# Minutes of the CEPC Ref-TDR Meeting on Dec. 17, 2024

## **Date and Time**

- December 17, 2024; 09:00 11:30
  - agenda: https://indico.ihep.ac.cn/event/24539/
- Participants
  - IHEP 122: Jianchun Wang, Mingshui Chen, Manqi Ruan, Jianchun Wang, Weidong Li, Miao He, Yong Liu, Feipeng Ning, Tianchi Zhao, Mingyi Dong, Shegnsen Sun, Quan Ji, Sen Qian, Yunyun Fan, Linghui Wu, Yiming Li, Fei Li, Huirong Qi, Zheng Wang, Gang Li, Haoyu Shi, Wei Wei, Xinchou Lou, Jingbo Ye, Boping Chen
- Remote
  - Xiaolong Wang, Qi Yan, Suen Hou, Lei Zhang, Hengne Li, Tao Lin, Haijun Yang, Xiaoting Li, Ying Zhang, Jingzhou Zhao, Zhijun Liang, Yunpeng Lu, Xin Shi, Fangyi Guo, Huaqiao Zhang, Jinyu Fu, Xiaolu Ji, Huaishen Li
- Minutes: Yong (for Zhaoru, exceptionally on leave)
- General updates
  - Jianchun: need to implement updates into the overall overleaf in recent two days

## General

- · Jianchun: need to implement updates into the overall overleaf in recent two days
- Overleaf server at IHEP
  - Gang: Fazhi Qi and Jingyan Shi promised a new server, but it was not yet deployed
  - Switch off "Auto Compile"
- Ref-TDR Chapter 2: overview of ref-detector
  - Haijun: requires 0.5 pages for each sub-detector

#### Silicon detector: Qi Yan

- Status report
  - Status of TDR chapter: aim for 80 pages

- Power cabling scheme
  - A summary table: numbers of power cables, optical fibres and cooling pipes
- Discussions
  - Jianchun: suggest estimate of material budgets in total (in X0), and also fractions of AI and Cu; also need to implement into detector geometry in DD4HEP

#### Beam background: Haoyu Shi

- Status report
  - Baseline version with shields: optimising shield design
  - Low-lumi Z needs more work on Vertex and ECAL
  - Status of Ref-TDR chapter
- Discussions
  - Jianchun: 50MW vs. 30MW at Z-pole
    - Haoyu: 10MW, 2T achievable for  $1.9 \times 10^{36} cm^{-2} s^{-1}$  (CEPC Acc-TDR), but still unclear about achievable luminosity at 3T at High Lumi Z
    - Jianchun: need inputs on the 2T/3T
    - Haoyu: accelerator colleagues needs months for lattice studies for 3T
    - 20% 30% luminosity at Z, half year at Z-pole -> what Z-boson statistics -> 100G
      Z-bosons, 4 orders of magnitude higher than that of LEP (10M Z-bosons)

## Vertex: Zhijun Liang

- Status report
  - Ref-TDR chapter: ~50 pages, 85% ready
  - International collaboration: ALICE management team will visit China this week and will visit IHEP this Thursday
- Discussion
  - Yunyun: LGAD yield issue in the IDRC review, remains further discussions -> Jianchun: prepare supporting materials

• AC-LGAD (2cm): shipped from Italy first to CERN and later to IHEP

## **General discussions**

- Tianchi: the overleaf document title, "Reference TDR" or "TDR of a reference detector"? very different meanings
  - Jianchun: it should be "Reference Detector TDR"
- Tianchi: the technical readiness level of some chapters may not be sufficiently high
  - Jianchun: identify those and plan routes to achieve goals

#### Gaseous tracker: Huirong Qi

- Status report
  - TPC updated design in mechanics: interconnections to ECAL, ITK and OTK
  - Beam-induced background: categorise BIB sources
    - Abundant in gamma rays (1MeV)
  - Ref-TDR Chapter 6: 40 -> 46 pages
    - Parts on cooling and cooling to be added
- Discussions
  - Manqi: space in TPC endcap reserved for cabling? -> Huirong: yes
  - Jingbo: optical module <10x20x4mm, 4 IN (10Gbps), 4 OUT</li>
  - Wei: space (height) dominated by power modules

# ECAL: Yong Liu

- Status report
  - Exchanged SiPM-crystal beamtest results with electronics colleagues, with input information for the SiPM-readout ASIC design
  - ECAL endcap mechanics: stress distributions
  - · Beam-induced backgrounds: updated results
  - Ref-TDR Chapter 7 with ~60 pages
- Discussions
  - Jianchun: crystal transverse granularity 10x10mm vs. 15x15mm, any conclusions?
  - Mingshui: results presented by Xuhao, minor impacts to inclusive pi0 in B-physics, but large impacts to B0-> 2pi0's; also evaluating CKM elements (systematics dominated); still difficult now to draw a solid conclusion on the granularity

- Jianchun: 60-70 pages normal for each chapter, may still need more information/materials for the crystal ECAL chapter, e.g. granularity optimisation studies as just discussed + crossref in physics
- Yong: right, also still need more materials on the backup options (SiW and ScW-ECAL)
- Manqi: still need further understanding and optimisations of detector design parameters e.g. ECAL transverse granularity
- Tianchi: crystal ECAL based on dual-readout in IDEA for FCC-ee; suggest explanations on the low-energy detection
- Mingshui: Higgs-electron coupling measurement at FCC-ee, which requires a very good resolution on electrons

## HCAL: Sen Qian

- Status report
  - · Progress on SiPM and glass simulation, with different attenuation lengths
  - Promising on the glass light yield: 1400 2000 ph/MeV
  - SiPM: 20CNY/pc, 80CNY for 4 pcs for one glass tile
  - Monitor system with LED for glass and SiPMs
  - Others: FaserCalo, LHCb Phase-2 ECAL with PMT, etc.
- Discussions
  - Jianchun: should focus most on CEPC Ref-TDR
  - Wei: 3 years for the SiPM-ASIC development
  - Jianchun: FNAL testbeam facility could be an option for CEPC R&D, considering LHC LS3 timeline during mid-2026 and 2029

# **Muon: Xiaolong Wang**

- Status report
  - Ref-TDR chapter status: 24 pages
  - Electronics
  - Detailed design: channel and module
  - Software nd simulation: muon ID and fake rate

# **Magnet: Feipeng Ning**

- Oral update
  - TDR chapter: 100% achieved

• Updated parameters and formats

#### **Electronics: Wei Wei**

- Status report
  - SiPM-ASIC design and tapeout: different scenarios
  - Discussion ECAL-FEE strategy for High-Lumi Z
  - Data-link ASIC (ChiTu) tapeout schedule
  - TDR chapter: 81 pages 95 %
- Discussion
  - Chip naming
  - Detector design and ASIC: coherent planning

## TDAQ: Fei Li

- Status report
  - TDR chapter: 32 pages
  - TDAQ meeting: Bhabha events
  - International collaboration: PIFI application with JLU Giessen professor

#### Software: Weidong Li

- Status report
  - Progress on several aspects: core, OTK, calorimeter, silicon, global track fit, event display
  - Chapter write-up:
    - Plan R&D part on the application of quantum computing

## Mechanics: Quan Ji

- Status report
  - General drawing: completed with updates on boundary and connection
  - Barrel ECAL: "suspended" connection design

- Endcap ECAL: "squeeze" connection design
- Route of cabling from
  - Barrel/endcap gap: calorimeters and tracking detectors
  - Beampipe: LumiCal and Vertex
- Ref-TDR chapter status
  - Completed: overview and connections of sub-detectors
  - To be done: installation design of sub-detectors, auxiliary facilities, underground experimental hall
- To be determined
  - Humidity requirements
  - Working temperatures for sub-detectors

#### **Physics: Mingshui Chen**

- Status report
  - tracking and vertex
  - Jet performance: barrel part achieves CDR performance, differential distributions
  - Studies on crystal ECAL granularity: inclusive pi0 from b decay (gold channel missing) ,  $\alpha_S$  with  $\tau$  (dominated by systematics uncertainty), CP in  $Z \rightarrow \tau \tau$  (statistics uncertainty dominated, TBD)

#### **Extra discussions**

- Xinchou:
  - Need to consider planning of informal reviews after the new year
  - Trying to identify possible issues
  - Target the formal review in April, 2025
  - Planning on further R&D activities after Ref-TDR