Minutes of the FMD meeting on Feb. 19 2001

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This is a draft. Please send me comments, clarifications and corrections.

1 Present:

JJG, JS, BSN, PG, VG, AM, AK, RG, LM, PS, OP, WT, VK, AA, GHC, AMR, LMZ, CG, AP, SC, SL, GP, TK, HB, JB

Following items refer to the talks on the agenda.

2 Si-FMD design overview (Jens Jørgen Gaardhøje, NBI)

Transparencies shown may be found on the new FMD home page (fmd.nbi.dk).

The geometrical layout of the proposed Si-FMD system was discussed and agreed upon. The proposed solution consists of 2 rings of Si-strip detectors each manufactured from 6"diam wafers. There will be two outer rings of 24 elements each and up to 4 inner rings of 8 elements each. The latter elements will be further subdivided in two either mechanically or electronically, yielding 16 elements.

The *background* of secondaries in the various detector segments was discussed extensively at the meeting and subsequently. Based on new calculations with ALIROOT including the most recent geometry it appears that the contribution from secondaries is at the 30-50% level for the Si-rings closest to the IP(denoted Si1 and Si2, inner and outer, respectively). For the Si rings on the left side of the IP, (Si3 and Si4) the background level increases to 100-150% at the level of Si3 and to 700-900% at the level of Si4. This background is primarily due to the beam pipe and associated elements (flanges, pumps etc). While modifications to the beam line system may reduce the background in Si3, the situation for Si4 requires drastic reworking of the beam pipe for this detector to be useful.

The *segmentation* of the Si detectors is subject to the following constraints: i) average occupancy (which bears on the multiplicity resolution and on the required dynamic range of the FE electronics), ii) pad size (which determines the capacitance and thus the matching to the FE electronics). Physics considerations probably requires only $d\eta = 0.1$ and $d\phi = 2\pi/16$. With a segmentation of each Si element (wafer) into 128 channels an average occupancy of 0.5-5 particles can be achieved. The larger number is for a small region in the inner ring of Si1. With this occupancy the multiplicity can be studied both by the energy method and the occupancy method. Average pad sizes will be below $1cm^2$. It is proposed to aim at a segmentation of at least 128 channels (depending on matching to FE electronics). With this segmentation the total number of channels in the Si-FMD is around 14000.

The role of the Si-FMD in the ALICE trigger system was discussed. With the advent of the VO plastic detector the Si-FMD is not required to participate in the Level 0 trigger. Participation in the Level 1 trigger requires, according to present overall ALICE schemes that the trigger signal be available before $5.2\mu s$ after the collision. It may be a problem to respect this requirement with existing FE chips.

The time schedule for Si development was discussed. We should aim at identifying a FE solution over the next 6 months or less, so that realistic prototyping can start already in 2001 and proceed with realistic beam tests in 2002.

3 FE and RO electronics (Børge Svane Nielsen, NBI)

Transparencies are found in http://fmd.nbi.dk.

Børge reported on the requirements for the FE electronics and on his investigations to find a suitable existing system that could be taken over 'as is' or with minor modifications. It was pointed out that it would be very advantageous if the Si-FMD system could use a FE and RO system that is already being used in ALICE and that development costs for radiation hard electronics is both very expensive (typically 100 kCHF) and time consuming (typically 1 year per version).

The change from Level 0 to Level 1 triggering means that front-end event buffering is unnecessary and that peaking times can be raised from about 25 ns to about 1μs. However, the 5.2μs requirement for Level 1 is far from trivial with existing FE electronics.

A survey of relevant existing FE chips is found in BSN's talk. There does not appear to be a system that immediately fulfills all requirements (mainly: the dynamic range, peaking time, radiation hardness, capacitance matching, no. of channels, read out frequency). In particular, no system appears to have the desired trigger functionality built in. Typical RO is through a serial buffer with readout clock frequencies up to 10 MHz which means that a 128 ch. chip will only be read out after $\approx 12\mu s$, i.e. too late according to the present ALICE trigger 'rules'.

A possible candidate is the HAL25 chip which is under development by the ALICE Si-drift group. It is rad. hard, has 128 ch, but is only designed for 13 MIPS dyn. range and a 10 MHz serial readout.

Another promising candidate is the Viking Va1-prime chip by the IDE A/S company. This is also rad. hard and has similar characteristics as HAL25, again with a relatively slow serial readout.

The PACE chip from CMS is still considered a backup solution, but the attractiveness of its specifications is somewhat spoiled by the complexity and the fact that the readout is geared towards CMS and does not readily transfer to the ALICE RO systems. Other front-end possibilities are less likely to meet our requirements.

A new option appeared just before the meeting and has not been explored fully. This is another Viking chip, called Va32-Rich, a 32 channel version of Va1-prime which also has a parallel read-out of all 32 channels. This opens the possibilities for a L1 trigger, if the 32 signals can be added by means of other electronics.

At this moment, we are not ready to conclude on the electronics issue which remains, however, vital for the overall design.

4 Electronics development in Athens (Aris Angelis, Athens)

Aris reported on the prototyping effort in Athens. A Si detector element has been produced and delivered from Canberra. The design of this Si element is different from the one considered for the final FMD (it has 32 sub elements arranged as a combination of strips and pads). FE electronics based on conventional (discrete) electronics have been designed. Test with sources are expected to commence in 2001.

The possibility of this system evolving into a design option for the Si-FMD FE electronics was discussed at some length. The requirements of radiation hardness have not been considered so far. It was pointed out that the time delays and the cost of porting the FE design to Rad. hard integrated circuits is important. Concerns were raised as to the time scale for the project.

In particular it was pointed out that with the production schedules connected with Si and electronics a decision on electronics must be made in

2001, preferably shortly after the summer.

Aris will produce a written outline of the details of the current test system and its time scehdule.

5 V0 detector (Rachid Guernane, Lyon)

Rachid reported on the V0 status. The V0 team now also includes a group from Mexico. A possible idea would be that the Lyon group builds the right V0 and the Mexico builds the left V0. It was pointed out that the design of the two should be considered as one and that V0 detectors should be based on similar technology and electronics.

The V0 detectors will provide a (fast) level 0 multiplicity trigger.

The geometry of the V0 detectors was discussed. It was pointed out that it would be advantageous for the subsequent data analysis if the acceptance of the V0 detectors is made to correspond to the acceptance of the Si 1 and 2 systems, even though the functionality as a trigger for the muon arm for p+p running only requires smaller acceptance. Thus the outer diameter of the VO 'disk' should be 35-37 cm if placed at the level of the absorber front face.

6 Photon Multiplicity Detector (Lalit Mangotra, India)

Lalit reported on the present PMD design. The PMD acceptance appears to be such that it does not contribute with additional background to Si4. At present Si3 is closer to the IR (270cm) than the PMD. Background from Si3 does not appear to contribute significantly to the accpetance of the PMD.

The left V0 detector (since it is in trigger) should be placed closer to the IP than the PMD.

In any case, the background issues should be explored quantitatively.

7 Status of T0 (Vladislav Grigoriev, Moscow)

The T0 detector was discussed. The funding issues related to the T0 radiator/PM option were discussed. It is clear that a decision must be made soon regarding the choice of technology (presently the radiator option is the baseline design) and with respect to funding that will enable this detector to move into the prototyping stage. The ALICE management is encouraged to address this issue since the T0 detector system is the central Level 0 trigger.

Tests of varous scintillators, radiators and PM tubes have beeen performed. There are indications that time resolution as good as 45 ps can be achieved, but there is a need for initiating systematic tests with the components that are being consideredg for the final design.

Test of double threshold CFD have also been made. Indications are that walk levels of 25 ps are achieved. Again a full prototype system should be assembled and tested in beam.

The number of detectors in the T0 system was under discussion. The present design has 12 tubes in each system (L and R). This gives 84% geometrical efficiencey for p+p collisions (assume about 200 particles produced by nuclear processes per collision in 4π). Doubling the number of radiators/tubes will increase the efficiency to about 95% .

It was discussed how to decide on what efficiency is needed. Presumably the pp luminosity is so large that all collisions cannot be accepted anyway. In that case a small loss in efficiency is unimportant, on the other hand one can argue that the primary trigger should always be as efficient as possible and a loss of efficiency will introduce a bias. These arguments need, however, to to be explored in more depth.

The T0 trigger electronics is vital for ALICE and must be specified further. ALICE assumes that T0 provides a deadtimeless trigger, with a yes/no answer every 25 ns, within 900 ns. The trigger should be able to identify events with hits in both arms within a narrow time window, to exclude beam-gas interactions. In addition, this or a simpler signal should be provided already at 100 ns as a start for the TRD.

8 Response simulations (Alexei Kurepin, INR)

Alexei showed new results on the multiplicity resolution that can be obtained by the Si system. The main problem is connected to the Landau tails in the energy response. An exercise in reconstructing the multiplicity from the total energy deposited in the case of moderate occupancy (0-10 hits per sector) yields good result for the average multiplicity and deviation around the mean value of 5-10% depending on how many detector segments are added in the off-line analysis.

It would be interesting to explore quantitatively the resolution obtained by studying the pattern of cells that have hits vs those that have no hits.

9 Background simulations (Alla Maievskaia, INR)

Alla showed the new simulations with ALIROOT that were already mentioned under section 2. The plot of the origin of secondaries clearly reveals that various flanges, pumps etc create significant background for Si3 and Si4.

It was agreed that the present ALIROOT version must be checked and that the description of the beam line etc. must be verified with the integration group (Lars Leistam). Later in the week Lars suggested that various flanges etc can be made smaller reducing the total amount of material by 20-30% . This must be pursued.

The background analysis highligths decisions which must be made ASAP. Can the beam pipe etc. be altered enough that the Si4 becomes a meaningful detector? A related question: how much background can we accept and still produce a meaningfull average multiplicity distribution at forward angles (estimate systematic errors on the background correction factors).

10 Organisation of future work. (JJG)

The need for better communication in the FMD group and with ALICE in general was recognized. This is particularly important as we move closer to prototyping, design choices and commitment of funds.

10.1 FMD home page

As a first step a home page has been established. It will until further notice be maintained at NBI (http://fmd.nbi.dk). It will among other material contain links to tranparencies shown at meetings, minutes, copies of documents,notes, tranparencies, links to other pages etc. Web master for this page is : Borge Svane Nielsen: (borge@nbi.dk).

The entry point to the FMD group in the main ALICE home page should be this page in order to avoid confusion.

10.2 FMD Mailing list

The FMD mailing list is maintained by the ALICE secretariat (Susanne Barras). If you are not receiving mailings or wish to be added to the list, please contact her.

10.3 Preliminary Design Study: PDS

It was agreed that written documentation is essential and that each subsystem should produce a preliminary design study (Si-FMD, T0, V0). We aim at written documents with figures by June 2001. These documents should contain a descrition of the physics goals, technical concept, design parameters, performance and background simulations etc for each subsystem that can be circulated within the collaboration.

All speakers are encouraged to submit their transparencies to BSN in electronic form (PS, PPT or PDF) for inclusion in the home page or alternatively to provide him with a working link address.

10.4 Physics Performance Report: PPR

The FMD group has not really participated in the PPR work although we have a chapter reserved. This has mainly been due to the lack of definition of the basic subsystems until recently but, it is now time to start thinking about physics performance in a broader sense. In particular, Guy P. and ALICE are requesting such input in connection with a global assesment of ALICE's physics capabilities.

FMD group members and others are encouraged to send to JJG (gardhoje@nbi.dk) ASAP short descriptions of physics considerations that may be attacked with the present systems, and also ideas about other desirable measurements that perhaps cannot be done with the present systems.