

Minutes of the first EMC assembly review meeting at Giessen, September 20-21, 2016

Fritz-Herbert Heinsius 28.9.2016

Participants: Bochum, Giessen, GSI and IHEP

Introduction and Current Status of the Slice Assembly

Hans presented the current status of the barrel slice assembly. The preparations are well advanced. Specific points are written in this minutes under separate topics.

Crystal assembly:

- Al capsules for the first slice were 3D-printed with halogen free PA 2210 FR. The material was irradiated with 1 kGy.
- The laser cut prototypes of the foils will be delivered next week.
- Bochum group will send temperature sensors for the assembly of the submodules well in advance before the first assembly on October 10.
- To continue the matching of APDs and gluing them to the crystals it is required to receive the promised 120 screened APDs per week.

Assembly schedule:

Assembly of the modules and super modules is scheduled in three sessions during the weeks 42/43, 45/46 and 49/50, starting on the 17.10., 14.11. and 5.12., respectively.

Cables and electronics within the slice:

The backplane sandwich PCB was shown. Four pairs of signal cables are soldered for the connections to the SADC. In addition, there is one cable for the slow control. For the first slice a HV distribution board with conventional electronics will be assembled. For the next slice one will use radiation hard chips with I²C bus and DAC included.

The flex cables (from cold to warm volume) are not long enough for type 11 crystals. These 30 cables have to be exchanged later. 160 flex cables are available.

There is an offer of 1000 pcs from two companies. The lead time is 10 to 11 weeks. The order of flex cables at GSI is delayed.

A difficult step is the connection of the support beam with all the flex cables. For the next slice the holes in the support beam will be placed such that they match the holes in the mounting plates.

Review of APD irradiation procedure

EPICS based HV control software was installed last week by Tobias and solved the hard- and software problems of the HV-control. In the morning the cabling of the APD irradiation setup was redone and checked (Andrea and Tassos). All APDs are getting HV and no short cuts are observed anymore. Markus presented the requirements for two matched APDs: $dV_{bias} < 0.1 \text{ V}$ and $d(1/M \cdot dM/dV_{bias}) < 0.1\%/V$. The distributions of 300 APDs are shown: $1/M \cdot dM/dV_{bias}$ at $M=150$ average around 6.2% and change of $1/M \cdot dM/dV_{bias}$ at $M=150$ before and after irradiation with a peak around 0.1/V.

According to Andrea the following parameters are checked before and after irradiation: V_{bias} , V_{break} , I_{dark} , I/M , $(1/M \text{ dM/d}V_{\text{bias}})$. About 81% of the first 300 APDs can be matched. Currently the glueing procedure is stopped due to missing data of the irradiated APDs (DB upload issue to be solved quickly). To keep the assembly schedule, 120 screened APDs are needed per week. At Giessen 400 APDs are irradiated and annealed per week. Irradiation time of 1 h is sufficient to get a dose of about 37 Gray. All measurements at Giessen are documented in a database: <http://www.ep1.ruhr-uni-bochum.de/endcapProductionDB/>.

Review of the glueing procedure including hands-on lab activity

Tom summarised the history of the glueing procedure and recent results from Bochum.

Discussion on the 1:2 problem of the APD signals: It is observed at Bochum during beam time, with cosmics and in cooling fridge and is identified as insufficient gluing (APDs are falling off during cold cycling). Similar 1:2 signal ratios are observed also for the three beam times with the Proto120: First beam time, type 1 crystals, 2 out of 7 (glueing was not thoroughly checked due to limited time), second beamtime 3 out of 10 and third beamtime 4 out of 18. No bad glueings were observed for type 3 crystals. For the first beam time the gain of the APDs were not exactly known. It is not possible to have different high gains (32 or 16) within one ASIC. Stefan will check the high/low gain ratios for the last beam time (this was done and was ok). It is suggested to measure the light output of 2 APDs where one is not glued.

Bochum uses now the recommended primer from Dow Corning. Glueings with primer resist at least a factor of 3 higher shear-off torque. Temperature cycling did not show a broken glueing connection. Four radiation hard glasses are available at Giessen and will be glued with and without primer and irradiated at Giessen.

Lab visit to the glueing facility in Giessen: In the air conditioned lab APDs are matched and sorted for the glueing procedure. The glueing itself is done in a clean room within the lab by trained students. Everything is well prepared.

Lab results: Measurements of the torque required to remove APDs from the PWO show comparable results between Giessen and Bochum glueings. However, for Giessen glueings only one APD is removed, while for Bochum both APDs sit together in one capsule and are removed together.

Giessen uses a Teflon tool to put only a thin portion of glue from a tube on the surface of the APDs (about 0.1 mm). Bochum utilizes a dispenser. The thickness of the Bochum glueings and the Giessen glueing without the Teflon tool are on the order of 0.15 mm. Thickness of the newer Giessen glueings are to be measured.

Positions of light pulser and THMP, routing of fibres

Reflectors to be placed into the glued front inserts need to be produced (Giessen). In the front there is only 3 mm available for the routing of the fibres. Routing of each group of 4*71 fibres will go along the row of 71 crystals. How to bundle, support and cover them needs to be studied (Andrey Levin). Fibres type: CeramOptec UV 200/220 P 28, outer diameter 0.245 mm, 4 fibres per crystal, 3.3 cm bending radius. The fibres will be fed within the cold area to the bottom part of the support beam and then along the signal cables to the position of the SADC crates, where the light pulsers (2 per slice) will be placed.

Due to the tight space the temperature sensors (flat cable length including temperature sensor is 50 cm), the cables will go along the inserts on the back. The IHEP group will produce grooves on the inserts and mount plates. The Giessen group will check side effects on a dismantled Proto120 module next week. They provide a list of inserts, which need to be modified. About 70-77 temperature sensors are planned (4 per group of 40 crystals). Adapters from the connectors on the flat cables to the flat ribbon cables need to be produced.

The THMP modules (two per slice) will also be placed at the position of the SADC crates.

Cooling and Insulation

Latest Orsay design has round PU cooling lines in front and back. Square lines would require less space in the front. In the back it maybe better for heat transmission from the mounting plates. For the front only 26mm is available for the light fibres, cooling lines, insulation and a thin aluminium plate.

To do: Check the drawings, is it possible to extend space towards SciTil?

Drawings are in EDMS with 2 loops only on the top (rectangular lines). Check that there is no interference with the cable holes. Insulation on the top is done with rock wool. Possible to use preformed material?

The first slice is to be tested standalone. Later two slices are separated only by a 1 mm thick Al-sheet. This is depicted in status6.pdf. For the slice one needs insulation on both sides (thickness does not matter) and possibly cooling to imitate the cooled crystals next to the slice.

Cables and connectors

- High voltage cables: On the HV distribution board there is one MCX connector for 4 crystals (8 APDs) foreseen. Bochum will check connection of MCX connectors to Huber+Suhner Enviroflex_178 cable (1.84 mm diameter). HV cables then go to a patch panel in racks next to the magnet (connectors and length of the cables are to be defined).
- Low voltage cable: To be defined
- Sensor cable: Flat ribbon.

Four pairs of signal cables and one slow control cable are soldered to the backplane sandwich PCB.

Review of IHEP delivery and assembly site requirements

A detailed process description can be found in EDMS document number 1421085/1. The assembly room is currently occupied by another group and will be emptied by end of September. A crane (2t, 1,87m lift height) is to be ordered in the week of this meeting. The transport of the slices to the outside is only possible through a window in the roof of the room. A problem is that it is not large enough and the slices need to be tilted. Forces on the slices and possible bending have to be calculated.

All packages arrived at Giessen. The material was inspected after the meeting by the IHEP group and no damages or missing parts were observed.