Warsaw University of Technology

ISE

EUROPEAN SPALLATION SOURCE

PRL Temperature Stabilization System

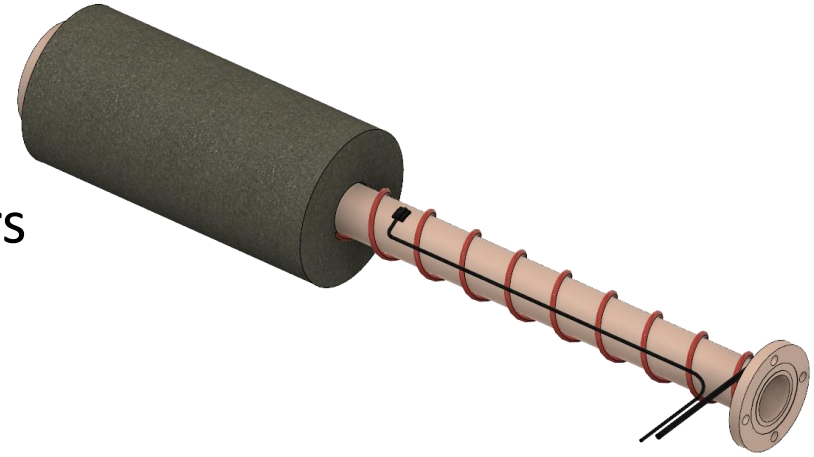
Radosław Papis

System overview – Requirements

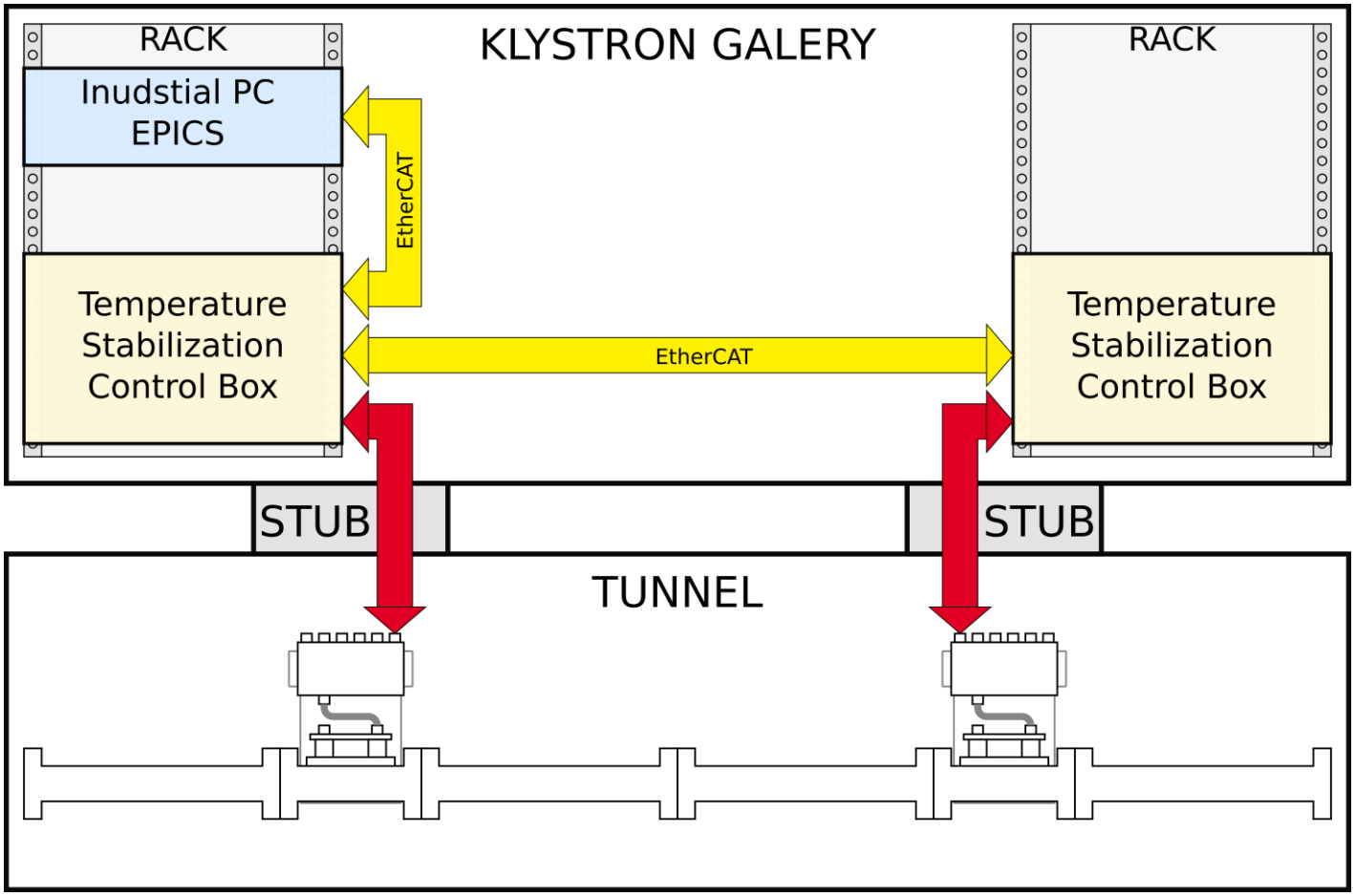
- Temperature stability: +/- 0.1°C
  - Based on phase stability requirements
- Materials: fireproof and radiation resistant
  - ESS requirements
  - Prohibited material:
    - PVC(heaters insulation) – due to fire safety
    - PTFE – due to radiation resistance
    - PET – due to radiation resistance
    - Much more…

System overview – Concept

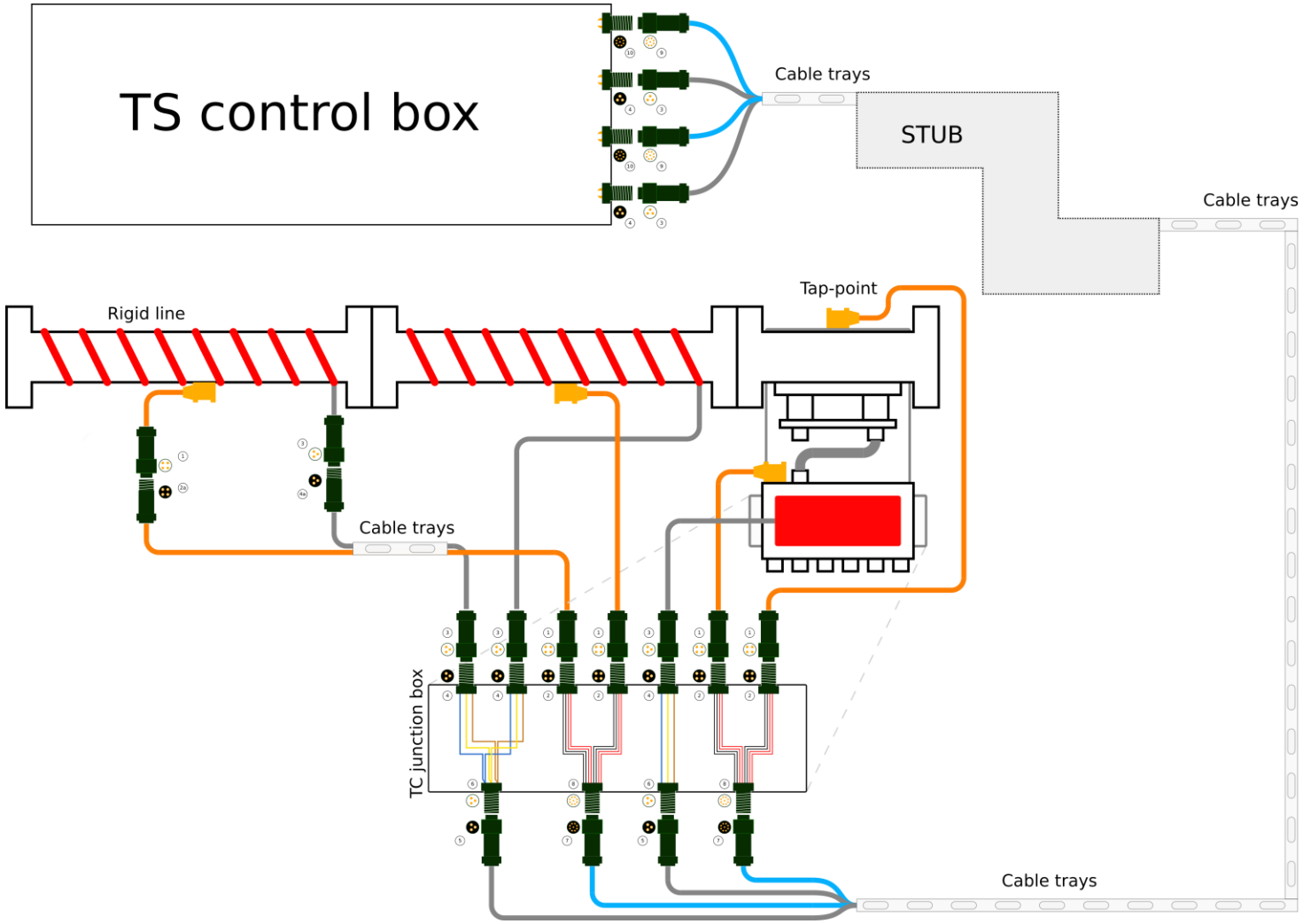
- Tunnel:
  - Heating tape on line
  - Platinum temperature sensors
  - Thermal insulation
- Klystron Gallery
  - Temperature Stabilization Control Boxes
  - Industrial PC/Server with controlling software



System overview – Concept

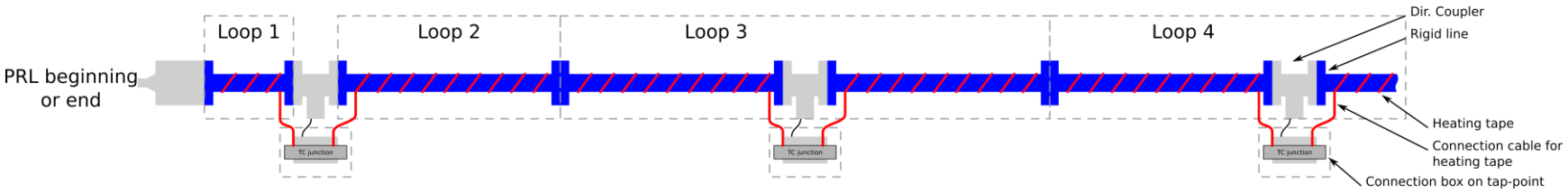


System overview – Concept



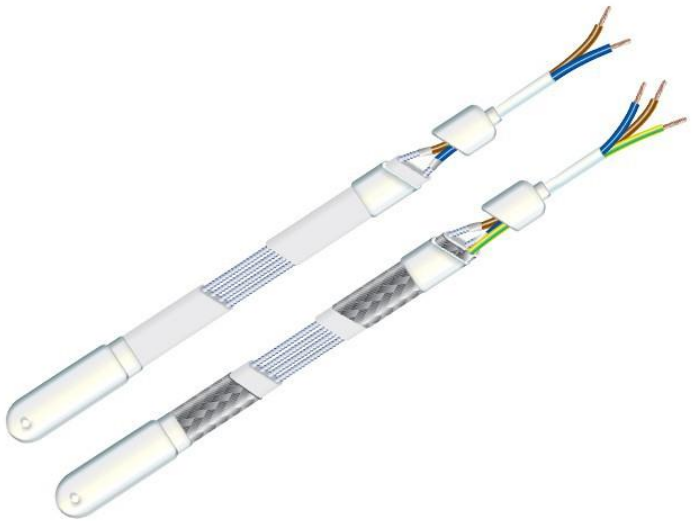
System overview – Loop placement

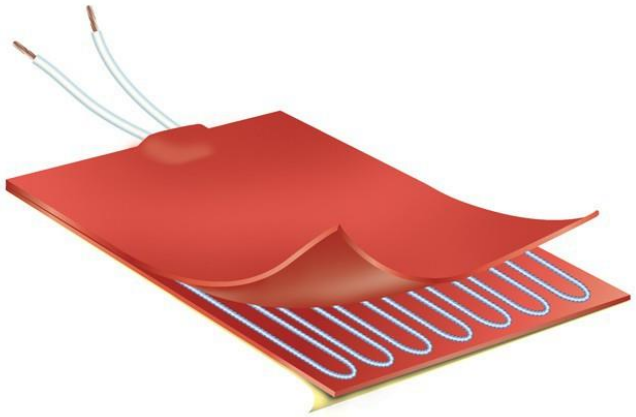
- Stabilization loop covers two section of rigid line an coupler in the middle.



Design - Heaters

- Rigid line
  - Silicon insulated heating cable
  - 50W per ~4m
- TapPoints and other stuff
  - Silicon insulated heating mat
  - Power depend on element mass and heat capcity





Design – Temperature sensors

- PT100 sensors selected
  - Popular in industry
  - Platinum wire on ceramic insulator
  - Soldered silicon insulated cable with connector

Design – Line insulation

- Rigid line
  - ThermaSmart PRO – Standard Pipe insulation tubes
  - Material: thermoplastic polyolefin foam
- TapPoint, couplers, power divider
  - ThermaSmart PRO – insulation sheets

Design – Cables

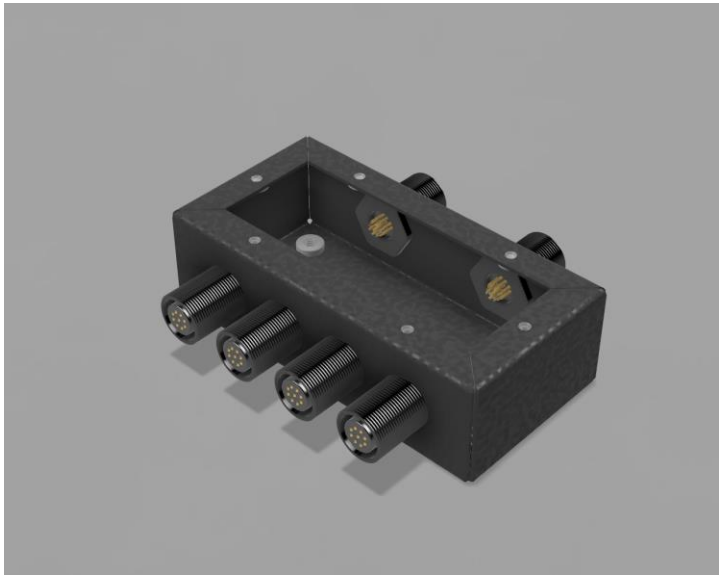
- Shielded cable for temperature sensors

- 3x1.5mm^2 for heaters

- PP and PUR insulation

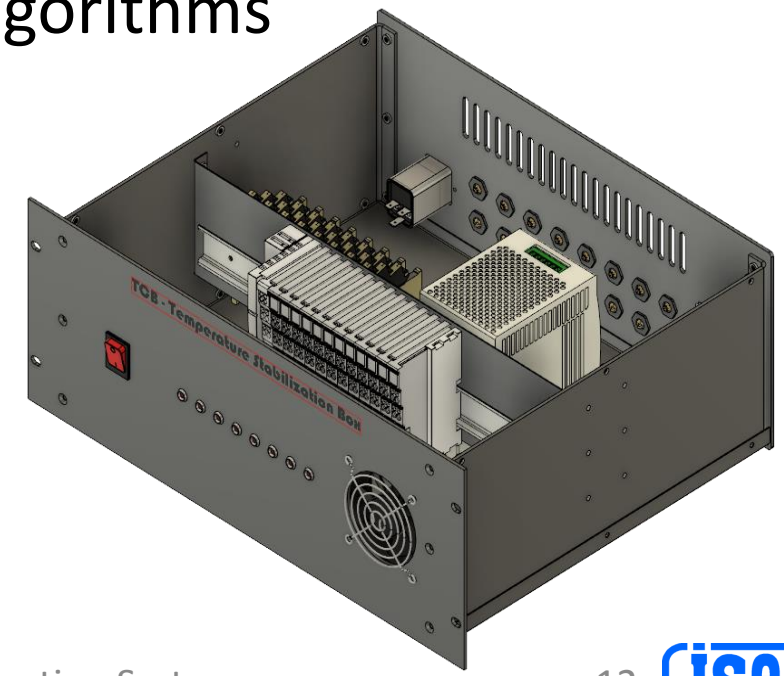
Design – connectors an junction box

- Junction box on TapPoints
  - Metal enclosure with connectors
- ST12 industrial connectors from WEIPU
  - Zink body, polyphenylene sulfide (PPS)



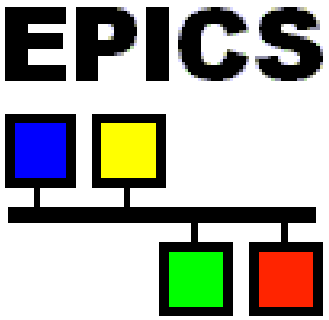
Design – Temperature Control Box

- Control box installed in klystron galery
- Based on Beckhoff terminals
  - PWM + SSR's for heaters
  - Temperature to digital converters
- Separate computer for loop algorithms
- Comunication : EtherCAT



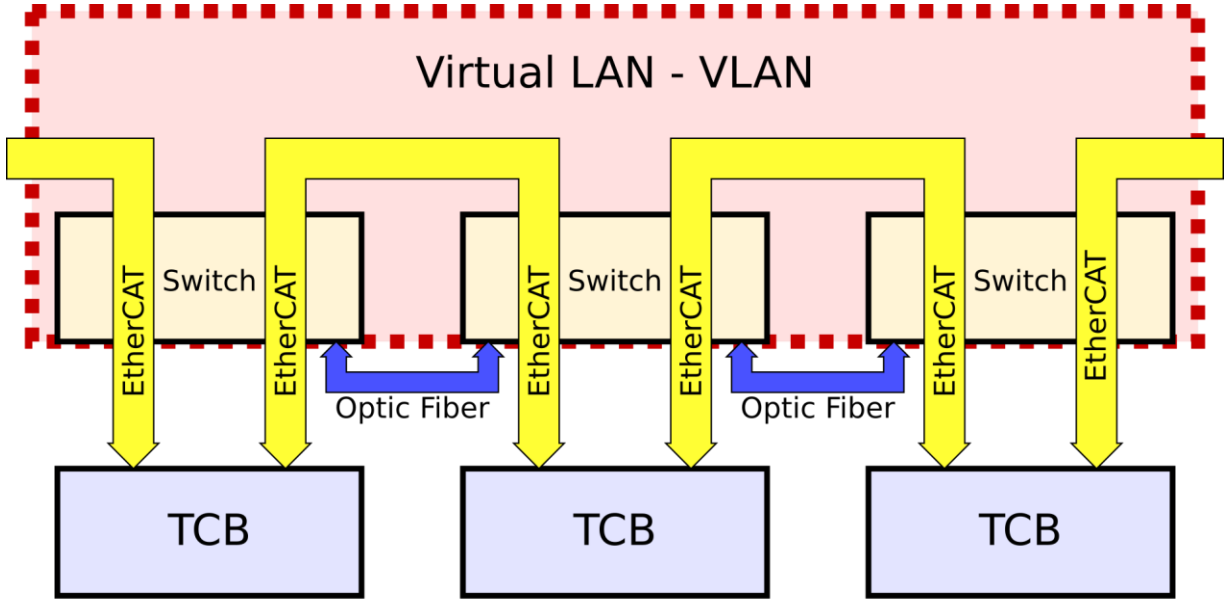
Design – Control software

- Installed on one Industrial PC
- System:
  - EPICS – Experimental Physics an Industrial Control System
    - Based on real time linux
    - Special driver for EtherCAT
    - Supported by ICS
- Algorithm:
  - PID implemented in SNL (final)
    - Cooperation with ICS
  - PID implemented in python (test)



Design – Network

- Based on network switch and Virtual LAN

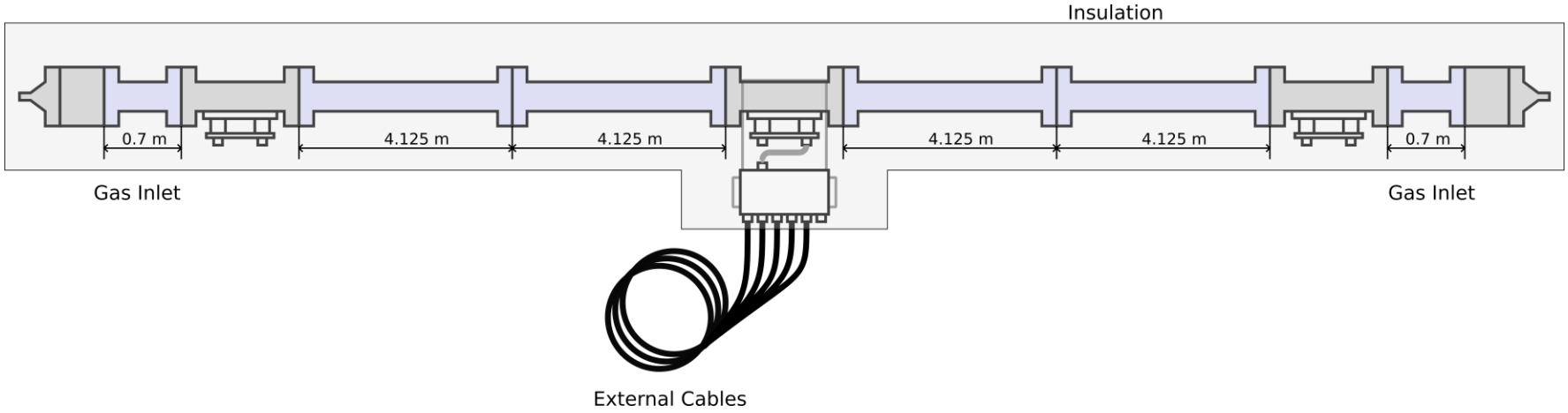


Design – Installation

- Cable database for STUBS – PREPARED
- Space in Klystron Gallery RACK's – RESERVED
- Temperature control boxes – Preparing for production
- Junction Boxes – Preparing for production

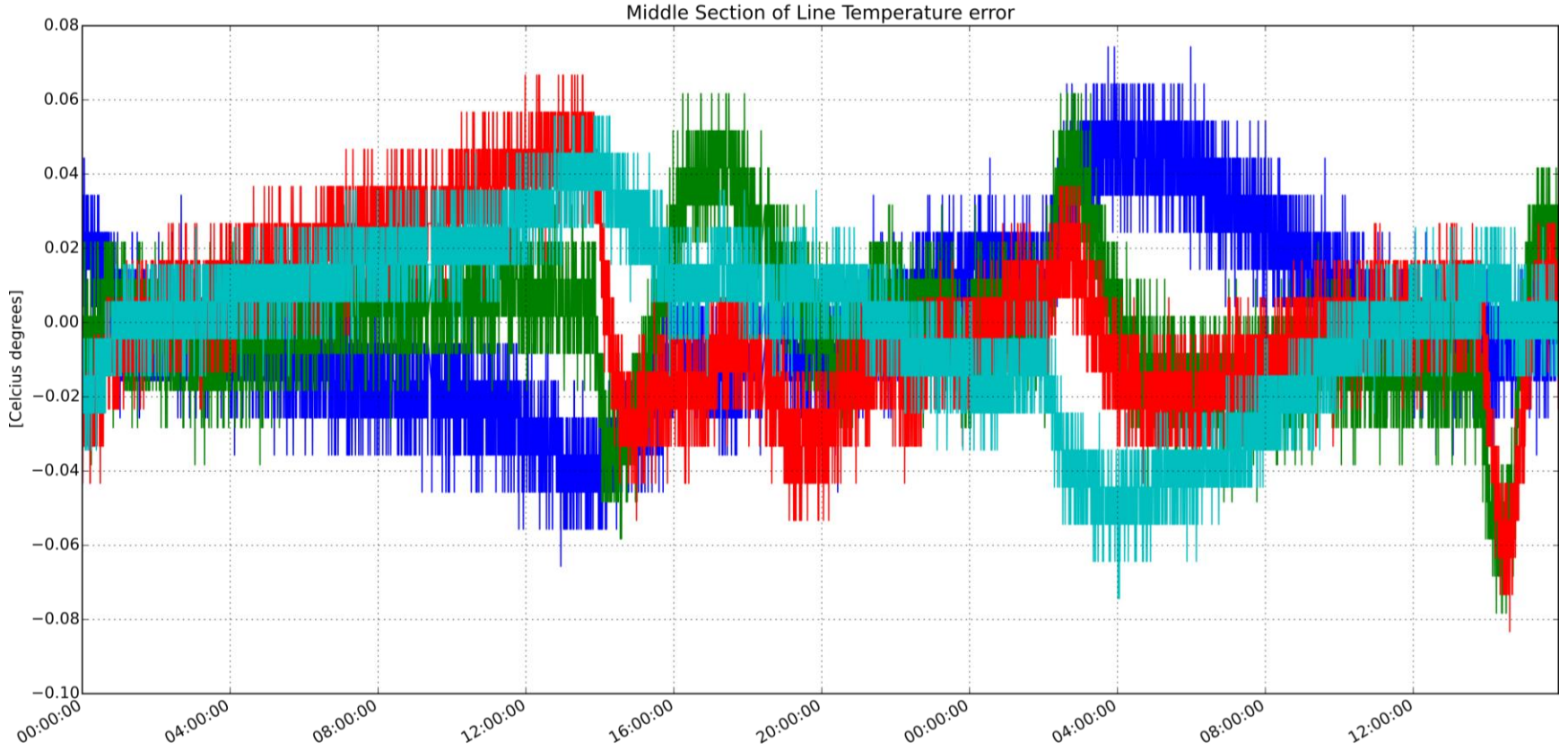
Prototype – Schematic

- Seven loops implemented at WUT
- 30 mm of insulation



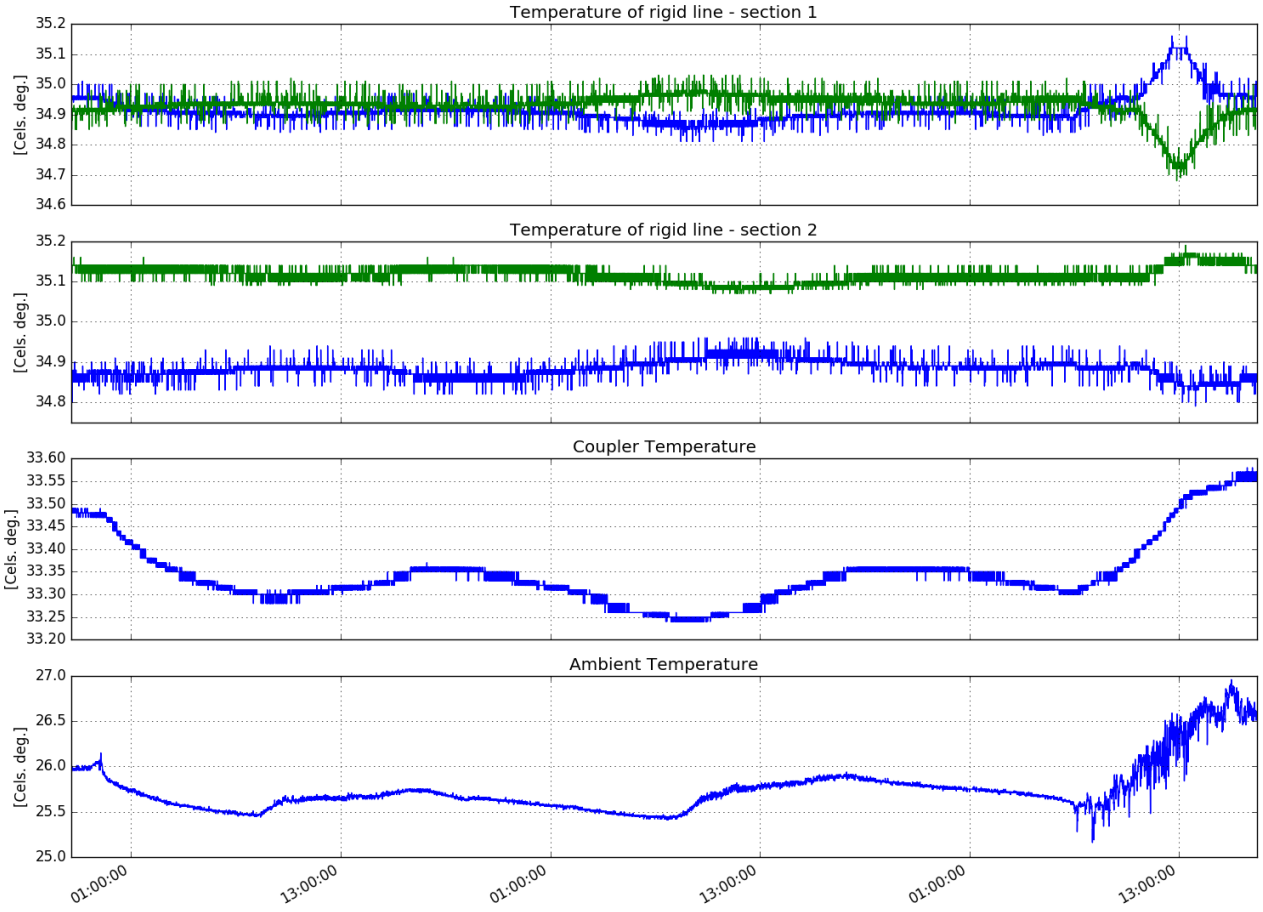
Prototype – Results

- +/- 0.1°C degrees can be achieved
- 2 degrees ambient temp. change



Prototype – Results

- Problems with insulation and heating on couplers



Prototype – Conclusions

- Generally it will work!
- Problems with insulation and heating on couplers
  - Poor insulation coupler in prototype.
  - Low power of heater on coupler

Prototype – Plans

1. Prepare TCB and Junction Box to production
2. Order elements, procurements
3. Run more test on prototype
4. Assemble TCB and Junction Box prototype, test it.
5. Start production
6. Start installation in KG
7. Run system

Prototype – Identified Risks

- TCB - Influence of KG ambient temperature on stability
  - Should be investigated
  - Add temperature stabilization inside TCB
- Problem with coupler temperature
  - Change power of heaters on coupler
  - Connect temperature sensor on coupler into stabilization loop
- Network and STUB cables are needed to commissioning