Notes about the JRA1 Meeting Hamburg January 2008 Ingrid-Maria Gregor

26 attendees + up to 4 people per phone (January 30th 2008)

I. Gregor: Introduction and scope of meeting

A quick look back at 2007 showed that it was a very successful year. We submitted 18 Memos and 6 Reports on JRA1. Please take a look, there is a lot of information available. The main scope of the meeting was the detailed planning of 2008.

Ph. Roloff: Latest Results on EUDET Test beams

In the first part of his talk Philipp presented the latest developments of the analysis software package EUTelescope. One of the latest achievements is the improvement of the alignment procedure. The existing processor EUTelAlign compares only two planes at a time, which is not very precise. A better solution is to use full tracks for the alignment and therefore it was already announced in Paris to try Millepede II. Parameters are grouped into local parameters which are only present in a subset of the data and global parameters. Millepede II solves the linear least squares problem with a simultaneous fit of all global and local parameters, irrespectively of the number of local parameters.

Philipp gave a short overview how Millepede is interleaved with the other parts of EUTelescope and presented results of how he tested the new alignment procedure. He also presented a list of open issues to be discussed in the software meeting on Thursday.

The data of the test beams at DESY in August 2007 (3 and 6 GeV electrons) and CERN in September 2007 (180 GeV pions) were reanalysed by Filip. Philipp summarised the most important results, a detailed report was given by Filip in the software meeting. The most important improvement of the analysis is a comparison of the data with a simulation based on Geant 4. The simulation describes the observed residuals well. Further it seems that the eta function used to calculate the hit positions is over correcting the data.

In the last part of the presentation Philipp reported on the experience with our users from the BeamCal collaboration which were using the JRA1 Telescope at DESY in December. Despite extreme start-up problems (see Ingrid's talk) they collected a reasonable amount of data and analysed them using the EUTelescope package. The shape of the diamond sensor is visible in the data and a preliminary Landau distribution of the collected charge was shown.

L. Reuen: New Results from CERN Testbeam with DEPFET

Lars reported on the status of test beam efforts in Bonn summarising the work of Julia, Sergei and himself. First he reminded us, that we had an alignment problem when integrating two DEPFET layers in the telescope. The DEPFET sensors were only positioned at the rim of the telescope acceptance. He showed a possible solution how to avoid this problem in future by using silicon strip detectors.

Sergei worked on the common DAQ, Lars presented different options on which level the DAQ system can be combined. Sergei achieved already a number of things: the Linux USB/DEPFET driver was written and tested up to 37MB/sec; the DEPFET I/O library was ported from Windows/Borland C++ to Linux/GNU C++. New Software for the distributed DAQ system was written. Of course the list of things to do is also still long.

Furthermore Lars reported that they decided to integrate DEPFET into the LCIO analysis frame work as the maintenance is excellent, Julia can work on it and it is hopefully ready for the next test beam period. She already wrote a lot of code, such as code to write the native DEPFET data into LCIO format and a specific pedestal and noise processor. A long to-do list was also shown.

I. Gregor: Experiences of AND with telescope users

In 2007 we had already three different users for our telescope and we gained a lot of experience with these users. The first users were the DEPFET group; we reported on this previously. The second group was the SiLC collaboration. They were using the EUDET telescope in October shortly after the end of the EUDET test beam. The whole JRA1 test beam crew helped to move

the telescope to H6 before leaving. With the support from Geneva, SiLC could smoothly take data with their new silicon sensors. So far they have problems to see correlations between the SiLC data and the telescope data. We assume that they did not implement the TLU correctly. As they might be using the telescope this summer again they are currently trying to adapt the TLU in their DAQ system. After the end of the test beam the SiLC group needed six weeks to ship the telescope back to Hamburg which resulted in a number of problems and affected the data taking of the next user (see below). In the discussion we decided that in future we will take the responsibility to ship the telescope ourselves and do not rely on the user. The financing of these transports has to be looked at.
The next user of the telescope was the BeamCal collaboration. They wanted to measure the absolute number of charge created by ionisation when a HEP particle of known energy passes a single crystal diamond. Using the EUDET telescope allowed them to measure the charge while removing edge effects.
Due to the late arrival the time to prepare the telescope before the start of the BeamCal test beam was very limited. Philipp managed to port all the software to one Linux computer and set up the system with the help from Geneva (Daniel and Emlyn) and Angelo. Before the BeamCal group arrived the telescope was nicely working. But when starting the actual data taking, a lot of problems started: Runs sometimes started only after a few minutes, problems with Linux version of the DAQ SW (MAC traces), TLU producer crashing (we assumed a problem with the TLU), no trigger busy during switching of the files (runs were stopped by hand before size limit was reached) etc. With a combined effort of both groups, the system got into a state that allowed data taking, even so the efficiency of the data taking was low. In the end 80.000 events were reached.
In order to avoid such problems for future users we will write a dedicated Memo which collects all the information necessary for the user (this information is currently distributed on a number of memos). It was also decided that this information will be kept on a webpage “what to do when”.
We will make clear to the users that they either integrate their system in our DAQ (reasonable for long time users) or at least use the full functionality of the TLU.

S. Mandry Test beam Result ISIS

Scott reported on the first result of the ISIS test beam last summer at DESY. They did not use the EUDET telescope but are planning to use it this summer. Scott presented an overview on the hardware needed for the ISIS sensors and details about the test beam setup. He presented first promising results of the test beam data analysis. He convinced us that the ISIS sensors can easily be integrated in the telescope this summer, also as the TLU is (naturally) integrated in the current system.

A. Besson Testbeam Results Mimosa16 and Mimosa18

Auguste presented the “final” result of tests with the Mimosa16 with 14 and 20 um epi layer. He reminded us about the characteristics and showed a nice summary of the efficiency, the resolution and the average fake hit per pixel/event were versus the discriminator threshold voltage. Numbers to keep in mind for Mimosa 16: digital: efficiency ~ 99.9 %; fake rate about 2 x 10-5; digital resolution ~5 µm; Analogue performance: S/N (MPV) ~ 16-17; residual ~2.1-2.5 µm. 14 µm and 20 µm epi layers have comparable performances (larger clusters for 20 µm). Overall the performances are very satisfactory.
In the second part of his presentation he reported on thinning, resolution and efficiency of Mimosa18. The preliminary numbers for M18 are: Noise: ENC~9.8 electrons at room temperature. The S/N (MPV) for the 14µm and 20µm epi layer is 27 and 30 electrons respectively. The Efficiency is about 99.85$\pm$0.15 % (prelim.) The fake rate studies are in progress. A test beam with four M18 was done and a resolution of ~1um was measured.
He also reported on the thinning progress: M18 was thinned at APEK in California to about 50um. Test with the bonding machine indicate thicknesses between 50 and 70 um. As reported in Paris, the first trial to place a thinned sensor on a board was resulting in a bow in the chips. A second trial shows no bow. Measurements with Fe55 and 120GeV at the SPS indicate no decrease in the performance of the chips. The thinning seems to be on a good track.

W. Dulinski First Results on SUZE01

Wojtek gave a short overview on SUZE01 which is the zero suppression circuit for Mimosa22+. He explained the proposed hit encoding for the binary readout of MAPS: encoding of adjacent hit pixels in a row (up to four in one group) plus a common row address (if more than one state/row), means data compression but no real clustering. He showed the general layout of SUZE and went through the basic specifications for SUZE01 and a projection for the M22+ performance. With present SUZE architecture, the limit for the hit rate is defined by the output data link. For one serial port/chip (1bit wide) @100 MHz, the maximum hit rate is ~300 states/frame (up to 106 hits/s; supposing 3 states/hit (overestimation), but beware statistics and the beam structure!). This rate can be (almost) doubled by the implementation of two serial links or by running (output port only!) at 200 MHz. It is not decided if one or two serial links will be used.
The SUZE01 was delivered in December and is currently being tested; so far no single bug detected yet. The chip works at the nominal frequency, several different input patterns give the correct sparsified result. More detailed tests in progress.

F. Guilloux Status Mimosa 22

Fabrice gave a detailed overview of the status of M22, which was received from the foundry on January 9th. He went through the details of what they learned from Mimosa 16 (.1 to .3) and summarised the characteristics of Mimosa22: it is processed in AMS-OPTO 0.35µm and has a pixel size of 18.4 x 18.4 µm². The number of pixel is 136 x 576 pixels [compared to the final number of: ~ 1088x576 or 1088x544]. Eight Analog Outputs and 128 end-column discriminators are included. The slow control interface is JTAG.
Functions included in M22: all the analog parts and the ¾ of the digital parts are embedded, with careful "scalable" design technique. Layout: The chip is ready for an "horizontal stretch" (to 20mm). Next step to the final sensor

- Full size analog & digital optimizations ➔ mainly due to long (~ 2cm) wires
- Implementation of Zeros Suppress

M. Goffe Mimosa 22 testing preparation

Mathieu explained us what is necessary to test the Mimosa22: Three boards are needed to test the chip:
• The proximity board where the chip is mounted and bonded. It includes the minimum front-end electronic, just the signal amplification for critical signals.
• The Analog auxiliary board: To buffer the 8 analog signal of M22 to be transmitted differentially in long distance (40 m). We will use two AUX_V4 to do the acquisition of the 8 channels.
• The Digital auxiliary board: it generates the 100 MHz clock of M22. Buffering the digital signals from DAQ to Mi22 (and the JTAG) and from Mi22 to DAQ in LVDS to be transmitted over a long distance (40 m). It provide also power supply of the chip and proxi_board
He gave us a status report on the new hardware pieces and the necessary software upgrades. The boards are designed and will be assembled soon. Mimosa22 is back from the foundry and will be bonded next week. After first bench tests, the detailed tests will start in March.

E. Corrin Status DAQ Integration Updates

Firstly Emlyn reported on the state of the documentation of the EUDAQ software. He moved the repository to HepForge: http://www.hepforge.org/projects/eudaq
During the test beam at DESY and CERN we had problems with the speed of telescope readout (or better the non-speed). A single access is very slow (~4 ms per access). Investigation showed time is lost reconfiguring VME on each access. This problem was also found independently by Lorenzo. They modified the driver to detect if settings have changed and only reconfigure if needed. A single access is now reduced to 2-3 µs. But we still lose ~4 ms every time we switch EUDRB (at least once per event: 6 boards * 4 ms = 24 ms at ~40 Hz max rate). The loading of the pedestals went from ~2.5 min / board to < 1 sec, but the readout speed is not significantly

improved. Emlyn is currently working on a driver change to access the boards only once per event to reduce the readout time. He reported on other issues which were fixed in the code and reported shortly on the updated RootMonitor from Joerg.

C. Bozzi Status DAQ Integration Updates

As Angelo was not available for this meeting Concezio summarised the latest progress on the EUDRB work. He reminded us that Angelo wrote a very detailed memo on the EUDRB where all the technical information is available. He reported that the improvement on the VME problem was traced down to the VME library which still included more system calls than strictly necessary, as already mentioned by Emlyn. Lorenzo prepared a new library which allows to go down a couple of orders of magnitudes in the execution time of a SCT. They feel it is no longer mandatory to modify the EUDRB's VME interface to support MBLT write cycles, as it was proposed to speed up the thresold/pedestal upgrading. Also managing slave-terminated blocks is now possible, due to a modification in the driver. Lorenzo has modified the driver and tested slave-terminated transfers in 2eVME and 2eSST successfully on a commercial board (CAEN V1290A): a slave-terminated block read does not cause anymore the flushing of all data buffered in the VME-PCIx bridge. To be tested on the EUDRB as soon as the 2eSST transfer mode is implemented. The next steps for the EUDRB are the 2eSST and multi event mode implementation in the VHDL code.
The Mimosa18 readout, where no new daughter card is necessary, should be available April 1st. Concezio also showed a introductory slide for the discussion on how to proceed. The afternoon discussion will be summarised below.

S. Mandry TLU progress

David send his apologies for not attending the meeting and Scott gave a quick summary on the status of the TLU work. TLU v0.1 was used in various test beams in summer 2007 and they received a number of useful comments from the users. The design of v0.2 is under way: RJ45 connectors unchanged. They will add four "HDMI" connectors (to allow connection to Calice clock-and-control unit) and four sets of LEMO trigger/busy/reset signals. Two sets with LVTTL output levels and two sets with NIM output levels will be added. Inputs can be switched between 50-ohm and high-impedance. The threshold is controllable by software (10-bit bipolar DAC).
The total number of DUT interfaces remains unchanged at six, but can be switched between LVDS, HDMI and LEMO under s/ware control. The "user interface" will be changed in such a way that the TLU can be used in stand alone mode.

I. Gregor Mechanics and Infrastructure

The test beams in 2007 helped to identify necessary changes in the mechanical support structure of the demonstrator telescope. The main issue is the cooling of the chip. The extreme flexible setup makes direct cooling difficult and it was observed that the temperature was stable, but too high. First improvements were done by redesigning a new L-piece which is much simpler and a direct metallic contact to the boards is foreseen. This new L-piece was tested last week; only small improvements were observed. Carsten is now working on further improvements. Apart from the cooling it was also experienced that the alignment of the telescope table to the beam axis as well as the measurement of the plane distances in z-direction are very clumsy. Improvements are foreseen for the next test beams in summer.

W.Dulinski Application of EUDET telescope for neutron source calibration at Cadarache

Wojtek presented to use the EUDET telescope at the neutron source at Cadarache in the Provence. The idea is to use the TAPI beam telescope (thinned M18 chips) with its very compact mechanics together with the EUDET DAQ (4 planes). A tentative date is the 21st of April 2008 and the test period would be one or two weeks.
Neutron flux in the beam: 6000 n/s/cm2 -> 6 protons/s/cm2
Official working hours (to be absolutely respected): 8 am till 4 pm. But automatic tests may continue through the night!
• All persons planning participation must apply for the entrance permit several (>6) weeks before

• Cadarache may contribute in the costs
In the discussion it was concluded that this would be a very interesting application of our telescope and this will be foreseen in the planning for the year (see below).

Detailed planning of 2008

The main topic of the discussion was the planning of the EUDRB. The main question was if a dedicated EUDRB readout for the Mimosa22 should be build or if we can directly go to a daughter card to read out the Mimosa22+. Wojtek prepared a few slides where he summarised his idea what would be the reasonable approach. He suggested working on the current EUDRB to fully exploit the performance of the demonstrator chip (MimoTEL). Increasing the flexibility (e.g. coexistence of different chips in the telescope) and the speed of the DAQ board would be of highest interest.
For Mimosa22+ we should clearly define the goal for the Mimosa22+ DAQ. In the discussion it became clear that the exchange of specifications was problematic in earlier times and these needs improvement. It was agreed that the specifications of the Mimosa22+ such as how many serial lines should be defined by end of February (IPHC/IRFU) to give INFN ample of time to design the board. It was also discussed that the performance of the system should be adjusted to realistic numbers of tracks expected in beams. These numbers should be defined on a short time scale as well.
The detailed planning of the project up to the point when the final telescope was discussed on the basis of a project plan. The main milestones for the next 18 months are:

- Mimosa22 (IDC) ready (31.03.2008)
- Mimosa22+ (final chip) ready (31.12.2008)
- Final readout ready (31.12.2008)
- Tracking Software ready (31.12.2008)
- Final Telescope ready (31.03.2009)

The last milestone was now shifted from originally 31st of December 2008 to 31st of March 2009 to account for the fact that the final chip is only available at the end of the year. This is defendable as we are already providing the demonstrator telescope. We have to work hard to meet this milestone.
It was also discussed where and when the demonstrator telescope will be used by whom.
The “telescope on tour” phase will start in April with the Cadarache test. Here we only have to provide the readout of 4 planes and some support to use the DAQ. Strasbourg would provide the TAPI telescope with chips. We have to organise when and from where we send EUDRBs and other infrastructure. All agreed that this is a nice project and we will start the organisation asap.
Next user will probably be SiLC for which we would move the telescope (complete setup) to CERN. We have to make sure that someone is present to setup the telescope and later on to store it in a safe place. This we will not leave up to the users due to the experiences from 2007. Ingrid is in contact with Emmanuelle Perez (SPS coordinator) to organise the details for the storage.
In July we have one week at PS (23.7-30.7 with DEPFET), two weeks at H6 (6.-20.8) followed by each one week DEPFET (probably using the telescope part time), and LCFI (telescope use possible) as main users. For the long phase at CERN we will provide support.
Still open is what happens after this, as there is interest of SiLC to use the telescope after week 40 at CERN (after end of September) but at this point the telescope is planned to be back at DESY. These details will be finalised in the next couple of weeks.

Next Meeting:

First week of May, Geneva (details to be defined)