Cabling and grounding for the HV system of the upgraded RICHes

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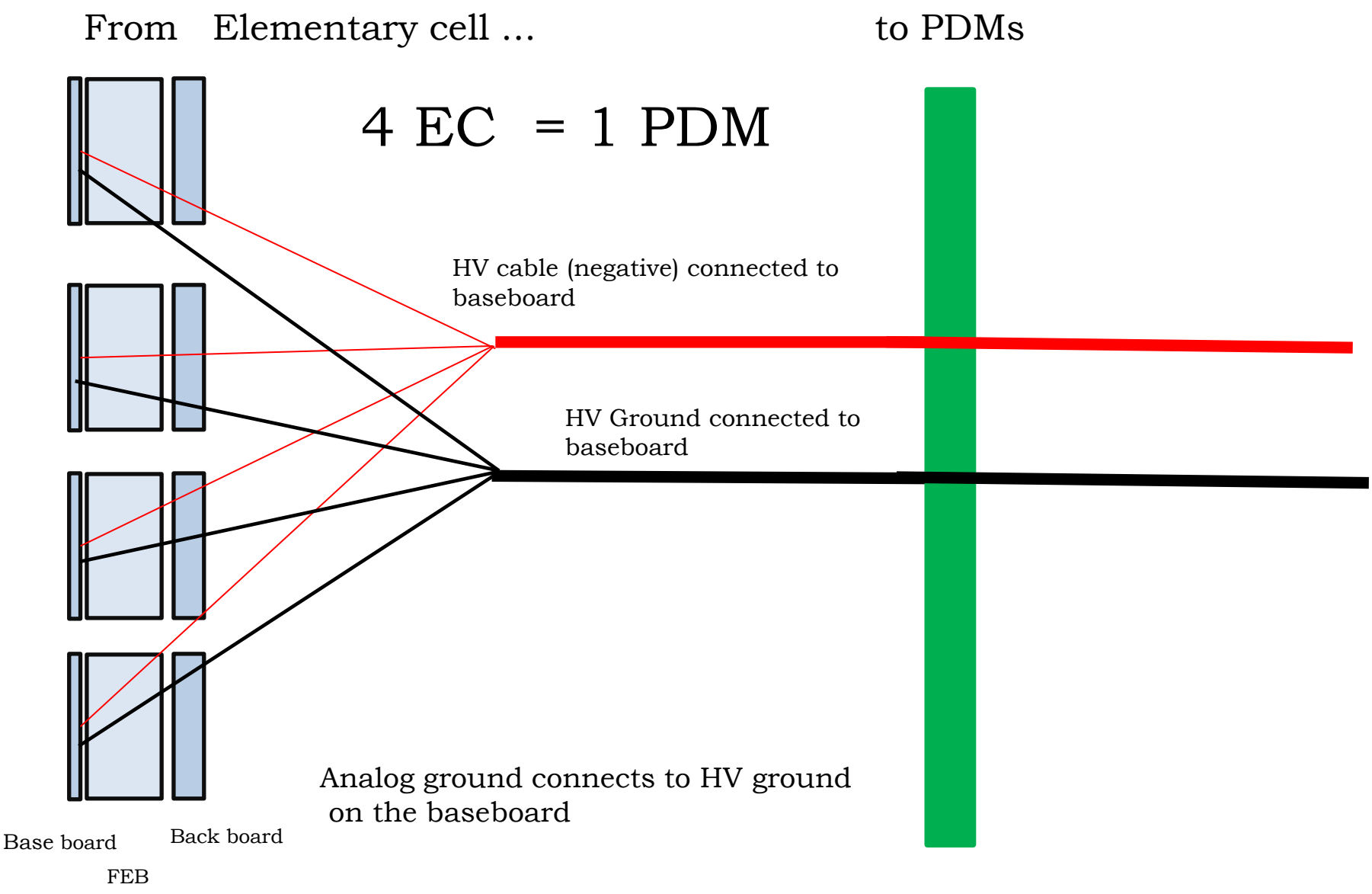
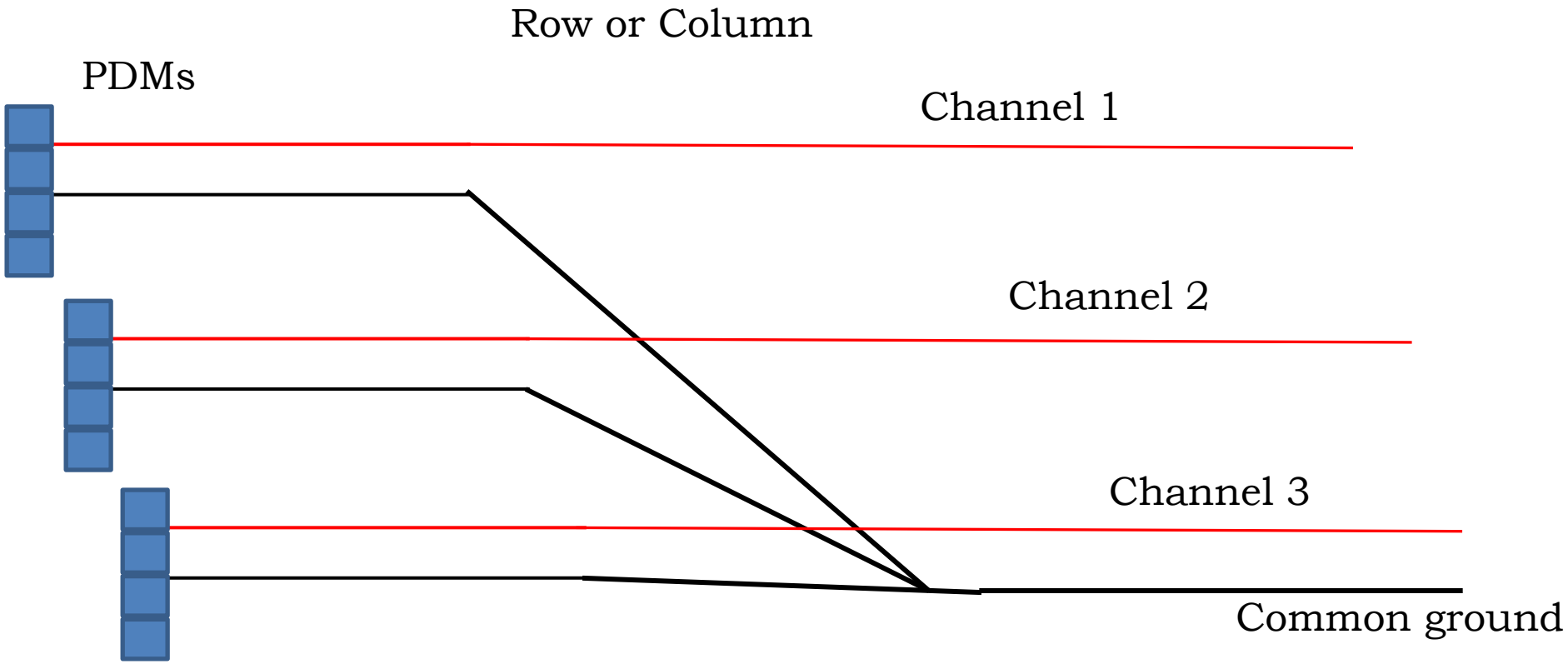
General layout of the HV system

- Riches will be organized in row or columns (TBD)
- We would like to have separate grounds on different rows (or columns)
- 2 companies are interested in providing such a system: CAEN and ISEG
- Off the shelf HV power supplies are organized in boards containing 12 (CAEN) or 16 (ISEG) channels sharing the same ground, (see next slides)
- Even if the final geometry of our detector is not yet fully defined, it looks very **likely** that:
  RICH2 will be organized in columns containing 6 PDMs in each column
  RICH1 will be organized in rows, each row composed by 3 PDMs

- If we ASSUME this geometry and we want to use off the shelf power supplies it's clear that we can't easily keep separate ground connection on different rows but using an excessive number of boards.

HV grounding

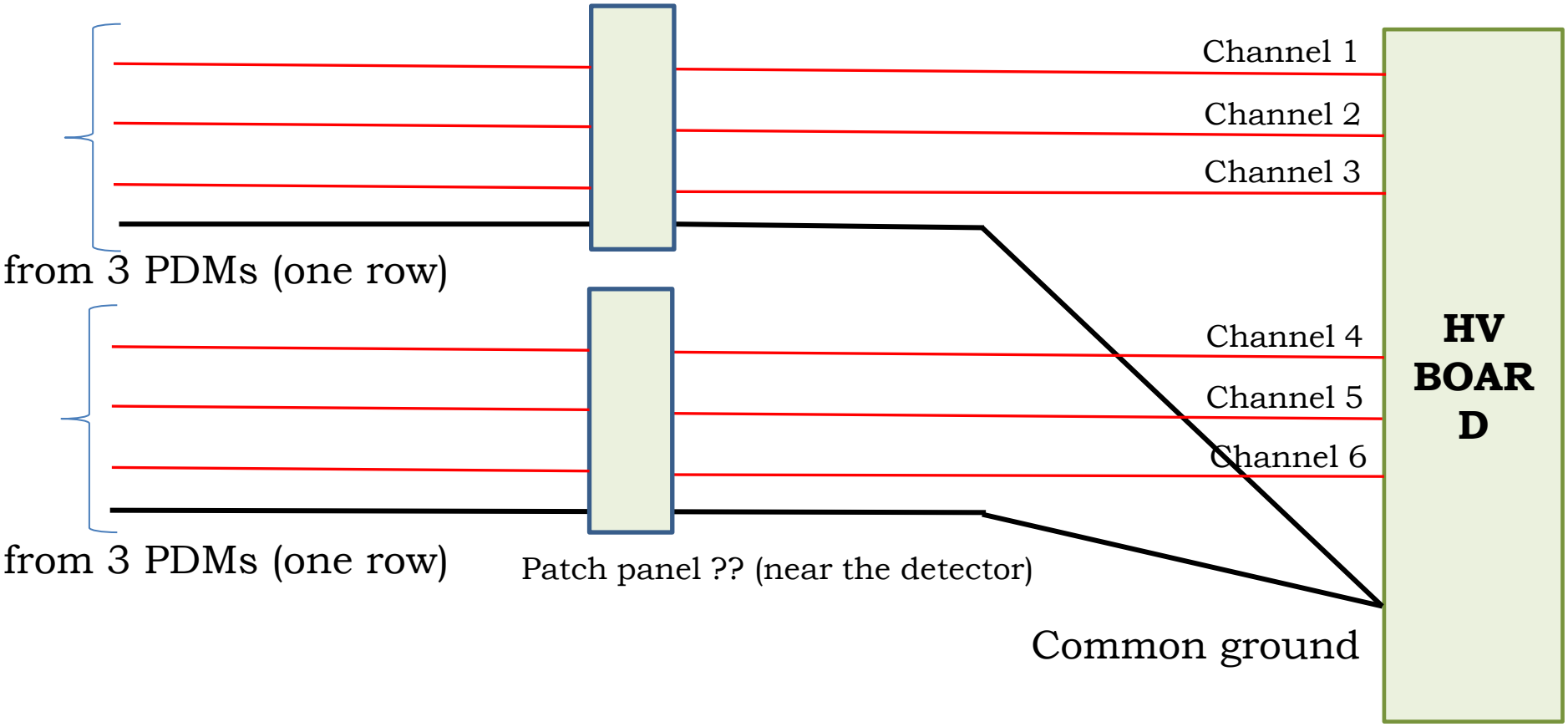




One row = 3 PDMs
This is a possible solution for RICH1

One column = 6 PDMs (not shown)
is a possible solution for RICH2,
connections are similar

… to patch panel , Hv boards and crates



HV board with 12 or 16 channels (6 shown)

Each HV board contains 12 (CAEN) or 16 (ISEG) channels and will power 4 or 5 rows in rich1, 2 columns in rich2.
Each HV board has common floating ground that is
each channel is floating w.r.t. system ground and other boards but shares ground connection with channels on the same board

Proposed cables

- **HV Cables**: column or rows are composed by PDMs, each requiring a different voltage (1 HV channel for each PDM)

  that is N voltages + ground connections to be defined + last dynode + spare
  CERN cable 04.31.52.025.4 bundles 14 HV cables (up to 3kV)

CONDUCTOR : Tinned copper
CONSTRUCTION : 7 x 0,16 mm Ø Ø : 0,49 mm
SECTION : 0,14 mm2
INSULATION : PE-HD Ø : 1,35 mm
SCREENING : Tinned copper braid Ø 0,15 mm
FIRE BARRIER : Aluminium – polyester
SHEATH : Polyolefine, red
SPECIFICATIONS Linear resistance : 139 Ohm/km max.
Use voltage : 3000 Vdc
Test voltage : 12 kVdc between conductors
Voltage breakdown : 25 kVdc between conductors
Use temperature : < 80°C
ACCORDING TO SAFETY INSTRUCTION IS 23

In case of need cables with 23, 37, 56 conductors are available.

HV boards and crate

- Two companies are interested:
- Caen
- Iseg

- I already presented a possible solution from Caen (see my presentation of June 11th: https://indico.cern.ch/event/321209/ based on crate SY4527 + A1583 (12 Channels 1.5 kV/10 mA - 12W)

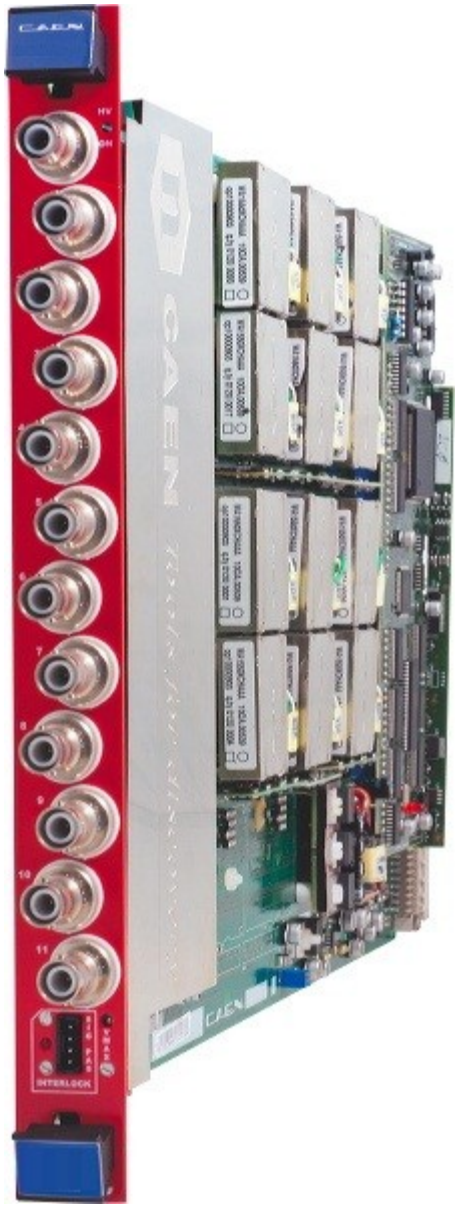
- Iseg is proposing something similar: ECH44A crate + EHS F013p_SHV (16 Channels 1.3kV/ 7 mA) This is a unit customized to meet our requests (did not exist beforehand…they have 1kv units off the shelf)

- Both power supplies feature "Common floating ground"
- We would prefer "Individual floating ground"

A1538D

12 Channel 1.5 kV/10 mA (12W)
Common Floating Return Board

- Channels with **common floating return**
- Available with either positive or negative polarity
- 0 ÷ 1.5 kV output voltage
- 10 mA current full scale, with 1 μA resolution
- max output power: 12W per channel
- 500 mV Voltage Set/Monitor resolution
- Programmable TRIP parameter
- Voltage ripple smaller than <20 mVpp (typical)
- Current generator operation in Overcurrent condition
- SHV coaxial connectors



The common floating return implies **that we must allocate one board to each column (as we do now)**

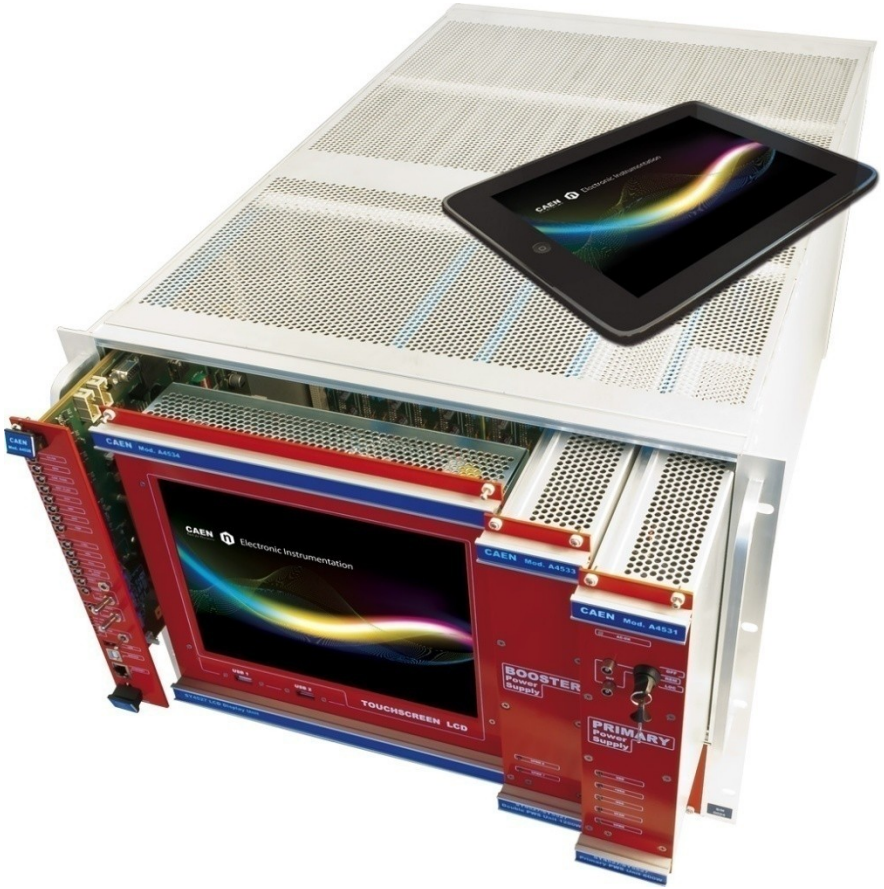
and all these boards must be inserted in :

SY4527
Universal Multichannel Power Supply System

- Communications via Gigabit Ethernet
- Communications via Wi-Fi (optional)
- OPC Server to ease integration in DCS
- Setting and monitoring of channel parameters
- 10.4" colour touchscreen LCD (optional)
- Live insertion of boards
- Trip handling

- **Max. number of boards per crate 16**

- **max power 600 W + booster 600 or 1200W**



Iseg boards (not exactly the same)

Iseg crate

Ancillary HV power supply

- In the central part of Rich1 where occupancy is highest we may need to power separately the last dynode of ~200 PM's
- this will require a moderate voltage (~70 V) and can be supplied by boards with floating channels:
- e.g. A1511B from **CAEN**
- or EHS F605x-F from **ISEG**

Comments and questions

- HV boards contain too many channels to be easily connected to our rows/columns unless we decide to share a common ground between them risking ground loops
- We must ask for separate floating ground,
- If we get it , fine, no more ground loops, connections become almost straightforward.
- Otherwise no obvious solution exists (to me).

- **UPDATE:** I have asked Caen and Iseg if they can provide boards with individual floating channels
  Caen said they will study the possibility

Spare