Status of TDR for MM mechanics and relatesd issues

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Intro

- NSW TDR contains two chapters on MM:
  - MM Detector technology and performance
  - MM Construction

MM for NSW

- Based on Joerg's W. concepts
- Established configuration:
  - Floating mesh
  - Two B-to-B doublets per wedge
  - 1 doublet with eta strips
  - 1 doublet with stereo strips (3 deg.)

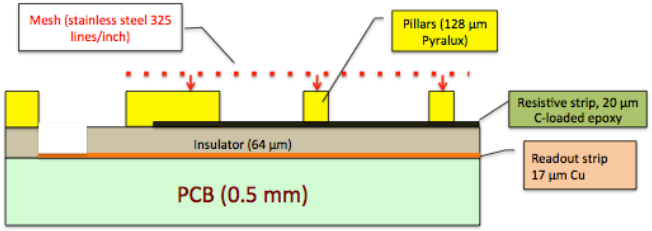


Figure 1.3: Internal structure of the MM readout boards, note that the mesh is not part of the readout PCB.

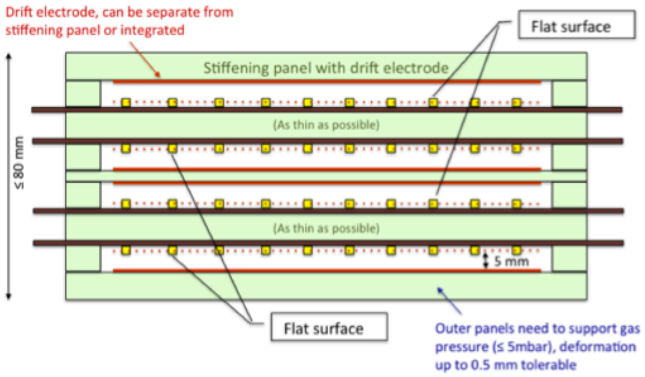


Figure 1.5: Arrangement of the detectors in a multiplet.

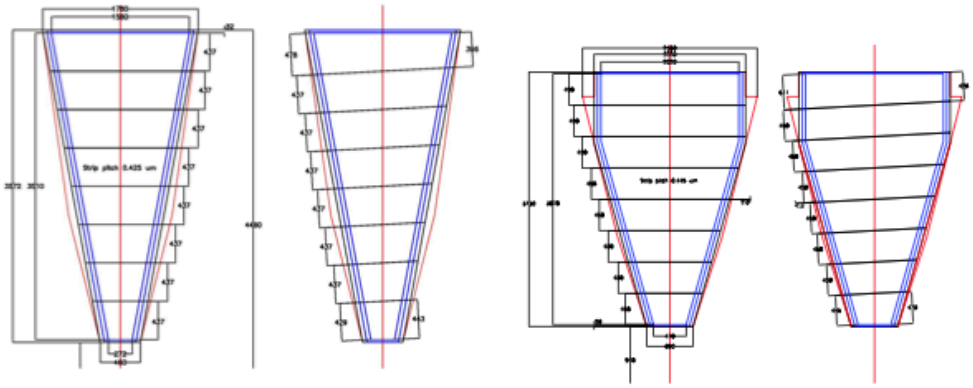


Figure 1.6: Segmentation of the small (top) and large (bottom) sectors into eight PCBs for the η (left) and stereo layers (right).

Wedge layout

- Two solutions under test
  - Single vs multi module wedge
  - Decision to be taken in July 2013
  - Pros' and Cons' are mentioned

The segmentation of the MM sectors in radial direction is still under discussion. Two approaches are being studied, one based on detector planes covering the full sector, the other splitting the sectors radially into two to four smaller modules. Mechanical prototypes of the two concepts are under construction and will serve to decide which way to go. The timescale for the decision is July 2013.

Both concept have their pro's and con's. The full-sector concept minimizes dead-space and simplifies the alignment system and services, however, puts a heavier load on infrastructure and logistics. In the several-module approach the dead space between modules in radial direction needs special attention. We envisage to solve this problem by building the chambers such that neighboring chambers overlap radially with at least two active gaps. In such a way completely dead areas can be avoided, guaranteeing at least two active layers being traversed per multilayer. The price to pay is a more complex mechanics and a larger number of different boards.

Support and alignment

- Mostly based on recent results from Patrick's simulations
- Still open options:
  - Al vs G10 spacer frame
  - Glueing vs screwing
- Spacer frame will also act as connection frame between the modules in the multi-module option
- Frame will be mounted in the NSW structure by mean of three kinematic mounts

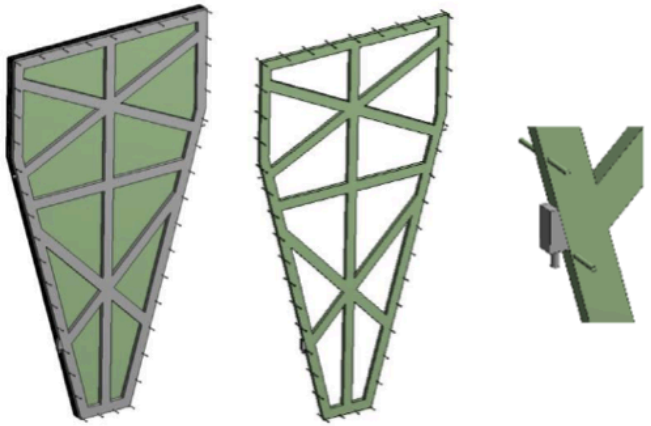


Figure 1.8: The MM central spacer for the full wedge solution. The drawing shows the position of screws on the external frame of the spacer. On the right a detailed view of one of the three supports is shown.

- Alignment: very generic description, refer to the NSW alignment system chapter

154 The alignment of the chambers follows the same scheme as used at present. An in-plane
155 alignment system, if required, will be integrated into the chamber support frames. For the
156 positioning of the chambers with respect to the alignment bars the alignment equipment
157 can be mounted on the multilayer surfaces on precision pieces that are linked to the
158 PCBs via precision inserts. The NSW alignment system is described in section **??**.

Studies of deformation of MM wedge

- Numbers are not final! They might change according to newer (more detailed) simulation

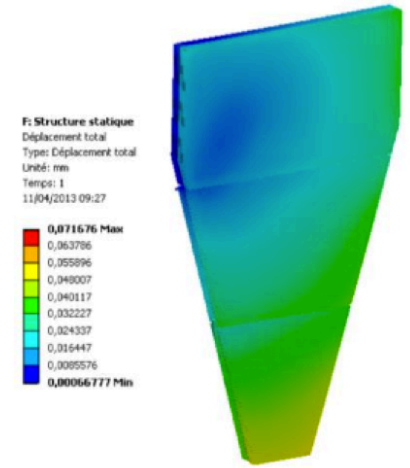
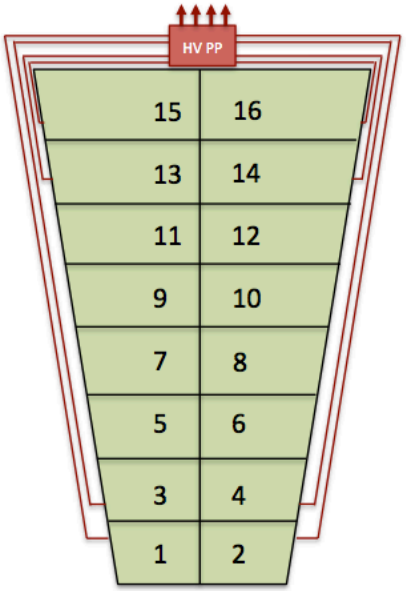


Figure 1.9: FEA simulation for two MM wedges (sector 5) made of three modules each screwed on a G10 central spacer.

Table 1.2: Deformation of MM wedge based on finite element analysis for 1- and 3-module wedge solutions and spacer frame of aluminum or G10. In all cases the modules are screwed to the central spacers.

	Full size wedge aluminum	Full size wedge G10	3-module wedge aluminum	3-module wedge G10
Maximum deformation in z direction (μm)	$\sim$30	$>$100	$\sim$35	$\sim$18
Maximum stress on the spacer (MPa)	$\sim$19	$\sim$7	$\sim$29	$\sim$8

MM Services



Readout boards

4 HV lines/layer:
HV 1 = 1 + 2
HV 2 = 3 – 6
HV 3 = 7 – 12
HV 4 = 13 – 16

16 HV lines to UX15 per quadruplet

MM readout board

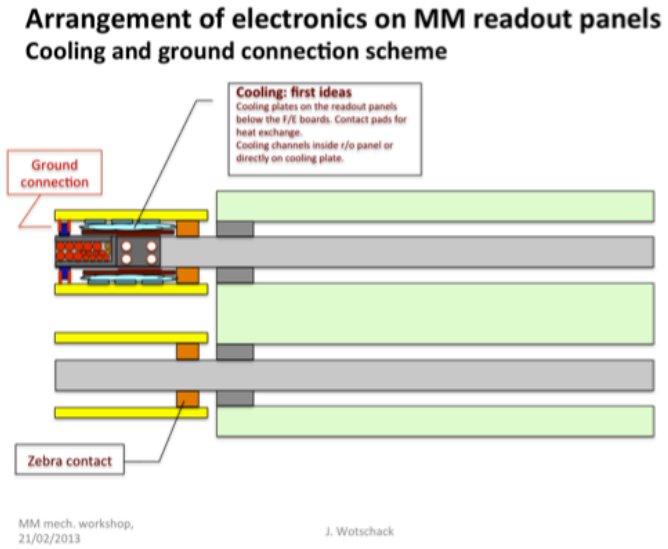


Figure 1.13: Integration of services in a MM sector, schematically.

- General description of the service is outlined.
- No conceptual changes are foreseen
- Some details can be added after recent studies (DC-DC converters from Dam A., advanced design of the cooling channels from Ulrich L.)
  These studies are still evolving, should we keep the general description or describe in more detail a system under development?

MM Construction (by Joerg W.)

- Flow chart

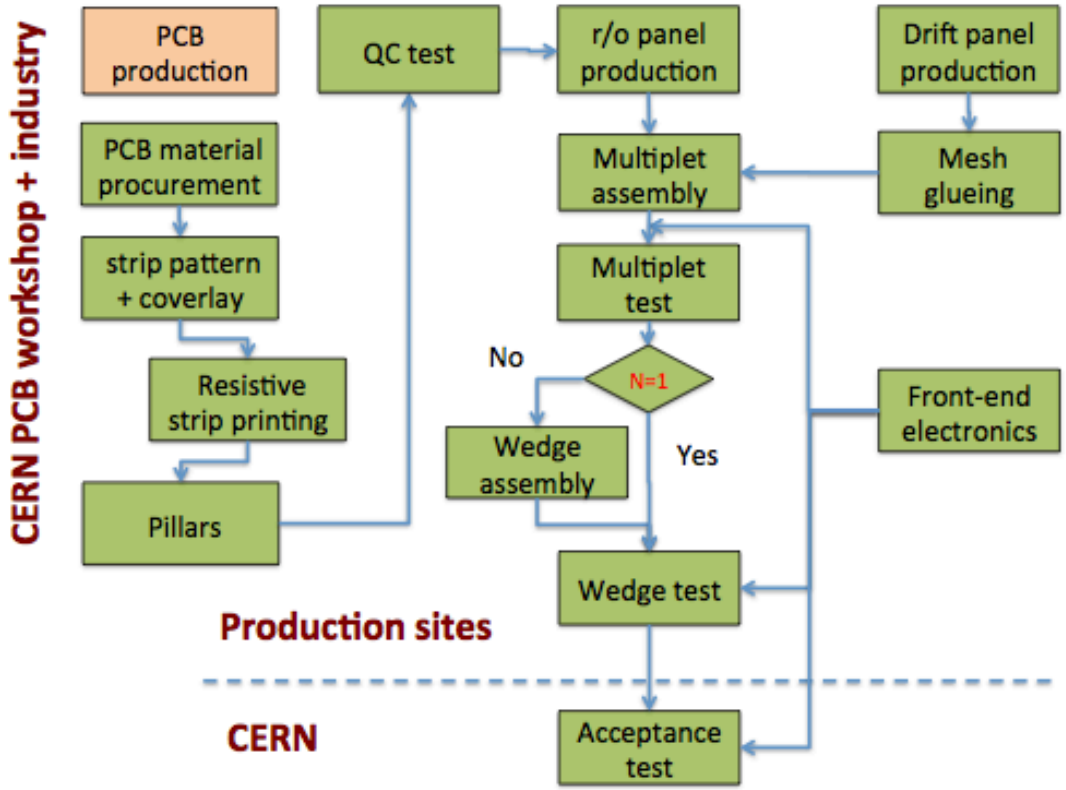


Figure 2.1: Flow chart of the MM detector construction.

Board production

559 **PCB layout** MM Collaboration together with CERN PCB workshop.

560 **PCB material procurement** either via CERN purchasing, taking advantage of the privi-
561 leged tax situation of CERN or directly by the production site.

562 **Production of films** three films per type of board are required, one for the PCB etching,
563 one for the resistive-strip pattern, and one for the pillar deposition.

564 **Etching of the readout pattern** and plating of the contacts with a layer of nickel-gold
565 (?)

566 **Lamination of coverlay** to produce an insulation layer between the readout strips and
567 the resistive strips., curing.

568 **Deposition of resistive strips:** either by screen printing or sputtering that have both
569 been proven to give excellent results.

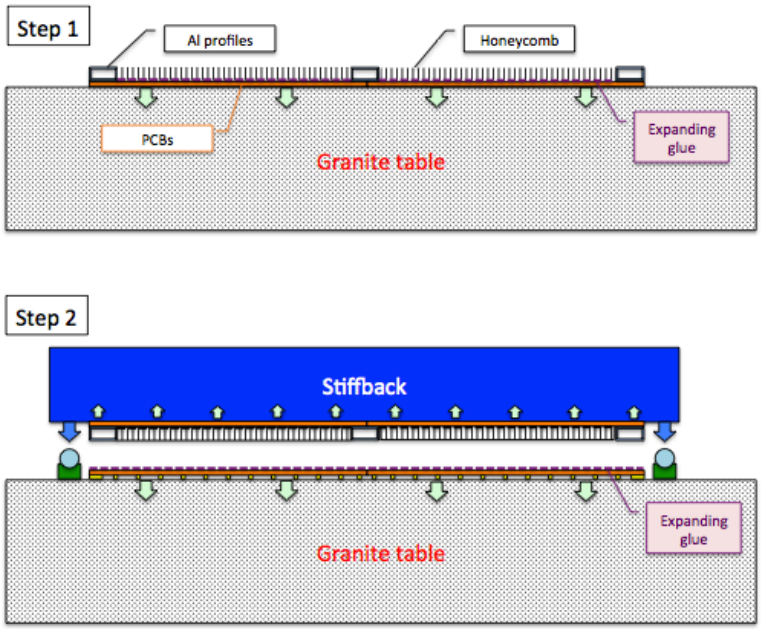
570 **Deposition of pillars:** that define the distance between the amplification mesh and the
571 resistive strips.

572 **Curing at 160 °C:** to stabilize the pillars.

573 **Finishing** Cutting the board to size and drilling, if required.

Single plane assebly

- The descibed procedure is based on the experience from the production of the large chambers at CERN (granite table, vacuum sucking system and stiffback panel)
  - Similar procedure for drift and r/o panels
- Different procedures are under development, not on time to be described in the TDR
- Description on how to align the two PCBs on the opposite sides of a r/o panel still missing
- Drift panels include frame with holes for gas distribution, O-ring for gas tightness and fame with pre-stretched mesh



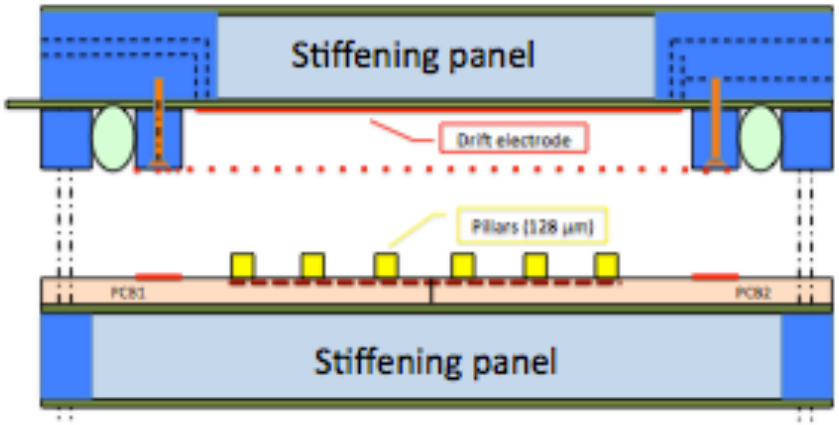


Figure 2.3: Schematics of the panel assembly method.

Quadruplet assembly

- Description of quadruplet assembly only sketched
- More ideas/drawings from talks of next sessions?

A quadruplet consists of two doublets each of which comprises a two-sided readout panel and two drift panels. The distance between the readout and the drift panels is maintained by 5 mm thick precisely machined bars plus a number of internal distance holders. The bars and distance holders define not only the drift space but, more importantly, they assure the co-planarity of the two readout doublets. The gas tightness is achieved by 6 mm diameter O-rings between the flat surfaces of the drift- and readout panels.

The assembly needs to be done on a flat surface with some positioning jigs. This is not necessarily a granite table given the stiffness of the individual panels. Each readout panel has a set of precision holes at defined positions with respect to the readout strips.The lateral positions of the two readout doublets will be aligned to each other using a simple but precise jig with a dowel pin, as shown in Fig. 2.6. The lateral positioning of the drift panels is not critical.

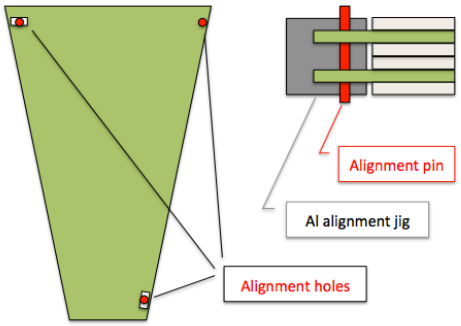


Figure 2.6: Schematics of the MM panel alignment showing in the left sketch the positions of the precise and elongated alignment holes and if the right drawing a sketch of the alignment jig.

Clean room of class 10000 or better is required

Quality control, final test and expedition

741 ## 2.4 Quality control, final test and expedition

742 The quality control proceeds in several steps, with the philosophy to avoid assembling
743 parts that are not qualified. The first step happens during the PCB production to make
744 sure that only boards that fulfil the quality specifications are glued to the stiffening
745 panels. The panels have to pass a control of their geometrical parameters and their
746 electrical properties (no shorts).
747 After the assembly of a doublet, the electrical integrity of the detector has to be
748 qualified. The drift electrodes must not draw any current when polarized with negative
749 HV up to 1000 V (operating voltage is 300 V). The mesh must be properly connected to
750 ground potential and the resistive strips are tested by applying HV in air and monitoring
751 the current. The currents should not exceed a few nA at +900 V on the resistive strips.

- Please find the time to read the sections of NSW TDR concerning MM mechanics
- Any comment and suggestion is more than welcome