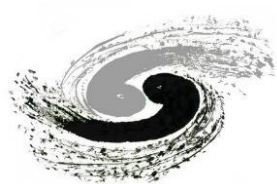


# CEPC HCAL: considerations and rough estimates for DAQ

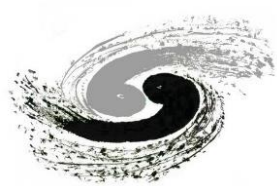
Yong Liu (IHEP), for the CEPC-Calo Conveners  
Sep. 30, 2020



# CEPC CDR: DAQ for HCAL

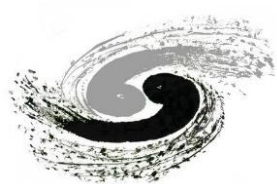
- Maximum event rate: 100 kHz
  - Peak event rate:  $\sim 32\text{kHz}$  at Z-pole
  - Safety margin: a factor of  $\sim 3$
  - $10\text{ }\mu\text{s}$  time window for readout
- HCAL: 2 options in CDR
  - Scintillator HCAL:  $30 \times 30\text{ mm}^2$  scintillator tiles
  - RPC HCAL (SDHCAL):  $10 \times 10\text{ mm}^2$  RPC pads
  - Longitudinal depth: 40 layers ( $\sim 4.7\lambda$ )

ECAL options	#Channels [Million]	Occupancy [%]	#bit per channel	#readout channels/evt	Data Volume per event	Data rate at 100kHz
Scintillator HCAL Barrel	3.6	0.02	32	0.72 k	2.9 kByte	0.3 GBytes/s
Scintillator HCAL Endcap	3.1	0.12	32	3.72 k	15 kByte	1.5 Gbytes/s
RPC HCAL Barrel	32	0.004	8	1.28 k	1.28 kByte	0.13 GBytes/s
RPC HCAL Endcap	32	0.01	8	3.2 k	3.2 kByte	0.32 Gbytes/s



# HCAL updates after CEPC CDR

- Based on the CDR values: scaling exercise
- One major scaling factor for scintillator-HCAL (AHCAL)
  - #channels: generally scintillator HCAL will have less channel count
    - Scintillator tiles:  $30 \times 30 \text{ mm}^2 \rightarrow 40 \times 40 \text{ mm}^2$  (a factor of  $\sim 1.8$ )
    - #channels is reduced in HCAL, but occupancy would get increased.
    - If the occupancy scales up linearly with reducing #channels (to be verified), the data rate remains unchanged
- DAQ for SDHCAL remains the same as CDR
- Other considerations on the SDHCAL
  - Currently R&D efforts ongoing on high-precision timing capability for SDHCAL
    - Timing resolution on the order of 10 ps would require higher **#bit/channel**
    - Remains to be estimated, based on the detailed technical design



# CEPC CDR: DAQ for ECAL

- Maximum event rate: 100 kHz
  - Peak event rate:  $\sim 32\text{kHz}$  at Z-pole
  - Safety margin: a factor of  $\sim 3$
  - $10\text{ }\mu\text{s}$  time window for readout
- HCAL: 2 options in CDR
  - Scintillator HCAL:  $40 \times 40\text{ mm}^2$  scintillator tiles
  - RPC HCAL (SDHCAL):  $10 \times 10\text{ mm}^2$  RPC pads
  - Longitudinal depth: 40 layers ( $\sim 4.7\lambda$ )

ECAL options	#Channels [Million]	Occupancy [%]	#bit per channel	#readout channels/evt	Data Volume per event	Data rate at 100kHz
Scintillator HCAL Barrel	2.0	0.036	32	0.72 k	2.9 kByte	0.3 GBytes/s
Scintillator HCAL Endcap	1.7	0.216	32	3.72 k	15 kByte	1.5 Gbytes/s
<b>RPC HCAL Barrel</b>	<b>32</b>	<b>0.004</b>	<b>8</b>	<b>1.28 k</b>	<b>1.28 kByte</b>	<b>0.13 GBytes/s</b>
<b>RPC HCAL Endcap</b>	<b>32</b>	<b>0.01</b>	<b>8</b>	<b>3.2 k</b>	<b>3.2 kByte</b>	<b>0.32 Gbytes/s</b>