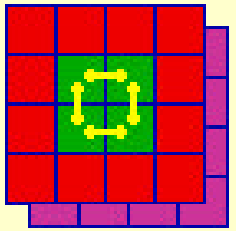
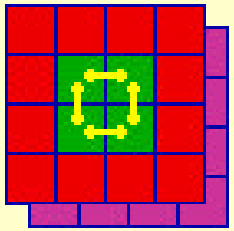



# TileCal Test-beam Studies with LAr Receiver

## 28–31 July; 24–27 August

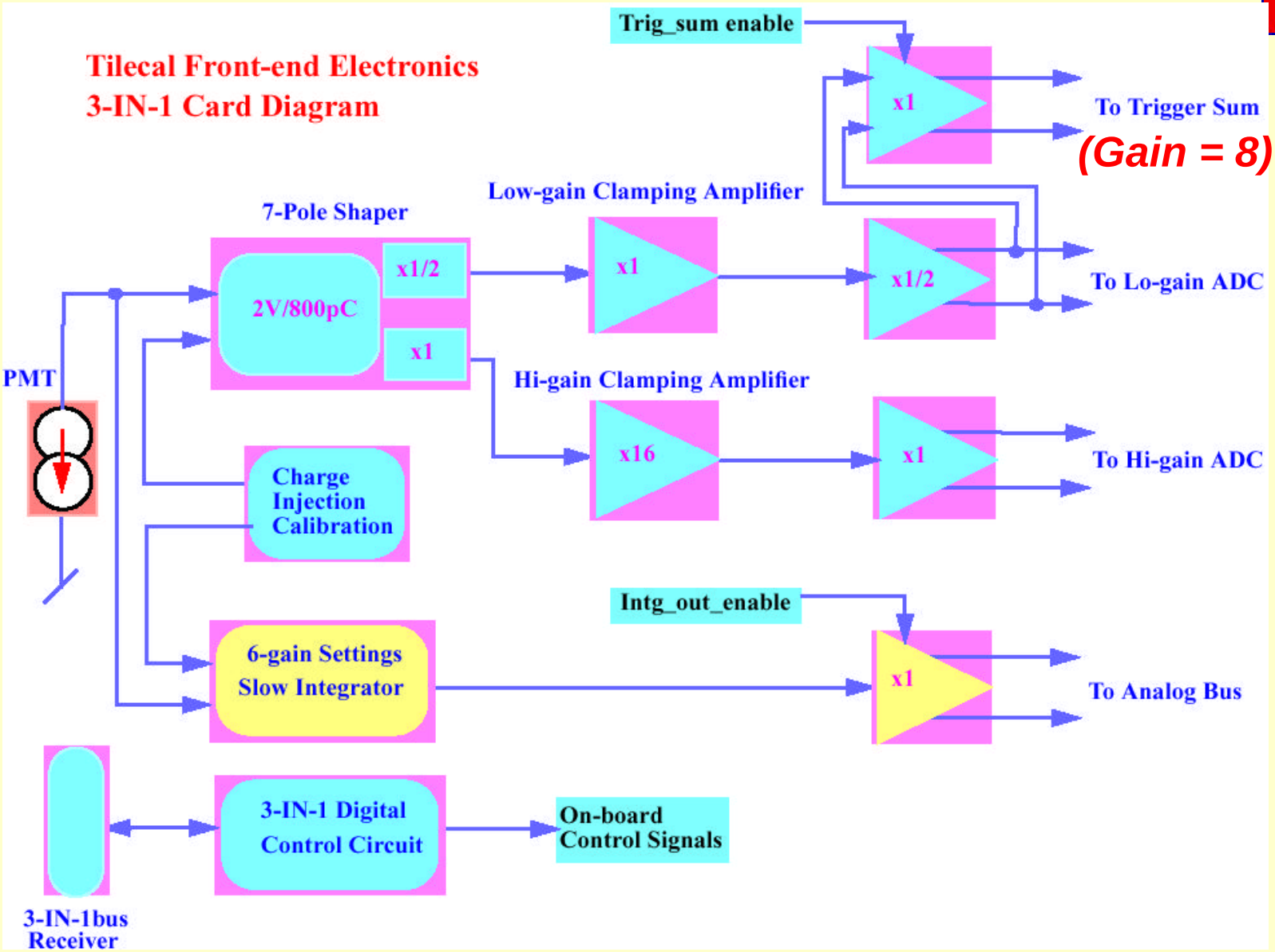
Eric Eisenhandler, Tony Gillman, Weiming Qian

# Background



- July/August - Eric, Weiming & Tony had 2 short visits to ATLAS Test-beam
- Goals:
  - Look at TileCal signals from prototype Barrel and Extended Barrel f segments – using calibration pulses and particles to assess gain requirements for Receiver module
  - Look at performance of LAr Receiver when fed with unipolar TileCal signals – latency, effects of AC-coupling, saturation, … to determine its suitability for TileCal use
  - Define requirements of TileCal muon/calo trigger Patch-Panel – connectors, grounding, …
  - Establish good working relationship with TileCal group
- During July visit –
  - No beam at all (vacuum problems)
  - Used charge injection system to examine signals and determine calibration of electronics
- During August visit –
  - Broken screw-jack ® TileCal at fixed height (beam in only one tower, close to its edge)
  - Further machine problems ® very little beam
  - Continued using calibration system to look at signal coupling out of Receiver

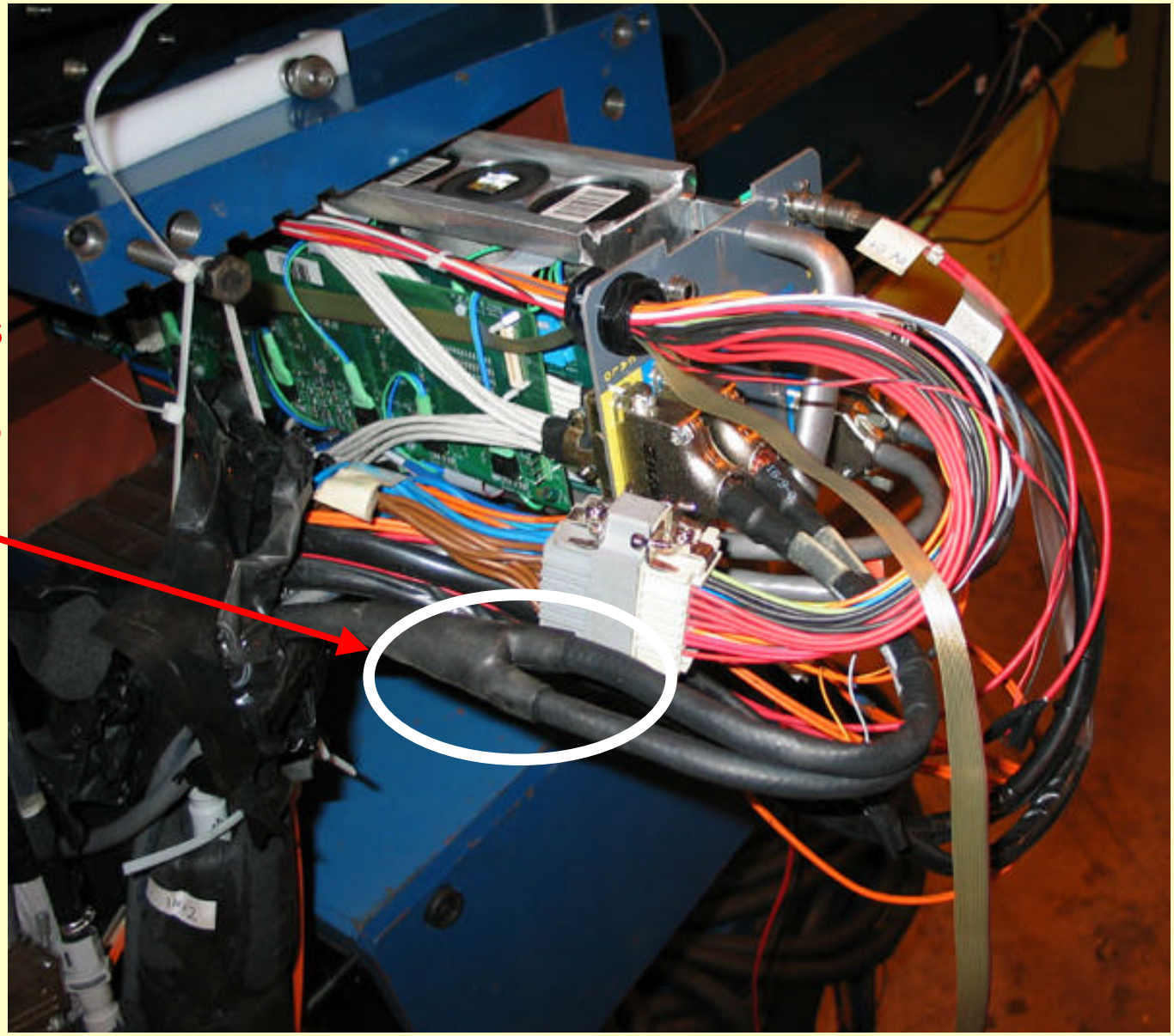
# TileCal electronics



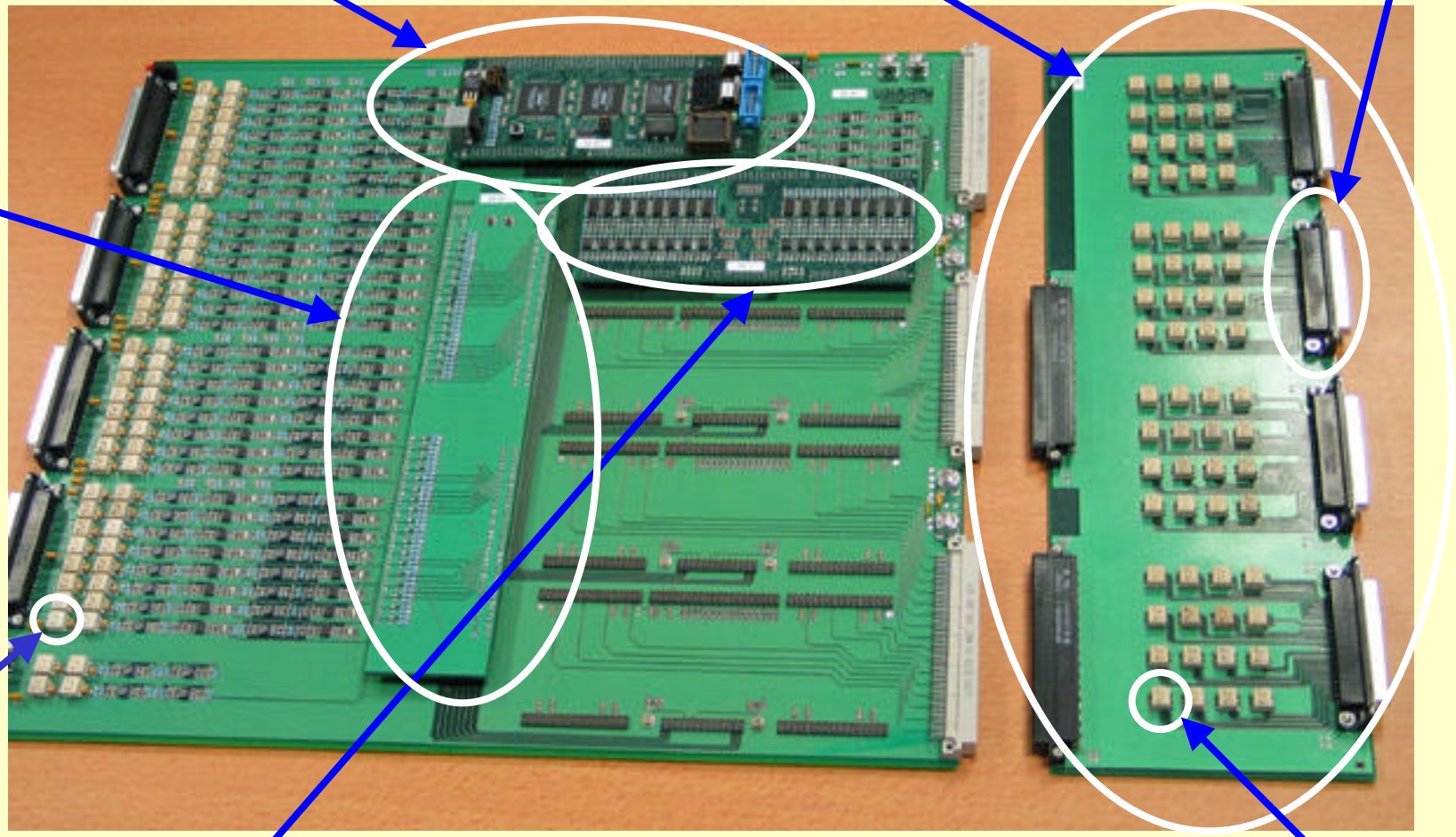
# Tile Calorimeter segments

# Drawer electronics

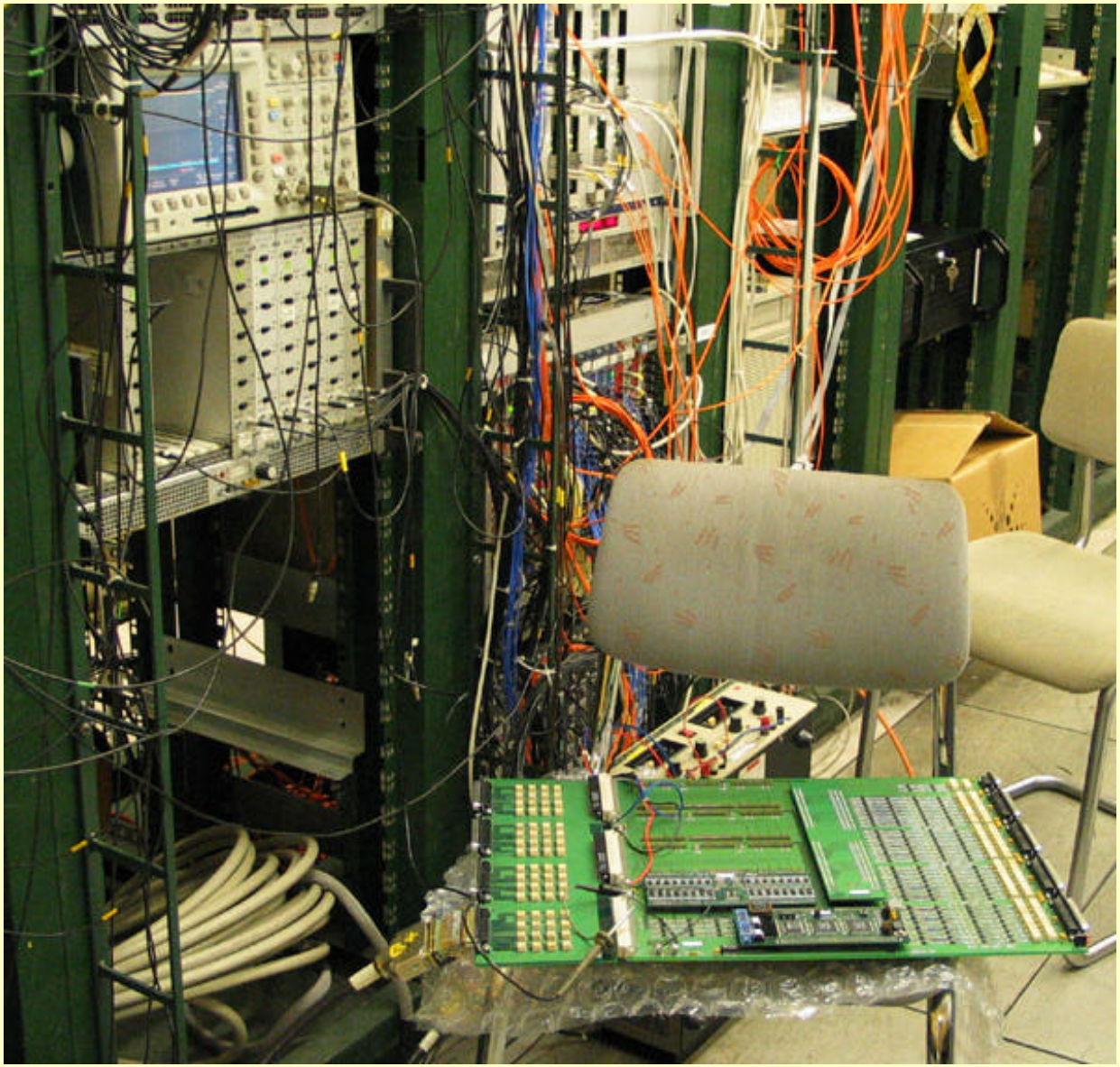
**Muon + Calo trigger cables merging into single 16-pair cable *(70 m)***



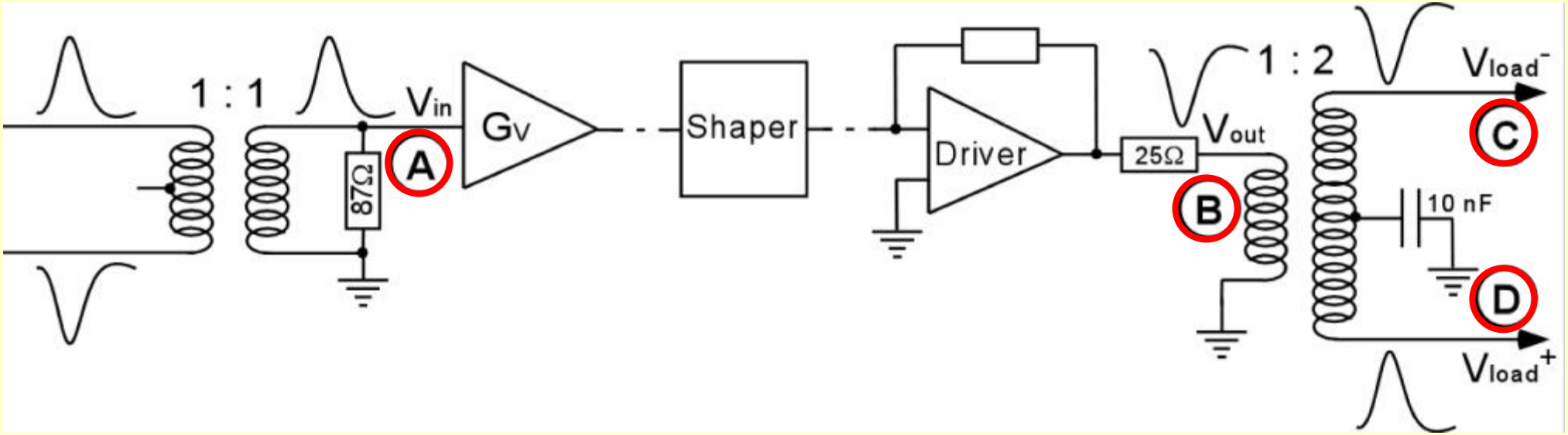
# Lar Rx module



# Low-cost crate system…



# LAr Receiver signal chain

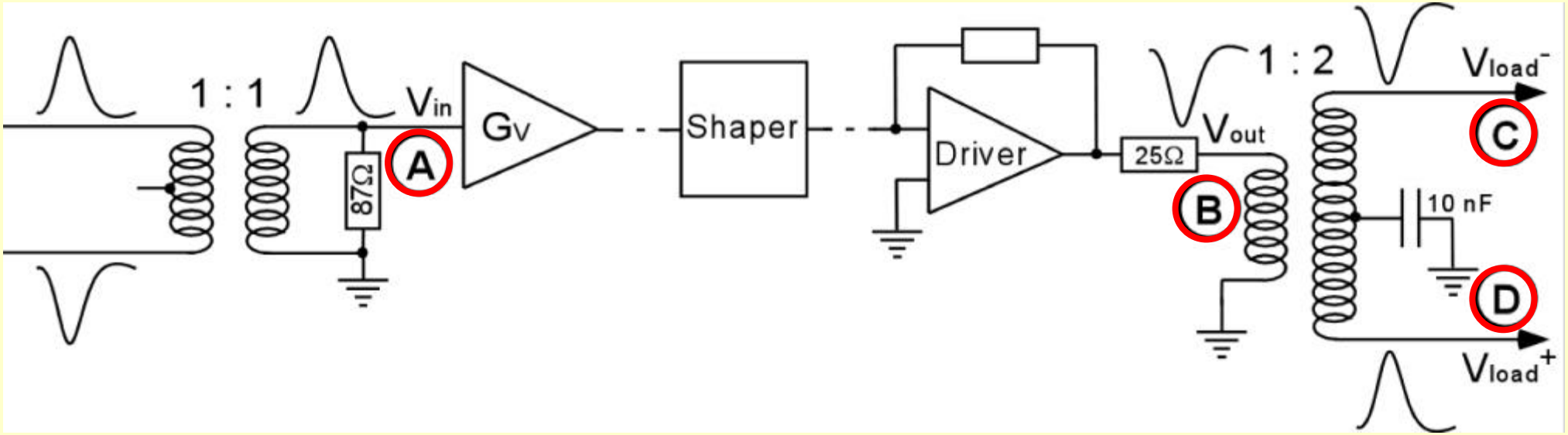



- AC *(transformer)* coupled on inputs *(from TileCal)* and outputs *(to PPr)*
- Signals monitored at high-*z* on DSO at points A, B, D *(single-ended)*

  ***n.b. transformer secondary not loaded***
- Gain – 10 mV/pC *(p-p differential signal)* at output of electronics drawer

  ® 6 mV/pC after 70 m cable *(attenuation ~40%)* – at point A

# LAr Receiver signal chain

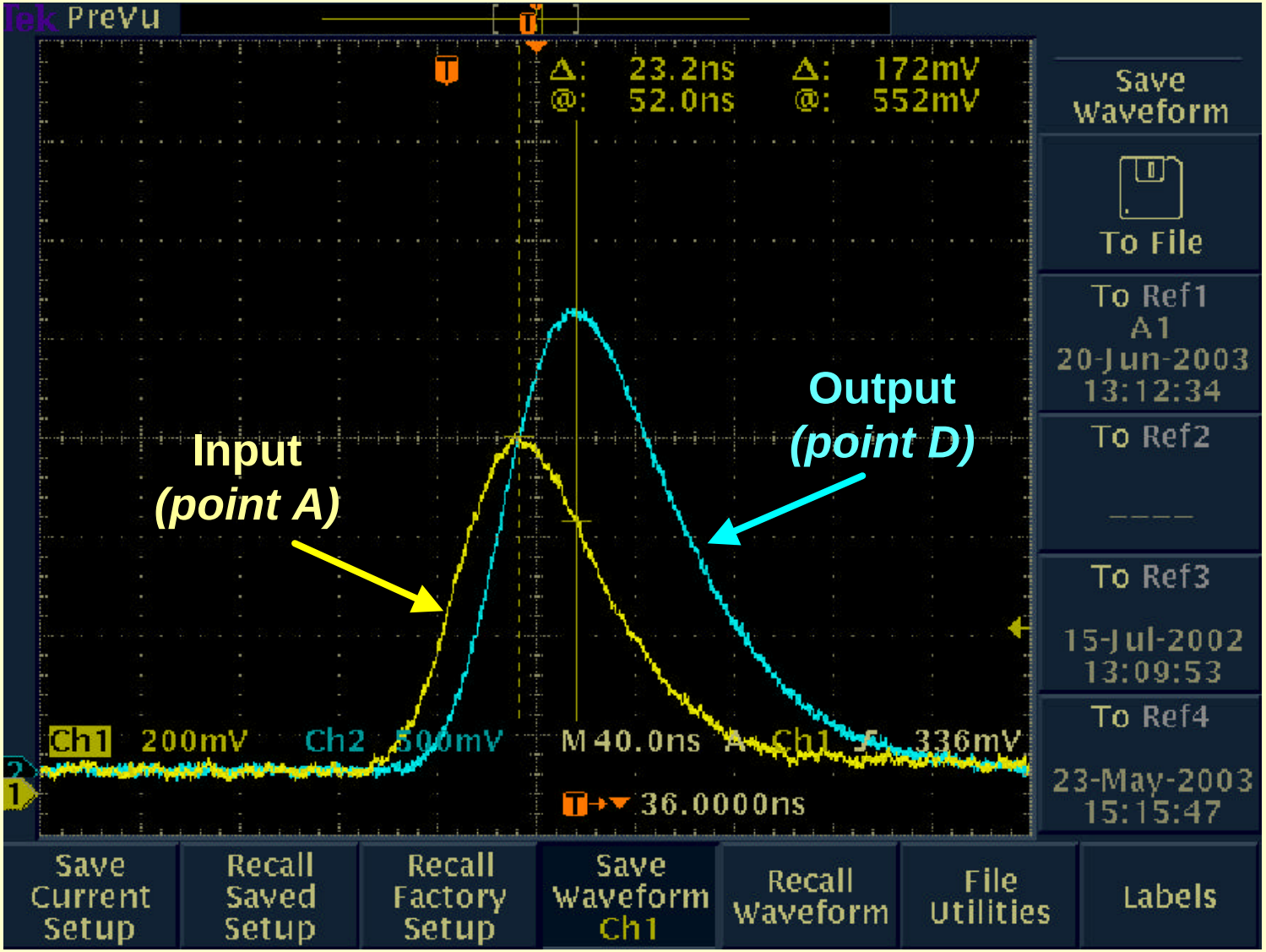



- Variable-gain stage controlled via USB interface – $G_v$ set to default gain value on module power-up

- Default open-circuit gain *(output transformer not loaded)*

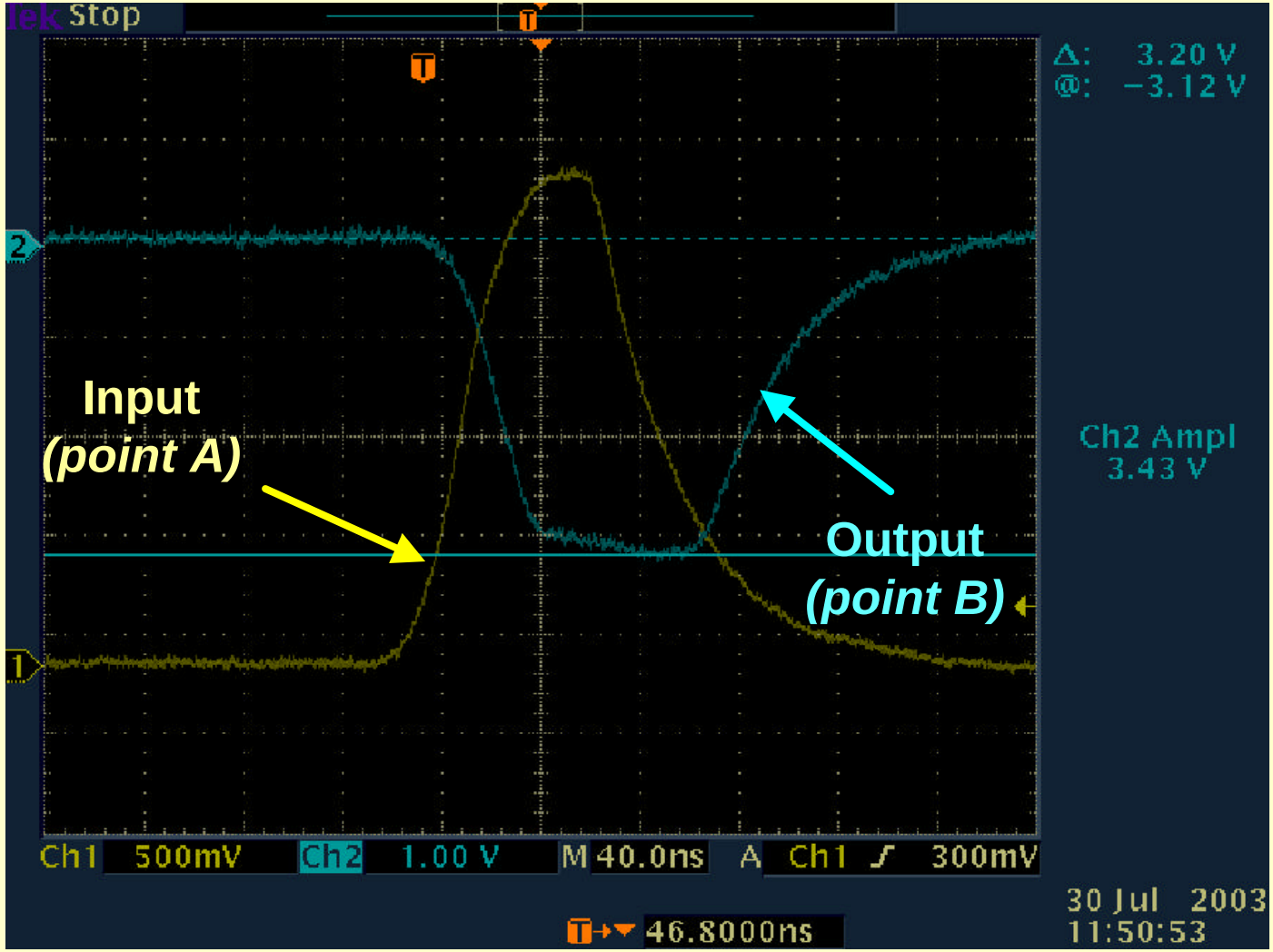
$V_{out}/V_{in}$ ~ 1.6 *(points A® B)*

# Q-injection signals



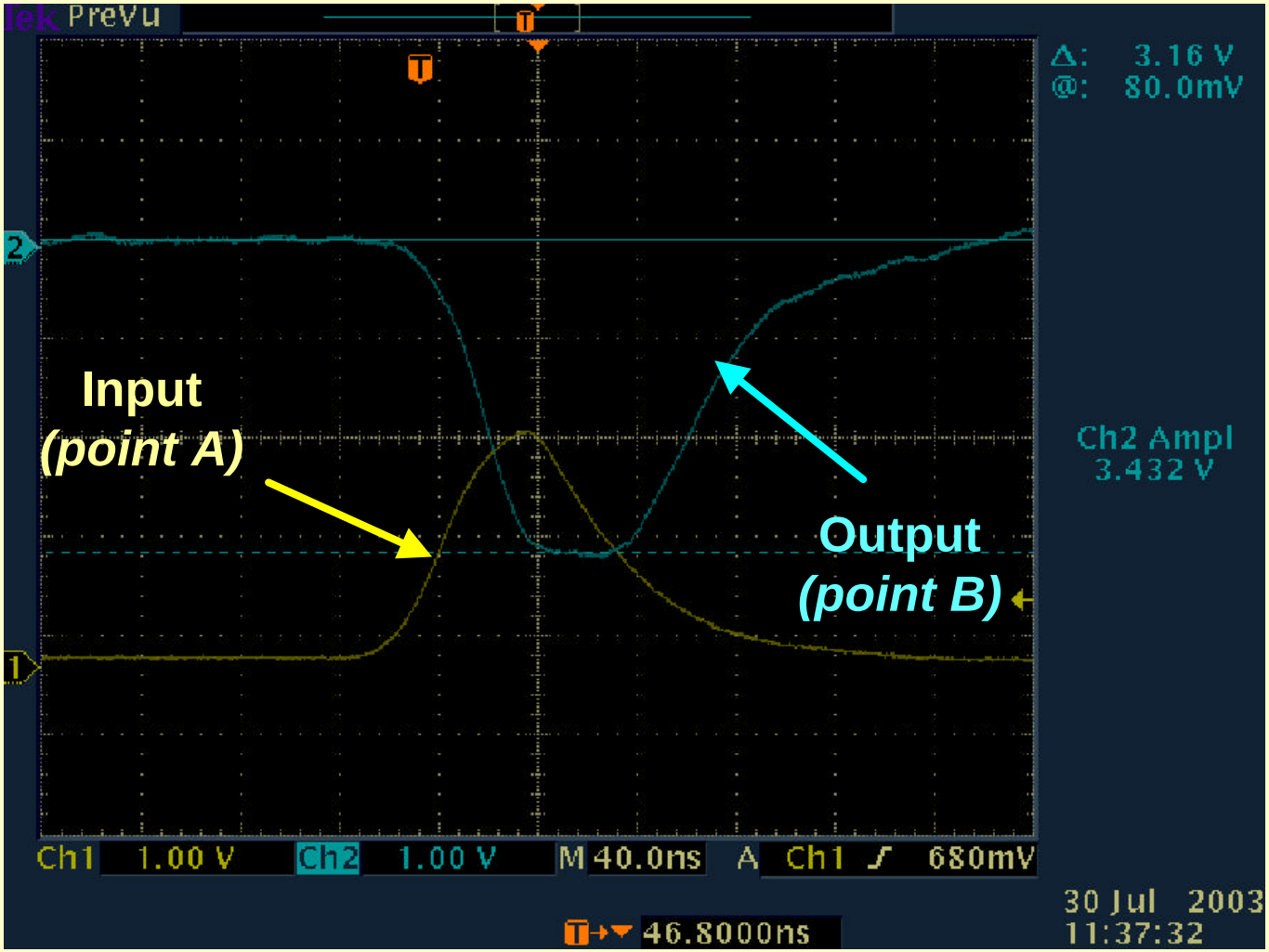

- **Risetime ~35 nsec; FWHM ~ 70 nsec; Rx latency ~23 nsec**

# Saturation effects – 1



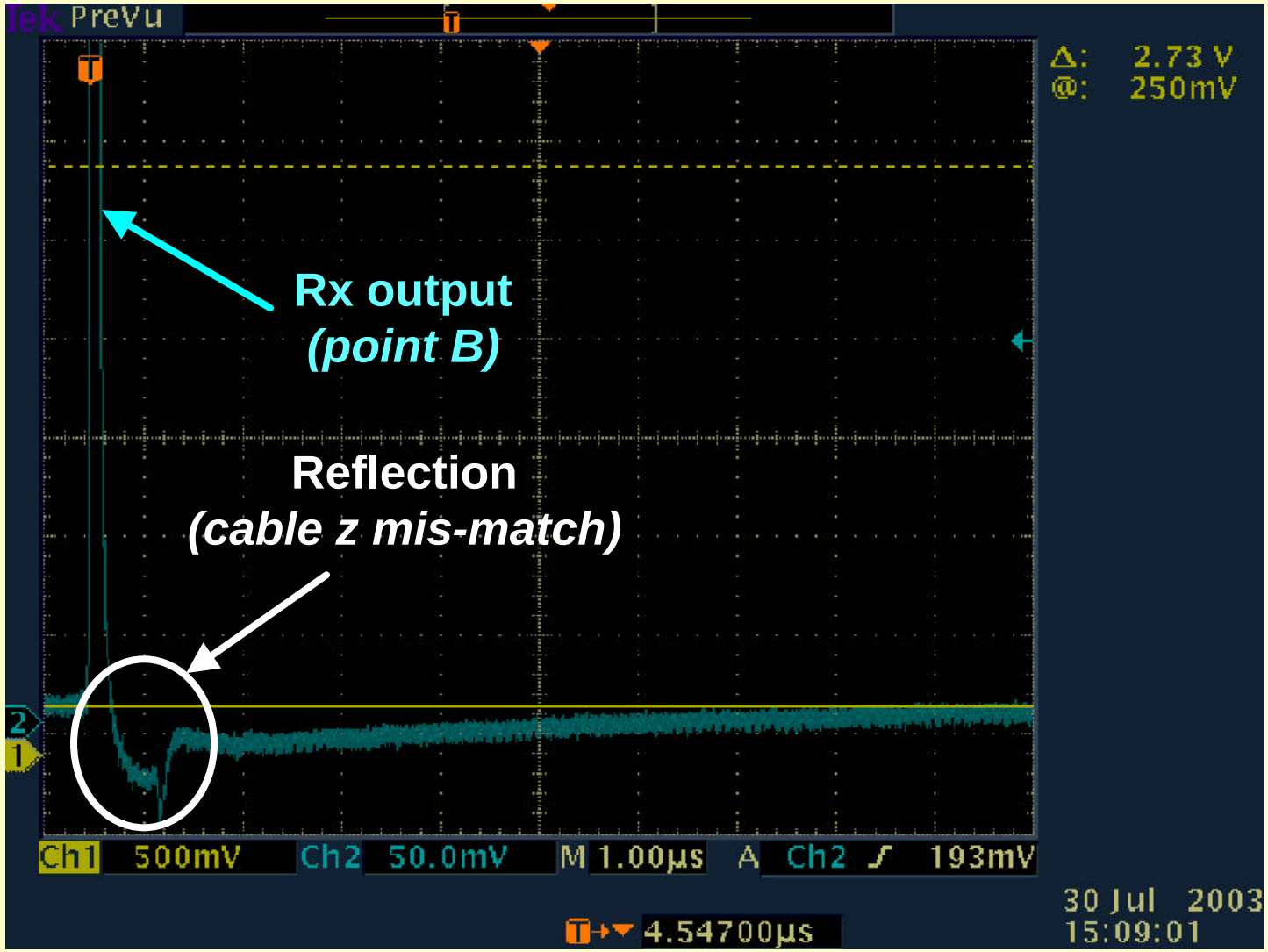

- **TileCal electronics chain starts to saturate between 300 pC and 400 pC**
  ***(input shown here already into saturation at ~2.4 V ~400 pC – 400 GeV)***

# Saturation effects – 2




- **LAr Receiver output saturates at ~3.3 V**
  ***(~350 pC – 350 GeV – at default gain setting)***

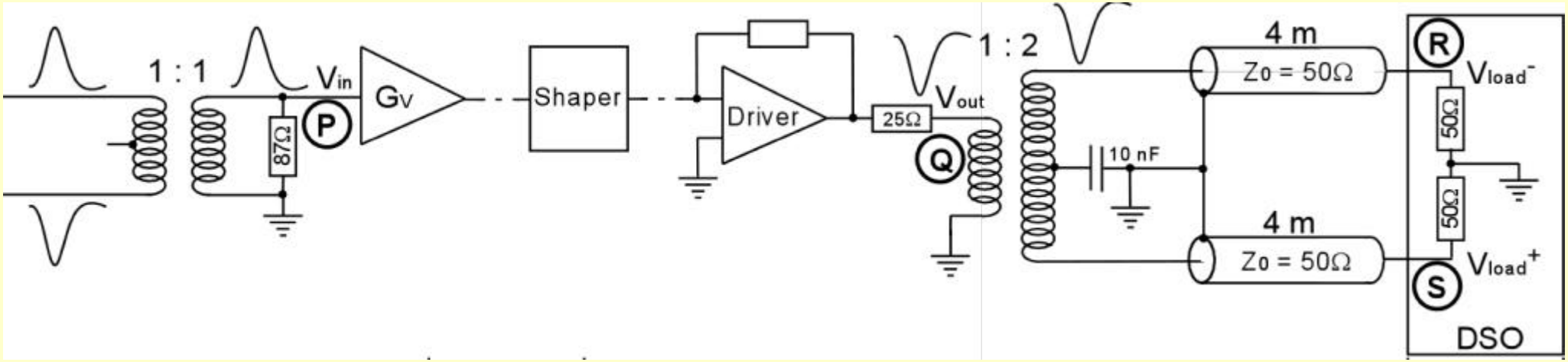
# Undershoot




- **AC-coupling effect ® ~1% post-pulse under *(over?)* shoot – t ~O(10 msec)**

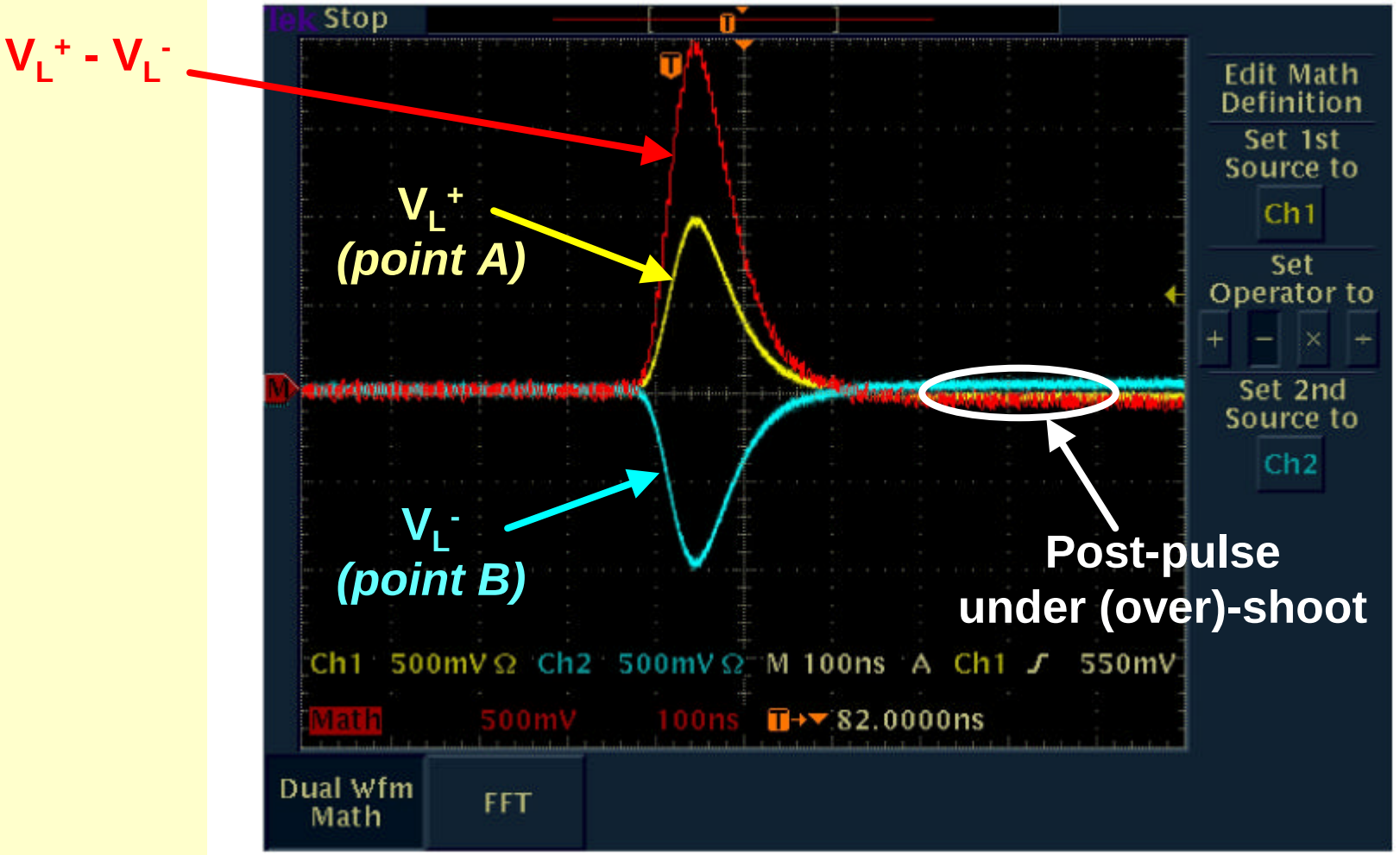
# LAr Receiver gain

- **Default overall open-circuit gain *(output transformer not loaded)*:**
  **$V_{out}/V_{in}$ ~ 1.6**
- **Loaded correctly *(emulation of PPM AnIn board)* overall gain is reduced:**
  **$V_{out}/V_{in}$ ~ 0.8** ***(points P® R/S)***

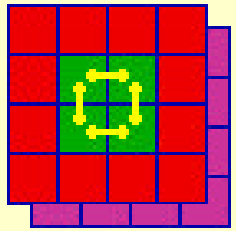


# LAr Receiver performance

- Input – 200 pC $Q_{inj}$ signal

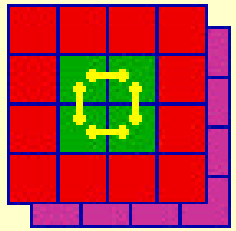


# *TileCal electronics energy calibration*



- TileCal signals were measured from electrons with energies of 50 GeV, 100 Gev and 150 GeV –
  - electron calibration ~11 mV/GeV
  - pion calibration ~9 mV/GeV
- This is broadly consistent with the scaling calculated when using the $Q_{inj}$ calibration signals
- *Conclusion:* LAr Receivers can be used as TileCal Receivers without any modifications to the gain ranges provided

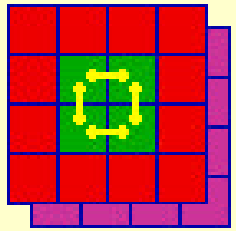
# Grounding issues



- ***How should the individual and the global cable shields be grounded?***

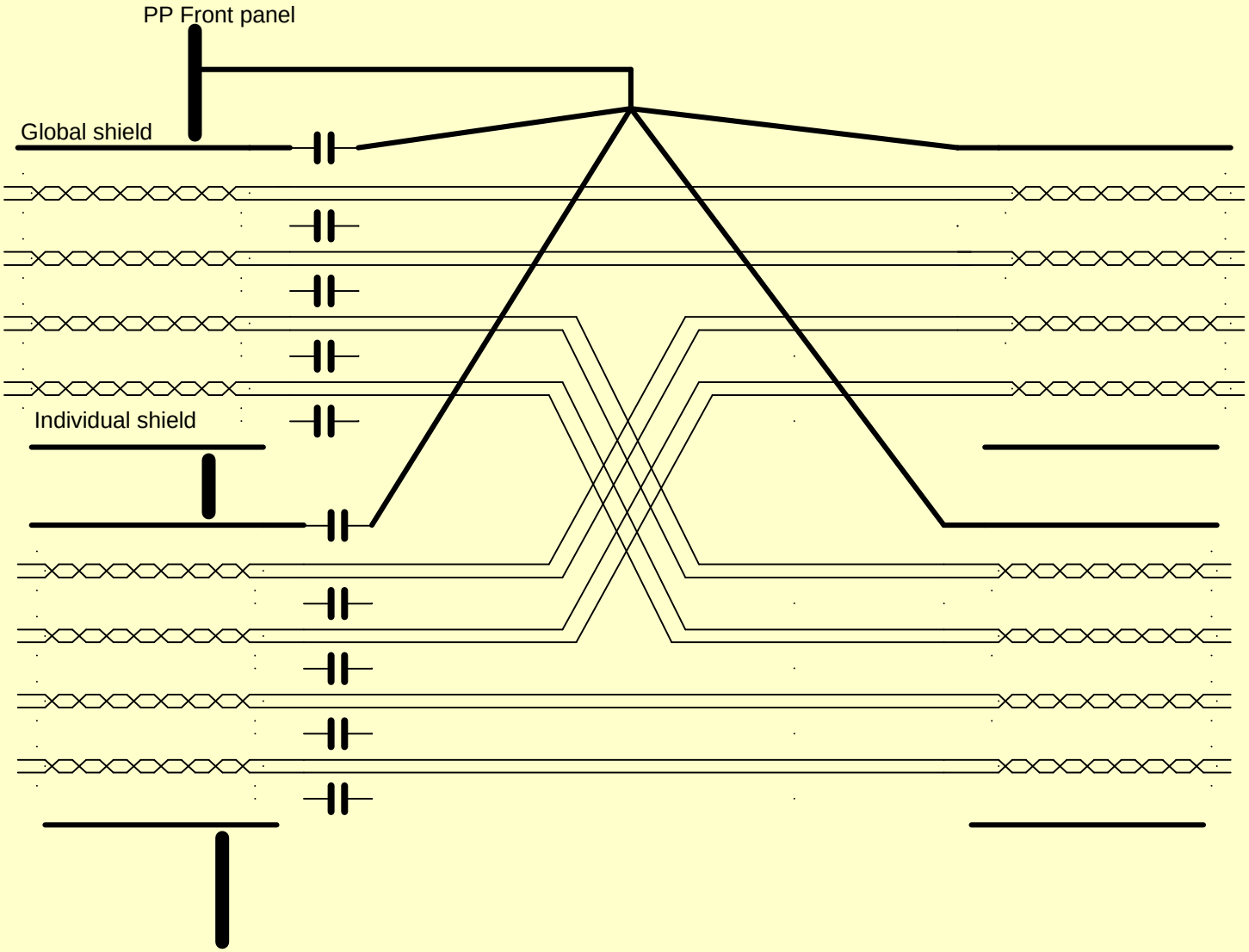
- **Tile Calorimeter lacks the single-ground cryostat body of the LAr calorimeter**
- **Ground potentials could vary for individual summing amplifier cards across the entire Tile Calorimeter**
- **Each TileCal signal cable pair shield is taken to a separate ground pin on the remote end 50-pin connector**
- **The LAr Rx uses a 37-pin connector, requiring groups of four individual cable pair shields to be connected**
- **Transition between grounding systems conveniently done in Muon-Calo break-out patch-panel ® TileCal and Lar grounding effectively identical**

# *Muon-Calo trigger break-out patch-panel*

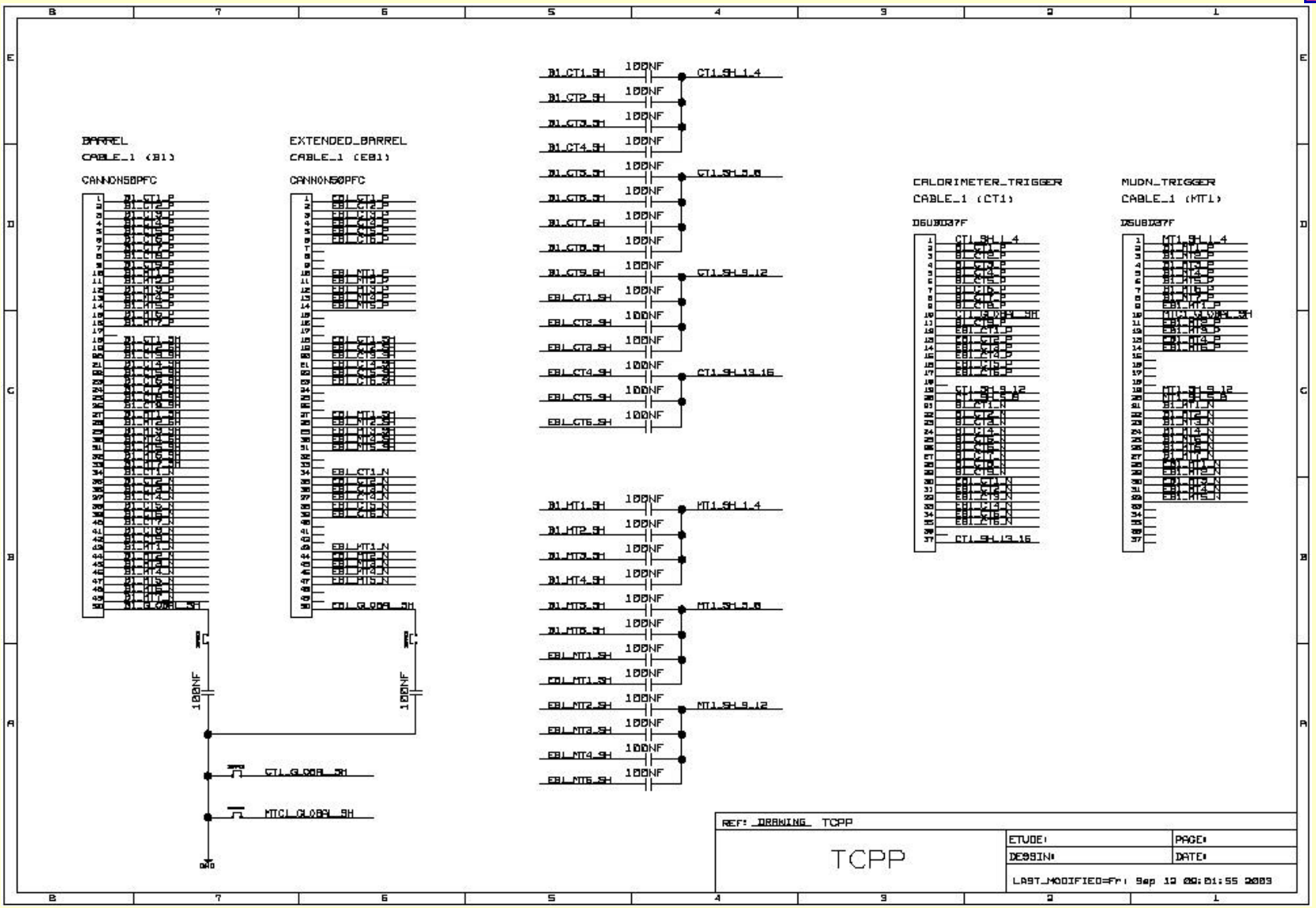


- **Patch-panel needed to separate muon trigger signals from calorimeter trigger signals, which share the same cables from the Tile Calorimeter**
- ***Barrel cables*** **9 calo trigger signals + 7 muon trigger signals**
  ***Extended Barrel cables*** **6 calo trigger signals + 5 muon trigger signals**
- **"Patch-panel" will actually be 64 9U modules in four unpowered crates**
- **Each module receives 4 TileCal cables on rear-mounted 50-pin connectors, re-orders the channels via controlled-*z* pcb tracking, outputs them on 4 front-panel 37-pin connectors – 2 * 15-ch calo cables and 2 * 12-ch muon cables**
- **Yuri Ermoline is organising schematics and layout at CERN – manufacture will be done via RAL – modules available ~November 2003 *(ready for TileCal cosmic-ray run?)***

# Muon-Calo trigger break-out patch-panel – crossover detail

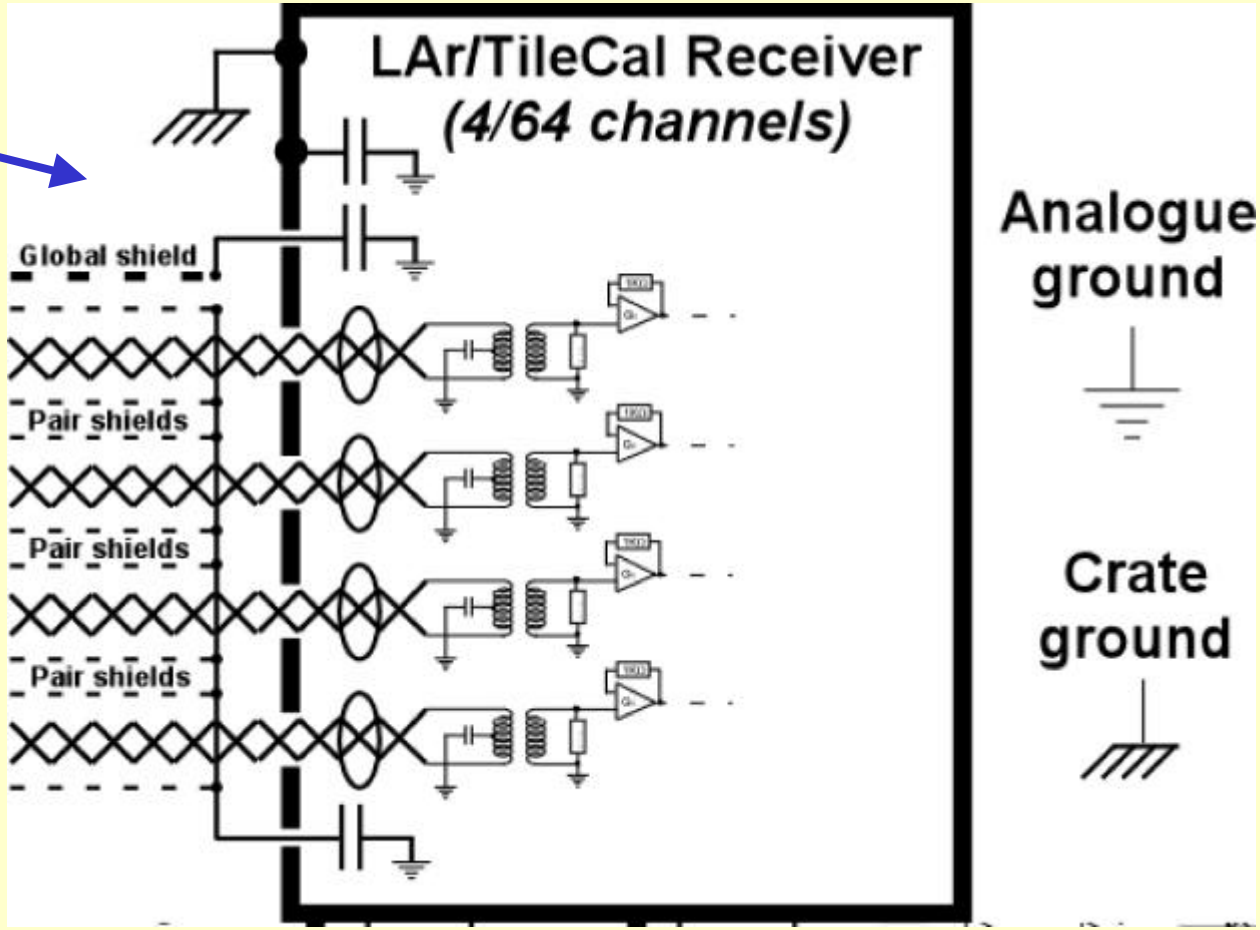


# *Muon-Calo trigger break-out patch-panel – schematics*



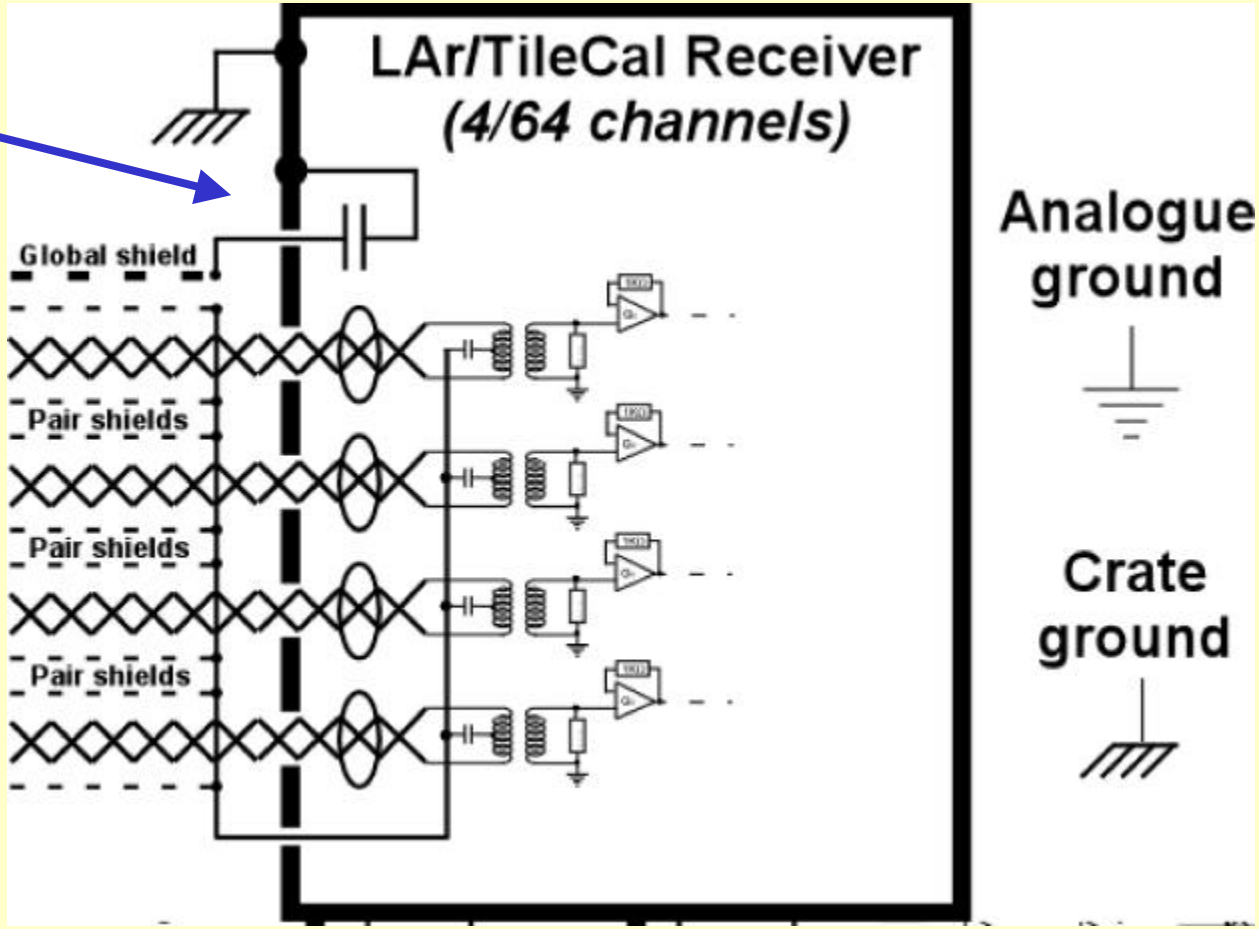
# Grounding issues

- Current LAr Rx input grounding scheme
- Signal pair shields coupled capacitatively to “noisy” crate ground not ideal?
- Weiming made interesting alternative proposal to avoid this problem …



# Grounding issues

- Proposed input modification – isolates signal grounds from "noisy" crate ground
- Should optimise common-mode noise rejection
- *Veljko Radeka's approval awaited*



# TileCal ® Patch-Panel ® Rx grounding scheme