Automatization of the measurement of temperature dependent gain and noise in ATLAS SCT modules.

DESY Summer Student Programme, 2012

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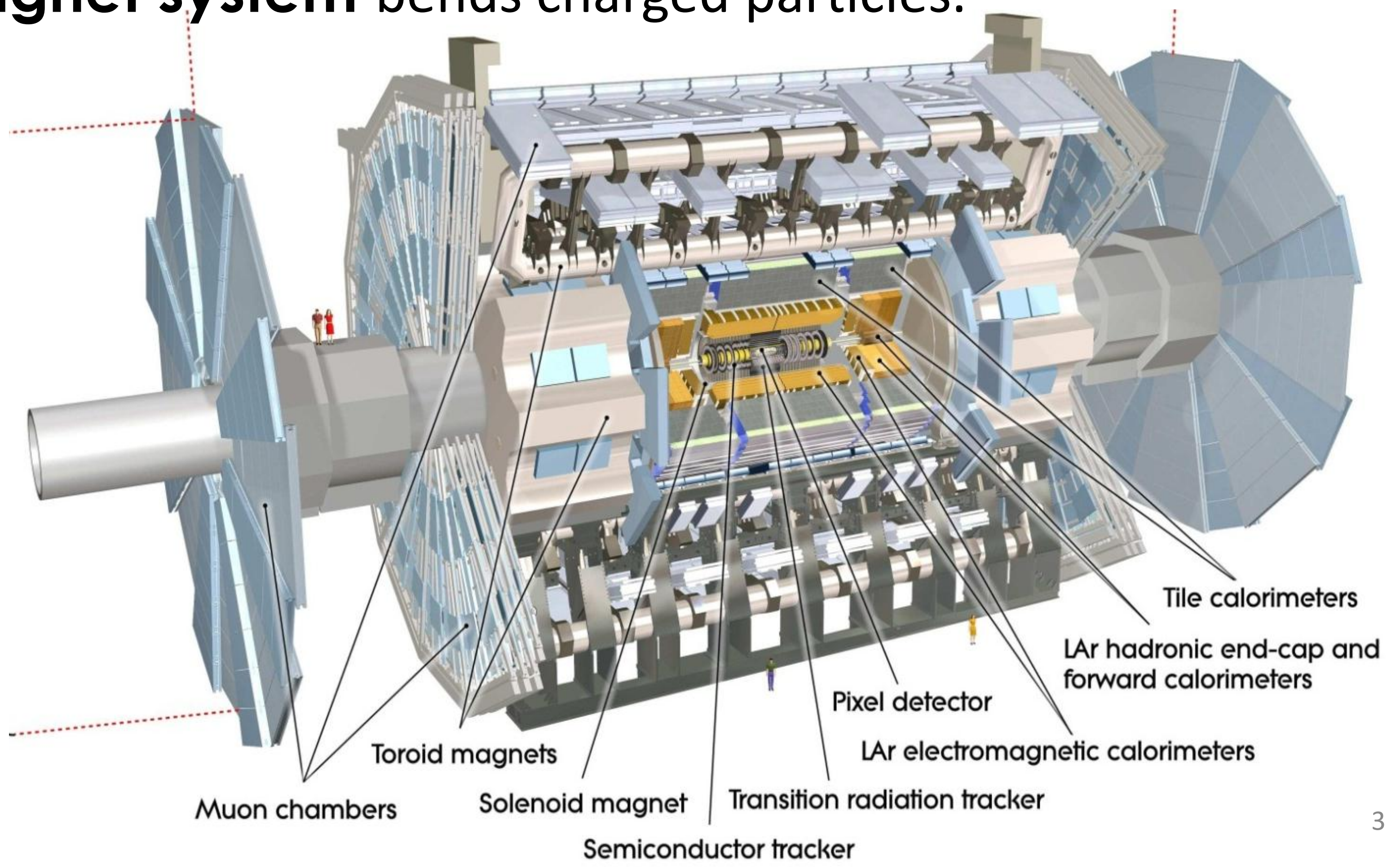
The ATLAS detector consists of four major components:

The **inner detector** measures the momentum of charged particle.

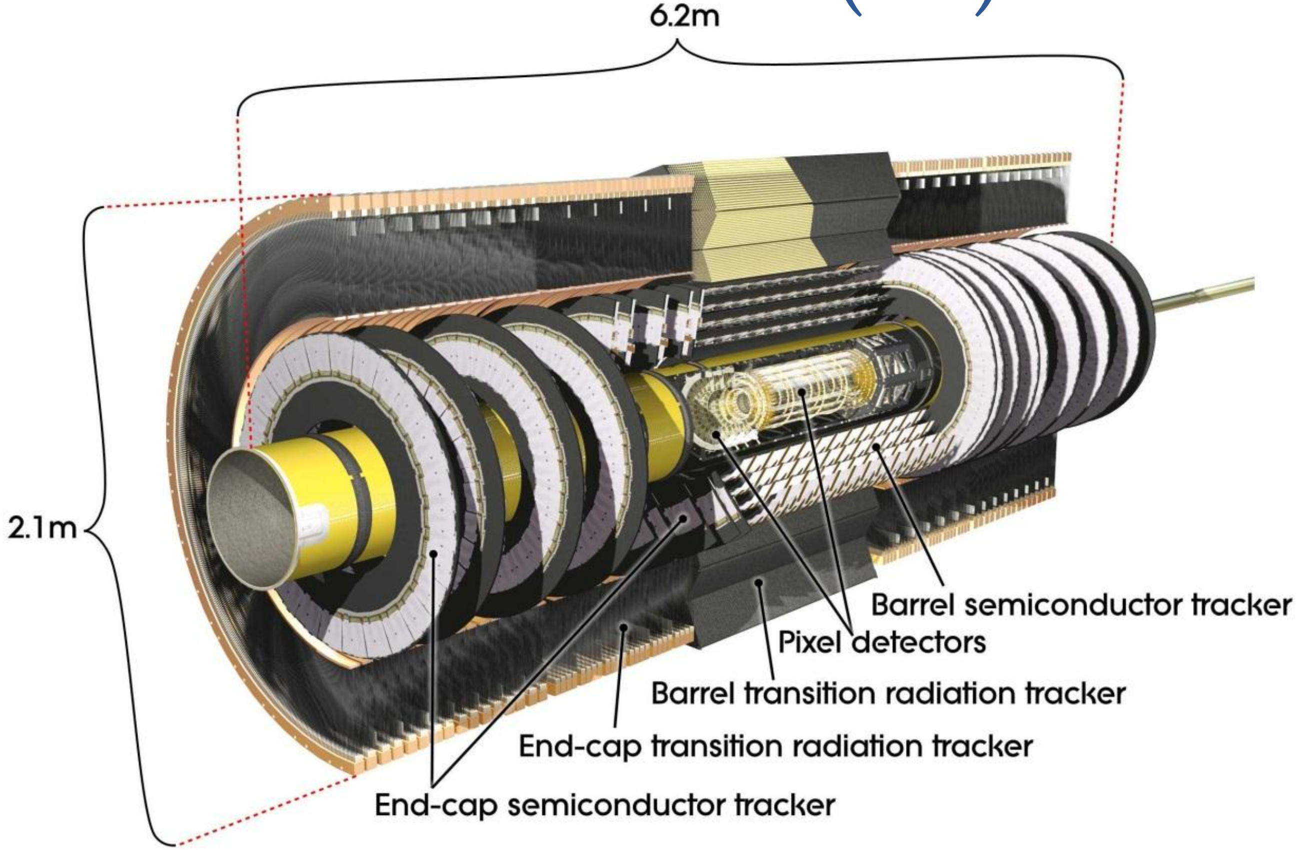
The **calorimeters** measure the energies carried by the particles,

The **muon spectrometer** identifies and measures the momenta of muons.

The **magnet system** bends charged particles.



Inner Detector (ID)



The inner detector (ID) consists of three independent but complementary sub-detectors.

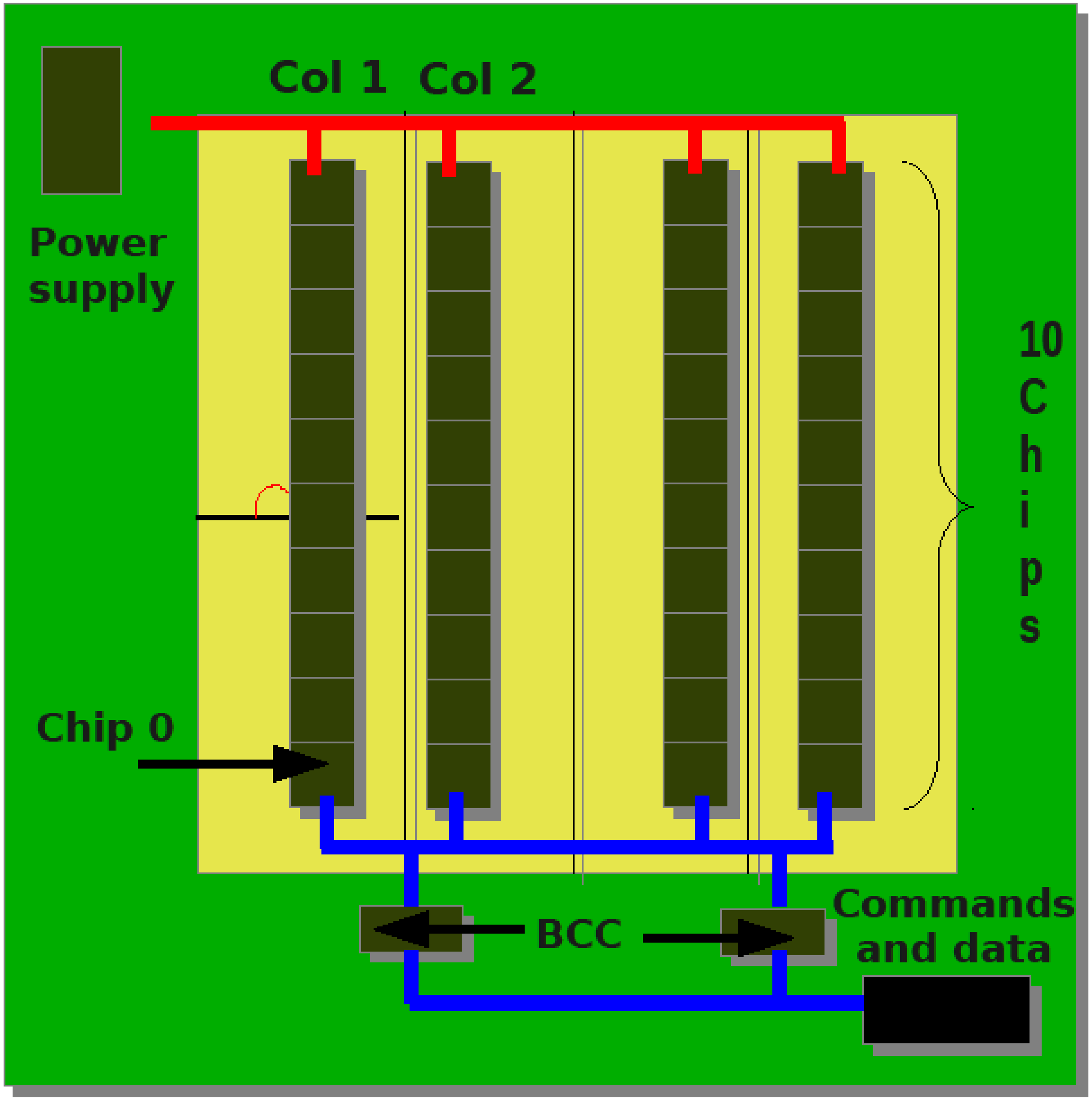
- **Silicon Pixel** detects short lived particles.
- **Semiconductor Tracker (SCT)** momentum, impact parameter and vertex position.
- **The transition radiation tracker (TRT).**

Atlas upgrade.

- **In 2022 a radical upgrade** for the ID is planned. In particular the **SCT will be replaced** by and improved detector.

- This change is primarily due to the **the limited life-time of the detectors** and the need for **higher granularity** for the HL-LHC phase.

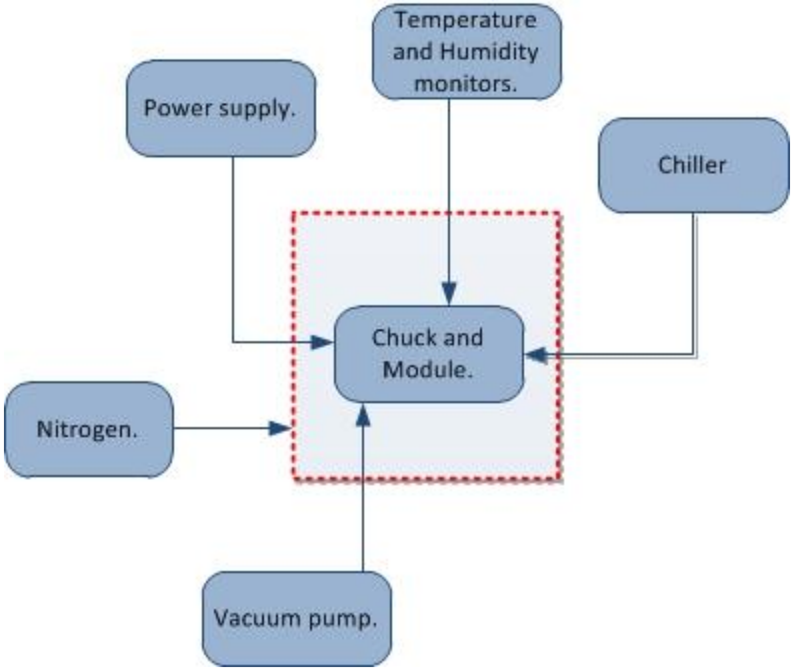
Experimental Setup: Hardware I

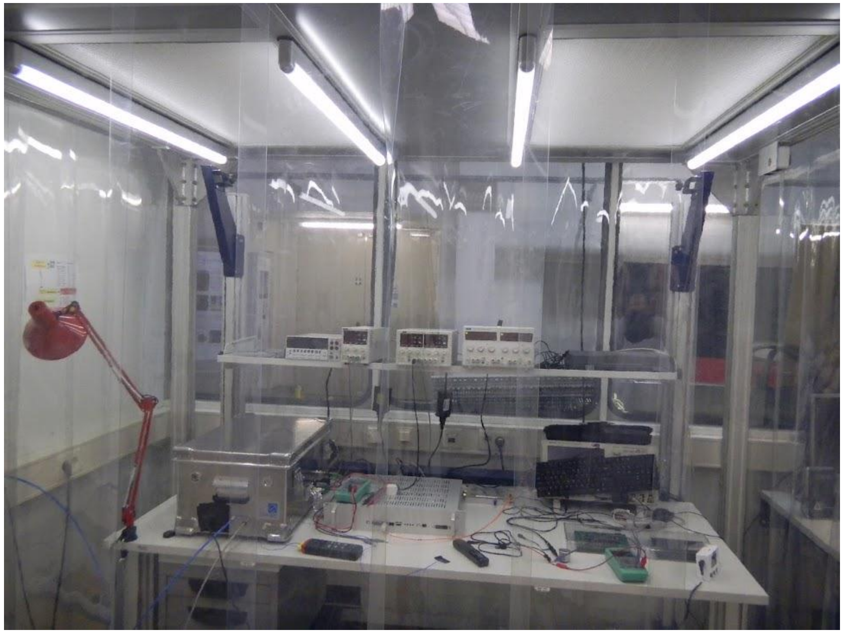



TC 250

Experimental Setup: Hardware I

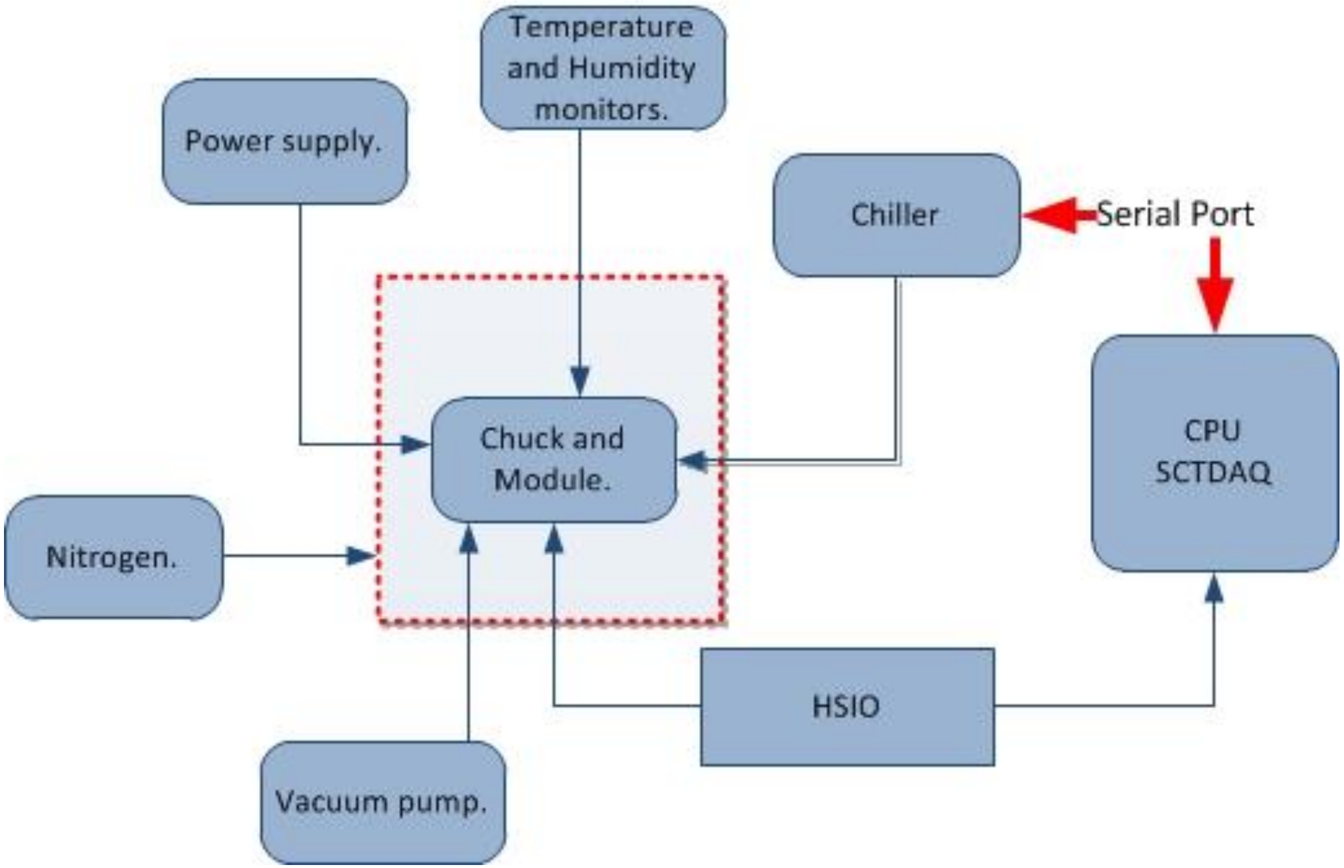
- The **module is fixed** to a chuck inside a metallic box
- A pipe is coming from the **chiller** in order to **control the chuck temperature**.
- We monitor the **air temperature and the humidity.**
- The voltage and current are supplied by two independent **power supplies** (TTI).





Experimental Setup: Hardware II

- The module under test is read out with the help of the high speed I/O interface board (HSIO) which is controlled with a computer software, called SCTDAQ.

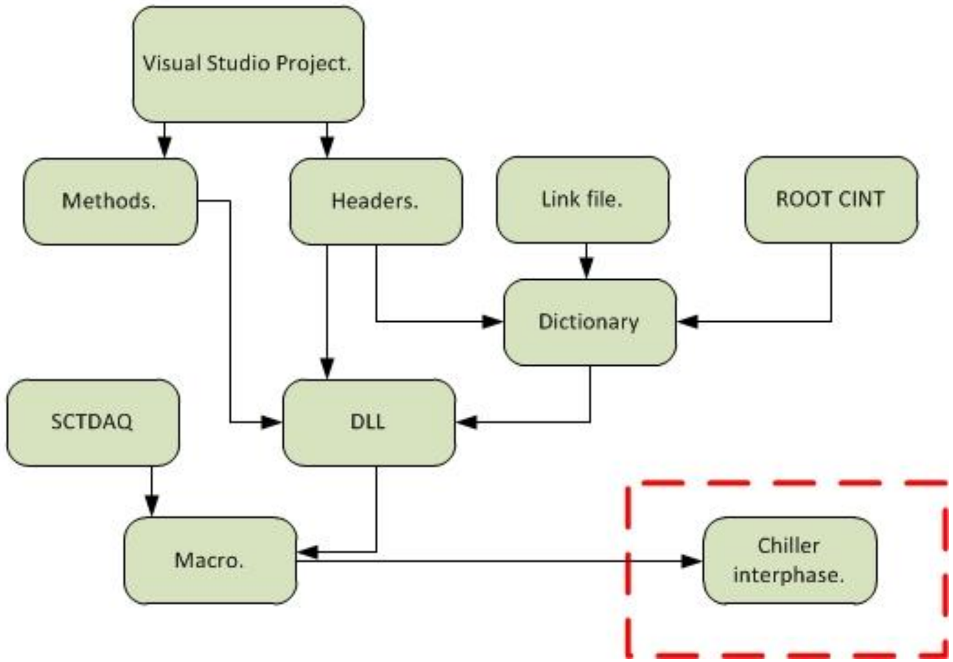


Experimental Setup: Software

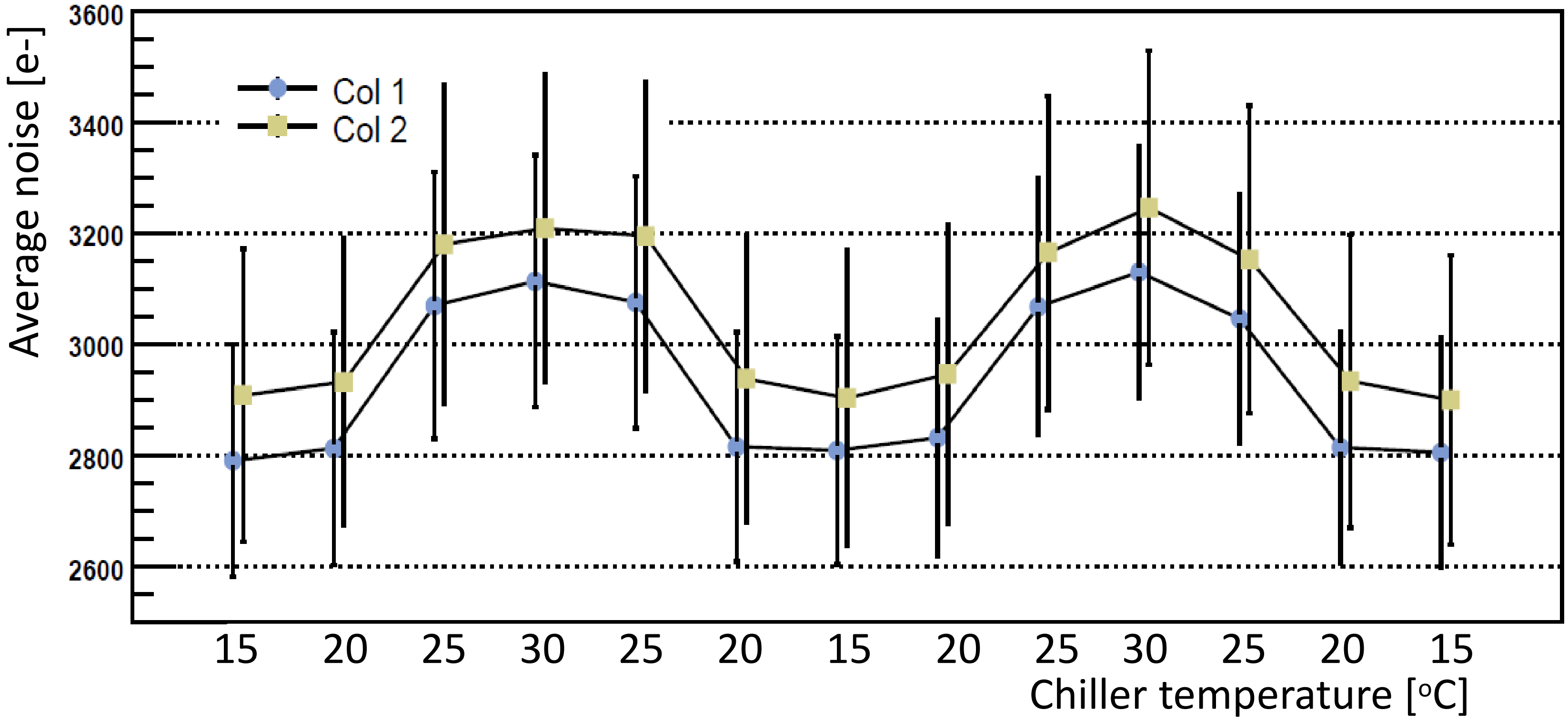
1.- We wrote a class in C++ languages to establish communication with the chiller interface.

2.- Using the class and the ROOT interpreter (CINT), we created a dictionary to enable ROOT access to methods in the class.

3.- We use the class in c++ and dictionary to create the dynamic library (dll) compatible with the SCTDAQ software.



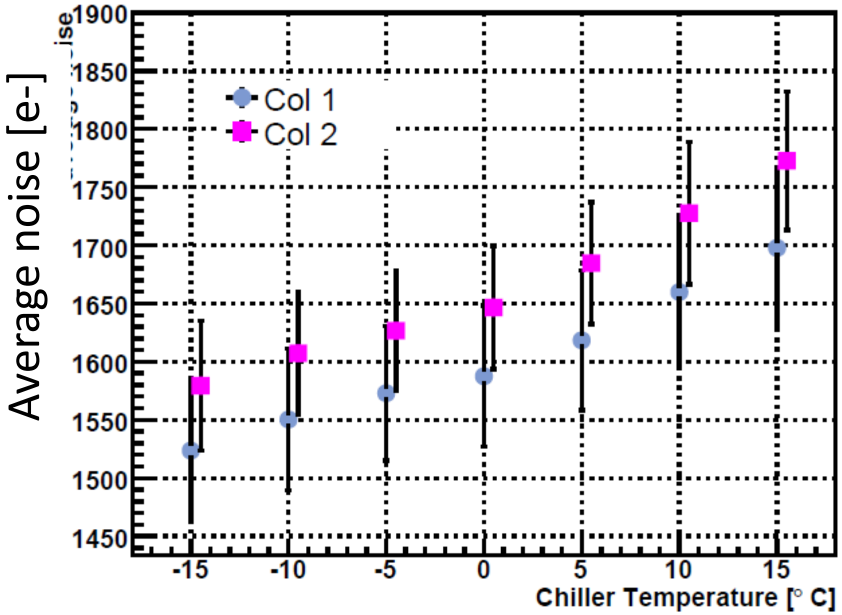
Results

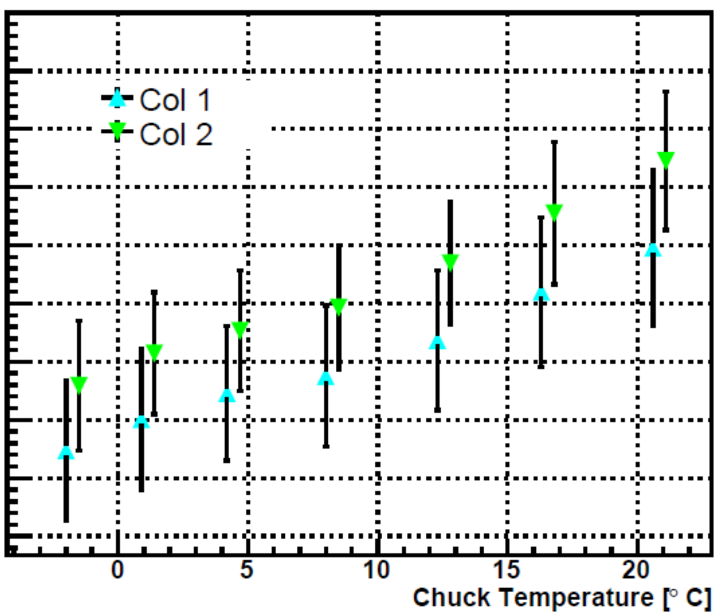


Previous measurements performed in Freiburg showed a trend of increasing noise over time, this was not seen here.

Results

We can observe a linear dependence of the noise on the temperature.





The observed noise difference between the columns is not caused by temperature, since Column 1 is at a higher temperature that Column 2, but the first one shows lower noise than the latter.

Conclusions

The main goal to establish **communication between the chiller interface and the SCTDAQ** was successfully done.

In the way of testing this communication we figured out some interesting properties of the modules and the components of the experimental setup:

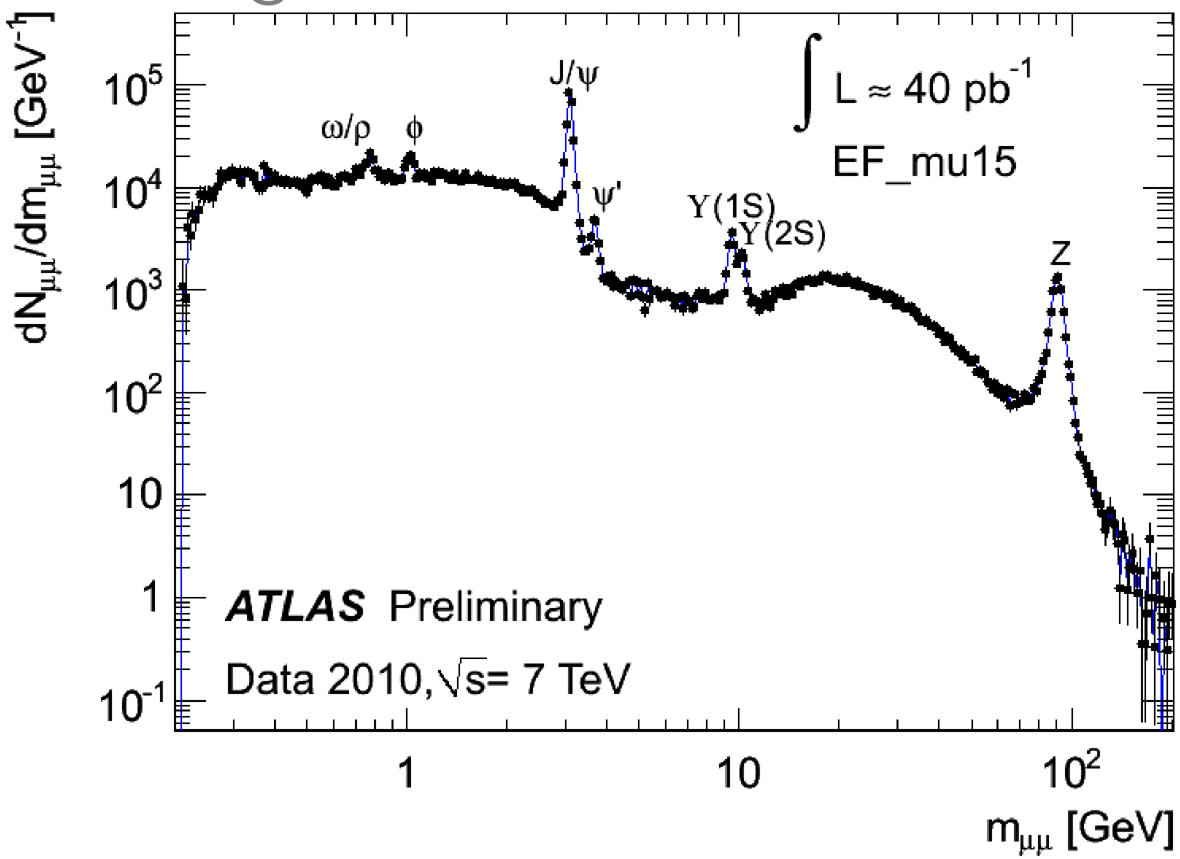
- **Linear dependence of the noise** measurements over temperature.
- The **noise difference between two columns** in the module shows behaviour opposite to that we expected: the warmest column is less noisy than the coolest one.

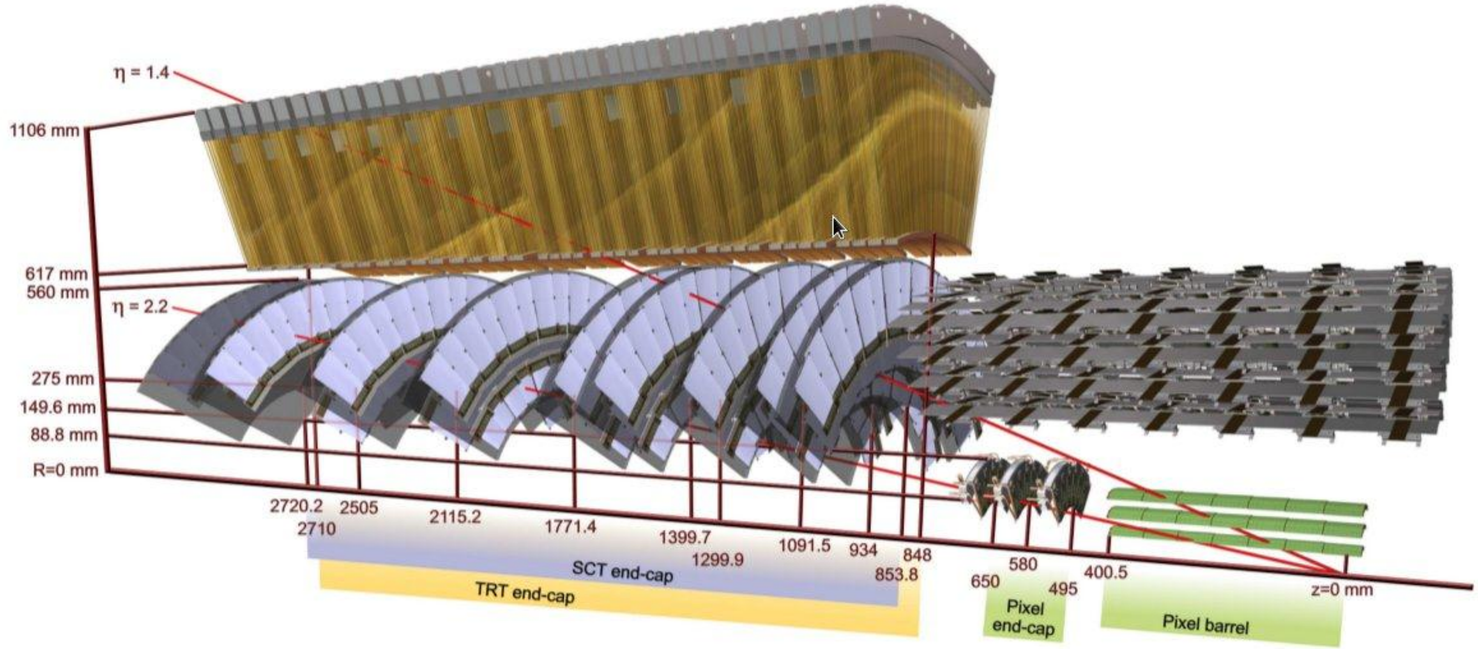
The end ☺

BACKUP SLIDES

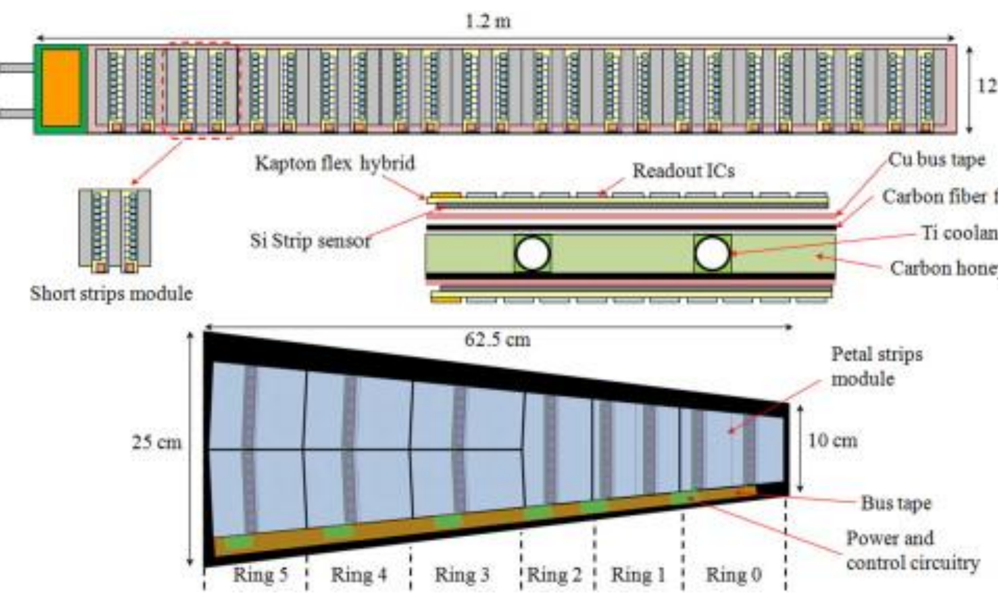
Atlas upgrade.

At high invariant dimuon masses the spectrum currently available runs out of statistics. An increase of the dataset will allow to explore the high-mass range further.

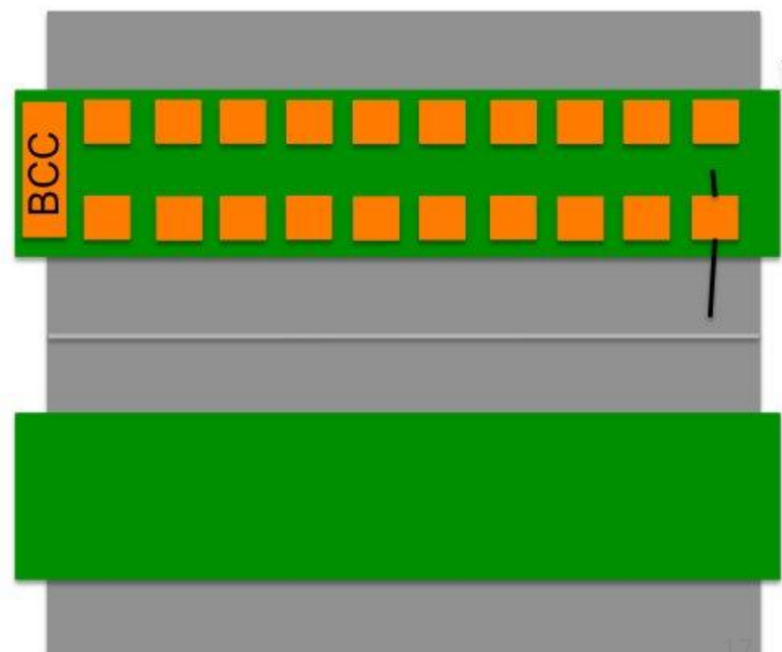




η = 1.4
1106 mm
617 mm
560 mm
η = 2.2
275 mm
149.6 mm
88.8 mm
R=0 mm
2720.2
2710
2505
2115.2
1771.4
1399.7
1299.9
1091.5
934
848
853.8
650
580
495
400.5
z=0 mm
SCT end-cap
TRT end-cap
Pixel
end-cap
Pixel barrel



1.2 m
12
Kapton flex hybrid
Readout ICs
Cu bus tape
Carbon fiber f
Si Strip sensor
Ti coolan
Carbon hone
Short strips module
62.5 cm
Petal strips
module
25 cm
10 cm
Bus tape
Power and
control circuitry
Ring 5
Ring 4
Ring 3
Ring 2
Ring 1
Ring 0



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