

Silicon Beam Telescope (SiBT) for Super-LHC detector studies

*Panja Luukka, Sandor Czellar, Jaakko Härkönen, Eija Tuominen,
Jorma Tuominiemi, Esa Tuovinen (Helsinki Institute of Physics)*

Lenny Spiegel (Fermilab)

*Tobias Barvich, Martin Frey, Alexander Furgeri, Frank Hartmann,
Bernhard Ledermann, Hans Jürgen Simonis, Pia Steck (Universität Karlsruhe)*

*Bernard De Callatay, Thomas Keutgen, Vincent Lemaitre, Otilia Militaru,
Pierre Rodeghiero (Université Catholique de Louvain)*

Alexander Kaminskiy, Dario Bisello (Università di Padova)

Regina Demina, Yuri Gotra, Sergey Korjenevski (University of Rochester)



Outline

Motivation

Work Plan

MCz-Si Detectors

Reference Detectors

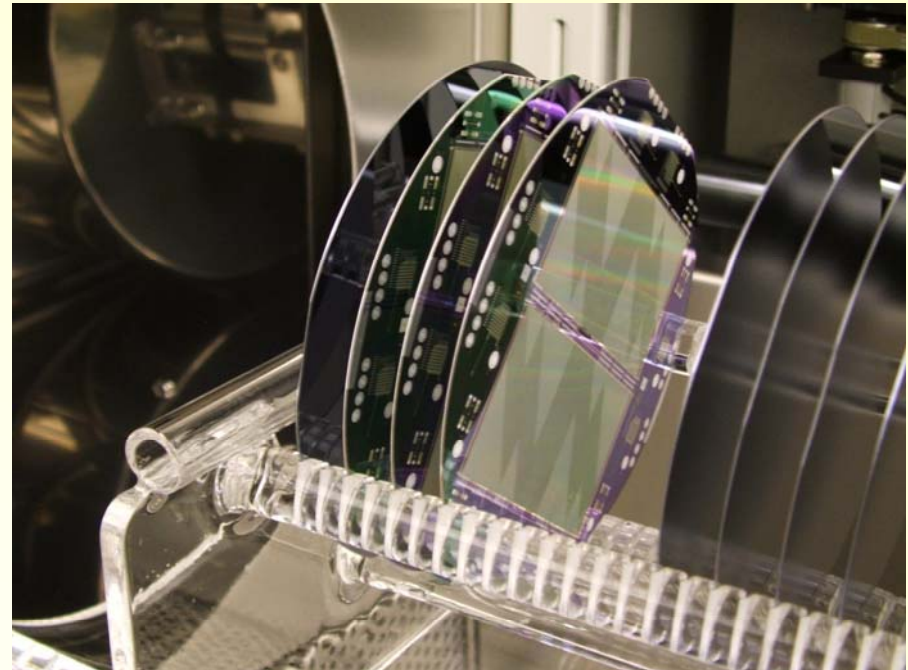
Module Production & Irradiations

Front-End Electronics

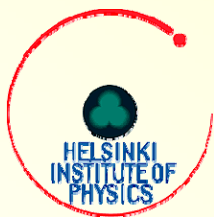
Cooling

Trigger System & Voltage Sources

Data Acquisition

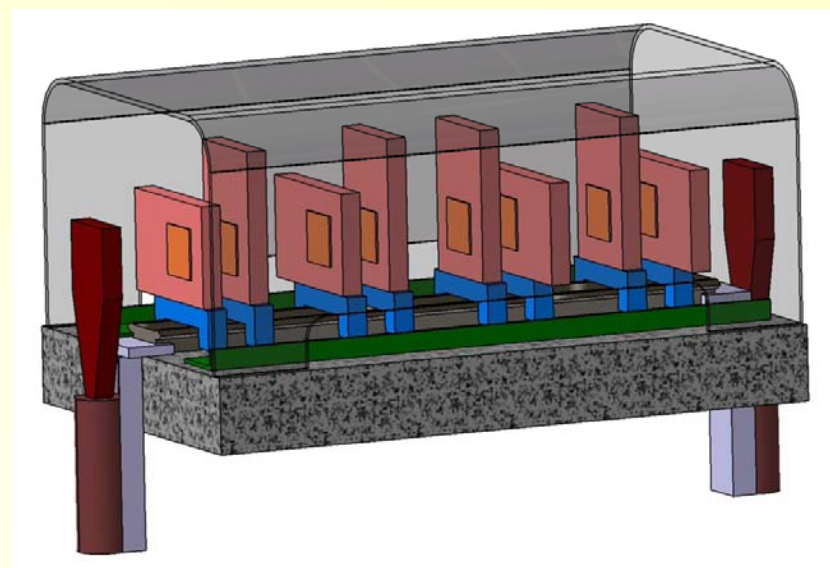


Current Status



Motivation

- Helsinki Institute of Physics (HIP) operates the Silicon Beam Telescope (SiBT) at the CERN **H2 test beam** since 1990
- SiBT has eight (8) **position sensitive silicon strip detectors** and appropriate front-end electronics and data acquisition system
- In **Super-LHC** the radiation fluencies are far beyond the operational limits of currently existing silicon detectors
- SiBT is a unique detector testing unit for **testing novel full-size particle detectors** for LHC updates
- Especially **Magnetic Czochralski Silicon (MCz-Si)** is very promising material for radiation hard silicon detectors



SiBT will be completely updated for the summer 2007 beam tests !



Czochralski Silicon Detectors

- Detector processing is done at the **clean room** of Helsinki University of Technology (TKK) Micro and Nanofabrication Centre (MINFAB)
- Material is **Magnetic Czochralski** 4" n-type silicon wafers
- **Two 4 cm * 4 cm detectors** are obtained from one wafer
- Other measures:
 - **Pitch** 50 μm
 - **768 strips** per detector (=6*128)
 - Suitable for **CMS 6-APV chip**

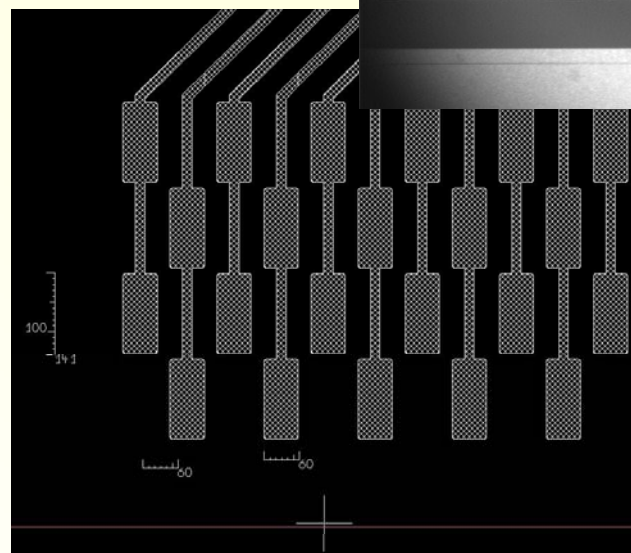
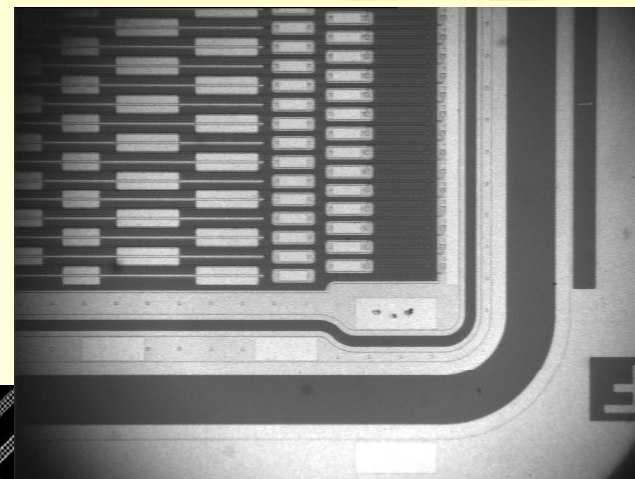


Esa Tuovinen processing silicon detectors at Helsinki University of Technology Microelectronics Center



Reference Detectors

- Reference detectors are Hamamatsu sensors made for **D0 run** Ib L2-5
 - 60 micron pitch
 - intermediate strips
 - size 4 cm x 9 cm
 - 640 channels
- **Pitch adapters** for reference and MCz sensors are made by Esa at MINFAB
 - glass material with Cr-Al metallization

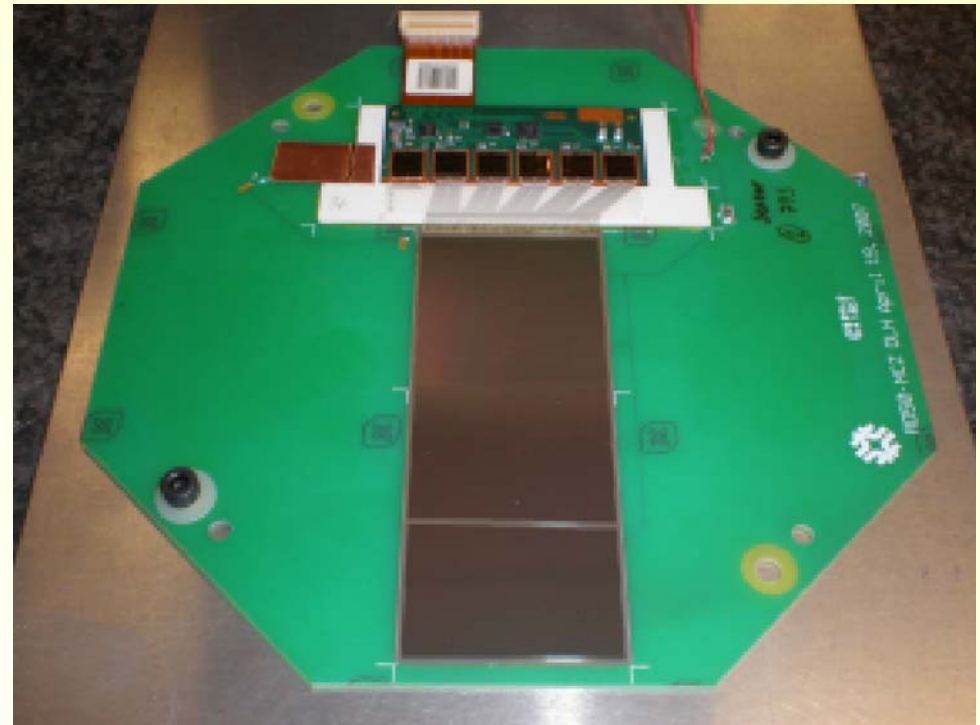




Module production & irradiations

Lenny Spiege, FNAL

- We have received CERN CMS 6APV TOB hybrids
- Reference detector modules are being built in Fermilab
- MCz-modules in Karlsruhe
- Irradiations are done in Louvain-la-Neuve (neutrons) and Karlsruhe (protons)
- Qualification tests for MCz-modules are done both in Louvain and Karlsruhe
- Qualification tests for reference planes are done in Fermilab.



Cooling

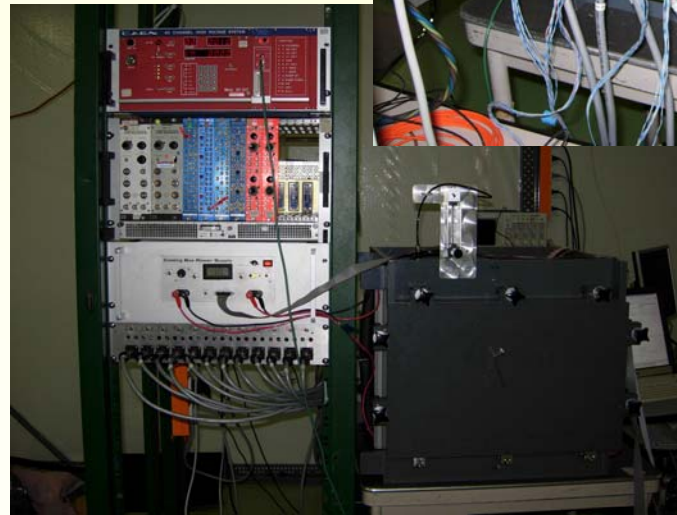
- FNAL **Vienna box** will house both MCz and reference modules
- Slot for up to **10 modules** with 4 mm spacing
- Temperature can be set down to **-20°C** (may be limited by load)
- Reference planes will be installed to **±45 degree** in order to get a proper track measurement





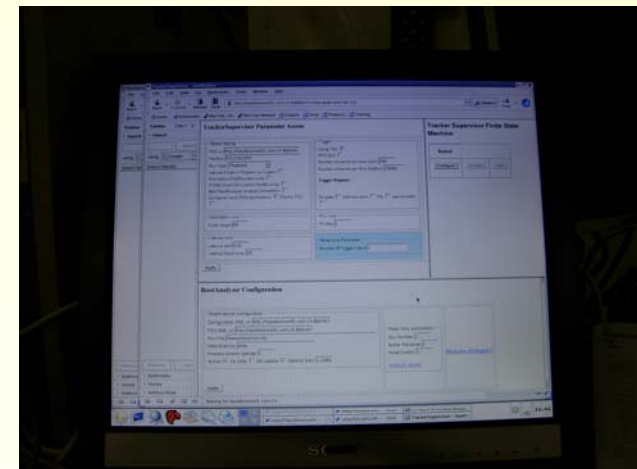
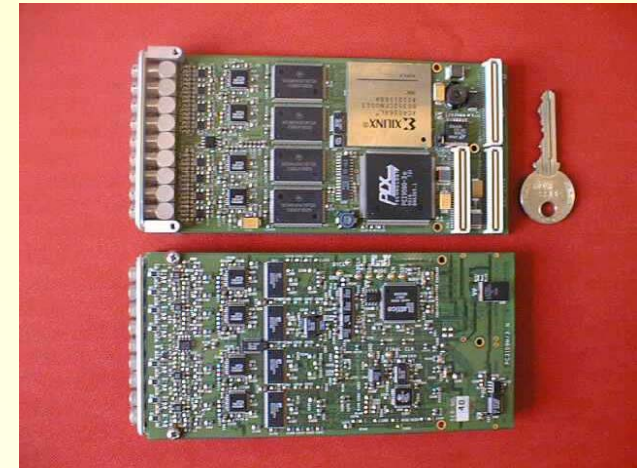
Trigger System & Voltage Sources

- **Low Voltage Power Supplies**
 - Standard PS, $\pm 6,5$ V
 - CCU, VUTRIs (->APV-hybrids)
- **High Voltage Power Supplies**
 - CAEN SY127 HV system
- **Trigger system**
 - Simple photomultiplier system
 - Trigger logics realized with NIM modules



Data Acquisition

- SiBT DAQ will be similar to that of the **CMS Tracker**
- Components for the DAQ are **recycled** from the Tracker module production test stations that have become obsolete after finishing the module production
- CMS Tracker **DAQ software** is being modified for SiBT operation





Status as of June 1st 2007

- **Beam tests** start at CERN H2 test station at June 18th, continue until September
- Functionality of the SiBT tested first, then MCz-Si detectors
- **The telescope with its cooling system is being commissioned** in B-186 CMS rod testing laboratory, will be moved to H2 @ June 14-15
- MCz-Si detectors have been characterized at Karlsruhe and Louvain
- Four **reference plane modules** are ready at Fermilab, a total of 12 reference will be ready in these days
- **MCz-Si detectors** modules are being constructed at Karlsruhe
- Neutron and proton **irradiations** to MCz-detectors will take place soon
- **Chiller** was stuck at purchasing procedure - plan B for telescope cooling with tap water has been developed