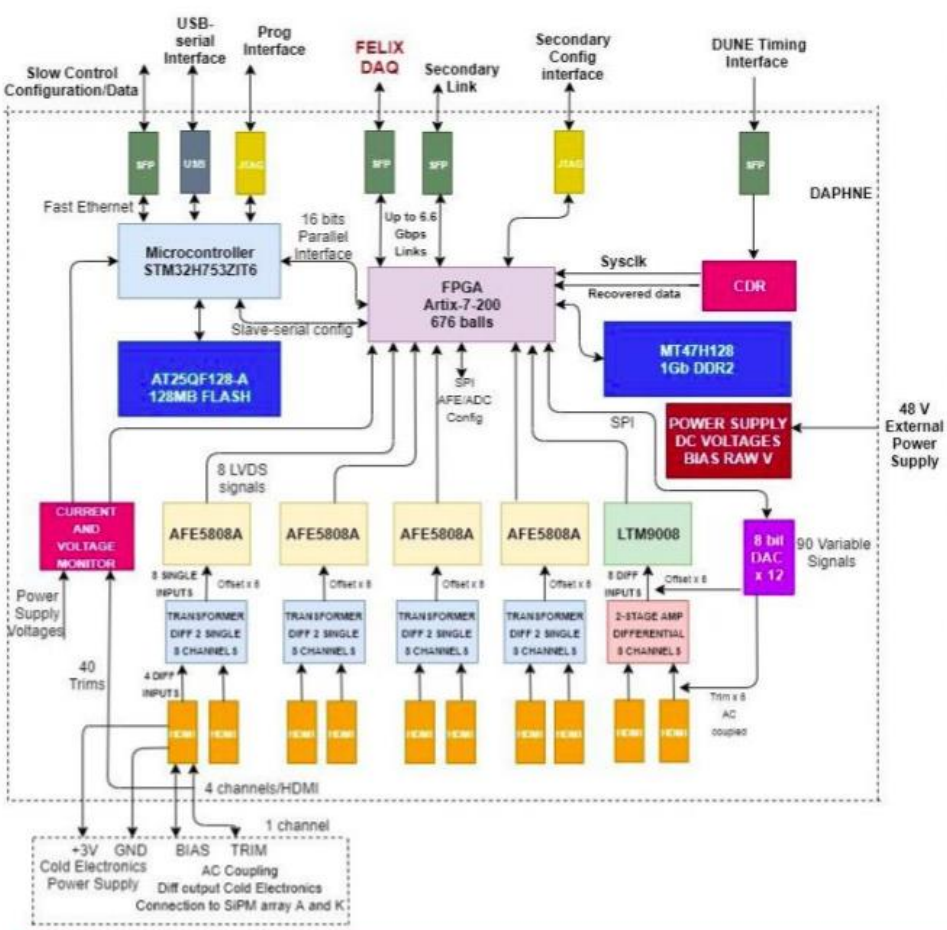
SIPM readout for VD

Paul Rubinov on behalf of EED

27 JUL 2021

HISTORY

- DAPHNE
  - Detector electronics for Acquiring Photons from Neutrinos



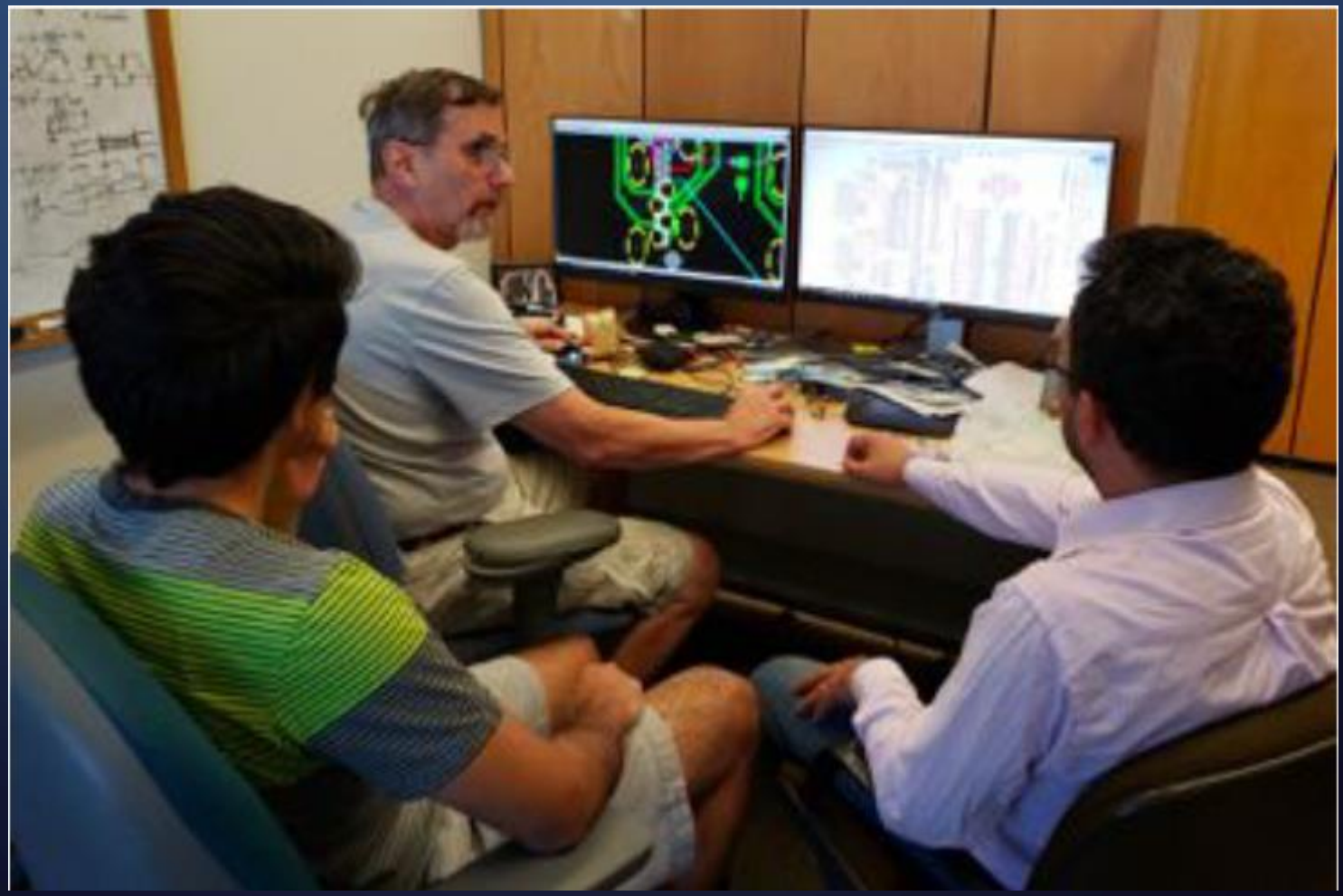
DAPHNE (Detector electronics for Acquiring PHotons from NEutrinos)

- 40 channels/65 Msps/14 bits
- Bias-Trim Voltage supply
- Cold Electronics power supply + 3V
- Gigabit link up to 6.6 Gb/s to FELIX DAQ/full-mode protocol
- DUNE Timing interface

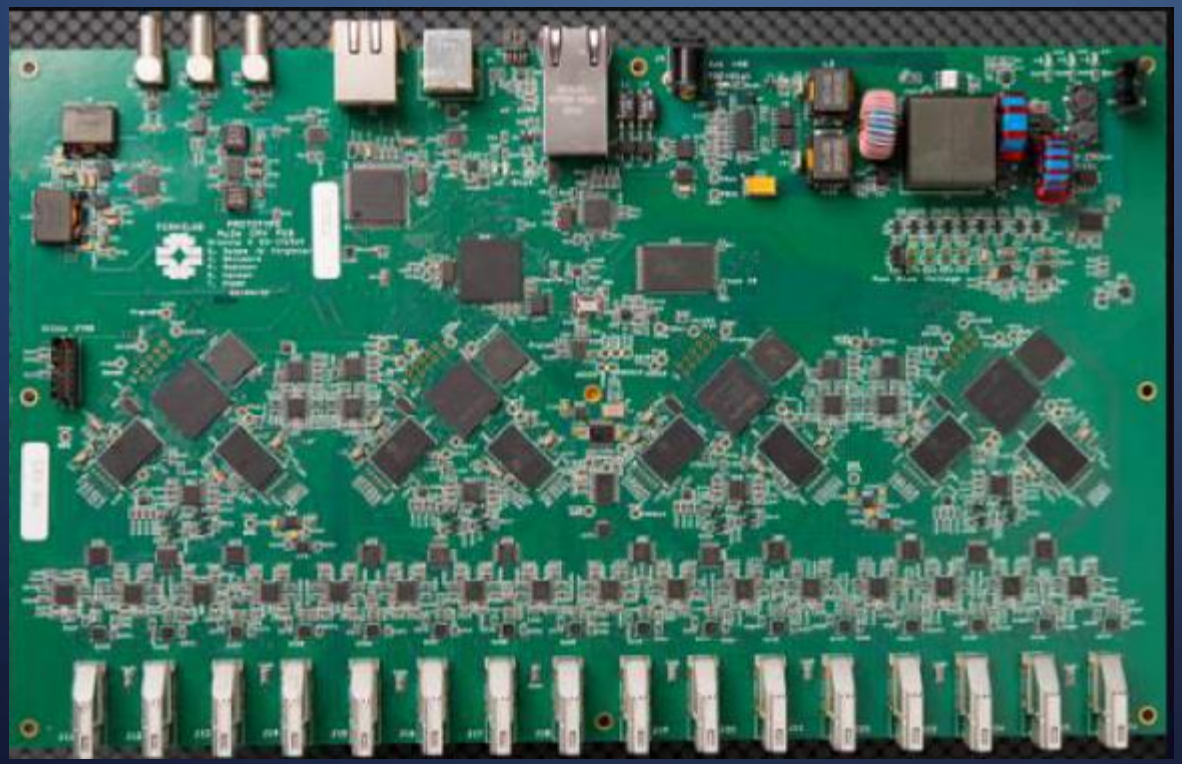
J. Castano
M. Toups

HISTORY

- DAPHNE
  - Long history – derived from Mu2e CRV FEB design

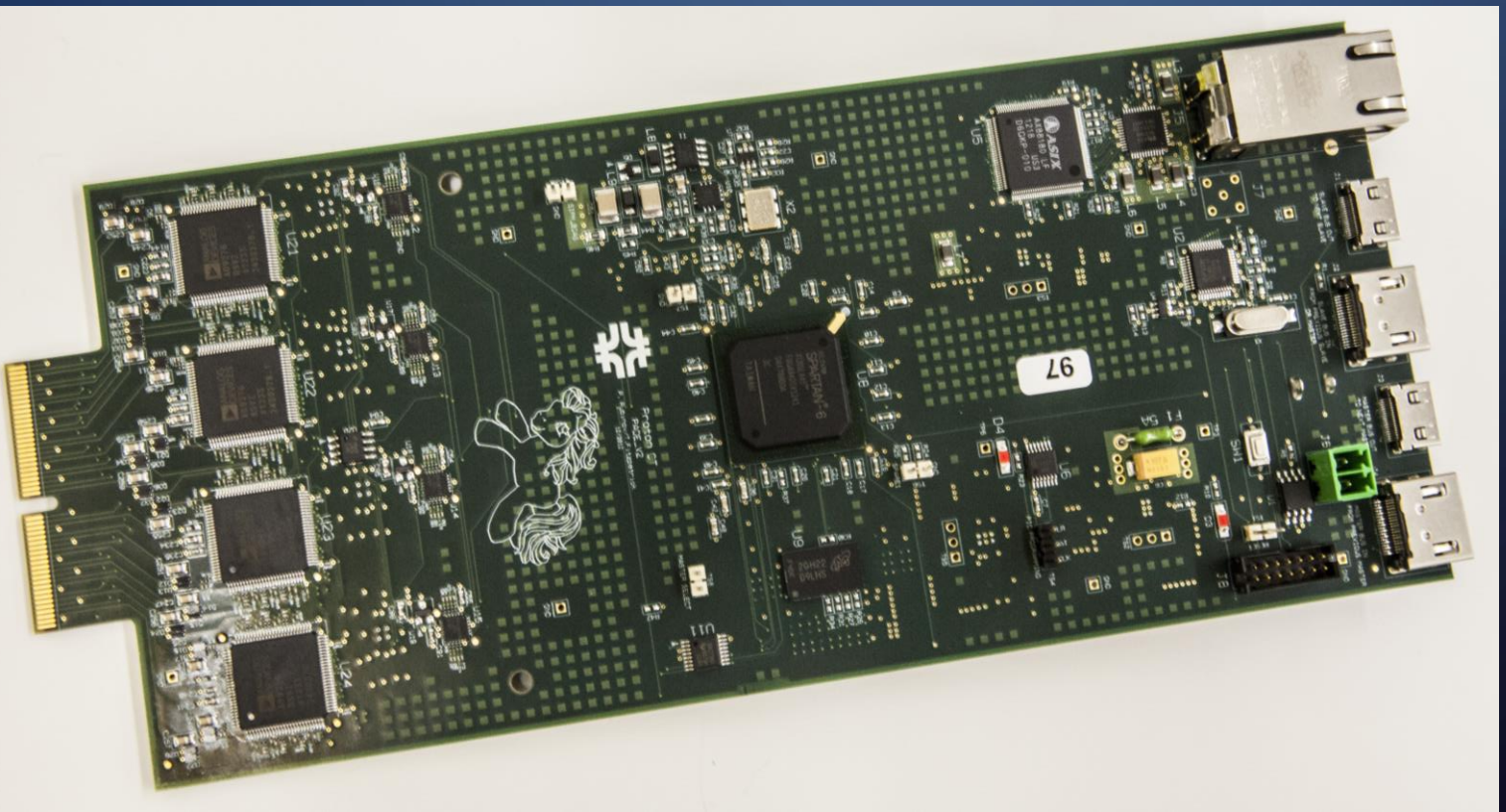


FRONT END BOARD FOR CRV 64CH USING ULTRASOUND AFES



FRONT END BOARD FOR PROTONCT 32CH USING ULTRASOUND AFES

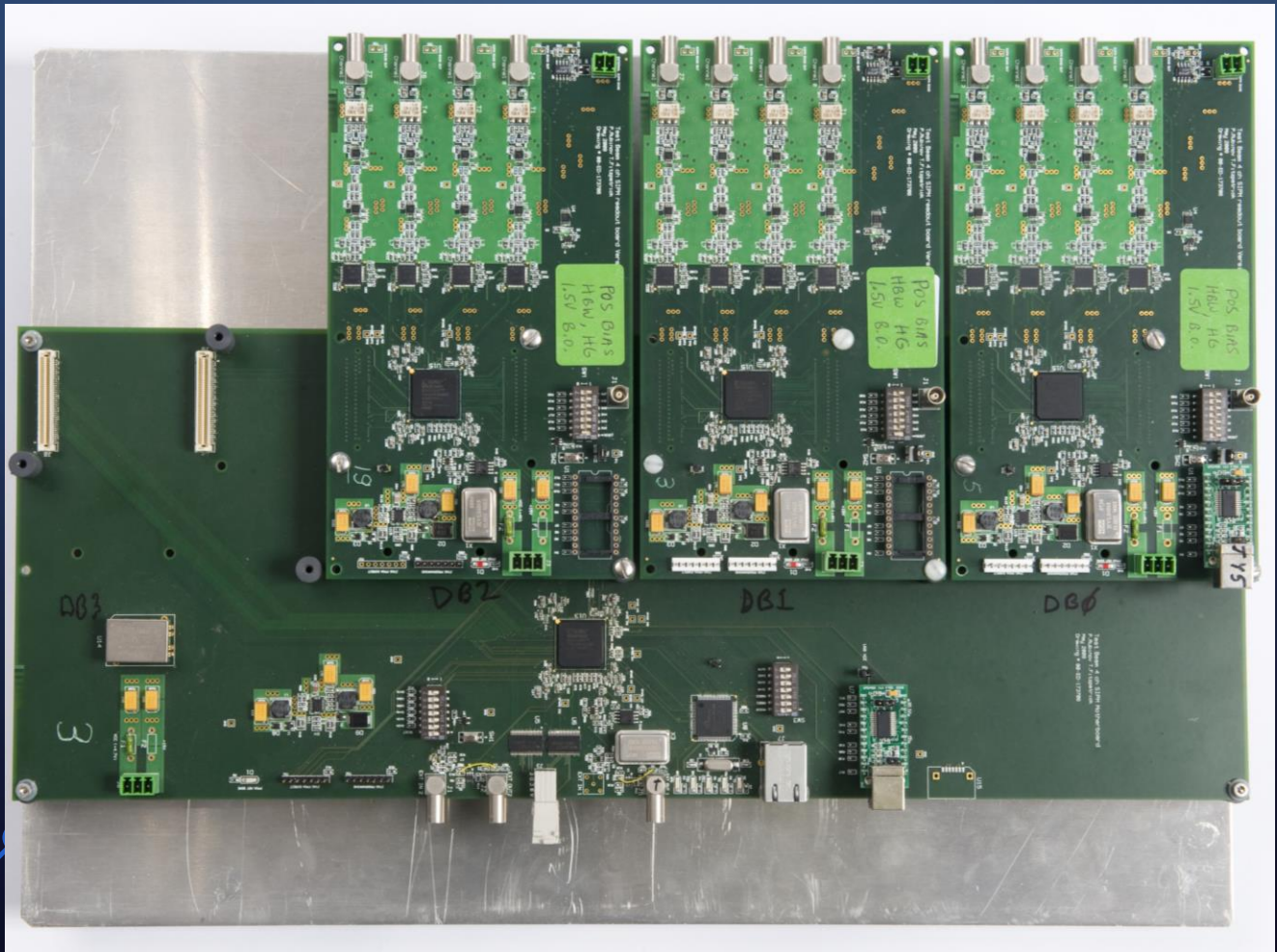
LVDS links and Gigabit Ethernet

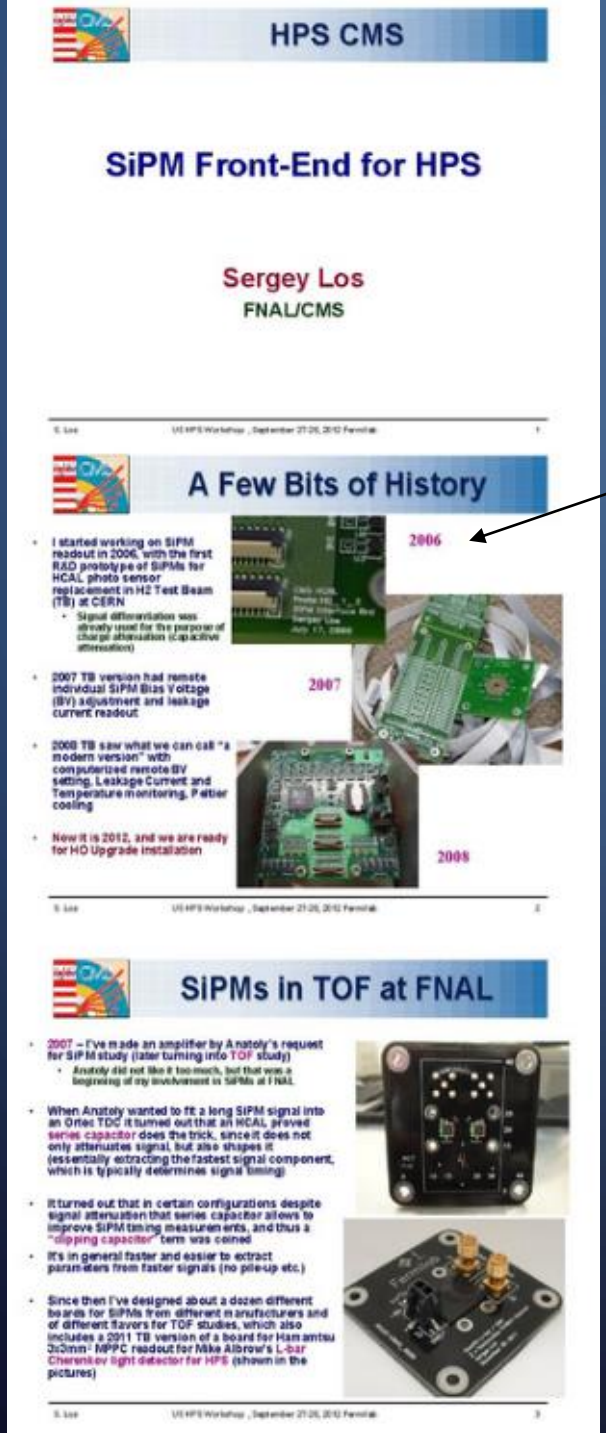


WAVEFORM DIGITIZER WITH INTEGRATED BIAS FOR SIPM READOUT

2009
Rubinov/Fitzpatrick

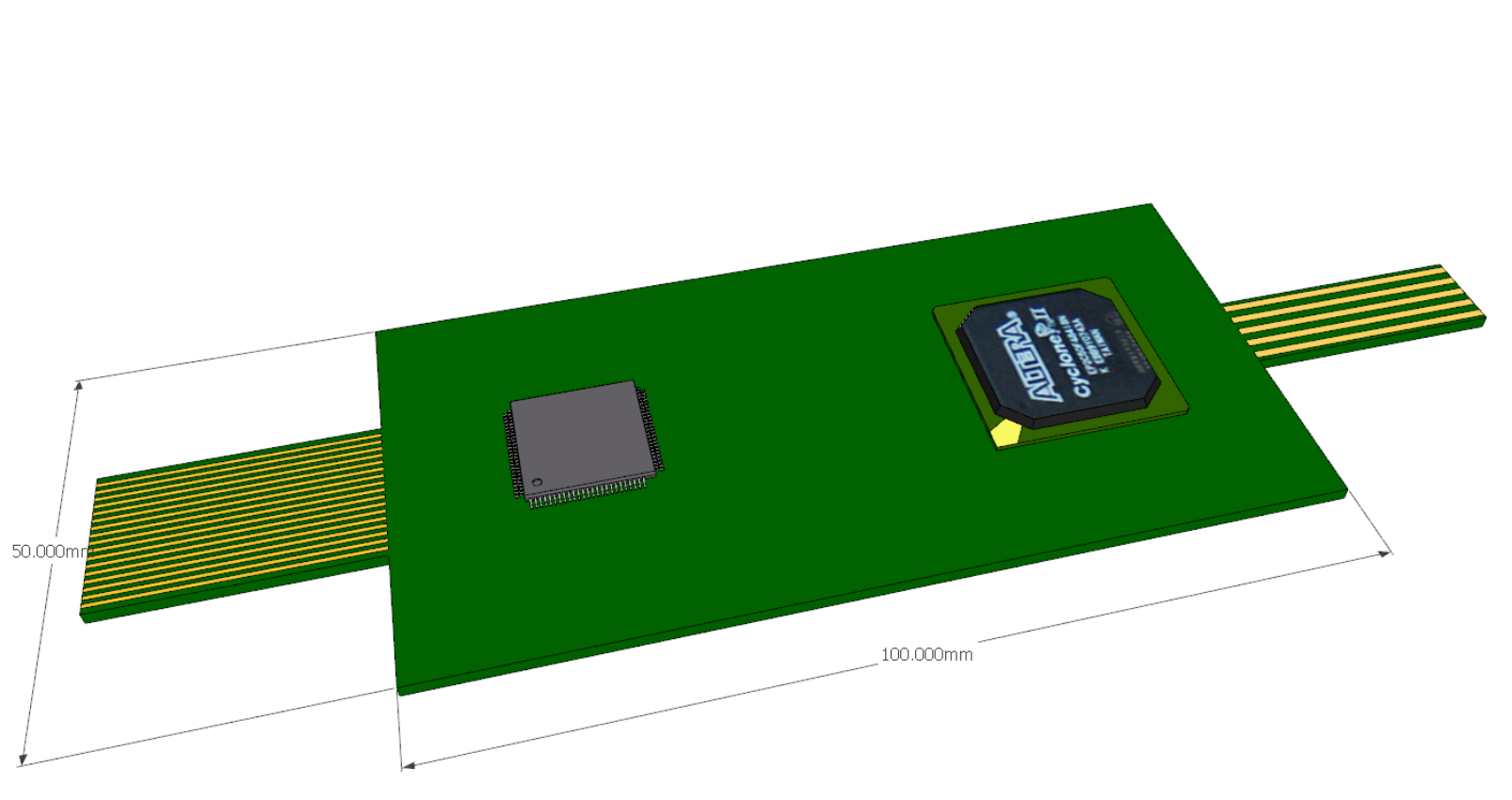
4CH DB
16CH MB with FastEthernet



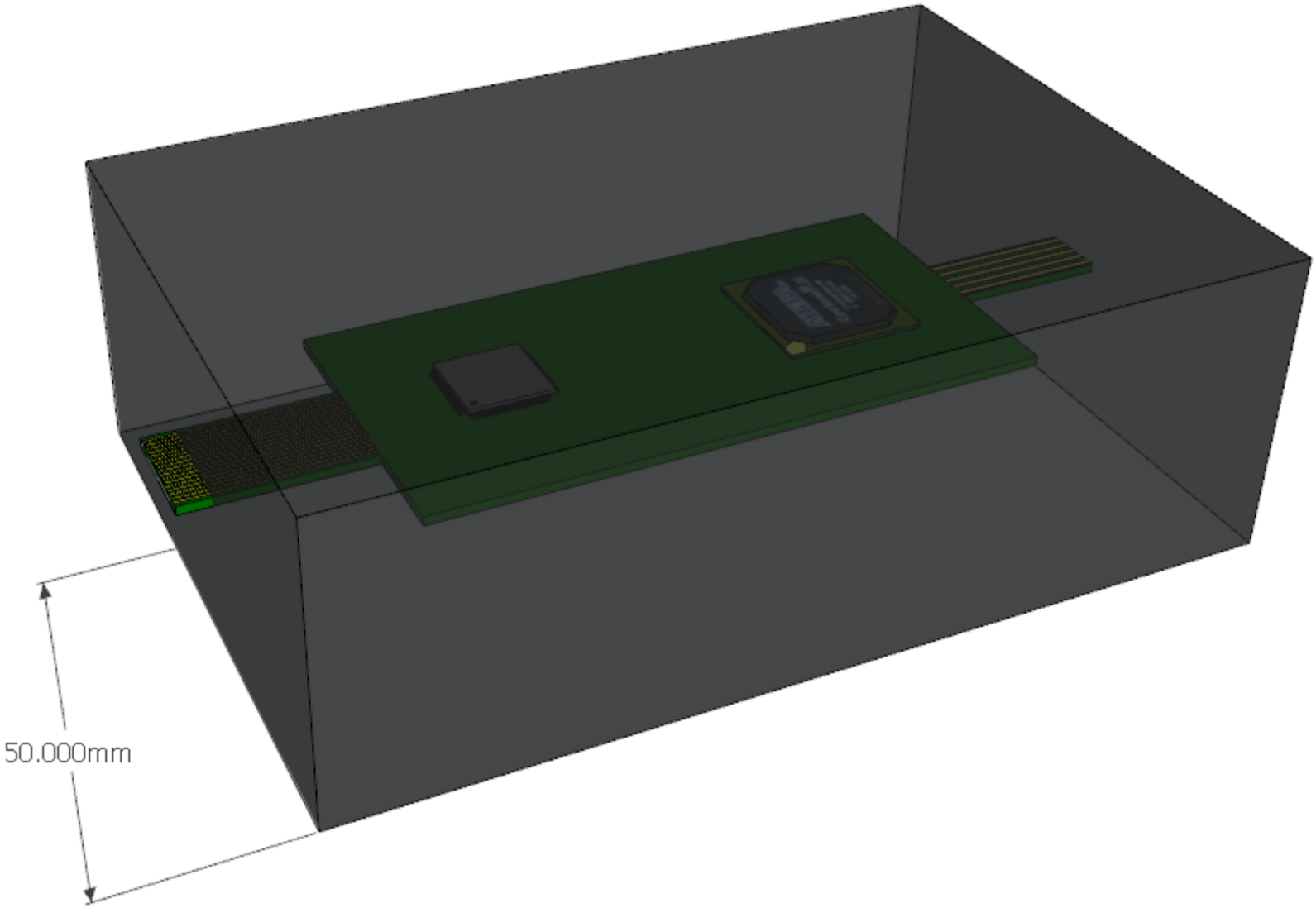

HPS CMS
SiPM Front-End for HPS
Sergey Los
FNAL/CMS
A Few Bits of History
I started working on SiPM readout in 2006, with the first RAD prototype of SiPMs for HCAL photo sensor replacement in H2 Test Beam (TB) at CERN
Signal differentiation was already used for the purpose of charge attenuation (capacitive attenuation)
2006
2007 TB version had remote individual SiPM Bias Voltage (BV) adjustment and leakage current readout
2007
2008 TB saw what we can call "a modern version" with computerized remote BV setting, Leakage Current and Temperature monitoring, Peltier cooling
Now it is 2012, and we are ready for HO Upgrade installation
2008
SiPMs in TOF at FNAL
2007 – I've made an amplifier by Anatoly's request for SiPM study (later turning into TOF study)
Anatoly did not like it too much, but that was a beginning of my involvement in SiPMs at FNAL
When Anatoly wanted to fit a long SiPM signal into an Ortec TDC it turned out that an HCAL proved series capacitor does the trick, since it does not only attenuates signal, but also shapes it (essentially extracting the fastest signal component, which is typically determines signal timing)
It turned out that in certain configurations despite signal attenuation that series capacitor allows to improve SiPM timing measurements, and thus a "clipping capacitor" term was coined
It's in general faster and easier to extract parameters from faster signals (no pile-up etc.)
Since then I've designed about a dozen different boards for SiPMs from different manufacturers and of different flavors for TOF studies, which also includes a 2011 TB version of a board for Hamamatsu 3x3mm² MPPC readout for Mike Albrow's L-bar Cherenkov light detector for HPS (shown in the pictures)

2006

CAN WE KEEP IT WARM IN LAR?



CAN WE KEEP IT WARM IN LAR?



CAN WE KEEP IT WARM?

- Thermal insulators:

Insulator	Thermal Conductivity
Vacuum	~ 250 m K/W
Closed cell foam	~ 50 m K/W
FR-4 (PCB)	~ 4 m K/W
Cu	~ 0.003 m K/W

ROUGH ESTIMATE

- Need about **150K delta T**
- Area is ~0.02 sq m
- Thickness limited to 2cm
- FR4 and Cu not important
- ~ 250mW per Ch

- **100 K/W**

MANY QUESTIONS

- Reliability
- Testing
- Thermal cycles
- Mechanical supports