

Development of MUCH Cooling system for mCBM



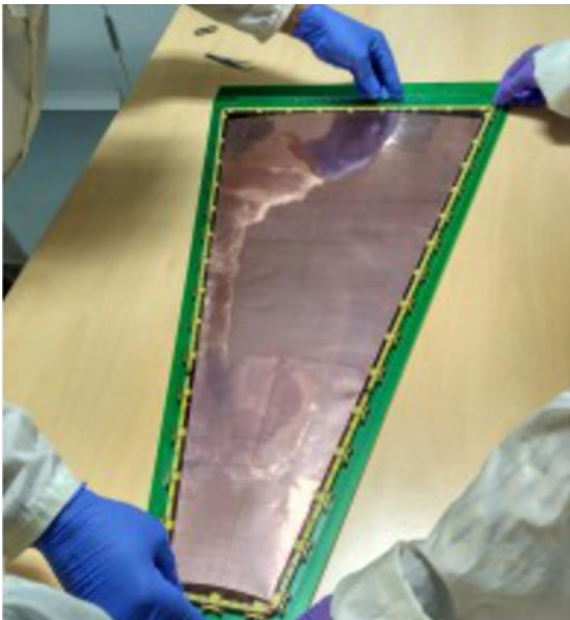
Chandrasekhar Ghosh
EHEPAG, VECC

Outline

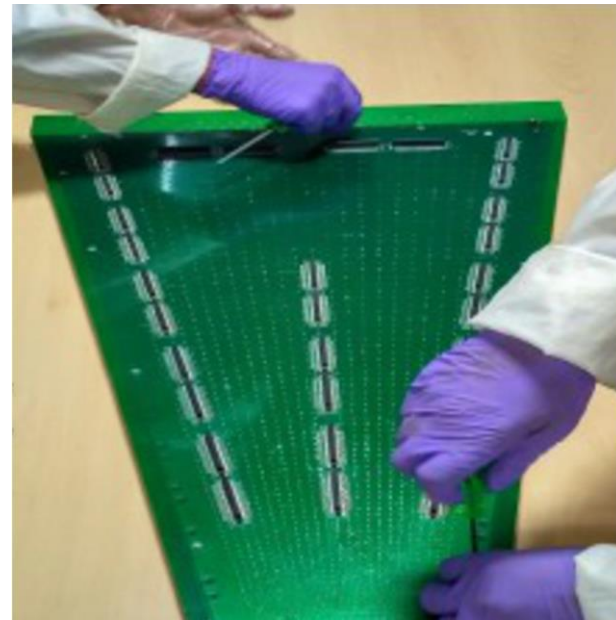
- Requirement of Cooling in mCBM
- Air cooling setup for mCBM
- Peltier Cooling test
- Rectangular Water Channel cooling for mCBM
- Mapping of MUCH PCB (MV2) for COSY Test Beam

Requirement of Cooling for mCBM MUCH FEB

- One Trapezoidal MUCH consists of 18 no of FEBs.
- Each FEB deposits 2.5 Watt heat.
- Total heat load for each sector= $2.5 \times 18 \text{ W} = 45 \text{ Watt}$.
- We need to remove this heat continuously to keep all the FEBs below $25 \text{ }^\circ\text{C}$



16-02-2018



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Cooling Plate arrangement at CERN SPS H4 Test Beam line



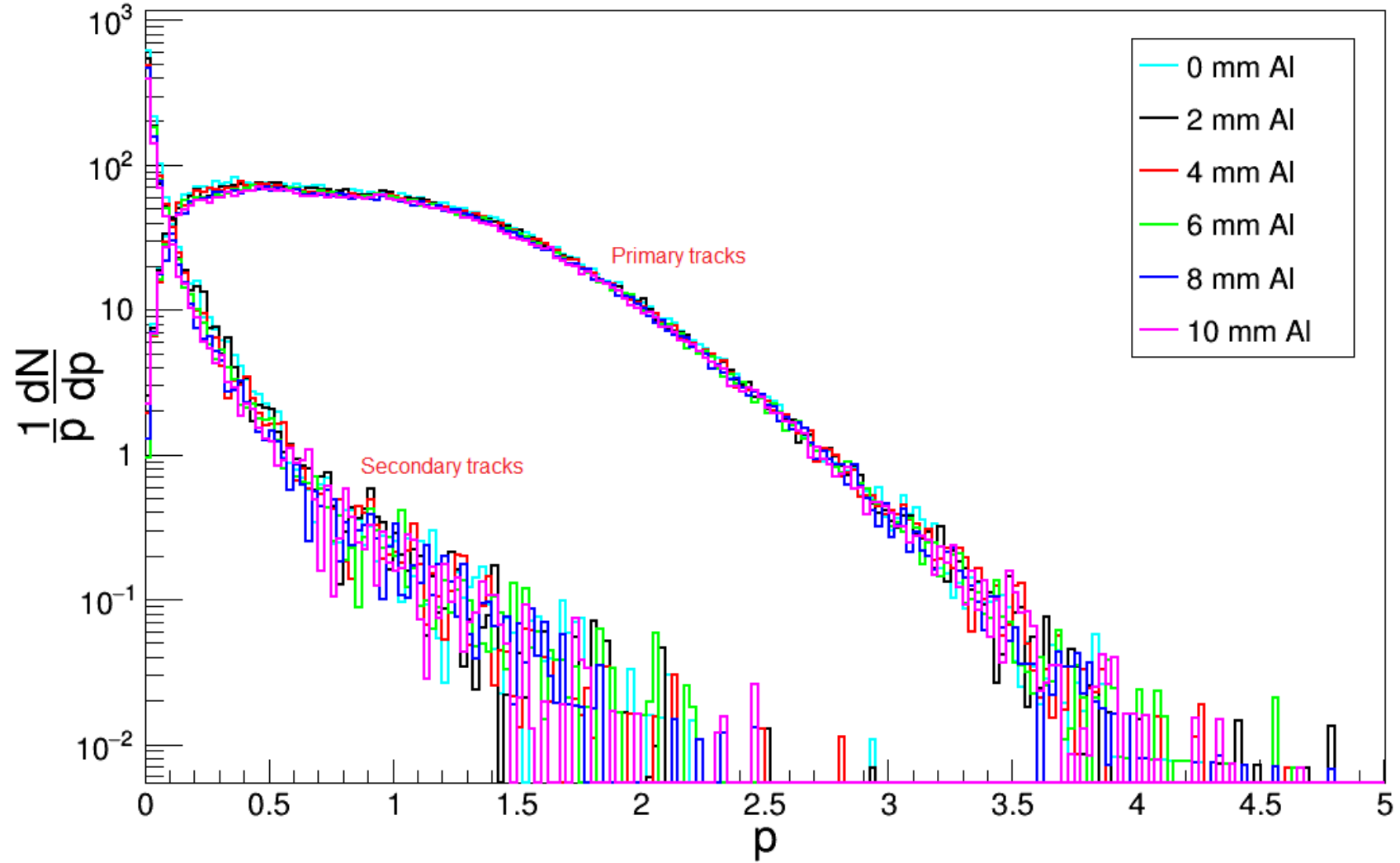
At CERN SPS H4 beam test during December 2016 two cooling plates were used

- One developed at Bose Institute*
- Other one developed at VECC Workshop

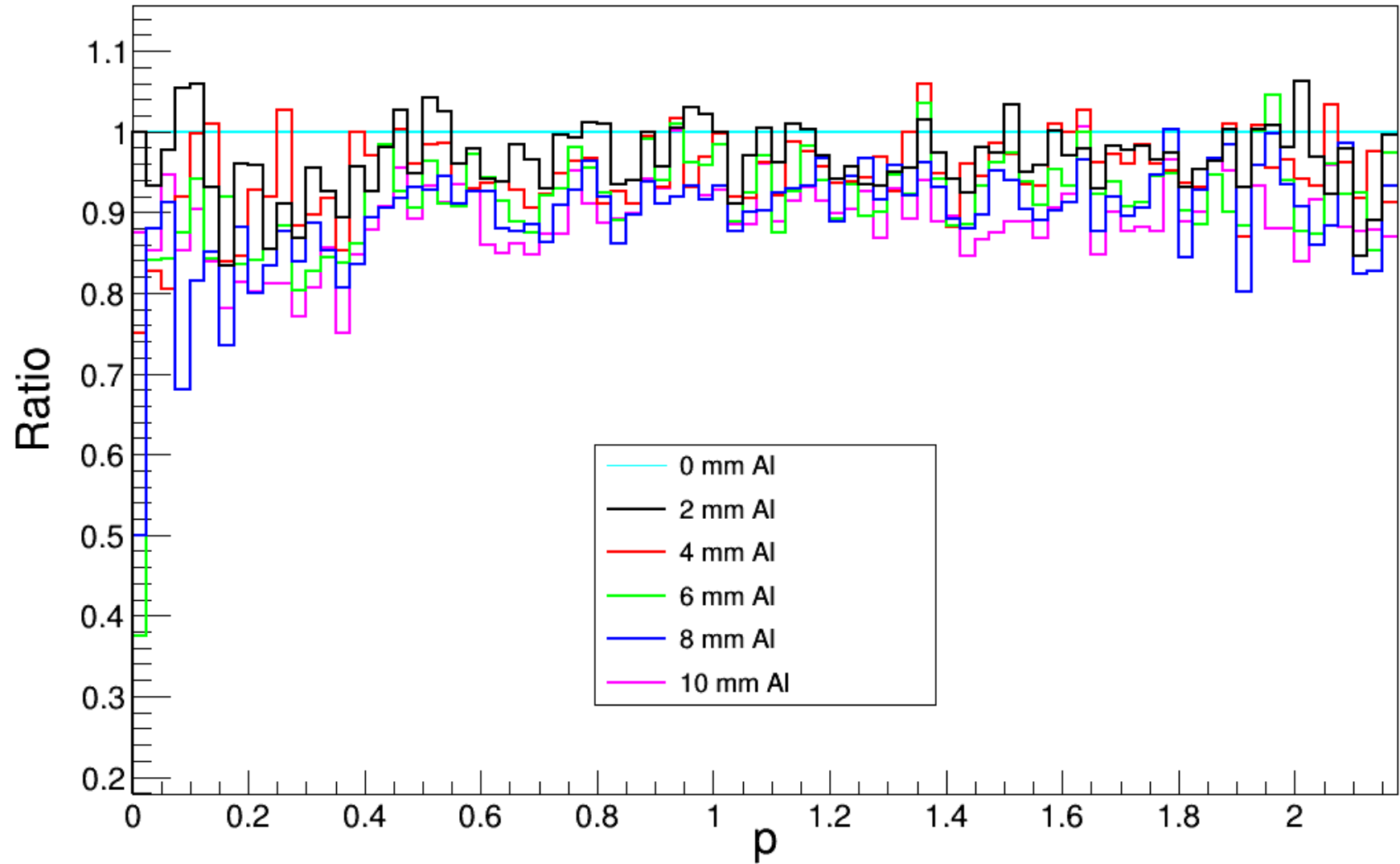
Both performed well to maintain the FEB temps below 25°C

**D. Nag et al, DAE Symp. on Nucl. Phys. 76 (2016).*

Effect of Aluminium plate on momentum of primary and secondary particles at TOF :



*Plot courtesy: Omveer Singh, AMU



Need to use minimum amount of Aluminium in MUCH coverage

*Plot courtesy: Omveer Singh, AMU

Air Cooling setup for mCBM

Component details:

No of Heating elements= 14

Resistance value= 10 Ohm

Heat deposited by each= 2.5 Watt

Temp sensor= DS18B20

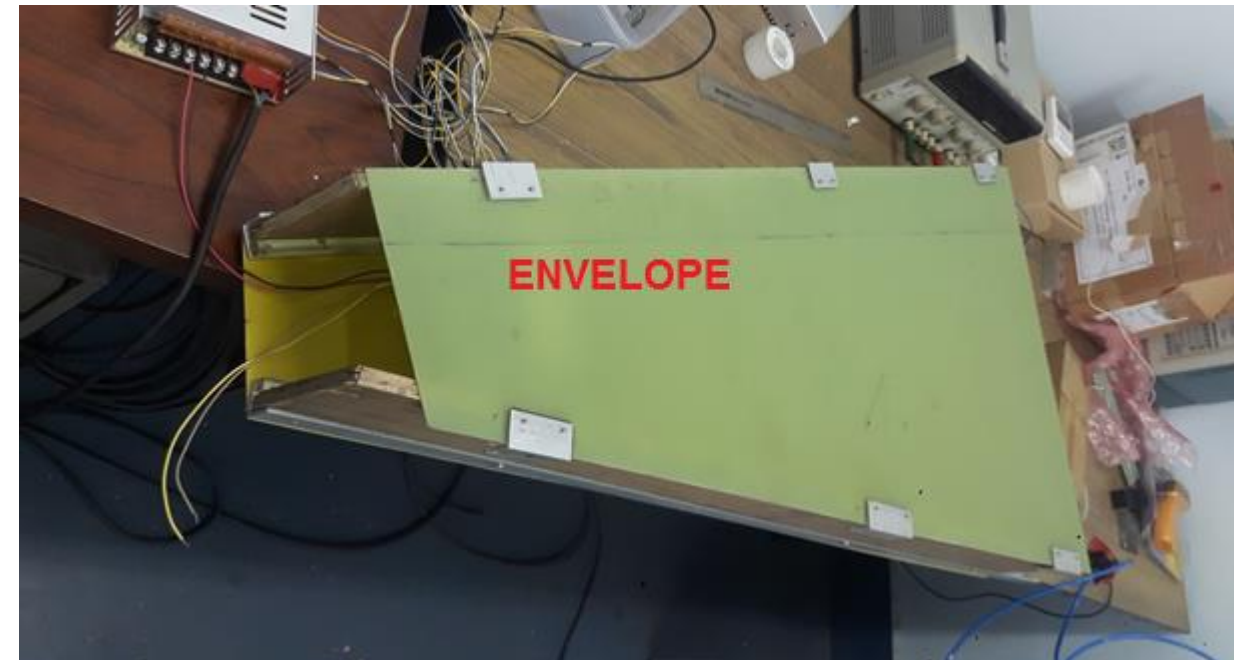
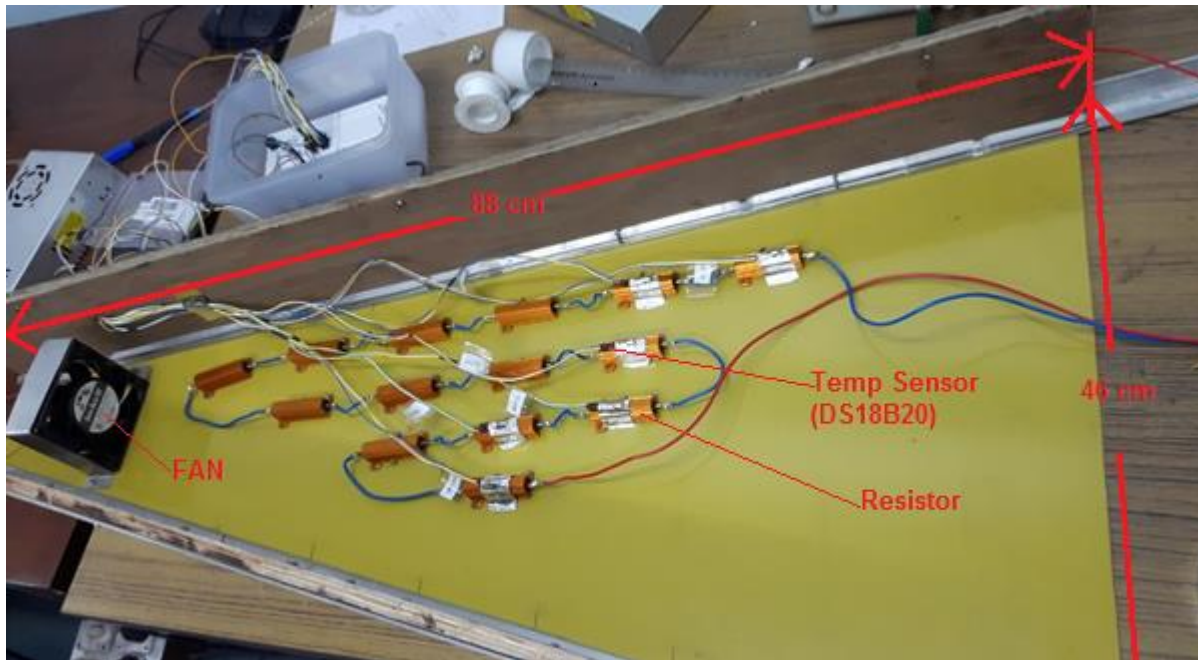
FAN Details:

Operating Voltage: 12.6 Volt

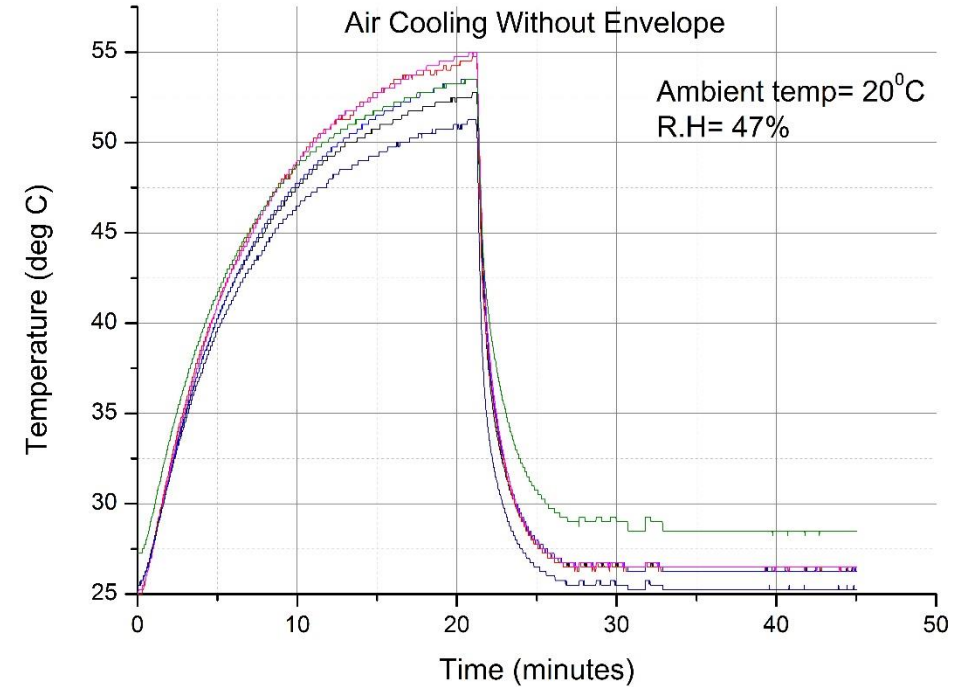
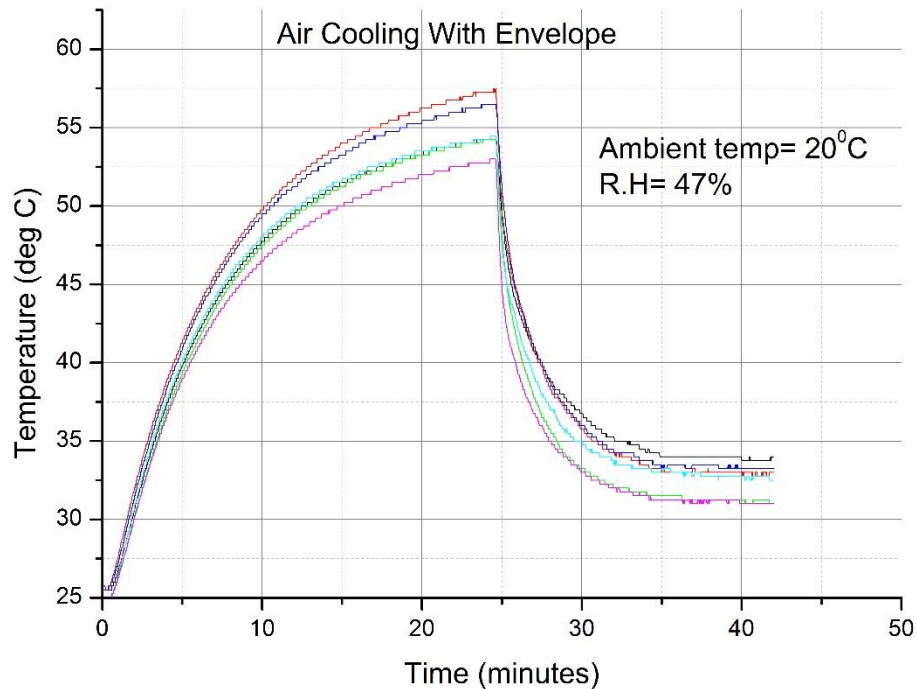
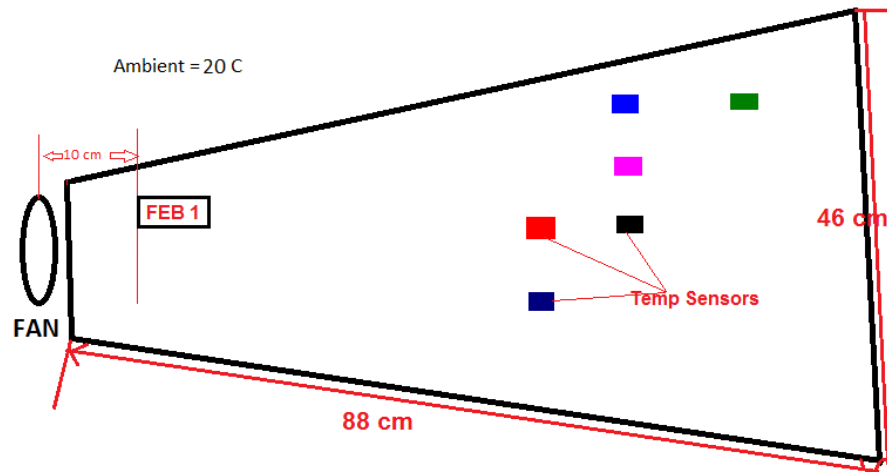
Airflow : 5.1 m³ /minute

Rated Speed: 14900 rpm

Lifetime: 70,000 hours continuous working



Results of Cooling Expt with and without envelope



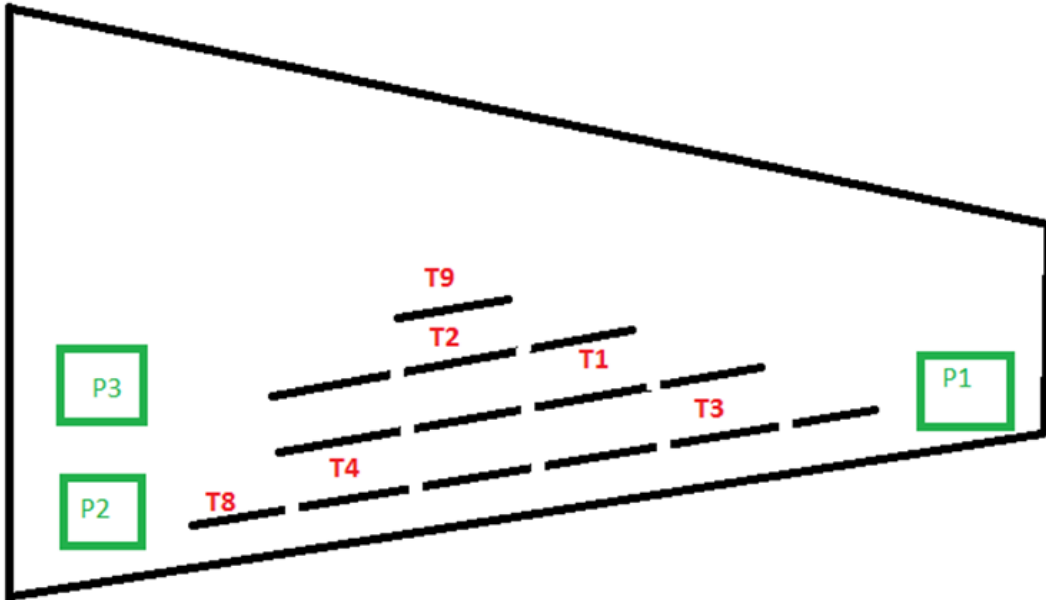
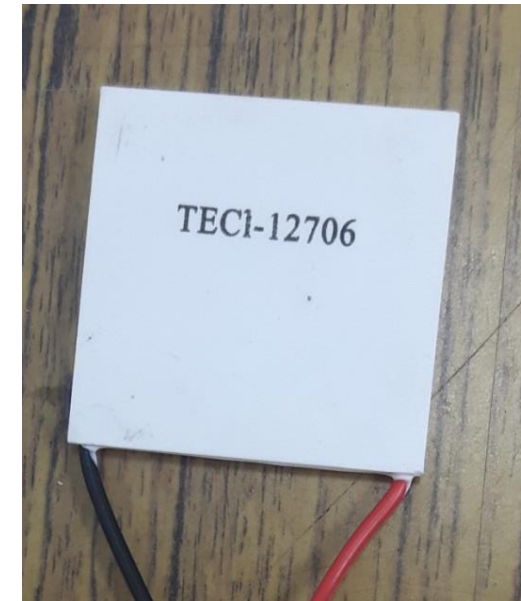
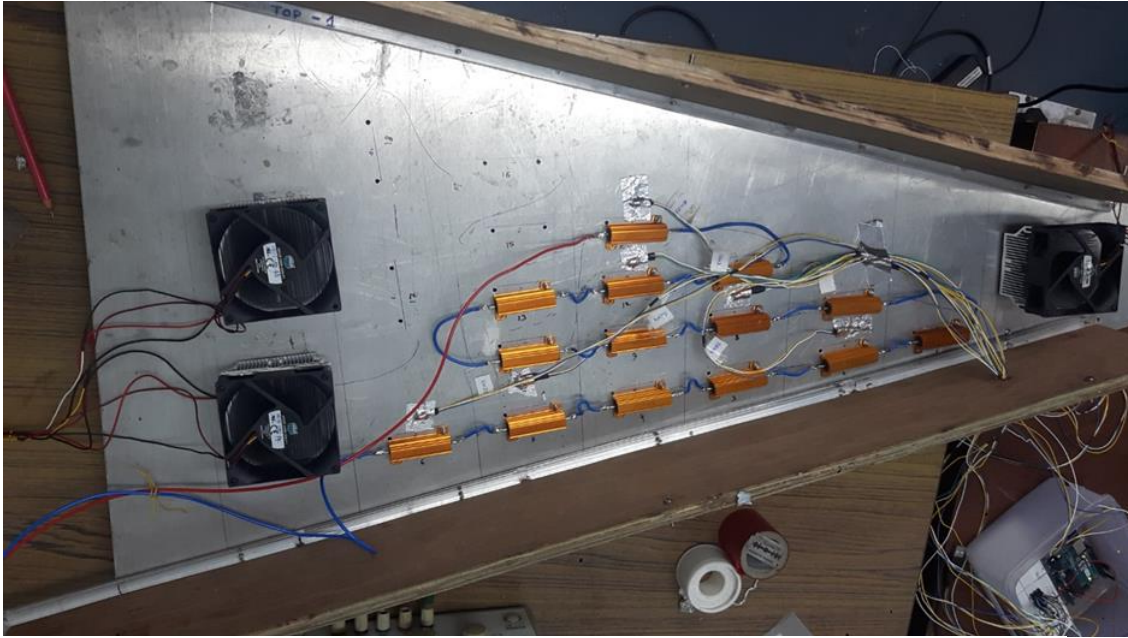
Results:

1. Without envelope case: within 5 mins the temp value comes within 25°C to 28°C.
2. With envelope case: within 10 mins temp value comes within 31°C to 34°C.
3. If we can make some proper airflow duct then cooling efficiency may get improved.



Engineering expertise needed

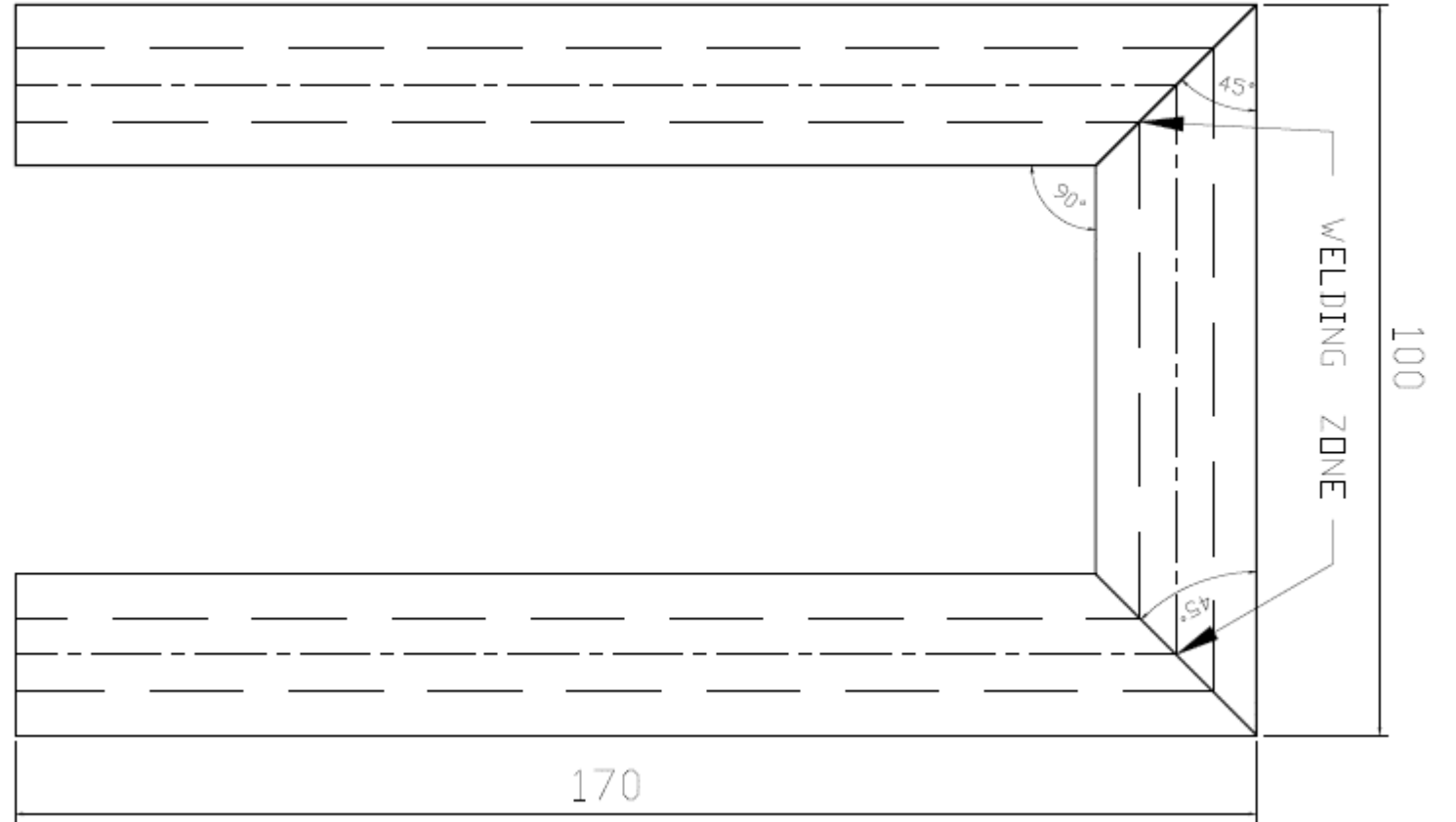
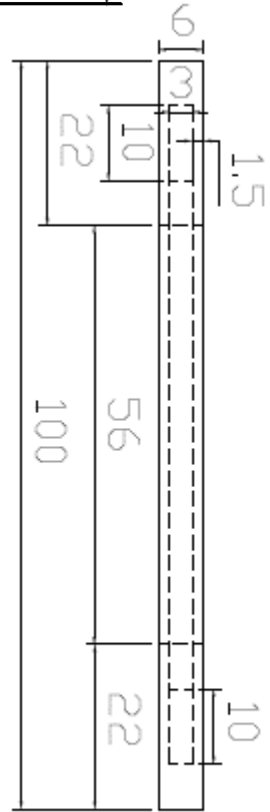
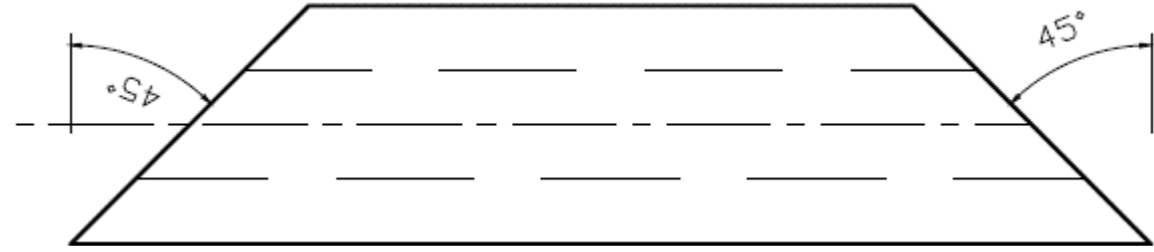
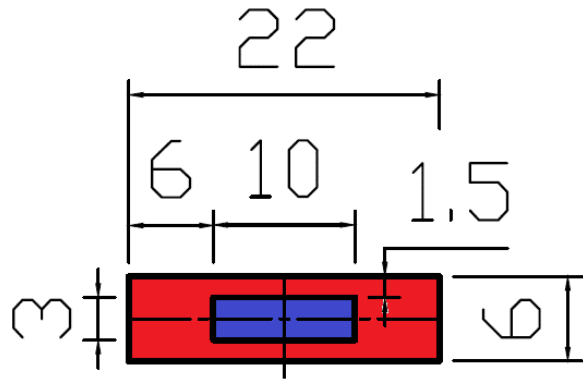
Peltier cooling on 2mm Aluminium plate



DATA SET 1 (R.T=23.5°C, R.H= 46%)

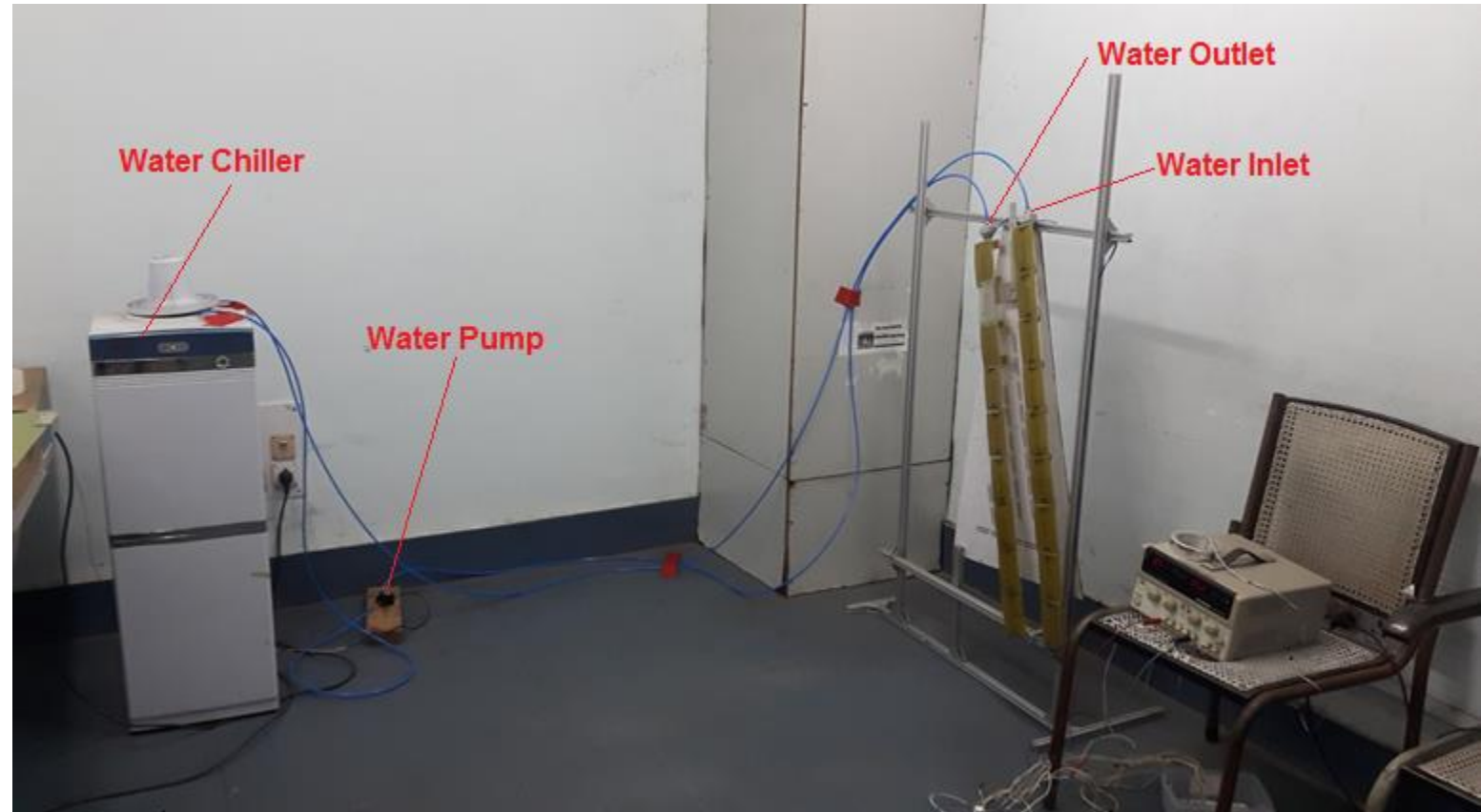
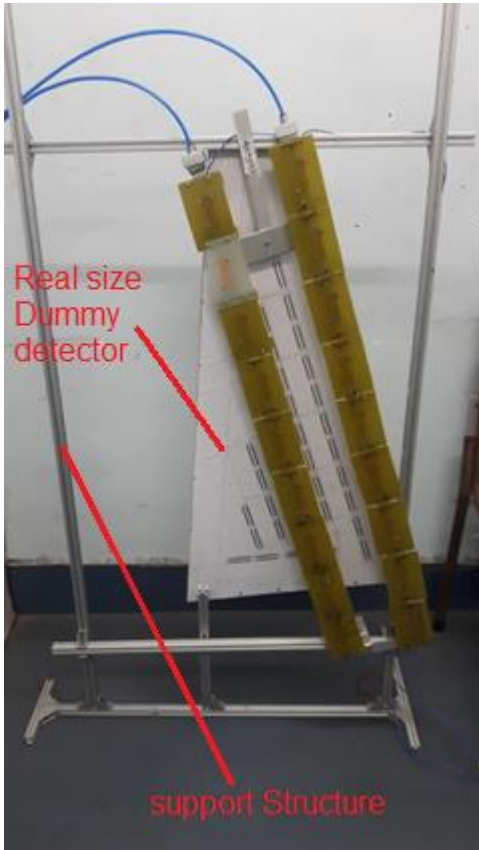
SENSOR No.	Before cooling stable temp(° C)	After peltier cooling stable temp(° C)	ΔT (°C)
T3	35.50	30.50	5
T8	31.75	24.00	7.75
T4	34.50	29.00	5.5
T1	36.50	32.00	4.5
T2	35.00	31.25	3.75
T9	33.75	30.00	3.75

Rectangular Water Channel Cooling for mCBM



RECTANGULAR WATER CHANNEL

Water Channel Cooling setup in VECC



Component details:

No of Heating elements= 18

Heating applied= $2.5\text{W} \times 18 = 45\text{Watt}$

Water Flow rate= 14 Lit/Hour

$T_{in} = 19^\circ\text{C}$

$T_{out} = 22.75^\circ\text{C}$

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Results:

- All the dummy FEBs were placed on the channel
- Temp of all FEBs were well maintained around 20°C
- Flexible cable length from FEB to PCB connector increases more than 10 cm

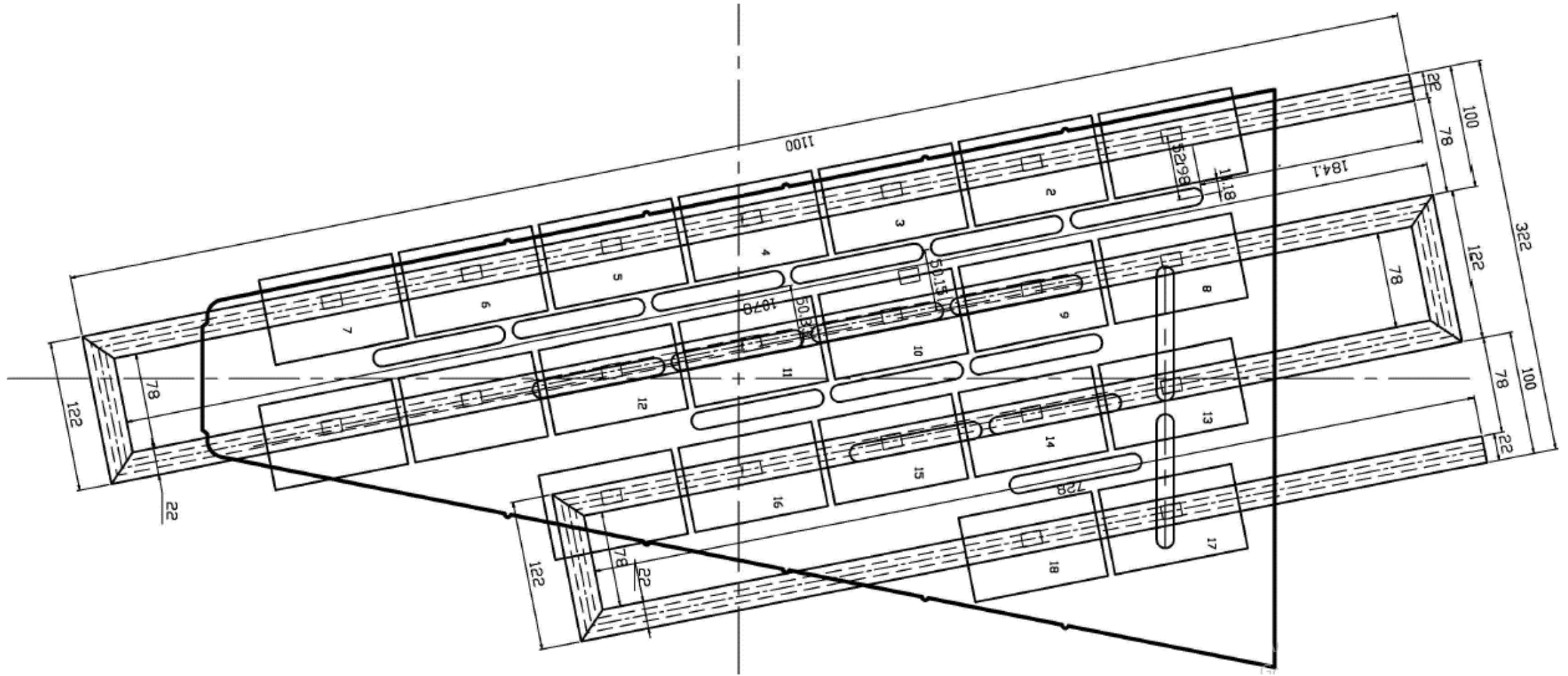


Modification of Channel design in process

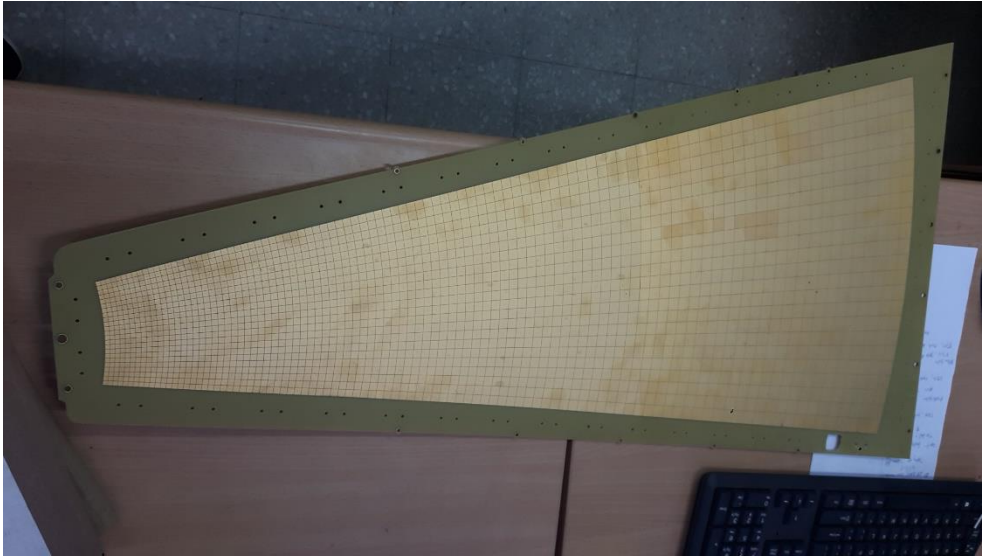
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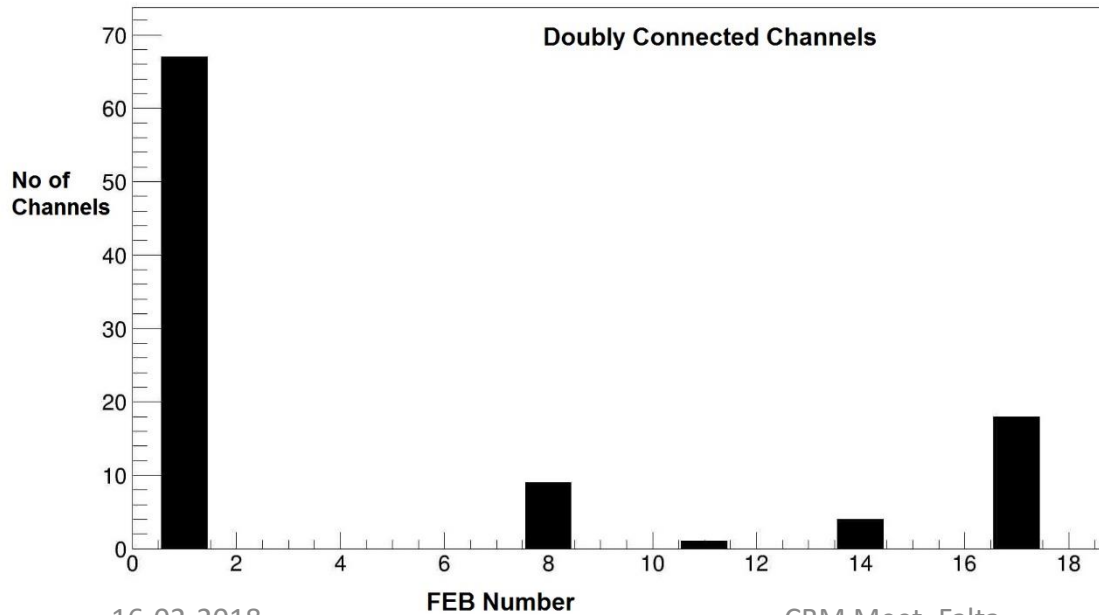
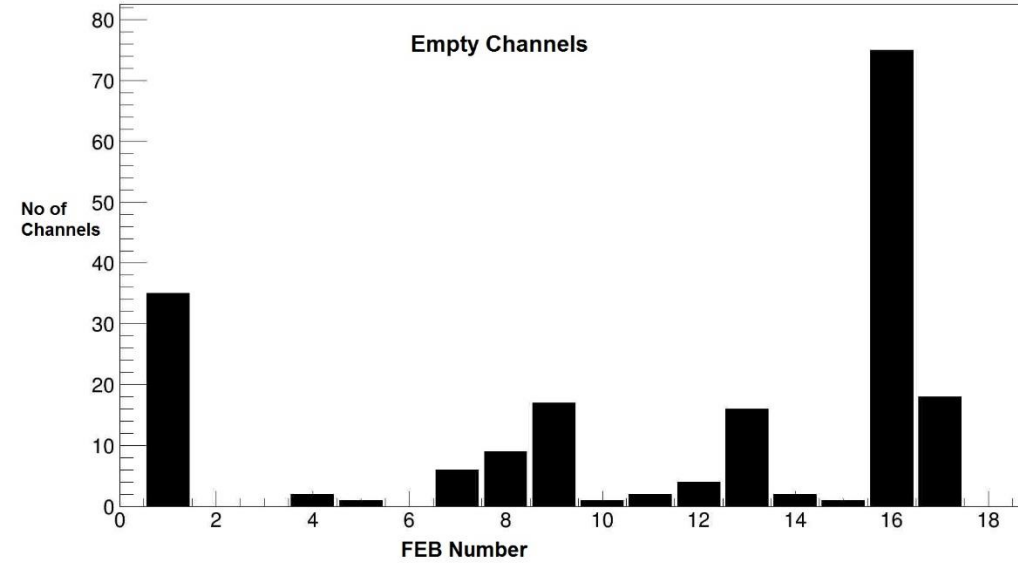
New Layout for rectangular water channel



Mapping of MUCH PCB (MV2) for COSY Testbeam



M2 PCB



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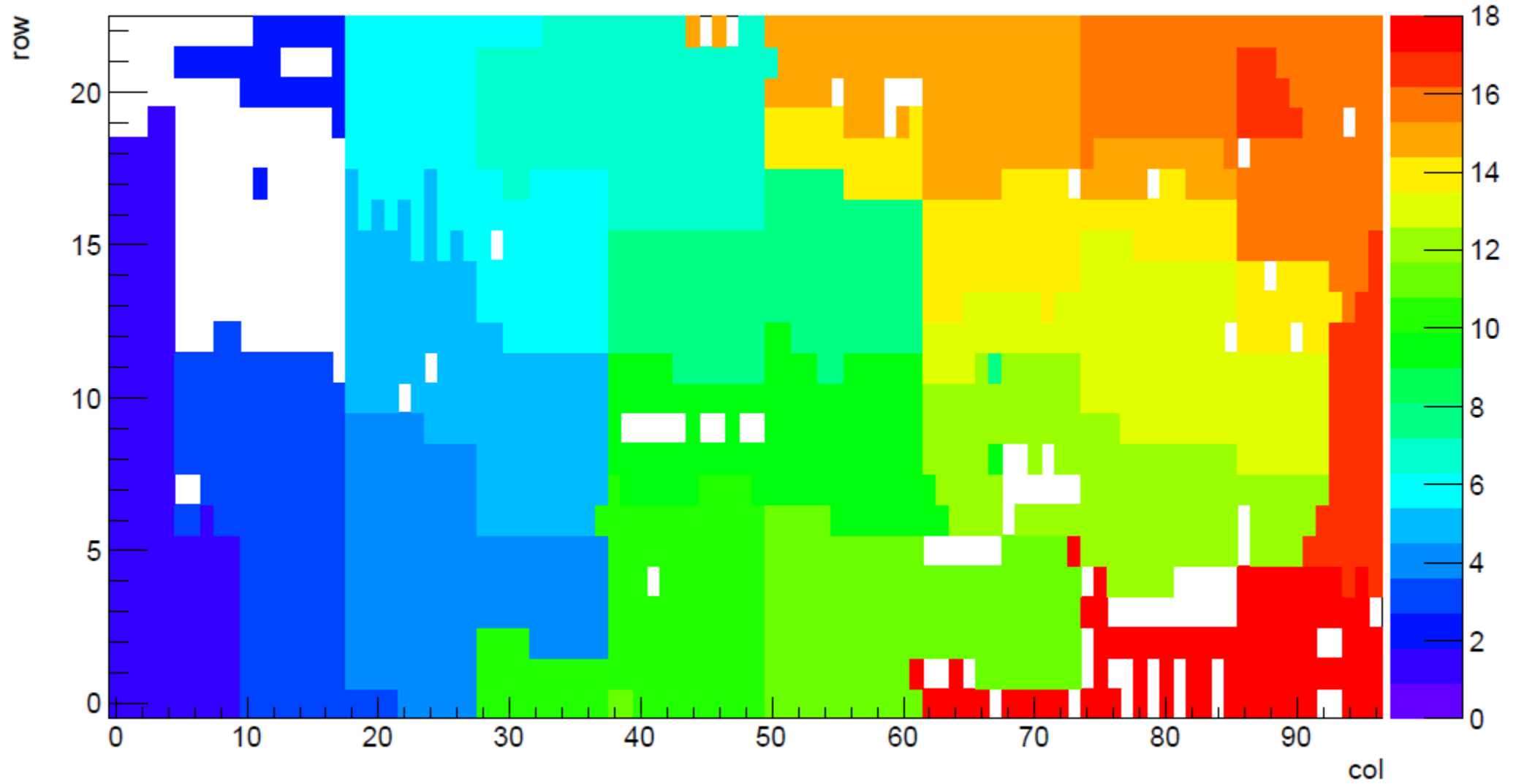
FEB Number

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Multiple connections	No of Pads
Single	2015
Double	198
Triple	3
Not Connected	15
Total	2231

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2DMapping



Conclusion:

- An Air cooling setup has been demonstrated  Need expertise to design a proper duct.
- Peltier cooling was tested  No satisfactory result. Heat extraction issue from hot side.
- Rectangular water channel cooling setup is being developed at VECC Workshop.

Thank You