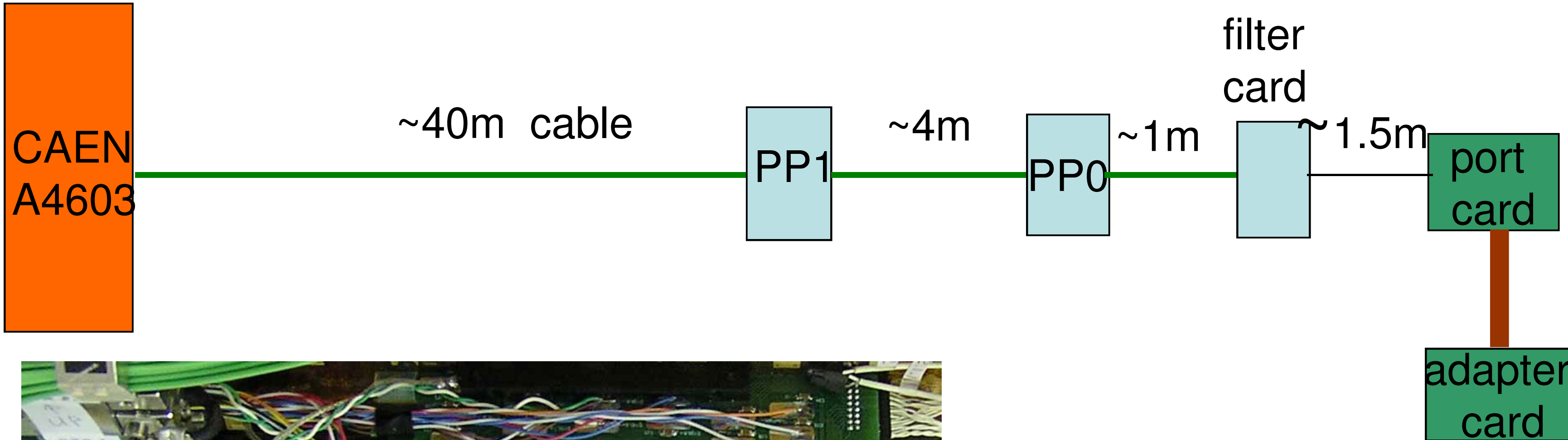
Pixel Endcap Power Distribution
Phase 1 Upgrade Plans

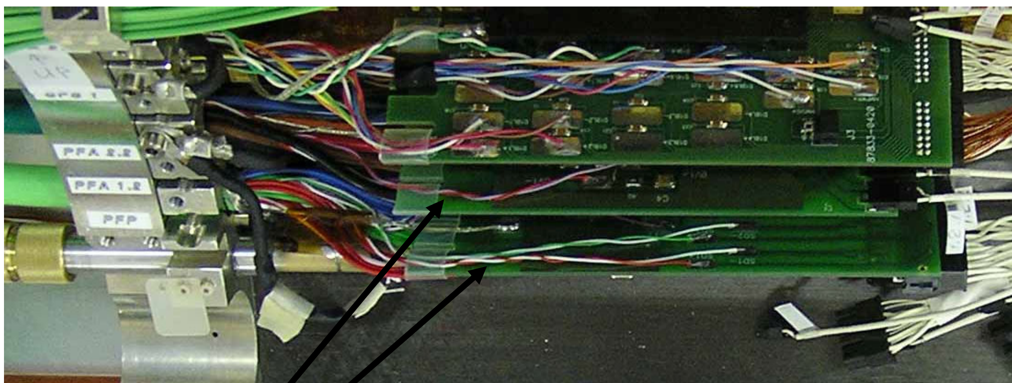
Fermilab, University of Mississippi, University of Iowa

Lalith Perera
University of Mississippi

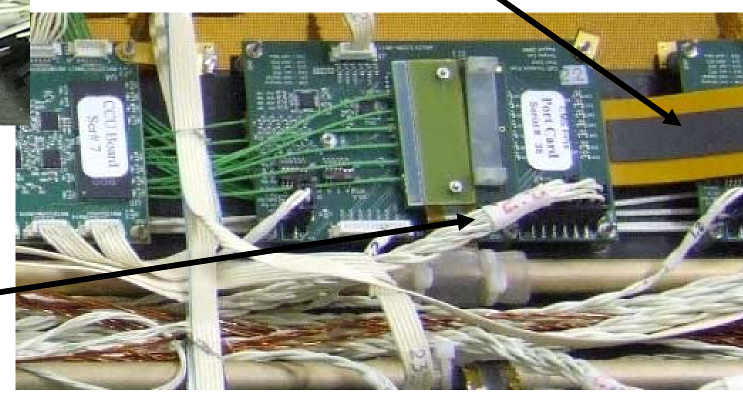
CMS Upgrade Workshop 10/28/2009

Current Endcap Power Distribution System





Power filter cards



Flex cable to the adapter card

Cables from filter card

Current endcap power cont…

- Each cable powers 6 panels - 135 ROC, 6 TBMs
- Vdig/Vana voltage sensing is done very close to the detector on the adapter card
- Overall resistance – mostly in the 40m cable
  - analog 0.6 ohms
  - digital 0.4 ohms

	Vset	Vconn	I
Analog	1.6V	3.6V	3.4A
Digital	2.6V	4.2V	3.8A

Endcap Phase 1 Upgrade Requirements

- Phase 1 upgrade -
  - 7 blades per cable - 224 ROC, 14 TBMs
- Digital current will go up with the luminosity – say 30%

CAEN A4603 rating

	Vset	Vcon	I	max Vcon	max I
analog	1.6V	4.9V	5.6A	5.8V	6A
digital	2.6V	5.8V	8.6A	7V	13A

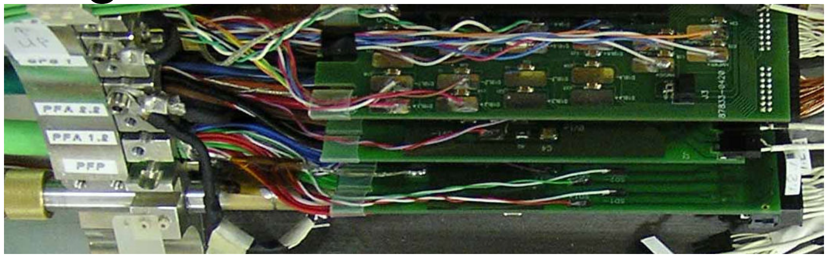
- Current CAEN A4603 supplies are marginally adequate for the phase 1 upgraded endcap detector
  - lower safety margin
  - At the turn on, ROC (PSI46) takes a higher current
  - have to modify CAEN modules for more voltage/power

Upgrade power requirements cont..

- Pixel barrel detector has to use DC-DC converters to provide power with the existing power infrastructure.
  - Need modifications to CAEN modules suitable to use DC-DC converters
- Modifications to CAEN modules are expensive
  - quote 6k Euro/module for changing maximum V/I set values
  - for higher maximum driving voltage (Vcon) it would be more (a new design)
- We will follow the same scheme as the barrel detector using DC-DC converters
  - Same power system for the whole pixel detector
  - Experience for the Phase 2 upgrade

Possible layout for DC-DC converters

- Phase 1: Analog current 6A, digital current 9A
- We will need multiple converters per each segment/cable
  - DC-DC converter rating about 3A
  - 3-4 converters for the analog
  - 4 or 7 converters for digital
- They will be placed on a PCB equivalent to the current power filter card near the end flange



- Issues:
  - This is about 2m from the detector:
    - there will be a voltage drop.
    - How do we measure the actual voltage/current at the detector

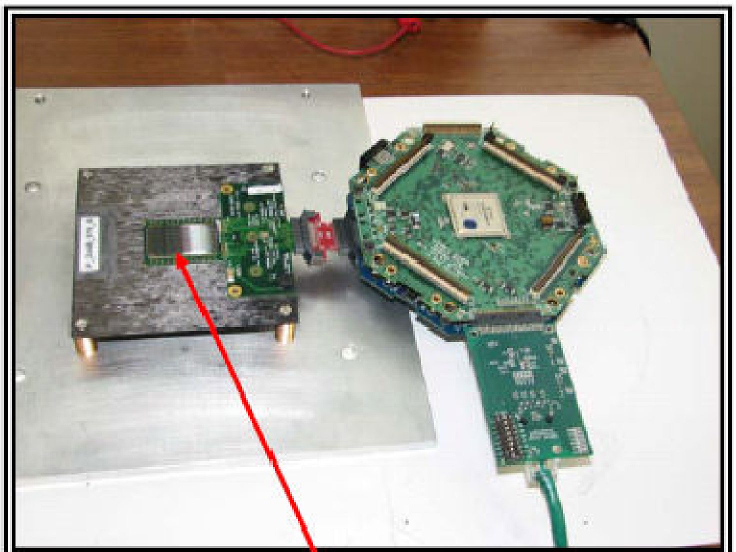
Possible layout, cont...

- Only fixed set of voltages are available (AMIS2).
  - Hardwired - less flexible in case require to change voltages.
  - May not be a problem with the new ROC.

- Even if the DC-DC converter chip is remotely programmable it is not straightforward to establish a communication path.
  - Few spare cables in the power cable may be used for signaling but the other end of the cable is at the CAEN racks (X2F balcony)
  - DCU/portcars are located about 1.5 from the end flange, communicate through FEC may need additional cabling in the service cylinder

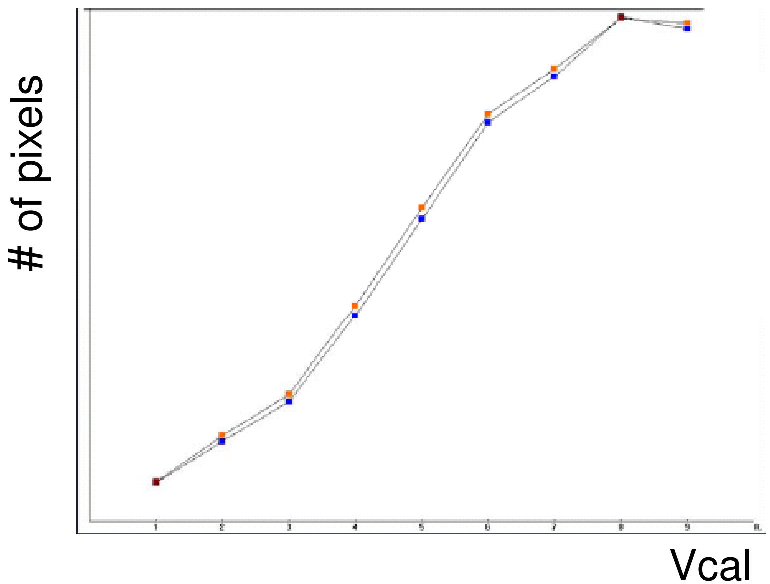
Work done at the Fermilab

- We have built DC-DC converters with commercially available converters
  - used with the PSI46 and the CAPTAN system.
- Noise Susceptibility measurements
  - Studied the behavior of the ROC injecting noise to the digital power line
- Results have been presented in previous power WG meetings
  - No significant degradation of the ROC performance with noise in power.



ROCs

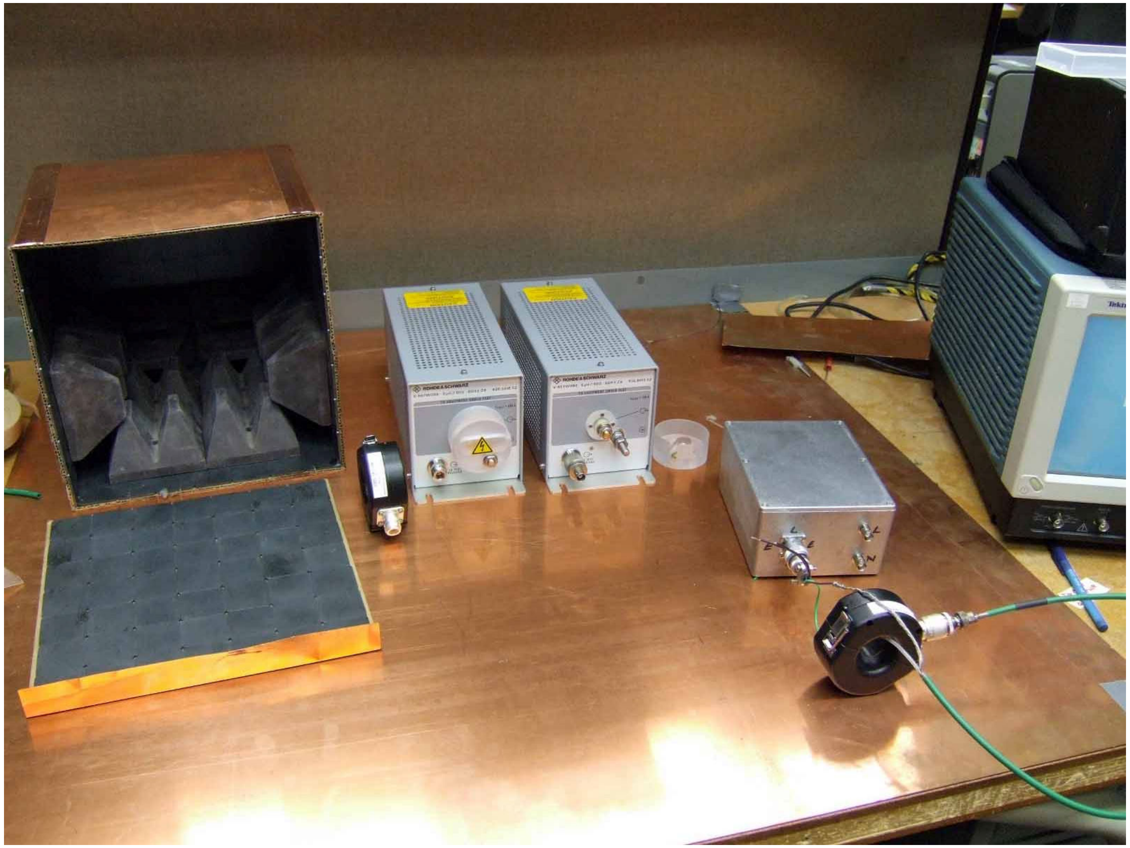
Test setup with DAQ /Power boards



Threshold distribution (S-curve) LM2734 vs Linear regulator

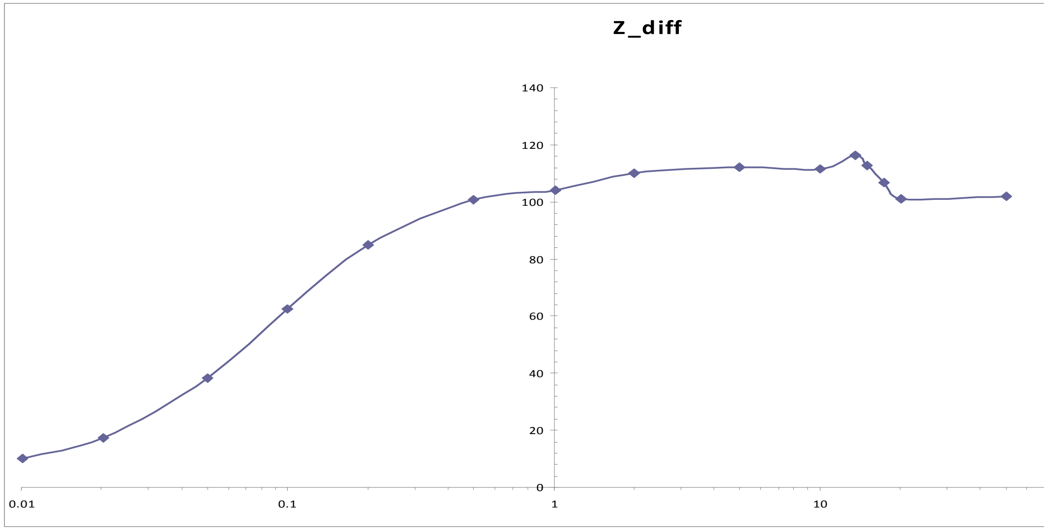
EMI Noise measurements

- We are in the process of setting up an EMI test stand
  - Followed CERN set up
  - Home built LISN similar to CERN design, 100 Ohm AC resistance 200k-50 MHz



EMI noise measurement cont

Ohms



LISN impedance

MhZ

- We also built a RF shield box
  - Metal box to shield from external RF sources
  - Inside covered with RF absorbing ceramic to minimize reflecting RF from the DUT.

Plans

- Test the DC-DC converter with the CERN power converter chip and make performance tests.
  - Performance of the pixel ROC
  - EMI noise
- Test the system at a 1.5 Tesla field
- Do a full scale test with actual power cable, modified CAEN power modules, DC-DC converter and an Fpix pixel detector panel