# Dark Photon Updates

- Detector scintillator + WLSF assembly
  - Almost done, ~by this week
- Fermilab safety document for detectors
  - Work in progress, sample documents in hands, ~by the end of Jan
- DAQ upgrade - done
  - x10+ improvement, parasitical data taking with E906 possible
- SiPM Readout
  - Fermilab preamp cards
    - Pre-production 20 cards arrived, being tested at LANL
- Trigger firmware and lookup table
  - V1495 I/O tested, using MC to develop lookup table
  - Full trigger firmware under development, to be ready by ~mid Feb.
- Progress in theory
  - Cross check calculations, plan a joint paper
- Project is on track
  - New trigger system installed at Fermilab in March

- Future E906 and SeaQuest schedule
  - Lost ~2 weeks of beam time due to accelerator issues
  - Likely to extend current run or more beam in the remaining run this year
  - Propose to Fermilab PAC dedicated dark photon search runs beyond E906

# Excellent progress in the last a few weeks

- Detector assembly, SiPM readout and calibration system
  - Hubert, Alex, Sanghoon, Shaun, Pat et al

- DAQ and Trigger firmware
  - Kun, Sho and Andi et al

- Dark photon project web page

  https://p25ext.lanl.gov/darkphoton/

# Trigger Detector Frames

4 frames for 1x1x80 cm bars
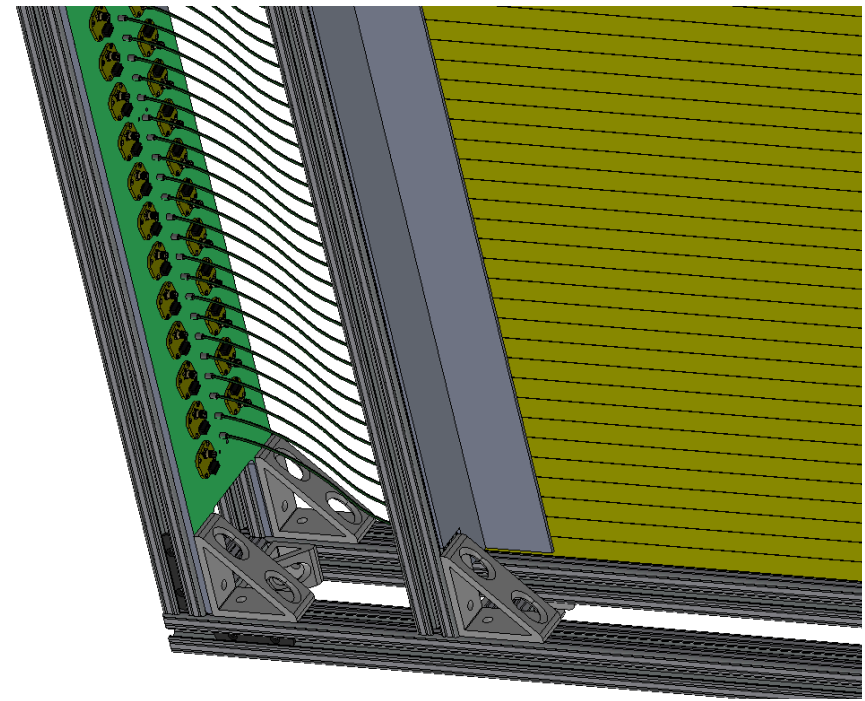4 frames for 2x2x100 cm bars
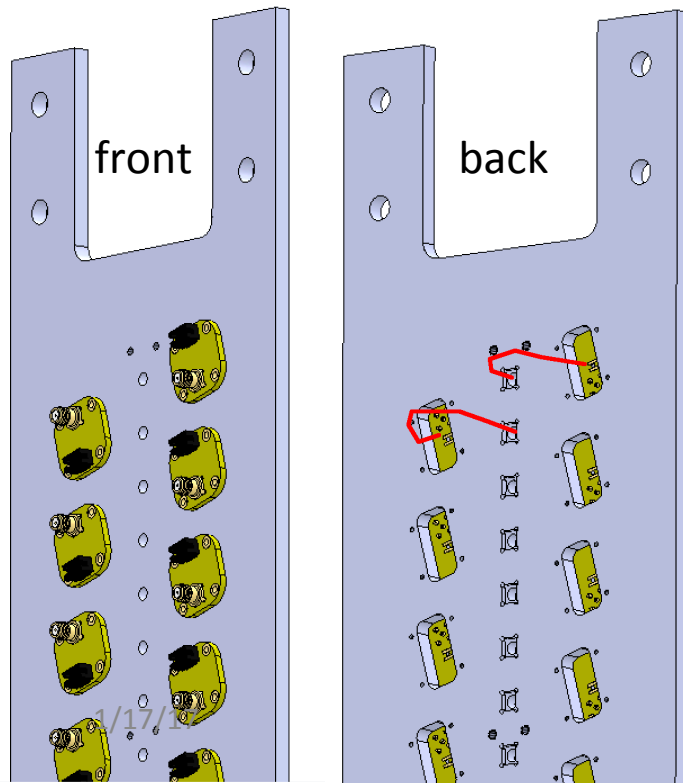
Mostly finished

To be done:
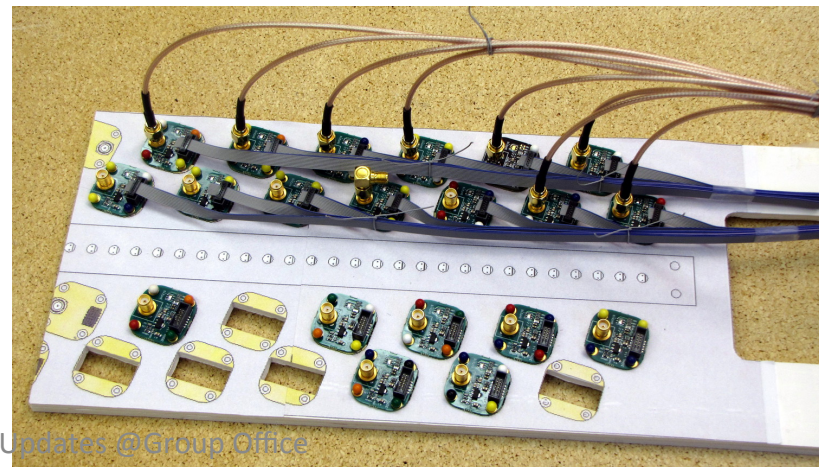- Feedthroughs and/or patch panels for cables
- Cooling air feedthroughs

# Readout plates

- Fibers and preamps in the front
- SiPMs connect with pigtails in the back

Fabrication bids are out;
complete in ~2weeks

front    back

Full-scale mockup for cable routing and
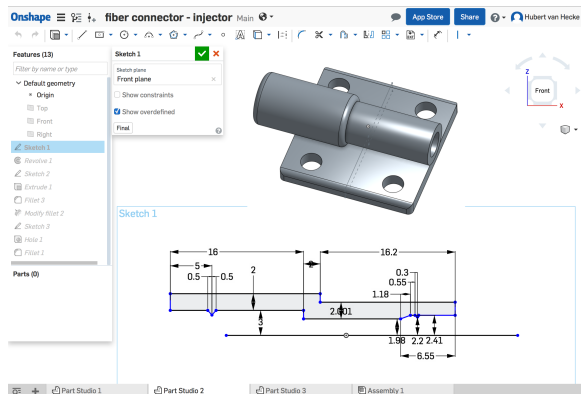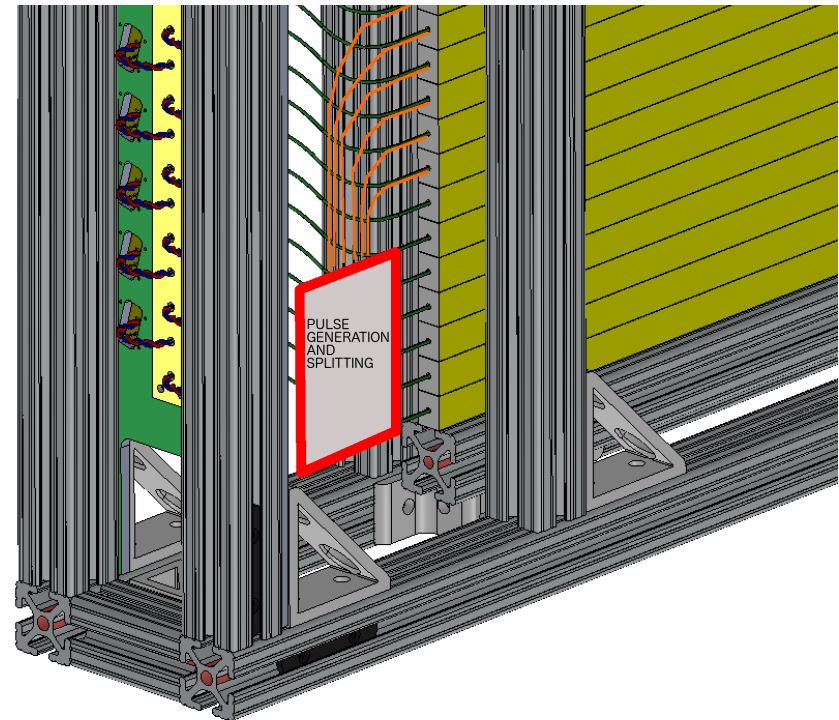connector finger space

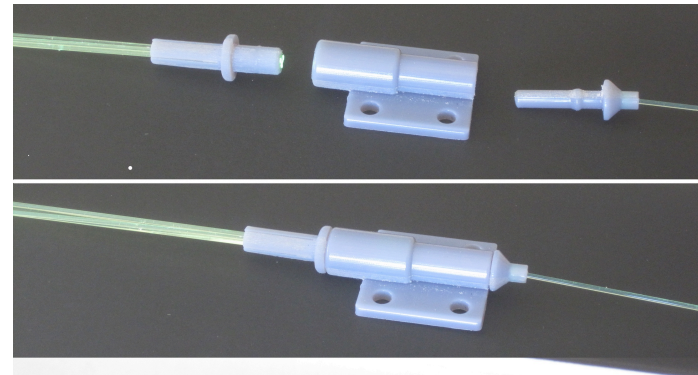# Calibration system designed and tested

- Use existing pulser board design from Pat
  - Two Drivers
- 1mm plastic fiber output
- Fan out to 7 (19) clear 1mm fibers
- Insert these into each scintillator bar

In progress:
- Lay out pulser board with a few more pulsers, and build
- Cut and polish pulser fibers
- Design mounting
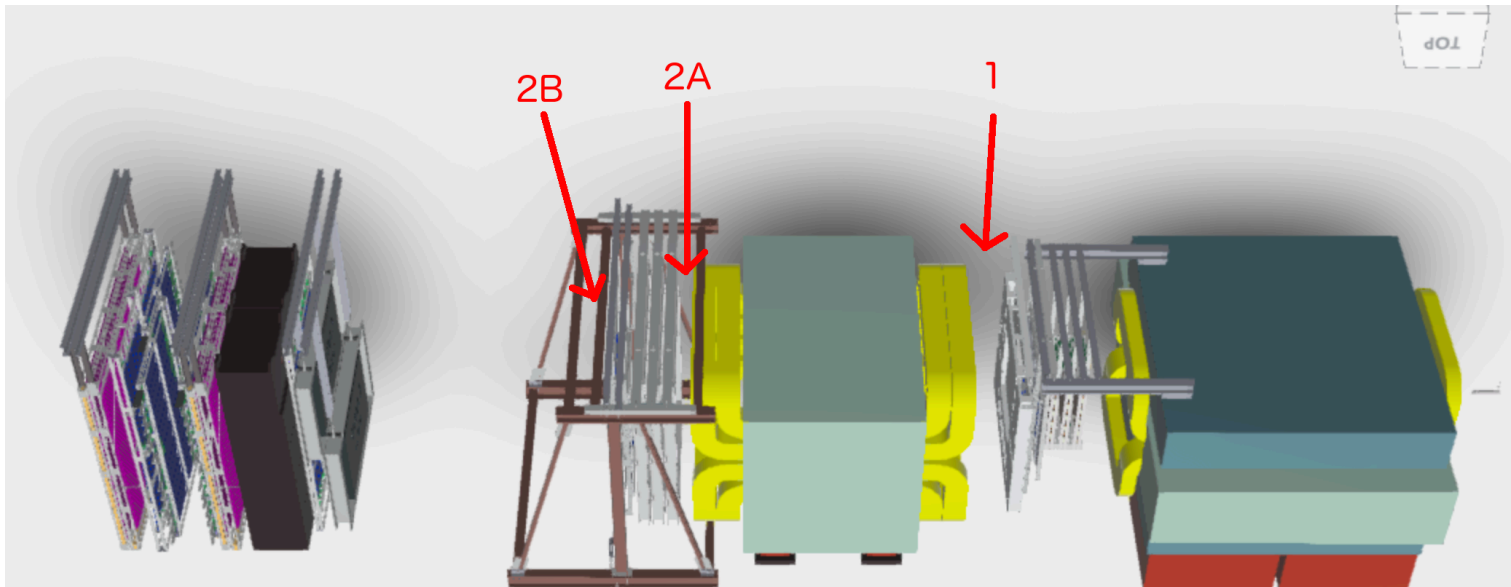
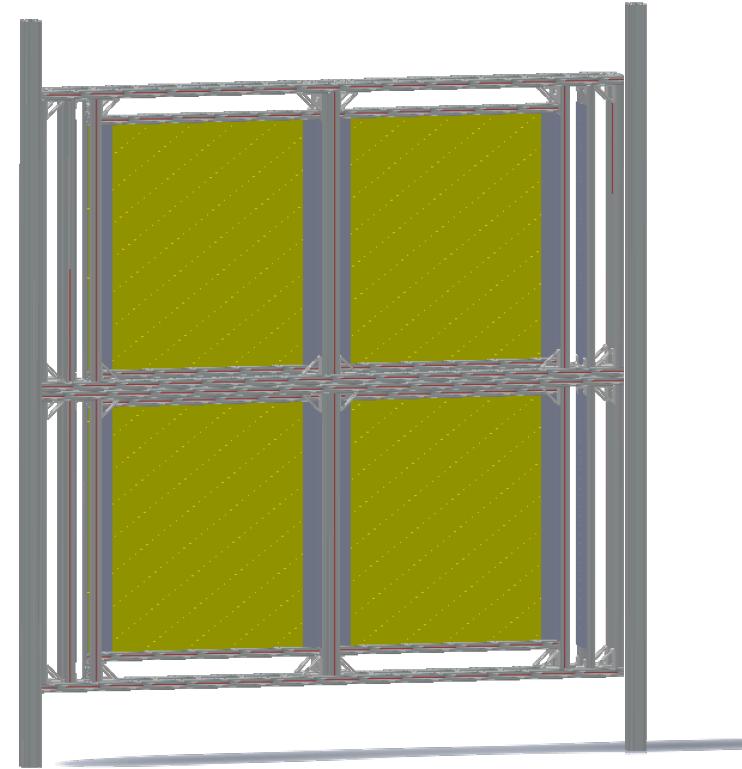PULSE GENERATION AND SPLITTING

3D print
1->7 fanout

# Installation Plan

- 4 boxes joined
- 2 vertical beams hold this assembly
- Anchored to floor and overhead beams

In progress:
- Details of mounting points
- Safety review document in progress
- Determine external cable routing
- Cooling fans

# SiPM Readout

- SiPM pigtail cables are ready for prototyping in the next week
  - This is the last component of the readout frontend (SiPM, pigtail, preamp, signal cable) and enables tests of signal-to-noise and crosstalk

- Fermilab preamp prototype has been tested at Fermilab
  - 20 pre-production units are at LANL and ready for QA, waiting on prototype pigtails

- Preparing mockup of patch panel/bulkhead to bring preamp signals out of the detector box

- Ferrite inductors may saturate in magnet fringe field - lab tests are planned to determine whether we should switch to inductors with nonmagnetic cores (already identified), ~complete test this week
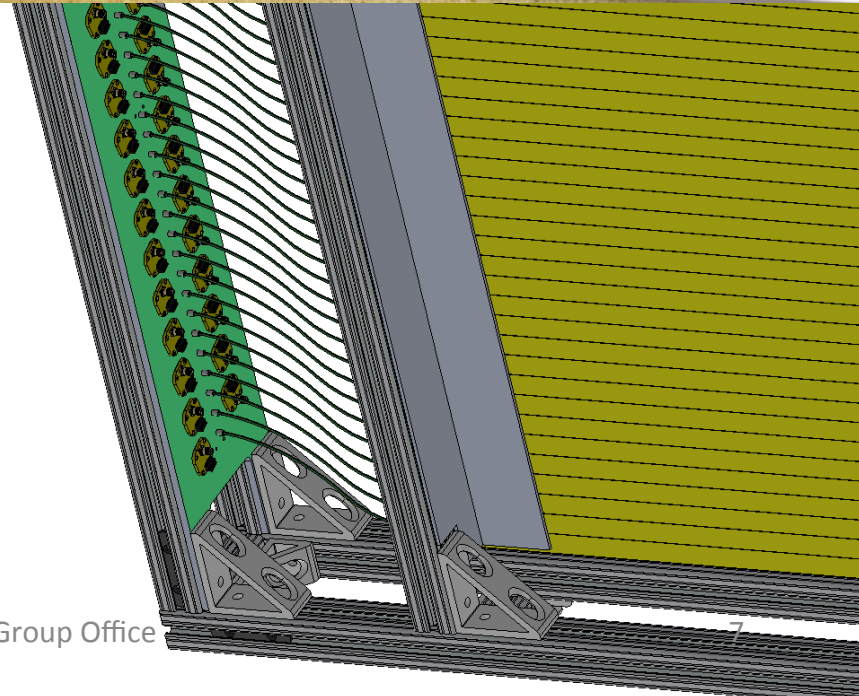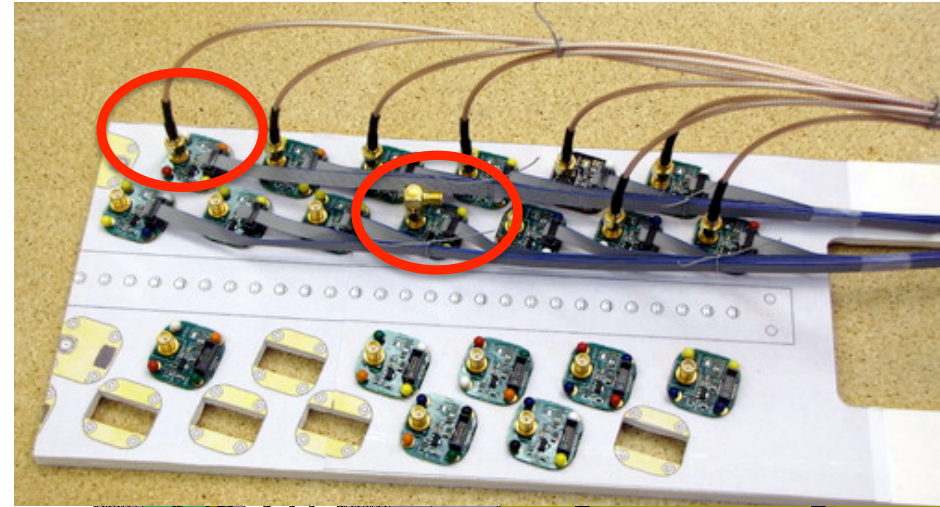
# DAQ upgrade: goal and achievement

- Improve the DAQ bandwidth by a factor of 10 to allow running '*parasitically*' alongside E906's main program

- Three independent upgrades:
  - MainDAQ: development of the FPGA and ARM microcode on the customized TDC
  - TriggerDAQ: adding SDRAM to the CAEN v1495 and development of the FPGA control code
  - BeamDAQ: development of the FPGA code of the dedicated beam intensity monitor readout



- All three systems have been successfully tested with beam (before Fermilab Main Injector broke).

- Now the upgraded DAQ is running continuously with cosmic rays to commission the rest of the spectrometer
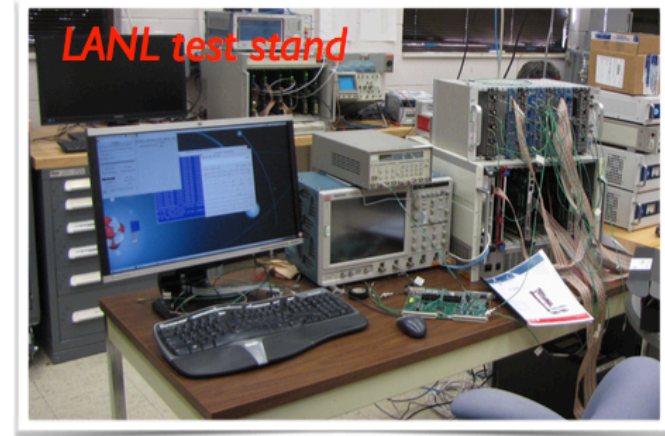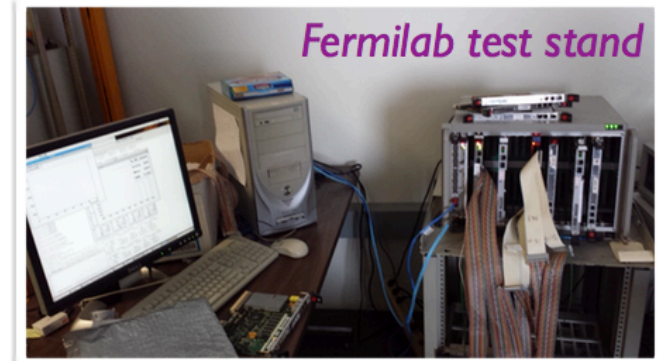
# V1495 Trigger Firmware Development

- Structure and building blocks of the existing firmware can be reused: TDCs, delay adjustment pipelines, trigger matrix lookup tables
  - Input channels (TDC and delay pipeline) are generic and do not need tochange
  - Lookup tables will have different content but operate in the same way
- More V1495 inputs
  - L1 trigger firmware must be modified to increase the number of supported input channels from 3*32=96 to 5*32=160
    - Primary challenge is expanding the channel addressing scheme by one bit: work in progress
  - FPGA utilization is not expected to be a problem: existing firmware uses roughly 40% of FPGA resources for input processing (should scale with input channels) and 20% for trigger lookup tables (should scale more slowly)
- Plan is to develop in stages to simplify testing
  - Modify the firmware blocks in a reverse-compatible way to support more input channels
  - Build a version of the existing L1 firmware that uses these blocks but is functionally unchanged (compatible with existing readout drivers and tests)
  - Modify readout drivers to support more input channels
  - Build the new firmware and test, by mid Feb
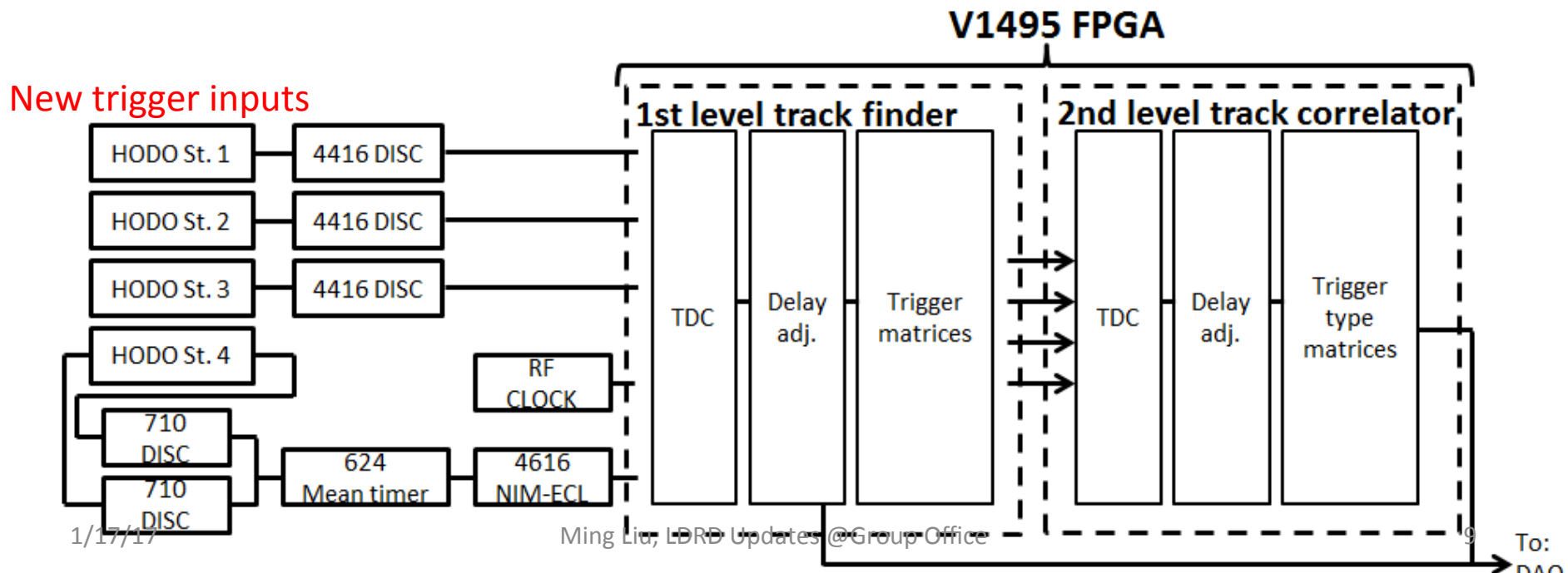
# To-do and Plan

- Preamp card production
  - Release for the full production after testing at LANL
  - Production completed by early Feb.

- Safety document
  - Engineering note for safety operation
  - Draft by the end of Jan

- Fully assembled detector shipped to Fermilab in mid Feb.
  - Installation in early march

- Work in progress at Fermilab
  - CAMAC & LeCroy 4413 installation at Fermilab
  - All hardware in hand and tested
  - To be installed by the end of Jan

- Standalone trigger crate and DAQ for commissioning at Fermilab in late Feb
  - All hardware in hand at Fermilab/LANL, V1495 and VME crates, cables etc.

- SeaQuest Collaboration meeting being planned for early March
  - Future program and run plan
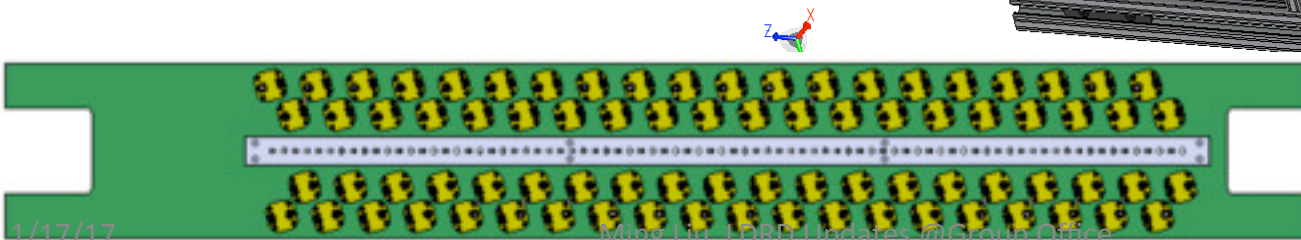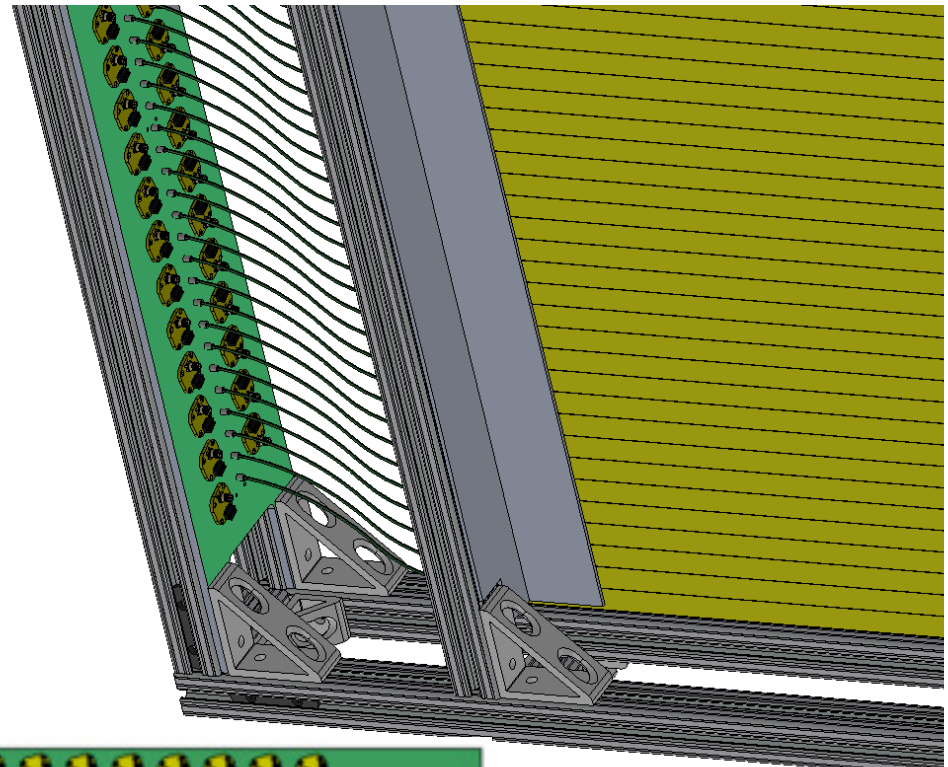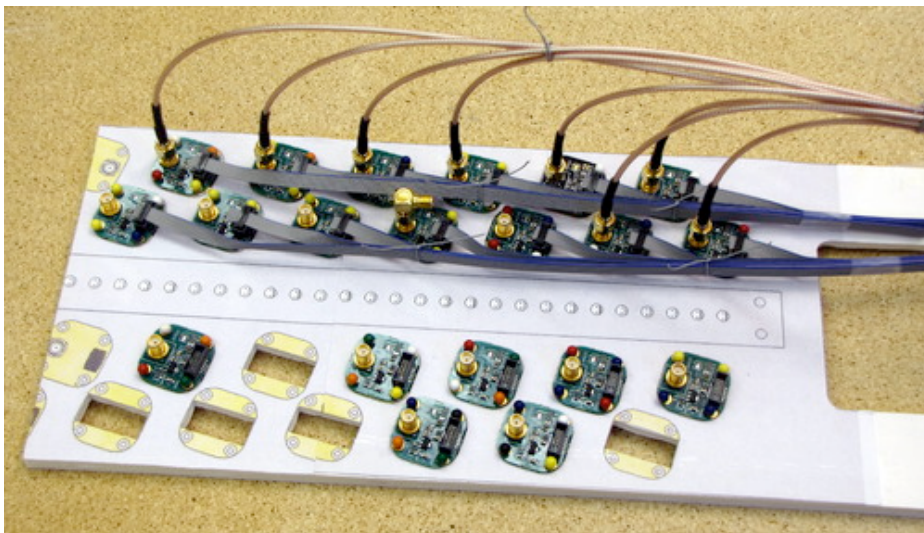  - In  Santa Fe or Fermilab

# backups

# Calibration System Tested

- Clear fiber with LED
- Sharp raising edge
- 1->7 (more) split



PULSE
GENERATION
AND
SPLITTING
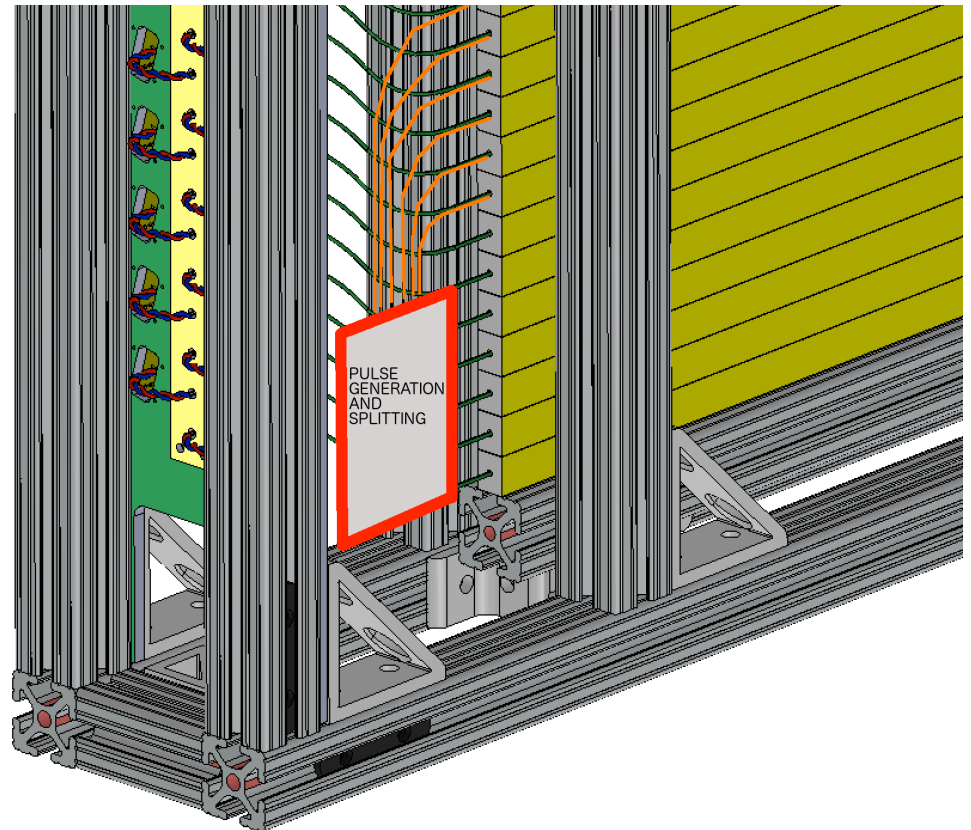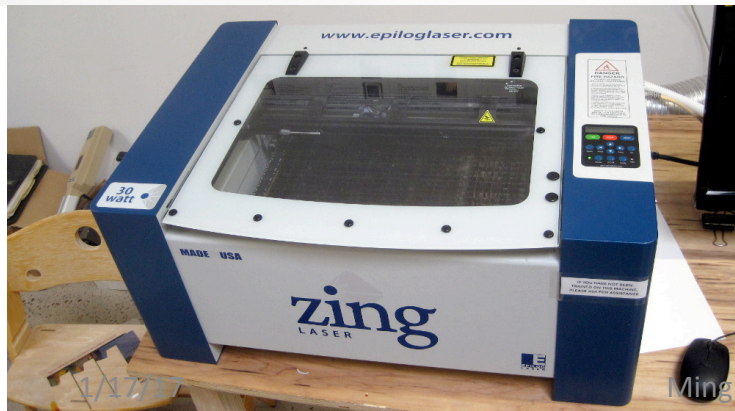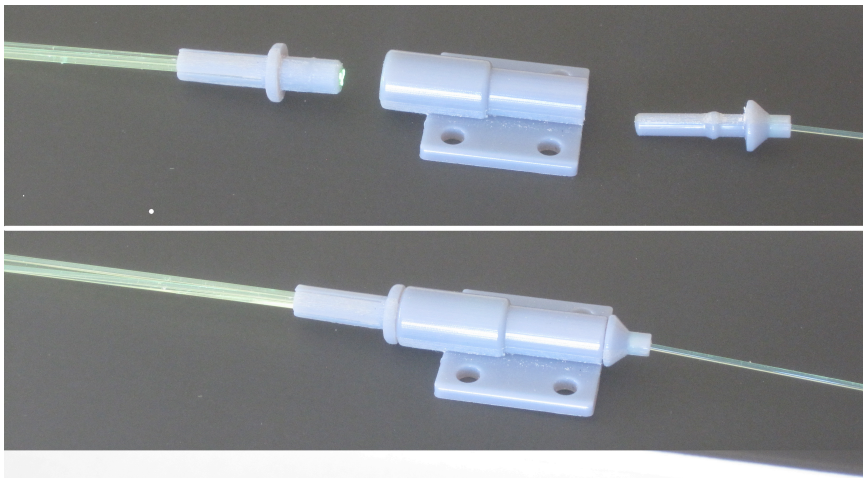
# Detector Assembly

- All frames assembled
- Mockup layout

# Installation Plan being Developed

- Detectors
- Readout crates and modules
- Cabling