# Raspberry Pi for slow control at the beam telescopes..

## DESY Summer Project 2016.

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# Overview

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# Introduction

## Motivation

Some environment parameters as the temperature, humidity and pressure might be important at the moment of characterize new sensors in the test beam telescope. This could be accomplished through the use of the slow control devices.

*(ref. Lange, Torben's talk.)*

**How to add the measurement of humidity, temperature and pressure?**





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# Introduction

## Beam Telescope

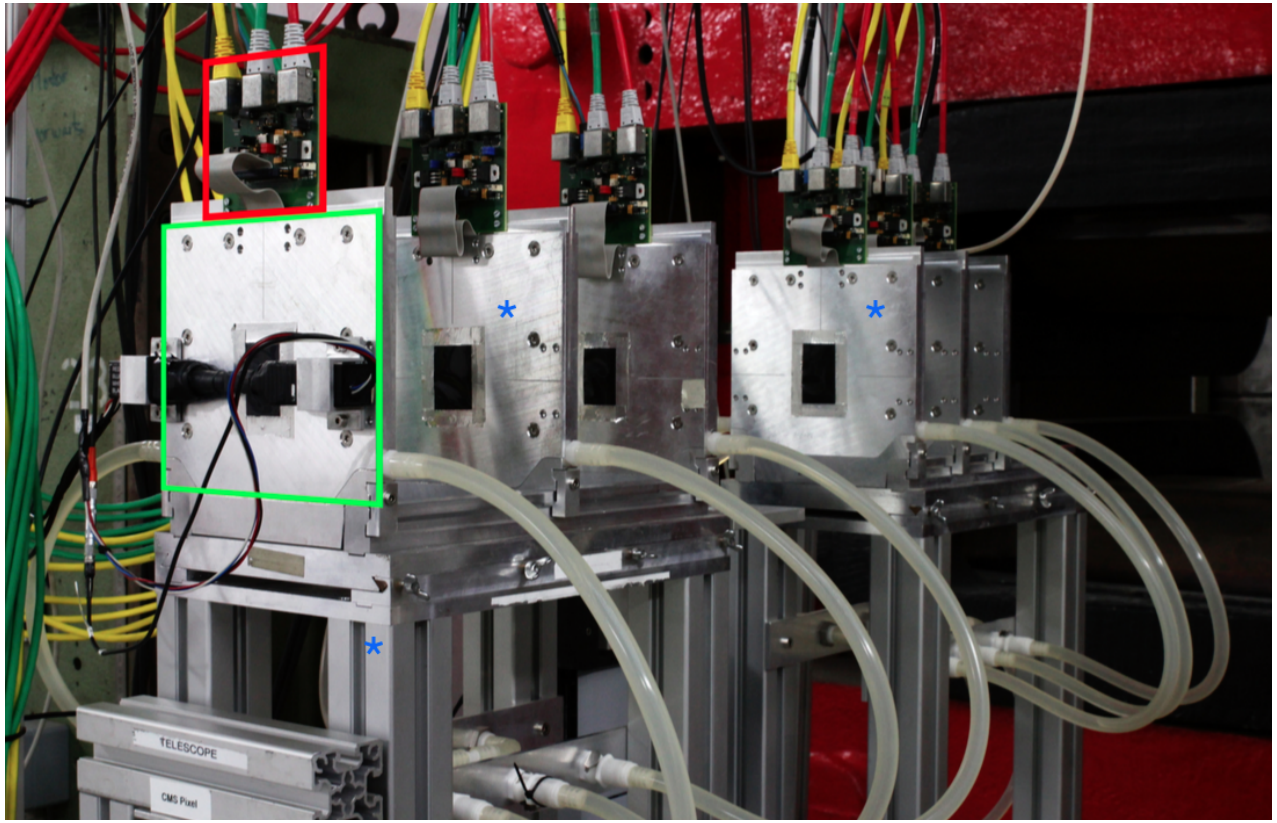


Figure: *DATURA beam telescope.Possible places to measure environment conditions (blue asterisks), aluminum frames (green) and auxilary boards (red).*

# Hardware

## General Overview

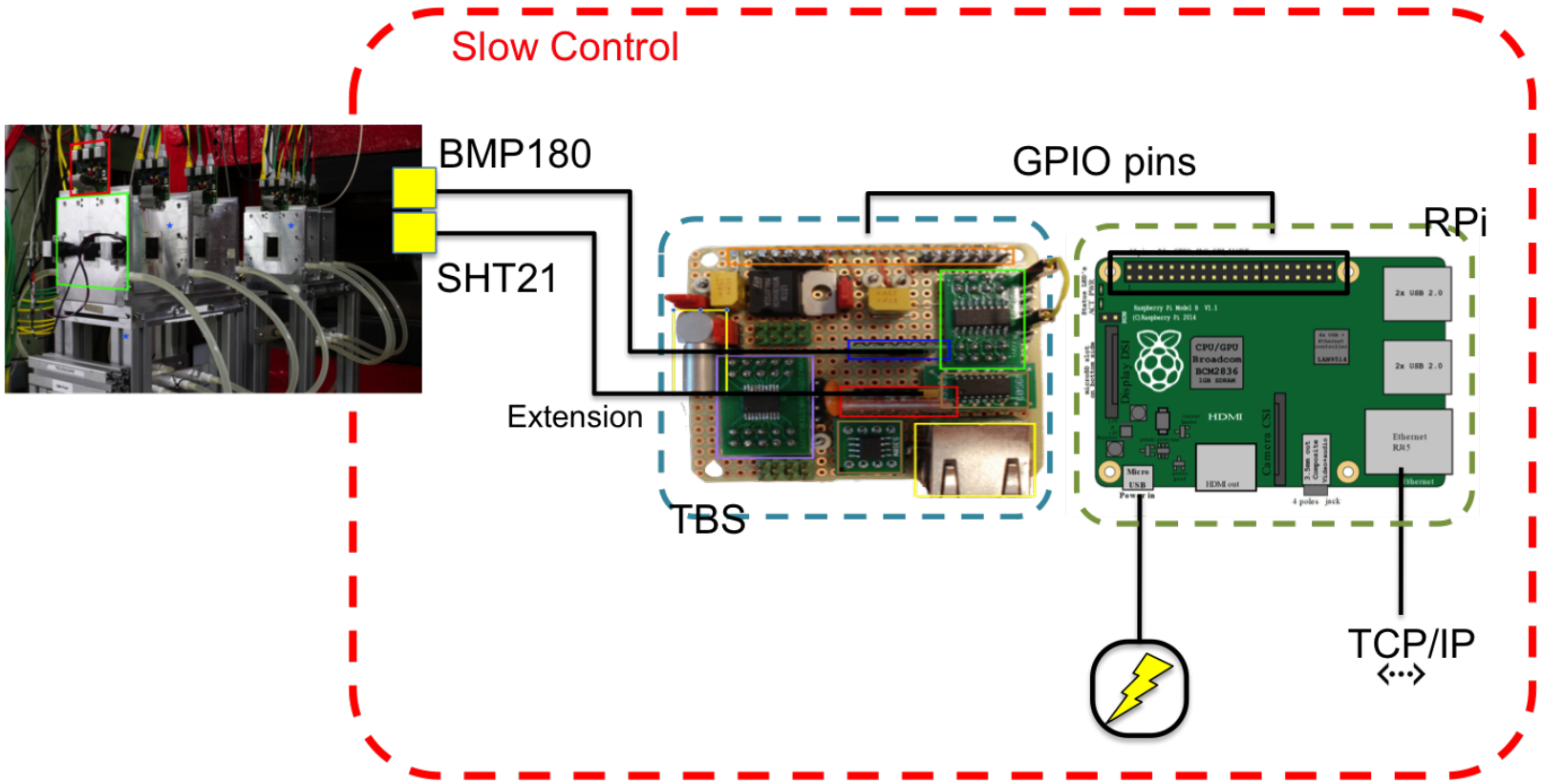


Figure: *General overview of the hardware in the testbeam.*

## Raspberry Pi

The Raspberry Pi (**RPi**) is a device which is capable to plug any kind of peripherals, in a few words is a tiny computer (credit card size). This RPi has:

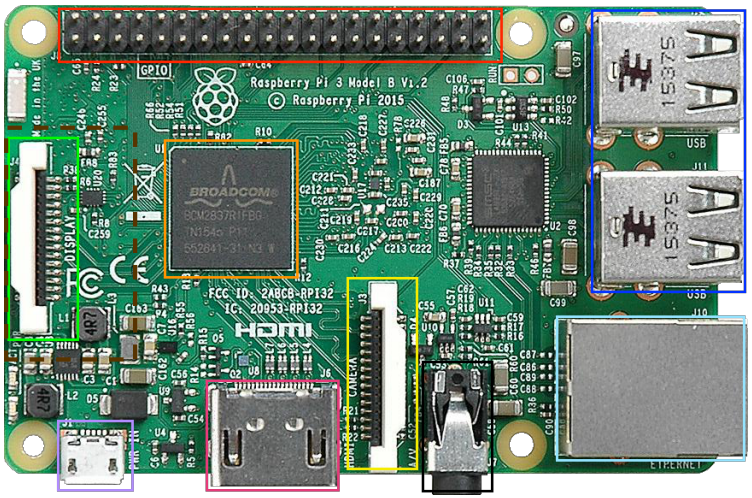


Figure: *Board Raspberry Pi 2 Model B.*

- 29 *General Purpose Input Output* (**GPIO**) pins.
- *Micro SD* card slot.
- *Camera interface* (**CSI**) and *Display interface* (**DSI**).
- 4 USB and 1 micro-usb, Ethernet, HDMI.
- 900MHz quad-core ARM Cortex-A7 (BCM 2836 32bit) with 1GB of RAM.





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## Test beam shield (TBS)

In order to integrated the slow control with the EUDAQ frameworks Torsten Külper (DESY) develop an external shield, necessary to get data from sensors considering the trigger signal from TLU.

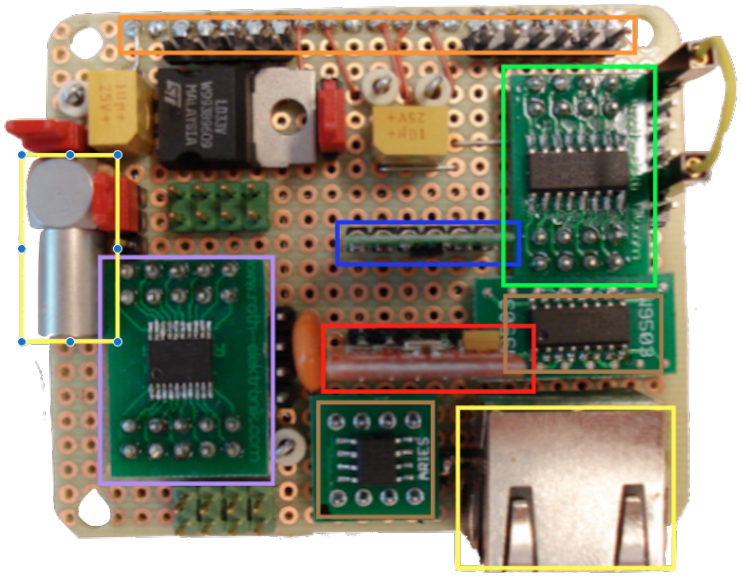

Figure: *Add-on board (top view). TBS is connected with RPI via GPIO port.*

- **GPIO** pins (Orange).
- Sensors: **SHT21**(Blue) & **BMP180**(Red).
- Analog trigger input and **TCP/IP** connection (Yellow).
- Counter (Green).
- Analog digital Converter **ADC** (Purple) and others.

# Hardware

## Sensors


Figure: *Sensor SHT21* (Humidity & Temperature). 6 GPIO pins connections.

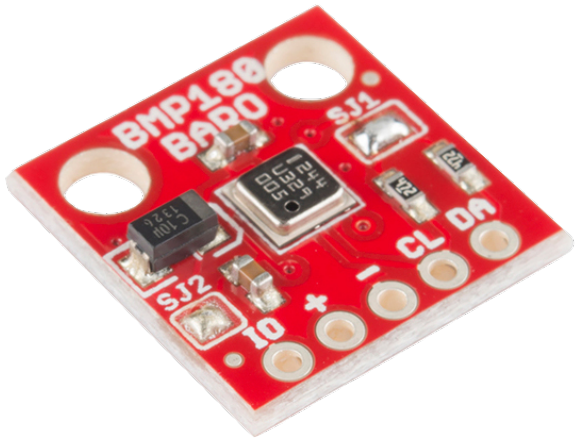


Figure: *Sensor BMP180* (Pressure & Temperature). 5 GPIO pins connections.

# Software

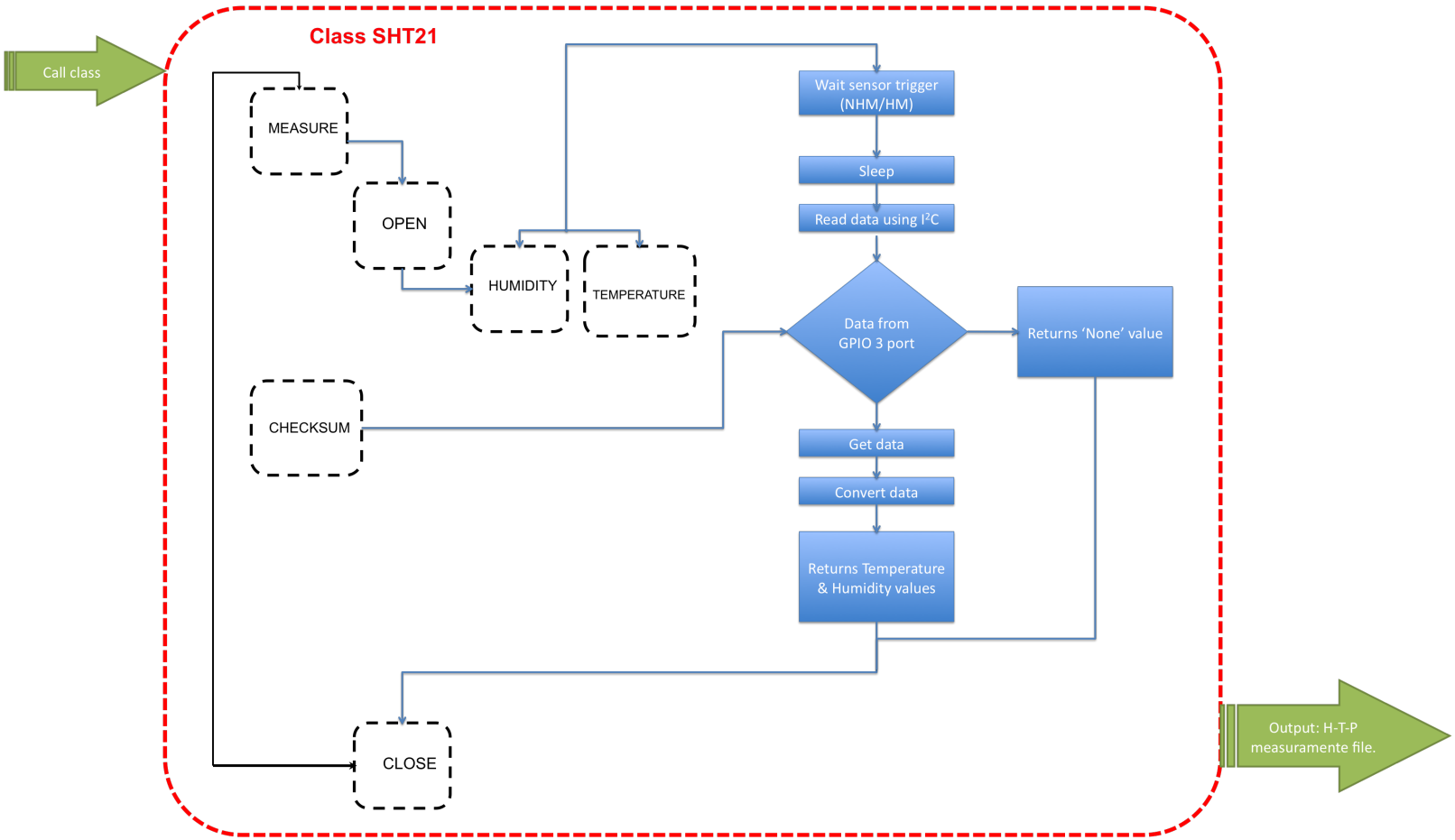


Figure: *Pseudocode* for sensor SHT21.

## Sensors-TBS connection

Figure: *Extension connections for the Test beam shield.* 6 and 5 pins.

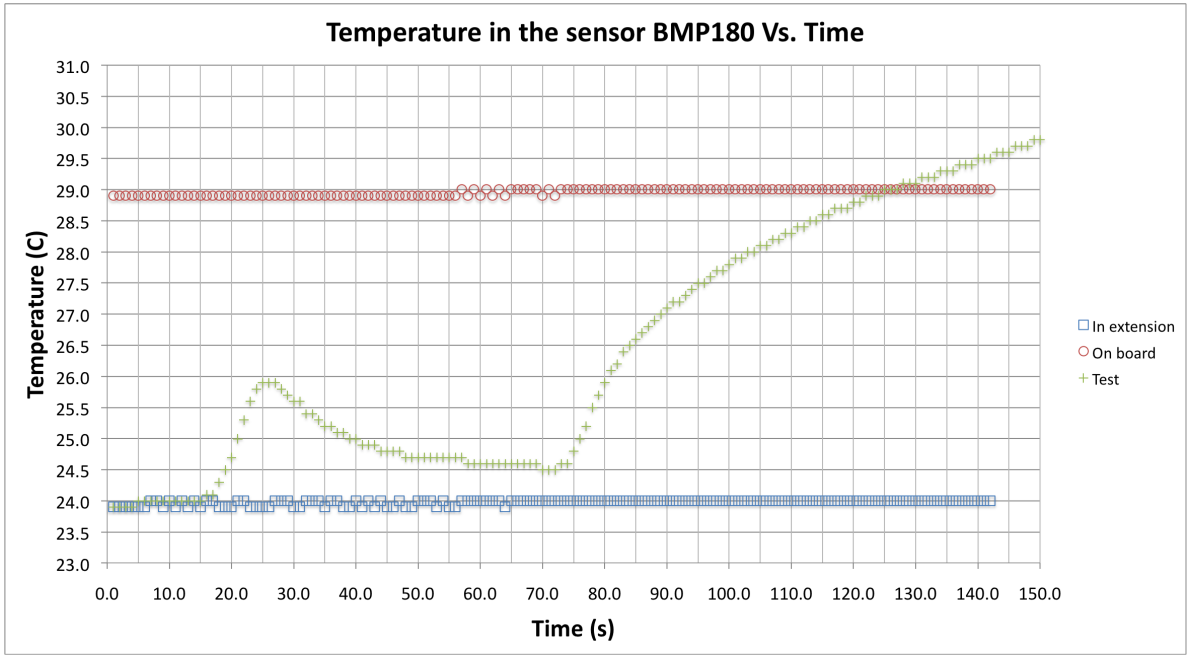


Figure: *Plot of the temperature with and without extension.*

# Software

## EUDAQ framework

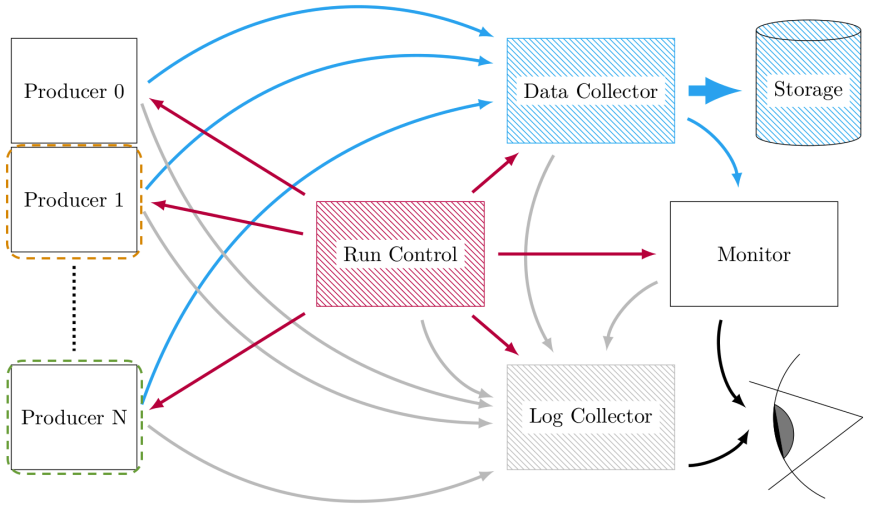


Figure: *EUDAQ architechture.*

1. *Run Control*(RC) ask the adrresses to *Data Collector*(DC) and *Log Collector*(LC).
2. Report it to the producers and the monitor.
3. Producers send its data and log data to DC and LC.
4. DC handles and merges the data.
5. DC save it in a file and also shown on the Monitor.

# Software

## Integration with EUDAQ

There is two possibilities to integrate the peripherials to EUDAQ:

1. *Slow Control as normal producer* (Triggered device).
   - Daemon and shared memory features need it in order to send data for every trigger.
   - Data duplication (**i.e** Trigger rate is ∼KHz and read-out time of RPi is ∼1s)

2. *Slow Producer as new kind of producer* (Not triggered).
   - Could be identified by the DC in order to get data or not data.
   - DC can receive data and continue in otherwise DC can keep going.

*(ref. Shirakova, Darya's talk.)*





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# Conclusion and Future Work

- For future works it is suggested to develop the same task using the sensor **Bosch BME280**, which can measure the temperature, humidity and pressure at the same time, in order to avoid the need of use a class or maybe 2 different codes. Here the datasheet of this sensor.
- Add an monitoring system (**e.g** IR heat camera) of the complete bench of the test beam in order to have a other reference of this parameters.
- Made a benchmark between the new idea of *Slow Producer* and the Classical idea of the *Slow Control System*.





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# Reference


- WiringPi
- Raspberry Pi Documentation
- Torsten's Documentation
- E. Corrin. "EUDAQ Software Manual". Edition (2010).
- H. Jansen, S. Spannagel, J. Behr, A. Bulgheroni, G. Claus, E. Corrin, D. G. Cussans, J. Dreyling-Eschweiler, D. Eckstein, T. Eichhorn, M. Goffe, I. M. Gregor, D. Haas, C. Muhl, H. Perrey, R. Peschke, P. Roloff, I. Rubinskiy, M. Winter. "Performance of the EUDET-type beam telescopes. ". arXiv:1603.09669v2.(2016).






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# Thank you!

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Please ask! :)