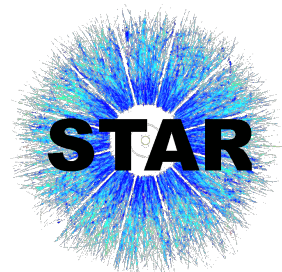

STAR Forward sTGC Tracker

Summary, Timelines and Milestones

Chi Yang

Shandong University



STAR Forward Upgrade Face To Face Meeting



FTT Constructions

BNL:

James D. Brandenburg, Timothy Camarda, Michael Capotosto, Alexei Lebedev, Tonko Ljubicic, Lijuan Ruan, Rahul Sharma, Prashanth Shanmuganathan, John Scheblein, David Tlusty, STSG + Students +

SDU:

Changyu Li, Yingying Shi, Zhen Wang, Qinghua Xu, Chi Yang, Qian Yang, Shangbin Yang, Shengguo Zhang

USTC:

Ge Jin, Feng Li, Peng Miao, Zebo Tang, Shuang Zhou

Tasks:

- Module R&D, mass production, quality and performance test
- Electronics R&D, VMM, mass production, test, electronics integrations
- Integrations, support structure, gas system, installation, interlocks
- Software, tracking, cluster finding

FTT Module Design

Three versions of FTT modules have been designed.

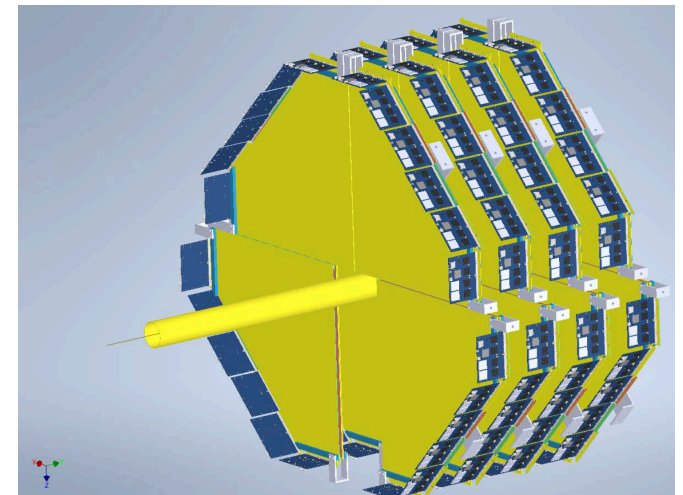
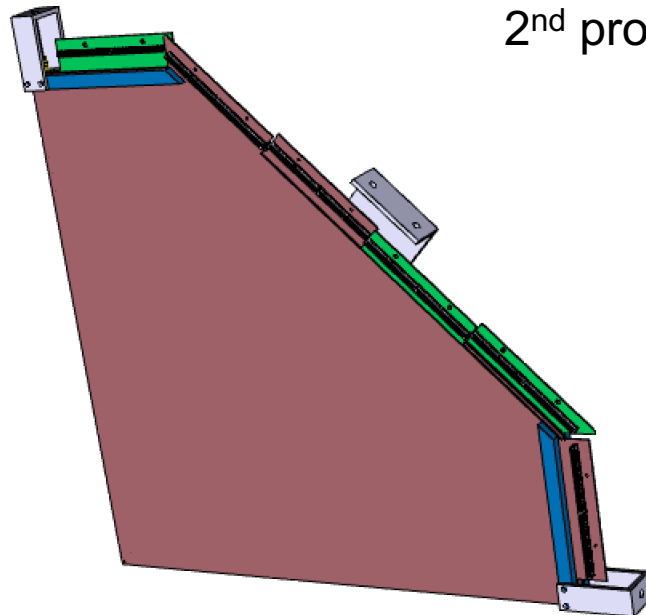
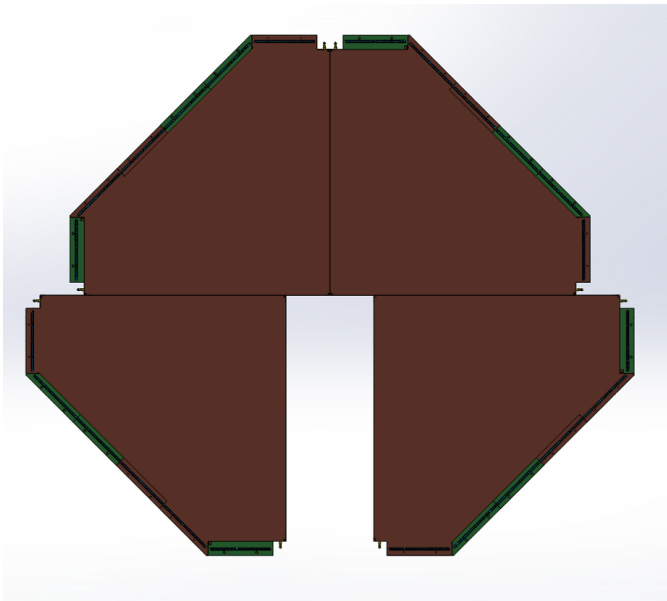
1st 30cm * 30cm square with adapters separately

2nd 60cm * 60cm square with TPX FEEs directly connected to PPPCB

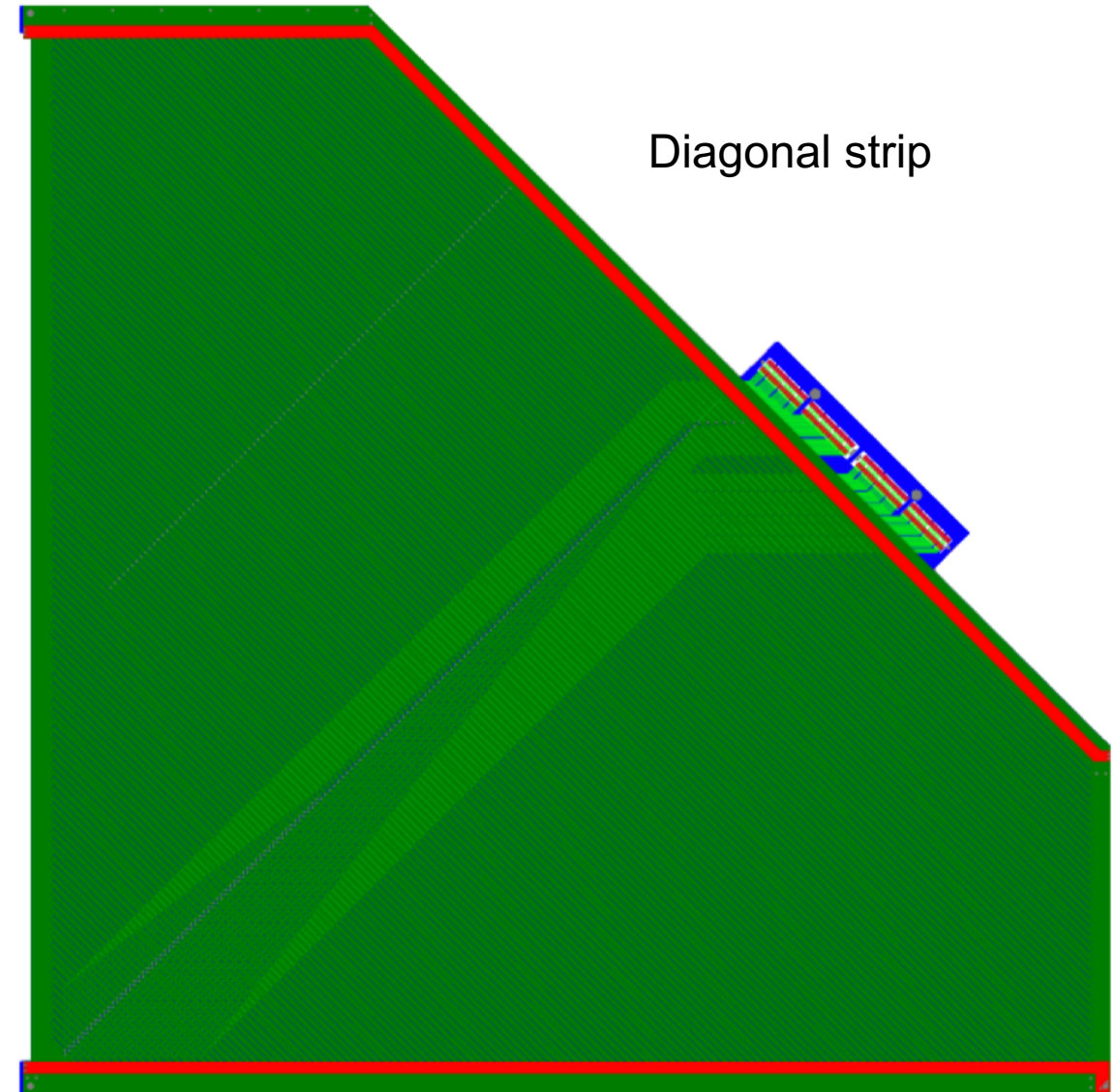
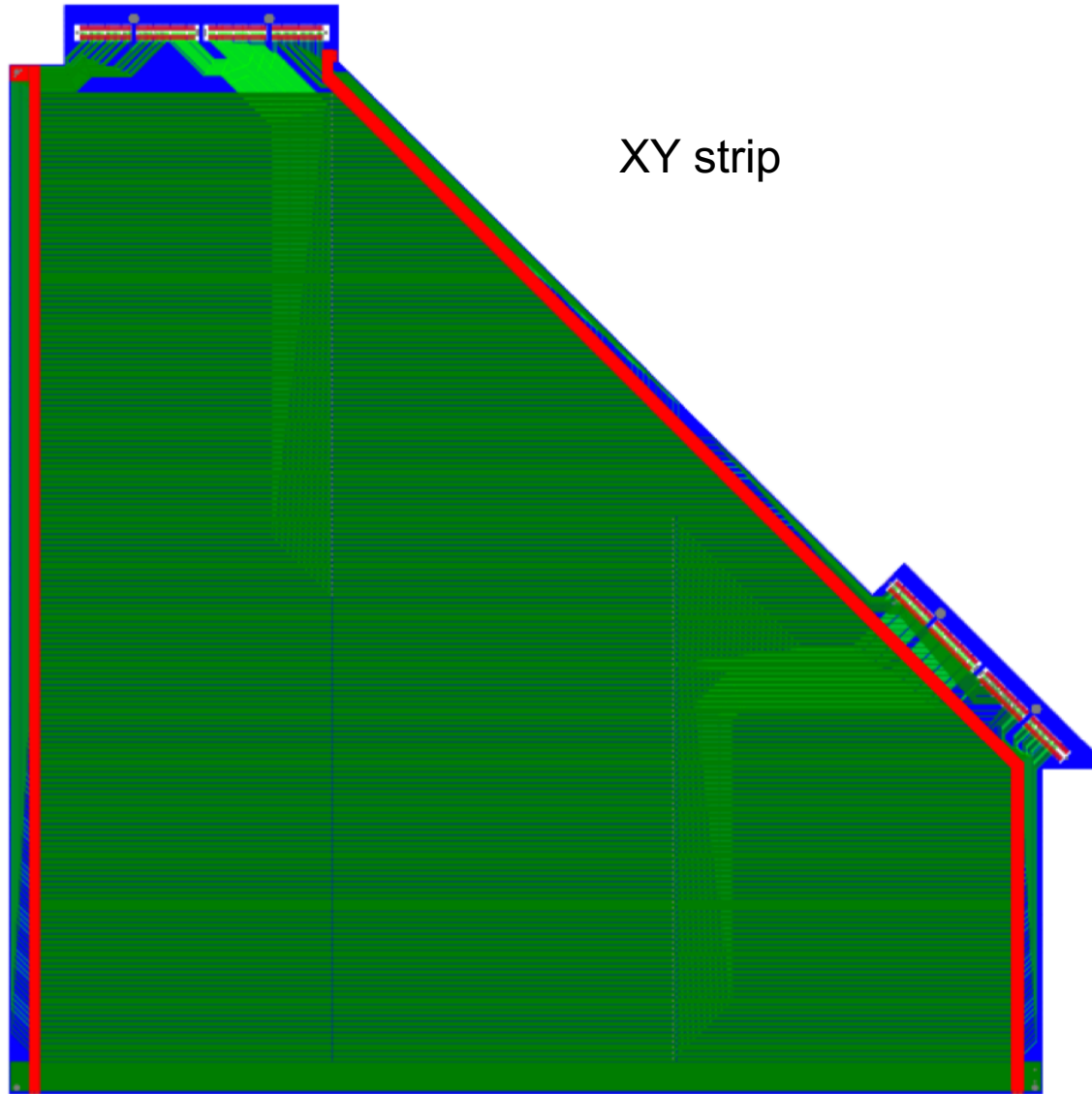
3rd ~50cm * 50cm pentagon with VMM FEEs directly connected to PPPCB and with diagonal strips

1st prototype was tested in Run19

2nd prototype was shipped to BNL in early July 2020

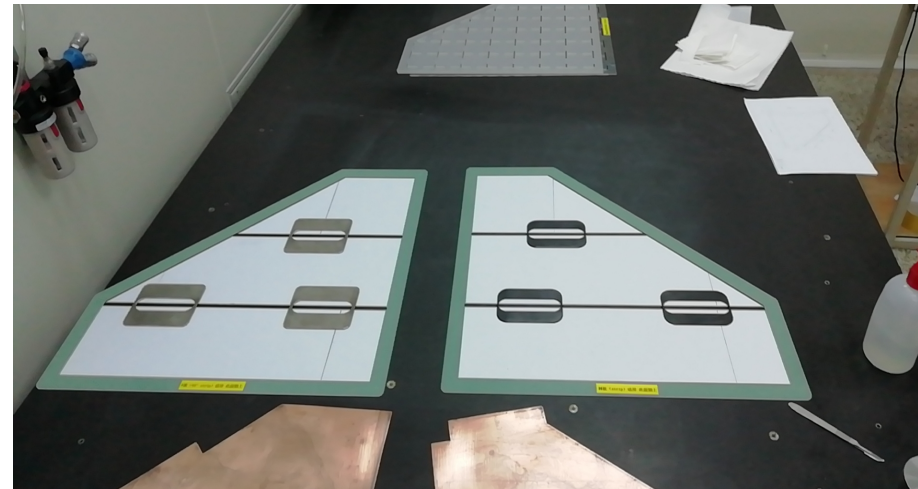
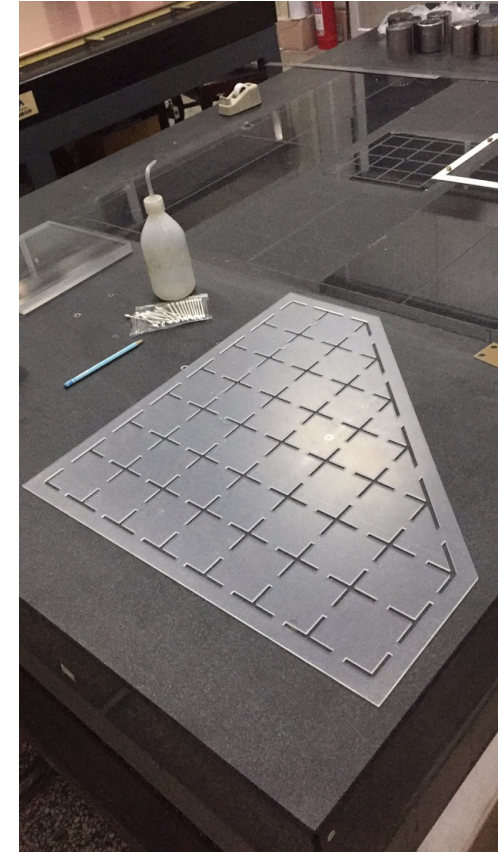
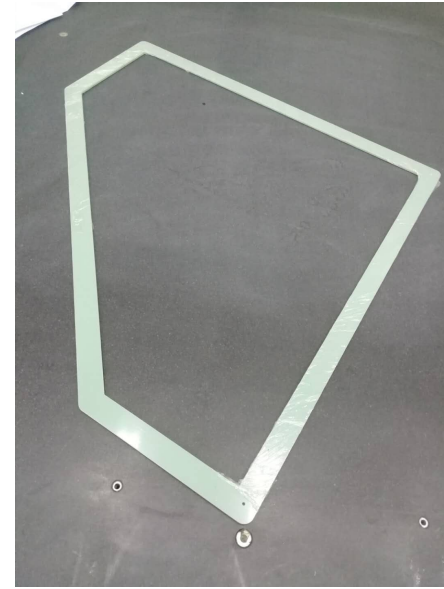


FTT Module Design



FTT Pentagon Prototype Production Readiness

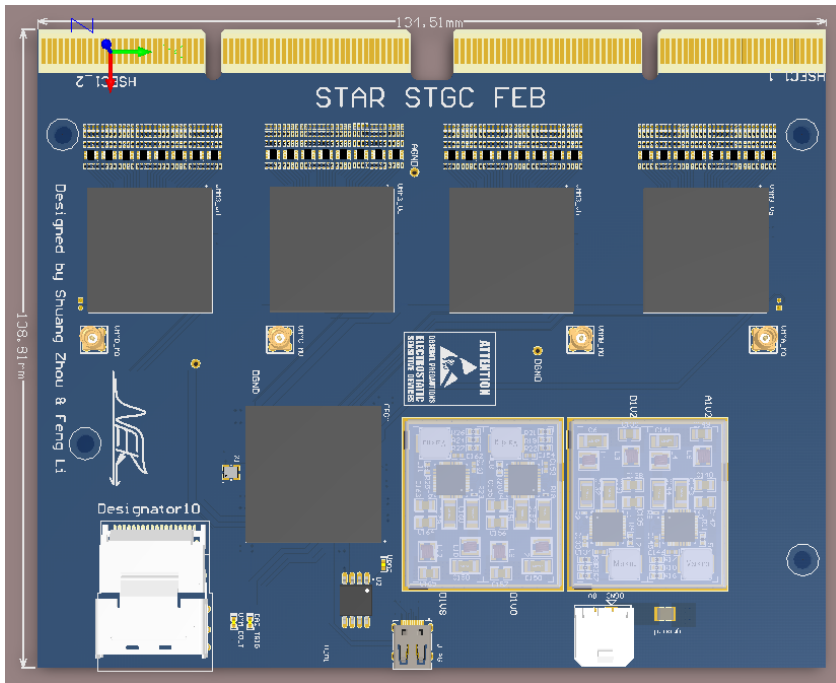
- PCB thickness and flatness check ✓
- Connectivity check ✓
- Painting Luka on support frame ✓
- Graphite spraying (this week 😊)
- Wire winding machine ✓
- Gas system ✓



FTT VMM Based Electronics

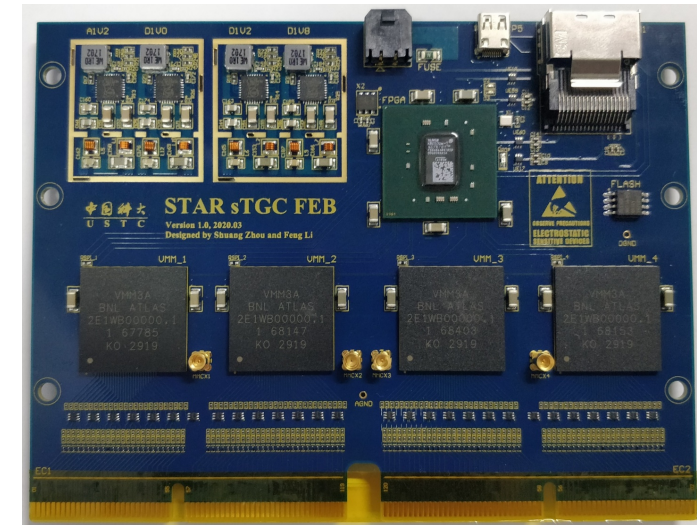
FEBs are designed based on VMM chips.
4 chips/board, 106 channels

FEB size 131.51mm*108.81mm



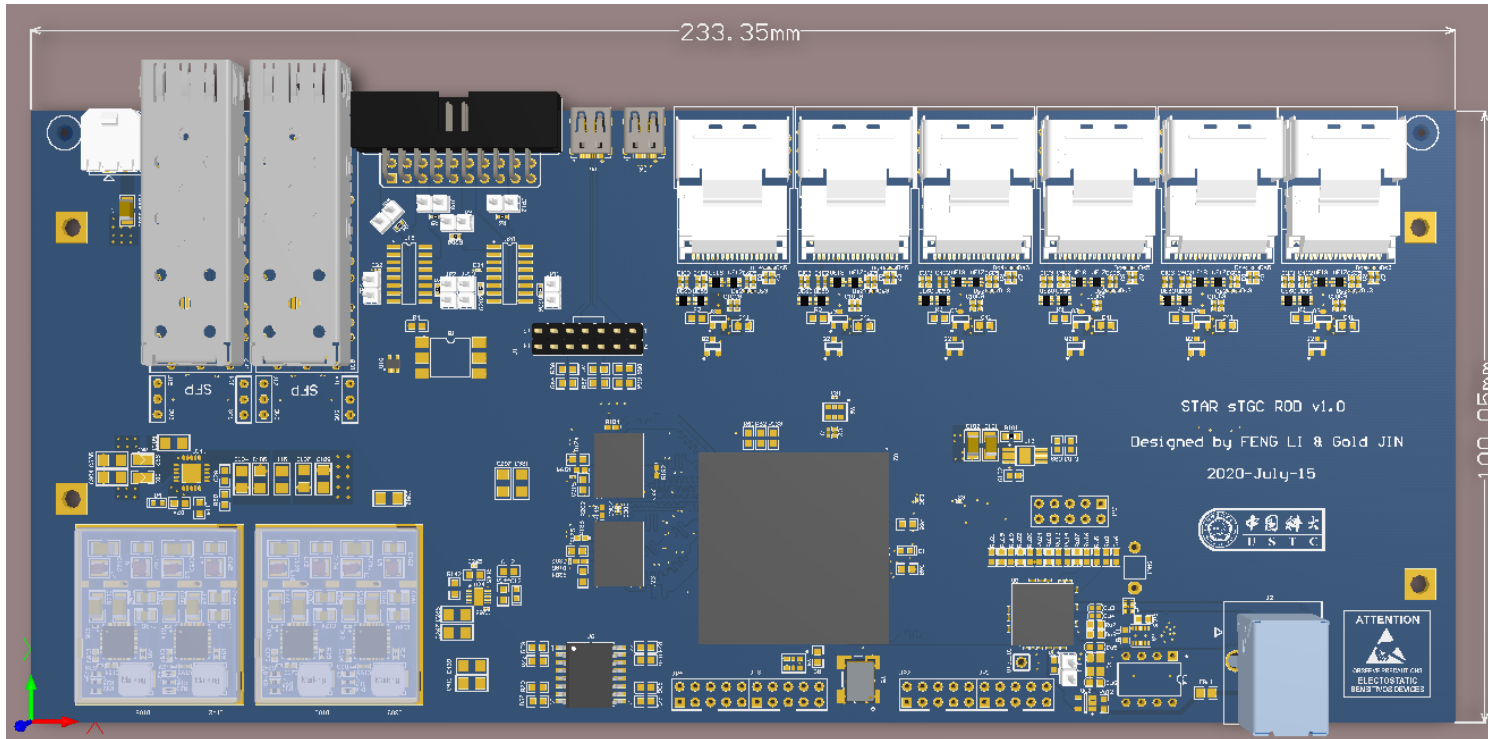
4 FEBs are fabricated and tested in June 2020.
VMM chips are from USTC in-kind.

Various tests are done (including the testing on power supply, basic functions of the FPGA, the performance of the GTX link at 4 Gbps by Xilinx IBERT core, the GTX link with different length (up to 3m) of the mini-SAS cable, VMM configuration).
No significant issue observed.



ROD and Firmware

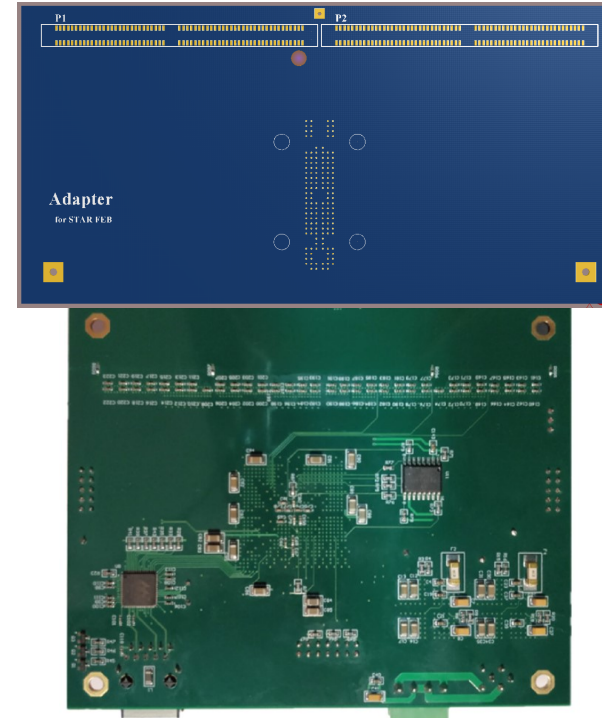
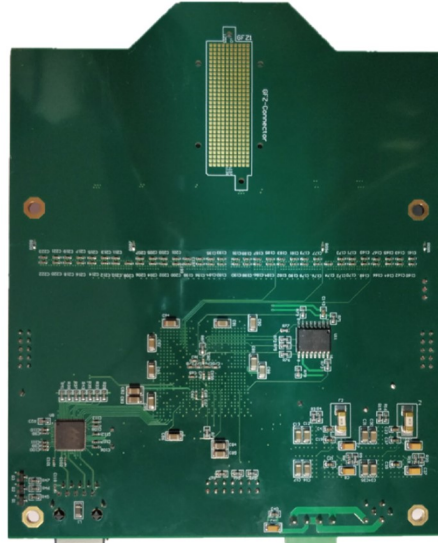
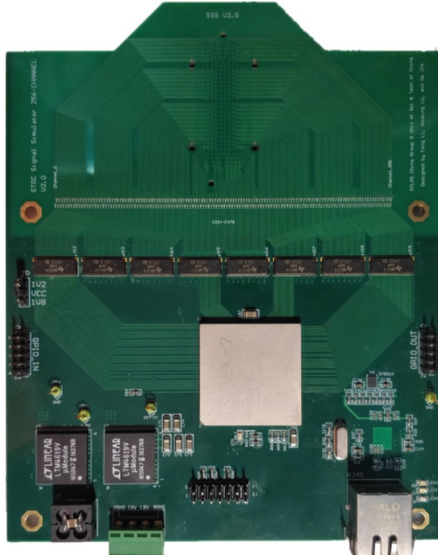
ROD size 233.35mm*100.05mm



RODs are in venter production.
Expect to get the boards in early August.
Then 1-2 weeks for soldering.

Firmware development ongoing:
Decode events data; Descramble; CRC
10G SFP+ code transplanting;
DDR3 code development

Signal Simulator Board + Adapter Board



- 256 channels charge output, $\sim 0.4\text{pC}$
- Used as external test pulse source for FEB

VMM status

- BNL got the quote of VMM chips.
- Purchasing is in processing, moving forward determined and slowly.
- Sub-contract is in finalizing.

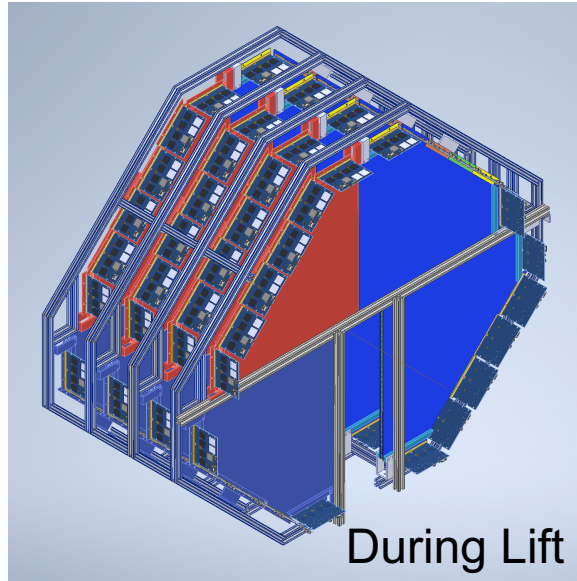
Significant progress after last f2f meeting.

**Joint test of the pentagon prototype and electronics is expected to start in Aug. 2020.
Based on the VMM chips from USTC in-kind.**

FTT DAQ: see Tim's talk in the afternoon.

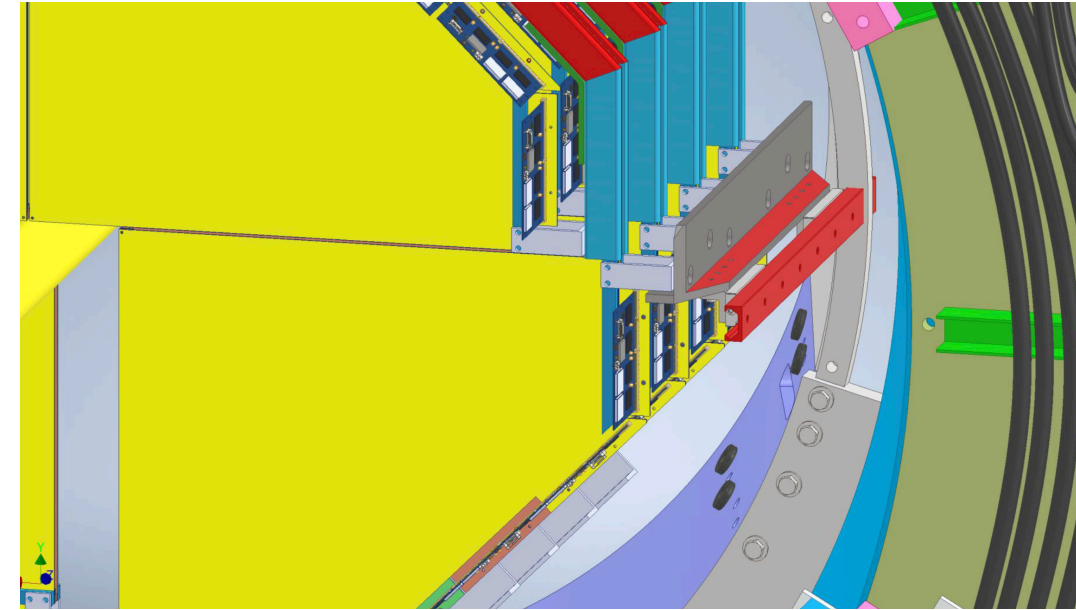
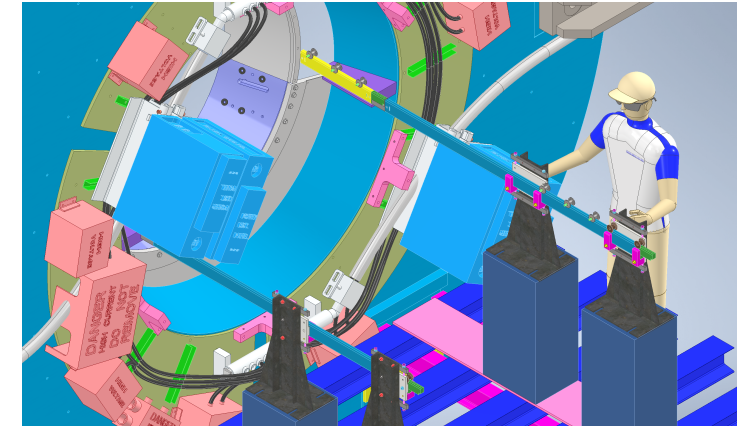
Integration

Frame Design (Still Work in progress)



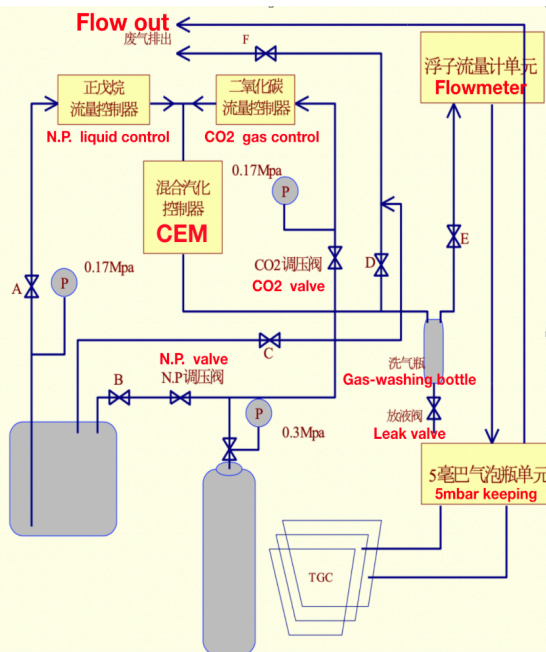
Tasks to be completed

- Frame design and analysis/Calculations
- Transportation cart design
- Heat load analysis
- Cooling duct system design
- Cabling design
- Rail system design
- Platform design

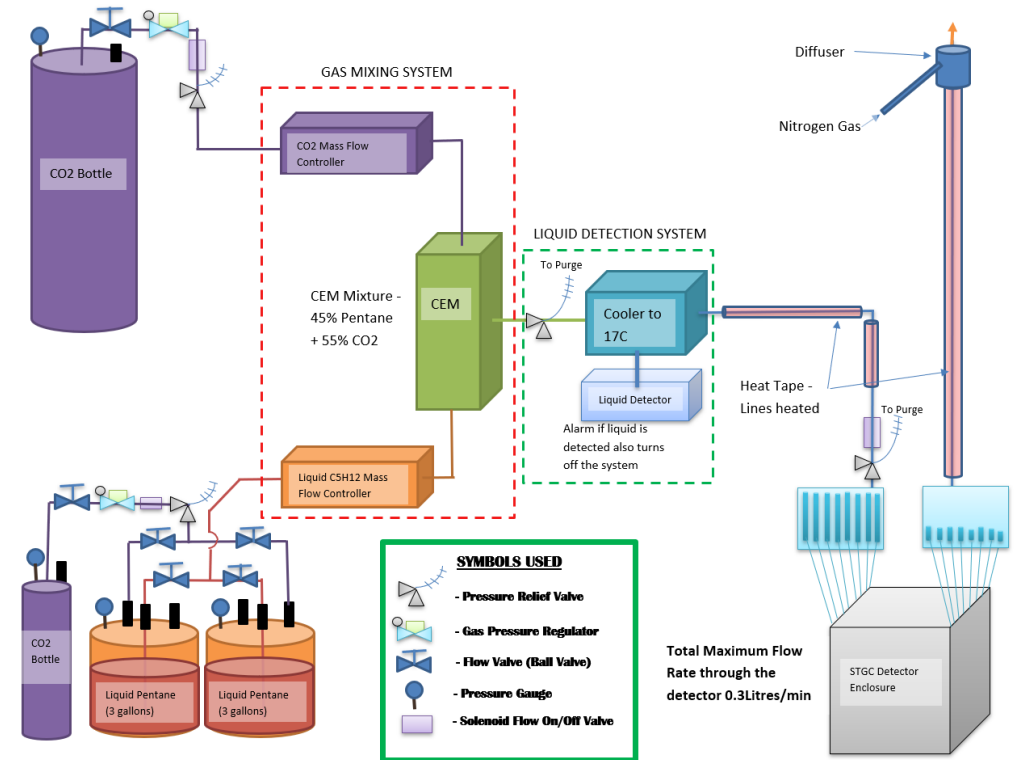


Gas System Based on Controlled Evaporator Mixer

New CEM based gas system at SDU has been built.

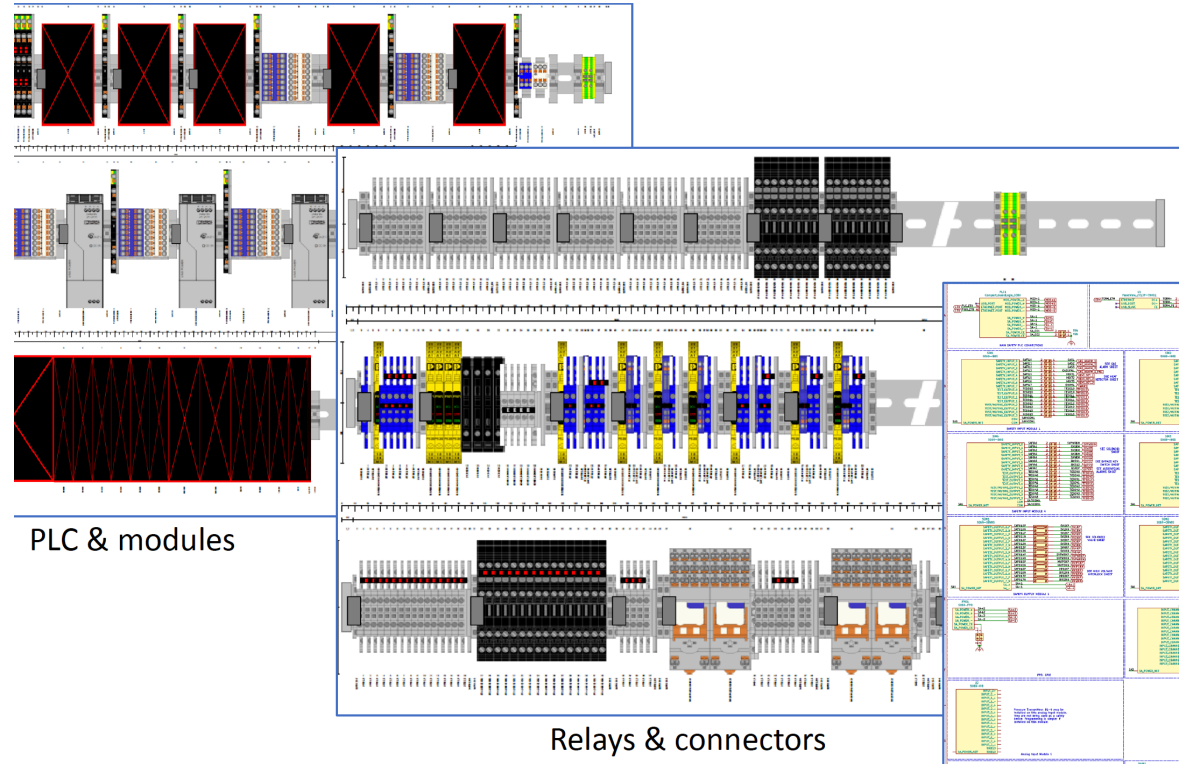


Layout of the CEM based gas system at BNL.



No CO2 envelop. Need accurate flow meter for each sTGC quadrant to track the potential gas leak.

Status of Safety and Interlock System

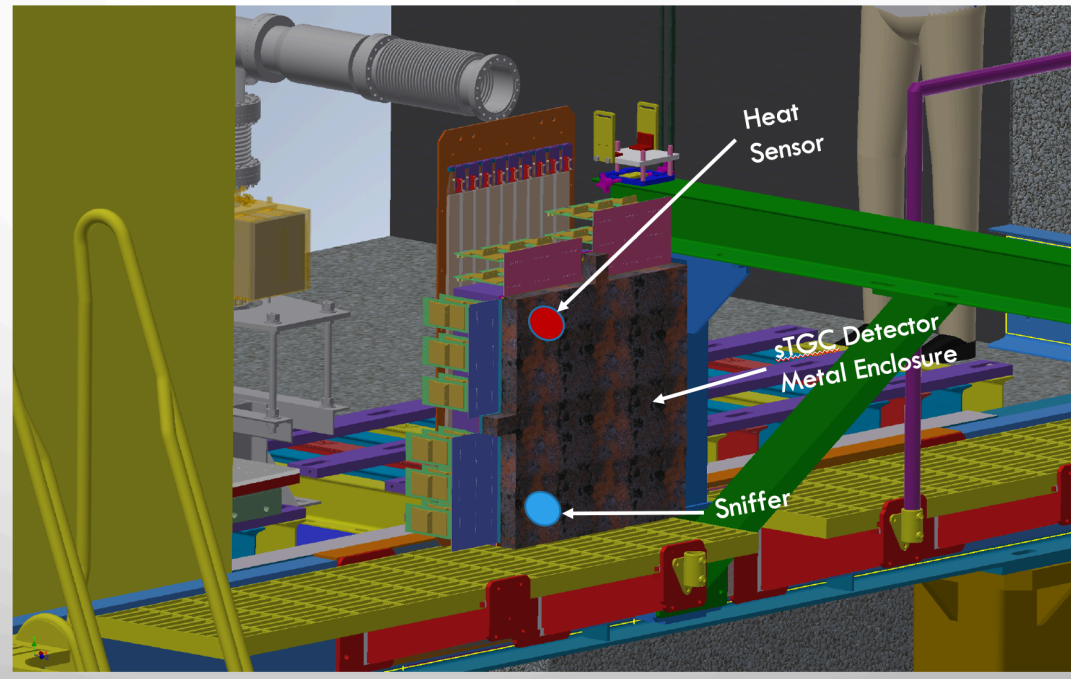


Final versions will available after review.

By: Michael Capotosto

- ESRC approved the interlock design
- Most of the PLC hardware are in hand or on track to receive by end of this month

Detector for Run 20



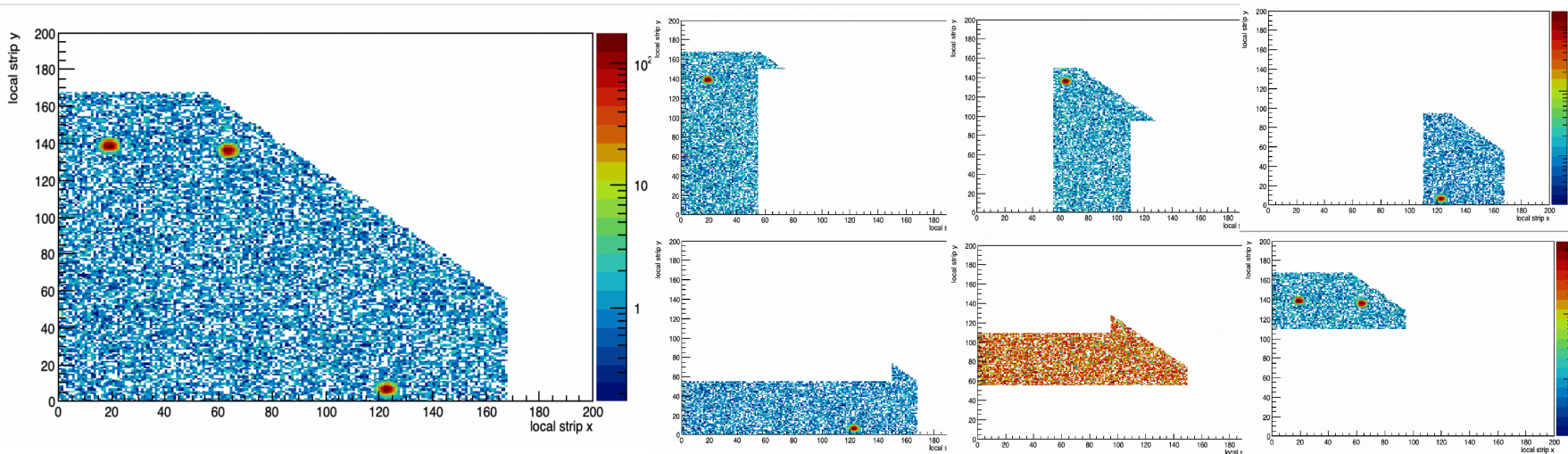
- Detector module for Run 20 will be enclosed inside a metal box equipped with gas sniffer and smoke detector.
- In case of a smoke signal or sniffer signal solenoid valves will shutdown the flow of gas mixture into the detector.

One of the key purposes for this prototype test in STAR operation is to check the leakage current in real beam.

- Pentagon prototype is expected to be delivered to BNL in late this year depending on the status of the joint testing of the prototype and electronics.
- BNL local test for pentagon prototype in clean room is in planning.

Software

- sTGC slow simulator is in planning (StgcSlowSimulator, StgcClusterFinder, ...)
- Test the 1D cluster finder performance at low multiplicity



To do list for cluster finder:

- Finalize the combine 1D hits to 2D hits part
- Test the performance at high multiplicity event
- Add Time information and diagonal strip in cluster finder

Timelines – Module Production and Electronics

Items	In Feb. 2020	In May 2020	In Jun. 2020
Module production			
Pentagon prototype design	Dec.2019 to Jan. 2020	Finished in Feb. 2020	Finished in Feb. 2020
Vender production	Jan. to Mar. 2020	Expecting in May.2020	Finished in Jun. 2020
Prototype production	Mar. to Jun. 2020	Jun.2020 to Aug.2020	Jul.2020 to Sep.2020
Final Design	Apr. to Jul. 2020	Jul.2020 to Sep.2020	Aug.2020 to Oct.2020
Vender production	Jul.2020 to Sep.2020	Aug.2020 to Oct.2020	Sep.2020 to Nov.2020
Mass production	Aug. 2020 to Jun.2021	Sep.2020 to Jun.2021	Oct.2020 to July.2021
Electronics production			
FEB prototype production	Apr. 2020	Expected to be finished in May. 2020.	Finished in Jun. 2020.
ROD prototype production	Apr. 2020	Still in designation.	Early Aug. 2020
FEB and ROD test with sTGC	May. To Jul. 2020	Jul.2020 to Sep. 2020	Aug.2020 to Oct. 2020
ROD firmware design, FEB site test, ROD interface protocol	Jul. 2020	Pending	Pending
Final Design	Oct. 2020	Pending	Pending
Mass production	Dec. 2020	Pending on VMM purchasing	Pending on VMM purchasing
VMM order placing	Pending	Pending	Pending

About one month delayed due to the custom clearance and material purchasing in module production. Extra efforts on tooling for mass production have been done, may reduce time cost for mass production. Expecting no shape/size changing between pentagon prototype and real module.

Timelines – Integrations and Software

Items	In Feb. 2020	In May 2020	In Jun. 2020
Integration			
Gas system	Apr.2020	Expecting two months after lab reopens	Aug.2020
HV & HV distribution box	Apr.2020	May.2020	Wait 60x60 prototype results
Interlock system	Apr.2020	Expecting two months after lab reopens	Aug.2020
Cooling		Expecting two months after lab reopens	Aug.2020
Supporting frame - STSG Prototype	Apr.2020	Constructed	Constructed
Installation Structure - STSG Final Design	Sep.2020	Sep.2020	Sep.2020
Fabrication of Parts-STSG	Dec.2020	Dec.2020	Dec.2020
Installation Structure - FST Final design	Aug.2020	Aug.2020	Aug.2020
Fabrication of Parts -FST	Dec. 2020	Dec. 2020	Dec. 2020
LV power supply		Dec. 2020	Dec. 2020
Software			
Develop cluster finding algorithm		Jun.2020	Done for 1D, working on 2D
Algorithm for constructing space points & rejecting ghost hits using diagonal strip information		Jul.2020	Pending
Develop an sTGC slow simulator		Summer 2020	Work in progress, pending

Milestones

Milestones	Schedule
Joint test of pentagon prototype and electronics	Aug. 2020
Gas system ready	Aug. 2020
Readiness review for mass production	Oct. 2020
Start of module mass production	Oct. 2020
Installation structure ready	Dec. 2020
16 quadrants shipped (4 + 5 + 7)	May. 2021
4 quadrants shipped	Jul. 2021
Start of FEB and ROD mass production	Pending on VMMs

Final remarks

Module production:

60cm * 60cm prototype shipped to BNL. The pentagon prototype production is ongoing.

Electronics:

VMM affairs move forward significantly. FEB prototype Done. ROD prototype in production.

Integration:

Gas system designed. Designations on installation frames and mounting frames are shown, need to be finished. Interlocks have been designed and get approved.

Software simulation:

Started from 1D cluster finder. Working on 2D and algorithm.

COVID-19: Significantly affected traveling. Delay some purchasings. Less impact on shipping.