Minutes of WP-meeting 151

Attendance:
DESY: Stefano Caiazza, Isa Heinze, Volker Prahl, Christoph Rosemann, Klaus Zenker
Webex: Ties Behnke, Paul Colas, Philippe Gross, Gilles de Lentdecker, Dan Peterson, Ron Settles, Akira Sugiyama, Wenxin Wang, Jochen Kaminski

PCMAG/LP setup, test beam:
Christoph: PCMAG

- PCMAG has been cooled down, the second expert from Japan, Makida-san, has arrived three days ago and everything is ready. Extensive tests have been started. High current tests have started already yesterday. Tomorrow the DESY group will be introduced in how to handle the magnet. There are a few safety aspects that have to be clarified: The electronics of PCMAG is distributed in two racks. It is not clear yet, if this is allowed by the DESY safety regulations.

LP

- The LP has been cleaned and both the cathode and the endplate equipped with 7 dummy modules have been attached to the LP. Flushing with gas has started yesterday and next week HV tests will start. Some cables inside the field cage have been changed to avoid the sparking.

test beam schedule

- It looks like the setup is ready for data taking starting early July. Paul expects to be ready with a few modules (see below) for a 2 week run. Starting beginning to mid of August the DESY modules will be ready for the test beam. Depending on how fast they can be commissioned the data taking will last until mid to end of September. Paul would also like to make some measurements with the complete set of 7 modules some time in September. Because of many conferences October is not a good month for anybody and starting from mid-November the Japanese module will be tested.
- Final discussions on the schedule in September will be done in July, when the DESY-module will be close to be finished.

News from the groups:
Paul: - The 7 module project will not be finished before July, since the CERN workshop has caused some delays. Sofar, only 2 modules have been delivered, of which one was tested successfully, and the other one proofed to be broken. The remaining ones will be delivered later.

Discussion on mechanical issues:
In this special session open issues should be discussed and a path to solve them should be agreed upon.
Jochen: One issue that came up during discussions in Fukuoka was the number of cables per endcap. The current number in the simulation model for one endplate consisting of 80 modules is as follows (according to Catherine Clerc): 1 HV cable (50 kV), 14 HV cables (1 kV, Ø: 0.14 mm²), 8 optical fibers, 1 low voltage lines (32 A, Ø: 0.785 cm²) and 1 ground line (210 cm²)
This seems to be optimistic and several contributions were discussed. The first modification is, that the current plan foresees 240 modules potentially increasing the service cables by a factor of 3. HV: The HV supply of the modules is only valid for Micromegas and increases in case of GEMs by a factor 4 or

6. Also, a possible gate has to be taken into account. On the other hand the HV supplied by one cable could be distributed over several modules. Also, a possible gate has to be taken into account. The HV is, however, only a small fraction of the cable cross section. Optical fiber: again, the number of modules gives the largest variations. LV: This needs to be re-evaluated with a better understanding of current electronics. Also the influence of power pulsing should be considered. Ground: This is by far the largest contribution and it was not known anymore, on which considerations this figure is based on. It was agreed that the need should be re-evaluated for both cases, the GEMs and the Micromegas. Paul and Takeshi should be asked and for electronics Leif, if they could do this.

Volker gave a short summary of his simulations on the TPC support. He first shows the available space, which is a gap 200 mm wide and 55 mm deep limited on one side by the HCAL junction plate and a 30 mm no go zone on the other side. In this area the cables and a the support bars have to go. Both a double-T bar and a rectangular bar as well as a flat ribbon cable were simulated. The preferred solution would be a bar support, since it also gives support in the longitudinal direction. However, more information on other materials (such as ceramics) is needed, since the current models require too thick bare sizes. In the case the flat ribbon cable additional installation is needed in the longitudinal direction to prevent the TPC to hit against the endcaps.
Another issue is the HV cable of the cathode. It has to pass out at one of the endcaps. It is not clear if it should be attached to the outside of the chamber, or if it could be buried in the field cage mantle. But this question is too detailed for the DBD.

Ties: Cathode: The simulation model for the DBD shows a large spike or 40 % X_0 in the middle of the detector. This was traced to the cathode support which is implemented as a 30×15 mm² rings of solid aluminum at the inner field cage as well as at the outer field cage. This results in a material budget of 30 % X_0. It was agreed upon, that this is too much and is likely because the complete service area inside the gas volume, which is at both radii 30 mm wide, was filled with the cathode support. Ron remarks that the support was 10×8 mm² at ALEPH (he attaches the appropriate page of the ALEPH handbook to the agenda).
Ties suggest a more elaborated sandwich structure of 1 mm carbon, 28 mm carbon-foam and 1 mm carbon resulting in a material budget of only 1-2 % X_0. The cathode should be glued onto these rings. First samples have already been produced at DESY for a different application, but seem rigid enough. DESY will make further tests. It is agreed that this seems feasible and the best solution. Therefore, the simulation model will be changed to a material budget of 4-5 % X_0 (including a safety factor or 2).
The cathode design itself should be very thin, currently the plan foresees a thin mylar foil covered with a conductive carbon-layer similar to ALEPH and STAR. The foil has to be under tension (200 kg ?) and will be supported by an inner and outer ring.
The field cage needs some more studies: There have been already some simulations by Saclay and DESY, but these simulations end in errors and singularities, because it is quasi impossible to implement composite materials, in particular honeycomb structures from first principles. It is more useful to produce small samples, measure the strength by measuring the deflection of these samples due to a weight and then implement the wall as an equivalent sheet of solid material (e.g. of aluminum) with the same strength. For installation and servicing it is important to know, if one can stand on the outer field cage (like at ALEPH) or not (like at STAR). Besides, one needs to know, how stable the field cage is to decide how to support the central cathode: It would have to be self-supporting with a small gap to the field cage, if significant movements or distortions are expected, or it could be fixed to the field cage, if the FC could be shown to be stable.

Paul: Saclay is setting up a new tool to evaluate various endplate layouts. It is meant to optimize the number of rings and modules with respect to several key parameters like deformation, material budget, weight. It is based on Cathya, which handles the various parameters and does the iteration and optimization, and ANSYS for the mechanical calculations. As a starting point for material budget, the values of the current MM module (which is not yet optimized for material budget, but still reaches 0.25 X_0) are used. Besides, the inner radius and the outer radius were fixed. Several endplate layouts with various number of rings and modules were shown and their weight, if realized in solid aluminum (10×2 cm^2 bars) were shown. A more elaborate implementation is needed.

Dan gave a short summary of his more detailed report from the collaboration meeting on 26th of March 2012. The requirements are near full coverage of the endplate with modules, low material budget (mechanical structure should be only 8 % X_0), high rigidity and only 10 cm thin. A FEA simulation of the endplate was made with a support at the outer and inner endplate. Several endplate models were tested and the deflection caused by a 2.1 mbar overpressure in the chamber was determined for each model. A space frame based model gave the best result giving a deflection of 0.22 mm in the longitudinal direction at a middle radius, while a simpler solid version gave a deflection of 50 mm. The space frame model was then used to produce an endplate for the LP and deflections were measured by pacing a weight in the middle of the endplate and the deflection was measured. The measurement yields a deformation of 28 µm and thus confirms the simulation of 23 µm. This model predicts a full endplate weight of 135 kg corresponding to a material budget of 8 % X_0. The endplate of the LP was predicted to be 8 kg, but final weighing gave a total weight of 8.8 kg. The additional material is possibly due to longer screws and thus could be removed. The mounting of the struts and the leveling was easier then expected and it is likely to be feasible in about 250 man hours. More difficult seem the production of a such a large size plate with the given precision. Also cold shocking is a solvable challenge, since it requires a sizable amount of liquid nitrogen.
Dan also gives some answers to the questions raised before the meeting:
(a) Rigidity/deformation of field cage and endplates for given scheme of TPC support
- → The current FEA model can be used to make studies of the influence on the deformation. Dan will study this.

(b) Structure of the central cathode electrode and HV supply/cable
- → Connection of cathode to inner and outer field cage is difficult during assembly. It would be possible to connect it through the inner field cage.

(c) Procedure of TPC assembly and installation
- → Some possible order of assembly was discussed (see slides).

(d) Monitor (deformation/misplacement)
- → Laser monitoring is needed.

(e) Support structure of the silicon envelopes
- → There is probably enough strength in endplate for this. If information is available they can be tested in the FEA model.

(f) material budget of endcap: most contributions are quite reasonable. Only the contribution of 0.1 X_0 of the cables need confirmation (see above). The 25 % X_0 can be achieved as the Micromegas modules have a material budget of 25 % X_0 already without optimization. But this does not take into account the endcap and the cabling. Therefore optimization is necessary.

In general it was felt, that the status of the mechanical understanding is in good shape. As stated in the text, there are a few issues which need to be looked at in more detail. For these volunteers have already been found.

AOB:
The next workpackage meeting will take place on June 21st.