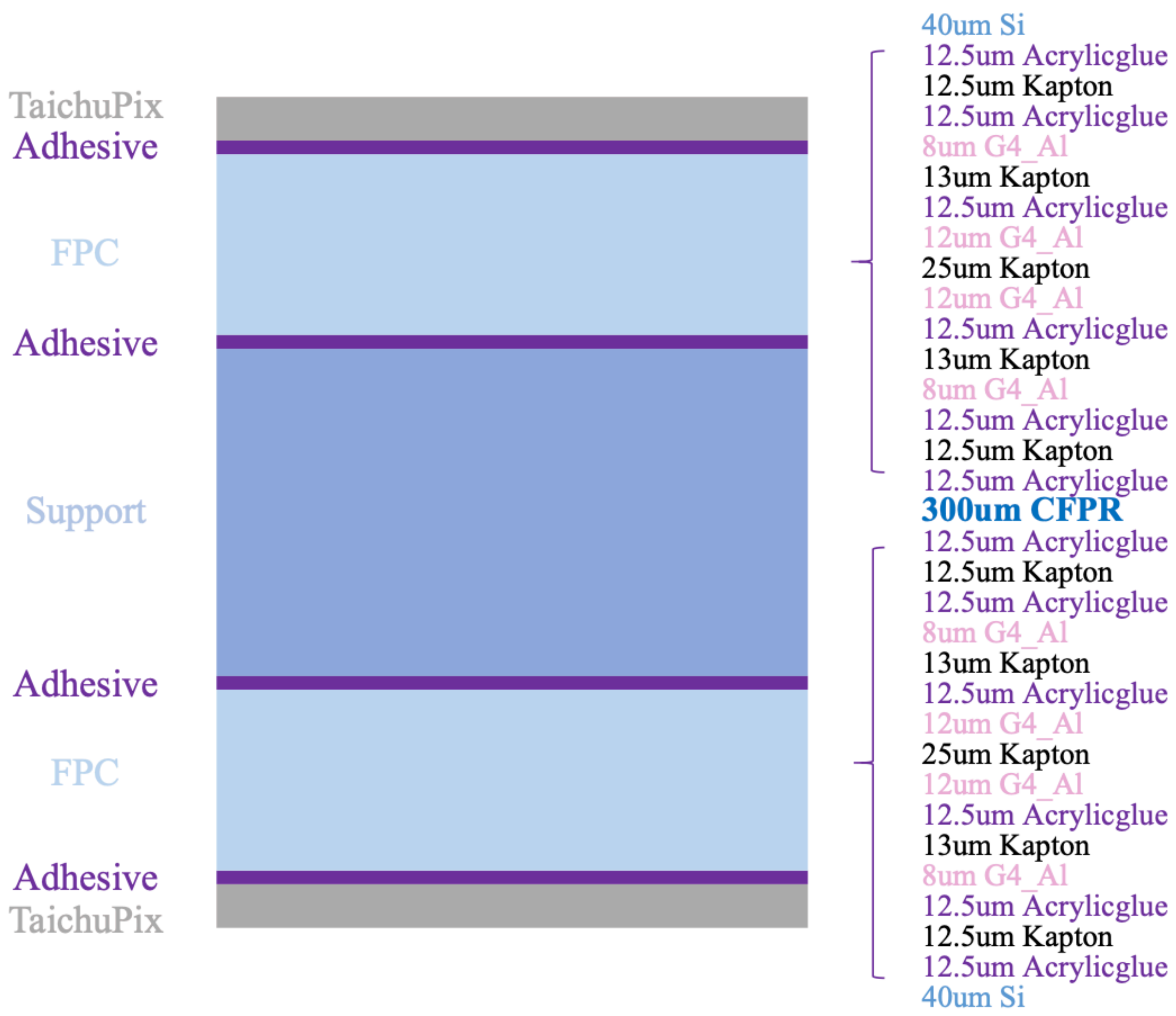


Figure 4.6: Longitudinal cross-section of a ladder, composed of two layers of chips and other materials, such as glue, carbon fiber, and aluminum. Each ladder of PVTX 5-6 in the vertex layout utilizes this structure.

- **Improved suggested caption:**
  - **Figure 4.6:** Simplified transversal cross-section of the ladder, composed of two layers of chips on the outside and other materials, such as glue, carbon fiber, and aluminum, in the bulk. Each ladder of layers 5 and 6 of the vertex detector utilizes this structure.

Chapter 4

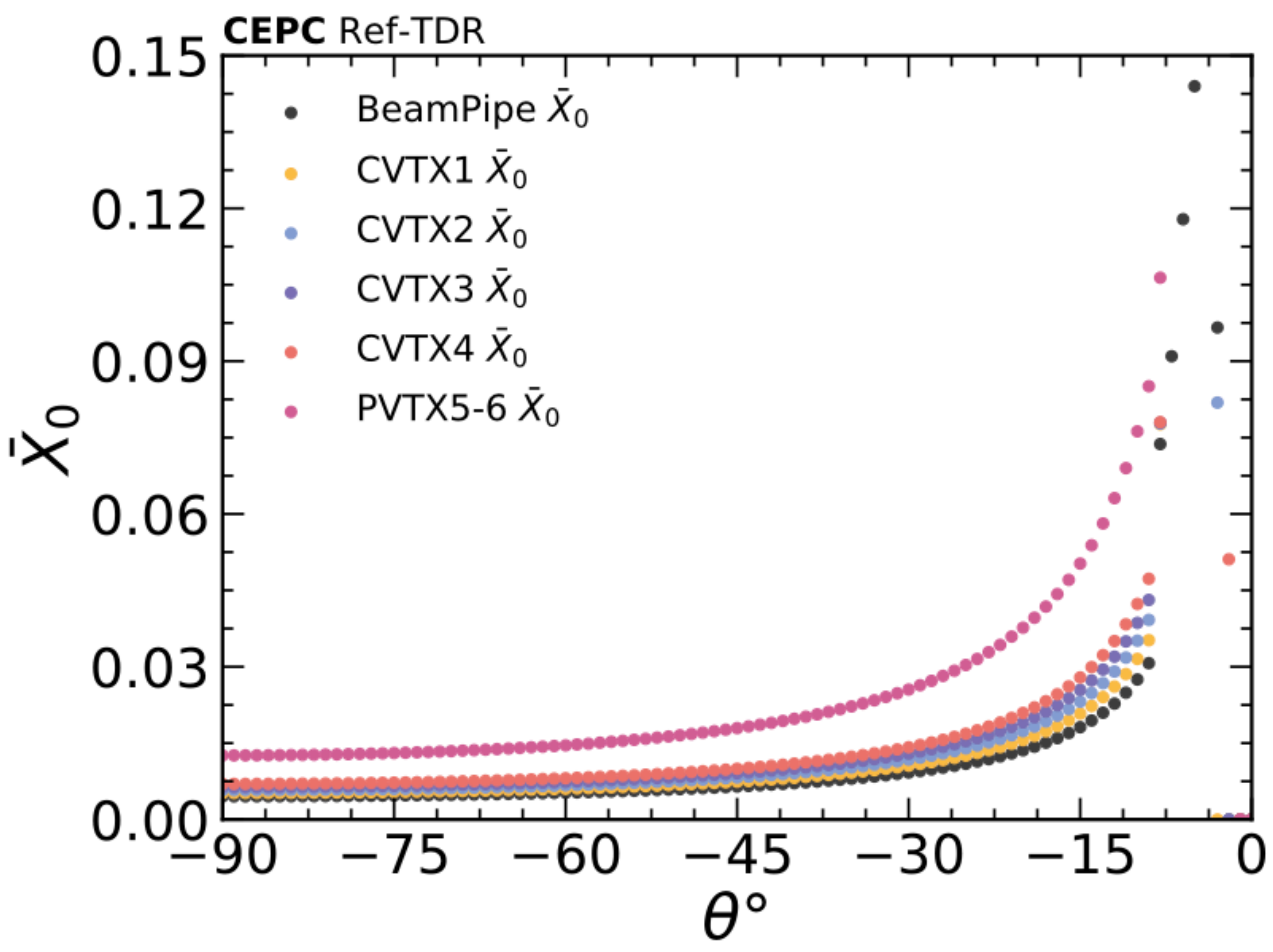


Figure 4.7: The average value $\bar{X}_0$ within the range of $\phi \in (0, 360)°$ of vertex detector varies with θ.

- Caption must have been written by a student....
  - X0 should be explicitly defined in the caption
  - This is the average X0 over the full azimuthal (ϕ) range as a function of the polar angle (θ) in degrees
  - Mention why X0 increases for small θ but actually comes down for very low ones (is this physical? binning?)
- Why polar angle θ with negative values? The symbol should not be θo. The units should be in parentheses or brackets. (e.g. polar angle θ (deg))
- Text defines CVTX1, etc with a space CVTX 1, CVTX 2....
- BeamPipe should be "beam pipe", as in text

Chapter 4

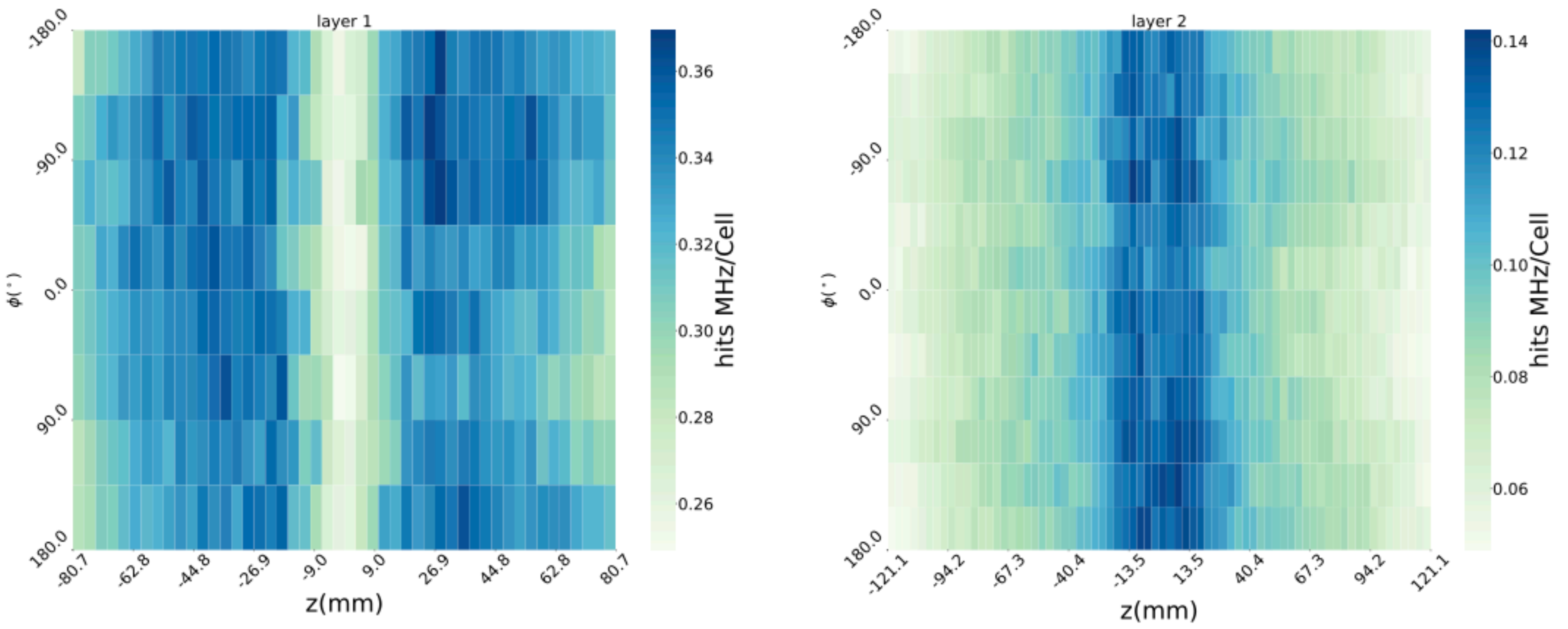


Figure 4.8: Hit rate distribution of Higgs mode. The shape of VTX is approximately cylindrical, where the x-axis can be equivalently regarded as the z-axis of the global coordinate, and the y-axis can be equivalently regarded as the polar angle ϕ of the global coordinate. Synchrotron radiation is not included.

- Missing labels (a), (b), which should be added in Latex, and explained in the caption
  - Font is too small .... very difficult to discern what is different between these two plots
  - Units of degrees should be (deg) not (°). You can use (°) after a number, but not to indicate the units in plot axis.
- Caption: text on x- and y-axis makes little sense. There is no axis in the figure. What do you really mean?
- Why is the rate a minimum at Z=0 in layer 1, and a maximum in layer 2? What is the B-field being used here?

Chapter 4

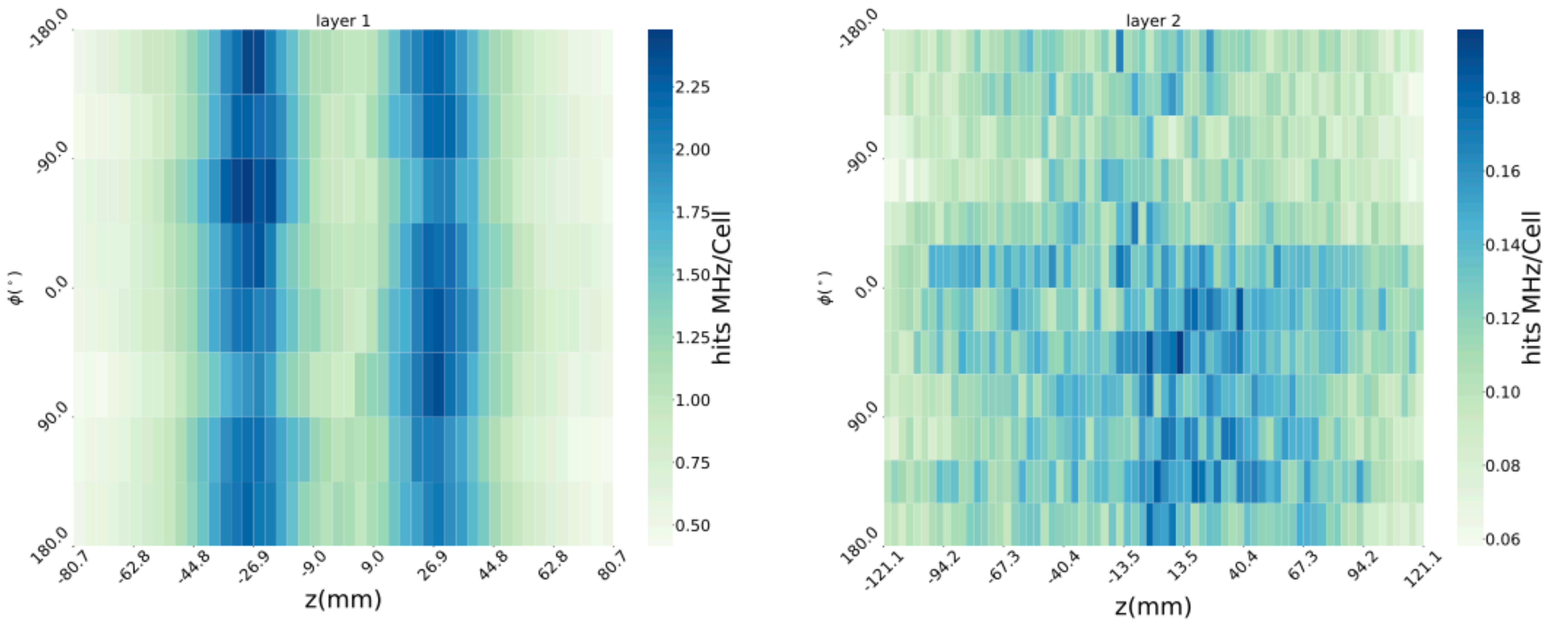


Figure 4.9: Hit rate distribution of Z mode. For we could not completely handle high-lumi Z mode now, as well as the major difference between high-lumi Z with Z mode is luminosity which means their hit rate distribution is similar, the hit rate distribution of high-lumi Z would not be shown here. Synchrotron radiation is not included.

- Same as previous plot
- Text really not clear... Just say what these plots are, not excuses for not doing other work

Chapter 4

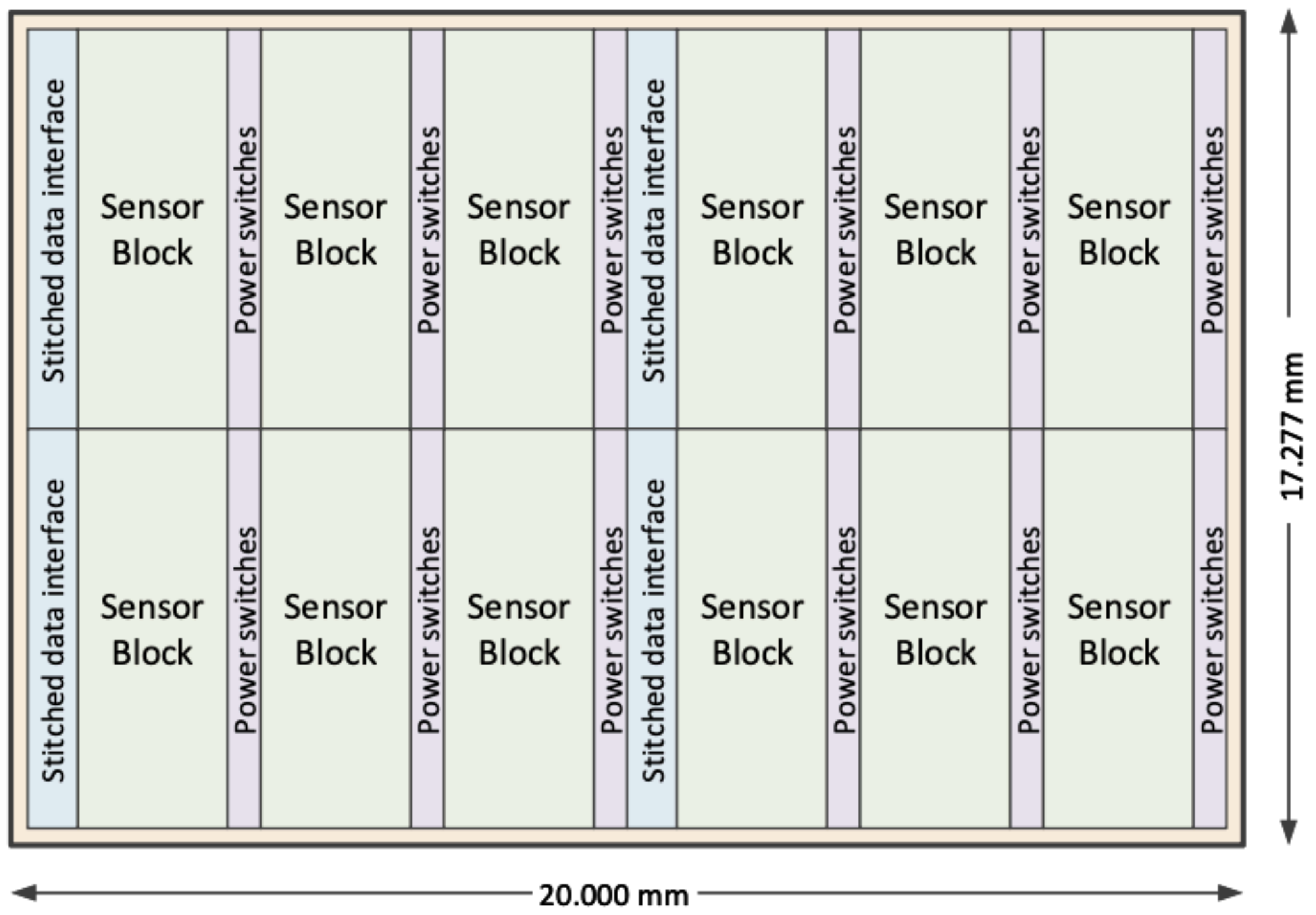
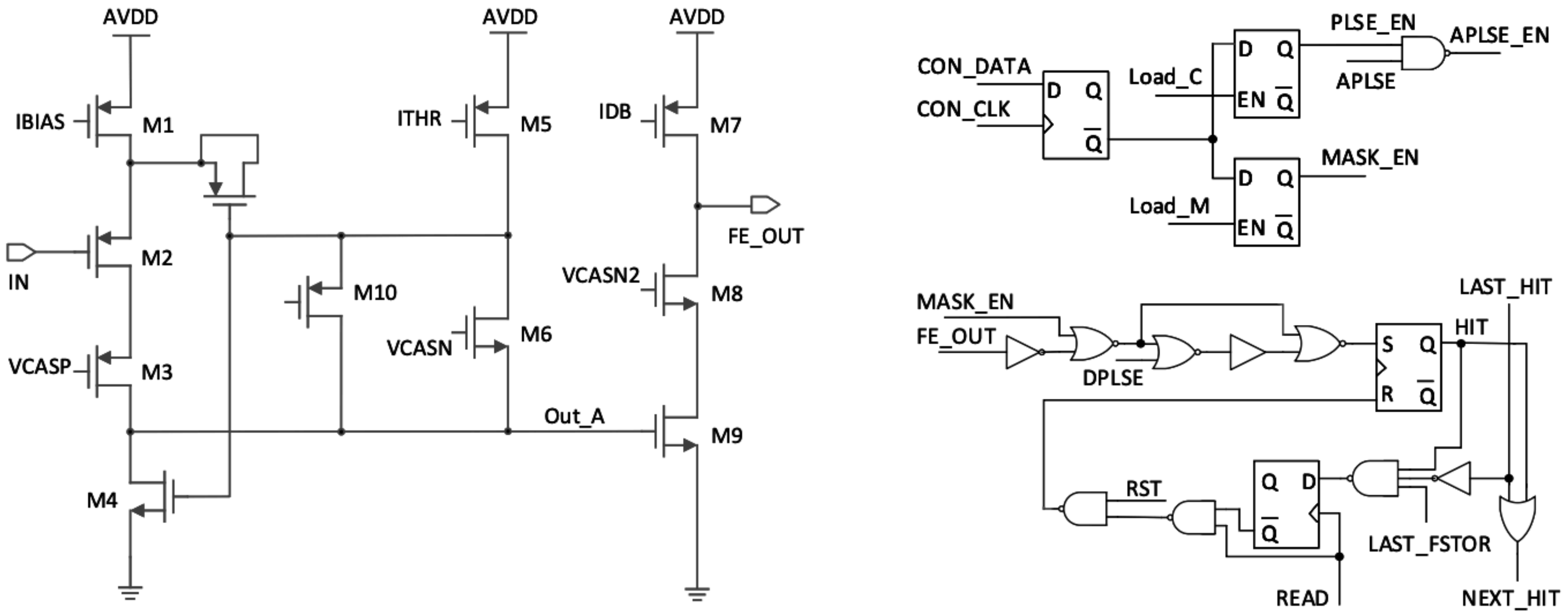


Figure 4.11: Proposed floor-plan for a RSU (not to scale). It contains several identical sensor blocks. Each of them has a pixel matrix with its own biasing generator, slow control and periphery readout circuit. Each sensor block can be selectively switched on/off. The stitched data interface blocks are used to transmit control signals and data to the edge of the stitching sensor.

- Good, but....
  - make it a little bigger so that the text can be read more easily

Chapter 4



(a) (b)

Figure 4.13: Schematic and block diagram of the in-pixel circuits. (a) Schematic of the analog front-end. (b) Diagram of the digital logic.

- Good, but....
  - Figure is not very useful without more details regarding what is being displayed because most readers are not electronics experts.
  - Caption should include the general functionality included: amplifier in analog front end, etc...

Chapter 4

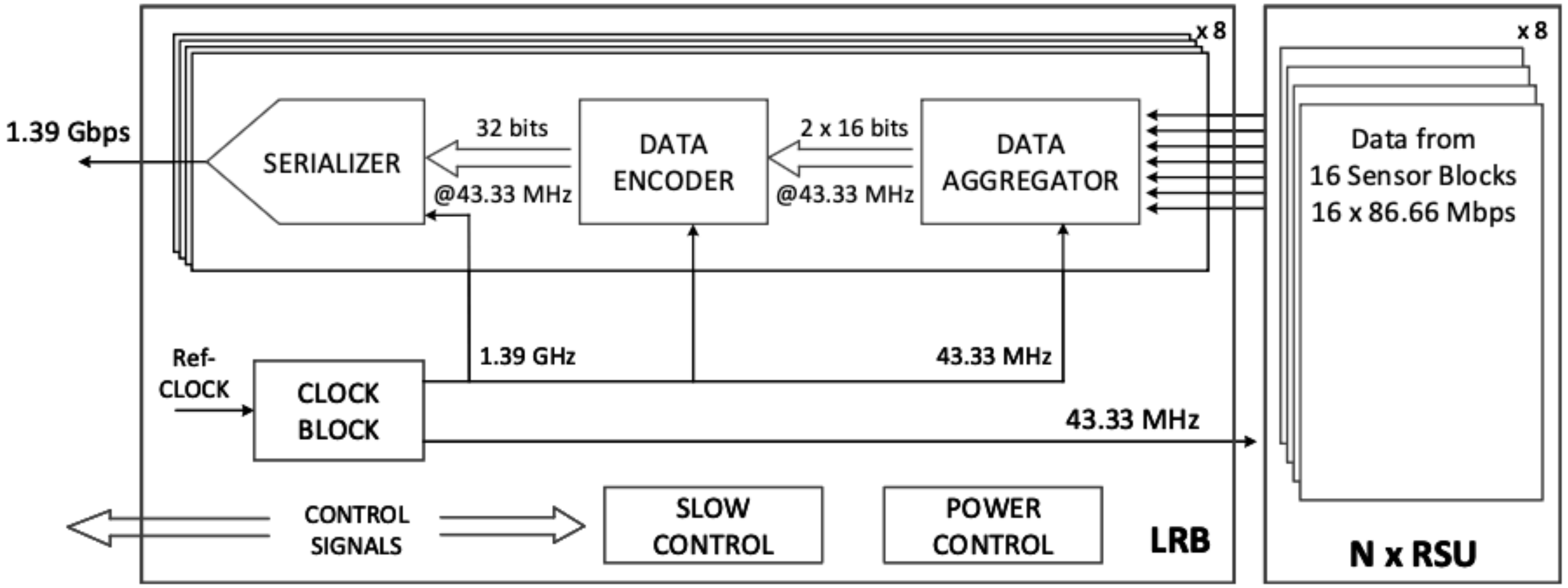
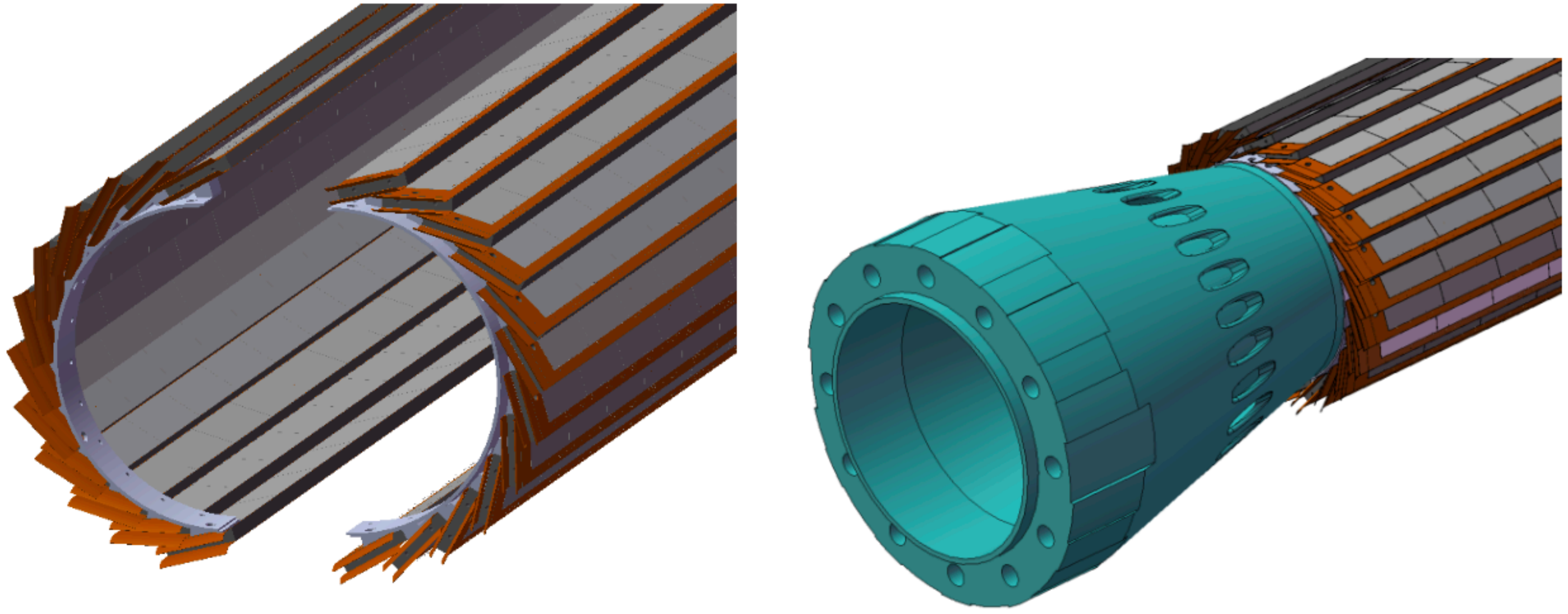


Figure 4.14: Proposed diagram of the LRB. All data from RSUs of one module has to be transmitted to the LRB. 'N × RSU' labeled in the right part of the diagram represents that different layers in the detector contain a varying number of RSUs.

- Figure is OK
- Caption needs to define LRB and RSU. People should not be forced to look for those definitions in the text

Chapter 4



(a) (b)

Figure 4.15: (a) The barrel assembly. (b) The barrel on beam pipe assembly (the outer tube of the beam pipe assembly is not shown)

- Figure (a) is not the barrel assembly, but only the two outer layers of the vertex detector, no? Note that "barrel" is jargon. There are many barrels... In this case, it could be the "barrel vertex detector" but we don't have an end-cap, so i do see why mention barrel here.
- Figure (b) similar comment, not clear what "outer" means here since it could be either in radial direction or in z direction. I assume you mean the outer radial tube

Chapter 4

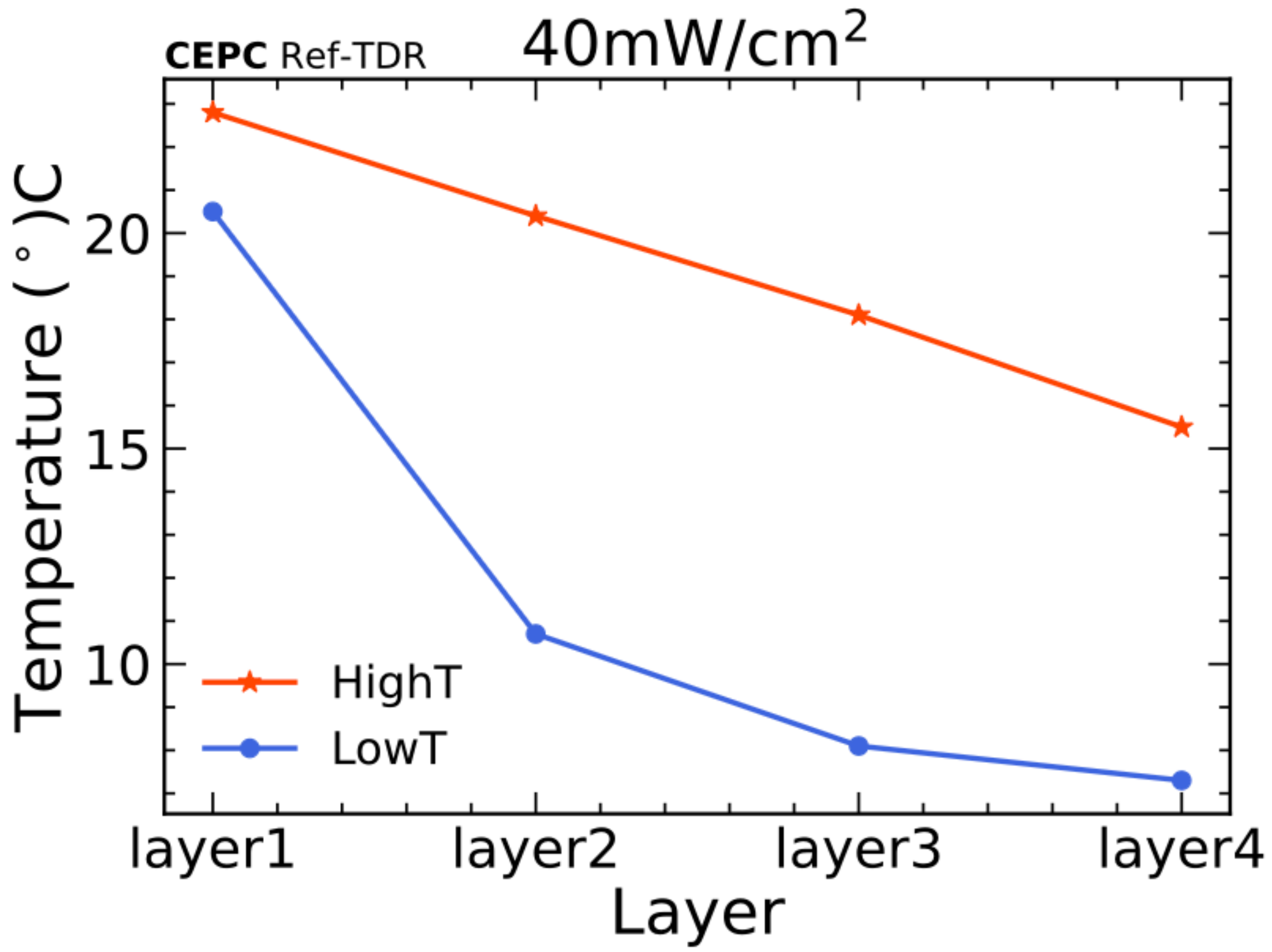


Figure 4.17: Simulation results for the cooling of bent CIS cylinders, with an airflow rate of 3.5 m/s. The beam pipe surface temperature, as shown in Chapter 3, is taken into account.

- The temperature units should be (°C) not as displayed
- HighT and LowT should be High temperature and Low temperature, or add a space before T (do not use new unnecessary symbols)
  - What is the definition of HighT and LowT?
  - What is the significance of 40mW/cm^2? It is not mentioned in the caption
- Caption:
  - "Simulation results for the cooling" could meaning many things. The plot shows a temperature measurement somewhere, where?

Chapter 4

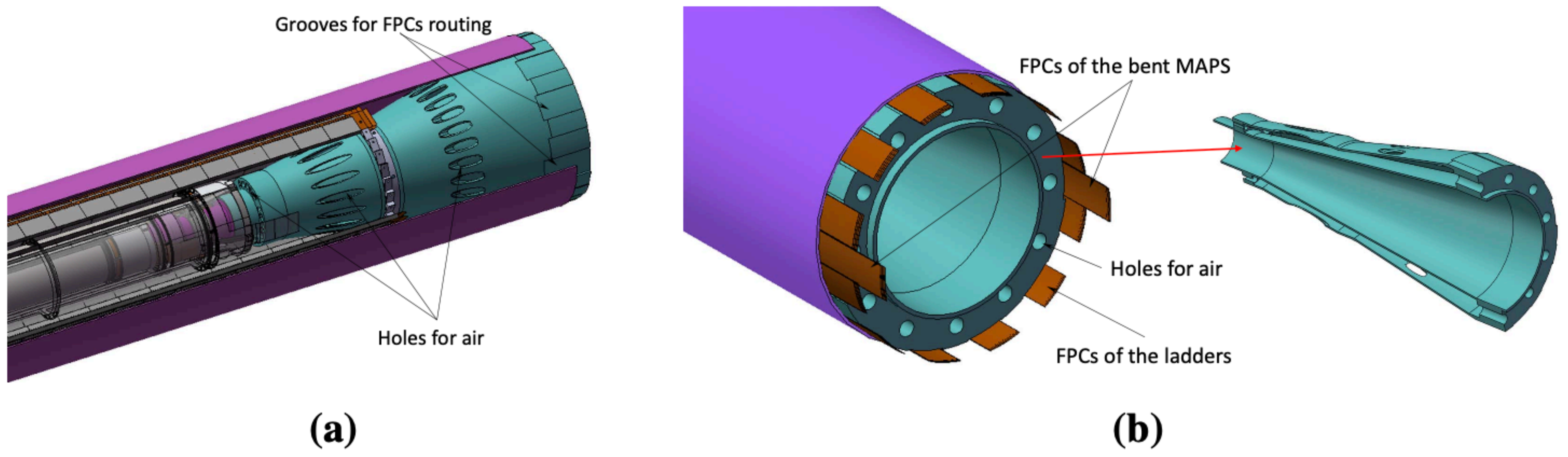
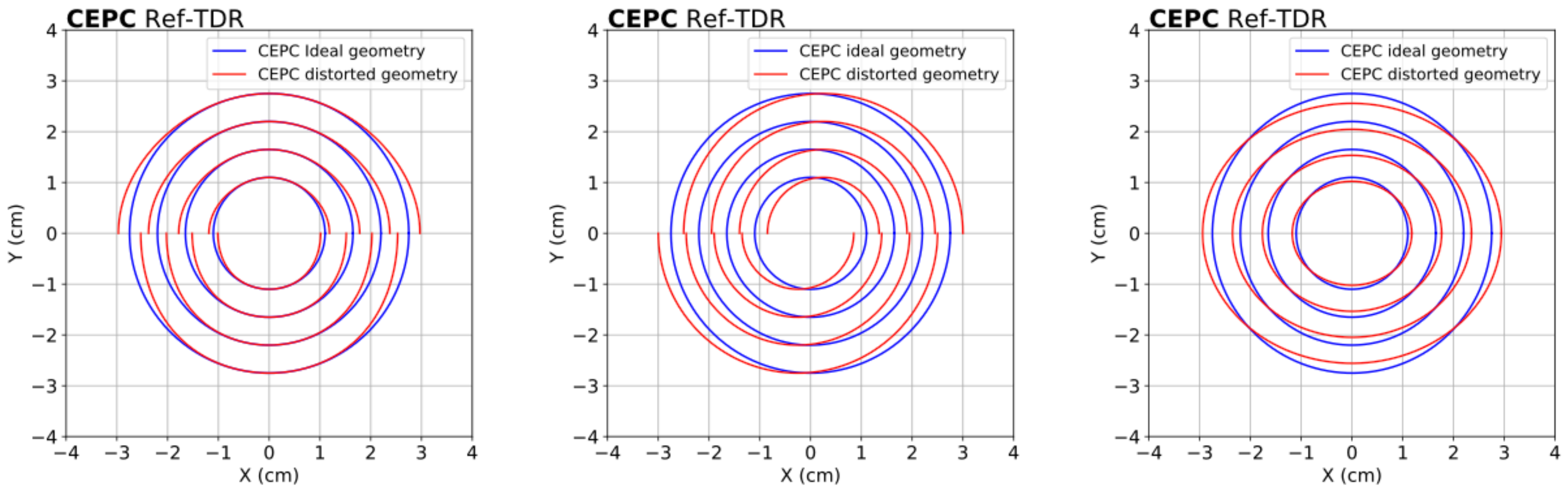


Figure 4.18: Air ventilation and cable routing of the VTX. (a)Air channel design with holes on global support structure for air distribution. Grooves on support structure is designed for FPCs routing. (b) The FPCs of the vertex detector routed out of the side of the beam pipe assembly, along with a cut view of the conical part.

- This figure was shown last week.
  - We fixed what i pointed out, the capitalization of "The FPCs..." but forgot to add a space after (a) and before "Air"
- **Please be proactive looking for problems. I cannot write everything**

Chapter 4



(a) **(b)** **(c)**

Figure 4.19: Illustration of the hit positions in the transverse plane with ideal vertex geometry and three deformed geometry. The amount of deformation is amplified with respect to the expected one for visualisation. (a) Elliptical deformation. The red distorted geometry is elongated horizontally, demonstrating a deformation primarily along the x-axis. (b) Illustration of the hit positions in the transverse plane for vertex geometry exhibiting irregular, wavy distortion. The distorted geometry has noticeable undulations, indicating non-uniform deformation affecting both the x and y directions unevenly. (c) Illustration of the hit positions in the transverse plane for vertex geometry showing a circular distortion with uniform radial expansion. The distorted geometry presents a uniformly increased radius, representing an isotropic deformation compared to the ideal geometry.

- Font is still too small !
  - There is space to make the plots bigger and/or increase the font size

Chapter 4

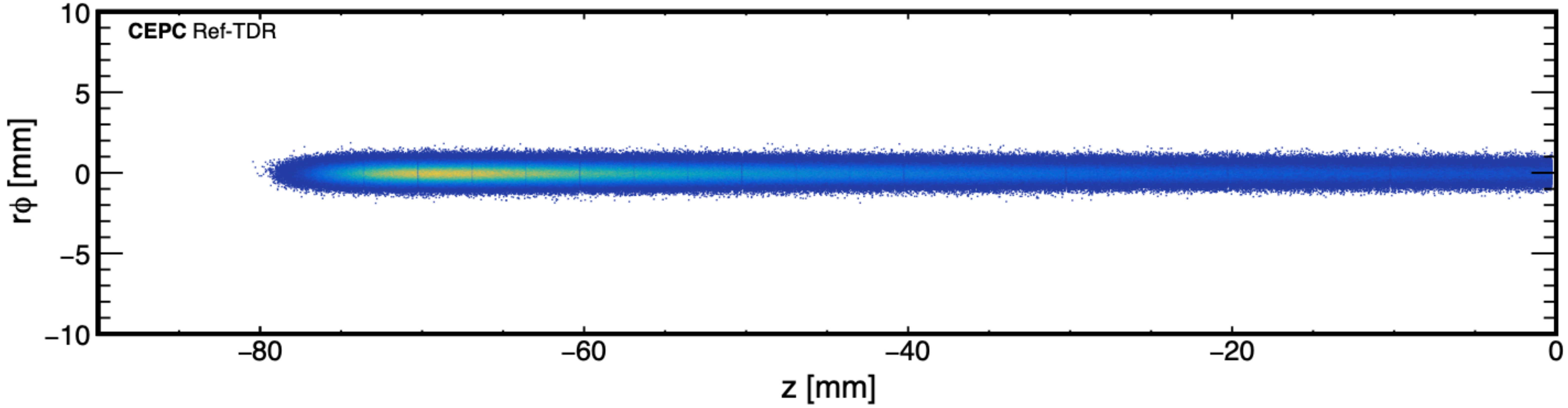
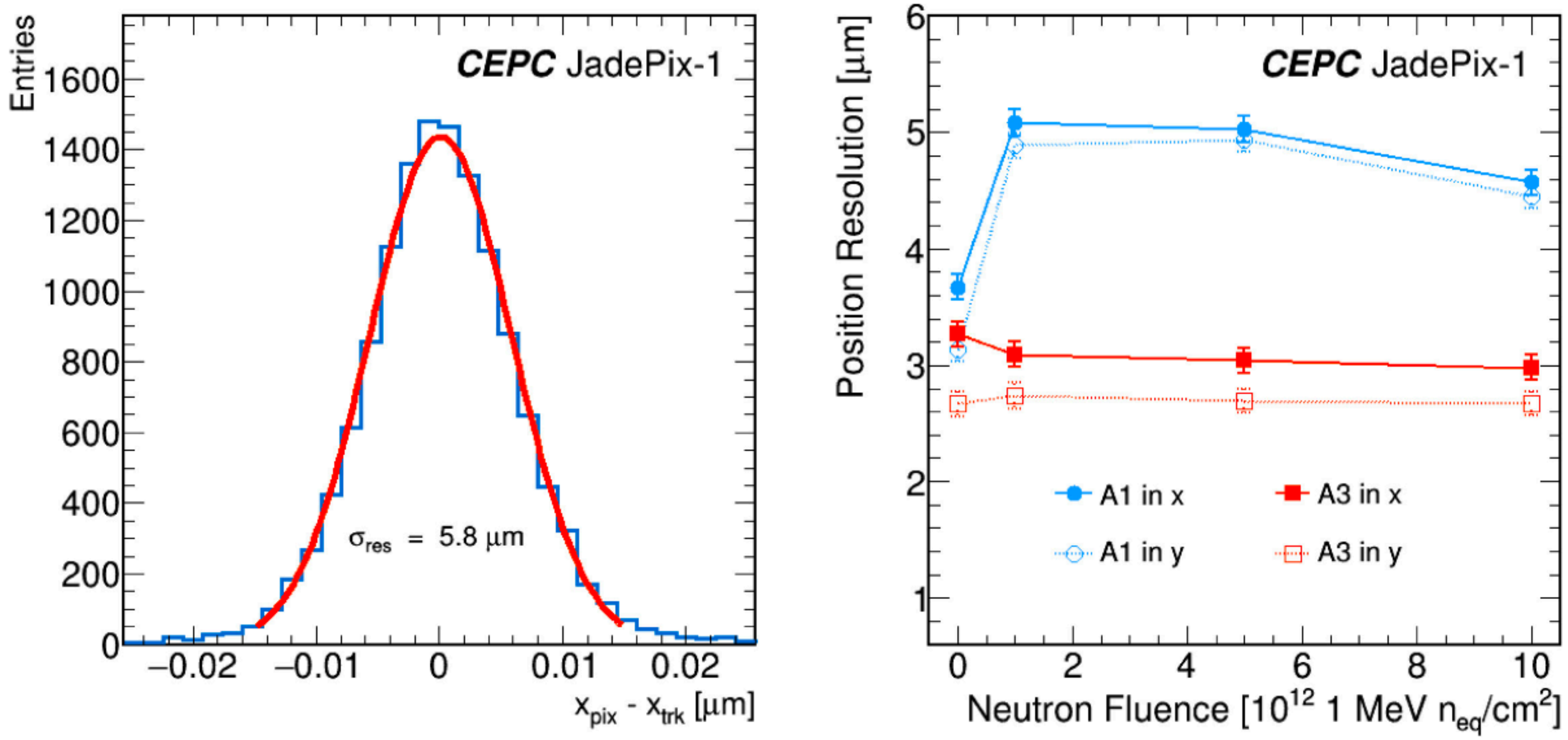


Figure 4.21: The laser beam spot on the second layer from (13 mm, 0, -85 mm) in cylindrical coordinate system, where the horizontal axis is the z-coordinate, and the vertical axis is the $r\phi$ coordinate. And each region is divided by a blank or lower rate than its neighbor means one sensor.

- CEPC Ref-TDR font is still too small. Are we ashamed of it? :-)
- Caption:
  - "Laser beam spot…" drop the "The"
  - Don't start sentences with "And" (I cannot understand this sentence either)

Chapter 4



(a) (b)

Figure 4.22: (a) Residual distribution of JadePix-1 sensor in the x direction. (b) Position resolution for sensors with a small electrode (A1) and a large electrode (A3) before and after the neutron irradiation.

- Caption:
  - "x" should be italic (like in the previous Figure)
  - Why is the resolution in the x-direction worse than in the y-direction?
  - A1 and A3 are not defined in the text, and here the regard small and large electrodes. Make the connection either in the caption or in the text.

Chapter 4

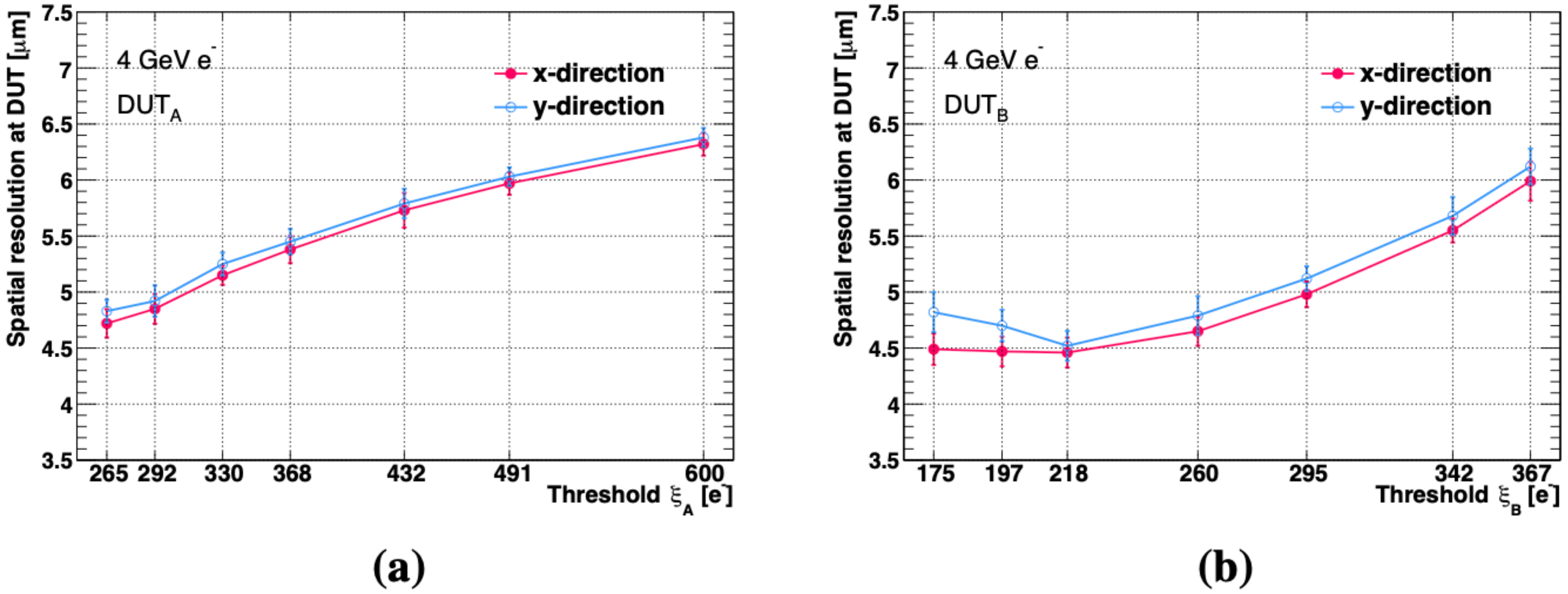


Figure 4.23: Spatial resolution as a function of threshold for DUT$_A$(a) and DUT$_B$(b) in the x-direction and y-direction. The error bars represent the total systematic uncertainty.

- x-, y-direction are not defined. Also not defined in the text, as far as i can see, although they are different in the results
    - Usually resolution in the x direction would be indicated with σ_x, etc..
- What is the difference between DUTA and DUTB?
- Missing CEPC labels

Chapter 4

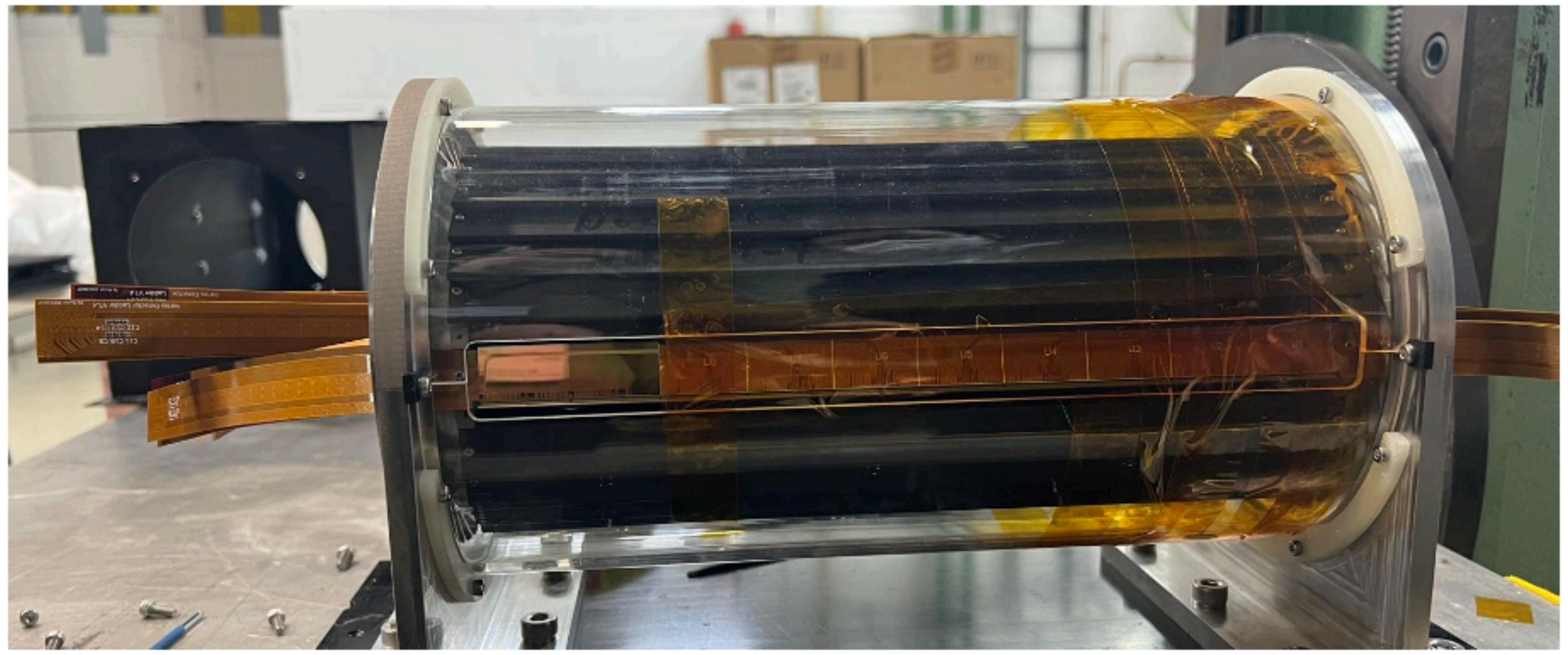


Figure 4.24: Planar vertex detector prototype with six ladders mounted for beam test.

- Caption does not explain what we are seeing? No way for the reader to know what 6 ladders were mounted.
  - First, the prototype had all mechanical ladders mounted
  - I assume you mean there are “6 instrumented ladders”. Somewhere in the text, we should say that each ladder had one Taichupix, and the beam was shot through the 6 ladders providing 12 measurement points

Chapter 4

Stitching/StitFig4.jpg

Stitching/StitFig5.jpg

(a) **(b)**

Figure 4.25: Prototype for bending test. (a) Testing of bending limit, the minimum bending radius of 12 mm has achieved. (b) Determining the damage-free duration of the bending wafer, this prototype placed for over 2 years without damage.

- Figure missing

Chapter 4

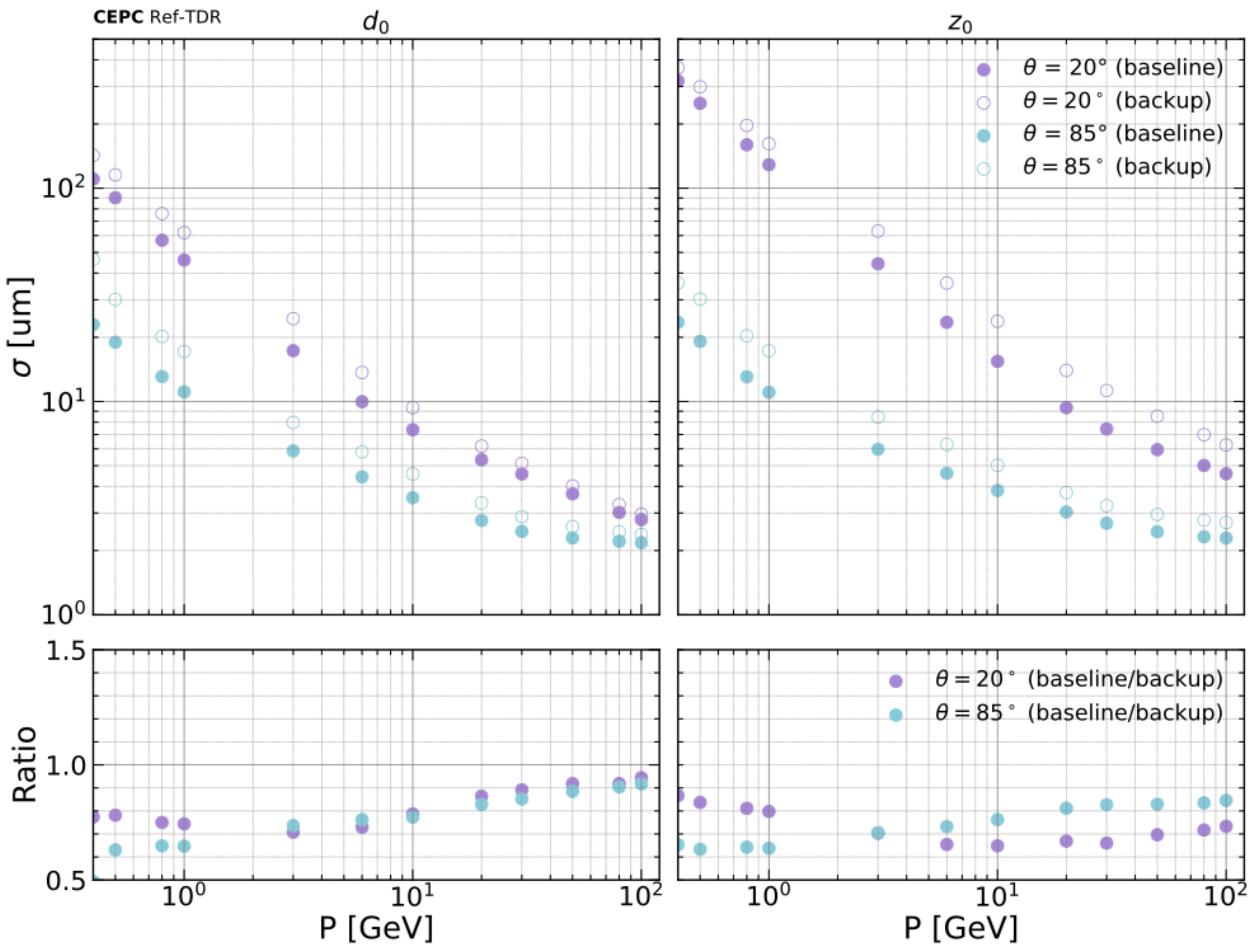


Figure 4.27: The resolution of the impact parameter d_0 and z_0 in the two schemes varies with the change in the momentum of the outgoing μ^- particles.

- Caption: this observation in the caption is obvious and irrelevant to this plot. We can conclude something relative to the comparison, but most important is to say what exactly is this plot (how it was obtained).
- This is for MC muon particles transversing the detector at two different angles, showing that the baseline detector has 10-40% better resolution than the backup solution
- It would be better to call the detectors by proper names, instead of baseline and backup, for instance "curved vtx" and "planar vtx"
- The font for CEPC Ref-TDR is too small

Chapter 4

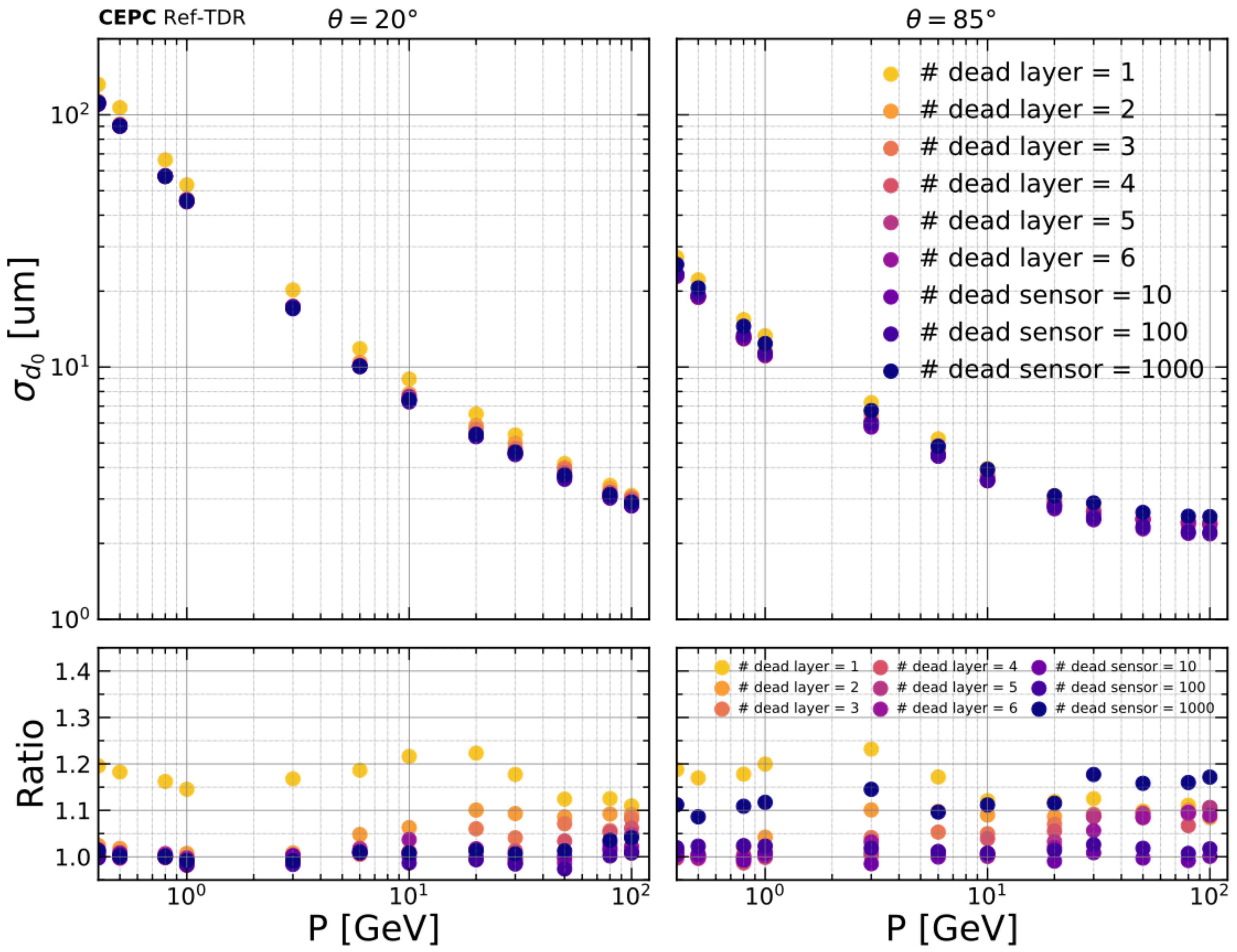


Figure 4.28: Resolution of the impact parameter d_0 for tracks obtained by the baseline vertex detector under different dead layer/sensor conditions, including complete layer failures and 10, 100, 1000 sensor failures (RSUs in CVTX, Taichu chips in PVTX), with ratios to the baseline scheme.

- No need for two legends in this plot. Should delete the one in the ratio plot, which is not readable anyway
- The font for CEPC Ref-TDR is too small

Chapter 4

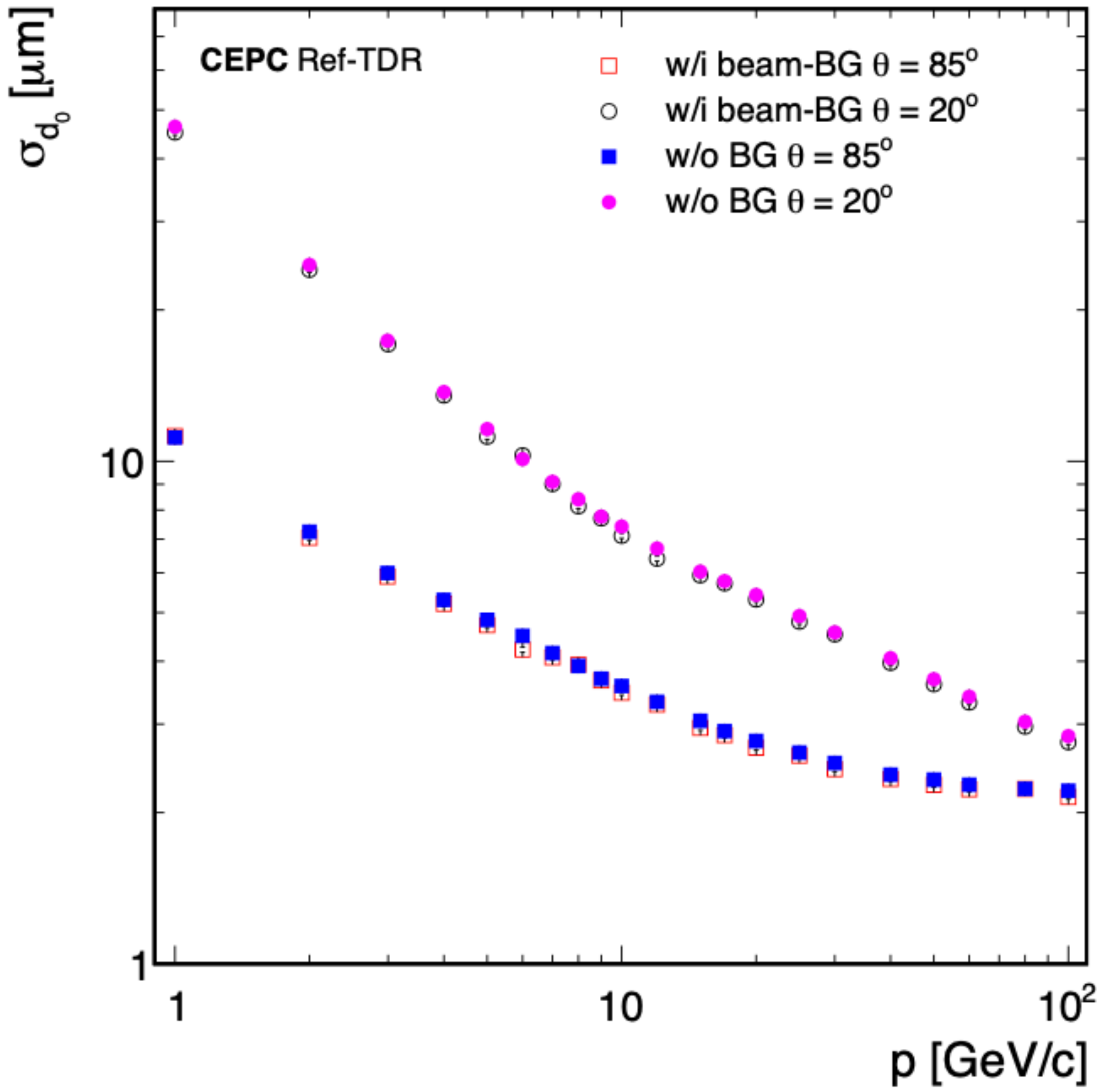


Figure 4.29: Comparison of resolution of the impact parameter d_0 of tracks between clean single muon signal (w/o BG) and mixing beam background (w/i beam-BG) at polar angle of 85° and 20°.

- Make fonts bigger. There is plenty of space, the plot looks empty
- Should use same style as Fig. 4.28 with a grid. Should not have two styles one after the other.
- w/i should be “with” , w/o should be “without”. Don’t invent abbreviations... w/i means Walk-In, not with.... With should be w/ but better not to use

Chapter 4

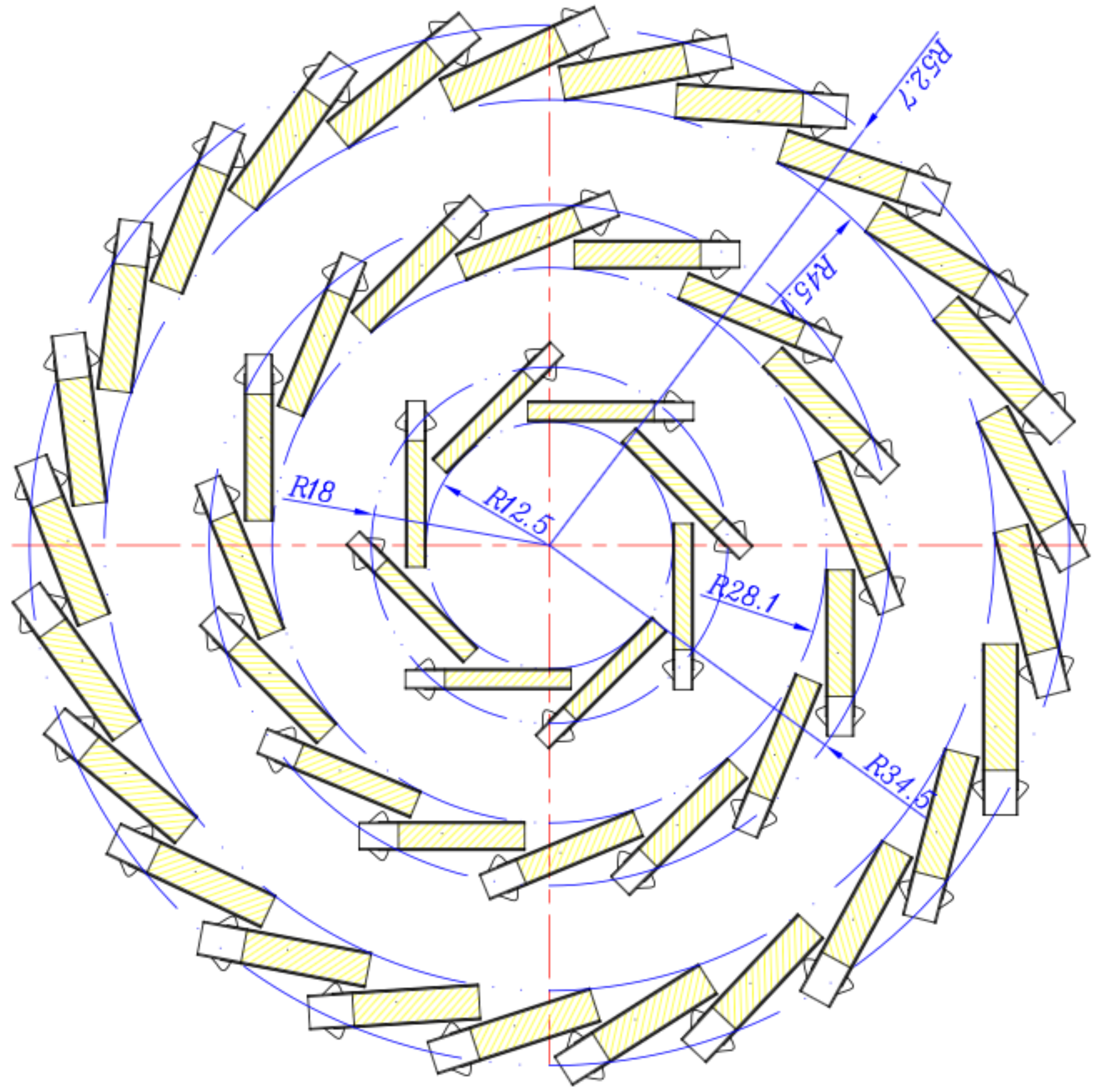


Figure 4.30: Sectional view of the VTX backup layout. All the 6 layers (3 layers of double sided ladders) are composed of planar CISs. PVTX 1-2, PVTX 3-4, and PVTX 5-6 include 8, 16, and 25 ladders, respectively.

- Units missing
- Call the vertex alternative, instead of backup
- Small numbers (less than 10) are usually spelled so, six instead of 6, three instead of 3.

Chapter 5

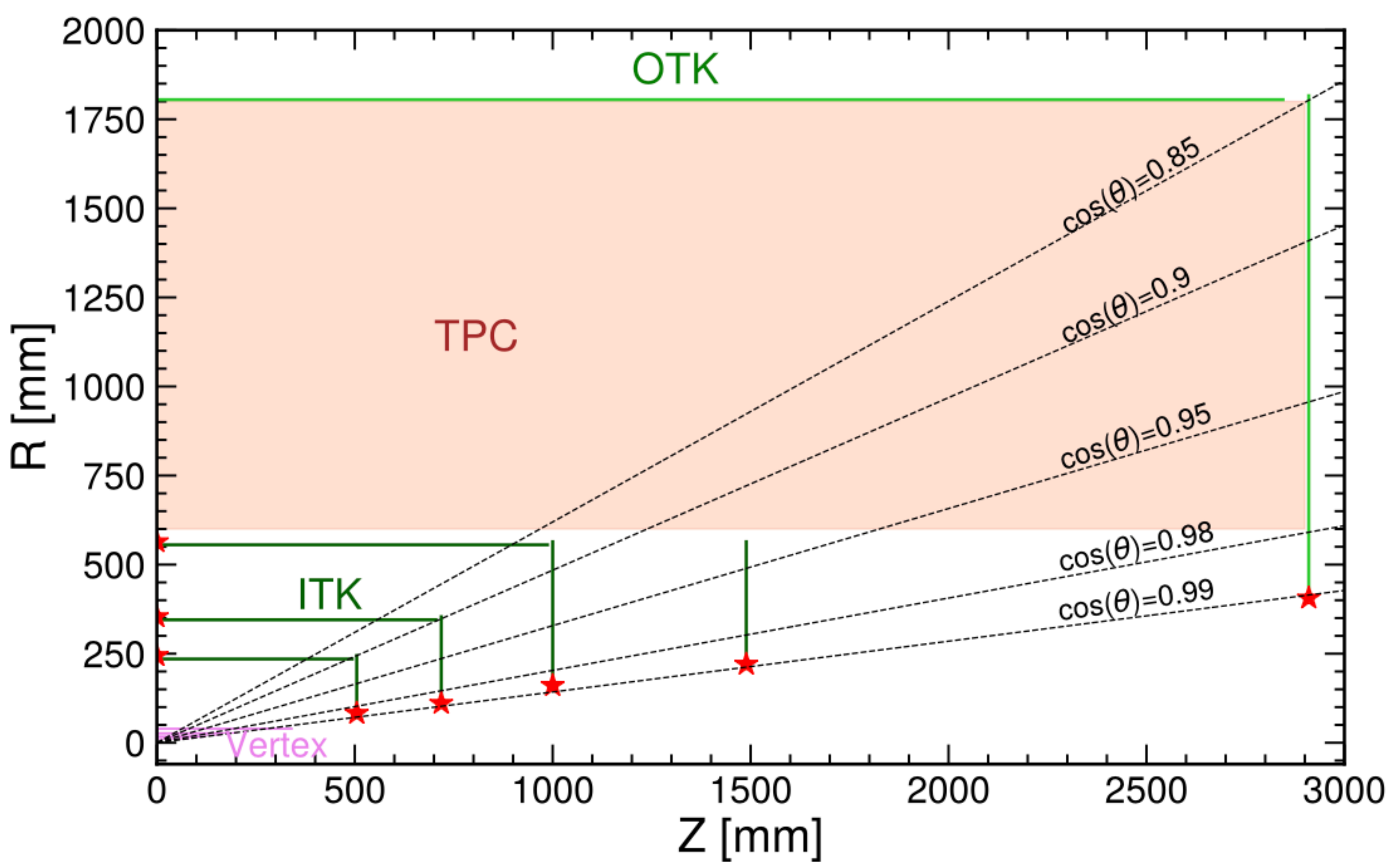


Figure 5.1: The layout of the CEPC tracker system. The tracker system comprises the Vertex Detector, the Inner Silicon Tracker (ITK), the Time Projection Chamber (TPC), and the Outer Silicon Tracker (OTK). The ITK consists of three barrel layers and four endcap layers. The OTK, as the outermost component of the tracker system, features one barrel layer and one endcap layer, providing both high-precision spatial and timing measurements. Action: To remove as it is already in Chapter 2

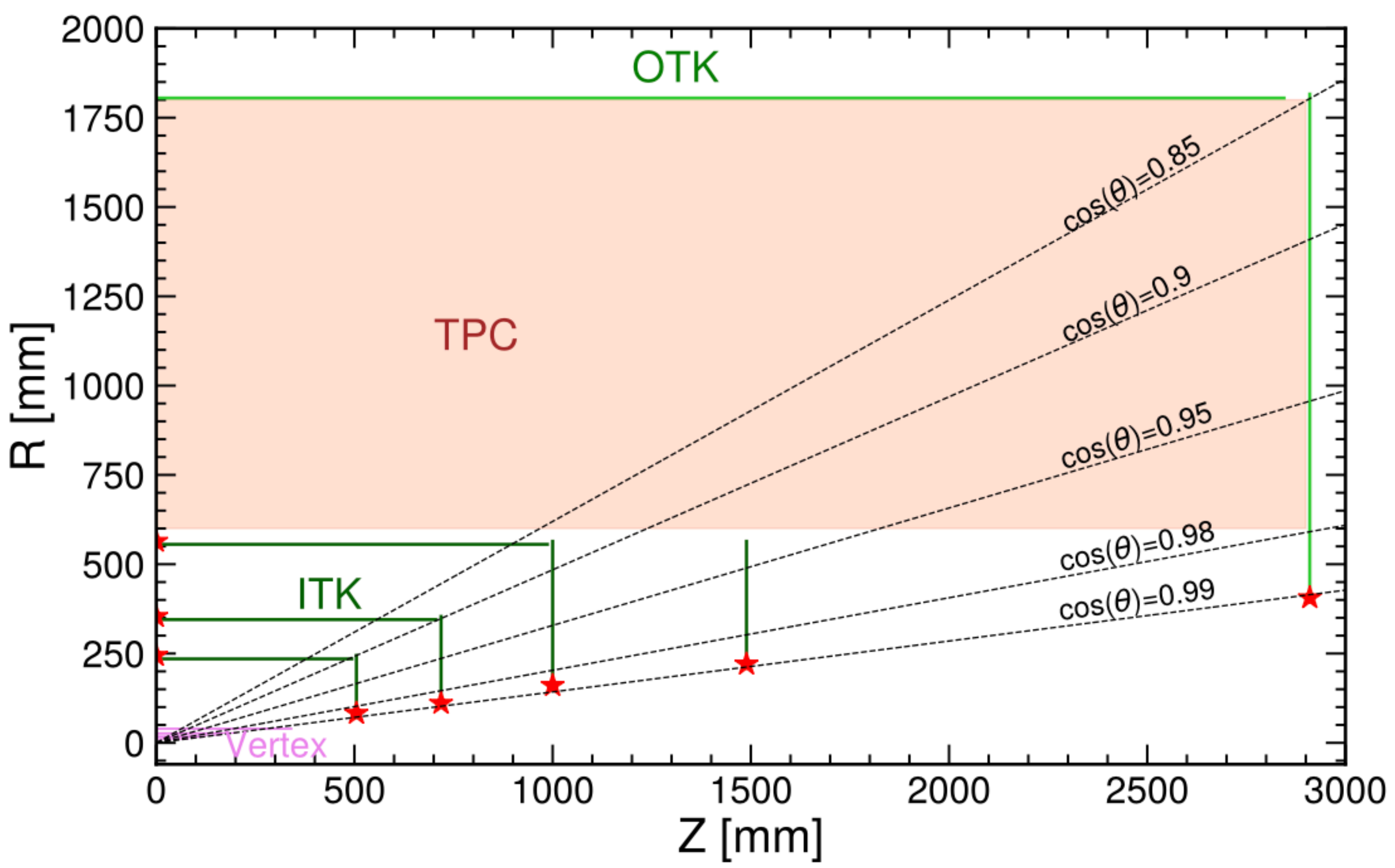


Figure 2.4: Layout of the tracking system of the reference detector. The innermost is silicon vertex detector with six barrel layers shown by magenta lines. The green lines represent Inner Silicon Tracker (ITK) and Outer Silicon Tracker (OTK) with four layers in barrel region and five disks in both sides of the endcap. The OTK provides both high-precision spatial (~ 10µm) and timing measurements (~ 50 ps), which can serve as ToF. The light orange area represents TPC which is embedded in a silicon tracker.

- Good, but repeated from chapter 2
- Caption could indicate that this figure is a reproduction of Figure 2.4 and keep it to facilitate reading
  - Captions are different between the two....
- **Former table from Chapter 5, with overview of all tracking should be moved to Chapter 2**

Chapter 5 - Table 5.1

- **Former table from Chapter 5, with overview of all tracking should be moved to Chapter 2**

Table 5.1: Parameters and layout of the Silicon Tracker. Silicon pixel sensors (HV-CMOS) and Low Gain Avalanche Detector (LGAD) technologies are planned for the ITK and OTK baseline, respectively. The column labelled $\pm z$ shows the half-length of the barrel layers, and the z position of the end-cap disks. The column labelled σ_ϕ and σ_t represent the spatial resolution in the bending direction and time resolution, respectively. The main parameters of the VTX and the TPC are also listed here for completeness.

Detector		Radius R [mm]		$\pm z$ [mm]	Material budget [% X_0]	σ_ϕ [μm]	σ_t [ns]
VTX	Layer 1	11.06		80.7	0.06	3	100
	Layer 2	16.56		121.1	0.06	3	100
	Layer 3	22.06		161.5	0.06	3	100
	Layer 4	27.56		201.9	0.06	3	100
	Layer 5	39.32		341.0	0.32	3	100
	Layer 6	39.69		341.0	0.32	3	100
ITK Barrel	Layer 1 (ITKB1)	235.0		493.3	0.68	8	3-5
	Layer 2 (ITKB2)	345.0		704.8	0.68	8	3-5
	Layer 3 (ITKB3)	555.6		986.6	0.68	8	3-5
OTK Barrel	Layer 4 (OTKB)	1,800		2,840	1.6	10	0.05
TPC	Inner wall	600		2900	0.16	—	
	Gas	625-1775		2761	~ 1	110-144 (220 hits)	
	Outter wall	1800		2900	0.16	—	
		R_{in}	R_{out}				
ITK Endcap	Disk 1 (ITKE1)	82.5	244.7	505.0	0.76	8	3-5
	Disk 2 (ITKE2)	110.5	353.7	718.5	0.76	8	3-5
	Disk 3 (ITKE3)	160.5	564.0	1,000	0.76	8	3-5
	Disk 4 (ITKE4)	220.3	564.0	1,489	0.76	8	3-5
OTK Endcap	Disk 5 (OTKE)	406.0	1,816	2,910	1.4	10	0.05

Table 5.1: Parameters and layout of the Silicon Tracker. The column labelled $\pm z$ shows the half-length of the barrel layers, and the z position of the end-cap disks. The column labelled σ_ϕ and σ_t represent the spatial resolution in the bending direction and time resolution, respectively.

Detector		Radius R [mm]		$\pm z$ [mm]	Material budget [% X_0]	σ_ϕ [μm]	σ_t [ns]
ITK Barrel	Layer 1 (ITKB1)	235.0		493.3	0.68	8	3-5
	Layer 2 (ITKB2)	345.0		704.8	0.68	8	3-5
	Layer 3 (ITKB3)	555.6		986.6	0.68	8	3-5
OTK Barrel	Layer 4 (OTKB)	1,800		2,840	1.6	10	0.05
		R_{in}	R_{out}				
ITK Endcap	Disk 1 (ITKE1)	82.5	244.7	505.0	0.76	8	3-5
	Disk 2 (ITKE2)	110.5	353.7	718.5	0.76	8	3-5
	Disk 3 (ITKE3)	160.5	564.0	1,000	0.76	8	3-5
	Disk 4 (ITKE4)	220.3	564.0	1,489	0.76	8	3-5
OTK Endcap	Disk 5 (OTKE)	406.0	1,816	2,910	1.4	10	0.05

Chapter 5

- Subfigure numbering (a), (b) should be done in latex, instead of incorporating into the figures

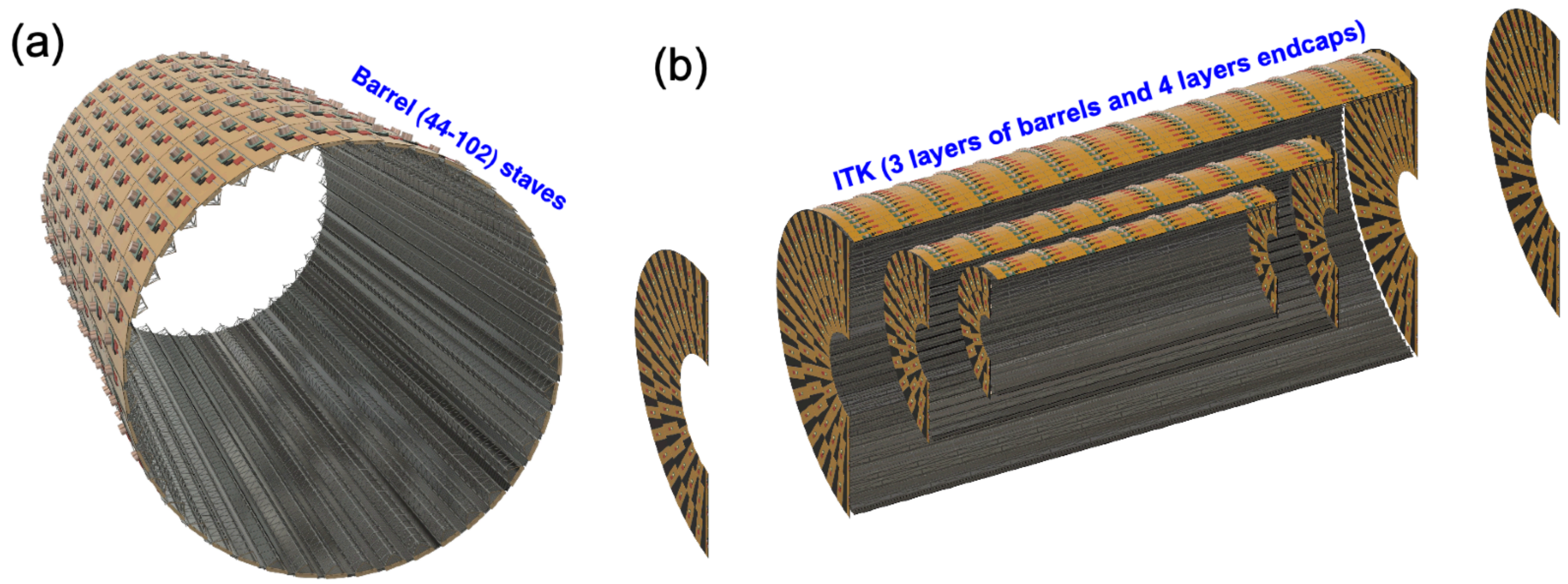


Figure 5.3: (a) ITK barrel and (b) ITK comprising 3 layers of barrels and 4 layers of endcaps. Each ITK barrel contains 44, 64, or 102 staves arranged in a staggered structure to mimimize dead area.

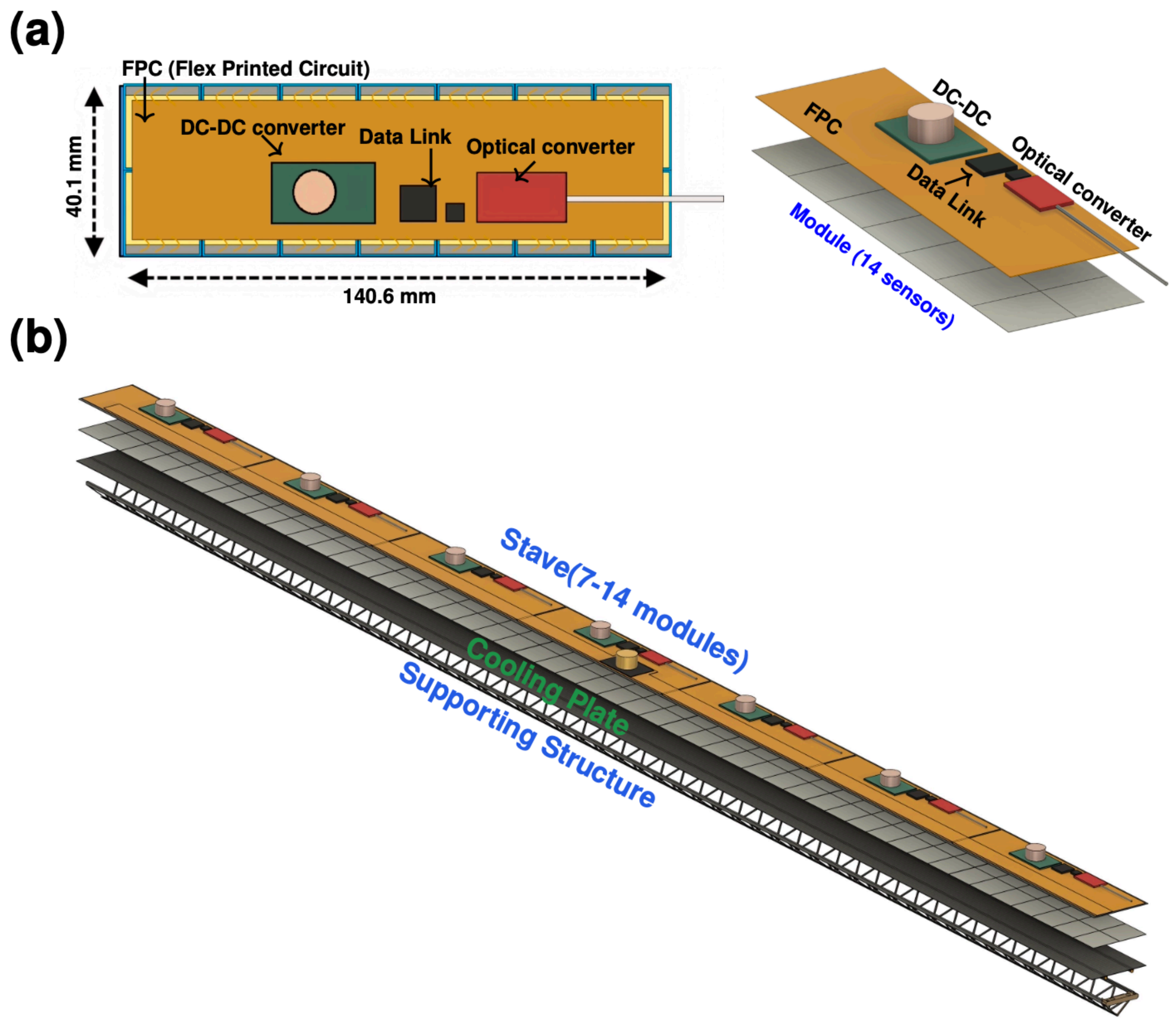


Figure 5.2: (a) ITK module and (b) ITK stave. The ITK module consists of 2×7 monolithic HV-CMOS pixel sensors, with their backside glued to a FPC board integrated with electronic components, including DC-DC converters, a data aggregation chip, a data link chip, and an optical converter. Each ITK stave is made up of 7, 10, or 14 modules, one or two long power bus FPCs, a plate with embedded cooling tubes, and a truss supporting structure.

Chapter 5

- Use subfigure numbering (a), (b) instead of left and right
- Indicate what "front" and "back" means, with front being closer to the IP. This is the first time such naming shows up

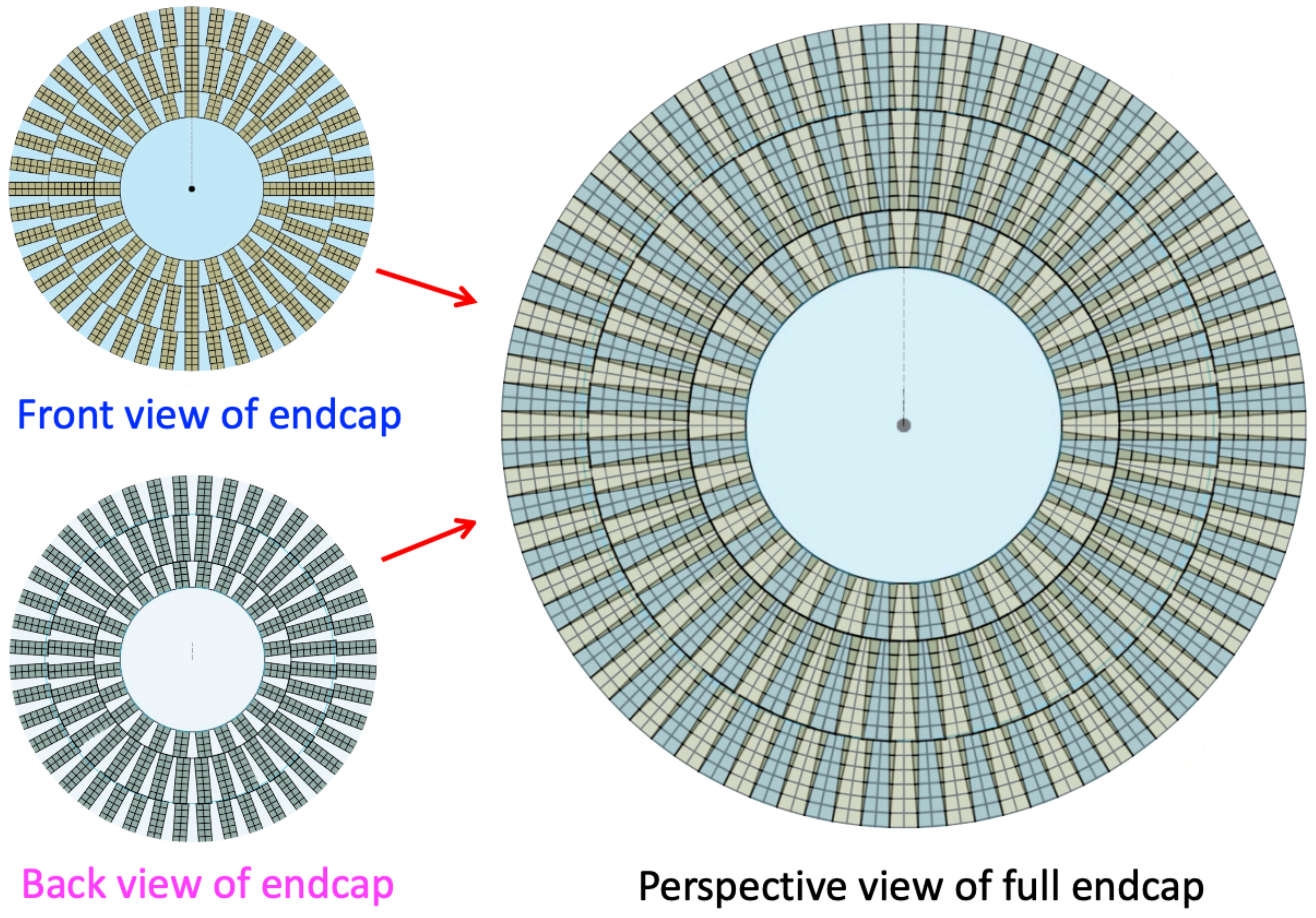


Figure 5.4: Perspective view of the sensor and module distribution for the fourth ITK endcap. The ITK endcap has double-sided detection faces (left), with the module layout on the two faces compensating for each other to minimize the dead detection area (right). The overlapping detection regions of the modules from the two faces are highlighted in dark green triangles.

Chapter 5

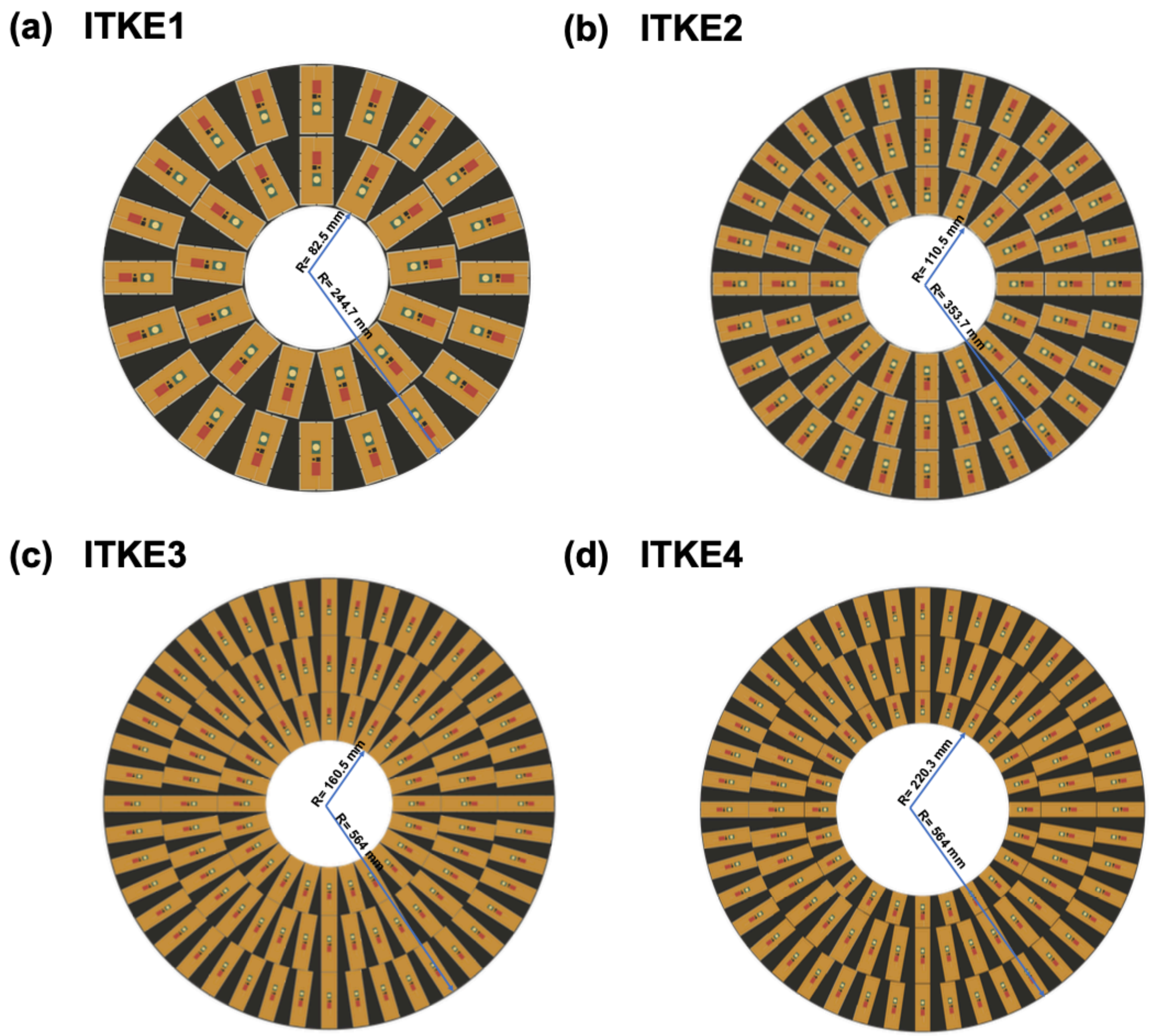


Figure 5.5: The module layout of the four ITK endcaps ITKE1(a), ITKE2(b), ITKE3(c), and ITKE4(d). Details are given in Table 5.5.

- Subfigure numbering (a), (b) should be done with latex.
  - Not sure if this split is needed since each endcap is already labelled and the different figures are not referenced separately
- Font for dimensions is extremely small. Text not readable. Could remove the “R =“ to get more space. Caption could mention that the radial dimensions are provided in the figures.

Chapter 5

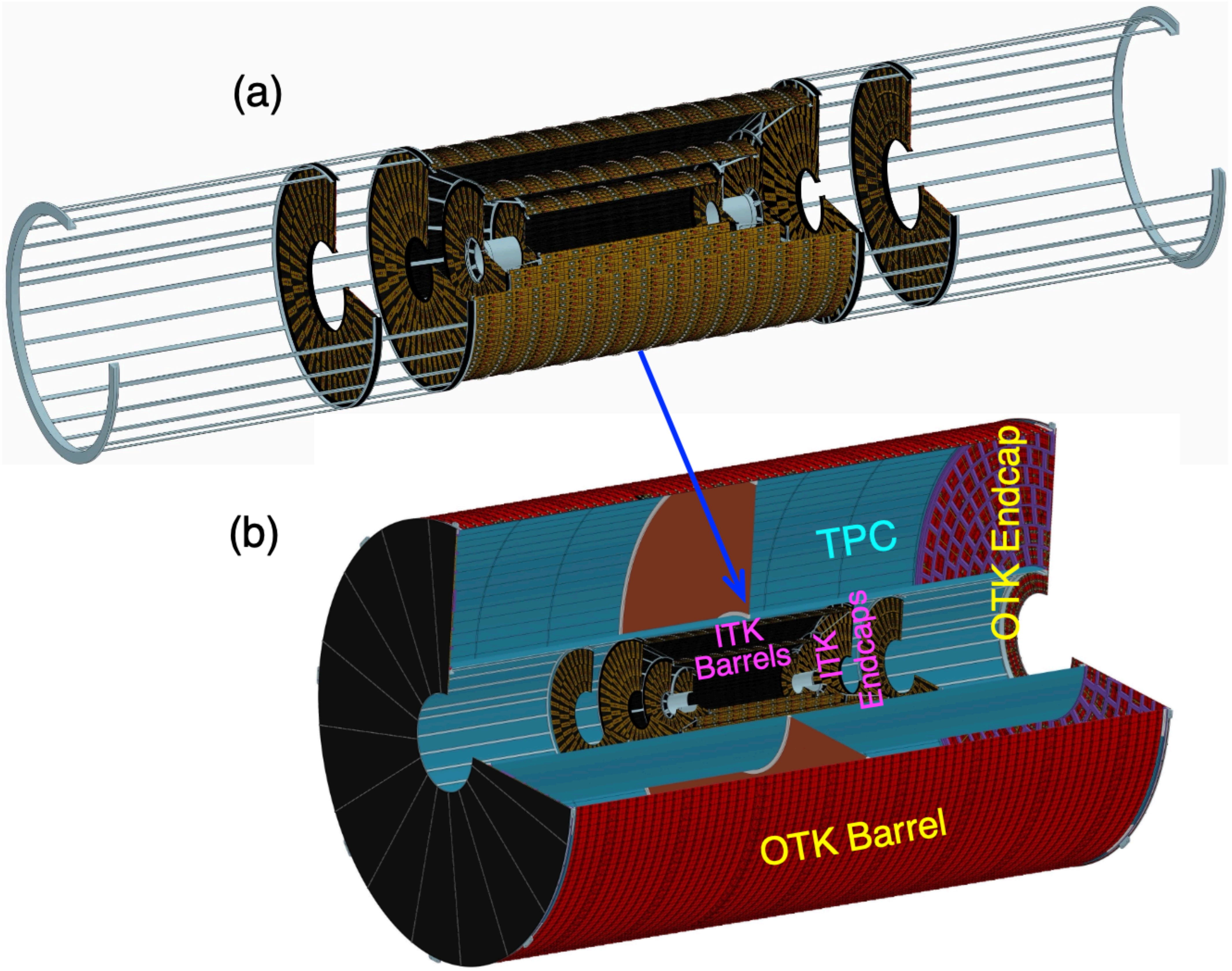


Figure 5.9: (a) Structure of the ITK, consisting of three barrel layers built from azimuthally segmented staves, and four pairs of endcaps mounted onto two end-wheel structures. Together with two extended connection rings, they form the complete ITK assembly. (b) Layout of the OTK (red), TPC (blue), and ITK (yellow). The OTK system consists of azimuthally segmented barrel staves and a pair of endcaps.

- Subfigure numbering (a), (b) should be done with latex.
- Figure 5.9b does not seem to be referenced in the text, and it does not bring any new information. At most, this could be in chapter 2, or mechanics when discussing the integration of the detectors

Chapter 5

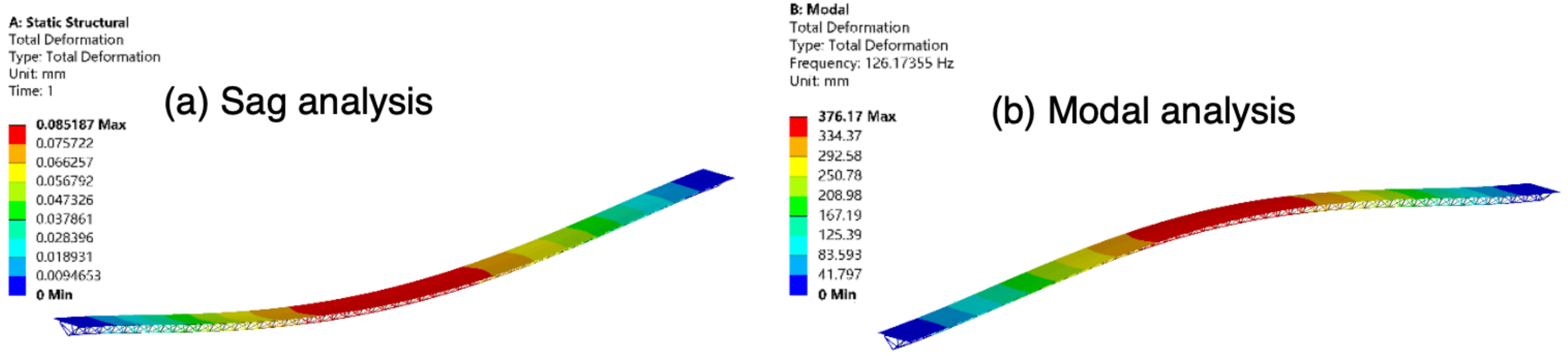
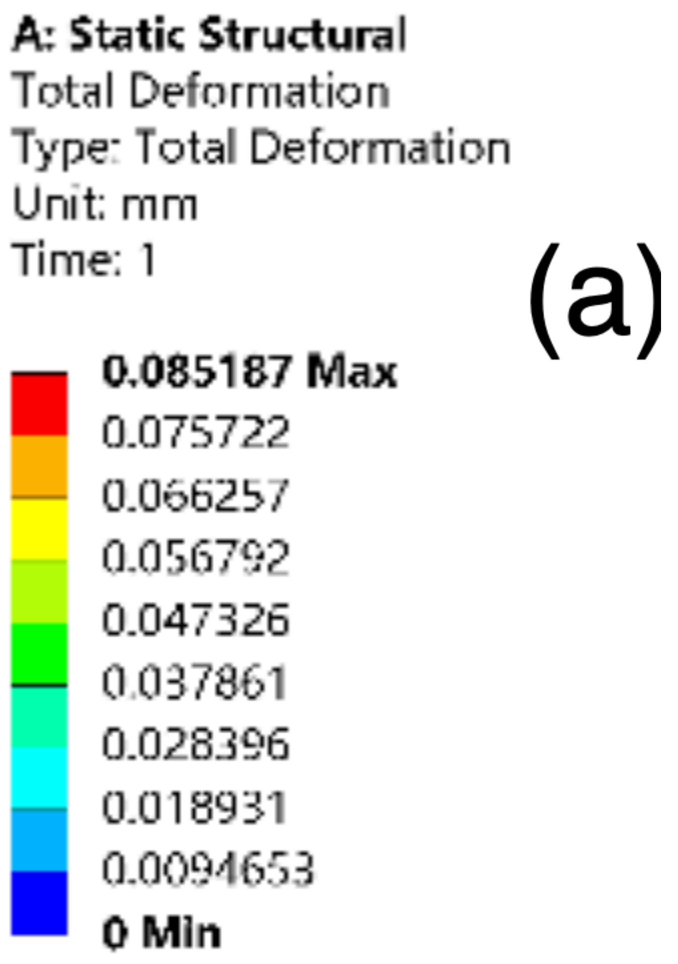


Figure 5.11: Results of (a) gravitational sag analysis and (b) modal analysis for the stave of the first ITK barrel (ITKB1). Both ends of the stave were assumed to be fixed supports. The blue color indicates zero movement, while the red lines represent maximum movement. The maximum sag is 85 μm, and the first natural frequency is 126 Hz.

- A nice caption for this kind of plot!
- Subfigure numbering (a), (b) should be done with latex.
- Font is too small and too many significant digits: 2 or 3 significant figures is enough, allowing space for larger fonts
- Figure is of bad quality. It seems to be two screenshots, merged and converted to PDF!



Chapter 5

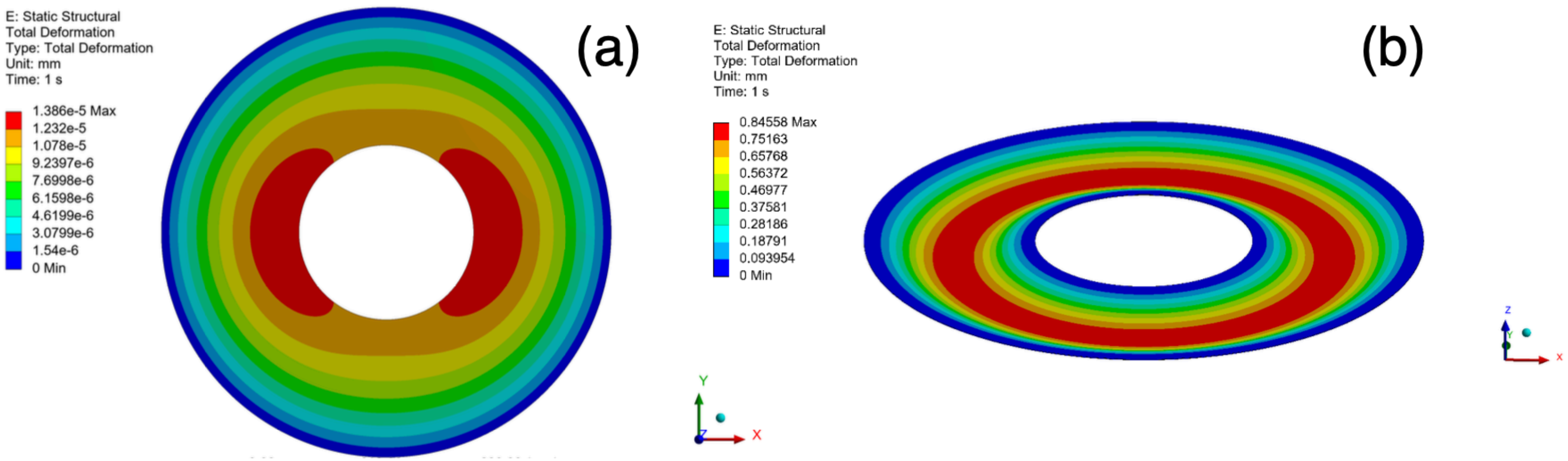


Figure 5.14: Deformations of the fourth ITK endcap in (a) the nominal position, with the outer ring of the endcap assumed to be a fixed support, and (b) the flat-lying position, with both the inner and outer rings of the endcap assumed to be fixed supports. The maximum sag is 0.8 mm in the flat-lying position (b), and negligible (< 1 µm) in the nominal position (a).

- Subfigure numbering (a), (b) should be done with latex.
- Font is too small and too many significant digits: 2 or 3 significant figures is enough, allowing space for larger fonts

Chapter 5

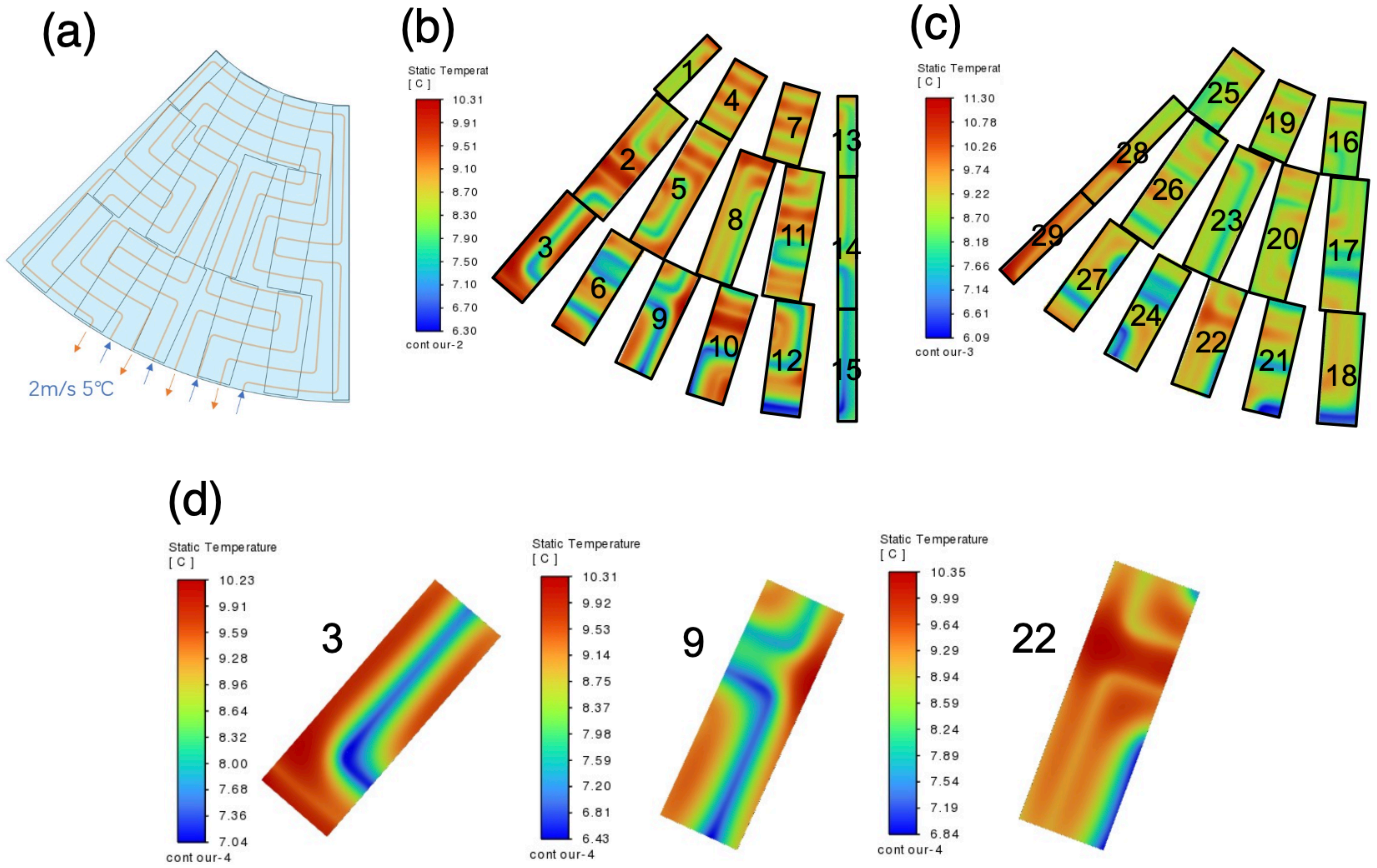


Figure 5.15: (a) Designed cooling loops for one eighth of the ITK endcap, featuring four closed loops arranged radially across 16 coil layers. Sensor temperature distributions for one eighth of the ITK endcap: (b) front-side sensors, (c) back-side sensors, and (d) three modules. All sensor temperatures remain below 11.3°C, and the maximum temperature difference across the plane is less than 5°C.

- Composite figure merged into a pdf file, quality is not optimal but acceptable. Some fonts are rather small. Probably not distinguishable on paper
- Caption: needs to mention the 2m/s 5C from first plot. What are the numbers? The “e” from the word “temperature” is cut off in two plots

Chapter 5

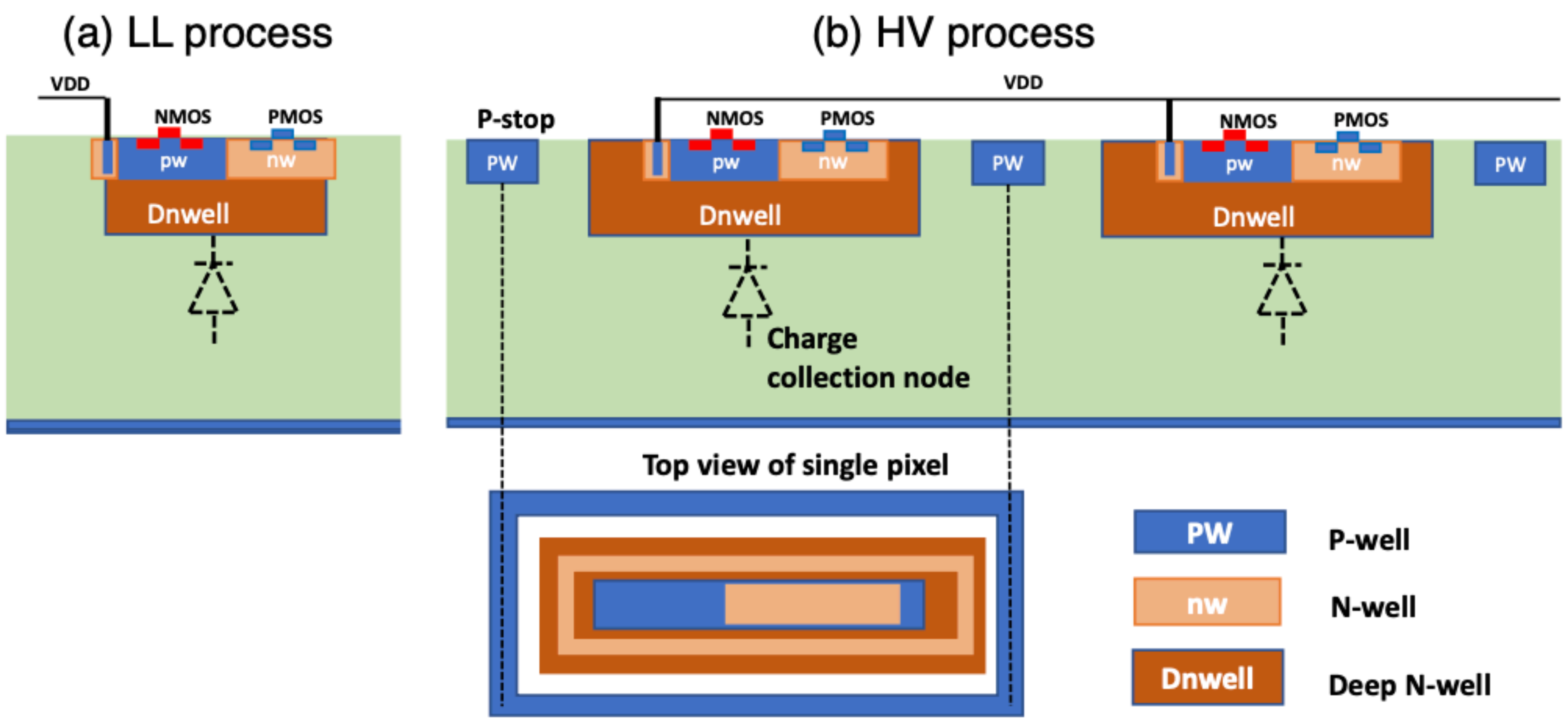


Figure 5.16: Cross-sections of the 55nm (a) Low-Leakage and (b) High-Voltage CMOS processes. The Low-Leakage process was used in the COFFEE1 chip, while the High-Voltage CMOS process was adopted in the COFFEE2 chip.

- Should use latex to number subfigures (a), (b)
- Separate figures (a) and (b) more clearly. Now some people might think it is the same figure

Chapter 5

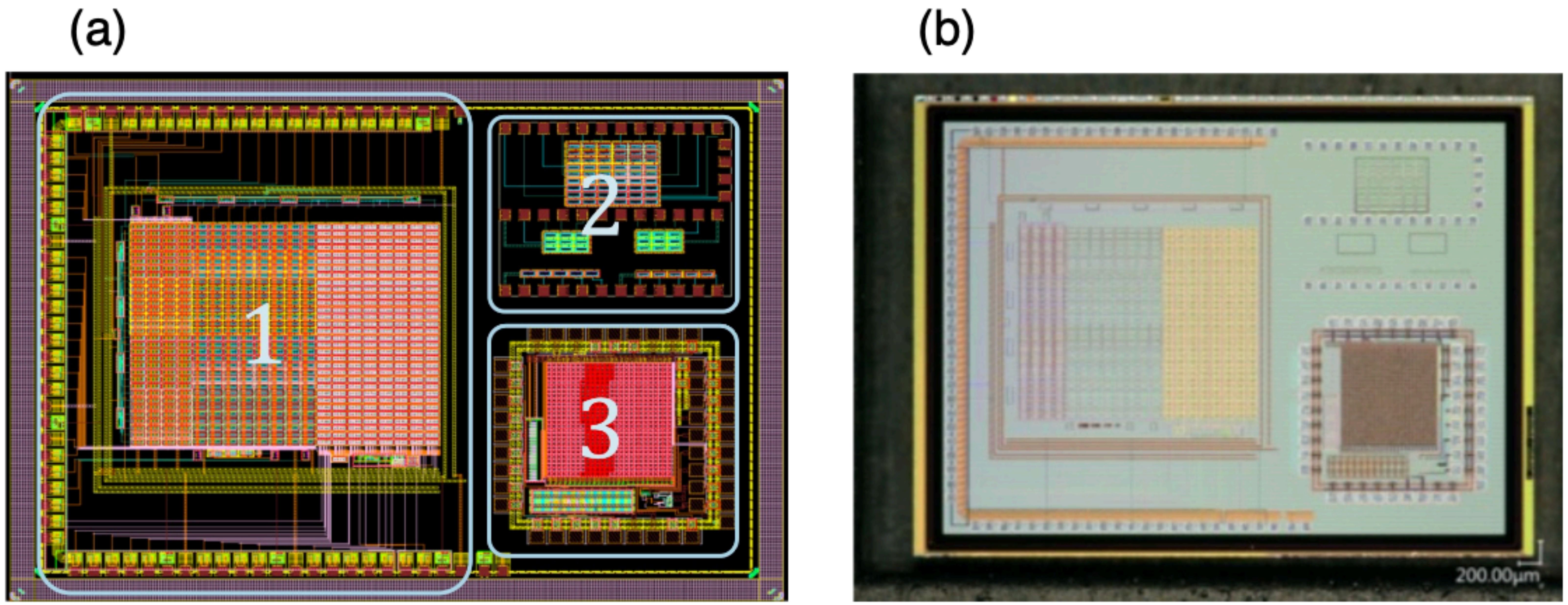


Figure 5.17: (a) Floorplan and (b) photo of the COFFEE2 chip. The chip comprises three sections: Section 1 contains diode arrays and in-pixel circuits; Section 2 consists of passive diode arrays similar to those in COFFEE1; Section 3 is designed for imaging applications with small pixels and is not directly relevant to the CEPC use case.

- Should use latex to number subfigures (a), (b)
- Separate figures (a) and (b) more

Chapter 5

- The subtitles should be capitalized
  - In-pixel electronics
  - Amplifier schematic
  - Comparator and output stage
- Nice explanation in caption but really much longer than similar caption in chapter 4, Figure 4.13

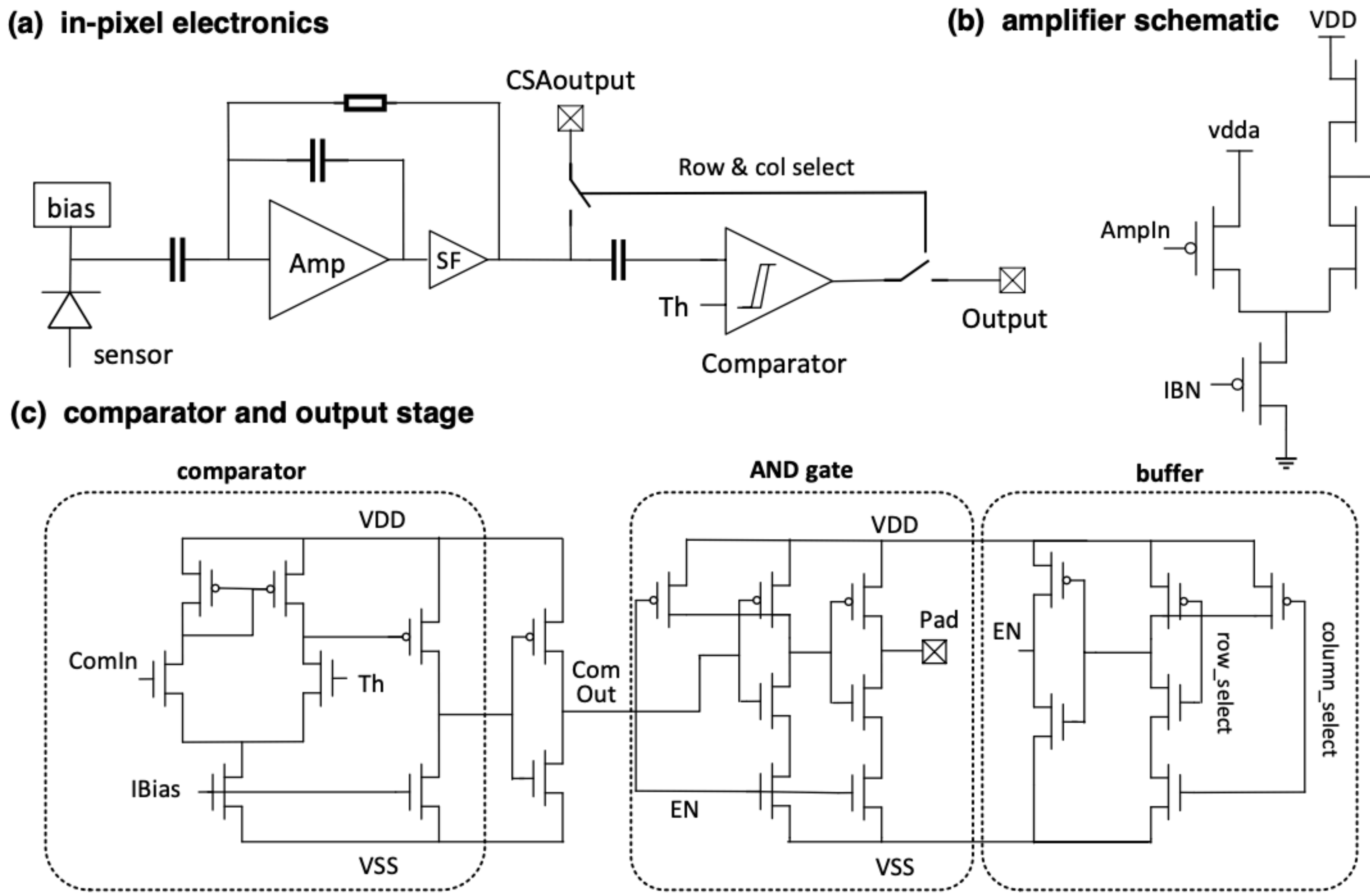


Figure 5.18: Schematic diagram of in-pixel electronics in Section 1 of COFFEE2. (a) The sensor generates a signal that is amplified by a charge-sensitive amplifier, consisting of a gain stage (Amp) and a source follower (SF). The amplified signal, labeled as "CSAoutput", is AC-coupled to a comparator, which converts the analog signal into a digital output. This output is routed to the exterior of the pixel via a shared output bus per column, with row and column select signals managing the pixel address. (b) Schematic of the amplifier (Amp), which operates using the current bias "IBN" and the voltage bias "VCAS". (c) Detailed circuit elements of the comparator and output stage. The comparator compares the input signal "ComIn" with the threshold reference "Th", using "IBias" as the current bias. The output signal "ComOut" passes through an AND gate and a buffer before reaching the external output pad. This configuration ensures robust digital signal readout, controlled by enable signals "EN", and facilitates row and column selection via "row_select" and "column_select". All bias signals are externally controlled, allowing fine-tuning of the amplifier during testing.

Chapter 5

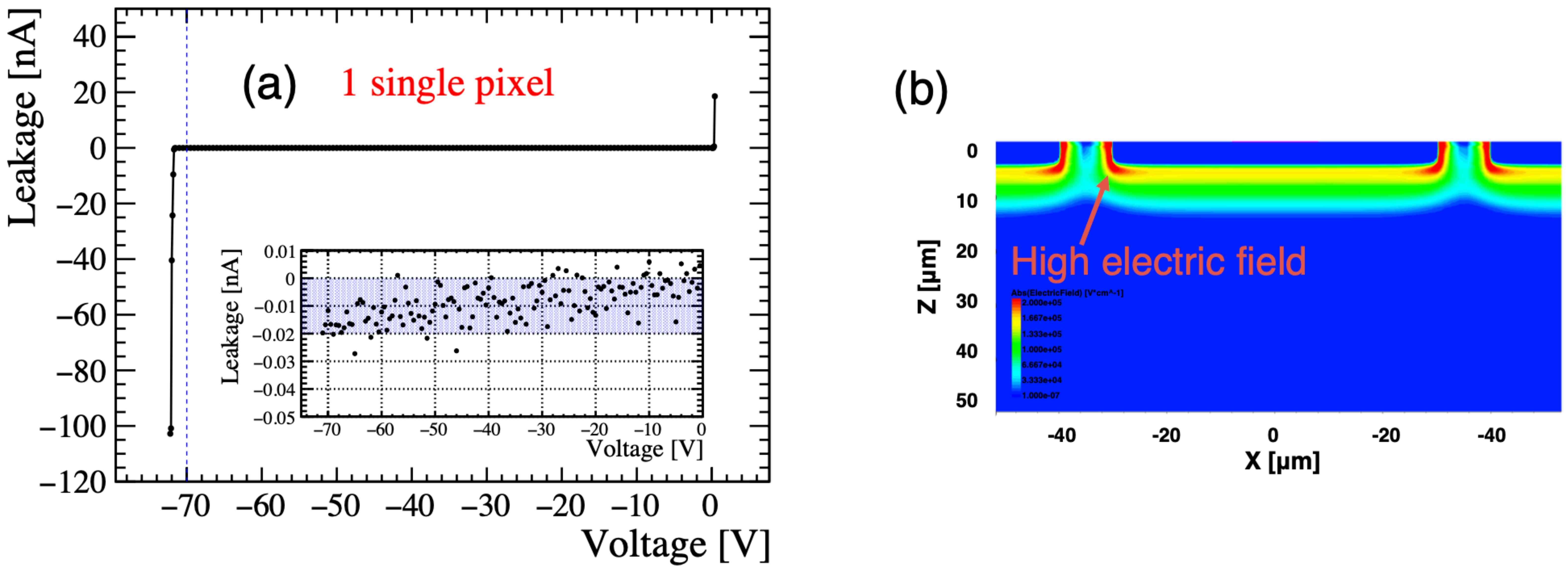


Figure 5.19: (a) IV curve of a pixel in COFFEE2 chip; (b) TCAD simulation of the passive diode under a reverse bias of −70 V. The breakdown voltage of the COFFEE2 chip is around −70 V, and the leakage current is at the pA level before breakdown.

- Should use latex to number subfigures (a), (b)
- Some fonts really too small, in particular the ones for the TCAD simulation!! Need to increase size

Chapter 5

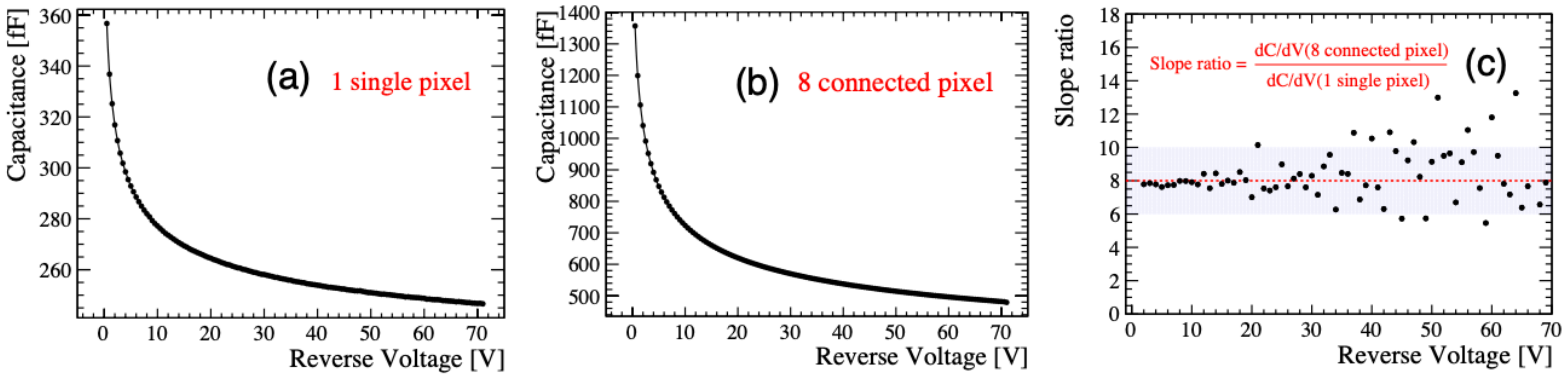


Figure 5.20: CV curves of (a) a pixel, (b) 8 connected pixels in the COFFEE2 chip, and (c) the ratio of capacitance of 8 pixels with respect to 1 pixel as a function of reverse bias. With the offset subtracted, the capacitance of a single pixel is 30 – 40 fF at a bias of −70 V.

- Should use latex to number subfigures (a), (b)
- Some fonts really too small, in particular the ones for the TCAD simulation!! Need to increase size

Chapter 5

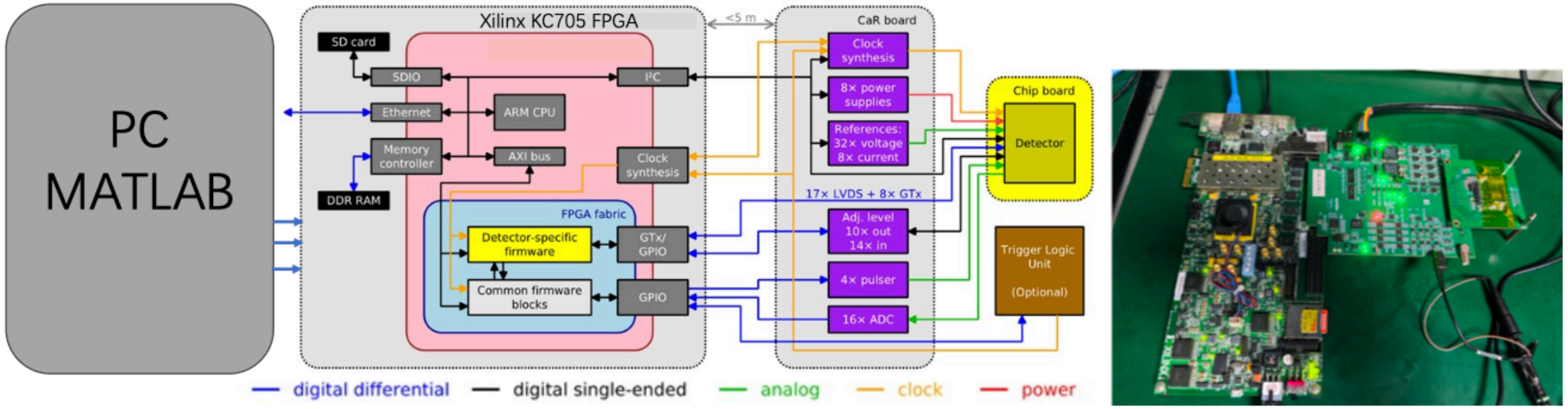


Figure 5.21: Test setup for COFFEE2 chip, consisting of a dedicated carrier board, a general-purpose control and readout board, an FPGA board, and a personal computer.

- Detailed schematic of testing board is not useful for a TDR. Can easily remove this figure.
  - Text is too small, not readable. We should simply with overall blocks, if we want to keep this, otherwise remove Figure
- There are two figures. Should use latex to number subfigures (a), (b)

Chapter 5

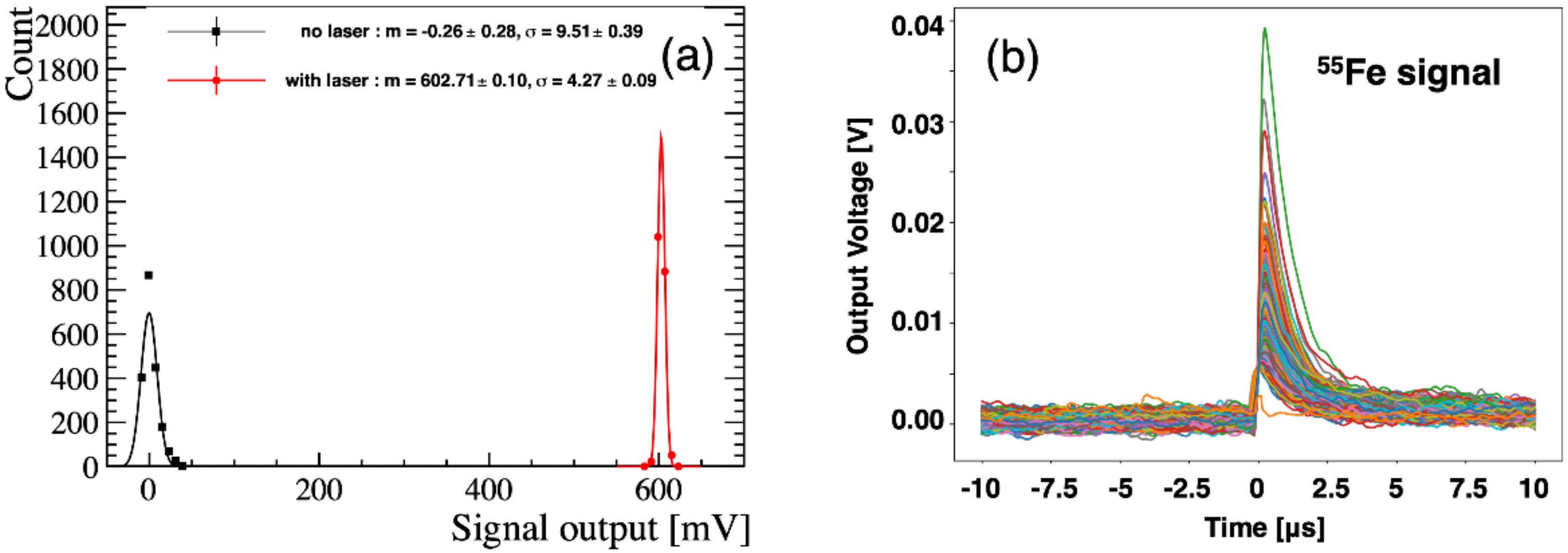


Figure 5.22: Responses to (a) red laser signals and (b) X-rays from ^{55}Fe in a pixel of COFFEE2. Clear signal responses were observed for both the red laser and the ^{55}Fe radioactive source.

- Text in (a) is too small, not readable. Remove it or increase font size
- Should use latex to number subfigures (a), (b)
- Caption should explain what is black and red curve
- Format style of these two figures side by side is different! This does not follow the recommended style provided by macro
  - No CEPC label

Chapter 5

- Another figure collection without much relation between parts.
  - At least the schedule should be a different figure. No point of saving space this way.
  - The timetable 5.23c is mentioned in the text before 5.23a and 5.23b
    - They should show up in order
  - Text in (a) is too small, not readable. I would suggest to make diagram bigger in its own figure
- Should use latex to number subfigures (a), (b)
- Split into 2 or 3 figures

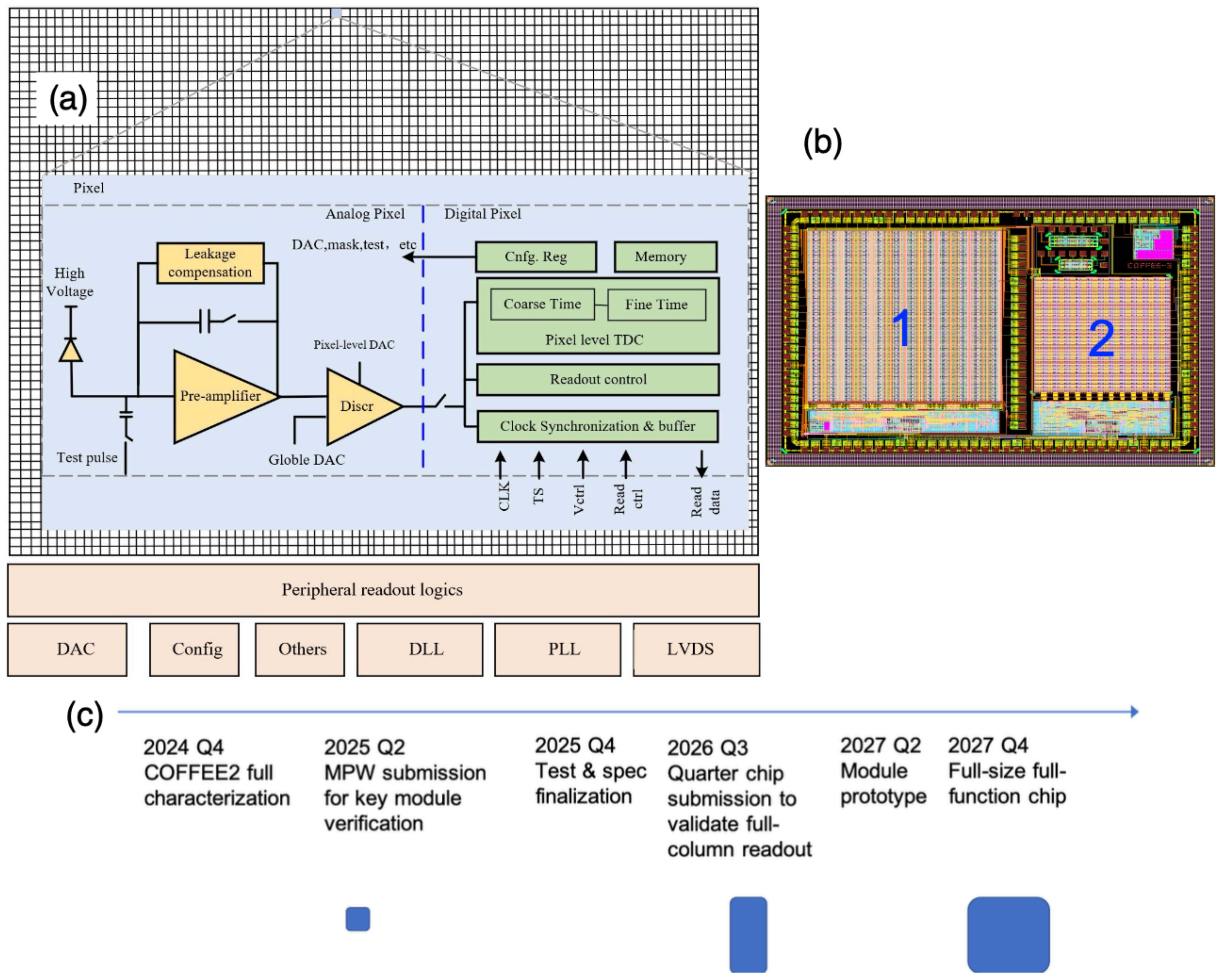


Figure 5.23: (a) Block diagram of the new data-driven readout architecture of the HV-CMOS sensor, featuring in-pixel fine time-to-digital converters (Time-To-Digital Converters (TDCs)). (b) Layout of the COFFEE3 sensor chip, consisting of two distinct pixel array sections: Section 1 features a CMOS-based array, utilizing both PMOS and NMOS transistors, while Section 2 contains an NMOS-only pixel array, using exclusively NMOS transistors. (c) Timeline of HV-CMOS development, with blue squares below indicating the relative chip sizes. After several rounds of tape-outs over 3 years, the HV-CMOS sensor is progressing toward a fully functional, full-scale sensor chip.

Chapter 5

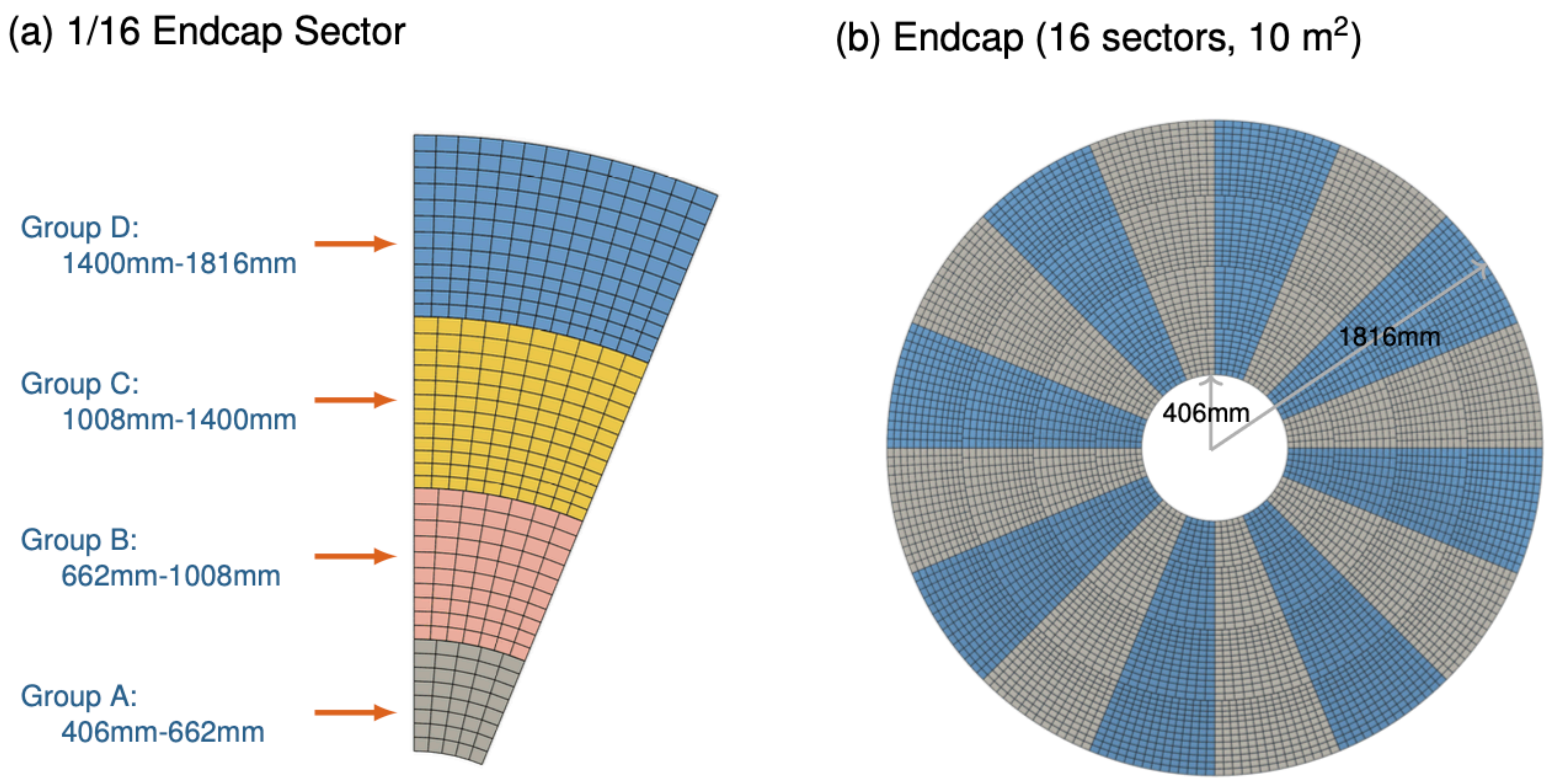


Figure 5.26: OTK sensor layout for (a) the 1/16 endcap sector and (b) the full endcap. The 1/16 sector of the OTK endcap consists of 42 rings of trapezoidal sensors, which are arranged into four groups: Group A, Group B, Group C, and Group D, each indicated by a different color.

- Add space between number and units, e.g. 1400 m (not 1400mm)
- Should use latex to number subfigures (a), (b)
  - Note that the style of this labeling is different from previous figures (e.g. Fig 5.24). This is why it should be made in Latex

Chapter 5

- Fonts too small to be readable. Is this what we want?
- What is the significance of the dashed line? Some sensors are outside the line… better move the line?
- Missing units
- Should use latex to number subfigures (a), (b)

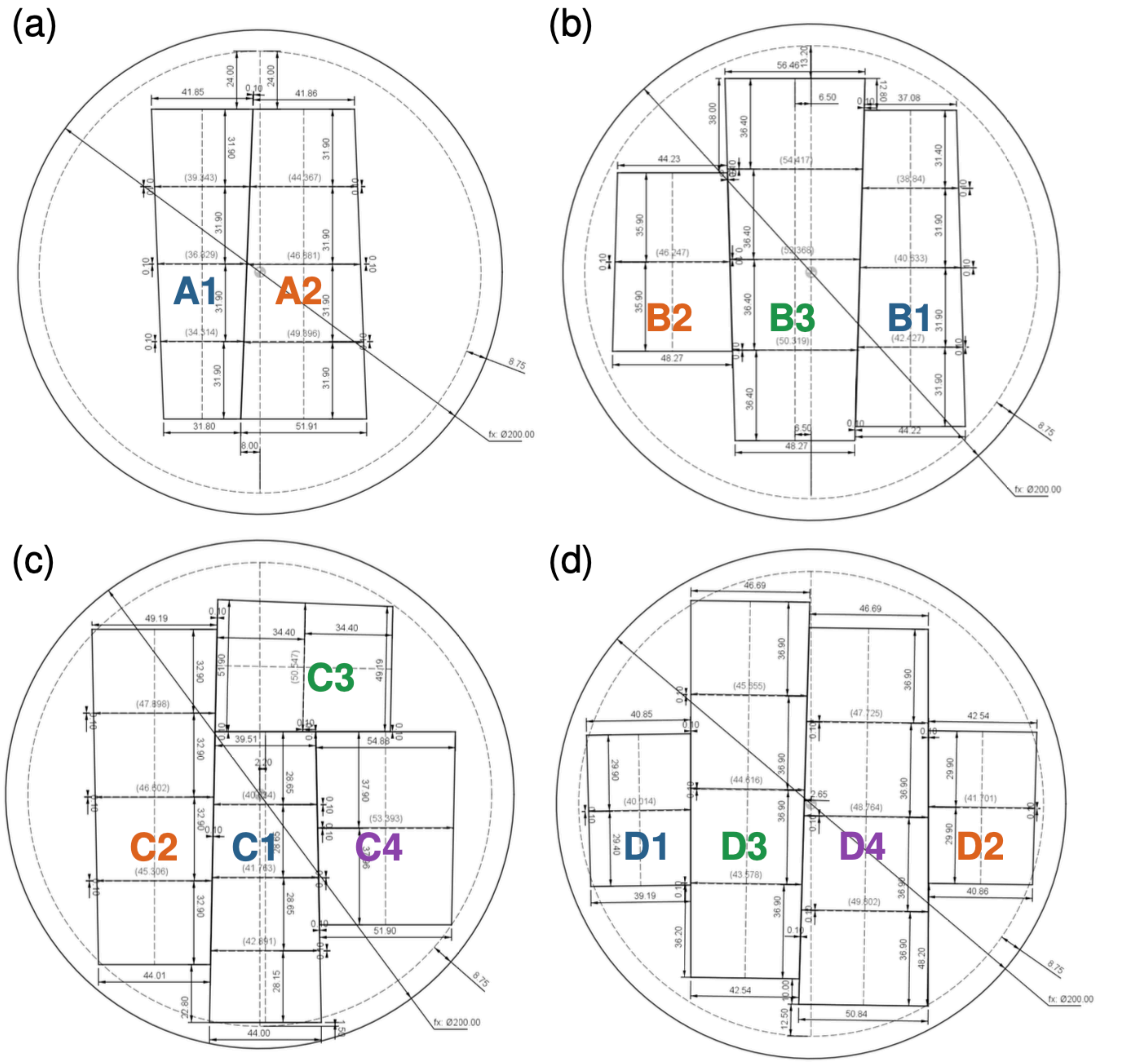


Figure 5.27: Four groups (A, B, C, and D) of OTK endcap sensors diced from 8” silicon wafer. Sensor subgroups B2, C3, C4, D1, and D2 each contain 2 trapezoidal sensors, while subgroups A1, A2, B1, B3, C1, C2, D3, and D4 each contain 4 sensors.

Chapter 5

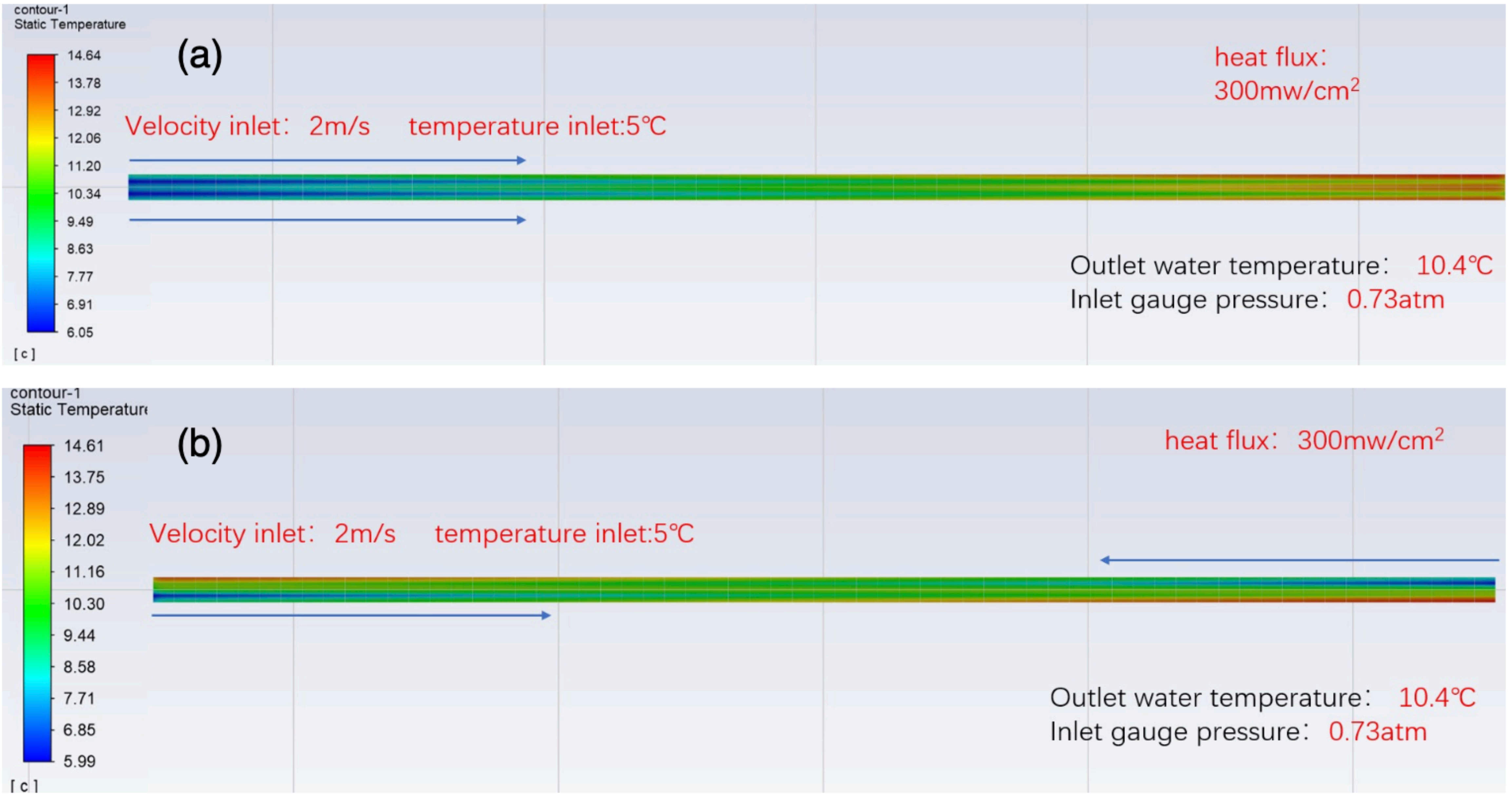
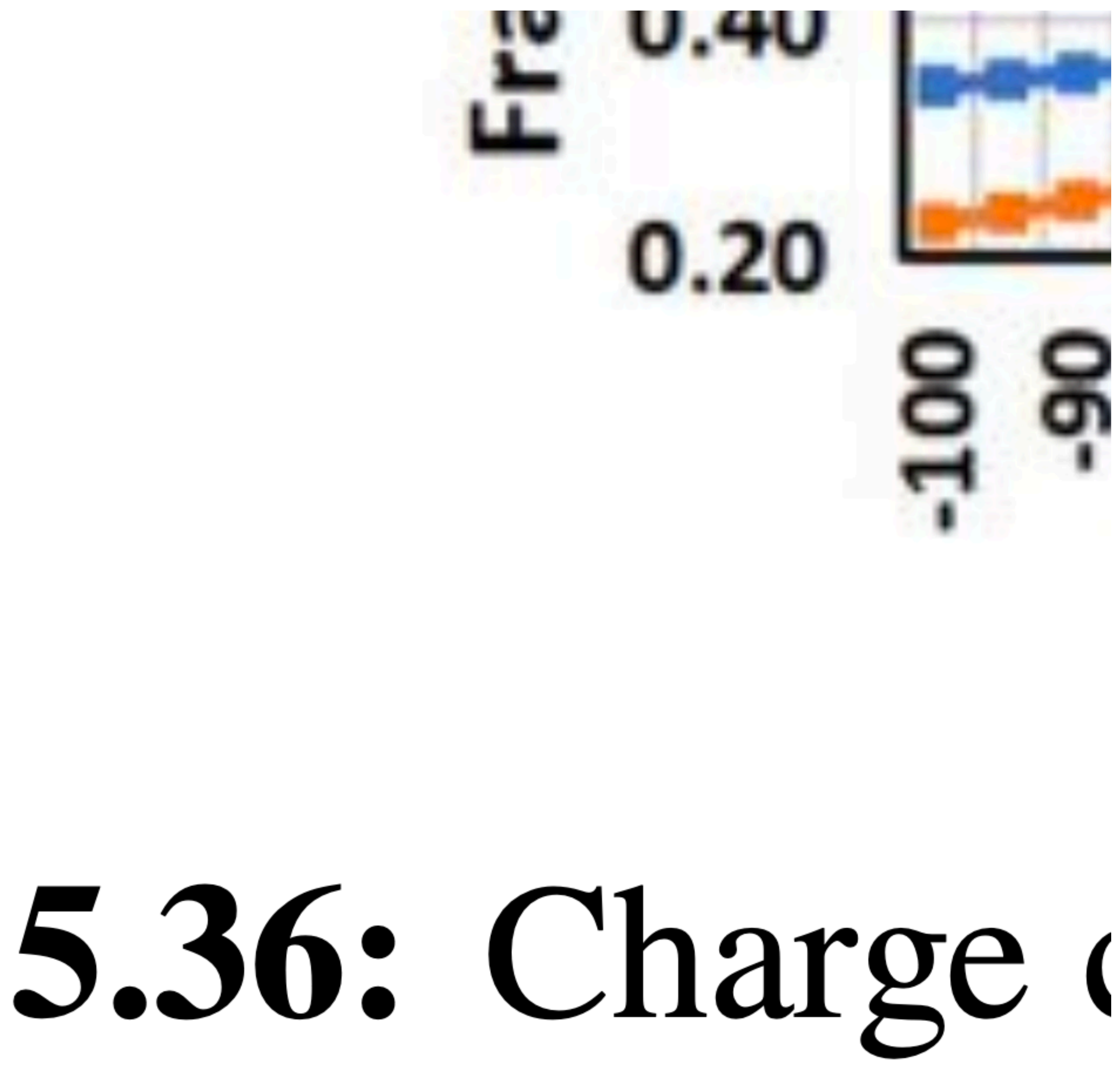


Figure 5.31: Simulation results of water cooling with a flow velocity of 2 m/s and an inlet temperature of 5°C for the OTK stave: (a) inlets on the same side and (b) inlets on both sides. The temperature across the stave remains below 14.6°C, and the temperature gradient along the stave is within 8.6°C.

- Font size of legend of top graph is smaller than the bottom one. They should be the same if displayed like this, in the same Figure.
- The word “temperature” has the “e” cut off
- Should use latex to number subfigures (a), (b)

Chapter 5



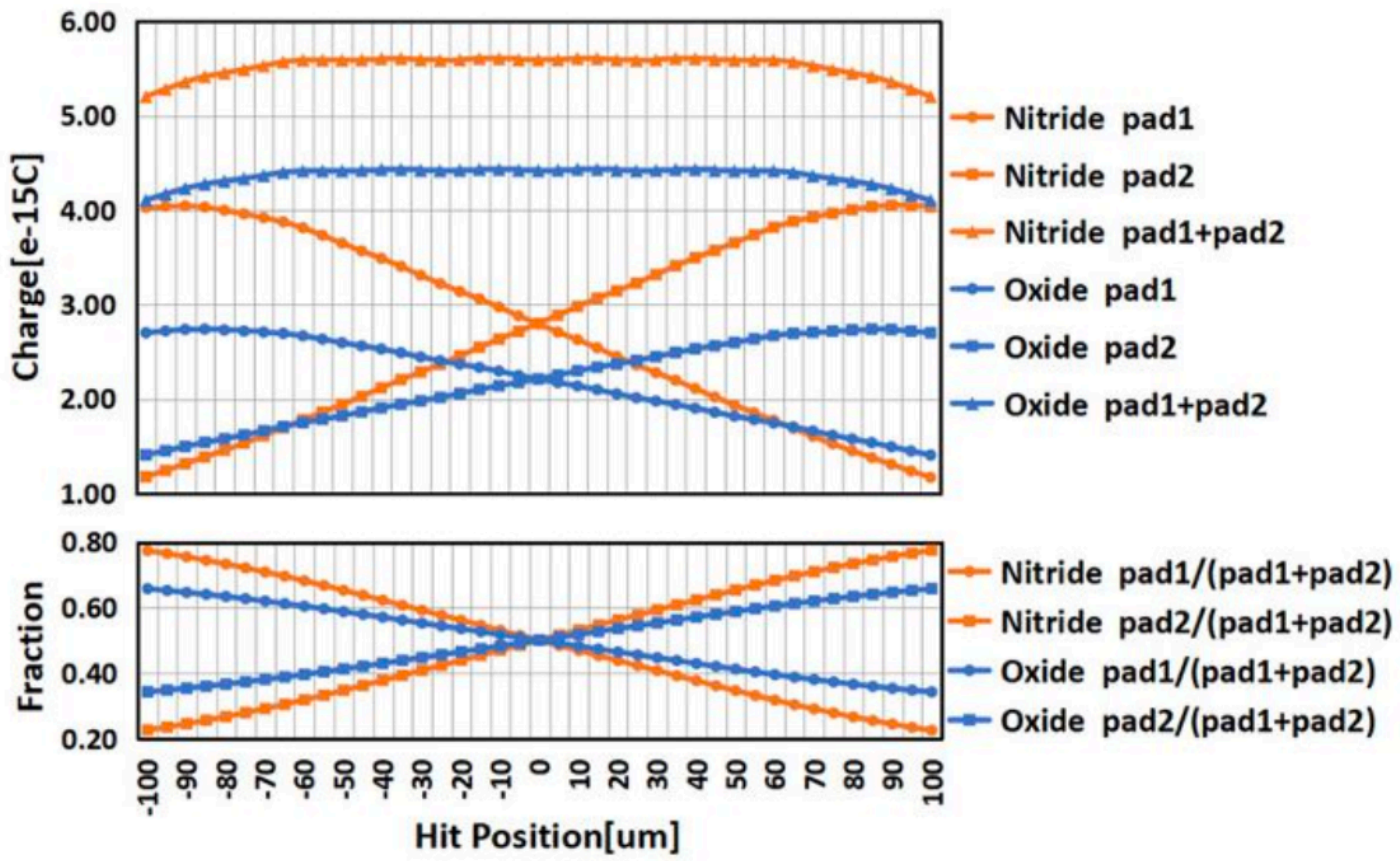
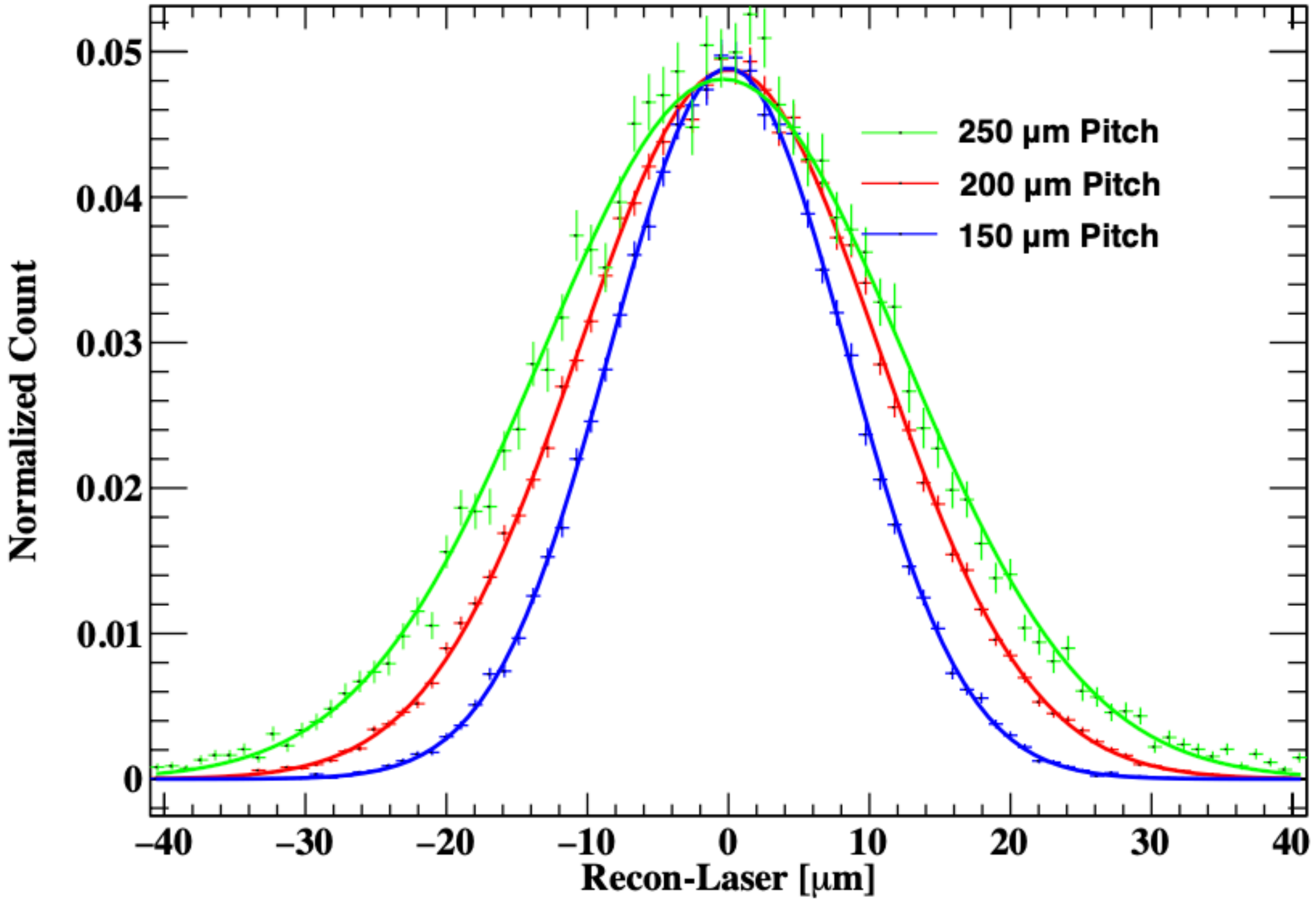


Figure 5.36: Charge collection of two neighboring pads (pad1 and pad2) as functions of hit position for two different dielectric materials: oxide (blue curve) and nitride (orange curve).

- Several Figures in Chapter 5 have bad quality, although they are in pdf format. Likely the pdf was created from another poor quality format. Fix if possible.

Chapter 5



- It does not follow the provided macro format
- No CEPC Ref-TDR label
- What is “Recon-Laser”? Explain in caption or update name

Minor text updates for Captions

Not an exhaustive list, but a rather comprehensive one

Chapter 4

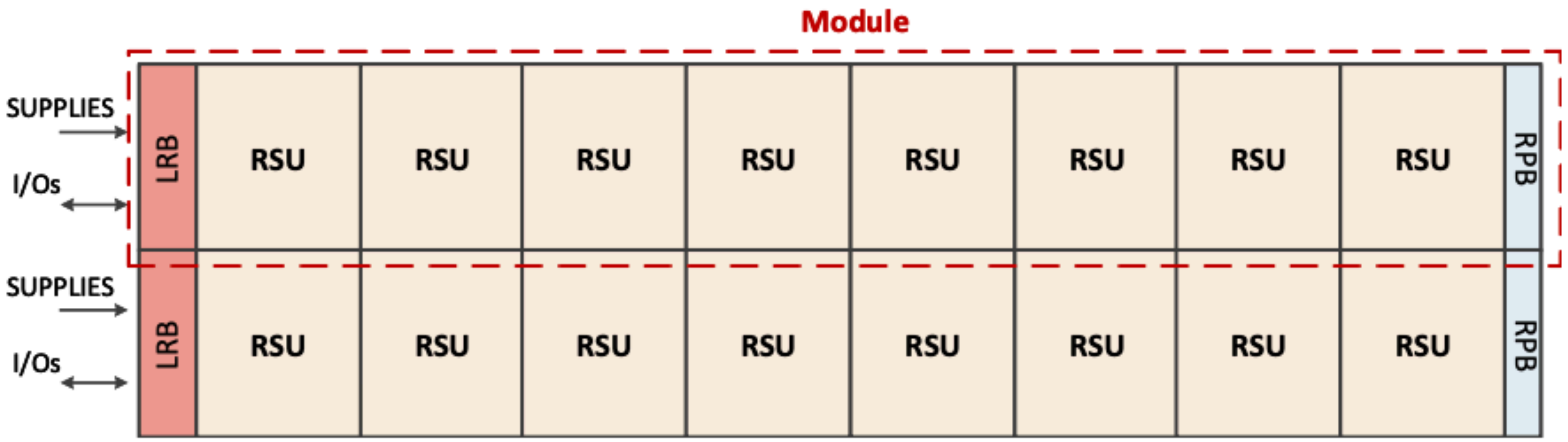


Figure 4.10: Top level floor-plan for a sensor of layer1 (not to scale). It comprises two identical modules, with one of them indicated by the dotted red rectangle.

- Good, but....
  - layer1 should be layer 1

The end

Reminder of updated editors

	Chapter	Primary Contact	Next Editors
1	Introduction	Joao Costa, Gang Li	-
2	Concept of Ref-Detector	Haijun Yang, Mingyi Dong	-
3	MDI and Luminosity Measurements	Haoyu Shi	Hongbo Zhu
4	Vertex Detector	Zhijun Liang	Meng Wang
5	Silicon Trackers	Qi Yan	Yanyan Gao
6	Gaseous Tracker	Huirong Qi	Tianchi Zhao
7	Electromagnetic Calorimeter	Yong Liu	Yifang Wang
8	Hadron Calorimeter	Sen Qian	Xinchou Lou
9	Muon Detector	Xiaolong Wang	Jianchun Wang
10	Superconducting Solenoid Magnet	Feipeng Ning	Qingjin Xu
11	Readout Electronics	Wei Wei	Jingbo Ye
12	Trigger and Data Acquisition	Fei Li	Zhenan Liu
13	Software and Computing	Weidong Li	Xingtao Huang
14	Mechanics and Integration	Quan Ji	Xiaoyan Ma
15	Detector and Physics Performance	Mingshui Chen	Hideki Okawa
16	Construction Cost	Miao He	-
17	Future Plan	Gang Li, Miao He, JCW	-

- People with editing token
  - Others certainly needed to help

- **Other people providing key input recently:**
  - Imad (ECAL and HCAL)
    - Meeting a few days ago
  - Paul Collas (TPC)
  - Jianming (Performance)

Document with editing and formatting instructions

- **Location:**
  - https://docs.ihep.ac.cn/link/AR2BD148C9193F430BBD59C8324A1A827D
  - 文件名：TDR format instruction.docx
  - 文件路径：AnyShare://ZHANG Zhaoru(zhangzr)/CEPC Det TDR/TDR format instruction.docx
- Please check it and follow its instructions
  - Includes rules about english
  - Specially important for new editors
- Provide feedback

TDR Format Instruction

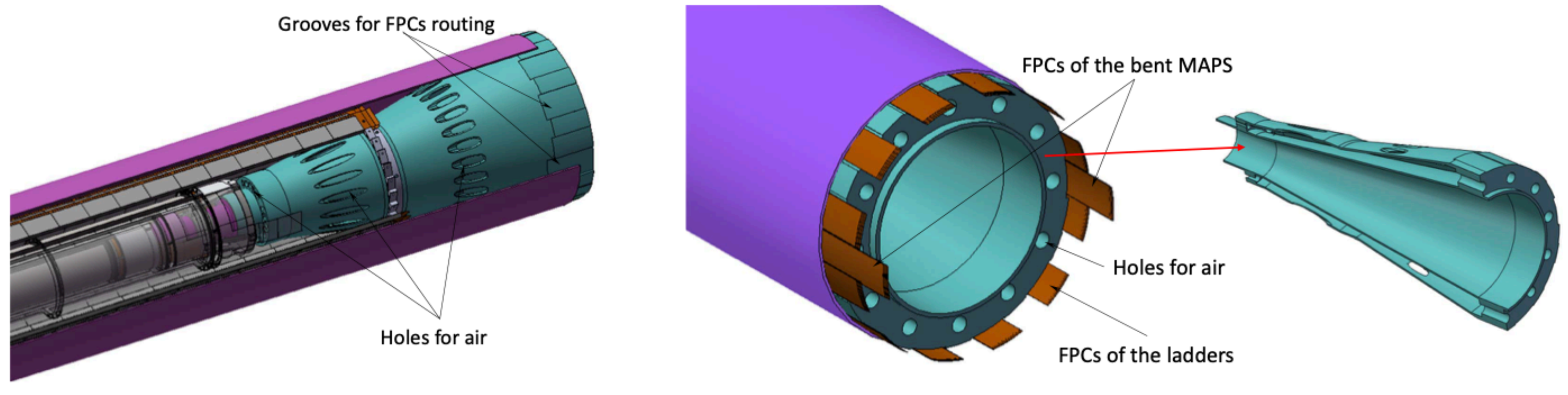
1 Chapter structure

Chapter X:	
X.1 Overview	
	Expected performance/requirements, Design overview
X.2 Detailed Design	
X.2.1 Detailed design	
X.2.2 Challenges and critical R&D	
X.3 Key Technologies to address challenges	
X.4 R&D and prototypes	
X.5 Simulation and Performance	
X.6 Alternative Solutions	
	Can be either backup or more advanced solution
	(demonstrate backup solutions are in hand and that their possible selection still meet the requirements)
X.7 Summary and Future Plan	
(X.8 Cost table and justification)	
	eventually to be moved to a common chapter

Requirement:
- Sections should not have more than 4 numbered subsection levels x.y.z.w
- If using AI, editors need to read the AI output and finalize the text themselves. Do not use AI output blindly. Also, AI usage should be focused on correcting English, do NOT write full sections using AI
- Figures and Table captions should be long and describe the figure/table, as needed. They should not be just a title. Reader should be able to understand content from the figure/table and caption.
- The document should be written in American English, not British English. More instructions are given below.

Format for multiple Figures

Figures numbering should have (a), (b), (c), (d) for multiple figures



(a) **(b)**

Figure 4.18: Air ventilation and cable routing of the VTX. (a)Air channel design with holes on global support structure for air distribution. Grooves on support structure is designed for FPCs routing. (b) the FPCs of the vertex detector routed out of the side of the beam pipe assembly, along with a cut view of the conical part.

Caption should mention it (a), (b)

Use capital letters after "." and small letters if using ","

Sample Latex to implement this

- Here is a Latex example of defining multi-plots with (a)(b) labels:
- \begin{figure}[H]
-    \begin{center}
-       \subfloat[][]{\includegraphics[width=.4\linewidth]{ *a*.pdf}\label{fig:TESTa} }
-       \hspace{.015\linewidth}
-       \subfloat[][]{\includegraphics[width=.4\linewidth]{ *b*.pdf}\label{fig:TESTb} }
-       \caption{..........}
-       \label{fig:TEST}
-    \end{center}
- \end{figure}

Example Pictures in need of improvements

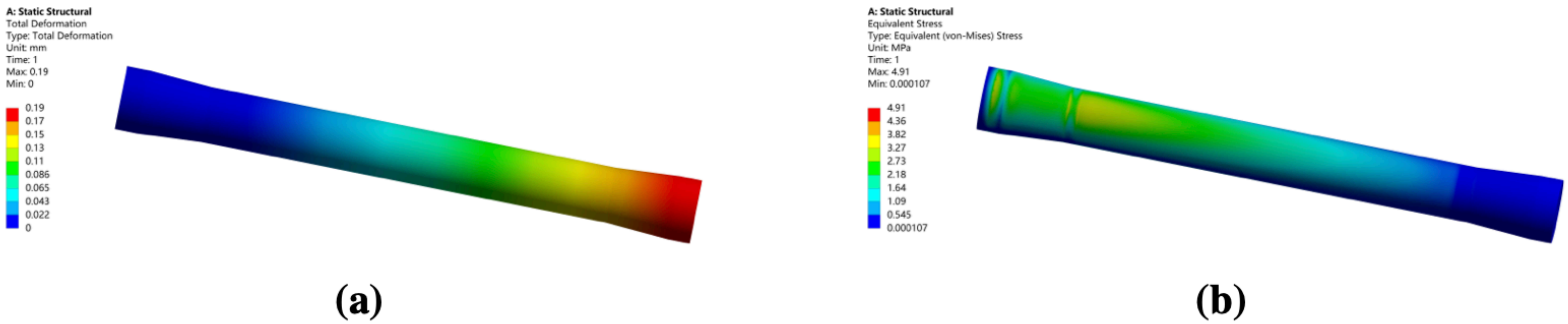


Figure 3.5: Stress analysis of the beam pipe when one end is fixed and the other end is cantilevered, the maximum deformation of the beam pipe is at the end flange, which is 0.36 mm, and the maximum stress at the outer beryllium pipe is 13.77 MPa.

- Numbering is correct (a) and (b), but it is **not used** in the **caption**. It should, in particular in such complex picture.
- Font still too small, legend is not readable

Example Pictures in need of improvements

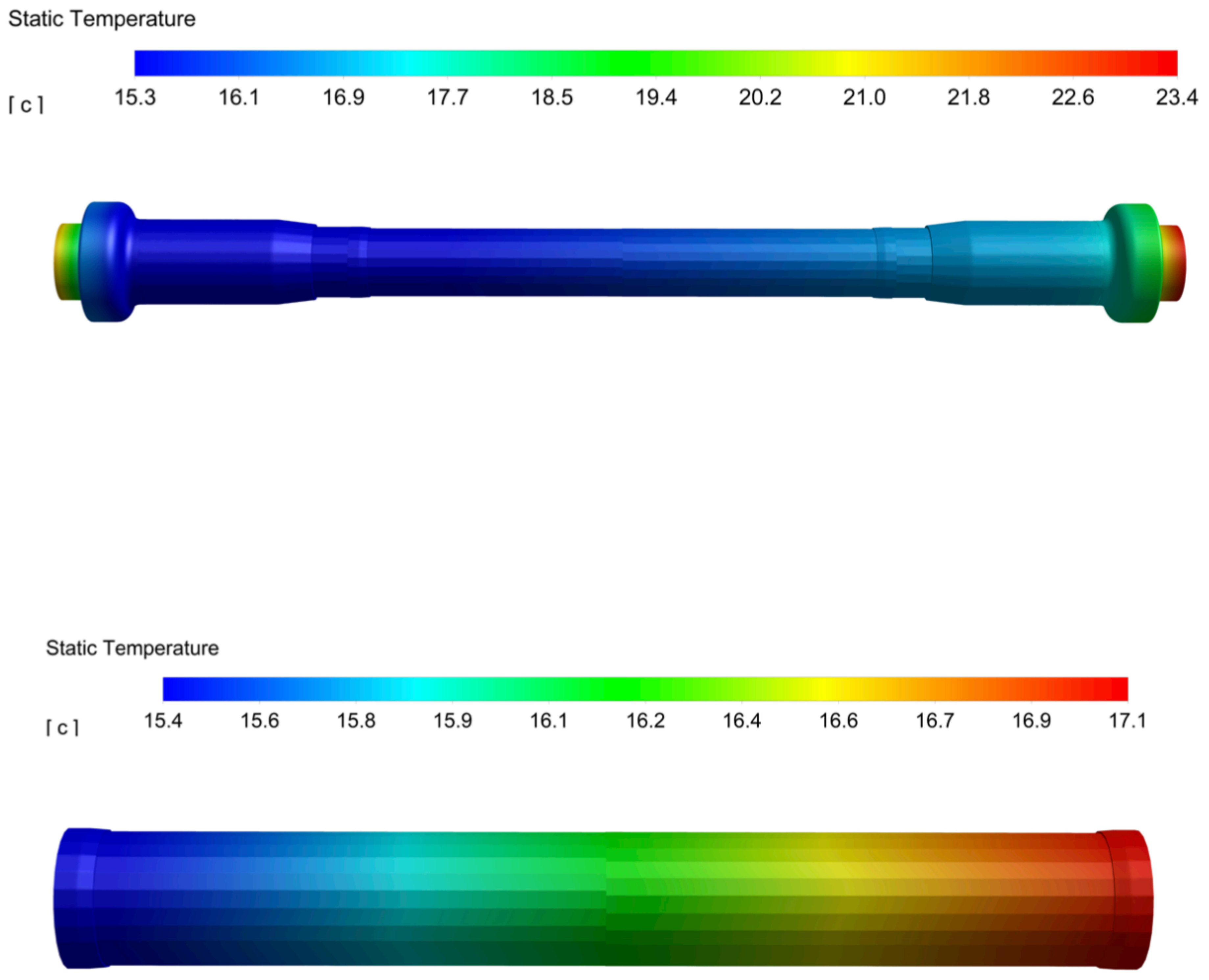


Figure 3.7: Temperature distribution of the central beryllium pipe, the left is the inner Be pipe while the maximum temperature of the central beryllium pipe is 23.4 °C, and the right is the outer Be pipe while the maximum temperature of the outer beryllium pipe is 17.1 °C. The unit in figure is °C.

- Numbering with (a) and (b) is missing all together

Example Pictures in need of improvements

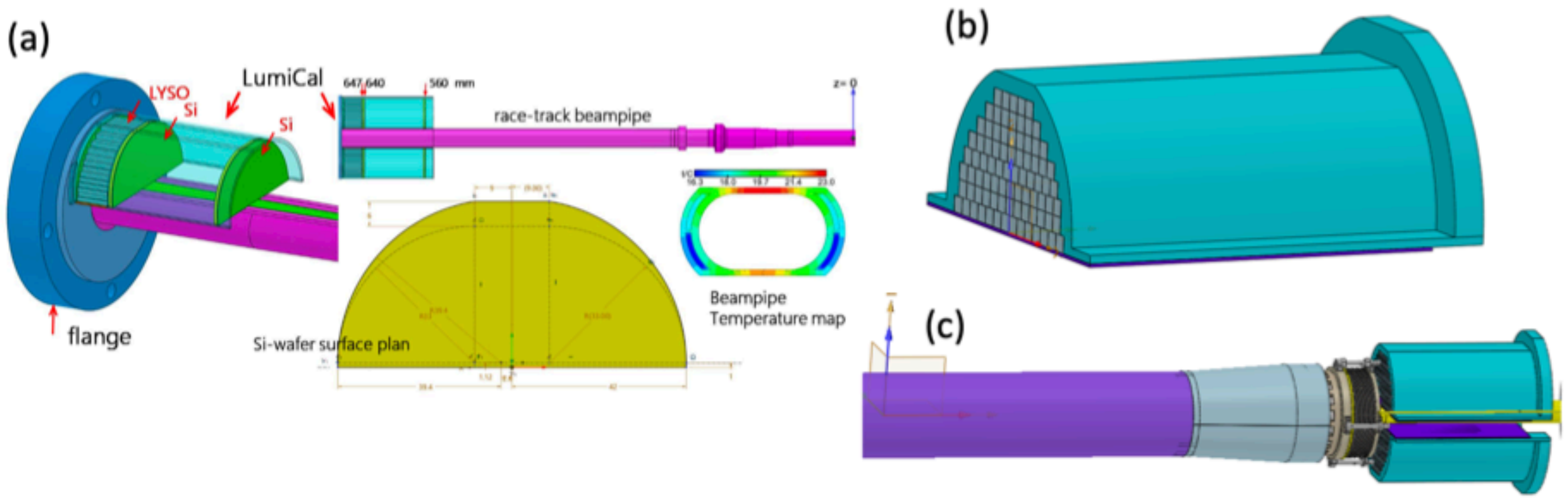


Figure 3.24: a) Mechanical drawings of the LumiCal modules before the flange of race-track beam-pipe. The two Si-wafers and $2X_0$ LYSO crystal bars are contained in half circular tubes above and below the pipe. The cooling of beam pipe has the water injected from the flange toward IP within the double Aluminum layers on the sides with the temperature map illustrated, b) Mechanical drawings of the LumiCal module beyond the flange, the $13X_0$ LYSO crystal bars covered by tungsten shell, and c) The LumiCal LYSO modules are contained in half circular tubes above and below the pipe.

- Proper number with (a) and (b) but font still too small. Can you read it?

Example Pictures in need of improvements

Too small

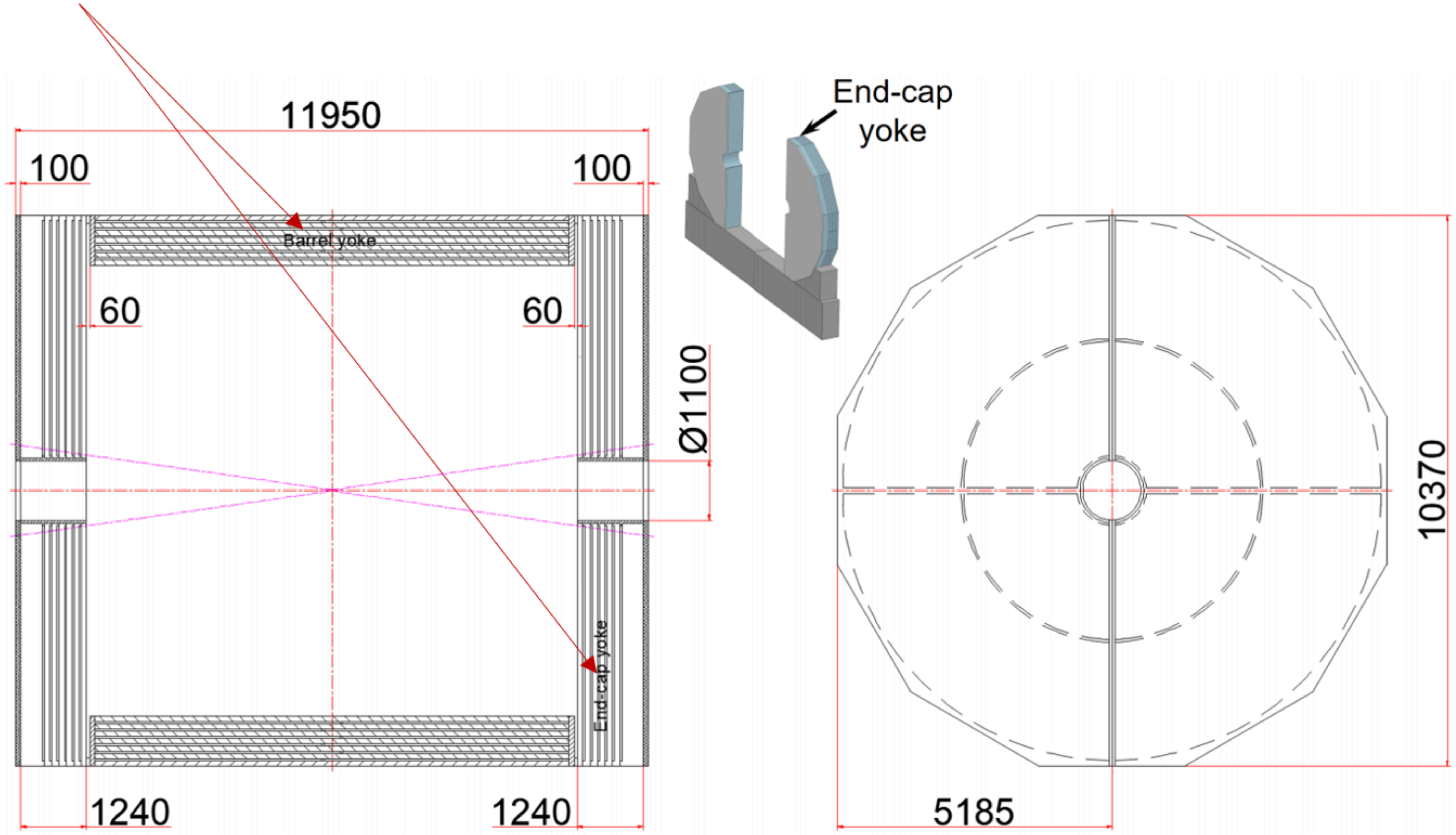


Figure 14.7: End-cap yoke dimension and location. (unit:mm)

- Text still too small
- When we fix one plot, we should fix all the similar plots (this was fixed in other plots)

Example Pictures in need of improvements

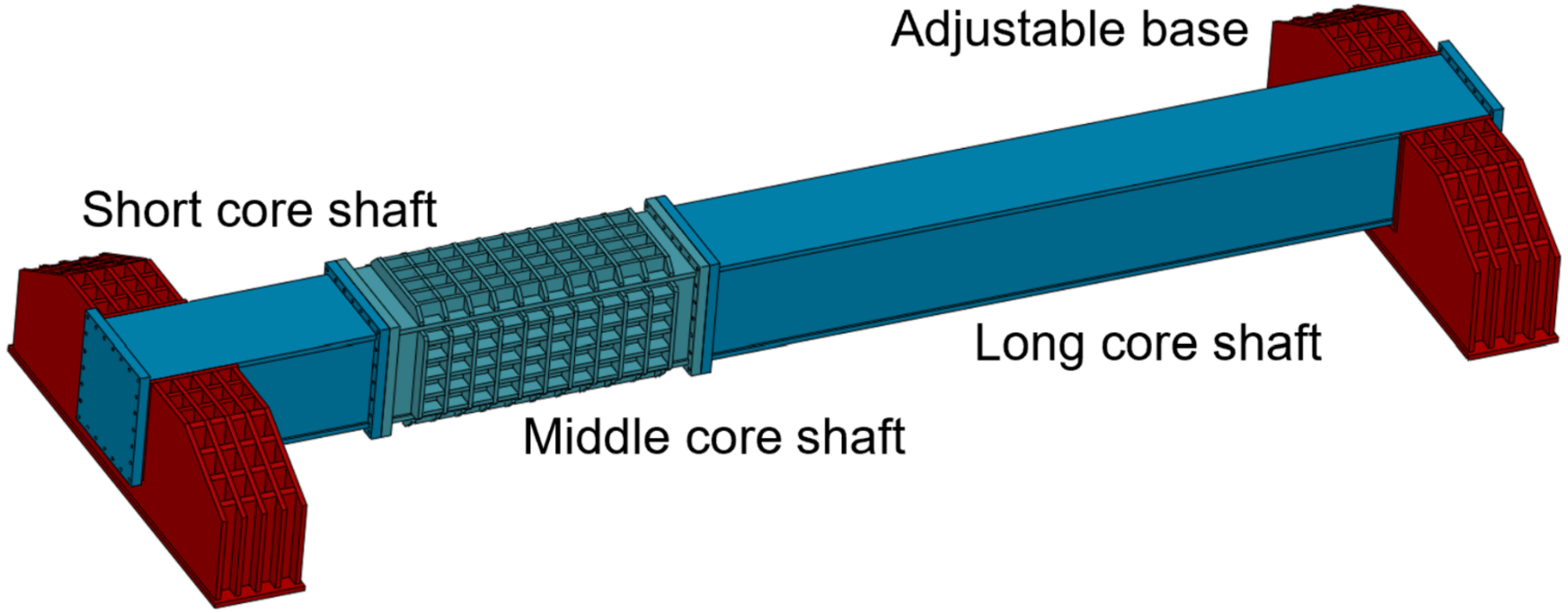


Figure 14.33: Three-section modular structure of the core shaft.

- Labels are ambiguous
- Add arrows to indicate what the labels correspond to

Example Pictures in need of improvements

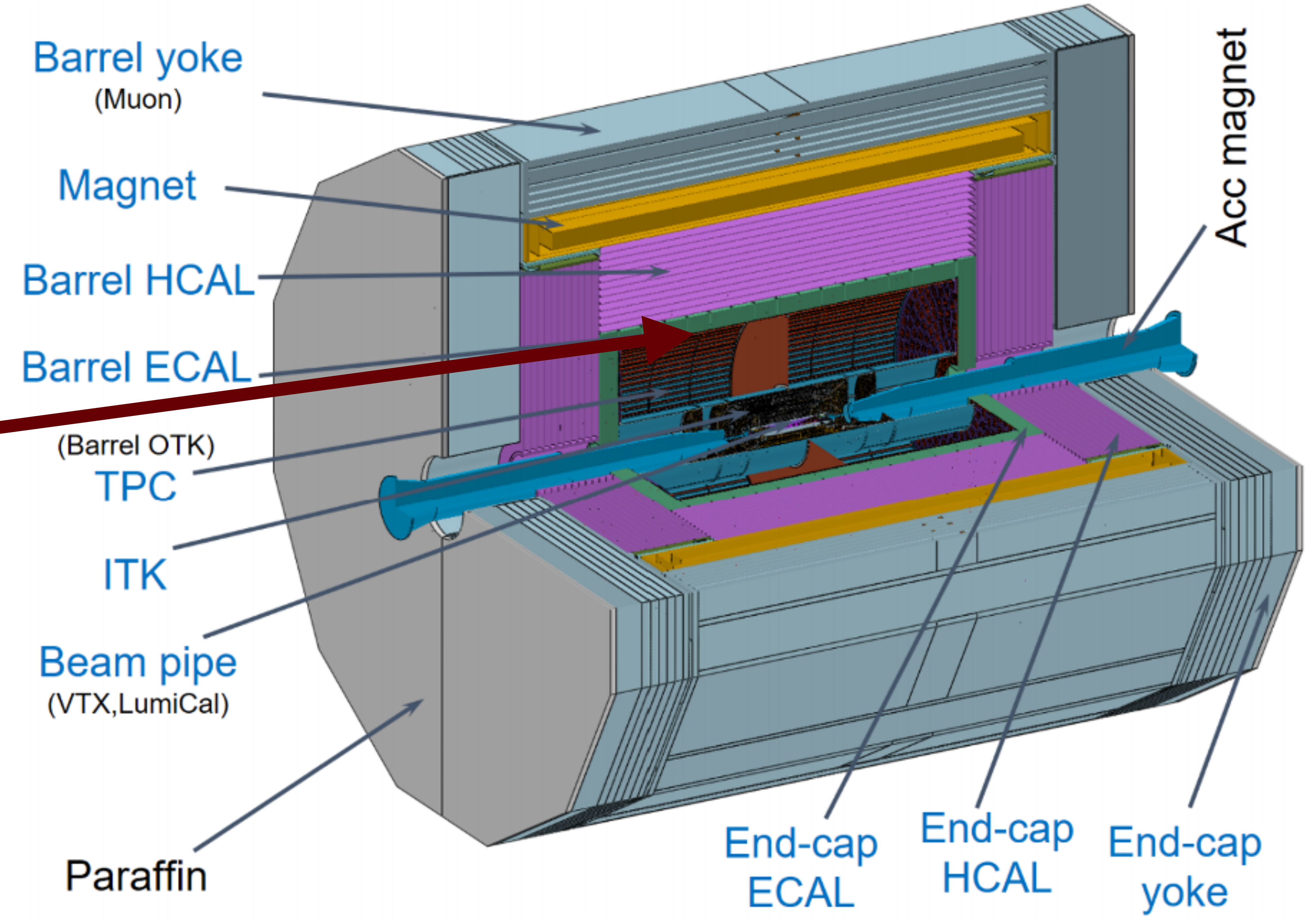


Figure 14.1: The overall layout of the CEPC reference detector.

OTK

Why Paraffin label is black?

- Text needs to be made uniform
  - OTK is a proper detector with a proper location, it should show up as such
  - Same for the VTX and LumiCal

Updates on ITK/OTK chapter

From Yanyan Gao

Previous outline

New outline

- Added an overview section with high level layout common to both ITk and OTk. Moved the hits information here as the specification
- Removed the previous section 5.4 on background (this was repeated from Chapter 3)
  - Half into Section 5.1 and half will be added to the readout electronics section when each detector is introduced
- Removing duplication
- Plan is to go through the rest of the chapter this week to further consolidate and streamline the sections

Updates on ITK/OTK chapter

From Yanyan Gao

Table 5.1: Parameters and layout of the Silicon Tracker. Silicon pixel sensors (HV-CMOS) and Low Gain Avalanche Detector (LGAD) technologies are planned for the ITK and OTK baseline, respectively. The column labelled $\pm z$ shows the half-length of the barrel layers, and the z position of the end-cap disks. The column labelled σ_ϕ and σ_t represent the spatial resolution in the bending direction and time resolution, respectively. The main parameters of the VTX and the TPC are also listed here for completeness.

Detector		Radius R [mm]		$\pm z$ [mm]	Material budget [% X_0]	σ_ϕ [μm]	σ_t [ns]
VTX	Layer 1	11.06		80.7	0.06	3	100
	Layer 2	16.56		121.1	0.06	3	100
	Layer 3	22.06		161.5	0.06	3	100
	Layer 4	27.56		201.9	0.06	3	100
	Layer 5	39.32		341.0	0.32	3	100
	Layer 6	39.69		341.0	0.32	3	100
ITK Barrel	Layer 1 (ITKB1)	235.0		493.3	0.68	8	3-5
	Layer 2 (ITKB2)	345.0		704.8	0.68	8	3-5
	Layer 3 (ITKB3)	555.6		986.6	0.68	8	3-5
OTK Barrel	Layer 4 (OTKB)	1,800		2,840	1.6	10	0.05
TPC	Inner wall	600		2900	0.16	—	
	Gas	625-1775		2761	~ 1	110-144 (220 hits)	
	Outter wall	1800		2900	0.16	—	
		R_{in}	R_{out}				
ITK Endcap	Disk 1 (ITKE1)	82.5	244.7	505.0	0.76	8	3-5
	Disk 2 (ITKE2)	110.5	353.7	718.5	0.76	8	3-5
	Disk 3 (ITKE3)	160.5	564.0	1,000	0.76	8	3-5
	Disk 4 (ITKE4)	220.3	564.0	1,489	0.76	8	3-5
OTK Endcap	Disk 5 (OTKE)	406.0	1,816	2,910	1.4	10	0.05

Simplify

No need to talk about other chapters

Chapter Structure

Chapter X:				
X.	**1**	**Overview**		What are we going to build? **Design**, expected performance ("requirements")
X.	**2**	**Detailed Design**		
X.	**2.**	**1**	**Detailed design**	
X.	**2.**	**2**	**Challenges and critical R&D**	
X.	**3**	**Key Technologies to address challenges**		
X.	**4**	**R&D and prototypes**		
X.	**5**	**Simulation and Performance**		
X.	**6**	**Alternative Solutions**		Can be either backup or more advanced solution (demonstrate backup solutions are in hand and that their possible selection still meet the requirements)
X.	**7**	**Summary and Future Plan**		
X.	**8**	**(Cost table and justification)**		Eventually to be moved to a common chapter

- Sections should not have more than 4 numbered subsection levels x.y.z.w
- If using AI, editors need to read the AI output and finalize the text themselves. Cannot blindly use AI output. Also, AI usage should be minimized to correct english, NOT write sections from scratch
- Captions should be long and describe plot, not just a title