

Power dissipation

Zhijun Liang



INSTITUTE OF HIGH ENERGY PHYSICS, CAS

Barrel Vertex detector mechanism design

Engineering design on the ladder (module) of vertex detector and support structure.

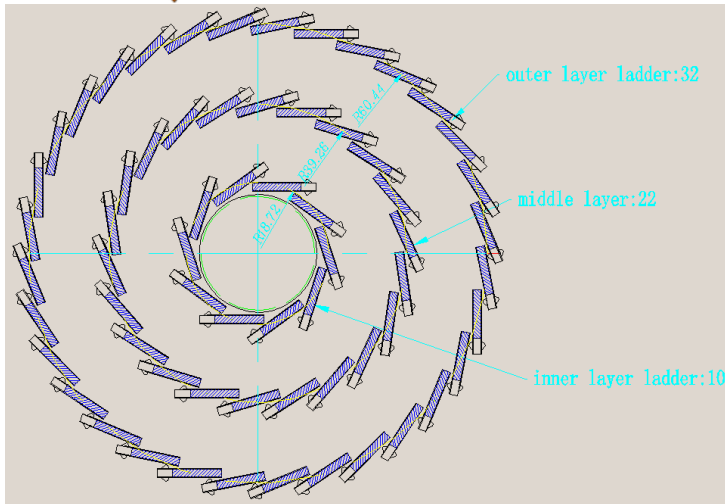
Monolithic Sensor chip : 14.8 x 25.6 x 0.05 mm (not consider stitching yet)

Ladder: support structure + chips + flexible PCB

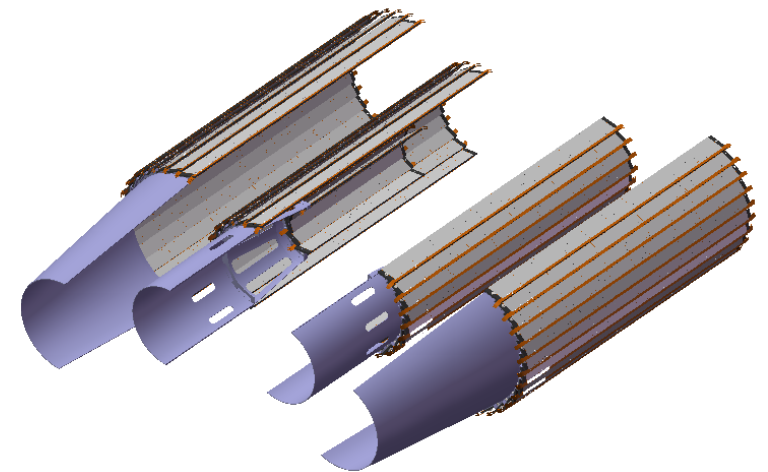
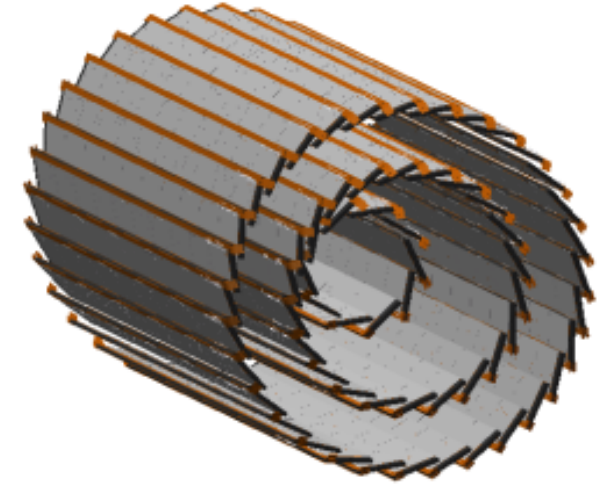
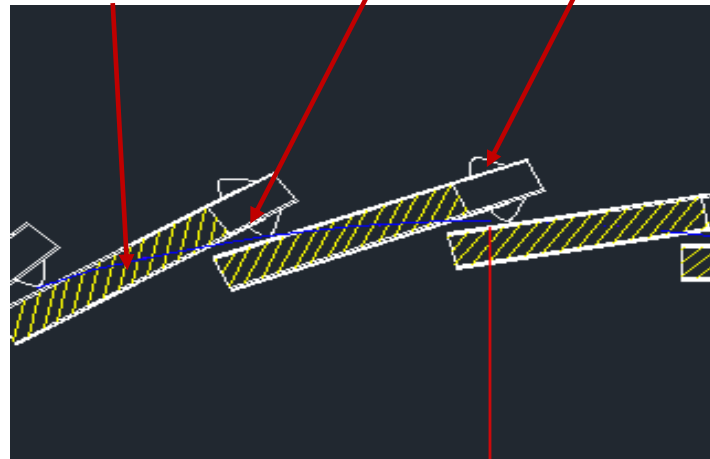
By Jinyu Fu

Ladder of inner layer(16.8 x 131 mm):
10 chips total including both sides

Ladder of outer two layers(16.8 x 264 mm):
20 chips total including both sides

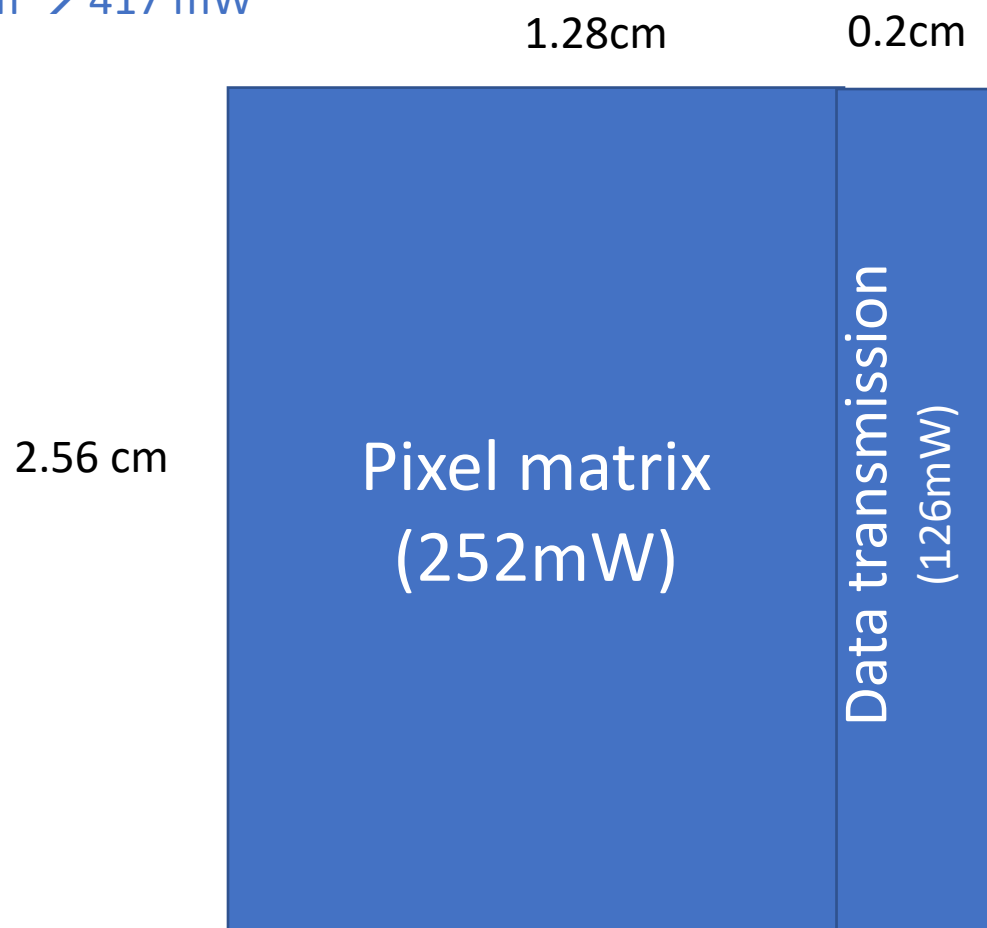


Active area Dead area Wire bonds



Power dissipation

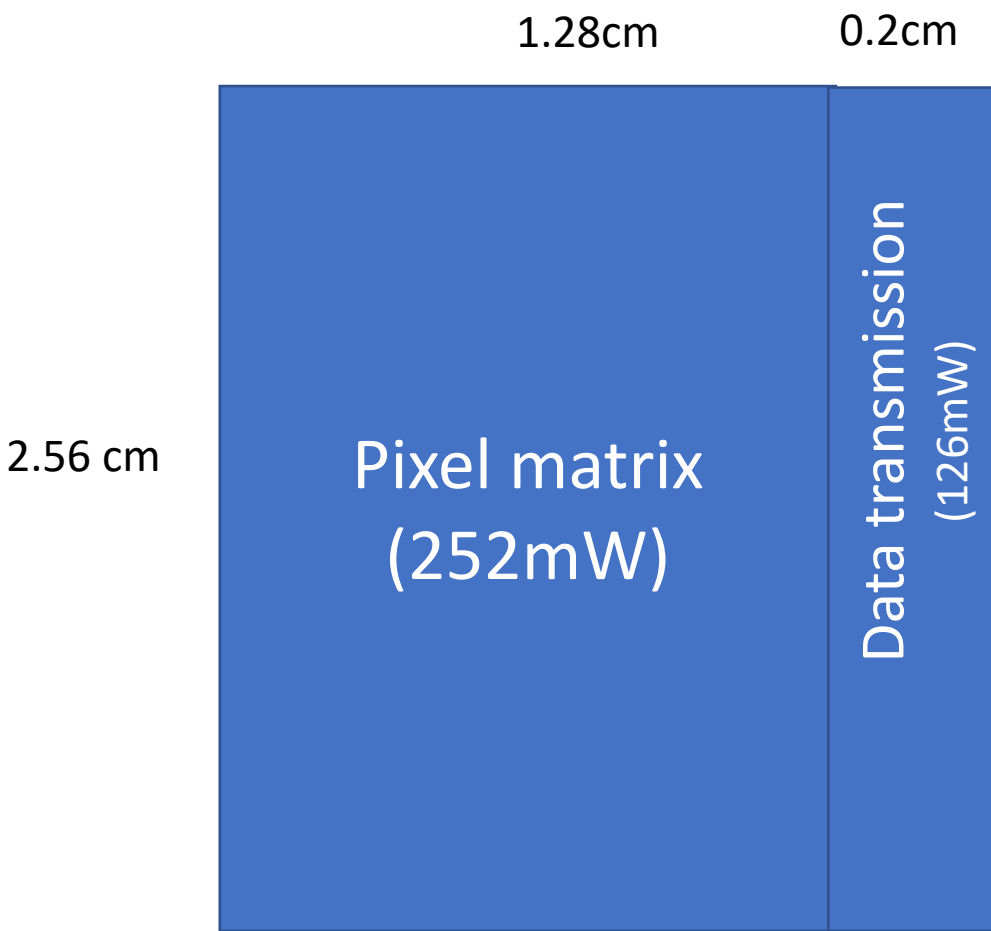
- Trigger mode: 100 mW/cm² (According to Wei)
 - Taichu full-size Chip : 1.48 x 2.56cm → 378mW
 - : 1/3 power dissipation in data transmission block (126mW)
 - 2/3 in pixel matrix (252mW)
- Triggerless mode: 150 mW/cm²
 - Taichu full-size Chip : 1.48 x 2.56cm → 417 mW
 - data transmission block (165mW)
 - pixel matrix (252mW)



Thermal mockup

- Need help to design PCB heater to emulate the power dissipation of Taichu chip
- maybe 2~3 version of PCB heaters?
 - One for trigger mode, one for triggerless mode ?
 - One to emulate the power dissipation after irradiation

PCB heater for ATLAS strip dummy module



Thermal simulation

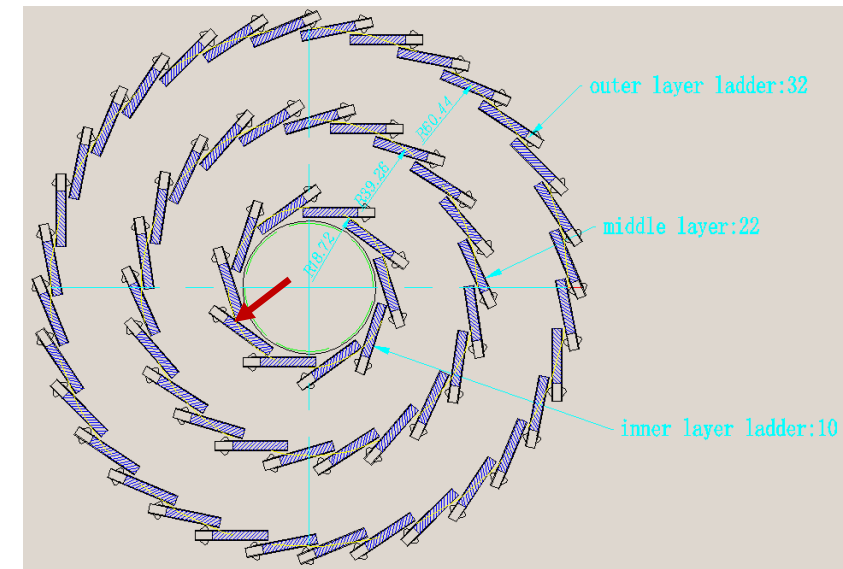
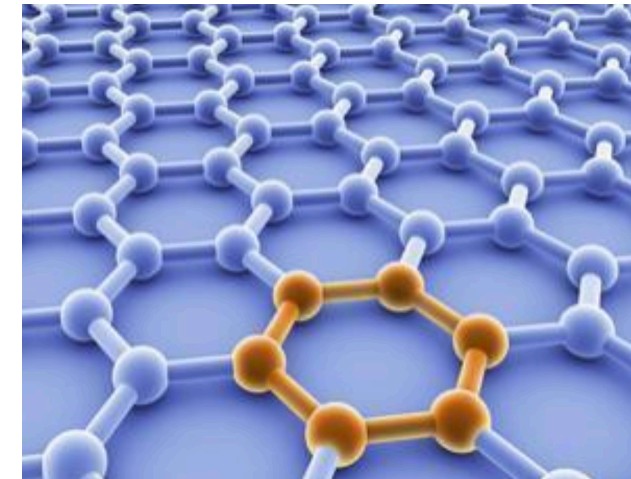
- Even using long barrel design with large Air flow
 - However, the temperature b layer of vertex detector is still high ($>50^{\circ}\text{C}$)
 - Too close to beampipe (limited air flow)
 - New idea about new material (Graphene) (Quan's talk)
 - Much High heat conductivity compared to Carbon fiber
 - What is Limitation in air velocity ?
 - Star HFT detector manage to provide 10m/s air flow)

Thermal simulation (By Jinyu Fu)

Power dissipation (mW/cm ²)	Temperature of beam pipe's surface (°C)	Inlet air temperature (°C)	Inlet air velocity (m/s)	Max temperature of inner barrel (°C)	Max temperature of middle barrel (°C)	Max temperature of outer barrel (°C)
50	30	0	2	57.1	29.1	26.9
50	30	0	3	54.5	24.3	22.9
50	30	0	4	52.3	21.3	19.9

Power consumption: $< 50 \text{ mW/cm}^2$ layer ,
temperature $< 30^{\circ}\text{C}$

Graphene



MOST2 midterm review

- 完成传感器芯片上所有功能模块的初步设计，并把各功能模块的设计集成，完成第二次传感器流片的设计。
 - 传感器像素单元尺寸小于或等于 25 微米 × 25 微米（基本完成？）
 - 通过仿真初步验证其抗辐照性能。（可以实测？）
 - X光辐照测试具体需要测哪些参数？
- 研制出单个传感器芯片的读出电子学、数据获取系统，对第一次 MPW 流片传感器芯片进行初步测试。（基本完成？）
- 完成的探测器单元模块的读出电子学与数据获取系统的初步设计。