

# Summary of Inner Tracker Silicon Meeting

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## 1 Status of what has been done

### 1) Tests of a silicon detector with a Helix FE

Philipp has tested a HERA B detector (double sided but only one side was read) half given to with the equivalent dose that will be given to the LHCb detector in 1 year. For the readout of this detector he has used the Helix chip . Zuerich tried to run the Beetle Chip. Unfortunately, this chip is not operationnal for the moment for some reasons that are independant of the Beetle itself. When it will work, it will provide 12 chanel (3 different technologies each providing 4 chanel) but we have to share with the GEM detector. He would like to mount a bench to test both the double sided and the single sided detector in a box which could allow to vary the temperature to study the effect of its variation.

### 2) Evaluation of the occupancy

Malica has presented some results, based on datas provided by Vadim Talanov, on what would be the occupancy in the inner tracker in the case of a detector of 20 cm long. She gave values in the case of tracker03 which is the one which will be the more irradiated. Moreover, she took the maximum value supported by a detector in this region to make her calculation so that she evaluated this flux in the worst case. She obtained:

- Flux =  $2.3 \times 10^{-2}$  charged part/strip/Int (for 100  $\mu\text{m}$  pitch)
- Flux =  $4.6 \times 10^{-2}$  charged part/strip/Int (for 200  $\mu\text{m}$  pitch)

Using the Poisson law, we can simply deduce the probability to have 2 or more particles/int in one strip:

$$- P(2) = 2.5 \times 10^{-4}, \text{ resp. } P(2) = 1 \times 10^{-3}$$

Olaf pointed out that we should take into account the fact that we could have several interactions in one bunch crossing. Tam has then calculated the corresponding probability:

- Luminosity  $\times$  cross section = nb of interactions:  $5 \times 10^{32} * 100 \times 10^{-27} = 500 \times 10^5 / \text{s}$
- Bunch crossing rate:  $400 \times 10^5 / \text{s}$

which leads to a mean of 1.25. Using again the Poisson law, we obtain:

- Probability to have 0, 1, 2, 3 int = 0.2865, 0.3581, 0.2238, 0.0933

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\*Summary by M. Tareb

It means that the probability that a strip is hit by 2 or more particles coming from 2 or more different interactions is:

$p = \text{prob to have one event in a bunch} \times \text{prob to have one or more event in the next}$

–  $p = 0.023 * (0.3581 + 0.2238 + 0.0933) = 1.55 \times 10^{-2}$  in the first case

–  $p = 0.046 * (0.3581 + 0.2238 + 0.0933) = 3.11 \times 10^{-2}$  in the second case

We discussed about the pile up which could be due to the electronics and we agreed that it was negligible after a explanation of Raymond Frei.

### 3) Estimation of the S/N

Tam presented arrays containing calculations of the signal over noise ratio in different cases (We will try to provide the corresponding excel files on the WEB). He studied for example the effect of the pitch, of the readout (every strip or 1 over 2 strip) with the hypothesis of a 300 micrometer thick detector of 20 cm long. and the ENC was calculated in the case of the Beetle FE We realised that this ratio was of the order of 10 which is not really acceptable before any irradiation... We discuss then the opportunity to have a double sided (which could be thicker as you need only 2 layers/station). Olaf also remarked that a nice paper has been written by CMS on this subject and we should compare ( CMS Note 2000/011) to check if the interstrip capacitance which is obtained against those obtained by other experiments is worth doing.

## 2 What has to be done

- 1) We all agreed that we should write an internal note every several months (between 4 and 6) to notify our progress.
- 2) We need to put effort on the study of the mechanical structure associated to the double sided detector to evaluate the feasibility: indeed R. Frei pointed out that it could be much more complicated than for a single sided one and in particular for the cooling system.
- 3) We need to find a prototype to do tests. Several possibilities are foreseen:
  - a person from Kiev proposed to philipp to give him one. It is a good solution since we don't want to invest a lot of money to do those tests but of course we are not sure of the detector reliability ...
  - A french company (Eurysis) can provide prototypes with large pitch as we'll probably have in the "final version".
  - Ask CMS and ATLAS (but, as it has been optimized for the VERTEX detector the pitch are smaller).
  - Mr Bowcock knows a company in GB which can provide the drawings in only one week and probably the prototype soon after (?). (but it is probably too expensive for the moment)

The tests will be done on either double sided prototype or P on N single sided prototypes which seems to be the simplest, cheapest, ... that we can have if we consider ATLAS and CMS conclusion.

### **3 Next meeting**

- Next meeting is scheduled on May 10<sup>th</sup> in Zurich at around 2 p.m.