CHAMBER design

Several technical aspects of the chambers have been left unresolved until now. In this report, we have tried to either give a concrete solutions to these design details or at least narrow down to a few possible options.

Some basic decisions have to be made prior to issuing of a first draft of the detector layout:

a) The final wire count and wire distribution in the detector:
    1) For the inner detector real-estate.
    2) For the layout of the PA motherboard.
    3) For the cable real-estate route.

b) The detector support configuration:
    1) For the PA motherboard placement.
    2) For the gas inlet/outlet.

c) General disposition of the electronic components around the magnet:
    1) For cable layout.
    2) For power supplies distribution.

These topics will be analyzed and discussed during the upcoming group meeting and hopefully frozen decision will result of it.

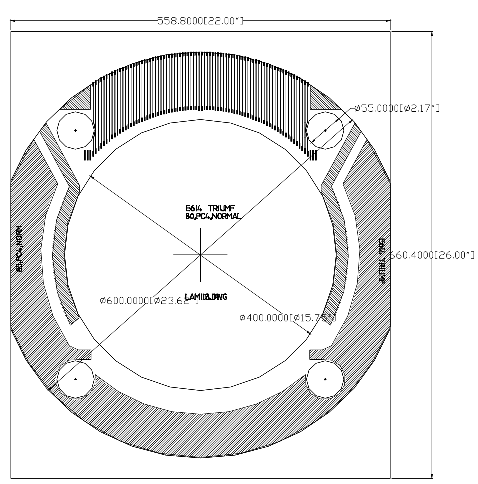
X/Y planes and chamber alignment procedure with G10 support ring

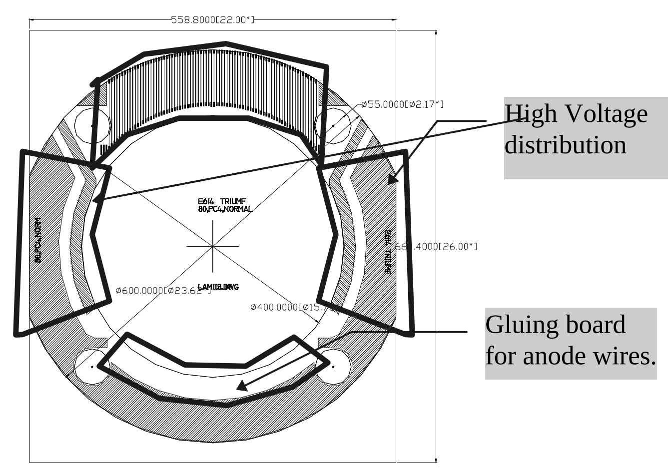
- Status : Need explanation and confirmation from VS.
- Problem: This assembly procedure so far did not take in account the extra G10 support that we plan to have in between each chamber stack (X/Y stack). Vladimir Selivanov (VS) expresses no concern about that aspect of the assembly even if the G10 support outer diameter (660mm) is larger by 30mm than the glass lamel. An explanation of the procedure is necessary.

Split in 2 to 4 parts of the Lamel design

- **Status :** Require VS approval.
- **Problem:** So far the large lamel dimension prevents having them made by an external company. The amount of time, material and human resources to produce these lamels in house should be considered to high. A recent suggested idea is to trim the actual lamel PCB design to fit the maximum bed size of the manufacturer. The maximal dimension of the possible board is 22”x26”. The figure below shows a possible trim of the original lamel design. The quotation from HADCO for 100 lamels is about US$230 per lamel + US$300.- for tooling. Gold plating is an extra US$50.- per lamels. Several advantages can come from this external job:
    a) All routing can be done precisely
    b) Choice of the G10 core thickness is possible at the mil level.
    c) Gold plating on all or partial part of the board.
    d) Double sided design possible.

  If splitting the design is viable, it can be extended to a quadruple split which would: reduce the cost of the lamel production by requiring only 3 PCB’s (if gnd resistors are not implemented)to be manufactured at smaller size. Eventual drawback of such design could be:
    1) Increase of time during construction due to multiple PCB alignment and gluing process.
    2) Weaken glass plane by not having a continuous layer of the G10 over the full glass surface.



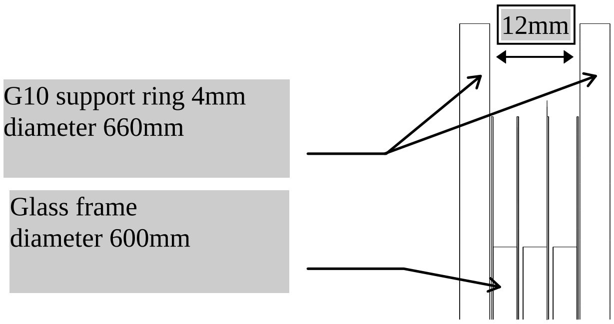


Lamel board with side trim.Lamel split in 4 sections.

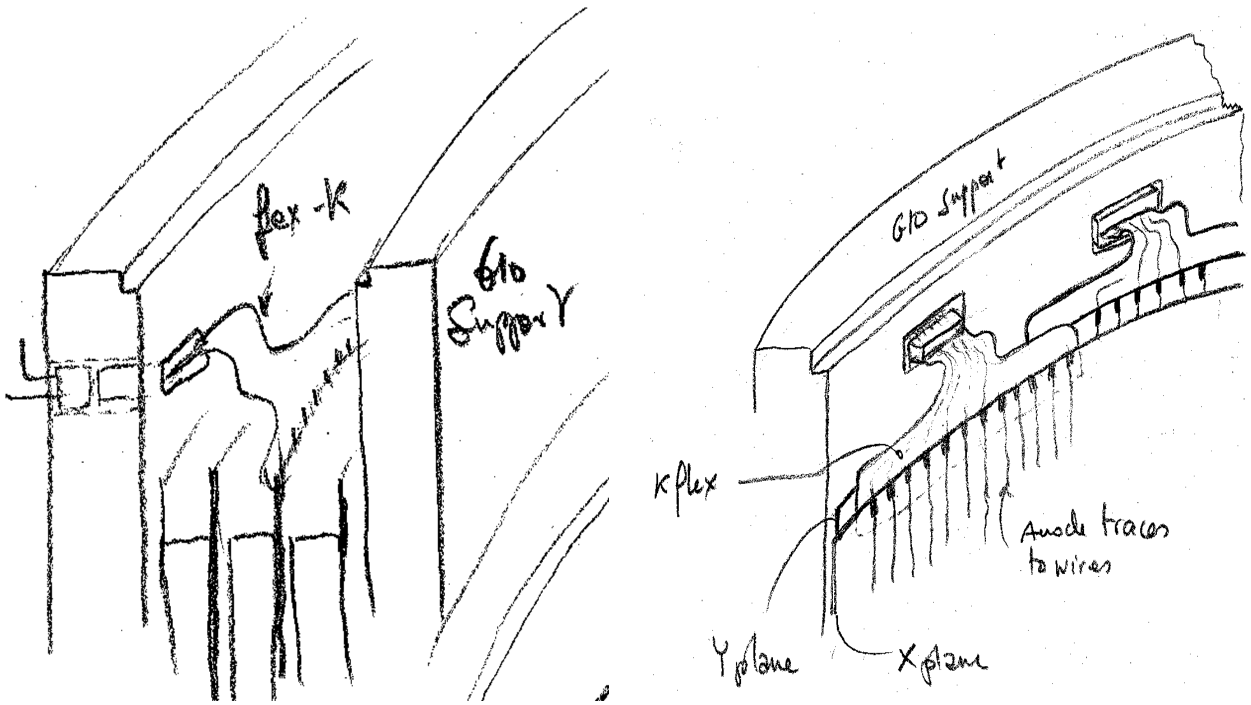
Anode signals extraction from DME volume

- **Status :** Firm proposal.
- **Problem:** The anode wires are soldered to the anode lamel which in turn, through Copper traces brings the signal to the edge of the lamel. There individual wire pads are available for soldering or connection to a wire. As the available space around the lamel is small (12mm width for X/Y plane) suggestion of

the use of a flexible Kapton PCB has been proposed. This type is widely available and can provide an organized signal transportation scheme.



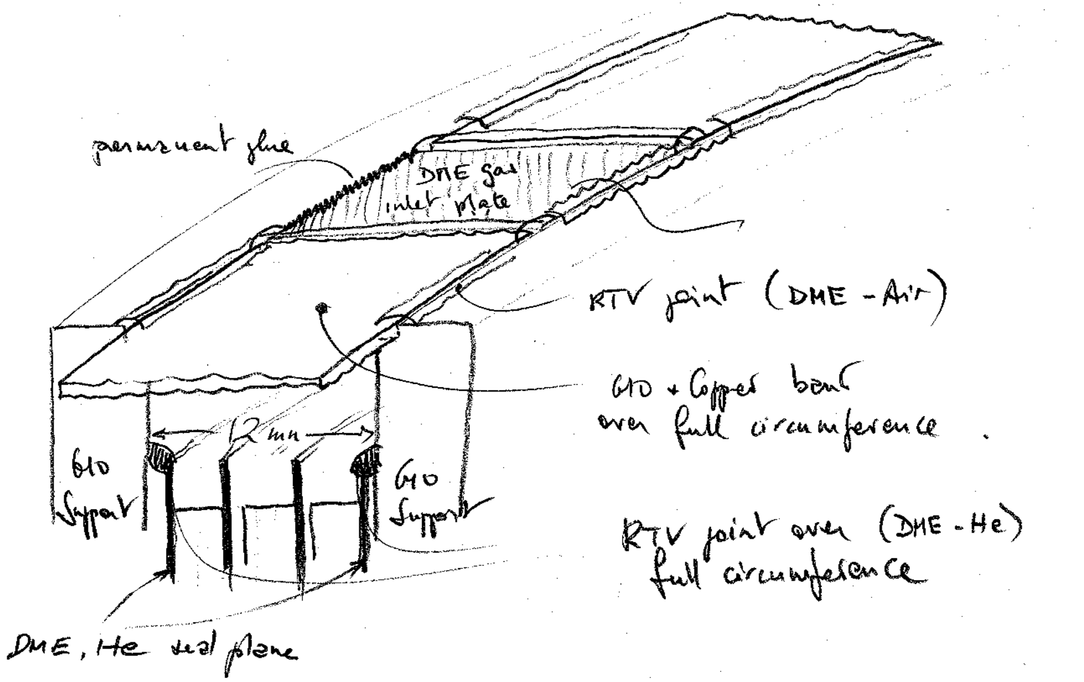
Cross-section at scale of a X/Y plane



Flex Kapton board for signal extraction through G10 support ring

DME volume (containment)

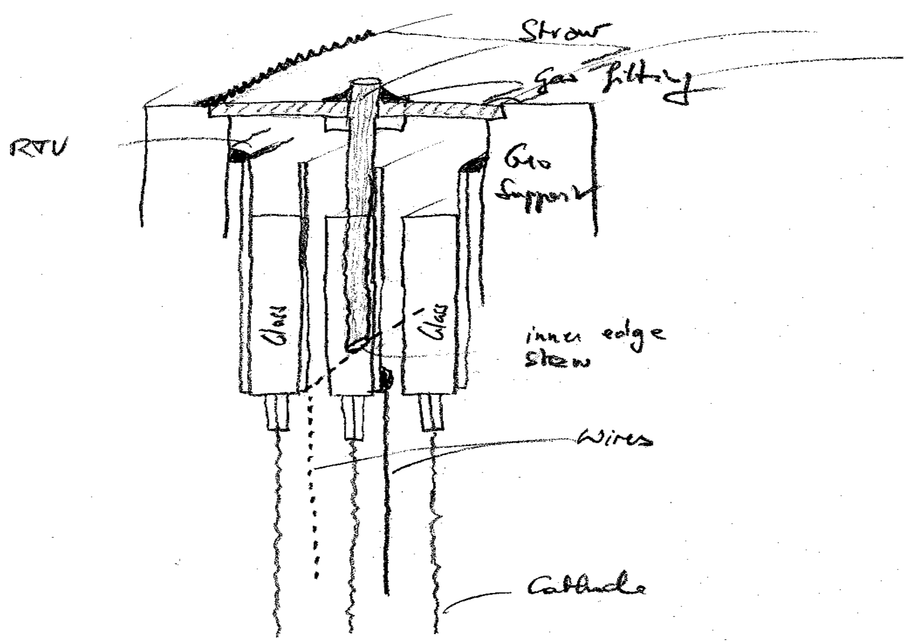
- **Status :** Firm proposal
- **Problem:** The DME volume will be separated from the air by a G10 band closing the 12mm gap between two adjacent G10 supports and from the Helium with two extra lamel seals inside the DME volume. The G10 band will act as inner gas pressure holder and EM shield. The actual seal will be done with RTV or similar DME resistant product. Inserted within the circumference a “DME gas inlet plate will be glued on one of the G10 support for rigidity with RTV on the other to prevent any stress on the chamber stack. This plate will support the necessary fittings for gas, temperature and pressures feeds.



DME inlet on G10 plate

DME inlet design

- **Status :** Firm proposal
- **Problem:** The gas flow has to be guaranteed in the active volume of the chamber. In order to do so, the inlet gas has to be brought to the inner edge of the active plane. The available space to feed the gas in between 2 planes is in the order of 500µm (4.0mm-3.2mm-2x0.25mm-glue thickness). The procedure will be done by inserting a flexible collapsed Kapton straw in between the planes up to the inner edge of the active volume. By pressurizing the inlet gas, the flow will be guaranteed to reach the center of the chamber. The gas exhaust will be collected all around the chamber through a outlet gas fitting.



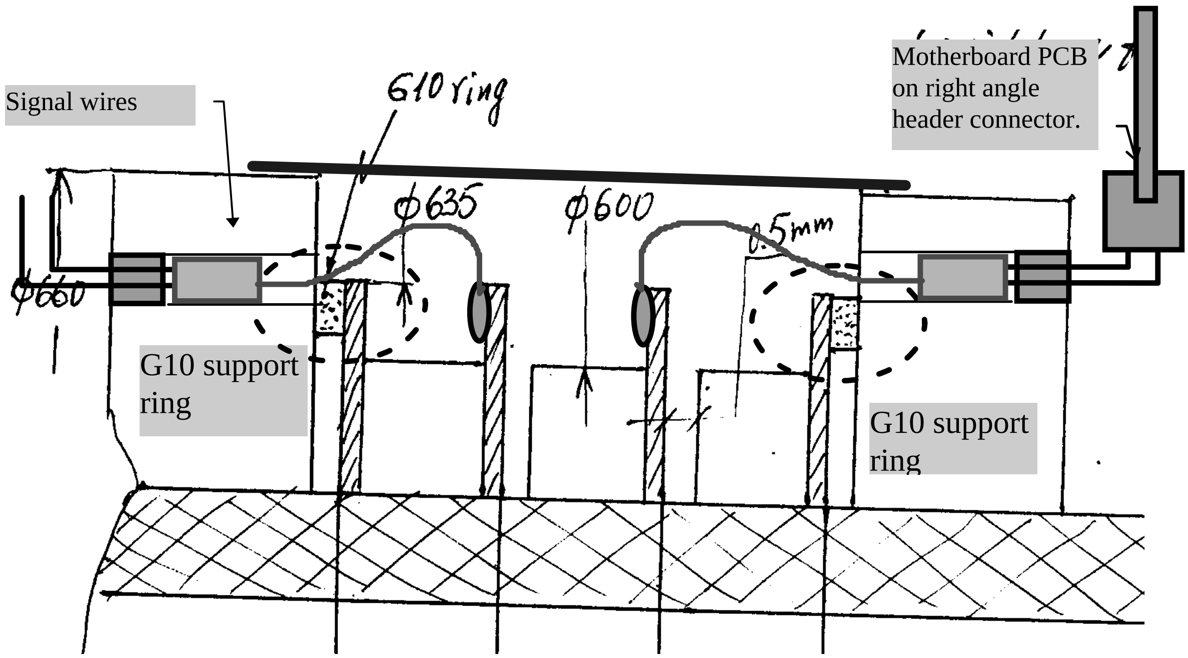
Cross-section for DME inlet

PA Motherboard design

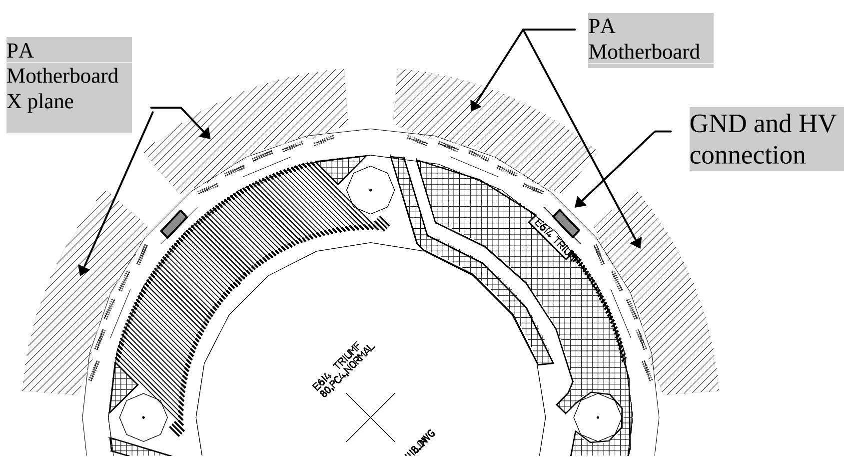
- **Status :** Strong suggestion
- **Problem:** In order to satisfy the different wire configurations, a single PA motherboard would be designed. This board may handle up to 80 wires (connection for up to 100 pins). The ground signal would NOT be passed for each individual signal but rather through a dedicated connector which could also support the HV signals (see *PA motherboard disposition*). The actual design of the motherboard has not yet been made as this design depends upon the type of the PA circuit that we may choose.

PA Motherboard support

- **Status :** Firm proposal
- **Problem:** The disposition of the pre-amplifiers will be in the air volume just outside the DME volume. They will be mounted on a main motherboard PCB which will be mounted on the G10 support ring. The actual attachment of the motherboard on the G10 support will done by the signal connectors acting as DME gas seal and connection feed-through between the two media.



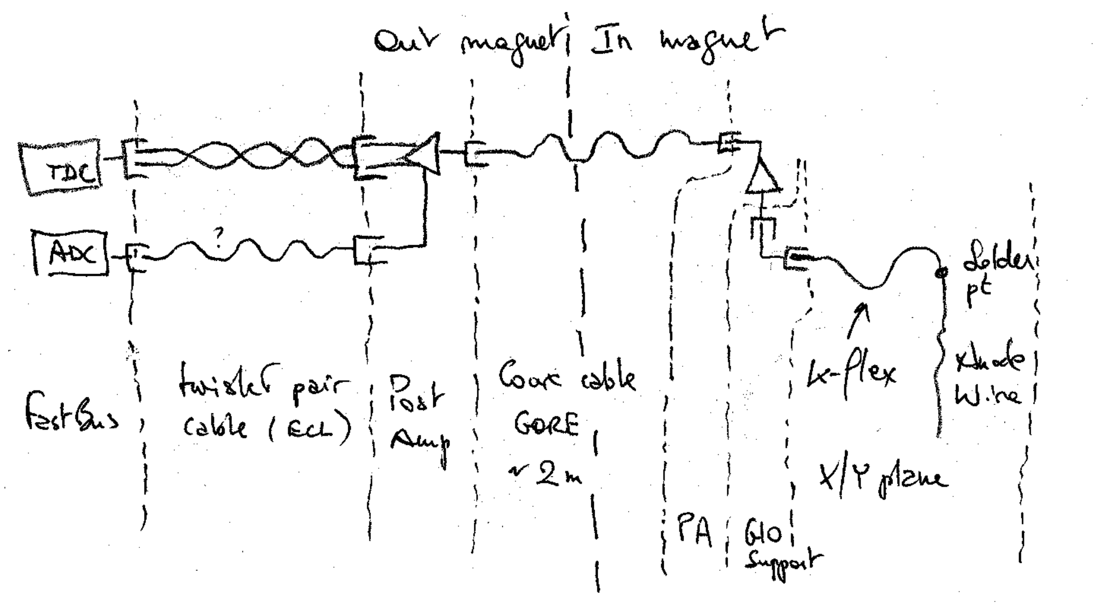
Signal path to the PA motherboard



PA motherboard disposition

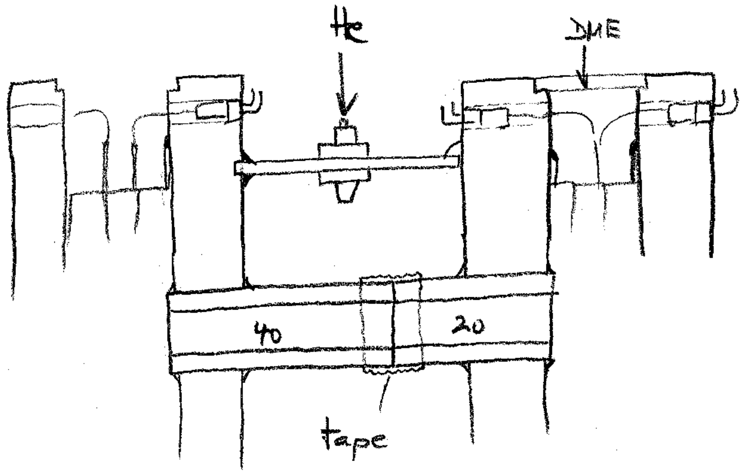
Signal extraction from the detector

- **Status :** Strong suggestion
- **Problem :** The connectivity scheme for a full signal chain involves several components. Connectors have to be implemented to allow easy maintenance to every part. The chain consists of:
  1) The signals output from the lamel are extended on the K-flex which remain part of the wire plane.
  2) The G10 support ring has the sealed right angle connector joining the K-flex to the PA motherboard.
  3) The PA motherboard has plug-in pre-amp hybrid, input and output signal connectors. This allows single PA replacement as well as full motherboard swapping.
  4) The analog output signals leave the motherboard from the top of the board in a direction parallel to the beam axes using a individual coax signal wire. The overall length of this cable should be kept as short as possible to the post-amp (<2m). For information, suggested cable to be used is the GORE 50Ohm type CXN1214 Teflon coax cable. The price was DM2.1.-/m in 1995 but quote 98 US$ 516.17/1000’ min 5000’(W.L. GORE (302)368-2575, 1-800-774-4673 Fax(302)292-5020)
  5) The post-amp should reside as close as possible to the magnet (mounted on the magnet itself) as they do not require maintenance (except for the threshold adjustment, possible remote control). The logical output signals (ecl) run on a flat twisted pair cable to the FastBus TDC’s. There is no restriction on its length. If analog output come out from the post-amp, coax cable will have to run the same distance to the ADC’s as the ecl cable.



Helium volume (containment)

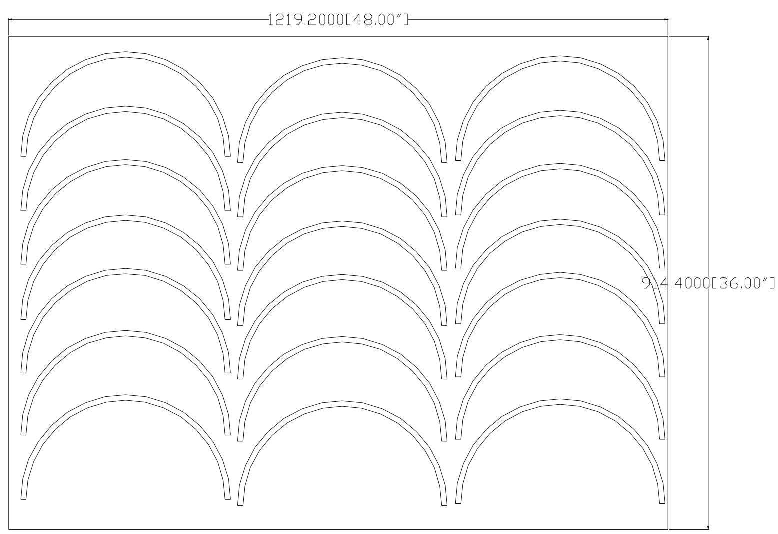
- **Status :** Firm proposal
- **Problem:** The Helium volume is delimited by the two external cathode foils and a G10 band closing the entire circumference of the detector (this design is similar to the DME volume described above) The He is fed through a He gas fitting installed on the G10 band. The G10 band is glued permanently to the outer side of one of the G10 support. RTV is then used for sealing the other side. The assembly of a pair of G10 support ring and one G10 band could be made as a module. The gap between the 2 G10 supports can be set to what ever dimension is required. In the case of a double glass ring for setting the gap to 60mm (new design), the modularity of the design can still be kept.



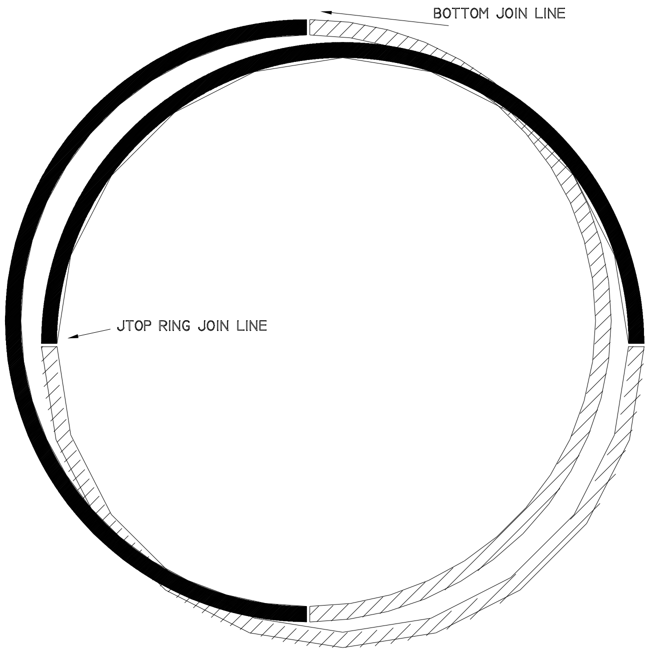
Cross-section for He inlet

G10 HV ring split

- **Status :** Require VS approval
- **Problem :** The HV ring holding the cathode foil in sandwich uses a large piece of G10 if manufactured in as a single piece. The suggestion here is to split this ring in two in order to reduce the cost. PCB company could eventually produce these HV-rings by directly routing (cut-out) the required contour on a G10 sheet of 1/16" thick. The split ring could be assembled by gluing the two ring halves on both side of the Mylar with a 90deg rotation, the strength of the module would be conserved. The advantage of going through a routing procedure is that the actual pattern can be anything. One of the ring had some half circle cut outs to allow the spacer to be installed (assembly purpose), these routing could then be done too. For information the cost of the raw G10 material for a thickness of 1/16" (1.6mm) is about US$ 50.- per 3'x4' sheet. The alignment of the two halves on one side can be guaranteed by proper end routing.



Sheet 3'x4' G10 with high density of halves HV ring



4 halves HV ring miss aligned for better view of the join line.

Reduction of the HV-ring width to 10mm

- **Status :** To be investigated.
- **Problem:** The active area of the chamber has been increase in order to allow a larger curvature radius of the detected particles. Originally the HV-ring had an inner diameter of 328mm with a width of 15mm. Attempt of reducing this width to 10mm may have some effect on the mechanical stability of the cathode plane (torsion, collapse, Mylar slip). The current prototype is showing cathode wrinkles which may be due to Mylar sliding through the glue joint. When the chamber is opened, this flaw will have to be investigated.

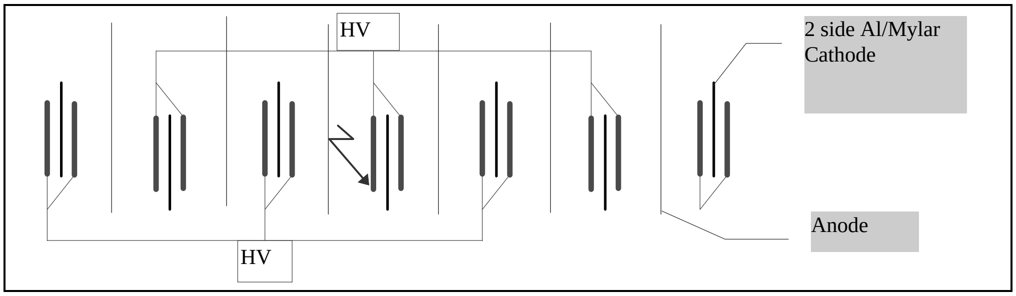
Tension control for cathode foil stretching

- **Status :** Required procedure.
- **Problem:** As the gas system for the full detector may not have a mechanism for fully controlled gas pressure and the resolution of each chamber is related to its electric field distribution, the cathode plane will have to be maintained in a constant position as well as we can. One direct improvement in order to address the deflection of the foil is to stretch the foil at the highest possible tension. But consistency of the stretching force applied to all the foils composing the detector is even more important. A proper mechanism will have to be designed to satisfy this requirement. Previous system such as the Hermes stretching table can be either used or duplicated to fit our setup. For information, the maximum linear tension for a 12 µm Mylar is around 600g/cm.

HV configuration scheme

- **Status :** Requires group decision.
- **Problem:** The choice of the HV configuration has been until now implicitly agreed for virtual ground wires. This scheme make the design of the chamber slightly simpler due to the missing decoupling capacitors on every wire. But due to the recent wire break in the prototype chamber, the high voltage configuration has been reconsidered. The current state of the prototype with at least a single broken anode wire prevent us to power the rest of the chamber stack. Grant Sheffer (GS) has traced the problem to the way the HV is applied to the 7 planes composing the prototype. As HV is shorted through the broken wire to ground through the pre-amp, it affects the other aluminized plane on the

other side of the Mylar (they are electrically connected). By "domino effect" the entire group powered by the same HV is shorted also.



A possible solution is to feed the HV to each side of the Mylar independently. As long as the Mylar dielectric can take such abuse, a single plane could then be completely isolated and remain at 0 Volt in the case of an anode wire short. Another alternative is to power the wires instead of the cathode and shutdown the wire voltage on the broken plane. In this case, the anode voltage would then be fed to the wires on the PA motherboard or just after it. This scheme raises several other concerns which I won't discuss here but it makes the design slightly more delicate.
VS envisages being able to power any plane without the pre-amp present. In order to do so, the anode wires have to be "virtually grounded" through a "large" resistance (4.7K). This grounding is done on the lamel itself, but I would consider having a dedicated connector which could replace the PA when not plugged in. This scheme would remove parts on the lamel and simplify its design.

Test pulse scheme

- **Status :** Requires group decision.
- **Problem:** A test pulse system is a concern for several members of the E614 group. So far nothing has been foreseen or even confirmed that "a test pulse system" has to be implemented. VS is reluctant to have any test pulse system which could increase the signal to noise ratio or the cross-talk level. One possibility suggested by Robert Henderson is to pulse the central cathode plane which would induce signals on both wire plans adjacent to the fired cathode. This elegant solution should satisfy VS but it has the disadvantage to generate a large current surge through at least the 2 adjacent planes (i.e. 160 channels). Under this condition you may induce a large enough signal that could trigger your down-stream electronic regardless of the condition of the pre-amps. In the other hand the RMC group used this method and by firing the entire detector were successfully able to single out dead and noisy channels. An other possibility for a test pulse system would be to build it on the pre-amp motherboard through a capacitive coupling pad or a resistive current injection. Both latter solutions allow you to segment the test pulse feed and handle part of the chamber if necessary. It would require a dedicated test pulse circuitry control.