

CEPC Detector TDR Meeting (Mar. 12, 2024)

09:00 - 11:40 (Beijing Time)

Meeting agenda and minutes

- indico page: <https://indico.ihep.ac.cn/event/21873/>
- Participants
 - Present in the meeting room (M.B. 112)
 - Yifang Wang, Manqi Ruan, Mingshui Chen, Jianchun Wang, Zhaoru Zhang, Weidong Li, Miao He, Yong Liu, Haoyu Shi, Feipeng Ning, Mingyi Dong, Gang Li, Shengsen Sun, Quan Ji, Zheng Wang, Zhijun Liang, Yunyun Fan; Huaqiao Zhang, Shaojing Hou, Huirong Qi, Xinchou Lou, Jinyu Fu, Hengne Li, Ling Zhao, Guang Zhao, Yiming Li
 - Online
 - Wei Wei, Hongyu Zhang, Jingzhu Zhao, Meng Wang, Haijun Yang, Jun Hu, Chengdong Fu, Kai Liu, Suen Hou, Jingbo Ye, Zhan Li, Mei Zhao, Junsong Zhang, Shang Xia, Ye Chen, Fangyi Guo, Yunpeng Lu, Jinfei Wu, Fei Li, Xiongbo Yan, Xiaolong Wang, Ying Zhang, Baohua Qi, Jianbei Liu, Yubin Zhao, Linghui Wu, Weisong Duan, Lei Zhang, Joao Guimaraes da Costa
 - Minutes: Yong Liu, Zhaoru Zhang

Software: Weidong Li

- Oral status update by Weidong
 - PID and tracking: stay with the schedule (next month)
 - Calorimeter: reconstruction and PFA (release in late June)
- Discussions
 - Yifang: software -> integration with sub-detectors (version, dimensions, ...)
 - Weekly report: Distance to critical path, target, requirement
 - Jianchun: person power involvements from universities
 - Weidong: major from IHEP, others from SDU/FDU

Electronics: Wei Wei

- Status report by Wei
 - Considerations on TPC and DC TDAQ
 - Readout schemes of pixel-TPC and DC: data rate and transmission
 - Cost estimates: ~27M CNY (TPC) vs ~49M CNY (DC)

- Remaining issues
 - TPC/DC join trigger? (-> further discussions with physics group)
- Plan
 - Preliminary readout schemes for TOF
 - Will discuss on readout schemes of pixel tracker and calorimeters
- Discussions
 - Mingyi: ~100M CNY in the previous TPC, the reason of cost reduction
 - Huirong: that was for 55umx55um, lower granularity for pixel dimensions for this updated TPC pixel (0.5mmx0.5mm)

Mechanics: Quan Ji

- Status report by Quan
 - Global mechanics design
 - Calorimeter, TPC decided, waiting for silicon parameters
 - Gap: 10cm between sub-detectors
 - Beam pipe (+LumiCal)
 - Vertex: late April
 - Tracker:
 - TPC: 0.6 - 1.8 radius range
 - Calorimeters
 - ECAL: 32 phi-segments
 - HCAL: 16 phi-segments
 - Endcaps encompass barrel
 - Magnet and Yoke
 - Integration
 - Yifang: TPC
 - Endcap: OTK+ECAL
 - HCAL
 - Visit to "Luoyang Mine"
- Discussions
 - Gap of sub-detectors
 - Yifang: inner/outer radius should be determined by sub-detectors including electronics and cooling, but gap should be determined and fixed by mechanics group. In this sense, gap should stay in 2-3 cm
 - LumiCal: precision of 0.1um
 - Suen: this precision should be 1um
 - Yifang: other than normal requirements, Suen (working with others) need to think about how to measure this precision of 1 um
 - Calorimeters
 - Yifang: suggest an offset in phi between ECAL and HCAL (turn for half module)
 - ECAL: module shape and gaps

- Yifang: need to quantify the impacts of gaps of ECAL/HCAL modules; high priority of ECAL (expected minor impacts from HCAL)
- Yoke shape
 - Yifang: further investigate deformation of normal shape/spiral shape. Gaps between sub-det should absorb deformation of yoke.
- Installation Integration
 - Yifang: barrel TPC+OTK; endcap: OTK+ECAL; separate arrangements of ECAL, HCAL
- Remaining issues for calorimeters:
 - Gaps reserved for cabling between barrel and endcap
 - Mechanics of endcap ECAL

Magnet: Feipeng Ning

- Status report by Feipeng
 - Magnet parameters
 - Physics design of detector magnet
 - B-field non-uniformity: 14.6% (peak-peak), 7% (average)
 - Yifang: this is expected to be ~1% (2-3% could be accepted); focus on outer/inner tracker
 - Yoke and stray field
 - Stray field of 50 - 100 Gs
 - Yifang: could consider to add a bit more yoke, given 3kton in total
 - Feipeng: will add a few layers of yoke, to control the stray field and to improve B-field uniformity
 - Magnet field at booster ring
 - Yifang: luminosity -> stray field

MDI: Haoyu Shi

- Status report by Haoyu
 - Background simulation and developments
 - LumiCal updating the design
 - Interaction region: optimisations

Vertex: Zhijun Liang

- Status report by Zhijun
 - Geometry and layout: a first design in late March (including endcaps)
 - Layout optimisation in CEPCSW
 - Feasibility studies on long barrel

- MDI background input
 - Need a tool to read out values of n_eq mapping from Haoyu
- Discussions
 - Jianchun: decide cooling scheme for endcaps asap

Tracker: Meng Wang

- Status report by Meng
 - Tracking system layout
 - TPC vs DC: performance comparison table
 - Silicon pixel tracker: initial design, data rate
 - Silicon strip tracker: single-layer strip, initial design of barrel module
- Discussions
 - Jianbei: TPC endcap material budget (17%X0) including cooling?
 - Huirong: yes, with dual-phase CO2
 - Meng: will stay within 50%X0 (as previously discussed with Manqi)
 - Jianchun: seems too large distance between layers in endcaps, need to optimize distance asap
 - Yifang
 - 100um precision in TPC seems to optimistic, reasonable with 110-120 um for a large TPC
 - Typo in $\leq 3\sigma$ (for K/ π separation) -> should be $\geq 3\sigma$
 - further investigate the dn/dx of TPC pad cell size
- Talk on Drift Chamber by Mingyi
 - Performance parameters, cost estimates, mechanics (+FEA), wire-tension, hit rate and occupancy at Z-pole

Calorimeters: Jianbei Liu

- Oral update by Jianbei
 - <https://indico.ihep.ac.cn/event/21809/>
 - Template for calorimeter option comparison
 - Input materials collected based on the template
 - Need to fix boundary conditions (< - mechanics dimensions)
 - Will update materials accordingly considering
- Discussions
 - Jianchun: stereo crystal configurations, will converge options and report at next CEPC Day
 - Yifang: calorimeter endcap designs for ECAL and HCAL: module assembly, performance...
 - Jianbei: will discuss and come up with first designs for endcap calorimeters

Muon: Xiaolong Wang

- Status report by Xiaolong
 - Activities focusing on scintillator option
 - Comparison of scintillator vs RPC options
 - Total 9M CNY for scintillator option (5 layers)
 - RPC option: requires more accurate estimates
 - Electronics
 - Back-end electronics: considerations
 - New design for front-end electronics
 - Plans
 - Will start simulation with spiral geometry
 - Production of scintillator bars (requiring a mould)
- Discussions
 - Yifang: need to scale the cost estimate of the RPC option based on the BES3 muon detector and the Daya Bay veto detector
 - Jianchun: Optimize comparison table, highlight key parameters

Physics: Manqi Ruan

- Status report by Manqi
 - Table of physics benchmarks
 - Significant improvement from Jet Flavour Tagging to Jet Origin ID
 - Performance studies
 - With TOF -> significant contributions to Jet Origin ID (Kaons)
 - SET impacts + TPC simulation
 - Need validation studies on digitization
- Discussions
 - Jianchun: 1-layer vs 2-layer designs -> critical design for strip/pixel detectors
 - Meng: significant (40%) improvement for H->ss (expected ~1k events at Higgs) -> need TOF?
 - Meng and Manqi favours TOF, especially for Z-pole
 - Can also consider to add TOF at the end of Higgs period, before starting Z-pole running
 - Yifang/Jianchun: Call for special meeting with vertex/tracker to review physics/performance

AOB

- Yifang
 - General good status since the past 2 months

- Key focus on calorimeters
 - Cost estimates: ~60% of total detector
 - Calorimeter endcap design
- Software (reconstruction + Arbor) for calorimeters
 - Updated geometry (inner/outer radius) -> CEPCSW
 - Implement sub-detector step by step into CEPCSW
 - repeat process using old ECAL+HCAL information
 - replace ECAL or HCAL one by one, check performance
 - replace ECAL+HCAL
- Xinchou
 - Physics benchmarks: wider and further communications
 - Higgs->invisible
 - FCC for instance: CERN is launching a project looking for dark matter
 - Funding for detector R&D
 - R&D dedicated to inputs for TDR: e.g. TPC
 - Preparations and considerations of R&D programs for the post-TDR period (EDR)