HELSINKI INSTITUTE OF PHYSICS

Testing of Czochralski silicon detector modules

P. Luukka [1)], E. Anttila [(1], H. Katajisto [(1], E. Haeggström [(1], J. Härkönen [(1], T. Mäenpää [(1], A. Onnela [(2] and E. Tuovinen [(1]

1) Helsinki Institute of Physics
2) CERN

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Motivation

We want to prove that Czochralski silicon is good material for detectors.

How to prove this?

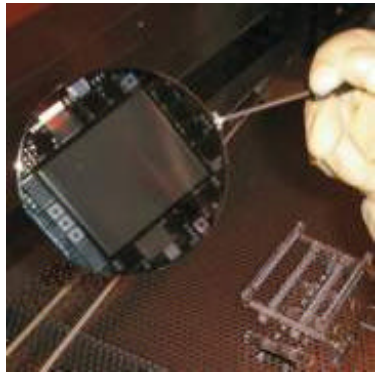
We need to show that the detectors made of CZ material actually see particles with reasonable efficiency!

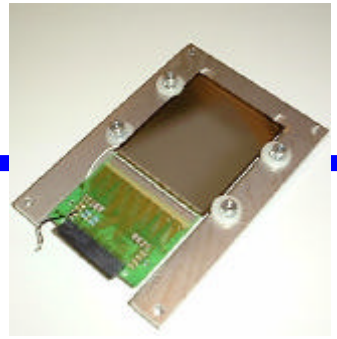
How we are trying to achive this?

Best way is to make beam tests but we have a problem:

we won't have test beams at CERN for next two years..

So we need to find other ways of testing our detectors.



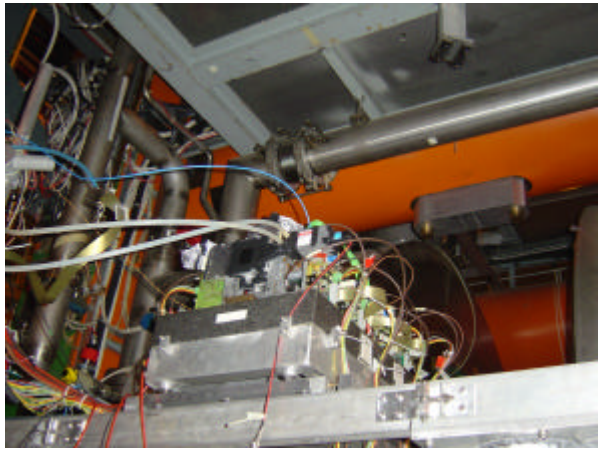


Beam tests this summer

We made a beam test in CERN H2 area this year with an old Czochralski module that has 1024 channels and VA1 chip hybrid

- **module had annealed 1 year in room temperature**
- **during test the detector was cooled to -17°C**

Our telescope has 8 detectors with 1024 strips (4 horizontal and 4 vertical) and CZ was replacing one of the vertical ones.



Offline analysis is still going on, so we don't have yet results about efficiency, resolution etc.

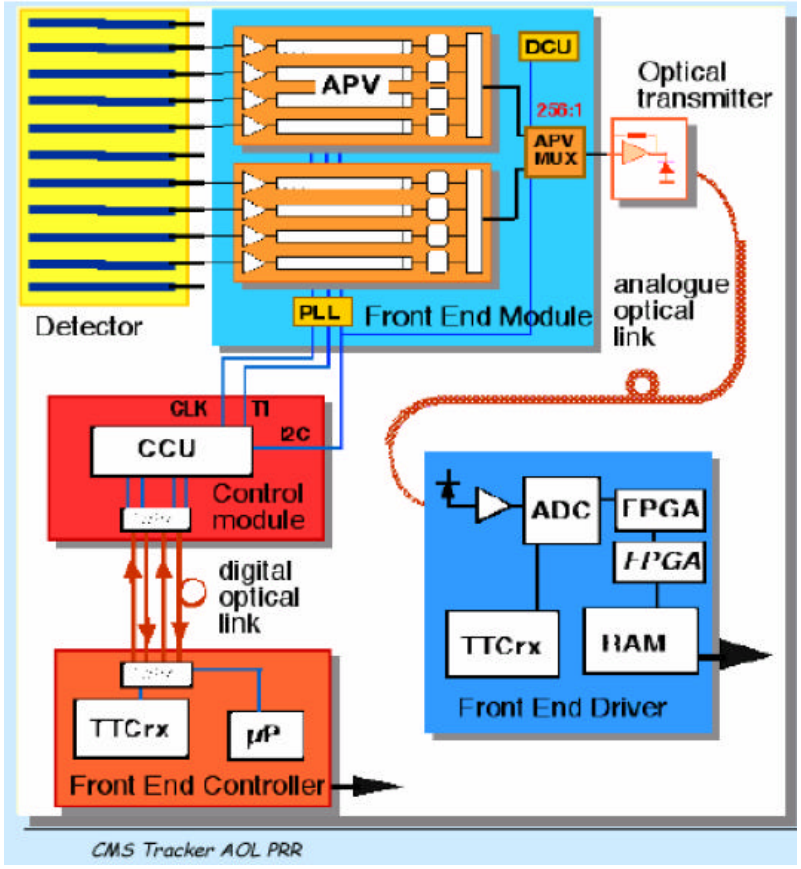
- **Offline analysis software doesn't seem to work properly with new ORCA, so we need to see if the old code is usable at all.**
- **Are we making certain corrections twice: first in DAQ SW and second time in the Offline analysis SW (cross bonded strips vs. straight bonded strips)?**

Before the beam test, the CZ module was tested with a LED pulser. Large percentage of the strips were dead and one probable reason can be scratches and dirt on the surface (old detector without passivation)

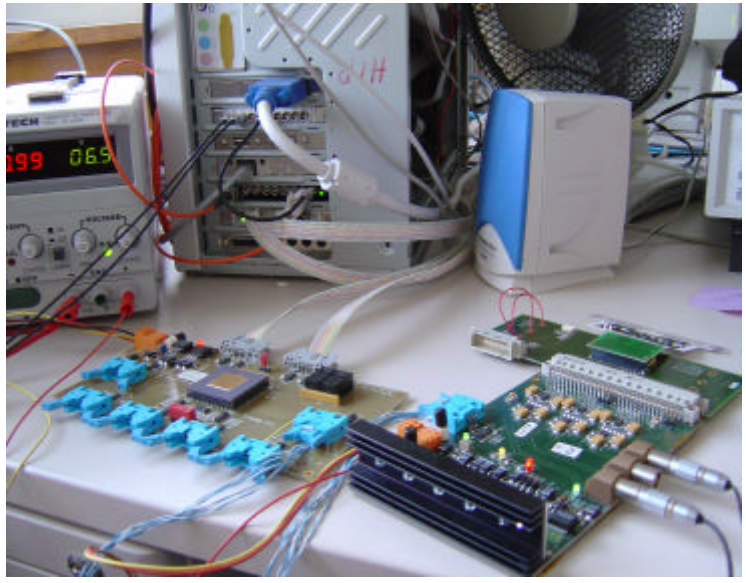
We tried to test the same detector also previous year (=why we had 1 year of annealing and surface damage..) and now found out few possible reasons why the test didn't succeed last year.

- **Trigger was unreliable**
- **We were reading the tail of the signal, because our timing was 700 ns late**

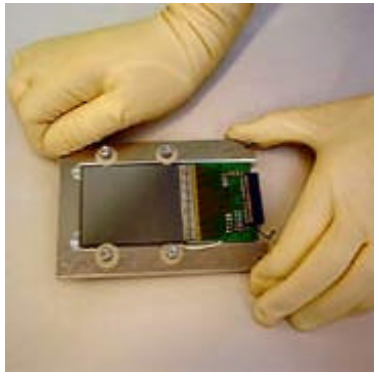
Our module testing setup



Data acquisition electronics of our module testing setup are similar to the electronis that will be used in the CMS experiment.

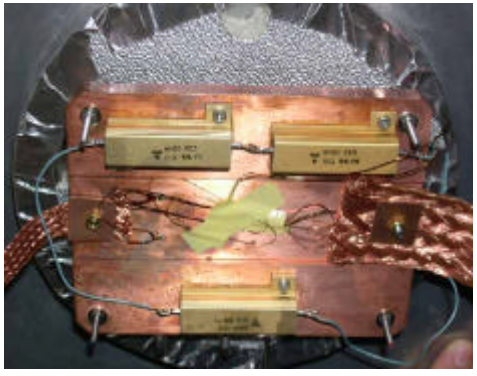


Our testing system is built for 1 silicon strip module, but it can easily be extended to house up to 4 modules. With small modifications even more, if needed.



In addition to the module testing the setup can be used to test CMS front-end hybrids.

- **For example for the RD39 collaboration we have tested some APV hybris in cold temperature.**



CZ detector modules

We have constructed our first CZ detector module with a standard CMS hybrid this summer.

More modules will be constructed in the close future when we have a new batch of CZ detectors.

- We have already two hybrids reserved for this purpose.

Learned from the first module that we have to design a better pitch adapter

- the old ones don't fit the hybrids we have

Need to do modifications to the support plate so that we can easily measure CV and IV also after module construction.

Have to figure out which way we should provide the HV to the module to guarantee good filtering etc.

Test Plan

First we want to check all the same parameters that are measured from the CMS Tracker modules

- signal to noise ratio
- pedestals
- noise
- common mode noise etc.

Then compare the results from our modules to the CMS Tracker module test results.

After this we want to irradiate our modules and check the same parameters again.

Plans to improve the testing setup

There will be no particle beams at CERN during next two years, so we need to have something that replaces our beam telescope as a characterization tool.

Easiest solution is to use a LED pulser for simple tests, but we also need to have something which is more similar to a beam, like a beta or gamma source system with scintillators to provide the trigger.

We have a possibility to use the gamma sources of CMS HCAL group in the future.

- **For this we have to develop our testing setup further: compact setup that is easy to move and install in short time.**

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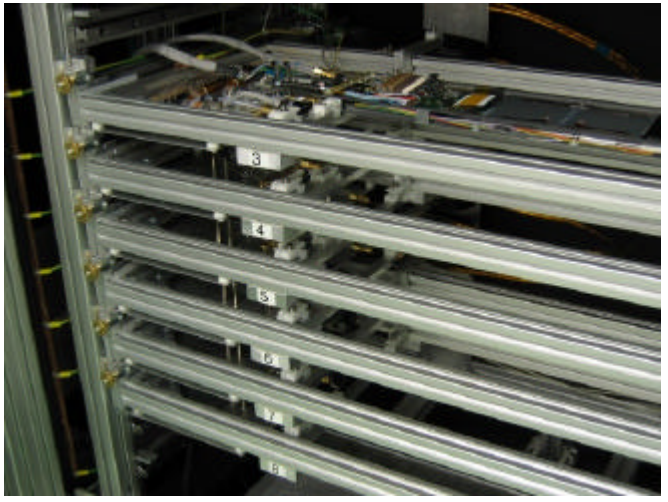
FinCrack

Cosmic ray telescope that will be set-up in Helsinki during next winter.

It is a ”little brother” of the CMS Tracker Outer Barrel Cosmic Rack that consists of 20 rods with two scintillators and is an intermediate step between a single rod and the full TOB Tracker.

Like its big brother, it will be used for system and integration tests, but in addition it can be used as a reference telescope for our CZ module tests.



Conclusions

We tested an old CZ module in a test beam this summer
- we are analysing the results right now
- even if we wouldn't get results, the experiment was very fruitful excerice for building a detector testing setup.

We have constructed the first CZ detector module with CMS front-end electronics.

We are soon able to test it with our own module testing setup with a source.

We are going to build more CZ modules after we have solved some designing questions.

There is possibility to check the most important detector parameters with a setup similar to a beam telescope = FinCrack.