RPC Module Signal and HV Connections

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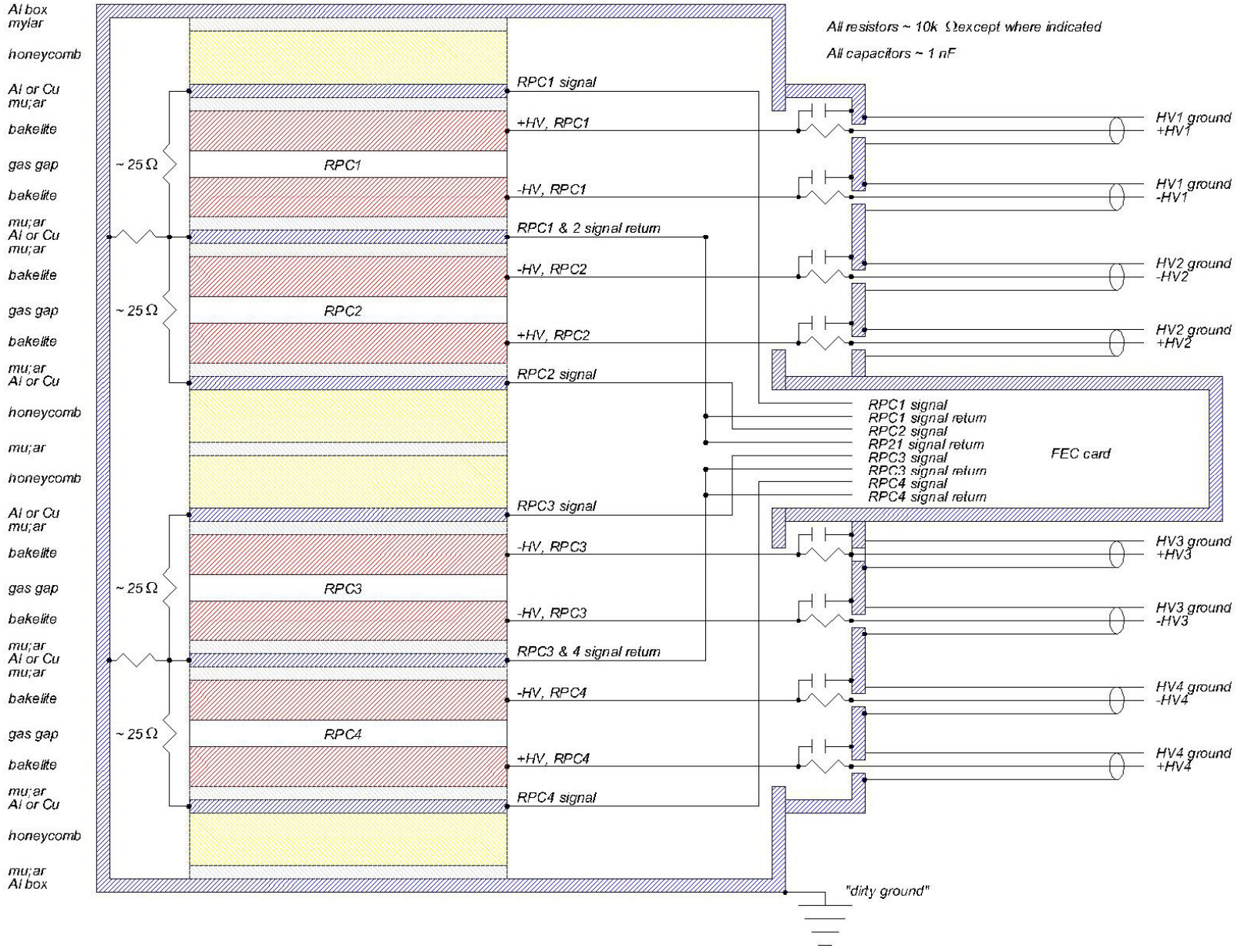
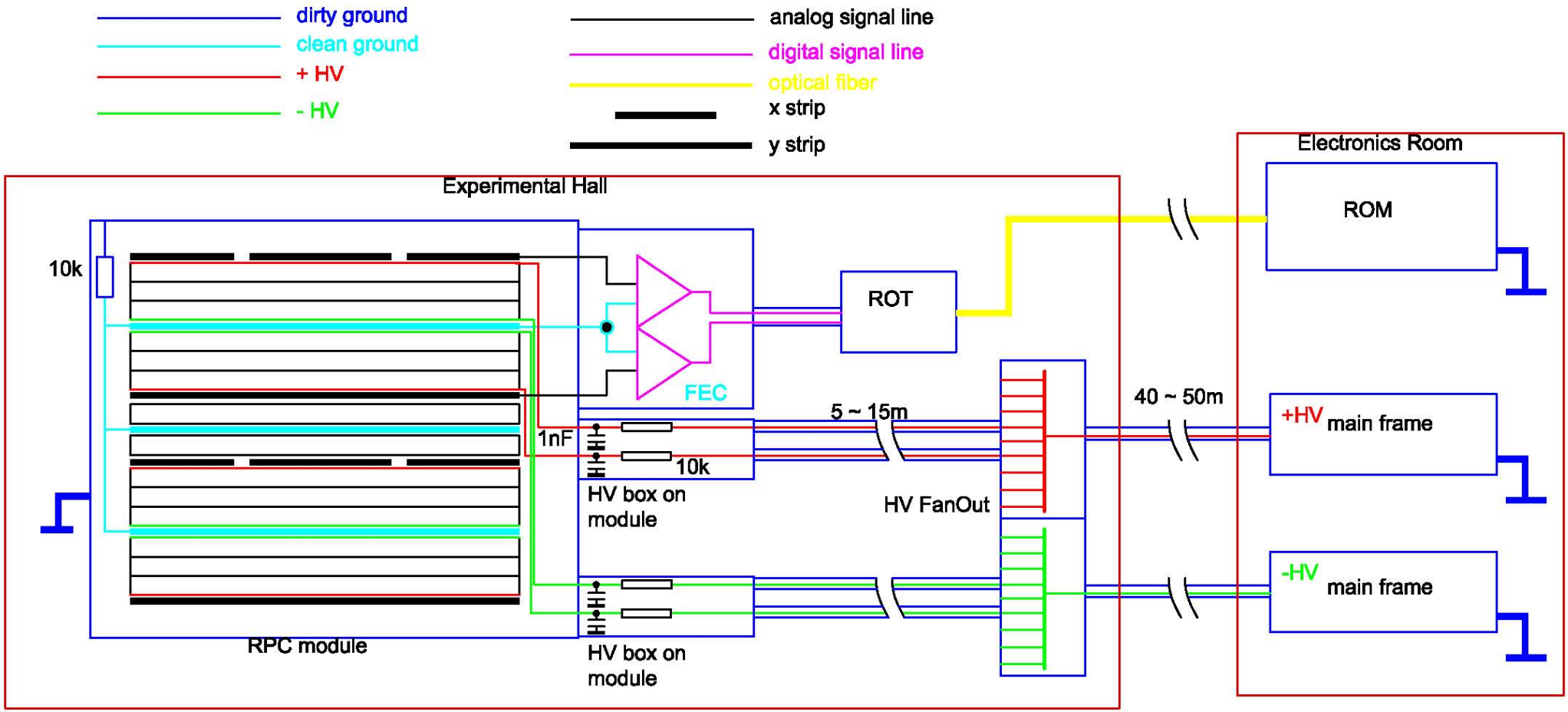
Changguo Lu, Kirk T. McDonald

Princeton University

McDonald's Recommendation of How an RPC Module Should Be Connected Electrically



Lu's Version of the Interconnects



Basically the same as McDonald's version.

Comments

Because the RPC modules are encased in Al boxes, and the RPC streamer-mode signals are large, these signals are relatively immune to noise issues. Likewise, the PMT's in the water pool are shielded by the Al boxes from the signals of the RPCs.

The exterior of the Al box enclosing an RPC module is connected to the "dirty ground" of the support frame. [Of course, there must be a DC connection between the "clean" and "dirty" grounds.]

Each RPC signal line must have a corresponding return line. The signal/return pair is sent to the FEC card on a stripline cable. [The FEC cards are mounted in shielded enclosures on the outside of the RPC modules.]

Because adjacent RPCs have electric fields in opposite directions, there must be a "return" electrode placed between the two RPCs. [This electrode is not shown in the drawing of Prof. Zhou, shown on next slide, nor on the drawing of Jon Link, nor in DocDB #2487 by Chris White.]

The return electrodes must be connected via resistors of ~ 10kΩ to the high-voltage ground to prevent these electrodes from charging up to high voltage. If no resistors are inserted, then noise pickup on the HV cable shields (and on the module "dirty ground") could be transmitted to the RPC signal/return.

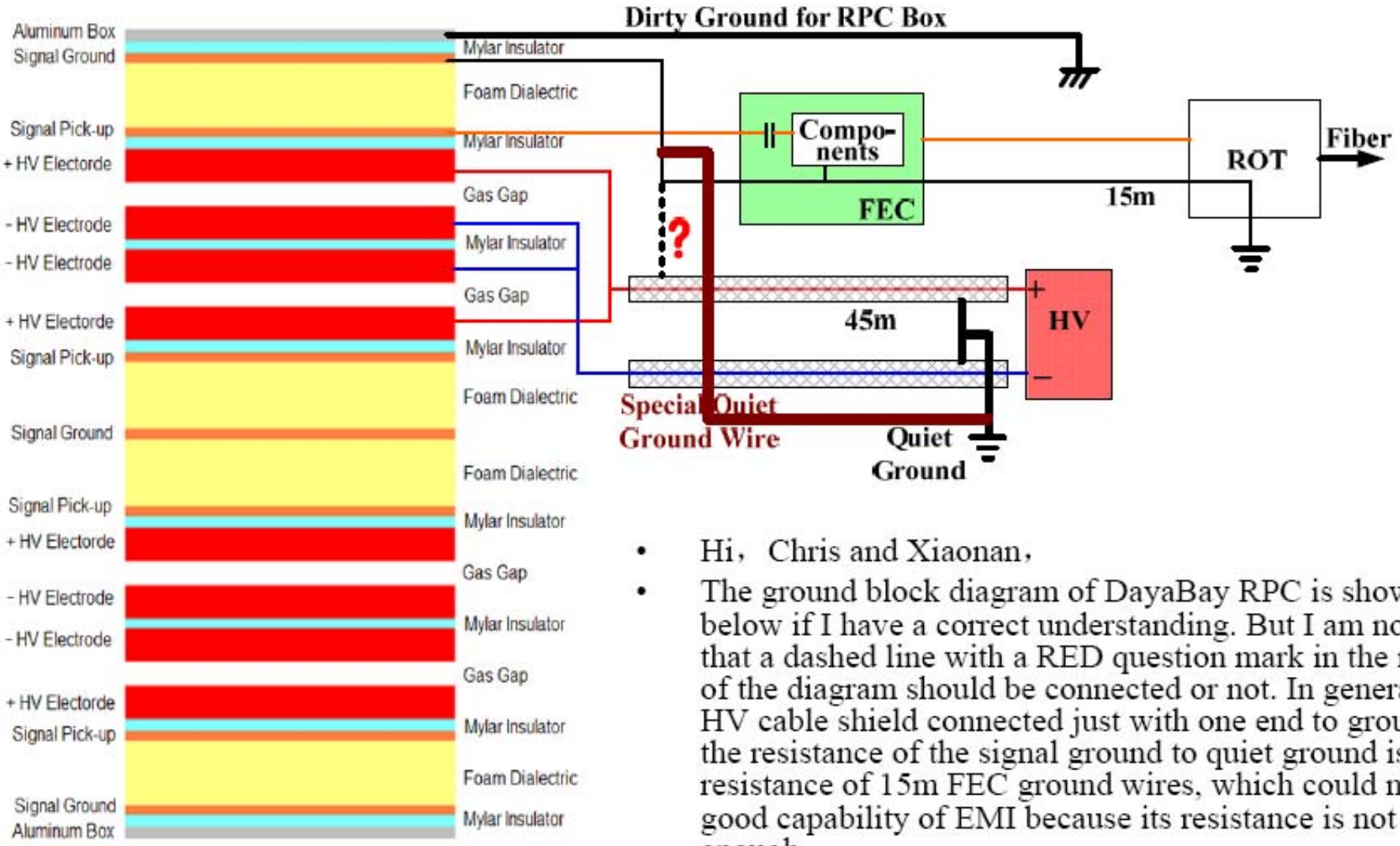
As shown on p. 2, two 10kΩ resistors on the INSIDE of the Al box can connect the return electrodes to the HV grounds, using the Al box, and the "dirty" ground as intermediate conductors.

The HV Interface Boxes should be made of metal to provide complete electrical shielding of the HV lines from the external electrical environment. The HV connectors could be isolated from the metal box to separate the "clean" ground of the HV crates from the "dirty" ground of the RPC modules (although this is not necessary if the "clean" grounding is properly done, and it adds some noise to the RPC signals).

The HV lines themselves should be connected to the bakelite electrodes through low-pass filters (≈ 10kΩ resistor and ≈ 1 nf capacitor) to provides additional suppression of ripple from the HV supply, and to isolate the HV crate/electronics room from the RPC modules.

There is no need for additional long "ground" lines between the HV crates and the RPC modules, as considered by Prof. Zhou, so far as RPC performance is concerned. Such lines might play a role in protecting crates in the electronics room from "noise" in the experimental Hall.

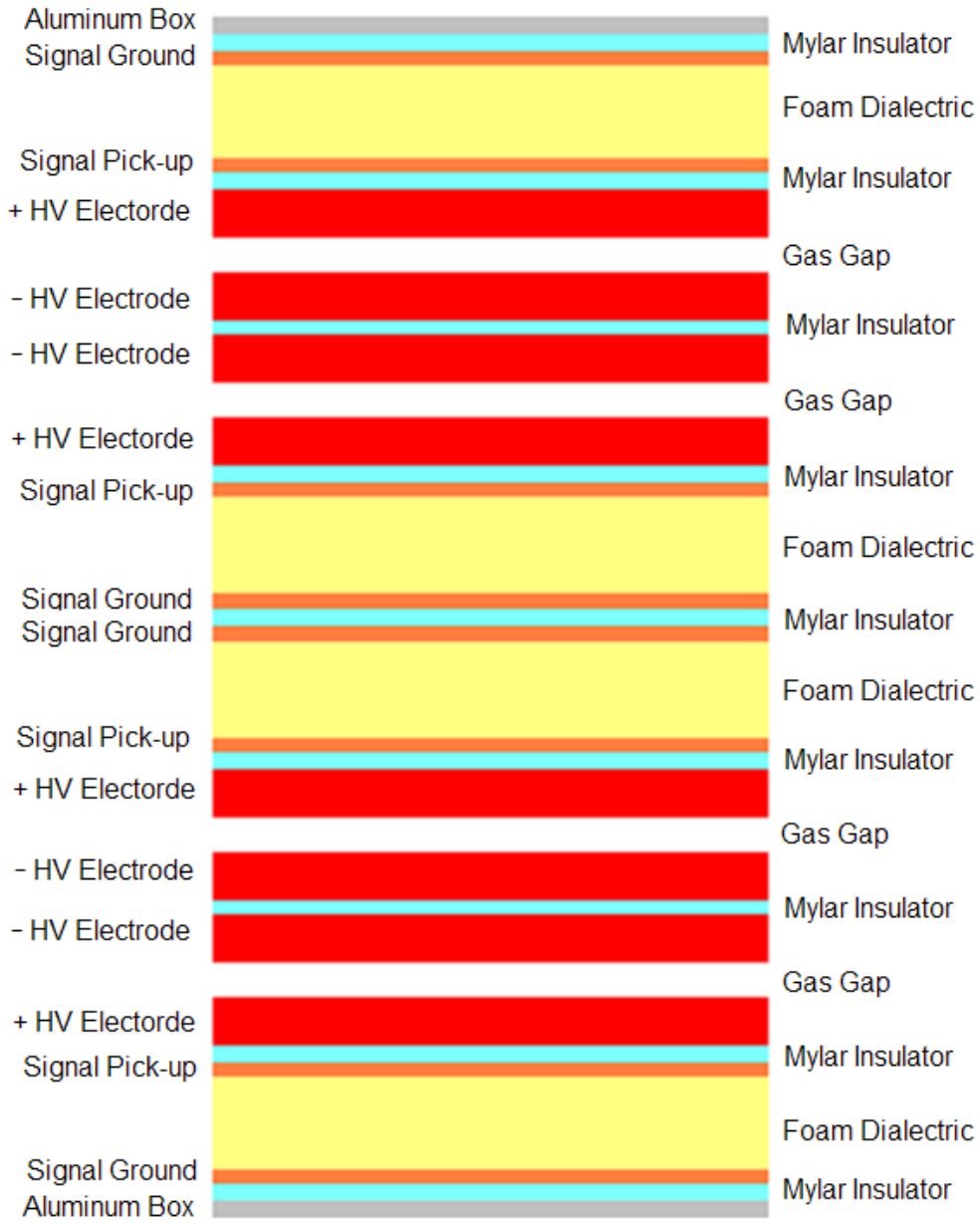
RPC grounding (Prof. Zhou's picture)



- Hi, Chris and Xiaonan,
- The ground block diagram of DayaBay RPC is shown as below if I have a correct understanding. But I am not sure that a dashed line with a RED question mark in the middle of the diagram should be connected or not. In general, the HV cable shield connected just with one end to ground, so the resistance of the signal ground to quiet ground is a resistance of 15m FEC ground wires, which could not be a good capability of EMI because its resistance is not small enough.
- Could we use a special wire with a small enough resistance to RPC signal ground, as shown a brown line in below picture, to increase the EMI capability?

Our view: There is no need for additional long "ground" wires between the HV crate and the RPC modules so far as RPC "noise is concerned. Such additional wires might reduce the effect of "noise" in the experimental Hall on the crates in the electronics room.

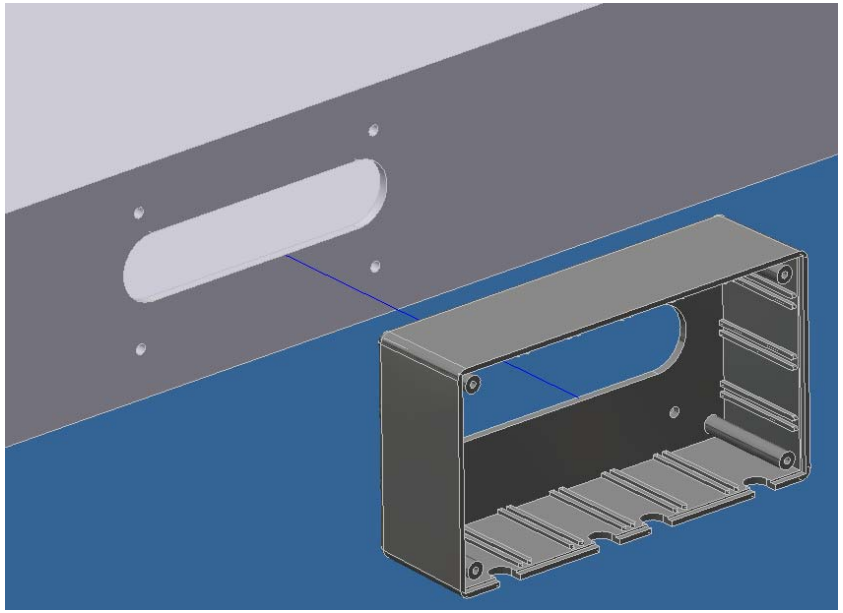
From Jon Link, DocDB #2644

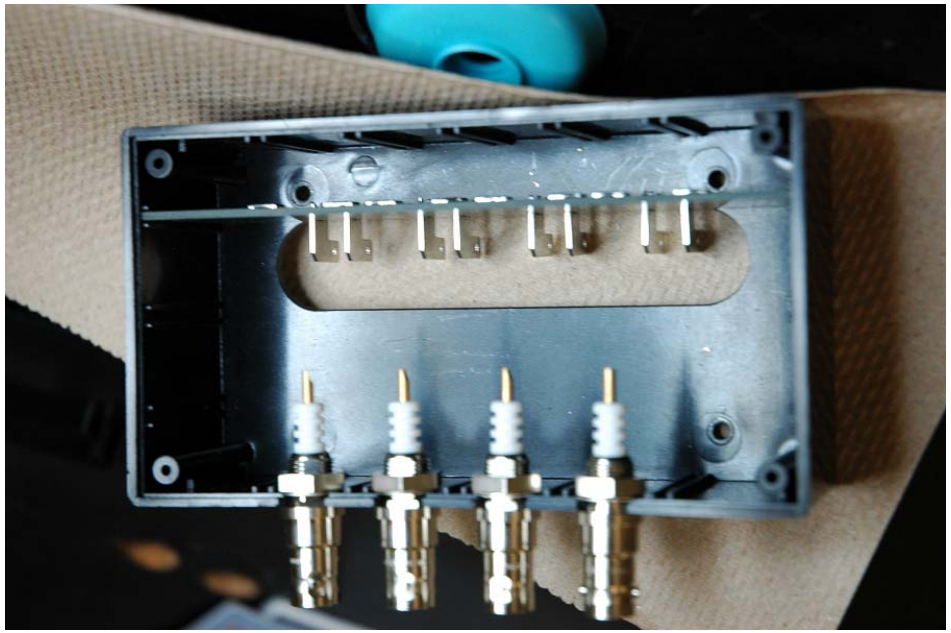


Signal Ground electrode between the -HV bakelite electrodes is missing.

There is no electrical reason to split the signal Ground between the central pair of foam dielectric layers.

From Jon Link, DocDB #2644





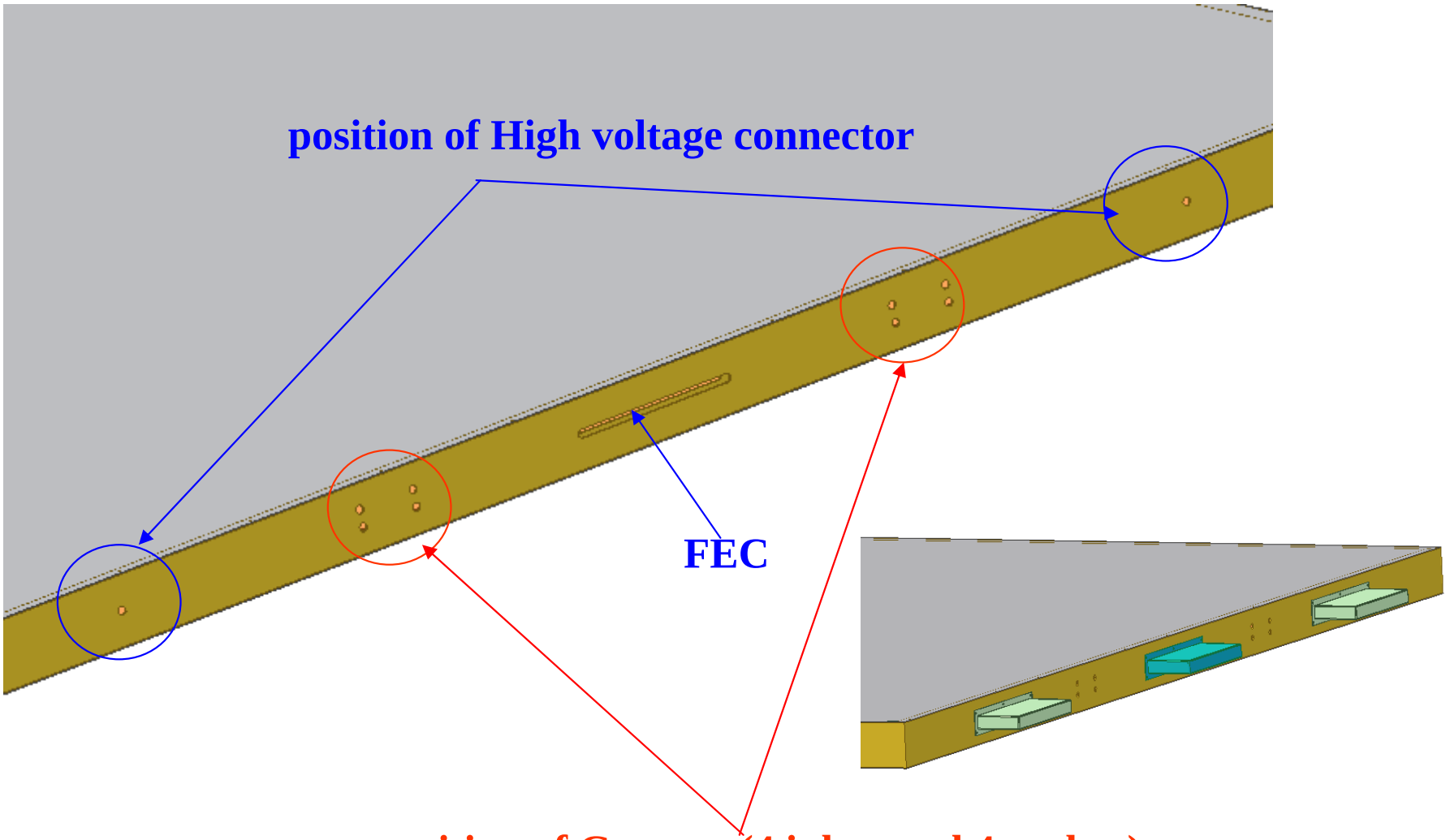
It would be better if the HV Interface Box had a metal housing, rather than plastic.

If plastic, the HV lines are exposed to the external electrical environment over a few cm, and could pick up unwanted noise.

A concern is that a metal box would connect the "clean" ground of the HV crate to the "dirty" ground of the RPC modules in the experimental Hall.

This is not a concern if the "clean" ground is properly done, via a Faraday cage around the electronics room, and all coaxial cables entering/exiting the cage via bulkhead feedthroughs.

From Jiawen Zhang & Xiaoyan Ma, DocDB #1980



Proposed layout is fine, assuming that the FEC boxes and HV interface boxes provide electrical shielding.