ePIC TOF Structure Thermal Test

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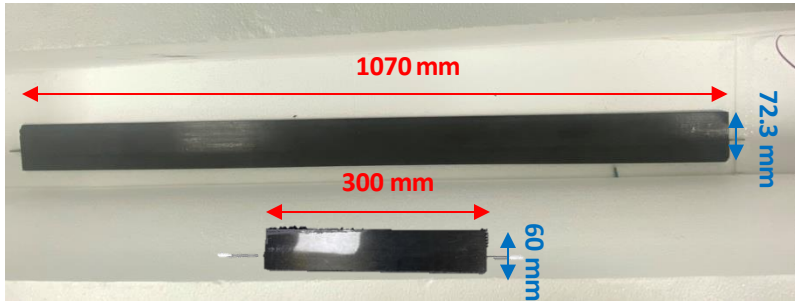
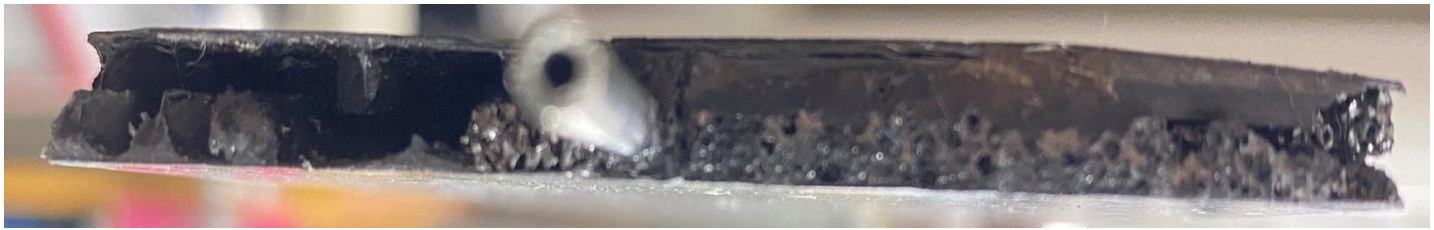
Half Stave (107 cm)

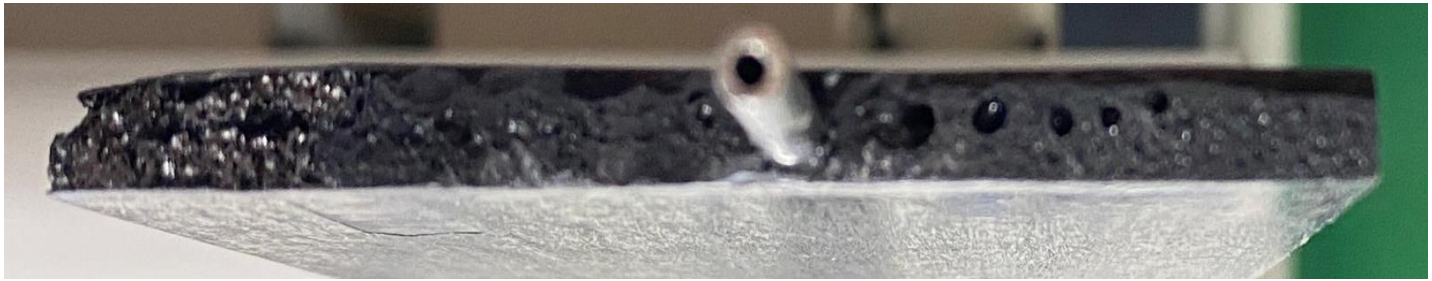


Cross-section of Half Stave

With pipe **Without pipe**



Water in



Water out

Without pipe **With pipe**

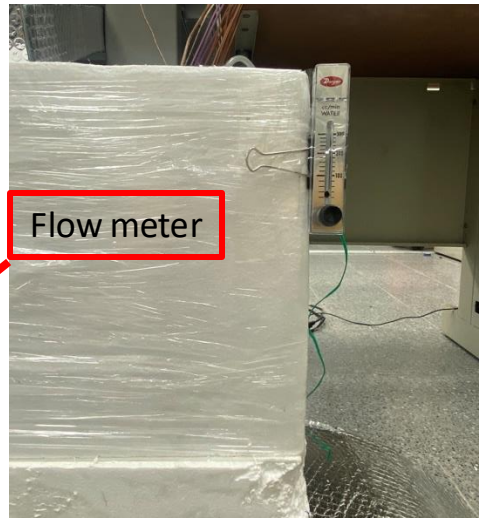
Test Setup for Half Stave (107 cm)

Cooling system

Computer and DAQ 1

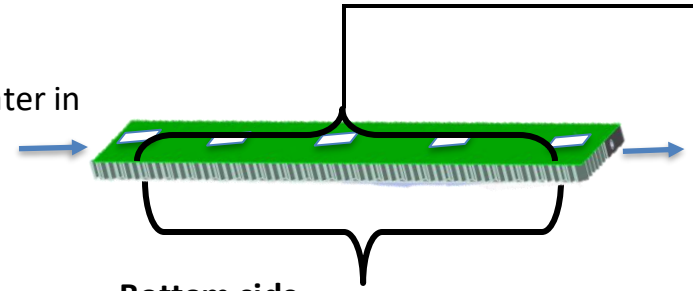
Power supply

Flow meter

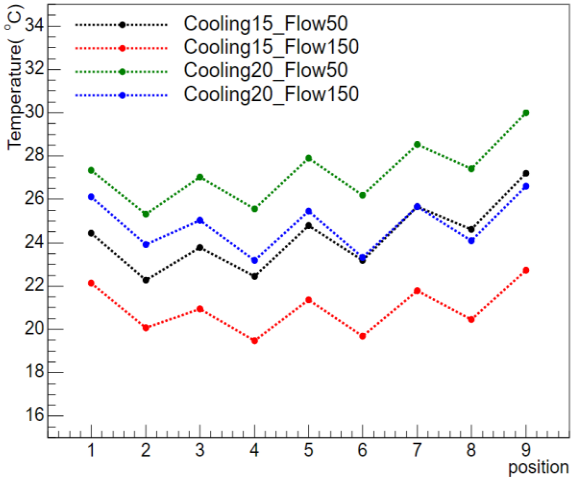


Temperature vs position along the length (Power: 20.1 W, without pipe)

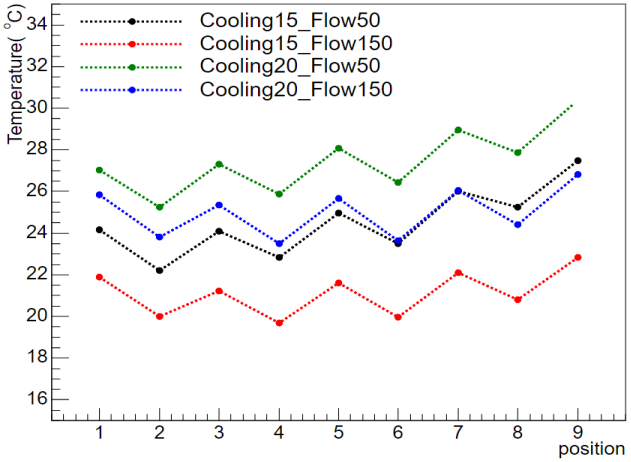
Water in

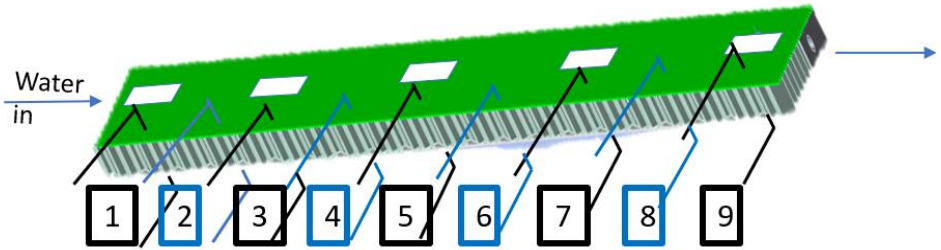


Top side

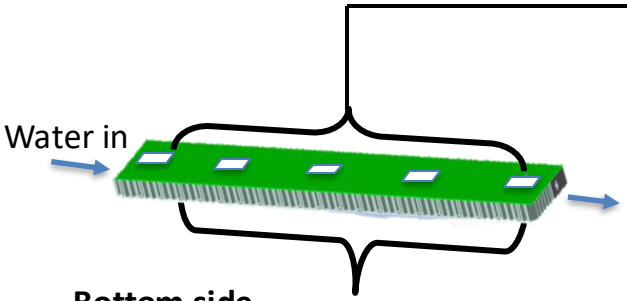


Bottom side

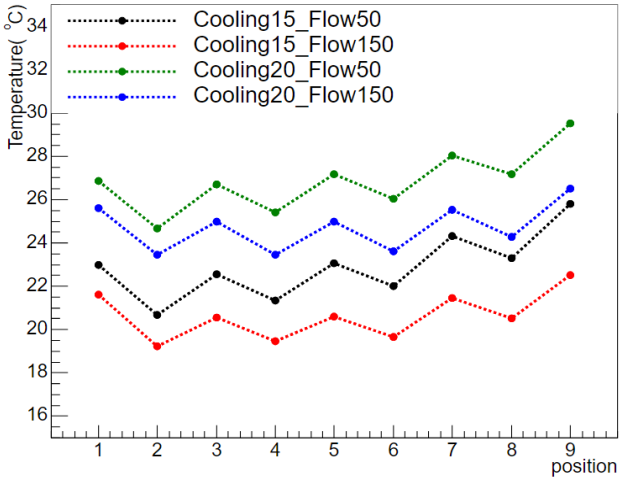




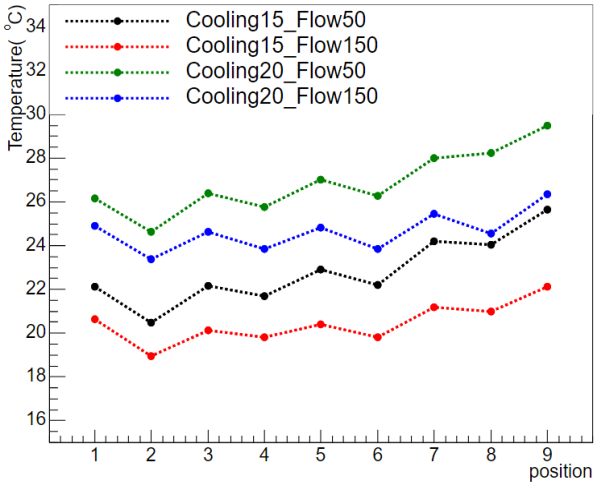
Temperature vs position along the length (Power: 20.1 W, with pipe)

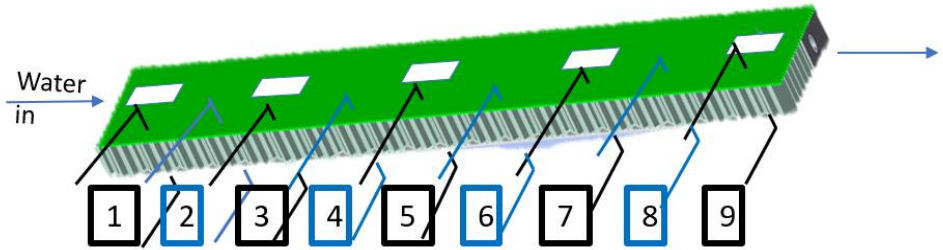


Top side

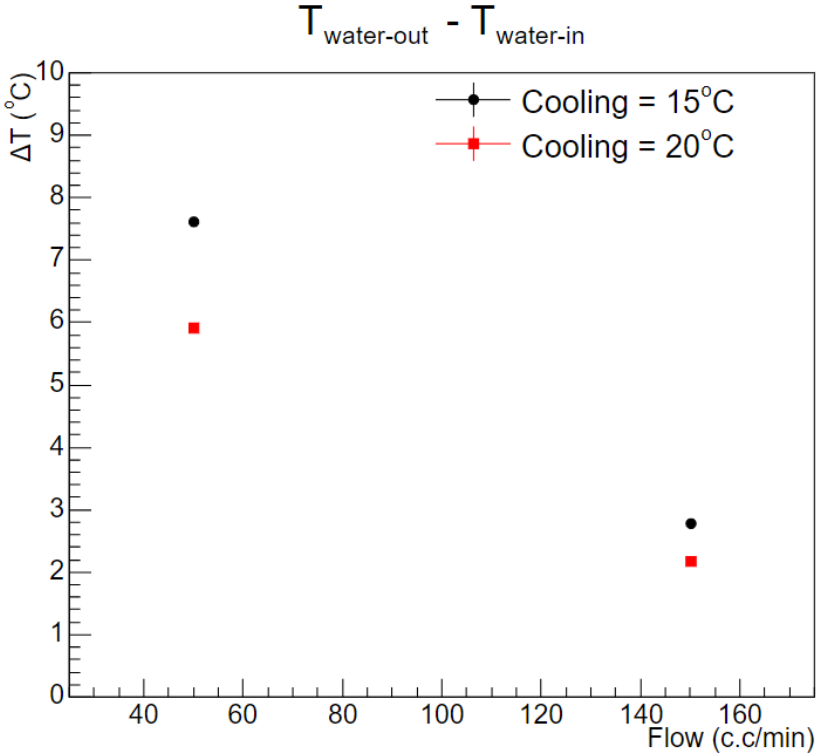


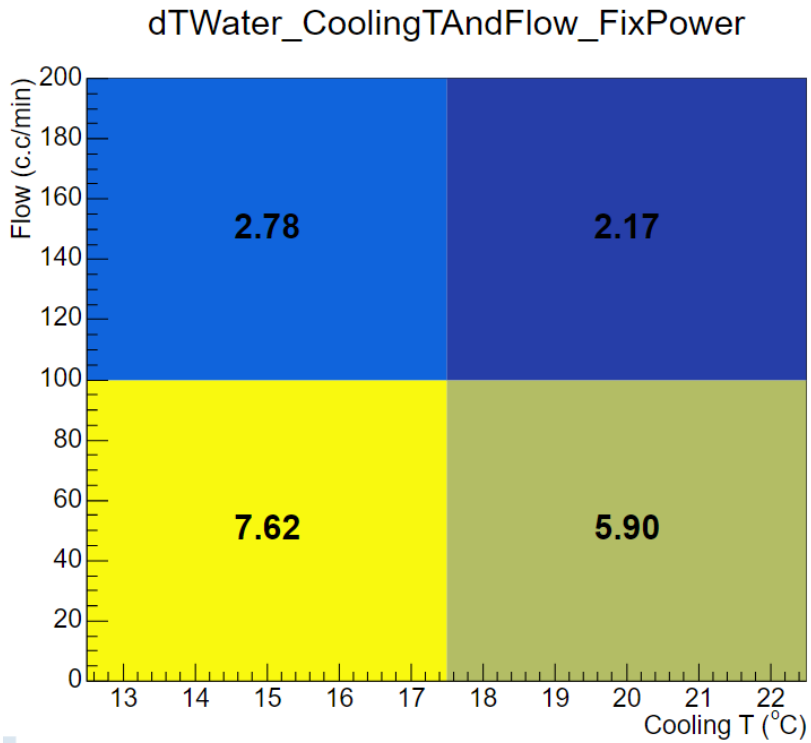
Bottom side



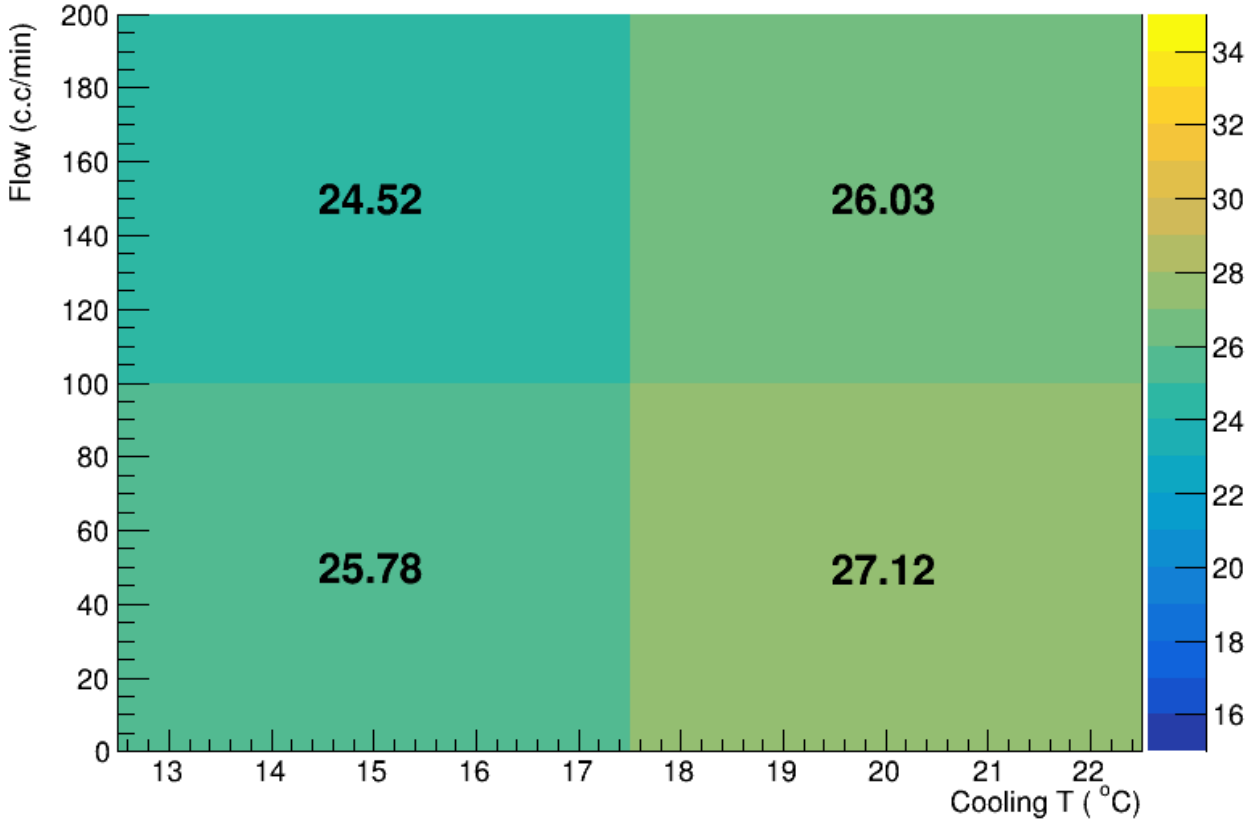


ΔT between Water-in and Water-out





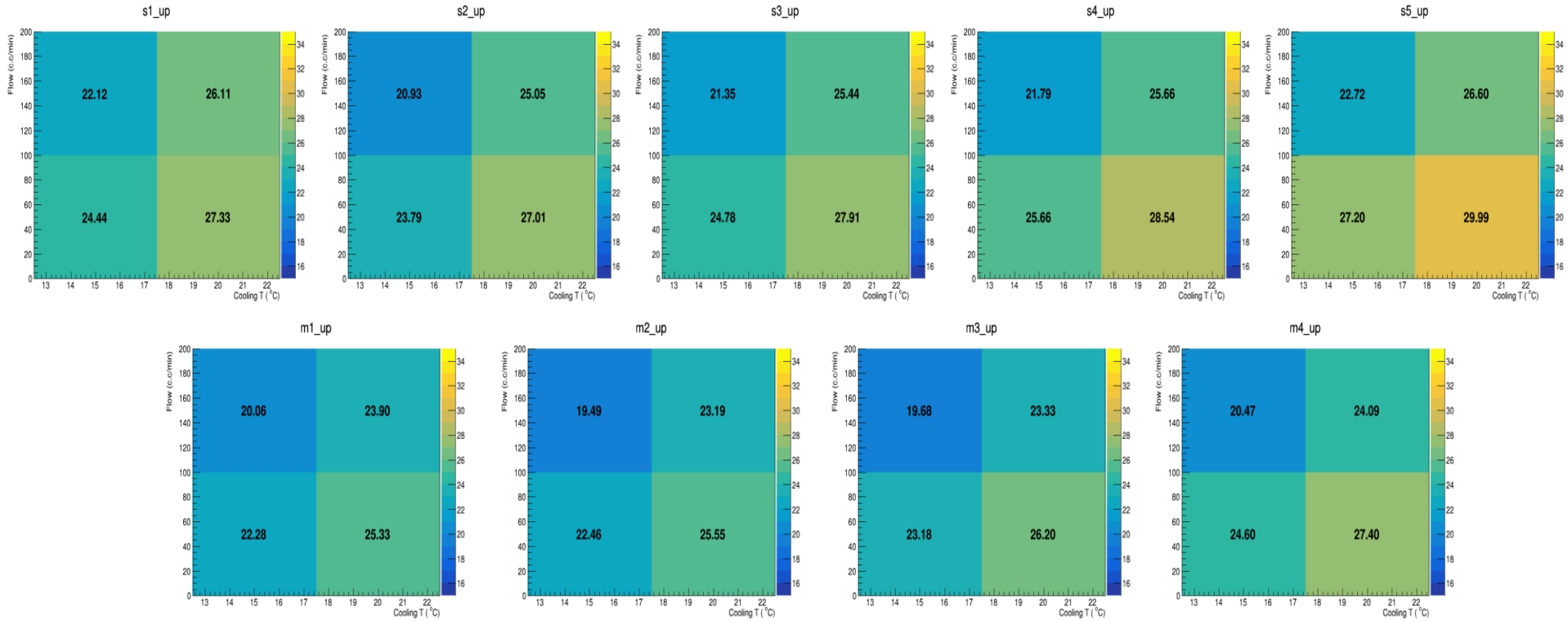
Temperature of environment



Temperature in different Flow and Cooling Temperature

(Power: 20.1 W, without pipe, top side)

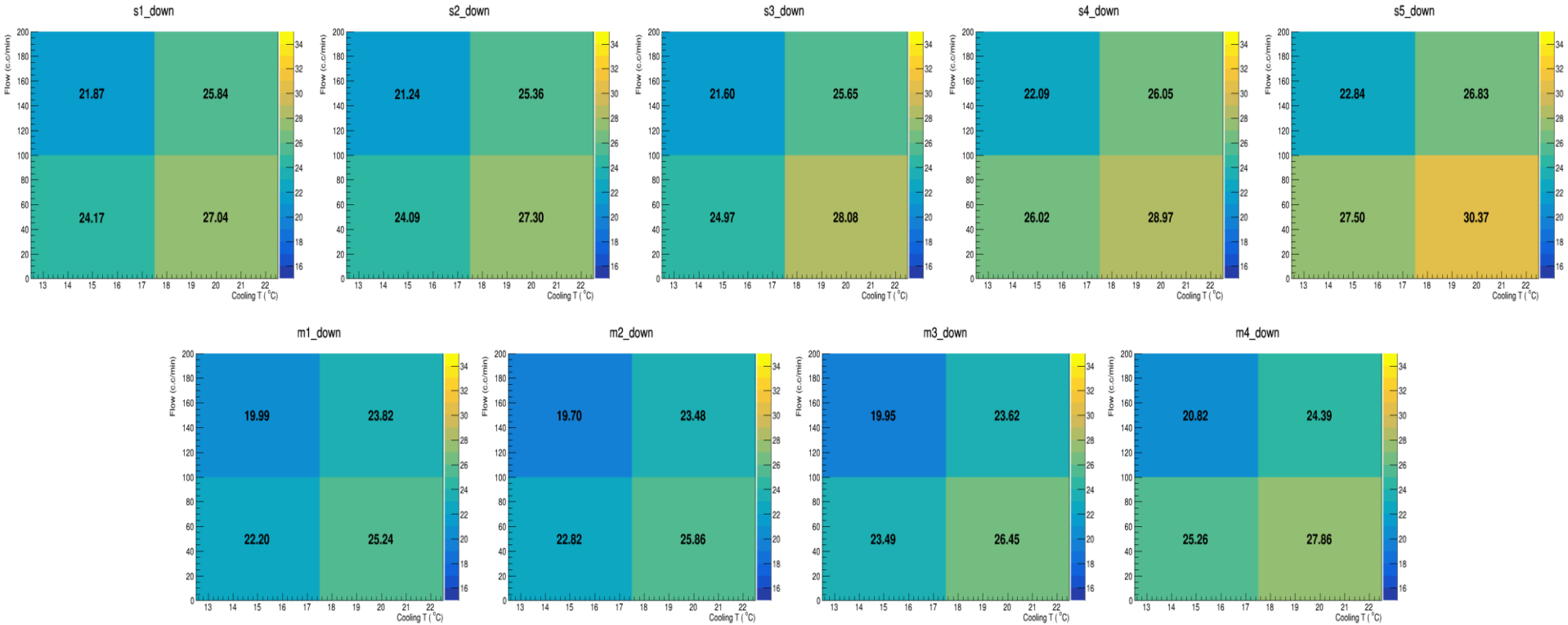
"S" for source ; "m" for middle(between source), Number for position (1 for water-in side)



Temperature in different Flow and Cooling Temperature

(Power: 20.1 W, **without** pipe, **bottom** side)

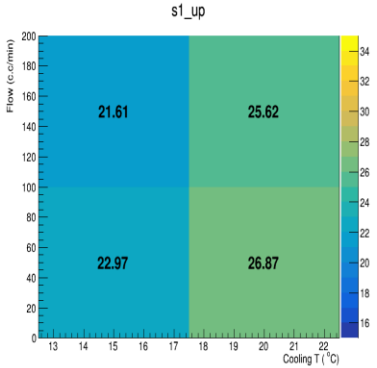
"S" for source ; "m" for middle(between source), Number for position (1 for water-in side)

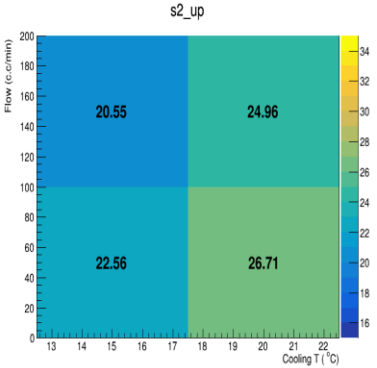


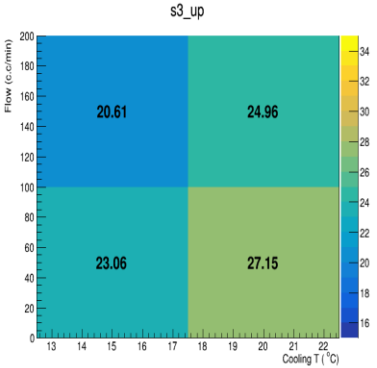
Temperature in different Flow and Cooling Temperature

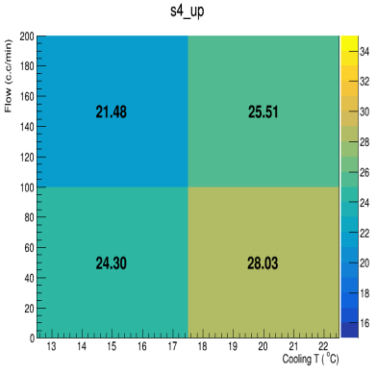
(Power: 20.1 W, with pipe, top side)

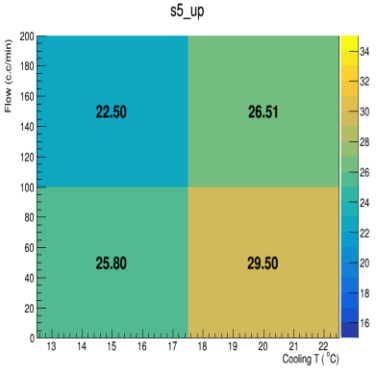
"S" for source ; "m" for middle(between source), Number for position (1 for water-in side)

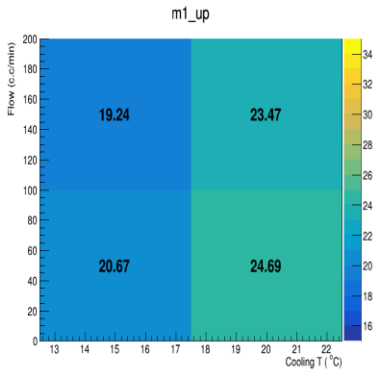


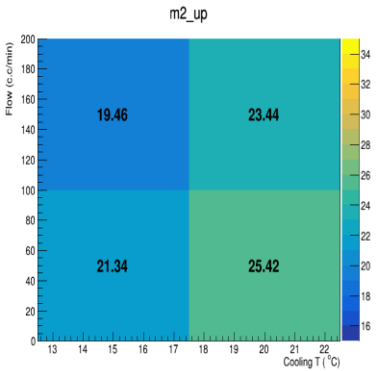


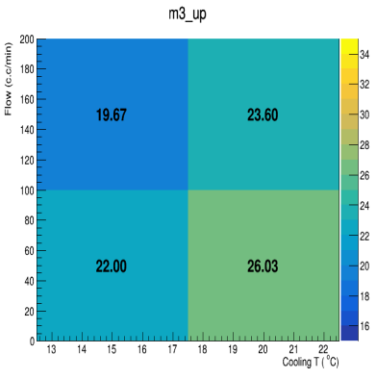


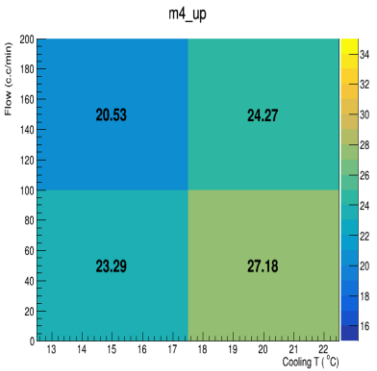








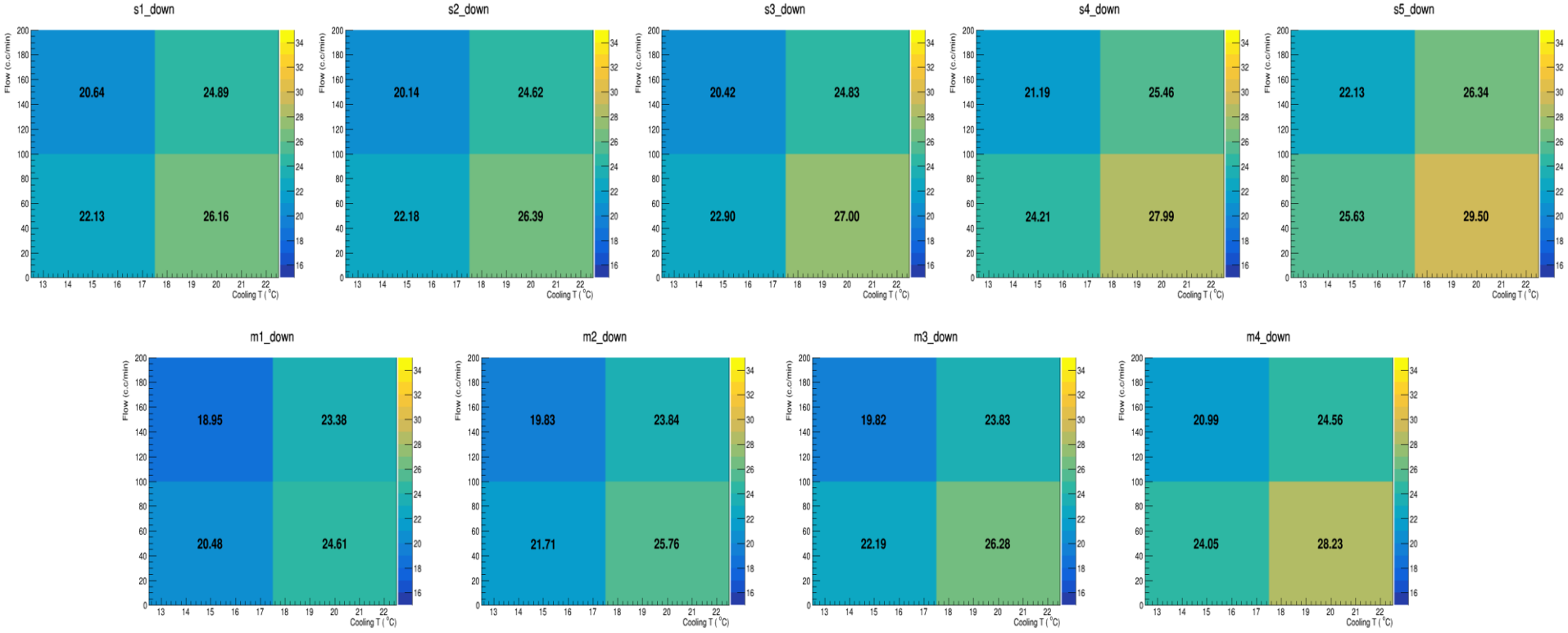




Temperature in different Flow and Cooling Temperature

(Power: 20.1 W, with pipe, bottom side)

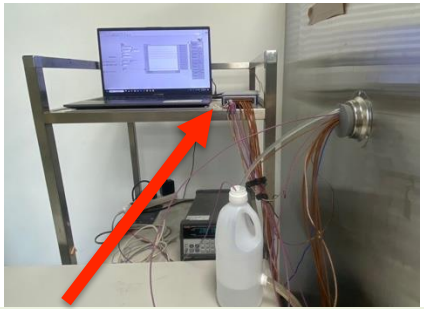
"S" for source ; "m" for middle(between source), Number for position (1 for water-in side)



Back up

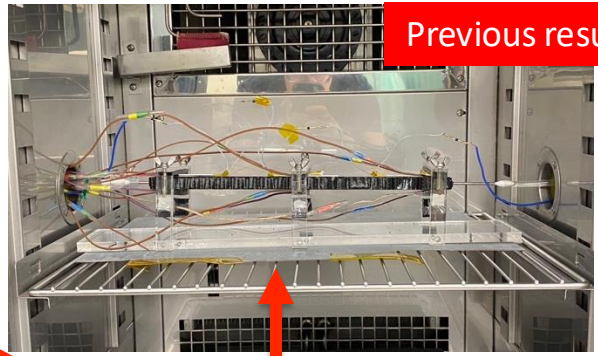
Test Setup for Mini Stave (30 cm)

Previous results



NI 9213 DAQ

- 16 channels
- Accuracy:
  - High-resolution mode : <0.02 ˚C
  - High-speed mode : <0.25 ˚C

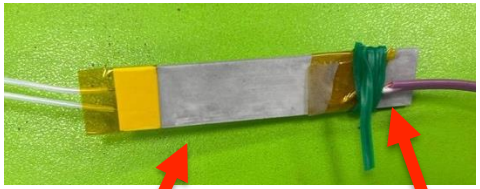


Environmental chamber

- Inner dimensions: 40 x 50 x 60 cm^3
- Temperature: -40 ˚C ~ 100 ˚C (± 0.2 ˚C)
- Humidity: 10% ~ 98% (± 2.5%)

Flow meter

- 20 – 300 cc/min



Heat source (x 9)

- Ceramic plate (5Ω): ~500˚C

Thermocouple (x 16)

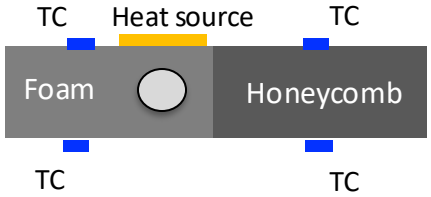
- Type E: -250˚C ~ 900˚C

Cooling system

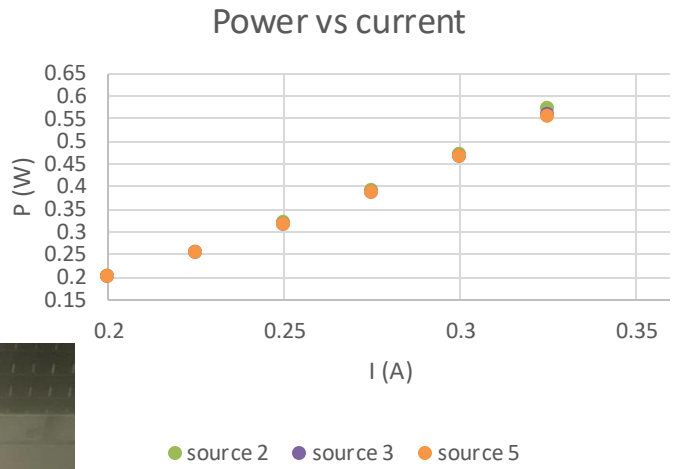
- Temperature: 3 ˚C ~ 32 ˚C

Test Setup for Mini Stave (30 cm)

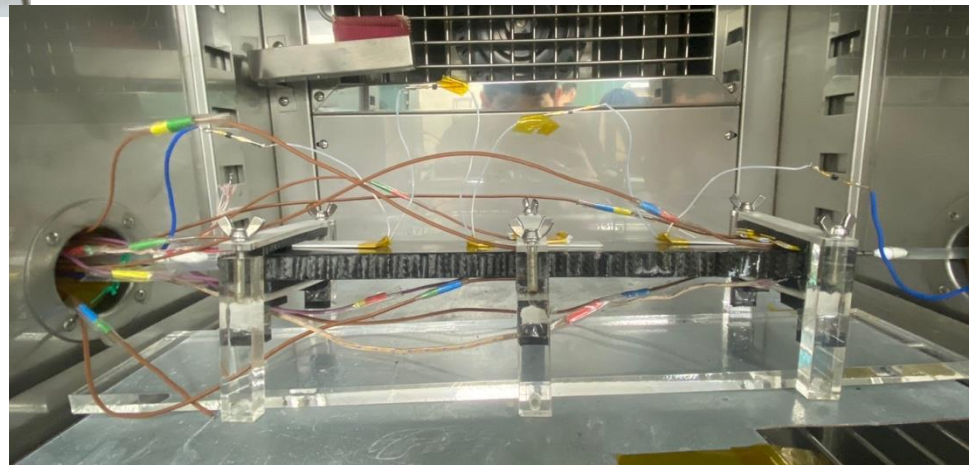
3D-printed holder



Previous results



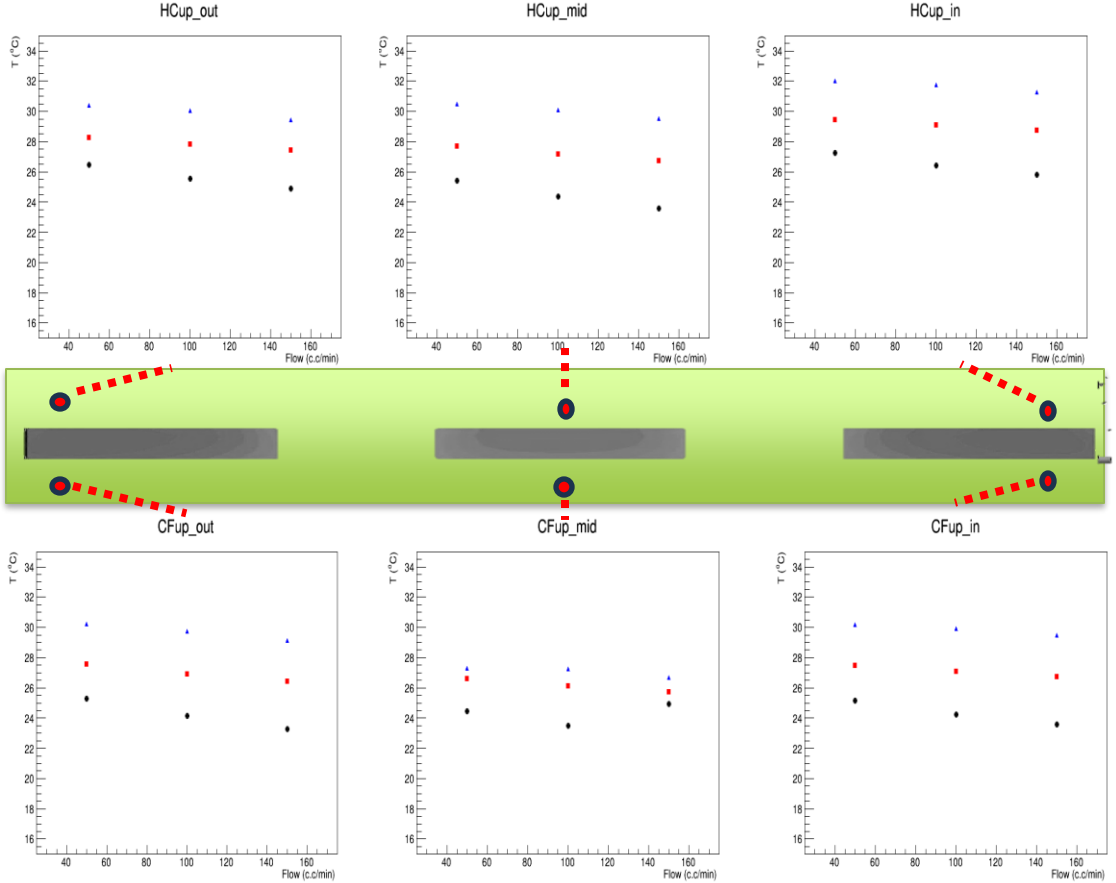
Water out



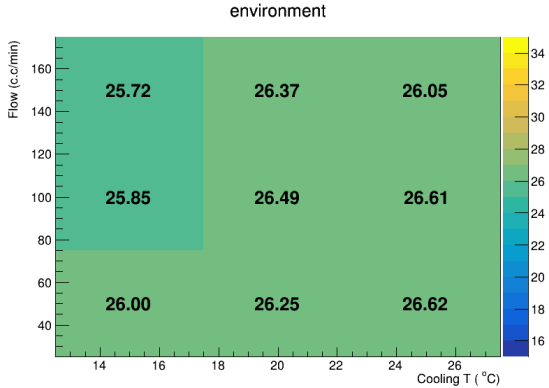
Water in

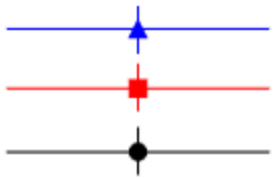
Top Side, Power : 6 W

Previous results



- Best cooling performance
  - High flow rate
  - Lower cooling temperature

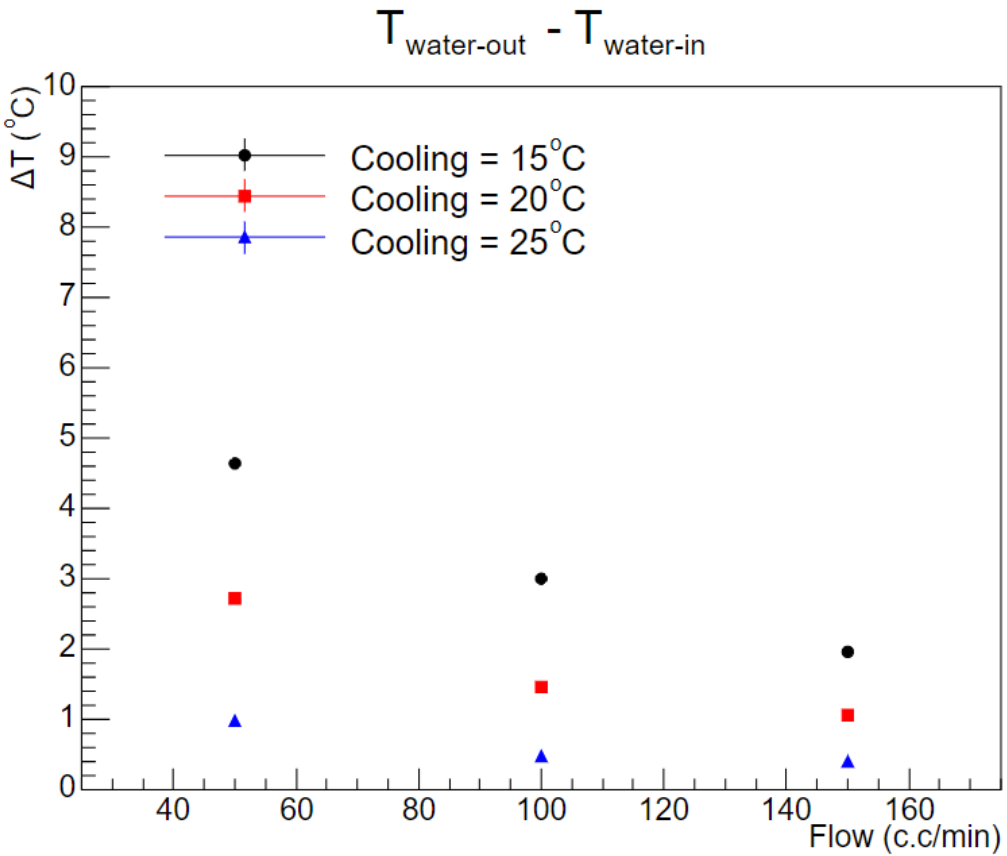




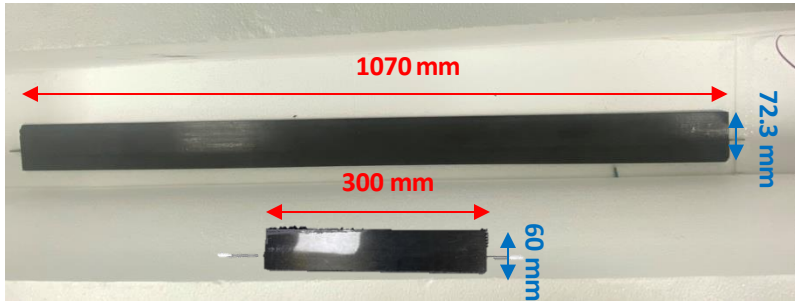
Cooling = 25°C
Cooling = 20°C
Cooling = 15°C

ΔT between Water-in and Water-out

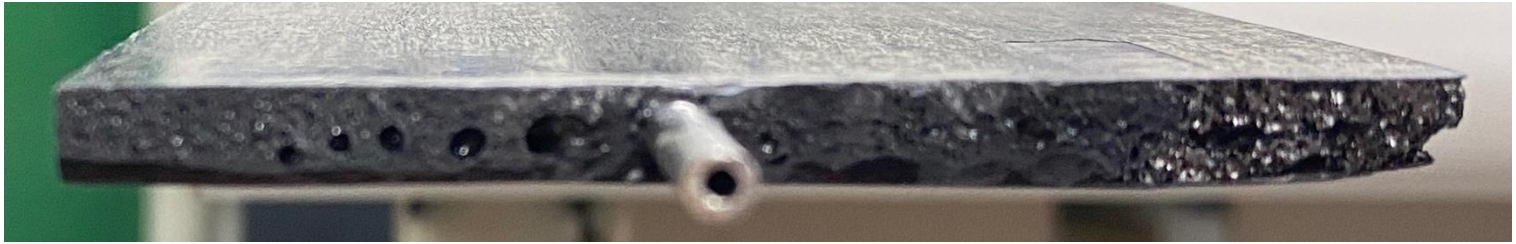
Previous results



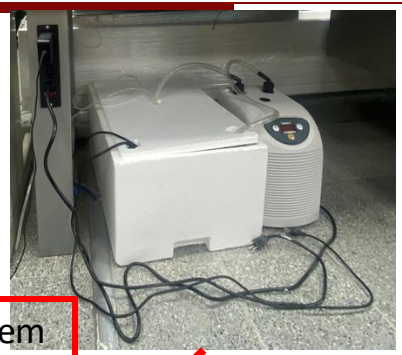
Half Stave (100 cm)



Cross-section of Half Stave



Test Setup for Half Stave (100 cm)



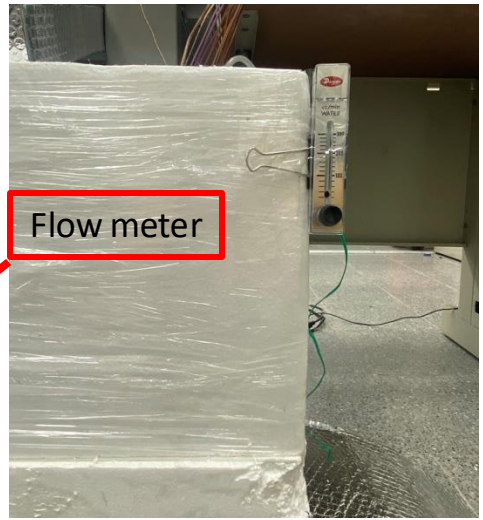
Computer and DAQ 2

Power supply

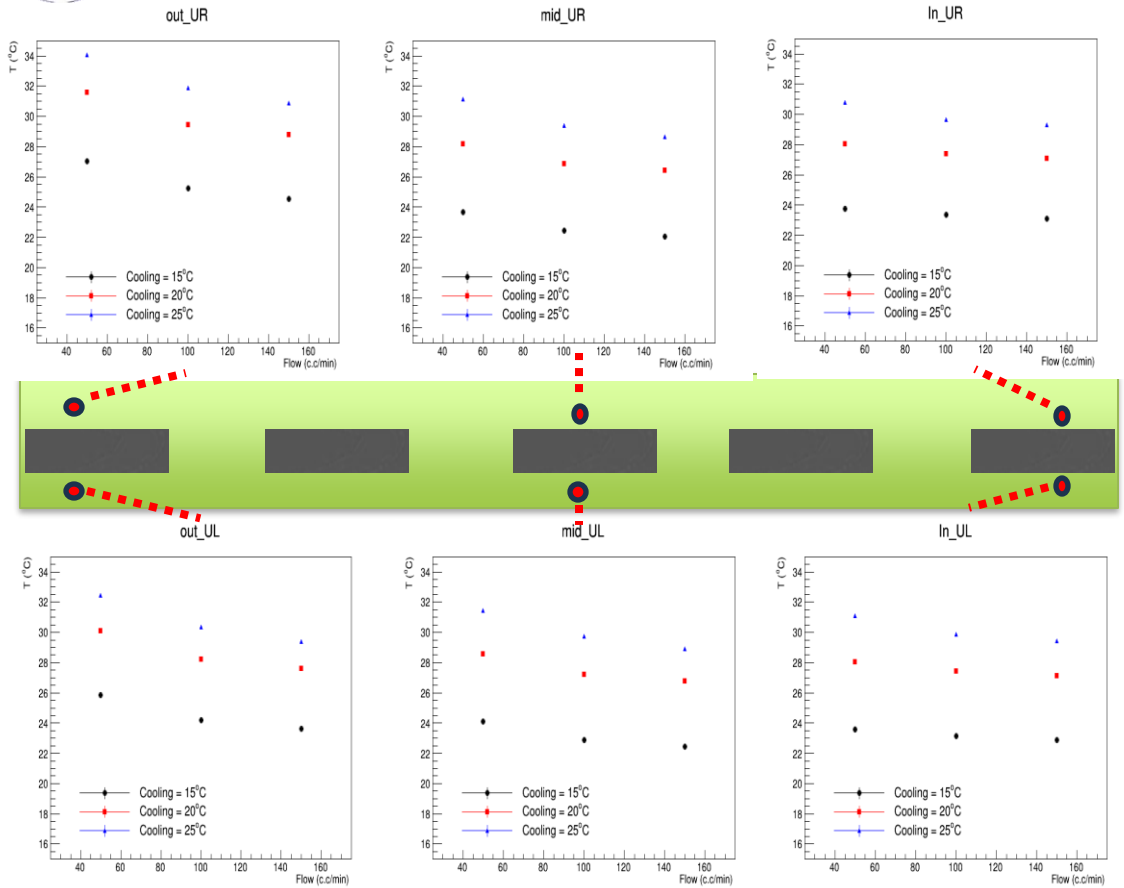
Cooling system

Computer and DAQ 1

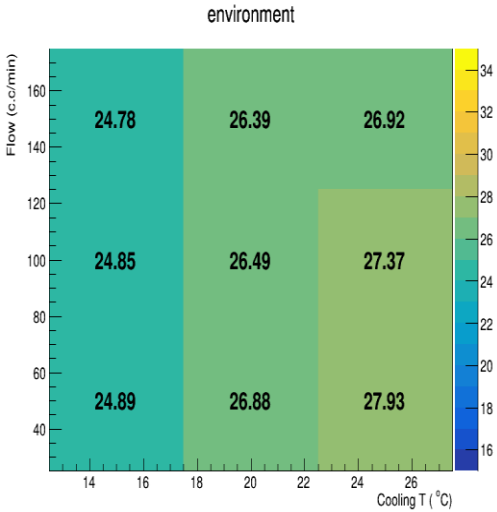
Flow meter



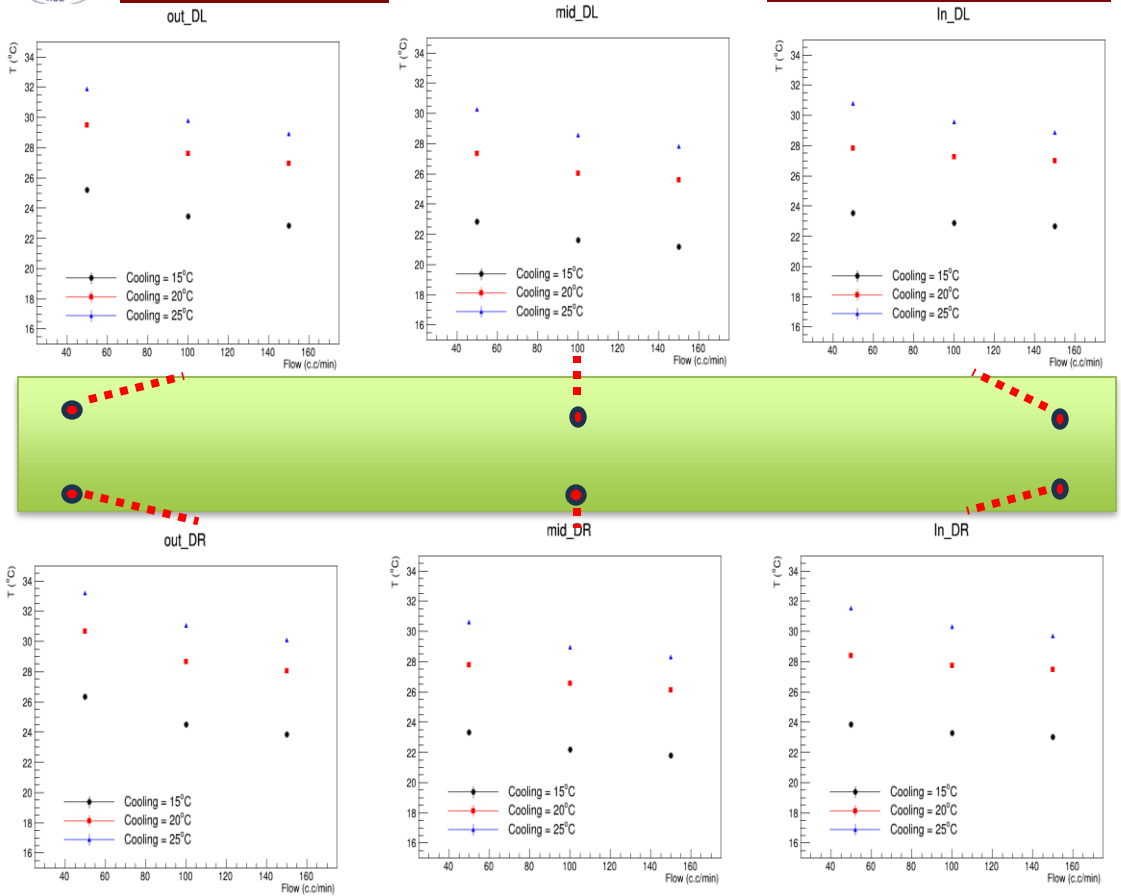
Top Side, Power: 20.1 W



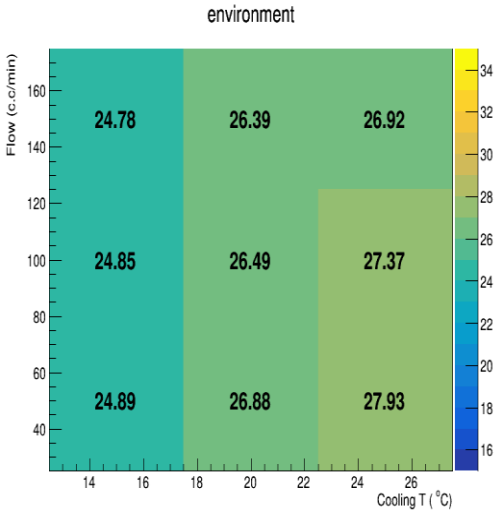
- Best cooling performance
  - High flow rate
  - Lower cooling temperature



Bottom Side, Power: 20.1 W

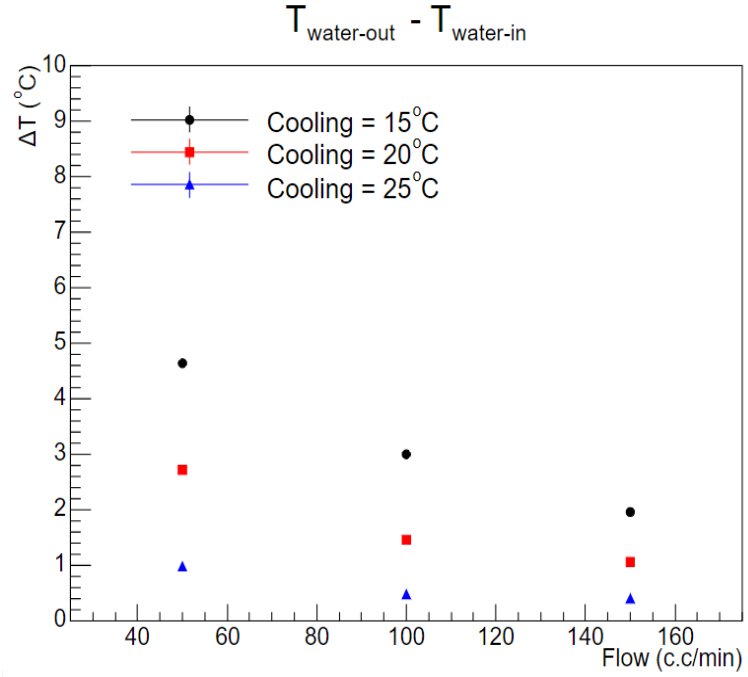


- Best cooling performance
  - High flow rate
  - Lower cooling temperature

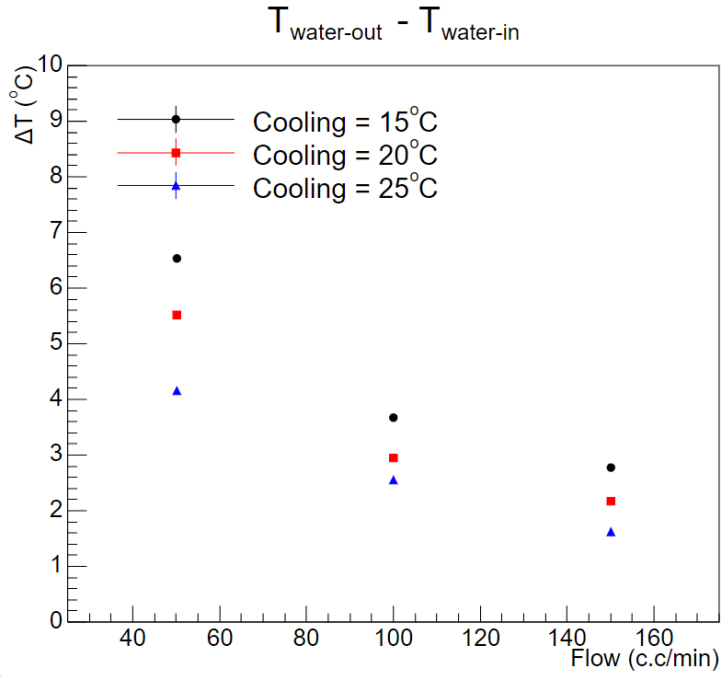


ΔT between Water-in and Water-out

- Half stave has larger ΔT



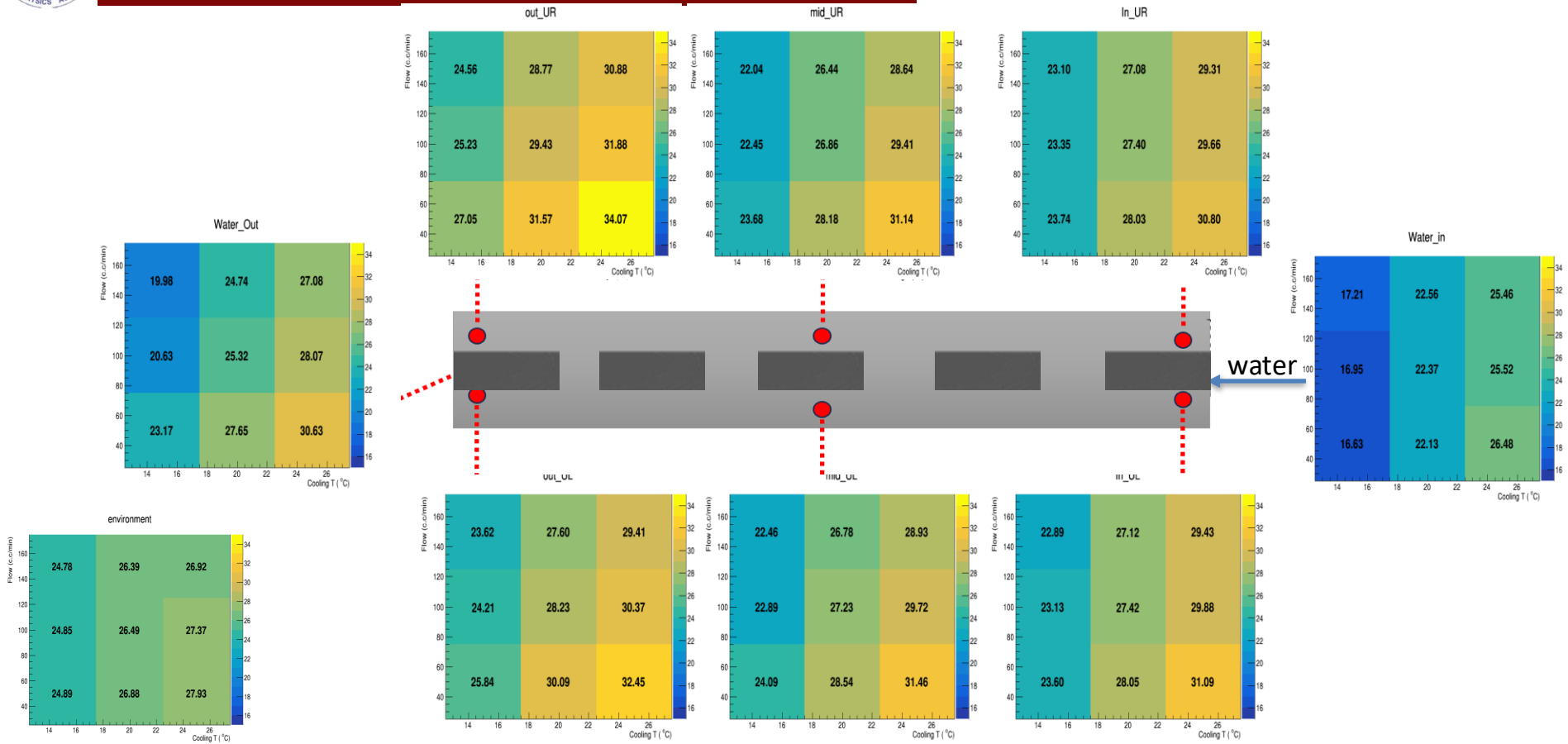
Mini stave



Half stave

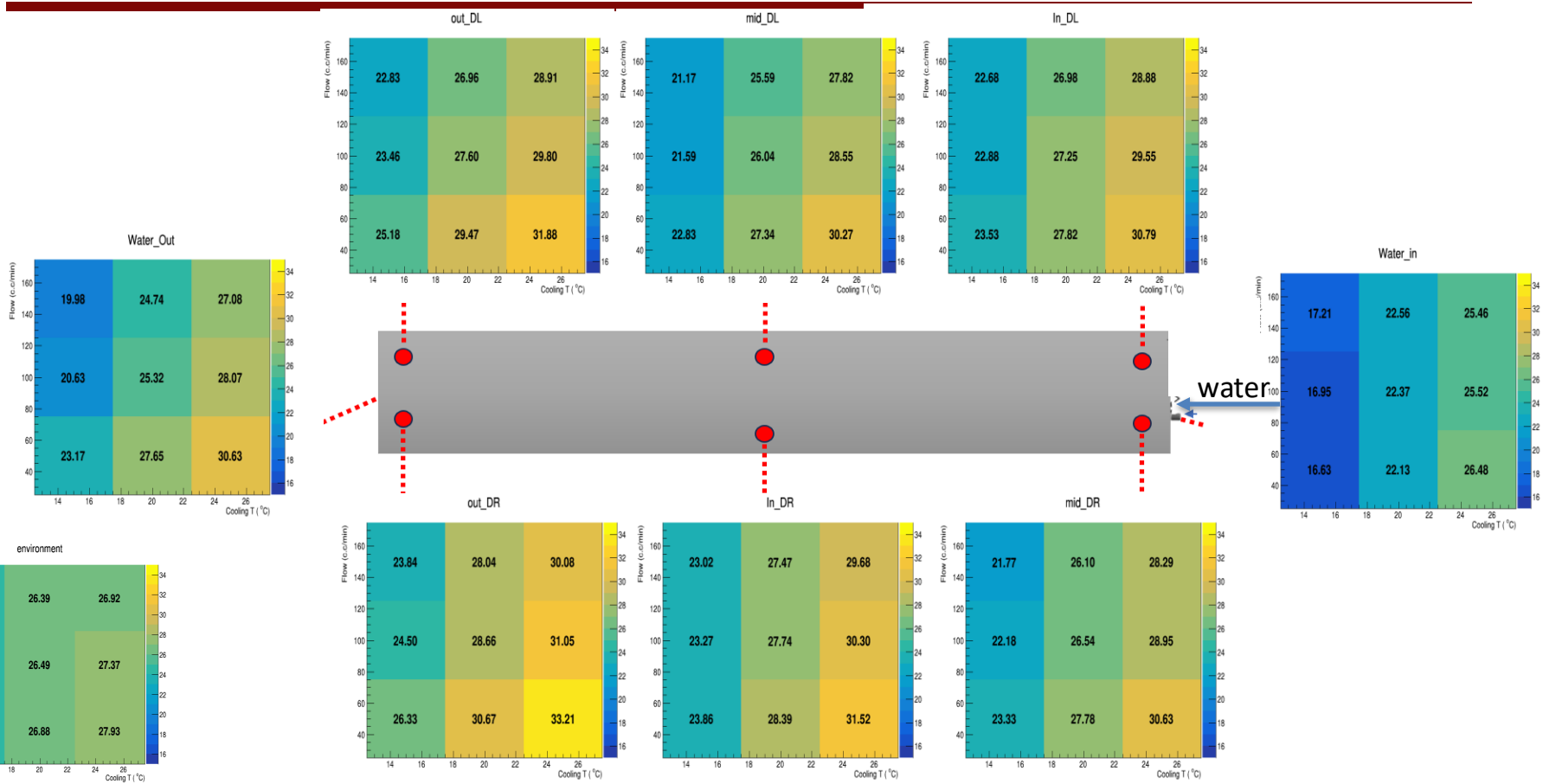
Temperature in different Flow and Cooling Temperature

(Power: 20.1 W, top side)



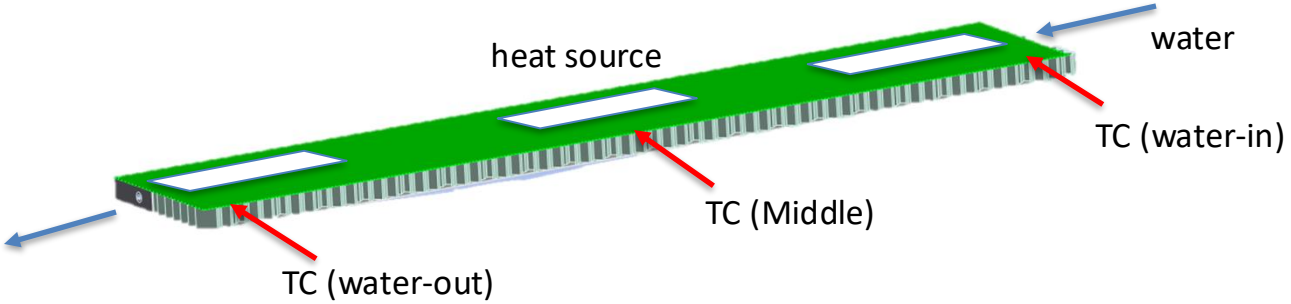
Temperature in different Flow and Cooling Temperature

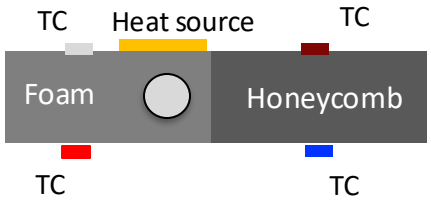
(Power: 20.1 W, bottom side)



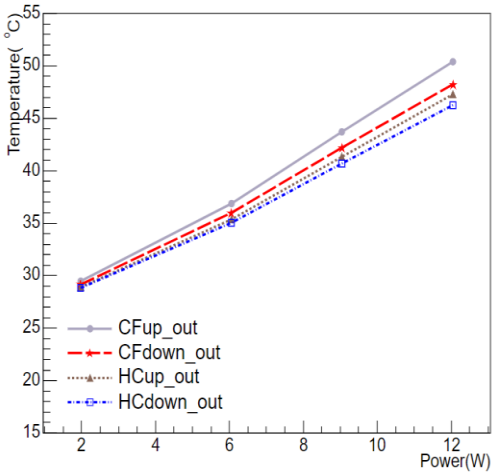
Back up

No Cooling water

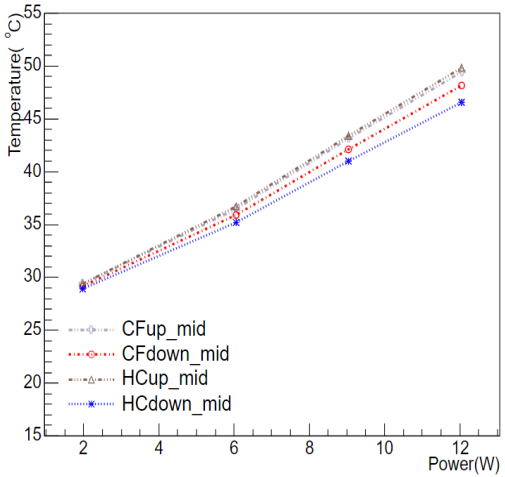




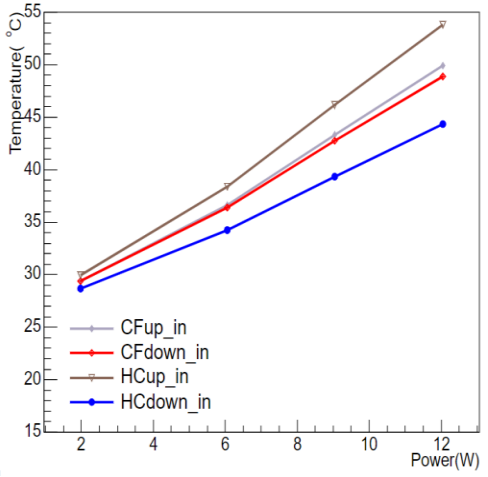
Water-out



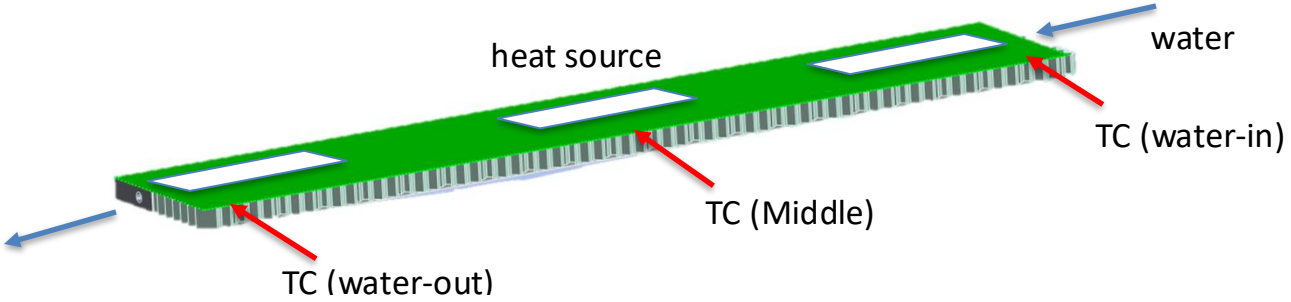
Middle

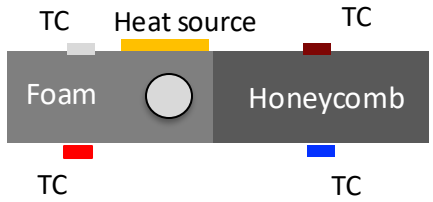


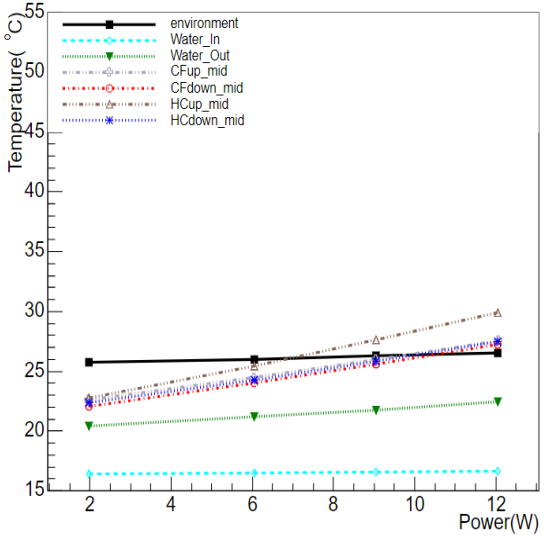
Water-in

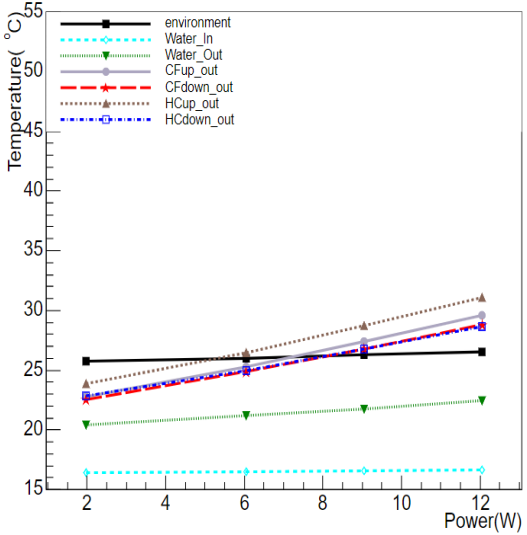


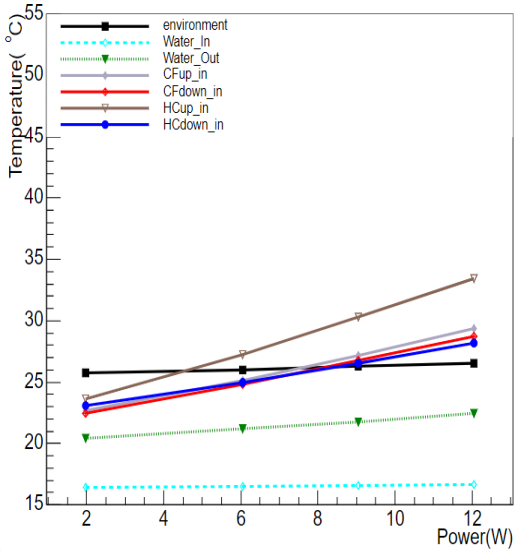
Cooling water @ 15 °C, 50 c.c./min



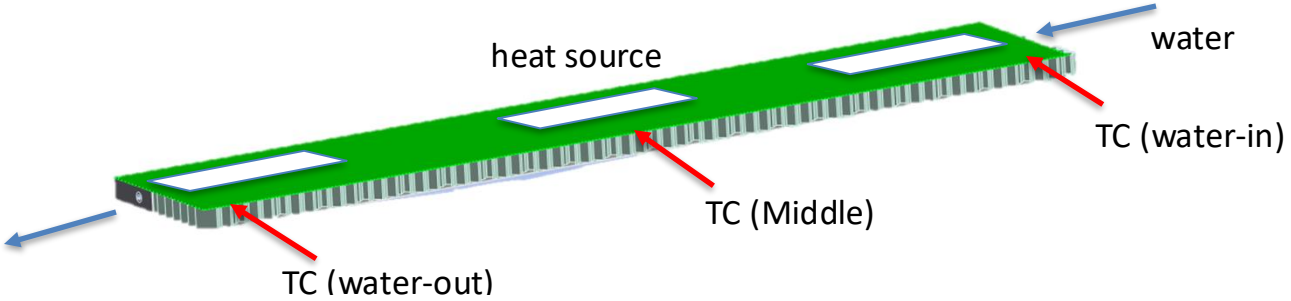


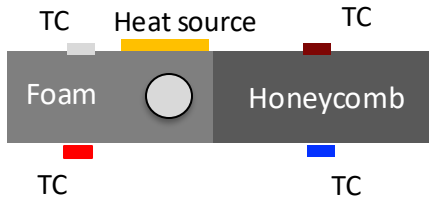


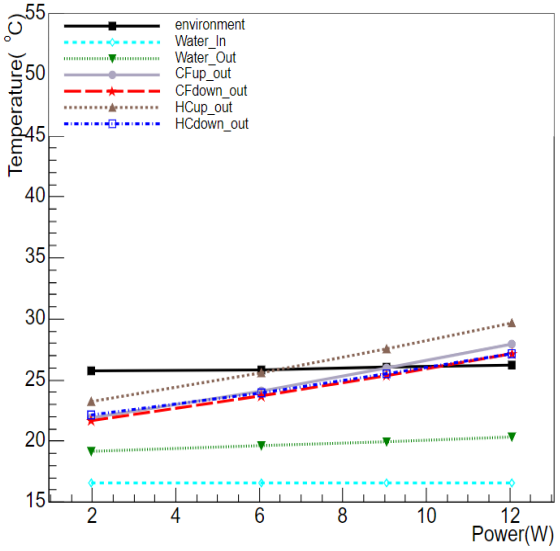


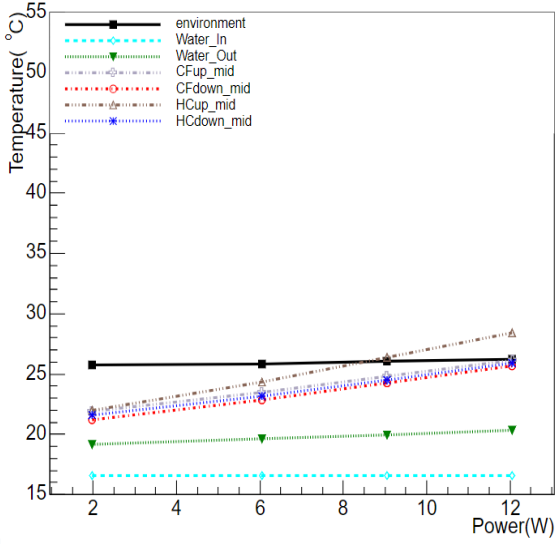


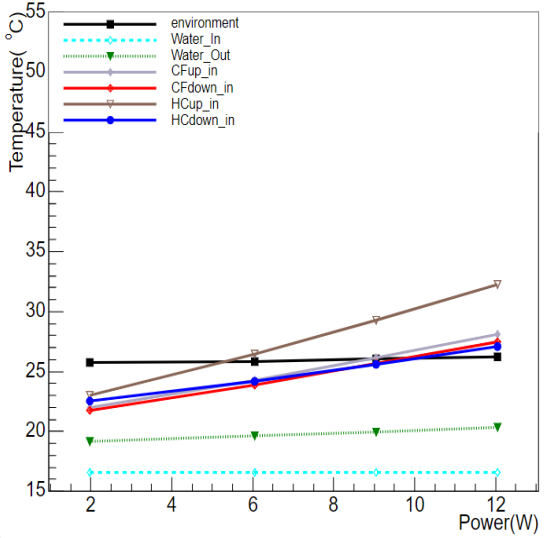
Cooling water @ 15 °C, 100 c.c./min



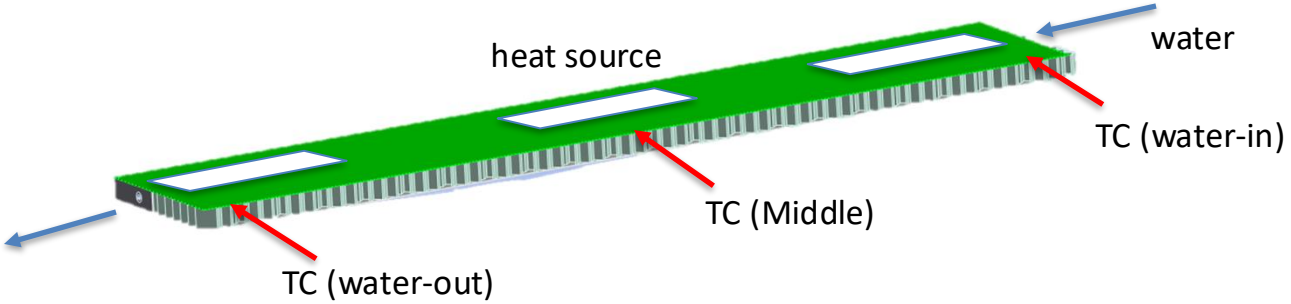


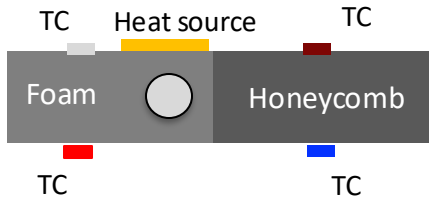


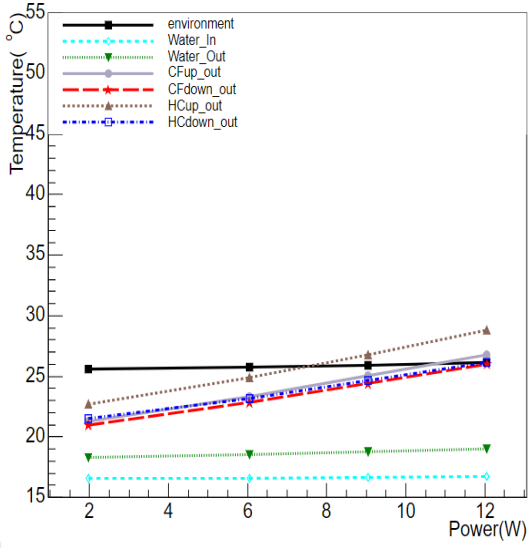


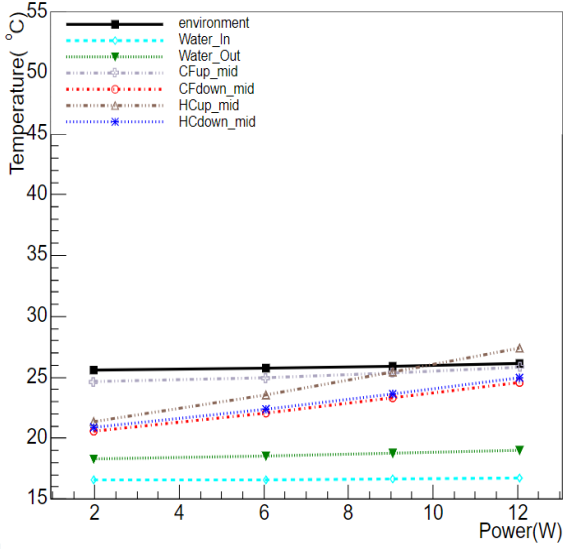


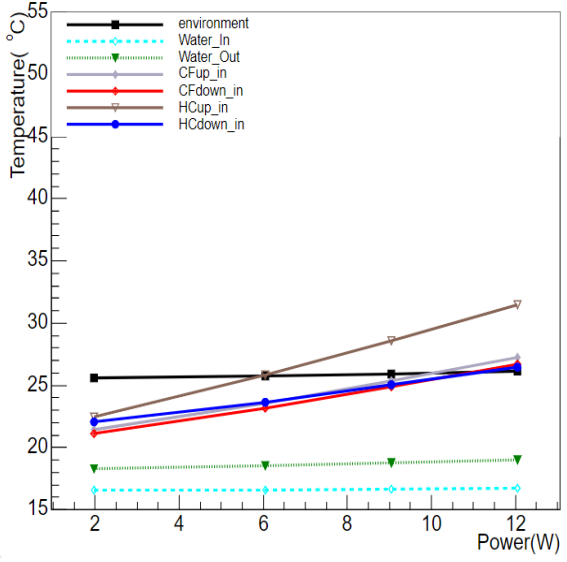
Cooling water @ 15 °C, 150 c.c./min



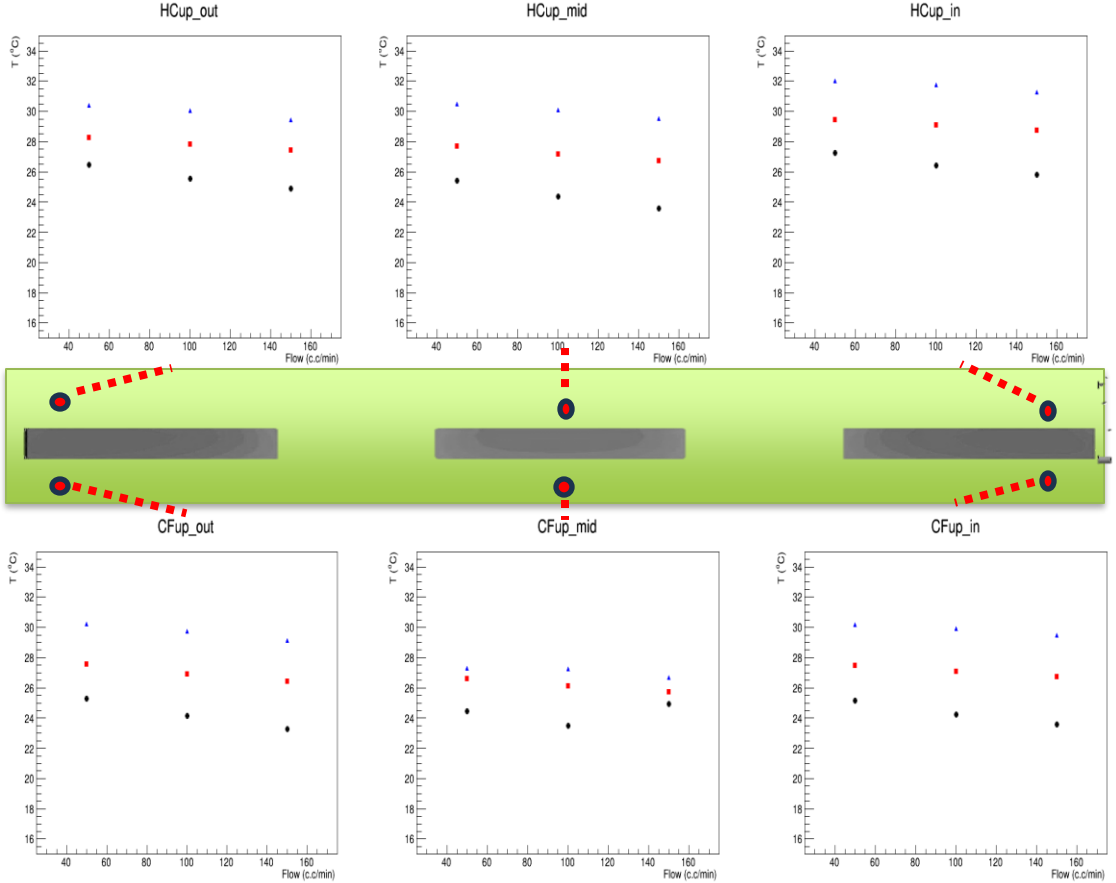








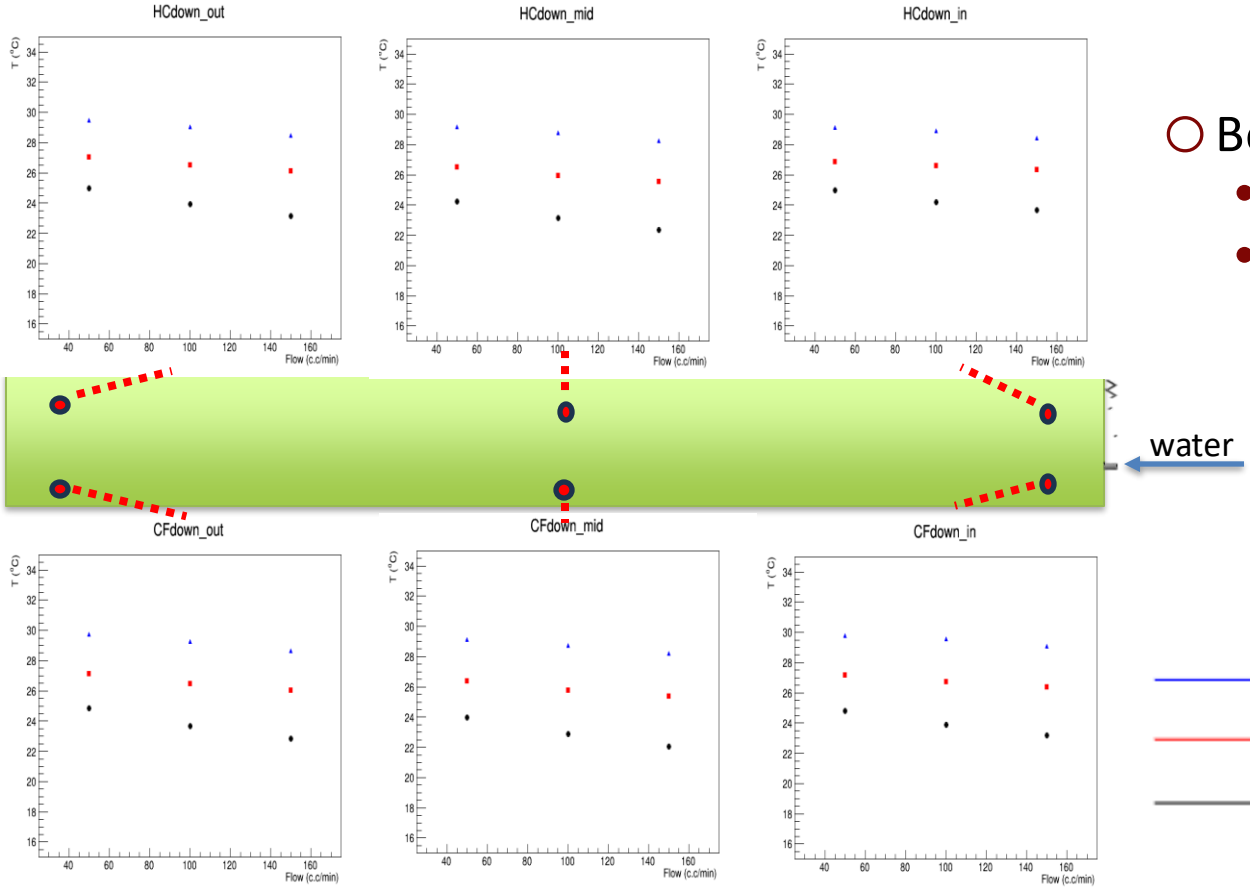
Top side , Power : 6 W



- Best cooling performance
  - High flow rate
  - Lower cooling temperature

Cooling = 25°C
Cooling = 20°C
Cooling = 15°C

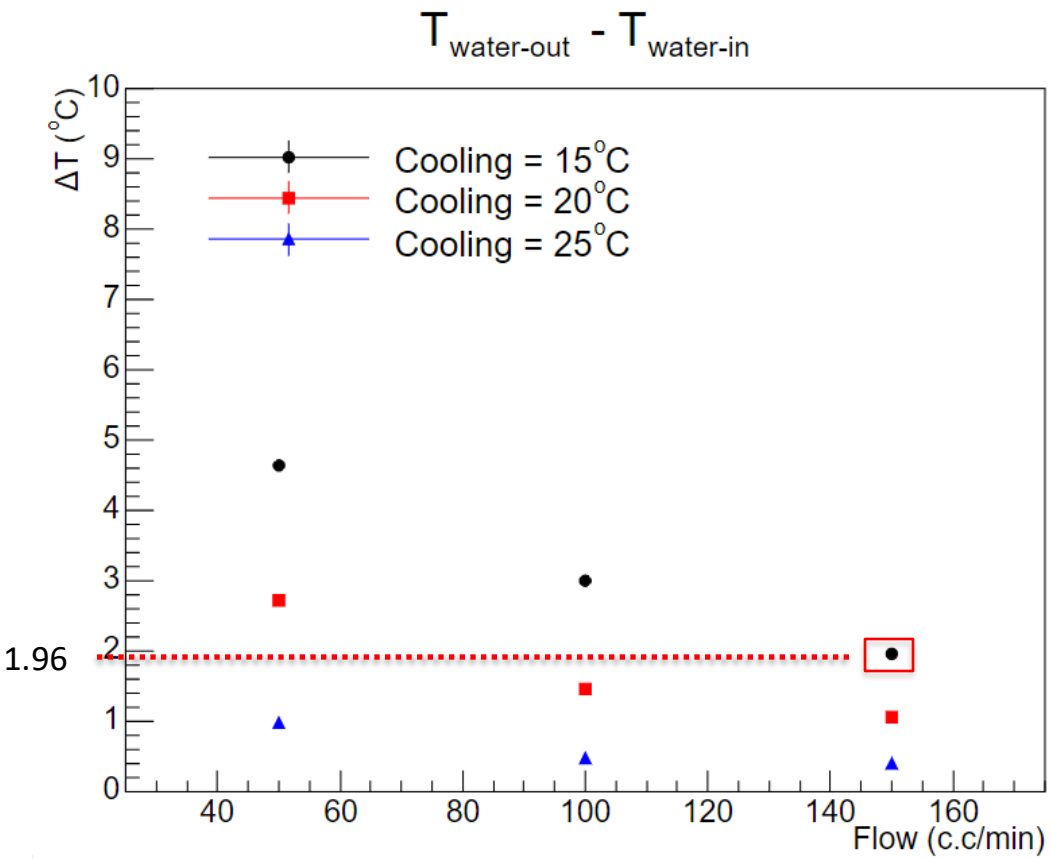
Bottom side , Power : 6 W



- Best cooling performance
  - High flow rate
  - Lower cooling temperature

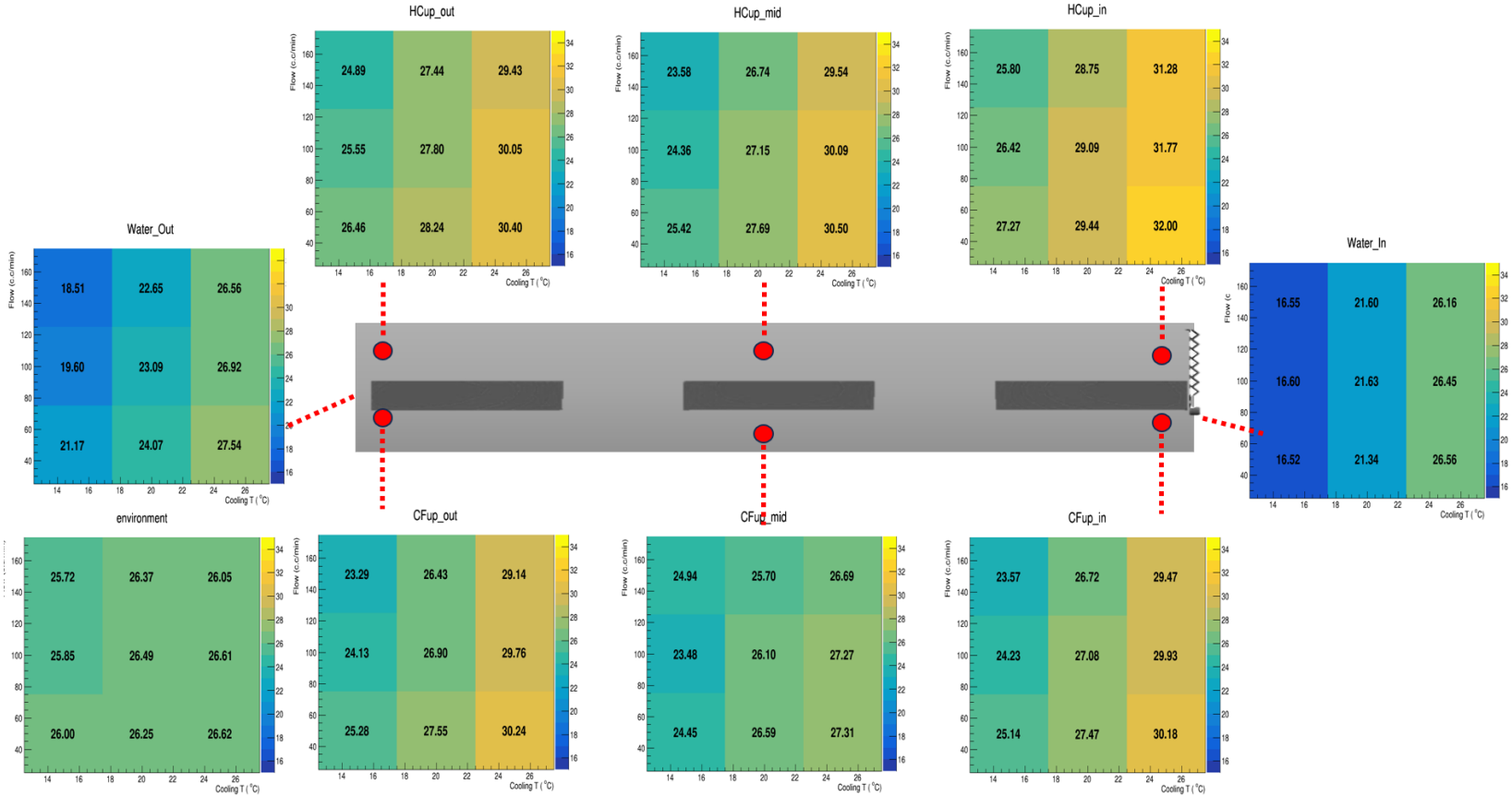
Cooling = 25°C
Cooling = 20°C
Cooling = 15°C

ΔT between Water in and Water out



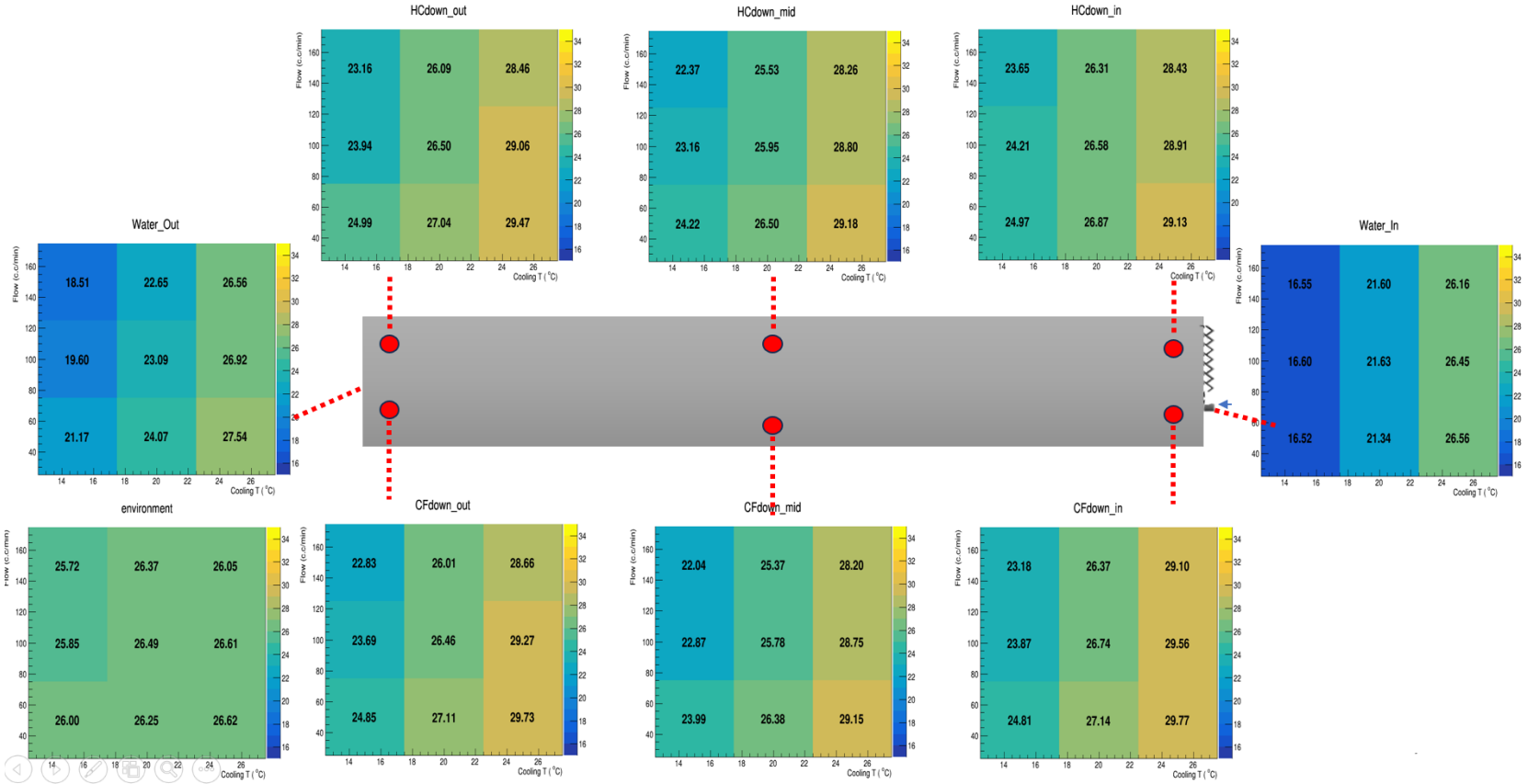
Temperature in different Flow and Cooling Temperature

(Power: 6 W, top side)



Temperature in different Flow and Cooling Temperature

(Power: 6 W, bottom side)



ΔT between Water in and Water out