Thermal testing of loaded cells for the ATLAS ITk Pixel OB

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CERN, 20th August 2019
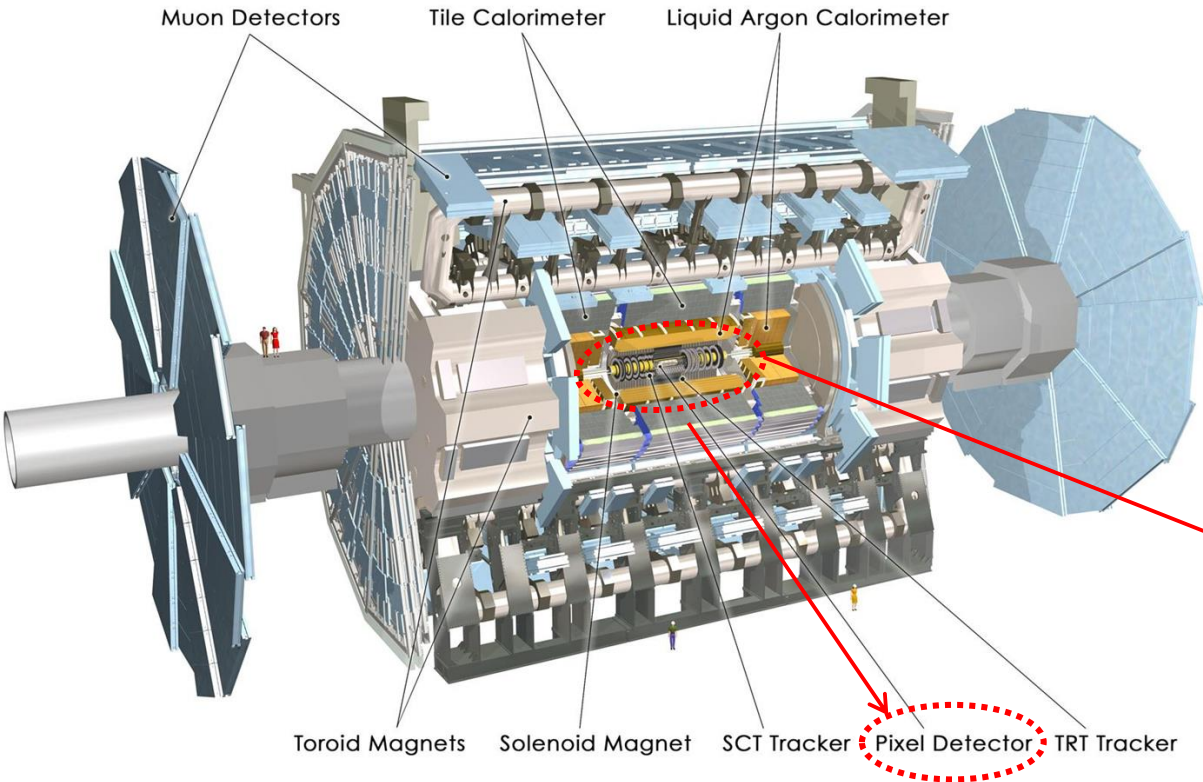
EP-DT
Detector Technologies

CIAO !

I am Giovanna and I am Italian. I am 24 years old.

About 2 months ago I got a Master's degree in

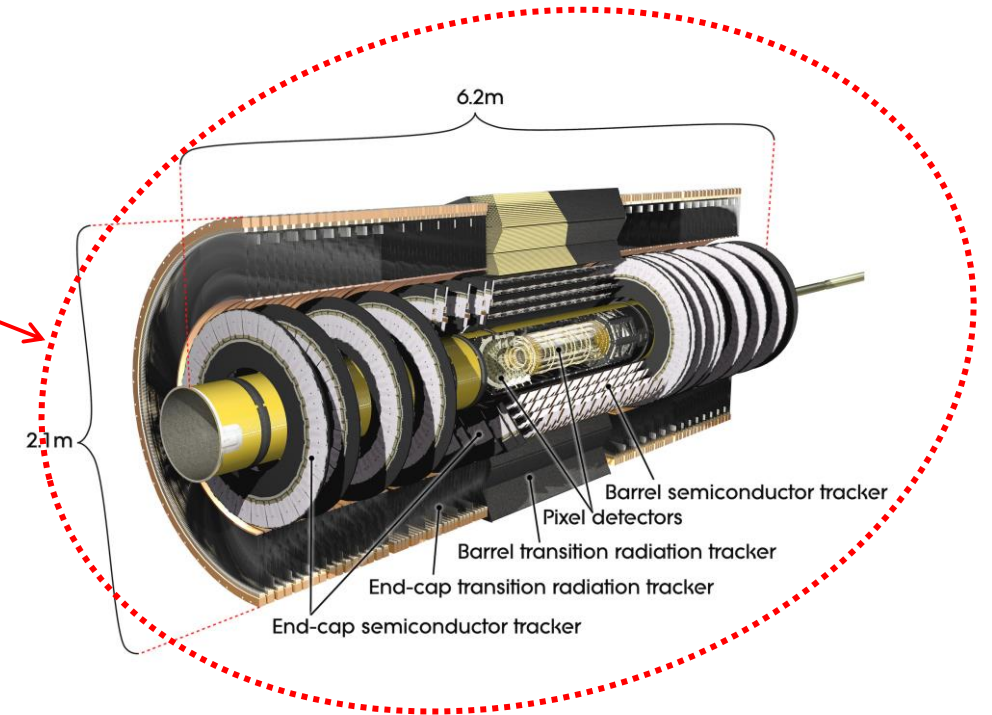Electronic Engineering at the Politecnico of Bari.

In the future I wish to have an exciting job and a

brilliant carreer with amazing people like those I
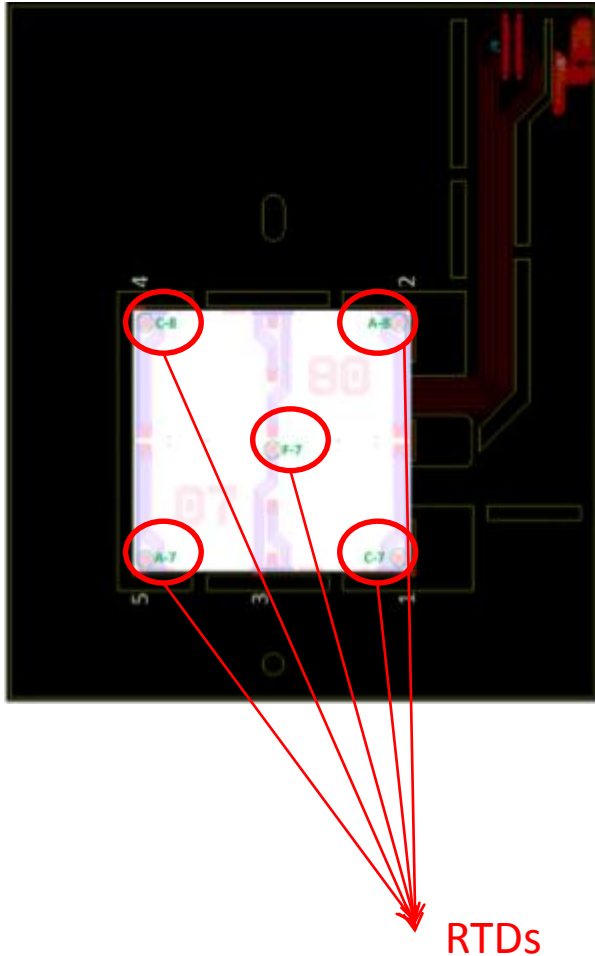
have found here !

ATLAS ITk

Muon Detectors
Tile Calorimeter
Liquid Argon Calorimeter
Toroid Magnets
Solenoid Magnet
SCT Tracker
Pixel Detector
TRT Tracker

New ATLAS Inner Tracker (ITk)
– Finer segmentation
– Faster readout and more storage
– Increased radiation hardness

6.2m
2.1m
Barrel semiconductor tracker
Pixel detectors
Barrel transition radiation tracker
End-cap transition radiation tracker
End-cap semiconductor tracker

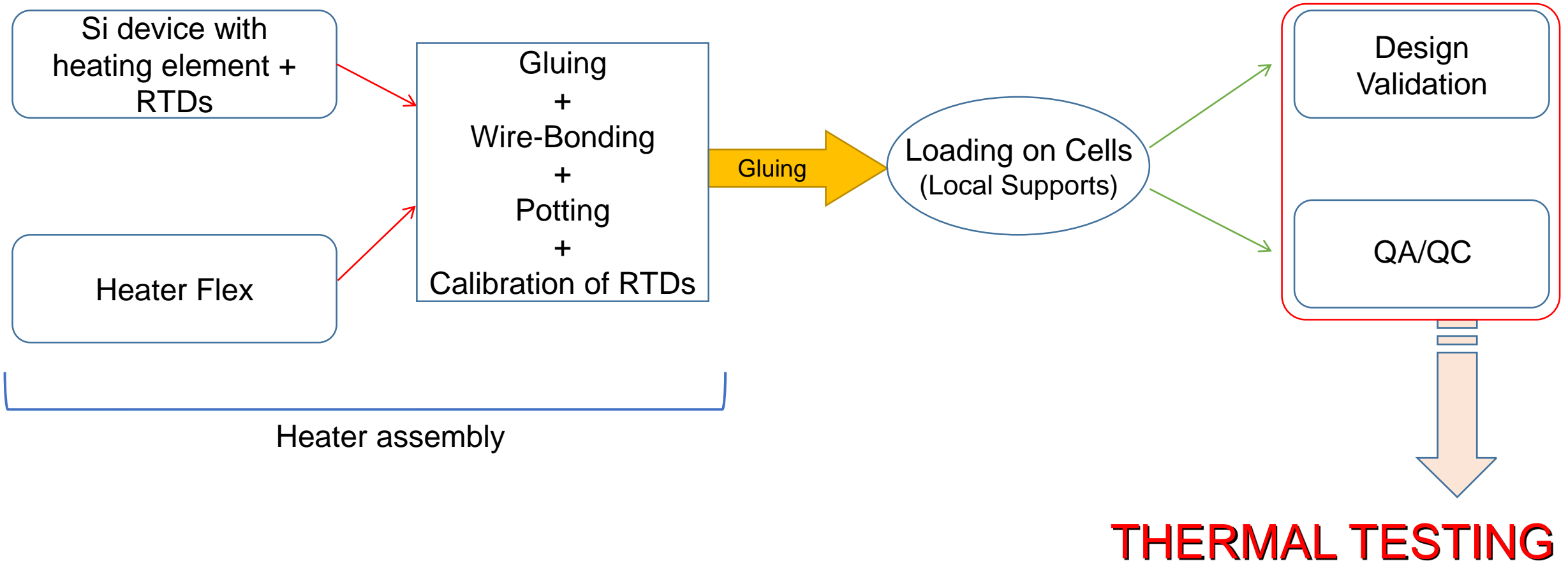# ATLAS ITk Pixel OB: thermo-mechanical mockups

RTDs

We need Thermo-mechanical mockups for the validation and qualification of the local supports:

- Validate local support design (i.e. Ensure it meets the specifications);
- Qualify the loading process and assess manufacturing variability across loading sites

For the Outer Barrel, at EP-DT we have developed new Si-heaters with embedded RTDs (Resistance Temperature Detector)

ATLAS ITk: Si-heater with embedded RTDs

Si device with heating element + RTDs

Heater Flex

Gluing + Wire-Bonding + Potting + Calibration of RTDs

Gluing

Loading on Cells (Local Supports)

Design Validation

QA/QC

Heater assembly

THERMAL TESTING

EP-DT
Detector Technologies

The measurements

MODULE TEMPERATURES OF INTEREST:

-20°C   0°C   5°C

POWER DENSITIES IN HEATERS OF INTEREST FOR EACH TEMPERATURE:

| 0 [W/cm²] | 0.1 [W/cm²] | 0.3 [W/cm²] | 0.7 [W/cm²] | 1 [W/cm²] |

LOADED CELLS FROM FOUR LOADING SITES:
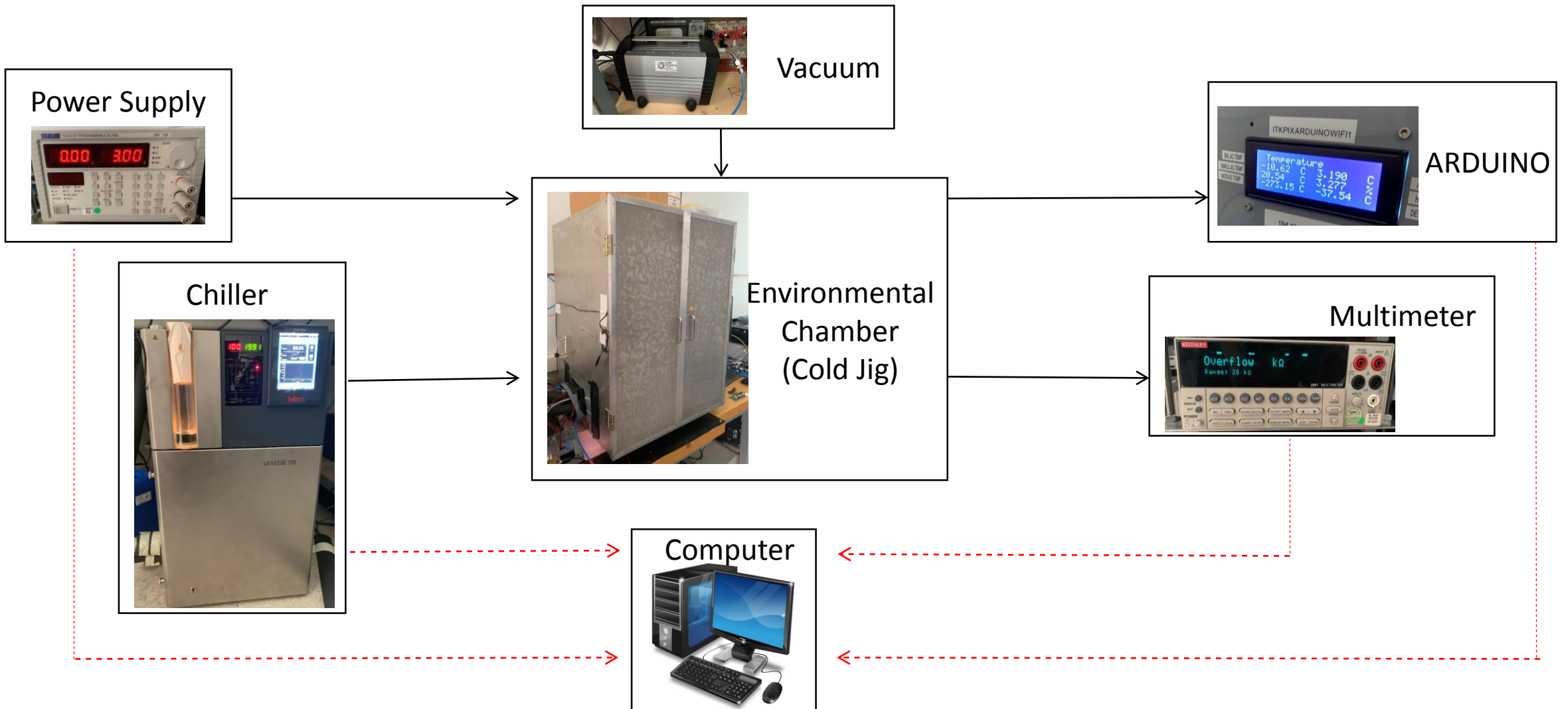
UniGE (Geneva)
CPPM (Marseille)
Japan
Wuppertal

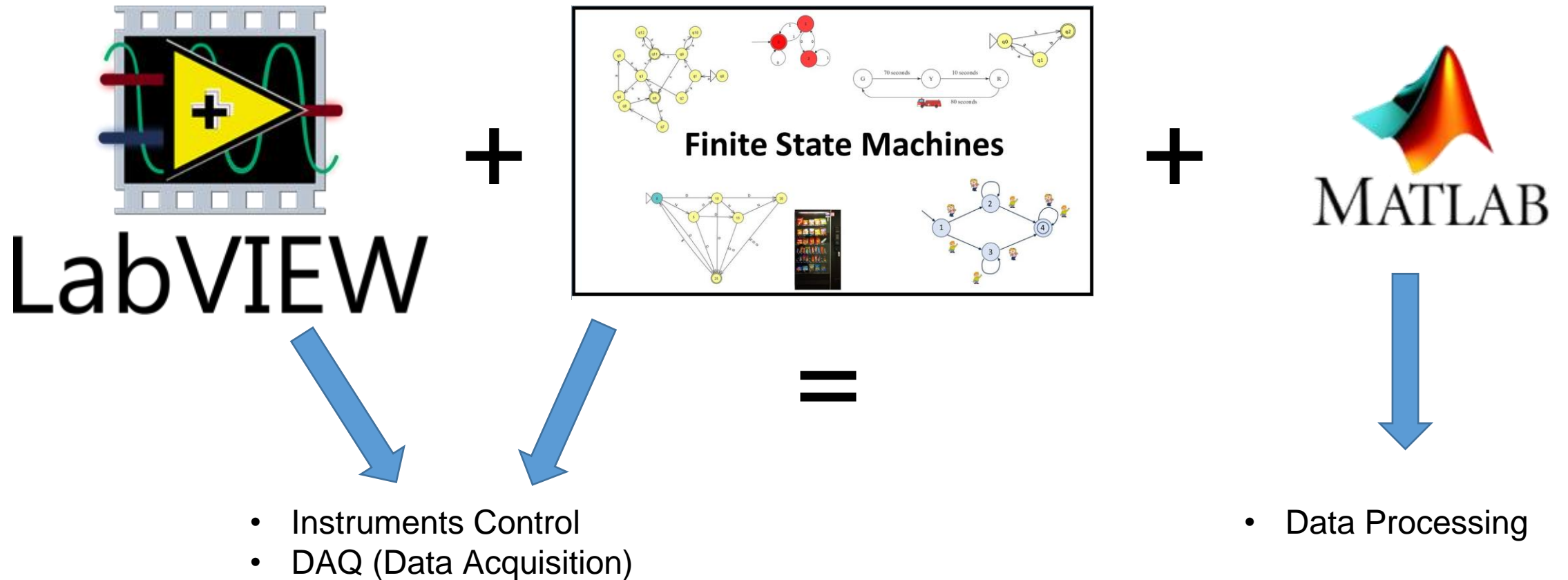In total ≈ 50 heaters

That means

$50 \cdot 5 \cdot 3 \cdot 5 \approx 3750 \; measurements$ **‼**

Heaters   Power densities   Temperatures   RTDs

Build Automated Setup for Thermal Testing of loaded cells

The Set-up

Power Supply

Vacuum

ARDUINO

Chiller

Environmental Chamber (Cold Jig)

Multimeter

Computer

Software

+

+

=

- Instruments Control
- DAQ (Data Acquisition)

- Data Processing

LabVIEW GUI

Results

Report example: these results correspond to the Japanese heater QU-H-01.

Conclusions

- For the new ATLAS ITk Pixel Outer Barrel we need thermo-mechanical mockups for the validation and qualification of the local supports.
    - At EP-DT we have developed new Si devices featuring a thin film heating element and embedded RTDs; Each Si-device is bonded to a heater flex, wire-bonded and then calibrated;
    - The assembled heaters are glued to the local supports to evalaute the thermal performance of the design and assess the variability between loading sites

- I have developed an automated system to carry out the thermal testing of the cells loaded with heaters; It relies on a LabVIEW script for the instruments control and the data acquisition; The test data is processed automatically with MATLAB;

- The setup is operational and the first results are satisfactory.

THANK YOU FOR YOUR

ATTENTION !