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Power Cabling for Silicon Tracker

骆首栋

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CEPC OTK Barrel Cable

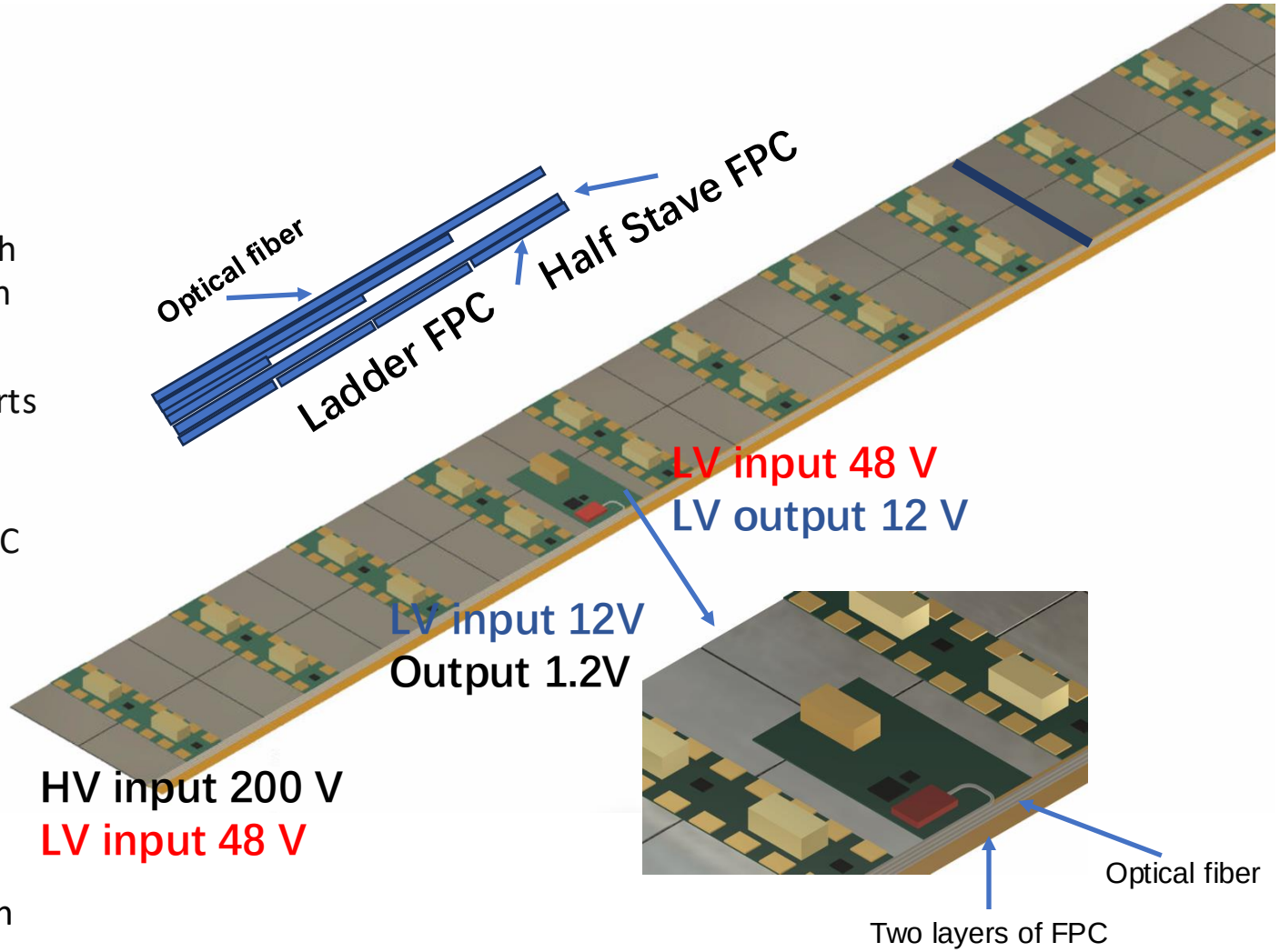
One stave is composed of 8 ladders.

OTK voltage transmission

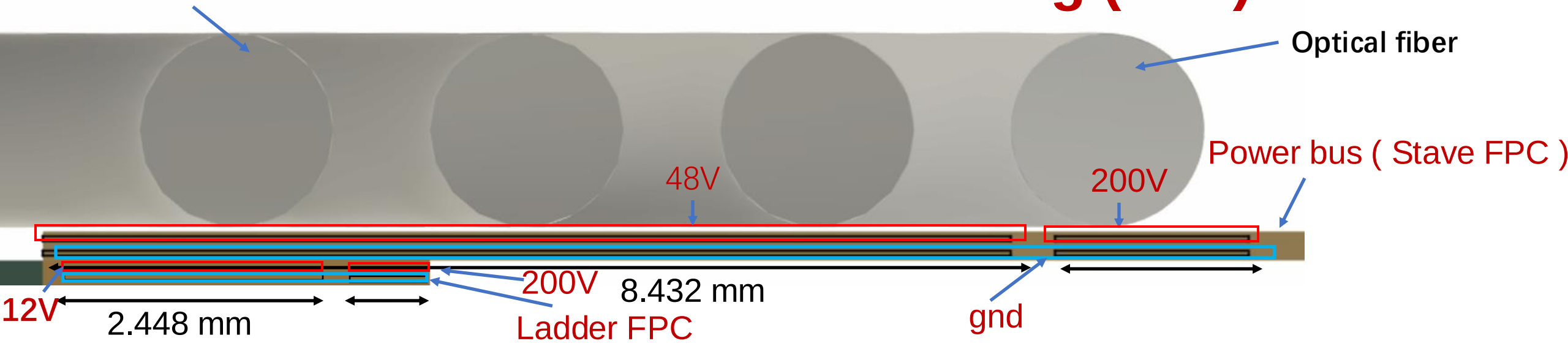
- The primary low-voltage (LV) input to the stave is 48 V, which is delivered to the secondary data aggregation board of each ladder via one layer of FPC （Stave FPC）.
- The secondary data aggregation board in each ladder converts the 48 V input LV to 12 V.
- The converted 12 V LV is then transmitted to the FPCs of all modules within the ladder through an additional layer of FPC (Ladder FPC).
- High voltage (HV) at 200 V is supplied to the secondary data aggregation board through the Stave FPC and subsequently distributed to individual sensors within the ladder via the Ladder FPC.

OTK voltage transmission

- Data output , clock and commands inputs transmit between sensor modules and optical module in secondary data aggregation board through Ladder FPC .



CEPC OTK Barrel Cabling (Cu)

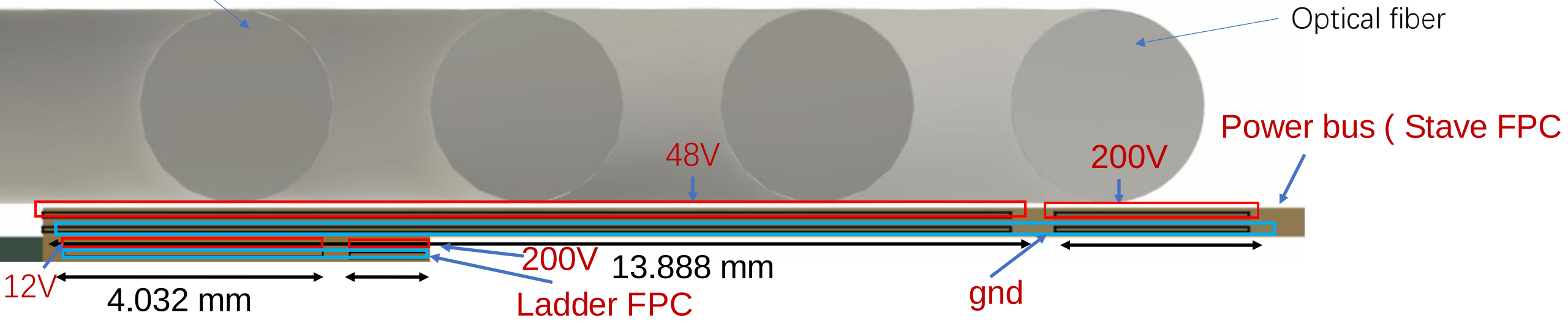


- OTK Barrel Power Bus
  - Power consumption: ~300mW/cm^2 ,224.5 W each Ladder
  - Cu resistivity 1.7x10^{-8} Ωm

Based on a metal layer of 25 micro in FPC and the voltage drop < 1 V , the minimum widths of the metal layers were determined by U=IR and $\rho = \mathrm{RS/L}$

Voltage (V)	current (A)	Resistance (Ω)	Length(mm)	Thickness(μm)	Width(mm)
48V	4.67	0.20	2480	25	8.432
12V	9.35	0.10	360	25	2.448

CEPC OTK Barrel Cabling (Al)



- OTK Barrel Power Bus
  - Power consumption: ~300mW/cm^2 ,224.5 W each Ladder
  - Cu resistivity $2.8\times10^{-8}\,\Omega m$

Voltage (V)	current (A)	Resistance (Ω)	Length(mm)	Thickness(μm)	Width(mm)
48V	4.67	0.20	2480	25	13.888
12V	9.35	0.10	360	25	4.032

CEPC ITK Endcap Cabling

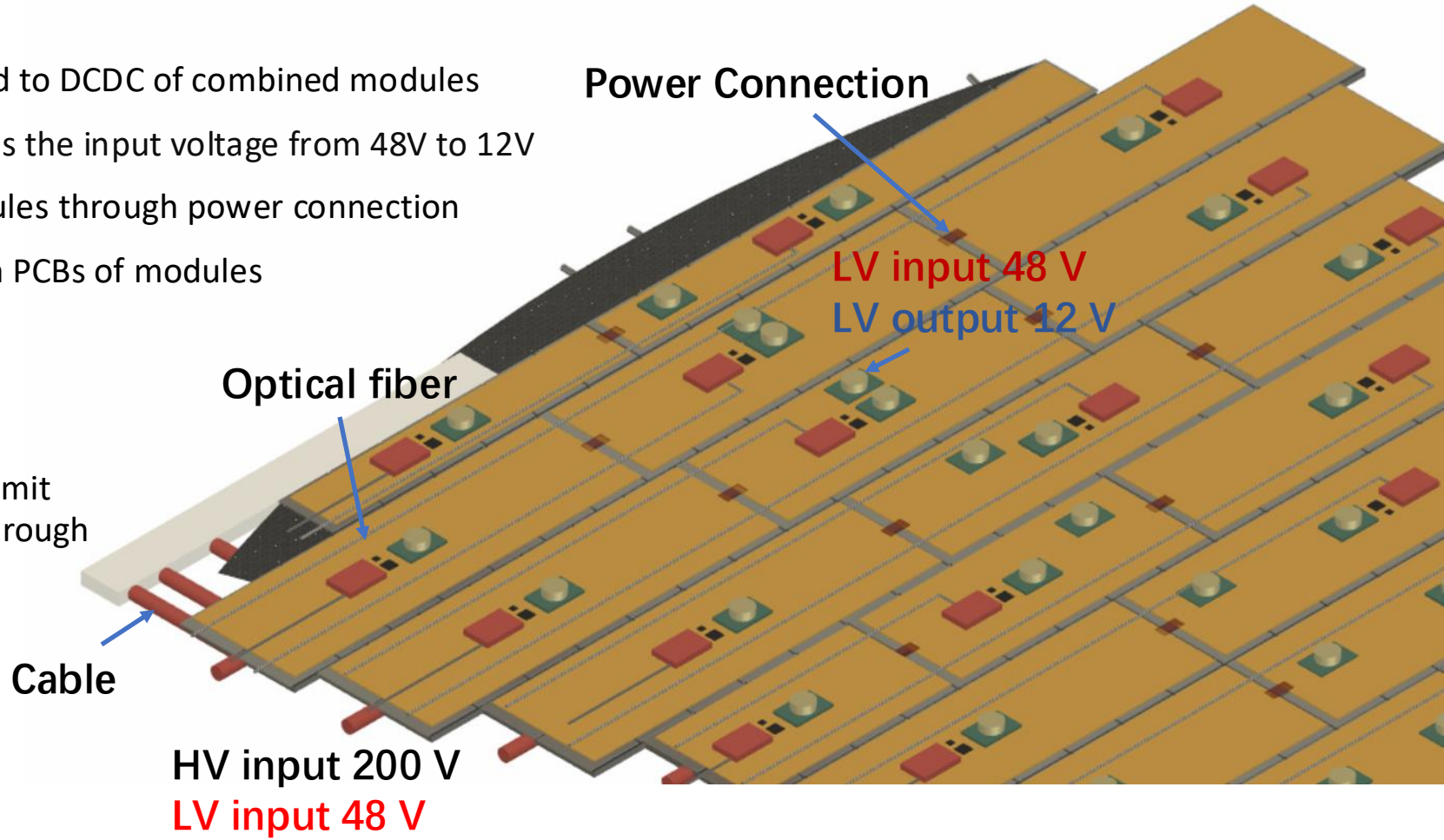
In each sector of the endcap, adjacent modules are interconnected via power connections, enabling the sharing of power supply.

ITK Endcap voltage transmission

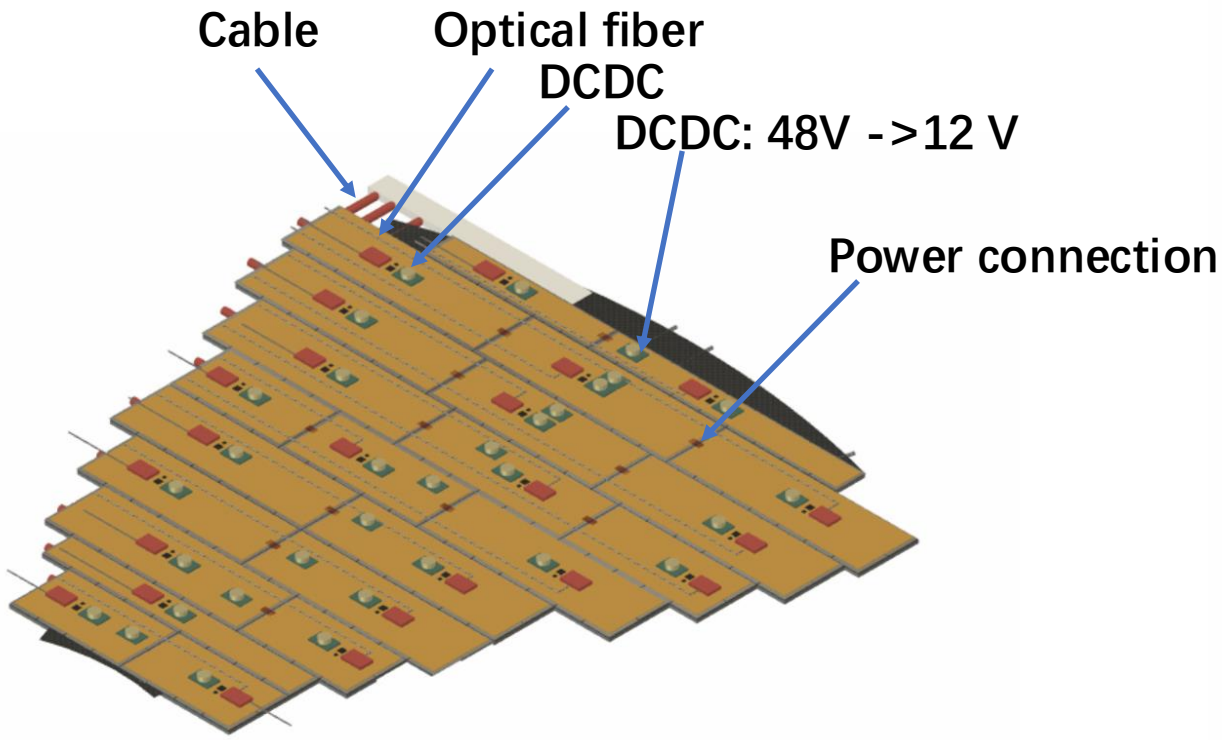
- The original LV input is 48 V , which is distributed to DCDC of combined modules
- The DCDC within the connected module converts the input voltage from 48V to 12V
- The LV of 12 V is transmitted to PCBs of all modules through power connection
- HV 200 V is transmitted to each module through PCBs of modules

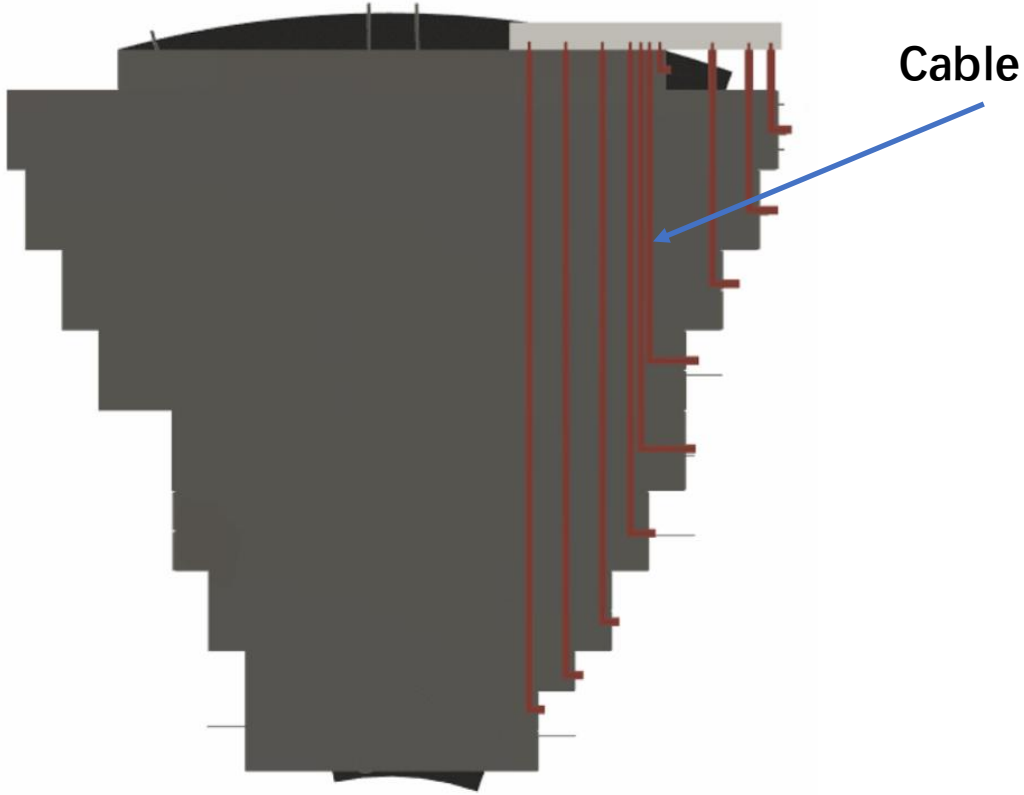
ITK Endcap Data transmission

- Data output , clock and commands inputs transmit between sensor modules and optical module through PCBs of each module



CEPC ITK Endcap Cable



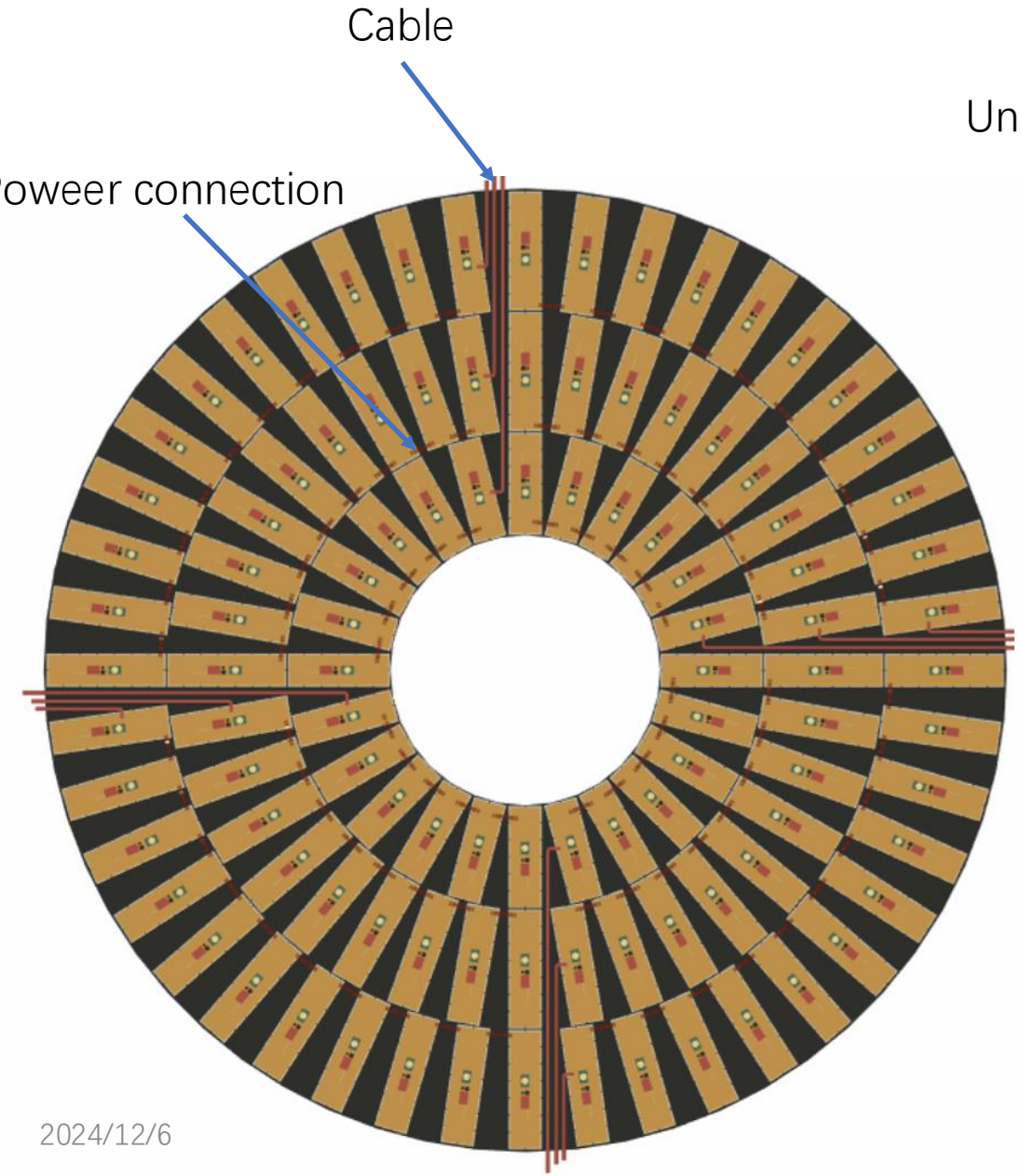


- ITK Endcap Power Cable
  - Power consumption: ~80mW/cm^2
  - Cu resistivity $1.7\times10^{-8}\ \Omega m$
  - R_{cable}: 5mm

Based on a metal cable with length of 250 mm , total power consumption ~6.4 W and the voltage drop < 1 V , the minimum radius of the metal cable were determined

Voltage (V)	current (A)	Module	Length(mm)	R(mm)
48V	1.3	2*10	250	1.2

CEPC ITK Endcap Cable



Under Study