

## Minutes of WP-meeting 266

### Attendance:

DESY: Ulrich Einhaus, Oleksiy Fedorchuk, Leif Jönsson, Uwe Krämer, Paul Malek, Dimitra Tsionou  
Vidyo: Paul Colas, Keisuke Fujii, Qi Huirong, Jochen Kaminski, Tomohisa Ogawa, Ron Settles, Aiko Shojia, Akira Sugiyama, Jan Timmermans

### General News:

Following the discussion and the email exchange, Ron had made a summary of the formulas given by Keisuke. It was then discussed what the implications for the DD4HEP implementation are. After some more discussion it was decided that only the B-field dependence should be corrected. Besides, the  $N_{\text{eff}}$  and other parameters ( $D_T$ ,  $D_L$ ,  $\sigma_0$ , ...) should be updated, but since the current numbers are conservative and should remain as a reference, Dimitra will see, if these numbers can be kept as default and a revised set of numbers can be implemented to be chosen if required. All other changes, for example, to make  $N_{\text{eff}}$  dependent on  $\sin\theta$ , will be less conservative and were therefore discarded.

The discussion of the reduction of 6.2 cm to 3.2 cm of uninstrumented area between the last pad row and the field cage was shortly picked up. Field homogeneity should be mostly good, but the servicing, in particular the calibration laser might be difficult to be implemented, at least without field distortion effects on the last pad row. But this will be only locally at 4-8 places.

Dimitra also asked about the implementation of the cooling pipes in the DD4HEP module. Currently 6-8 tubes stubs are foreseen for the cooling per TPC quadrant. It was discussed that this is too much and that one incoming and one outgoing pipe per endplate would be enough. Maybe the diameter has to be increased and definitely the pipes have to be lengthened and lead through the gap to the outside. There is also the question if the cables should be added. The 25%  $X_0$  includes everything on the endplate, but not the cables end pipes supplying HV, power and cooling to the endplate. Jochen is posting a summary table with current estimates for the cables to this agenda.

### PCMAG/LP setup, test beam:

Dimitra: PCMAG/TRACI/test beam area:

- Oliver has tested the movable stage. He found a small difference of about 100 $\mu\text{m}$  when going from front to back to front again. He will study the origin of this difference. The stage can now turn again from +45° to -45°. Now PCMAG is ramped to its full magnetic field again.

### News from the groups:

Dimitra had a test beam last week at the T21/T22 beam area. The KPIX chips were bonded to LAL sensors and mainly DAQ and synchronization issues were tested, which was successful. For the final detectors the sensors have been ordered by Hamamtsu and will be delivered at the end of July. At the end of summer the KPIXs will be bump bonded on the sensors by IZM, Berlin. And at DESY they are setting up an assembly line for the remaining components. In particular the DAQ card has to be modified, since an additional connection for the event number and clock of the TLU has to be added. For this Uwe and Dimitra will discuss the layout with colleagues at SLAC during the AWLC2017.

Jan and Jochen said that the test beam at Bonn with a first Timepix3 GridPix is delayed by a few

weeks, because there were vacuum problems in the accelerator. However, the time was used to study and implement a minimal synchronization of the Spidr readout of Timepix3 with the EUDET telescope.

Aiko presented an update of the dE/dx-analysis of the last test beam data. She uses a truncated mean (30 % of highest charge hits are removed) of the 26 measurement points. The energy resolution is 13.9 % without the gatingGEM and 14.4 % with the gatingGEM. This value is constant throughout the drift distance of 50 cm. Aiko also simulated the dE/dx measurements with 220 sampling points from consecutive tracks from different events and obtained a dE/dx resolution of 4.7%, which is below the original goal of 5%. It was pointed out, that the ionization of electrons is about 1.4 times higher than that of MIPs, so their energy resolution will be a bit worse. There is also no degradation of the charge signal or the energy resolution with the drift distance observed. Hence there is no sign of attachment. In the Asian GEM modules, a significant gain variation has been observed along the beam direction up to some tens of %. The gain correction, however, made only a tiny effect on the dE/dx resolution for the 220 sampling points. This is consistent with the theory prediction that the fluctuation is largely controlled by the primary ionization statistics and the relative variance due to the secondary ionization and other sources of fluctuations in the later stages is suppressed by  $1/\langle N_{\text{primary}} \rangle$ .

Paul M. added that he is also studying the dE/dx resolution of the DESY-GEM module and he also reaches about 5%. For an inter-channel calibration they pulsed the GEM to get the same signal on all pads. This shows, that there are only small fluctuations in the calibration and this has no big impact on dE/dx.

Paul C. reported that he is preparing further measurements of electron transparency and ion feedback at CERN with the gating GEM. He has received the gating GEM from Tomohisa and has given the GEM to Rui for framing. The gating GEM has a somewhat irregular shape (rectangular and not quadratic) and the contacts for the two electrodes is at the same position, which creates some difficulties for contacting it.

AOB:

The next workpackage meeting will take place on July 6<sup>th</sup>.