

Meeting on Ladder Design and Test Beam Results for the Si Inner Tracker Lausanne June 1st 2001

Participants : *Jean-Philippe Hertig, Raymond Frei, Tran Minh Tâm, Malica Tareb, Benjamin Carron, Frank Lehner, Philipp Sievers, Achim Vollhardt and Olaf Steinkamp*
(following the order (counterclockwise) around the table).

Part 1 : Layout of the ladders

The latest shape for the inner-tracker is a cross-shape one with boxes left + right and top + bottom ; each ladder will have at maximum 2 sensors and will be 78 mm wide.

How do we align the ladder on the frame, how do we imagine the ladder to be ?
We have to come to the TDR with only one option.

Support of the sensors :

- Material : Carbon-Carbon foils as proposed by Cracow (Michalowski).

One has to isolate the sensors' back planes which are connected to HV. This isolation can be made by

- i** the thickness of the glue (60 to 100 μm) or
- ii** a foil of Kapton (25 μm) ;
- iii** Can the Carbon-Carbon be coated with some polyimide ? How then can we ensure the uniformity ? There are industries which coat things with polyimide ; check if this process is possible (Lausanne).

Thermal properties : the thermal conduction is enhanced in the direction of the fibre. What is the thermal conductivity of this C-C fibre, not only in the direction of the fibres, but also perpendicularly to this direction ?

Mechanical properties : the “wings” of the U or H shaped support is about 2 mm high and the thickness of the foil ranges from 300 to 500 μm . It is not possible to make a “H” shape with the Carbon-Carbon foils. Can Krakow produce the whole bunch of supports (12 meter square) ? We will surely have to make contract with them.

- Another possibility is to use the Carbon fibre type AMOCO k100x which is easier to make and can be done in U or H shape.

Calculation of the heat flow :

Zurich has rented a finite element programme for 1 year and will have a physicist from Poland to run it.

Gluing :

We can use the glue to ensure the electrical isolation. Use the Dr. Neumann's glue? We can also put low Z particles in the glue to increase its thermal conductivity. Investigate at CERN.

The measurement of the thermal and mechanical properties will be made in Lausanne. Use glass to simulate the Silicon. We can certainly open holes in the support, but can we afford to have them? This question must be answered by the heat flow calculation.

How do we assemble a ladder :

Provided that the sensors are precisely cut (i.e. $< 20 \mu m$), one can use the GLAST and ATHENA methods of positioning. Otherwise, one has to use the target (crosses) which are drawn on the detectors for the positioning of the detectors. (ATHENA use the edges and **precision holes on the hybrids** to align the sensors.)

What will give the precision of the positioning in our case? We can have the precision pole(s) on the ceramics and/or on the Carbon support. The design of Mr Hertig allows the alignment and then the transfert of the sensors onto the Carbon support, the reference of the sensors being given by poles on the Carbon support itself. During the discussion, Achim puts forward a new idea to align the sensors in the Carbon support with the alignment given by poles in the support : this idea consists in opening some "holes" in the U shape carbon support and put it on a larger support having pins against which the sensors can be positioned.

The design having the positioning pole on the ceramics seems to have a disadvantage in the sense that if one has a failure on an hybrid, one has to take out this single hybrid out, hence, jeopardizing the positioning of the ladder.

Another question which can be raised about the poles on the Carbon support and on the ceramics is the one about the thermal expansions of the Carbon support, of the epoxy glue and of the steel...

Ueli Straumann and Valery Pugatch join the meeting in the afternoon, after the lunch break.

How shall we proceed?

Things to be done :

- a) Finite element analysis for a full size ladder and smaller size ladder.
- b) Full size thermal model with a dummy detector and smaller size model with the 4 inches Si detectors. These models can and will also be used for the tests of the mechanical assembling procedure.
- c) Thermal model to be built in Lausanne.

Frank points out the importance of the model of the 4 inches sensor with the irradiated (or not irradiated) sensors which we already have.

If the tests and calculations listed above do converge, one can think that this should be a good point to the TDR.

Occupancy with the new geometry

Max occupancy is about 6% in station 3 in the old geometry. With new geometry, it will be at maximum 10% in station 3.

Station 4 is no more there. Station 11 is gone. Station 3 will move downstream \Rightarrow lower occupancy still.

Sensor : 11 cm x 7.8 cm geometrical dimensions, 108 mm x 76 mm sensitive area, strip pitch of 237.5 microns, 320 strips per sensor.

1 box is now : 2 sensors high, overlap 2.5 mm, 52.9 cm long, 22 cm high. A standard box is 7 sensors wide.

Part 2 : Test beam analysis

Valery presents the results of the analysis done by Heidelberg.

There were a telescope in front and after the ladders under test. The strategy of the analysis is to reconstruct straight tracks and determine the properties of the test sensors as a function of the expected track impact : on can then scan the sensor with a bin of 15 microns around the impact. 2 days of data ; 1st sensor of long ladder, long shaping, the timing were not yet optimal for the long ladder (3 sensors).

Results :

- Efficiency varies between strips
This is due to the share of charges between 2 strips
- Cluster charge varies between strips
With long ladder the collected charge is smaller.
- Resolution varies between strips
- Signal/noise varies between strips
30 to 20 for short ladder, about 10 for the long ladder
- Conclusions
Systematics to be done
Reprocess data with better calibration
Use full alignment and select high quality tracks

Benjamin shows the results of the analysis of the data collected with the SCTA

- Calibration, correlated noise, data vs time.
- SCTA gain was only 2/3 of the one of other SCTA tested at CERN! Benjamin describes the SCTA functionality and how he managed the triggers.
- One can see the evolution of the amplitude as a function of time (modulo 25 ns) The amplitude recorded during the 2nd cycle seems low : this might be the consequence of the fact that we considered only the amplitude of a single strip and not any multistrip cluster.
- Conclusions

We can eventually use a new SCTA HC chip (if available) during the July test beam with the VELO.

How do we proceed with the analysis ?

1. Michael has made the code available for people in Zurich to run
2. We have to understand the clustering.

The next meeting will be in Zurich. The final date will be proposed by Olaf by electronic mail. The meeting ends at 16h12.

Minutes collected by TRAN Minh-Tâm