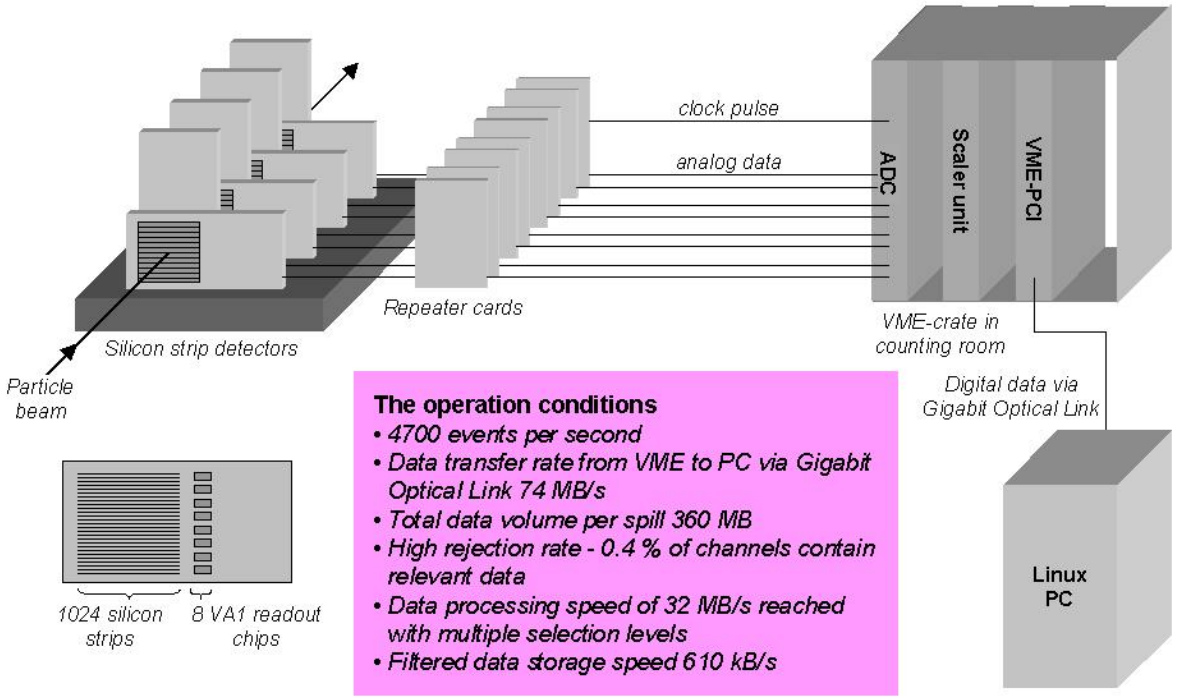
What is Helsinki Silicon Beam Telescope?

- Helsinki Institute of Physics (HIP) has operated the Silicon Beam Telescope (SiBT) at the CERN H2 test beam area since 1990.
- SiBT has eight (8) position sensitive silicon strip detectors with appropriate front-end electronics and data acquisition system
- SiBT is a unique detector testing unit for testing novel full-size particle detectors (resolution, efficiency, and signal-to-noise ratio).

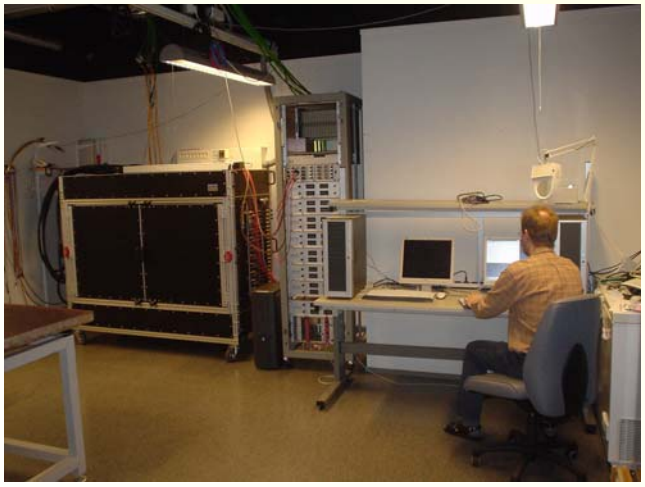


Picture 1: Old SiBT

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

Motivation for the SiBT update

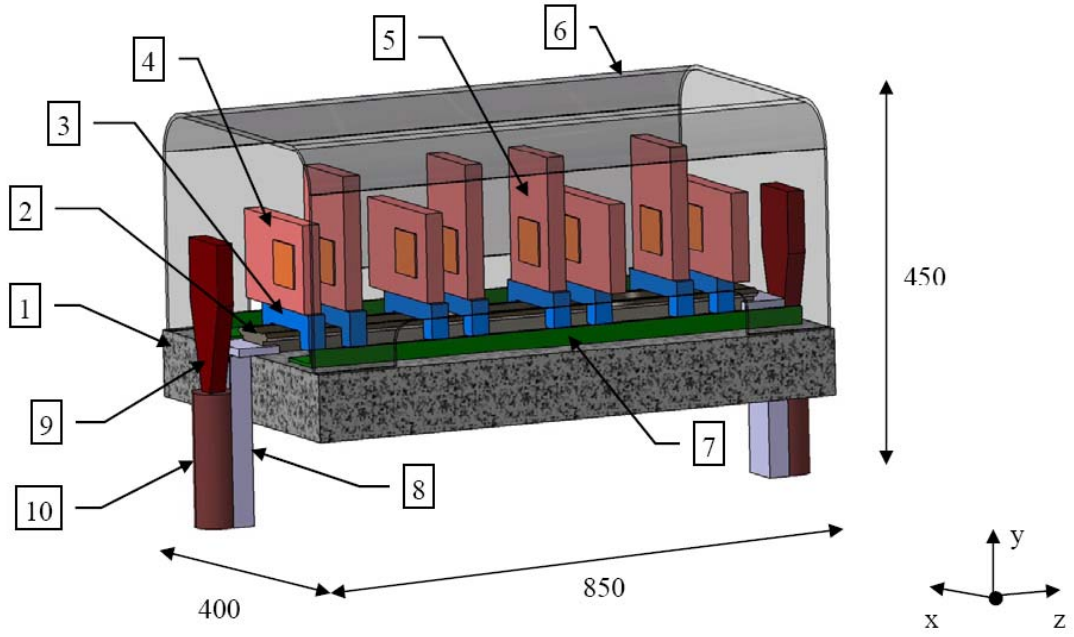
- Novel radiation hard detectors are being developed for Super-LHC, and LHC Council requires tests on full-size detector systems.
- Other CERN detector groups have inquired possibilities to test their detectors with our beam telescope.
- SiBT and our other unique testing unit Finnish Cosmic Rack (FinnCRack) reinforce each other., especially after the upgrade.



Picture 2:
Teppo Mäenpää working with FinnCRack at HIP Helsinki Laboratories

Picture 3:
HIP students installing cables for SiBT at H2

SiBT mechanics



Picture 4:
SiBT Mechanics. Picture by Erkki Anttila.
Note: real directions of the scintillators are perpendicular instead of parallel

- Existing:
  - Component 1: stone base
  - 2: support rail
- Need to be built:
  - 3: support frame for detector enclosures
  - 4: detector enclosures
  - 5: detector encloseure with cooling
  - 6: cover plate
  - 7: attachment system for front-end electronics
  - 8: support for scintillators
  - 9: scintillators
  - 10: photomultipliers

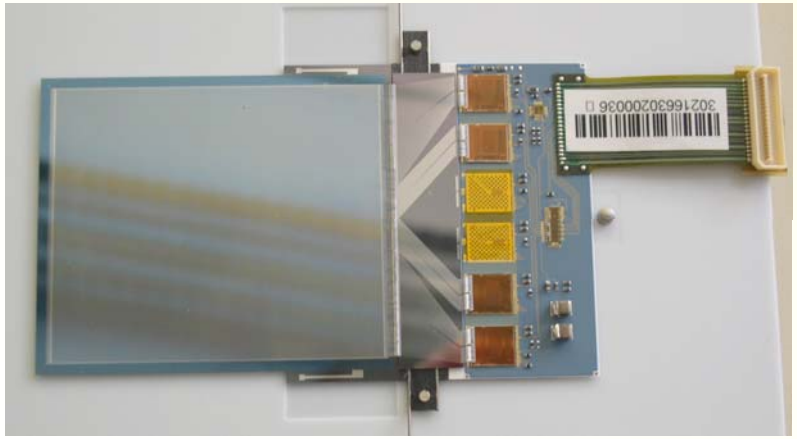
SiBT detectors

- Detector processing will be done at the clean room of Helsinki University of Technology Microelectronics Centre
- Material is Float Zone 4" n-type silicon wafers obtained from CERN RD50 (depleted at 50 V)
- Litography masks are designed so that two 4 cm * 4 cm detectors will be obtained from one wafer
- Other detector measures:
  - Pitch 50 um
  - 768 strips per detector (=6*128)
  - Suitable for a CMS 6-APV chip

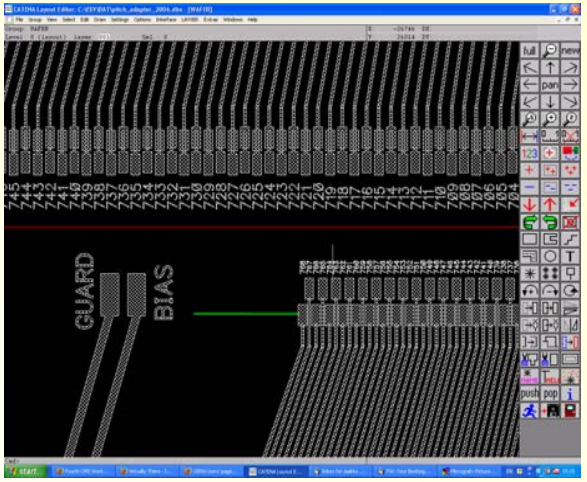
Picture 5:
Esa Tuovinen processing silicon detectors at Helsinki University of Technology Microelectronics Center

SiBT front-end electronics

- Hybrids
  - We need at least 8 hybrids + 4 spares, currently we have 5 hybrids
- Bonding
  - at CERN detector laboratory?
- Pitch Adapters
  - Needed between detector and APV-hybrid, layout already done



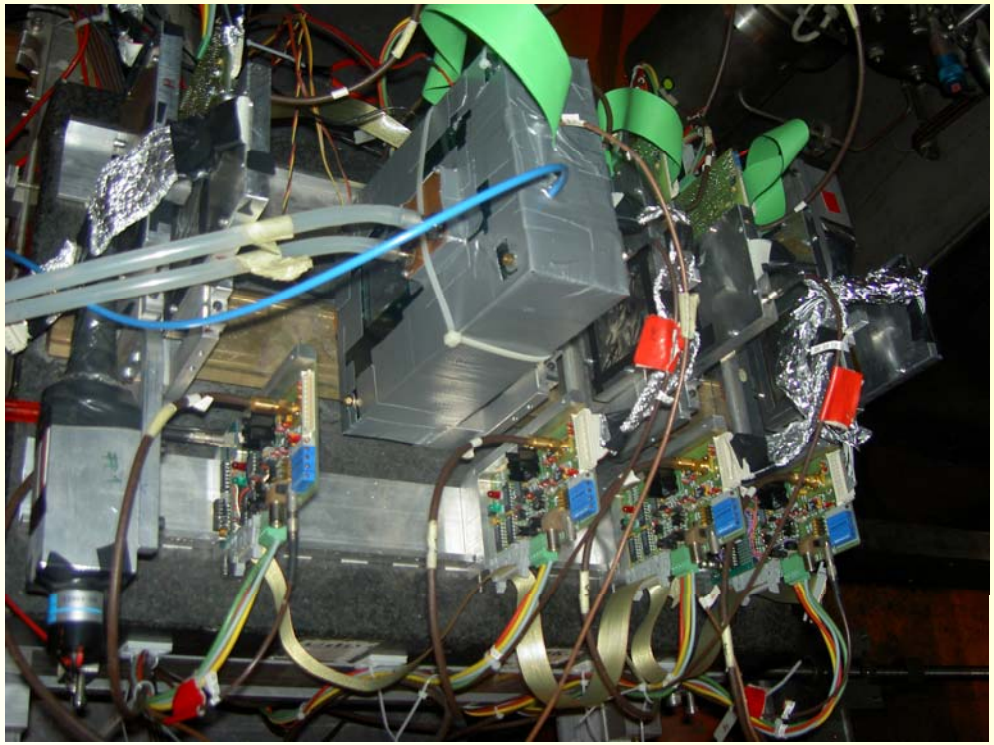
Picture 6:
CERN RD39 silicon detector module with APV-hybrid.



Picture 7:
Example of the pitch adapter layout made by Layed-program

SiBT cooling

- Design based on a cooling box with Peltier –element and chiller
- Minimum temperature of the detector inside the box will be – 16°C.
- Humidity inside the box will be about 30 %, flushed by dry nitrogen
- Based on Thermo Electric Cooler
- Cooling box will be easily opened and non-hermetical



Picture 8:
Cooling box containing the detector under tests attached to SiBT during the summer 2004 beam tests

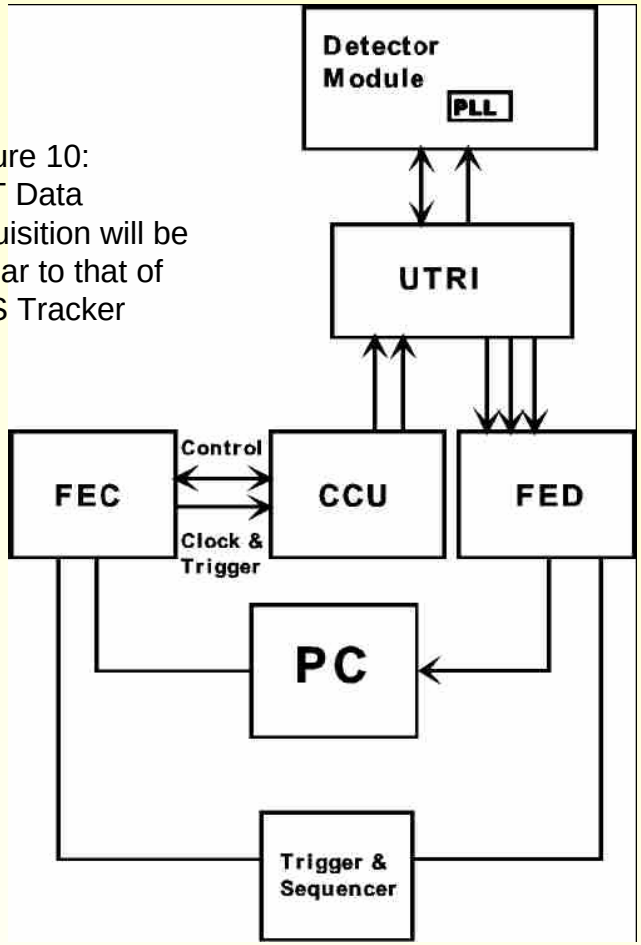
SiBT trigger system and voltage sources

- Trigger system:
  - Incl. 2 scintillators, 2 photomultipliers, 2 discriminators
  - Incl. 5 shapers, 1 coincidence unit
  - Power supplies control and monitor electronics
- Low Voltage Power Supplies
  - 10x 2.5V/3A and 1,25V/2A fast reacting PVs with voltage and current monitors
- High Voltage Power Supplies
  - For reference detectors 8x 0-100V/2mA PVs with voltage and current monitors
  - For the detector under investigation the power supply will provide up to 1000 V

Picture 9:
Dr. Sandor Czellar beside four high voltage power supplies and a trigger box he has developed and manufactured for the Finnish Cosmic Rack. Similar PVs and Trigger Systems are used in CMS Tracker module testing centers.

SiBT data acquisition

- The SiBT DAQ will be updated to be similar to that of the CMS Tracker
- The major difference is that electrical front-end drivers (FED) will be sufficient.
- We have most of the readout components (1 FED, 1 tracker readout interface, communication and control unit, front-end controller, trigger and sequencer card)
- but we would still need for the telecope readout:
  - 2-3 electrical FEDs
  - tracker readout interface schematics
  - More APV-hybrids



Picture 10: SiBT Data Acquisition will be similar to that of CMS Tracker

Cost Estimate for the SiBT Update

Activity	Cost / CHF	COST / €
Mechanics & Cooling	4,000	2,500
Detectors & FE-electronics	10,000	7,000
Low Voltage Sorces	15,000	10,000
High Voltage Sources	10,000	7,000
Trigger incl. Photomultipliers	10,000	7,000
Cables & Connectors	5,000	3,000
Others ?		
TOTAL	55,000 CHF	35,000 €

Conclusions

- We would appreciate if you have any comments or suggestions concerning the design etc. of the telecope.

- In order to provide this tool for the full size detector characterization, we also would be happy to get help in:
  - getting certain components such as the APV-hybrids, FEDs etc.
  - in the software development e.g. if you have students, who would like to get hands-on experience in the software development of a DAQ or online/offline analysis.