



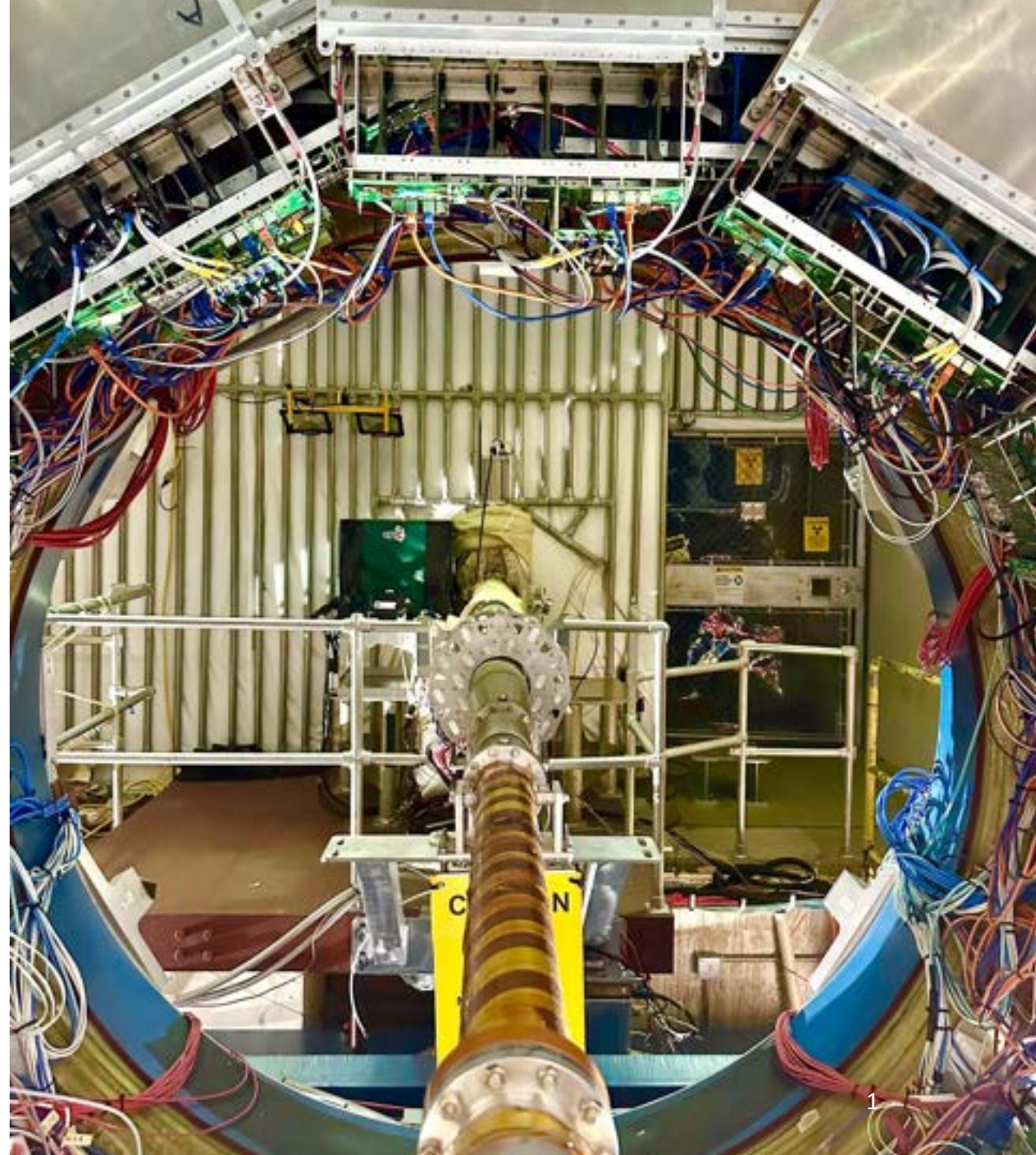
Calorimeter Insert Prototype Test at RHIC

Sean Preins

ePIC Calorimetry Meeting

University of California, Riverside

3/6/24

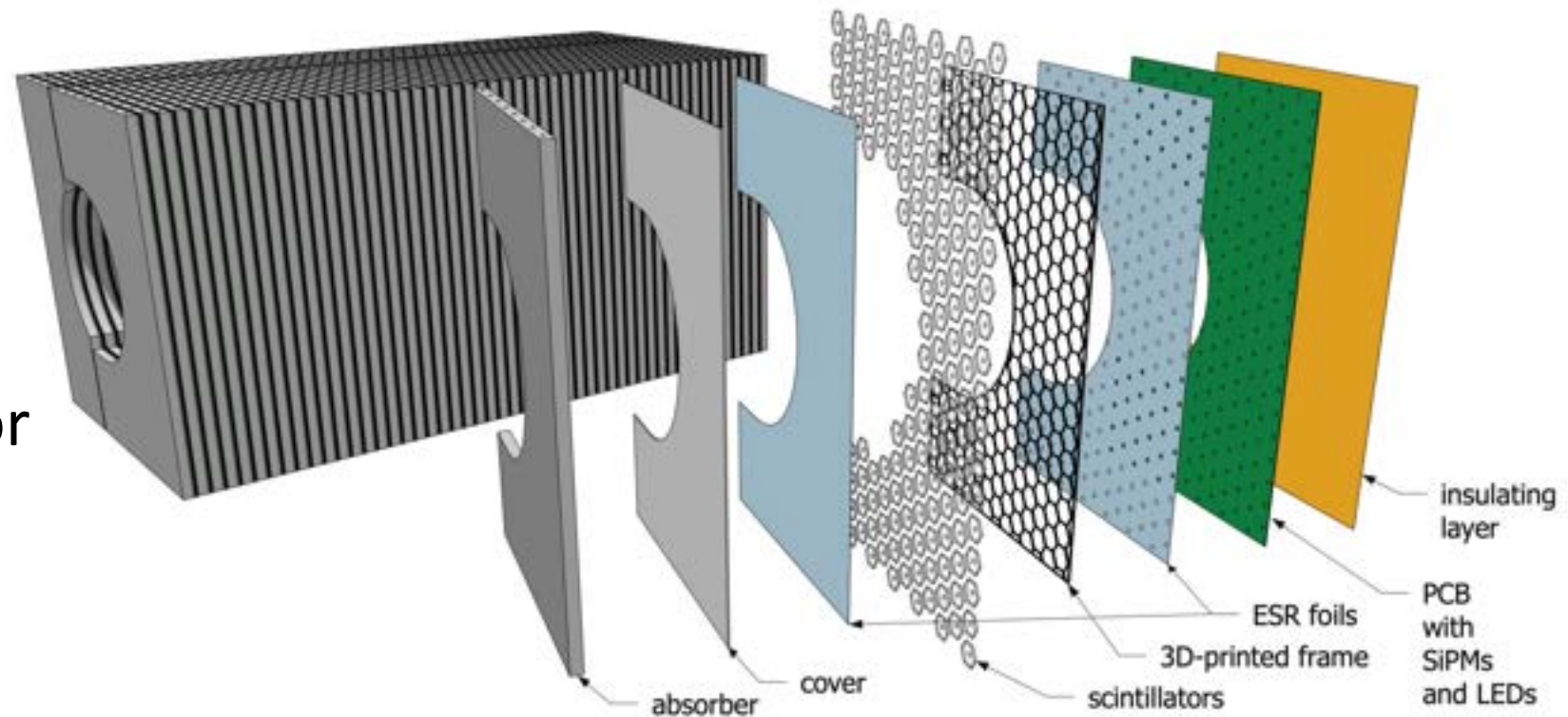


Overview



- Background and previous tests
- Gen II Prototype for HG-CALI
- Initial installation at STAR
- Upgrade plans

Background

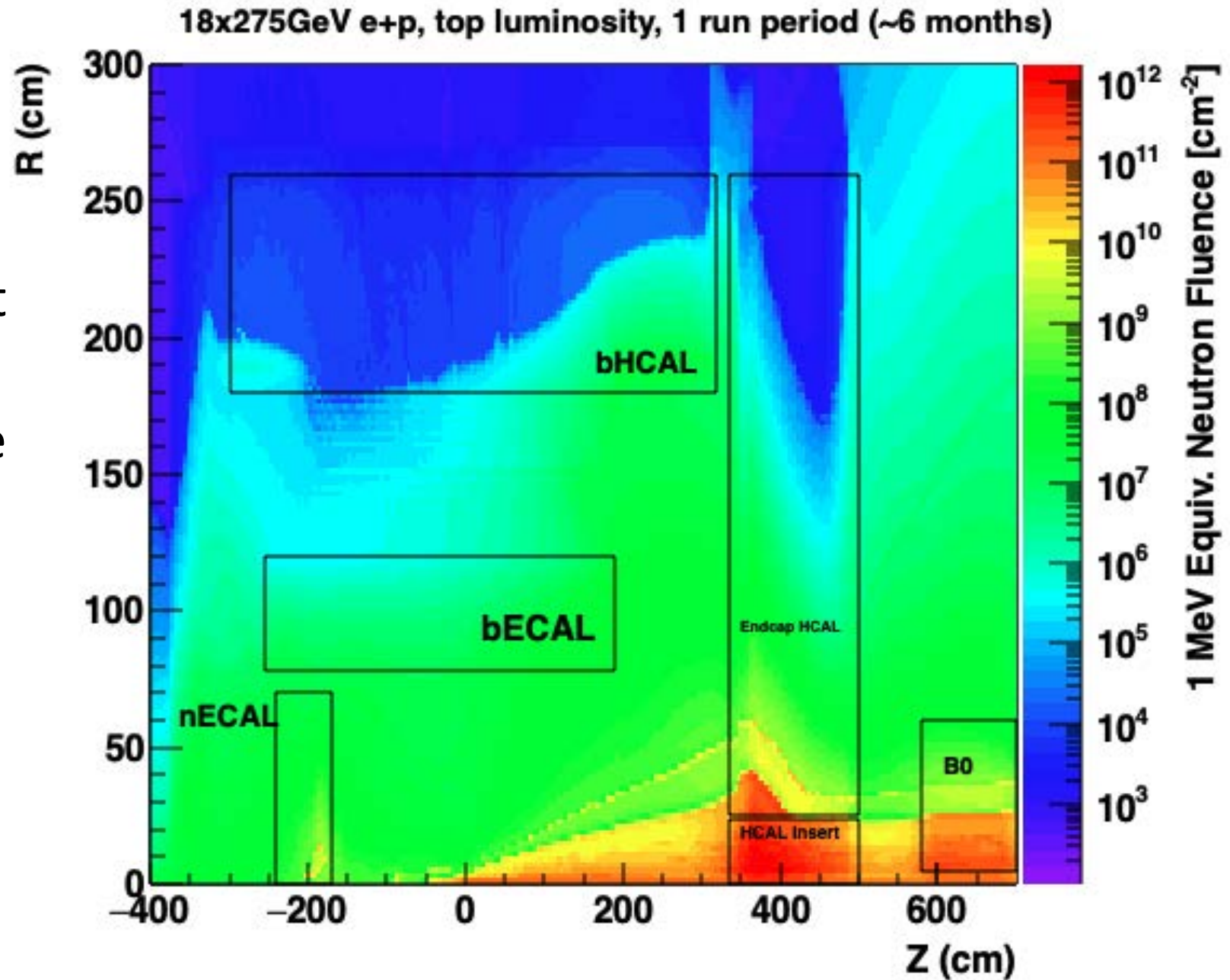
- Continuation of studies for developing CALI, a high granularity SiPM-on-tile sampling calorimeter
- Same technology will be used in the ZDC

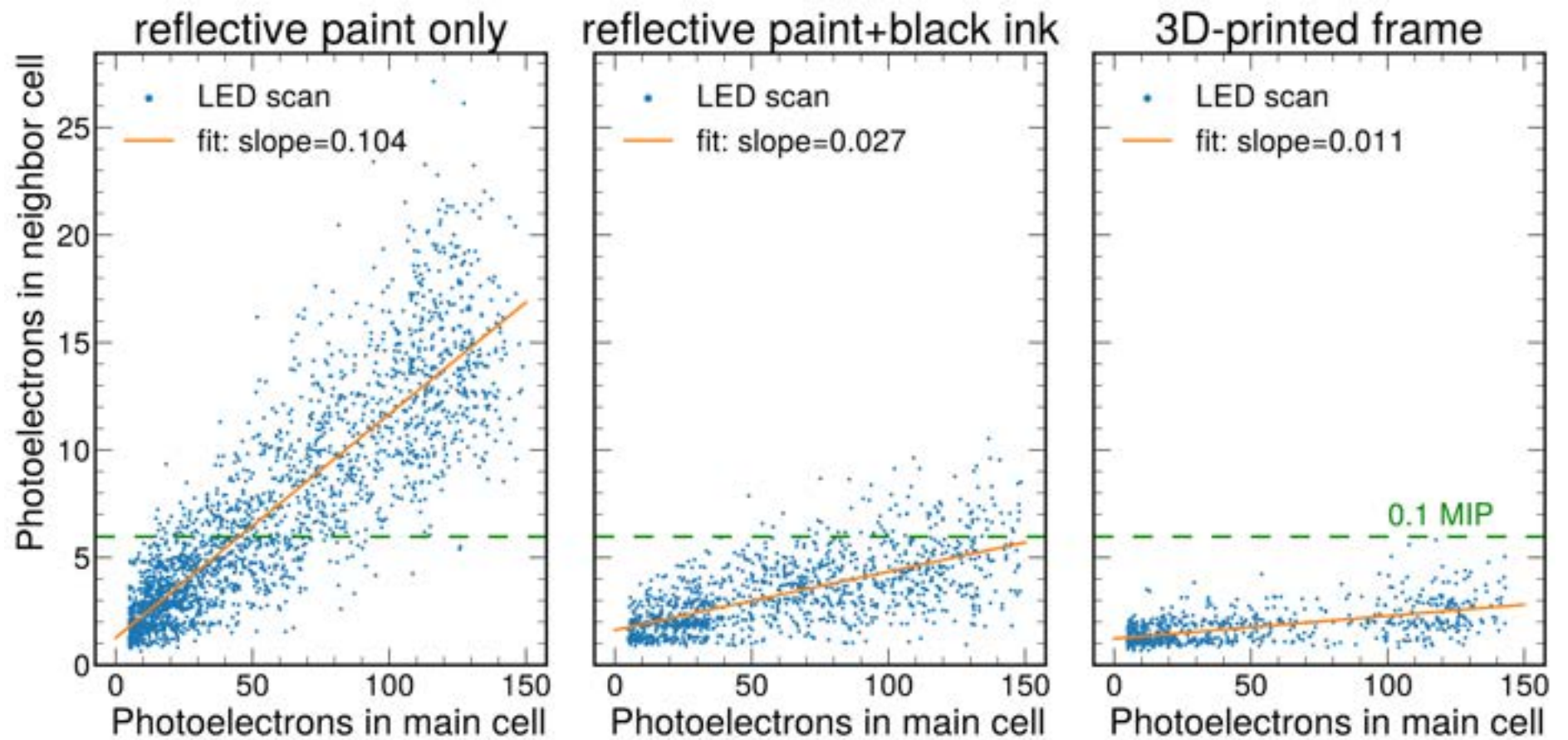


A high-granularity calorimeter insert based on SiPM-on-tile technology at the future Electron-Ion Collider

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- CALI will receive the largest radiation dose in ePIC
- Effects of radiation damage to SiPMs and annealing needs to be studied
- Current test at STAR will be informed by upcoming UC Davis irradiation test





- Benchtop tests studied light yield and timing resolution of SiPM-on-tile configuration
- Validated new method of segmenting tiles with 3D-printed frames

Studies of time resolution, light yield, and crosstalk using SiPM-on-tile calorimetry for the future Electron-Ion Collider

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Published 26 May 2023 · © 2023 IOP Publishing Ltd and Sissa Medialab

[Journal of Instrumentation](#), Volume 18, May 2023

Citation Miguel Arratia et al 2023 *JINST* 18 P05045

DOI 10.1088/1748-0221/18/05/P05045

Gen I Prototype

- Gen I Prototype was tested at Jefferson Lab Hall D pair spectrometer in January 2023
- Consisted of 40 channels, 10 layers of iron absorbers / SiPM-on-tile boards



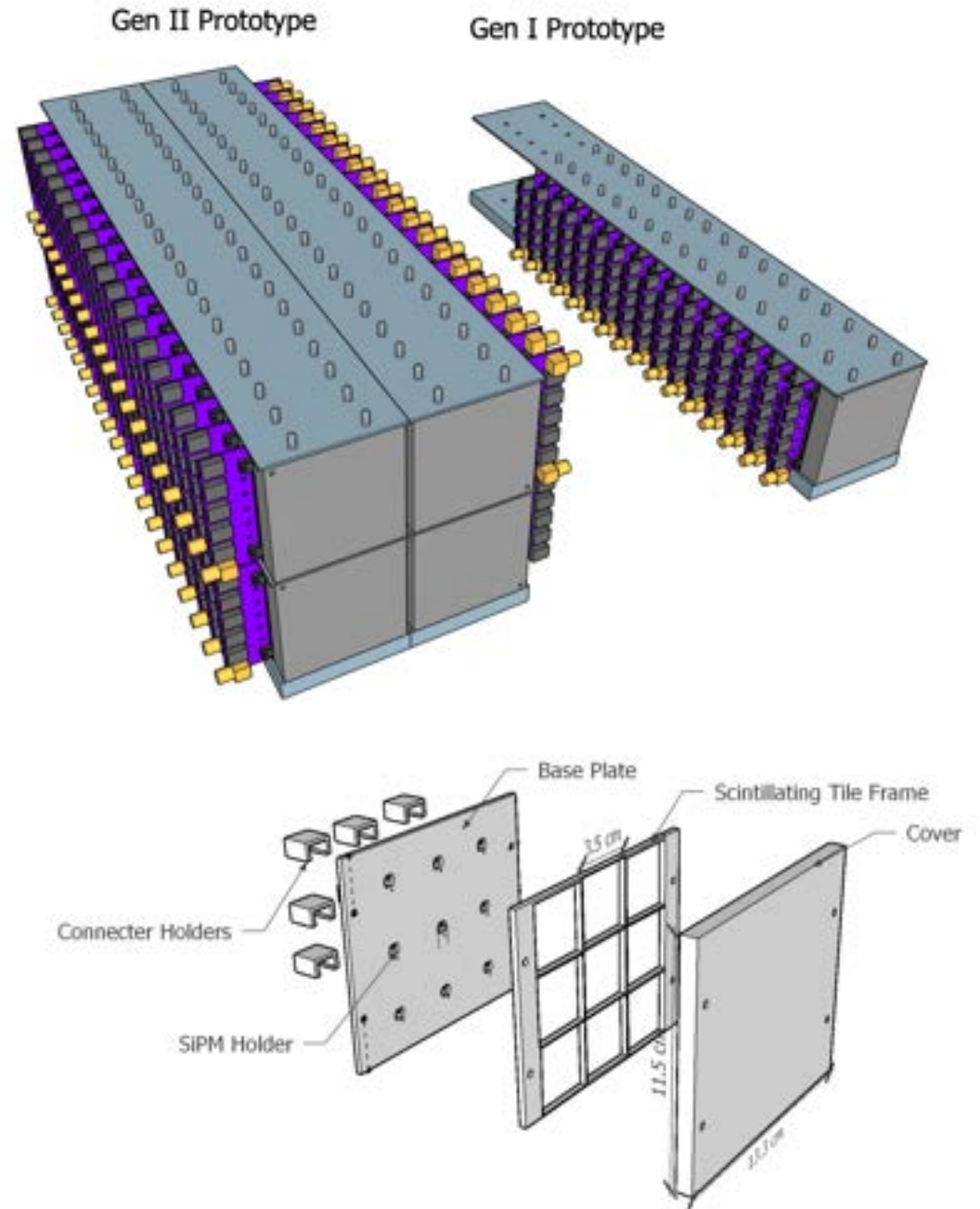
Article

Beam Test of the First Prototype of SiPM-on-Tile Calorimeter Insert for the EIC Using 4 GeV Positrons at Jefferson Laboratory

Miguel Arratia^{1,2,*}, Bruce Bagby¹, Peter Carney¹, Jiajun Huang¹, Ryan Milton¹, Sebouh J. Paul¹, Sean Preins¹, Miguel Rodriguez¹ and Weibin Zhang¹

Gen II Prototype

- Gen II prototype consists of ~300 channels, 20 iron layers
- Same blocks and mechanical design as ZDC
- Has three hodoscope layers in front
- Installed in the east side of STAR at RHIC, within $3.2 < \eta < 3.6$ range to emulate CALI conditions in ePIC

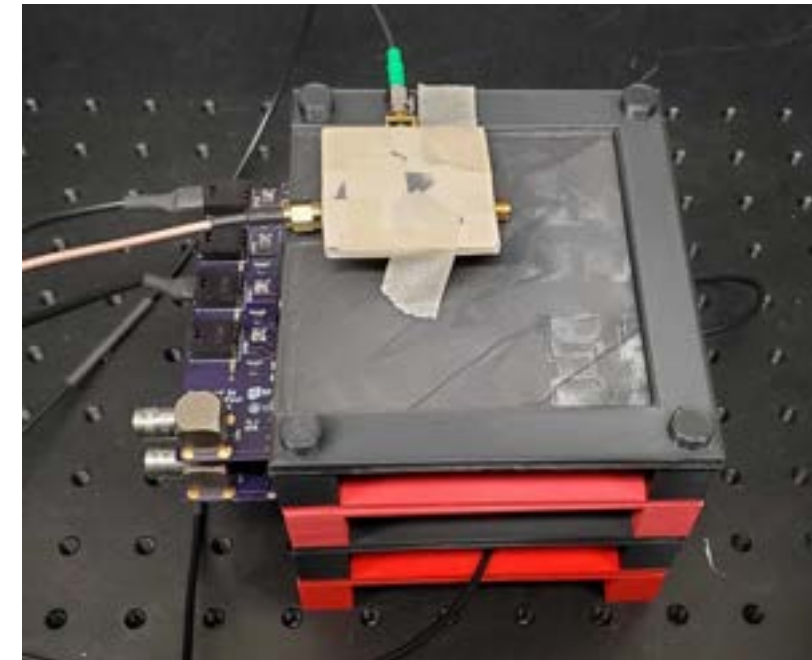




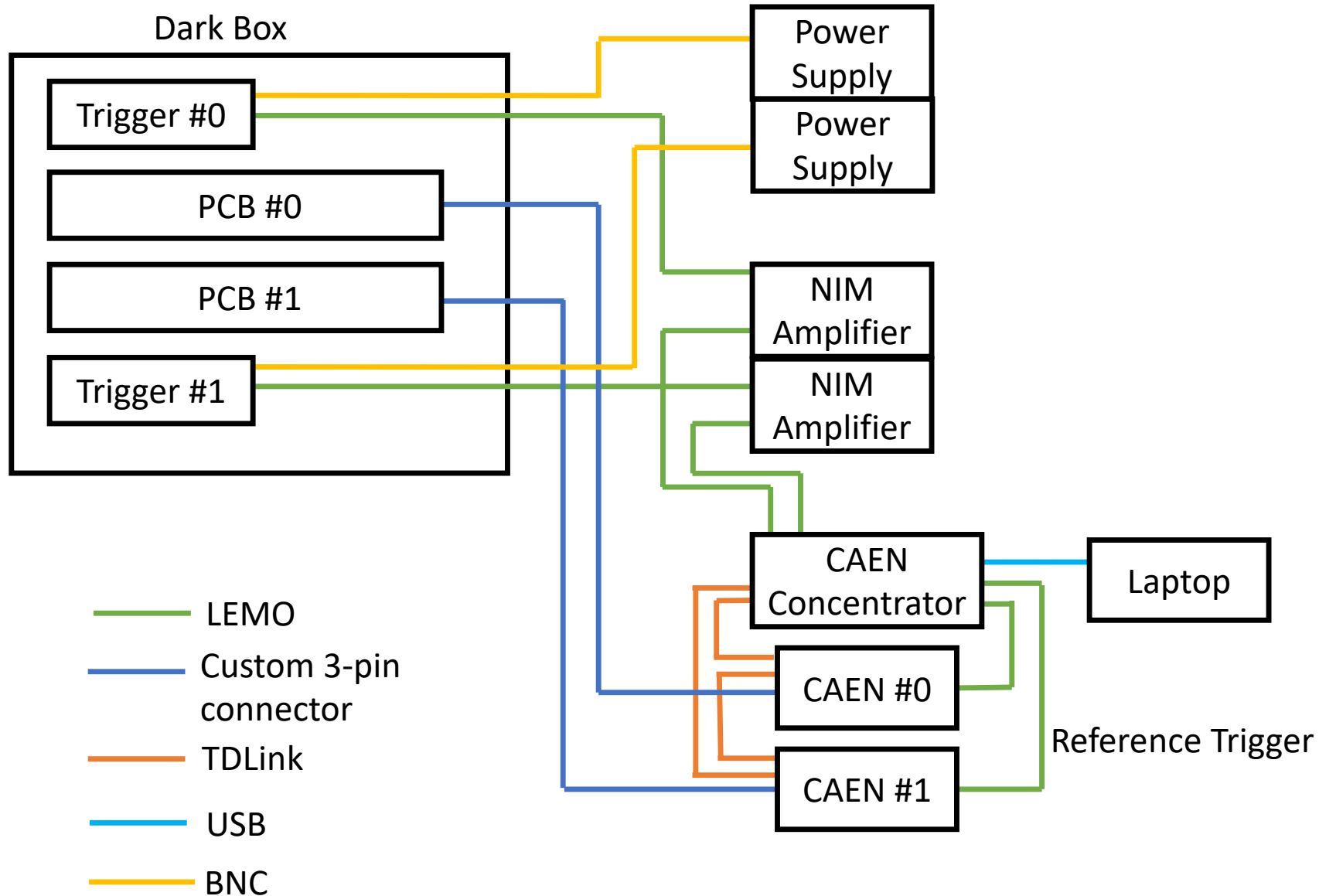
- Base plate, dividing plates, and scintillating tiles are machined in-house
- Consists of high granularity hexagonal tiles in front, larger granularity square tiles in rear
- All 302 channels have been tested with cosmics at UCR

Cosmic Test Setup

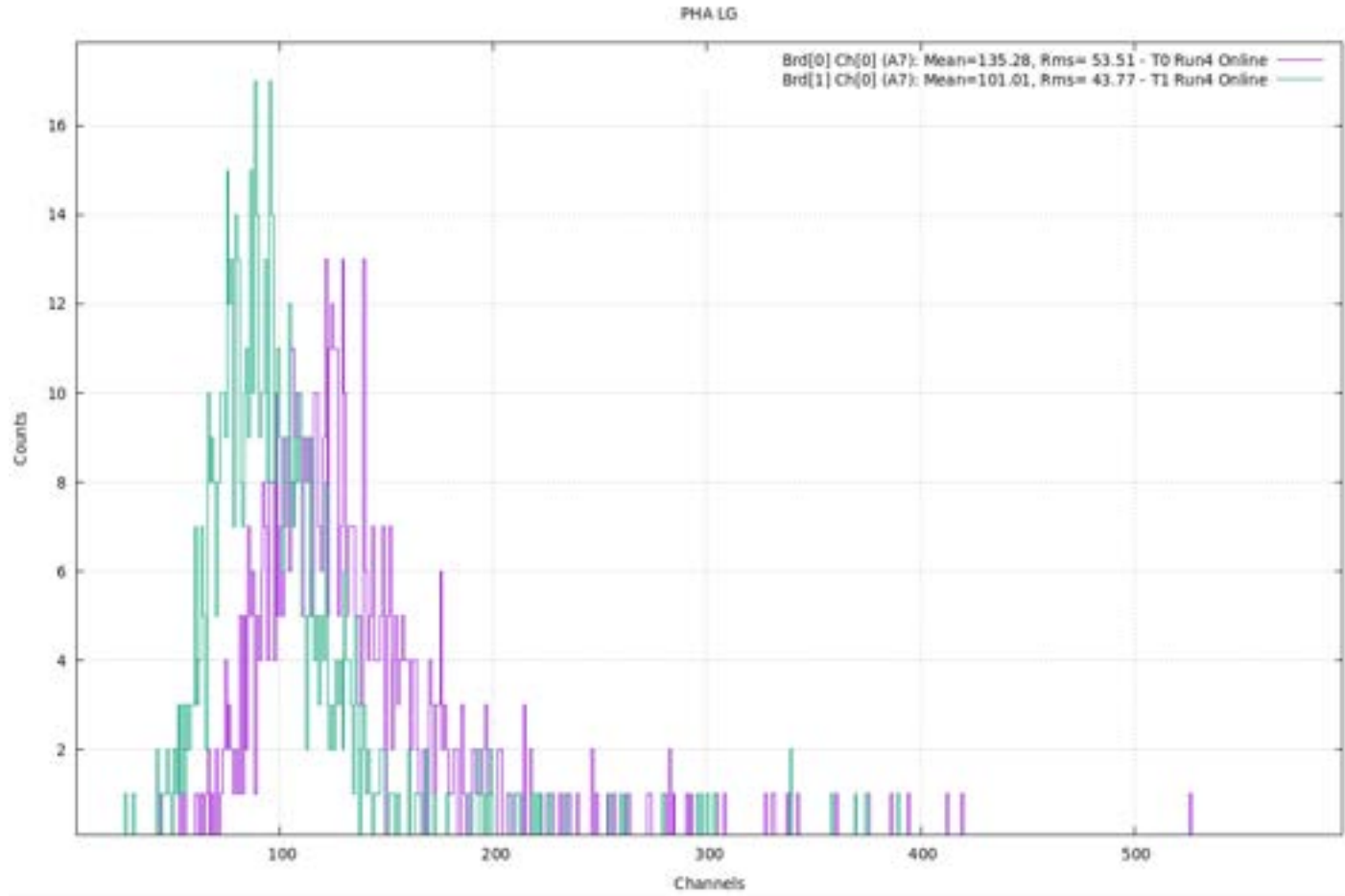
- Reading multiple CAEN units requires an external trigger system
- Coincidence test with two external trigger tiles, recording across two CAEN units



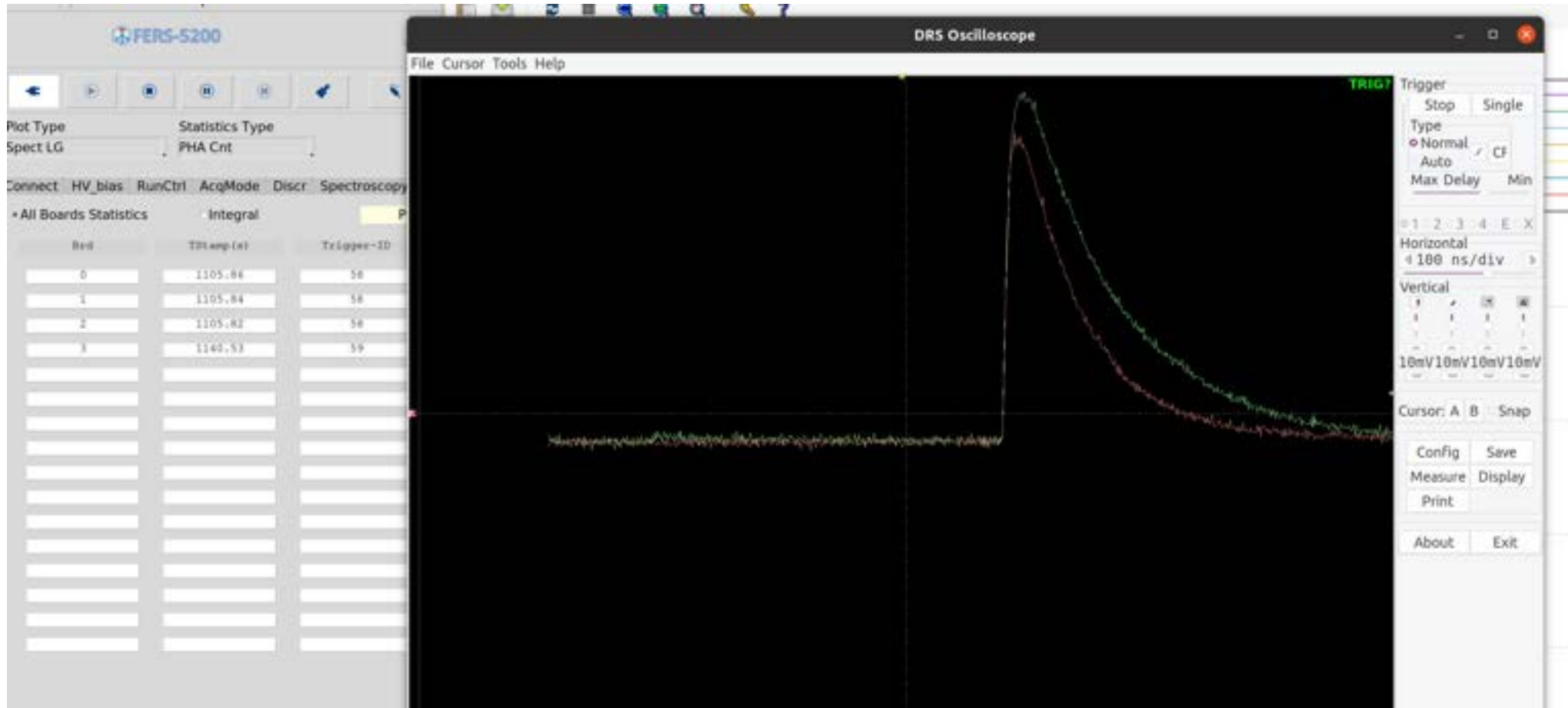
10 meters



- Cosmic ray landaus measured, triggered on external tiles, with 10-meter-long cables
- Demonstrates external triggers can synchronize data collection across multiple CAEN units



- External trigger was upgraded to come from DRS4 evaluation board
- Reads four channels, trigger logic can be modified in-situ from external DAQ laptop

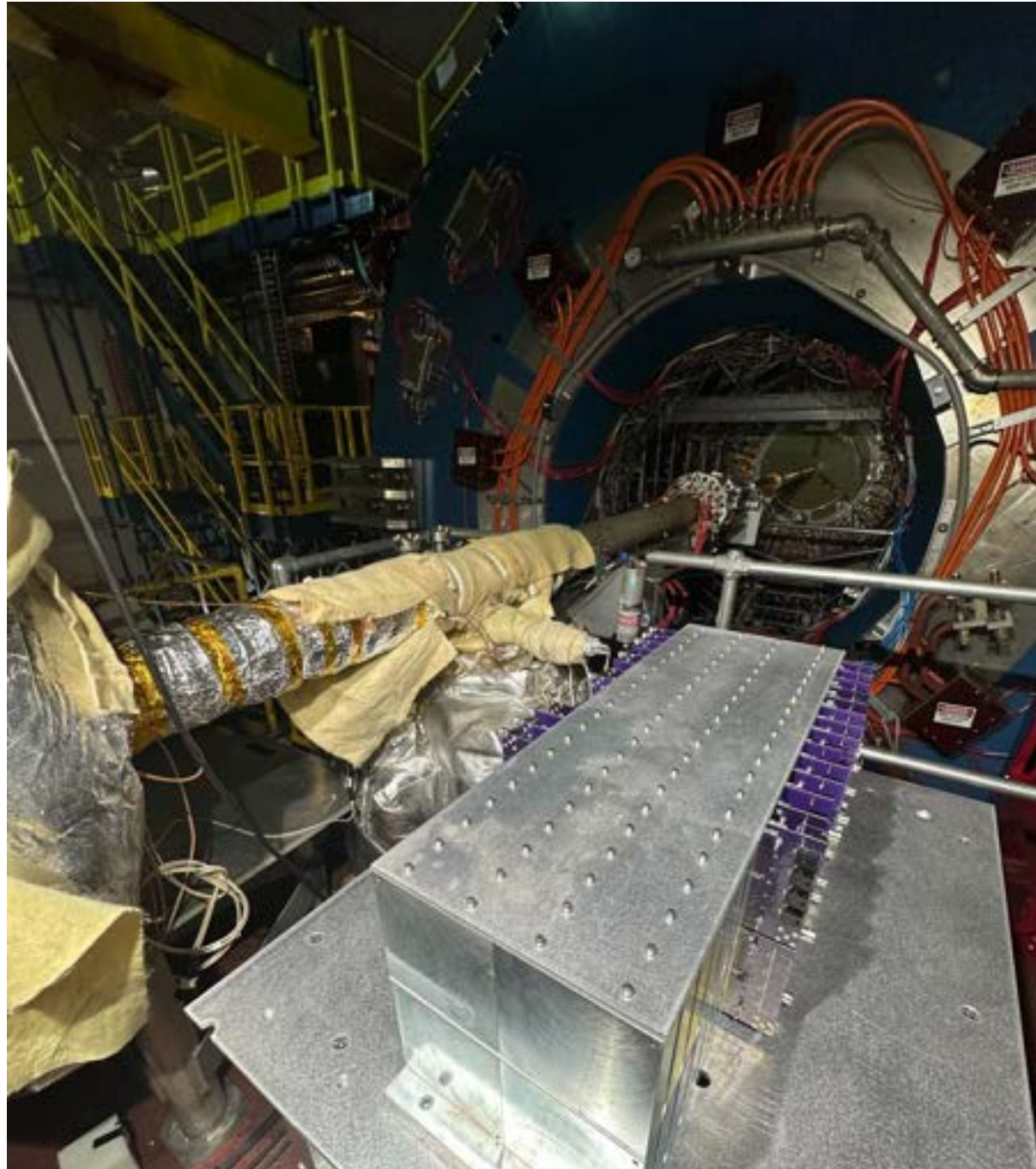
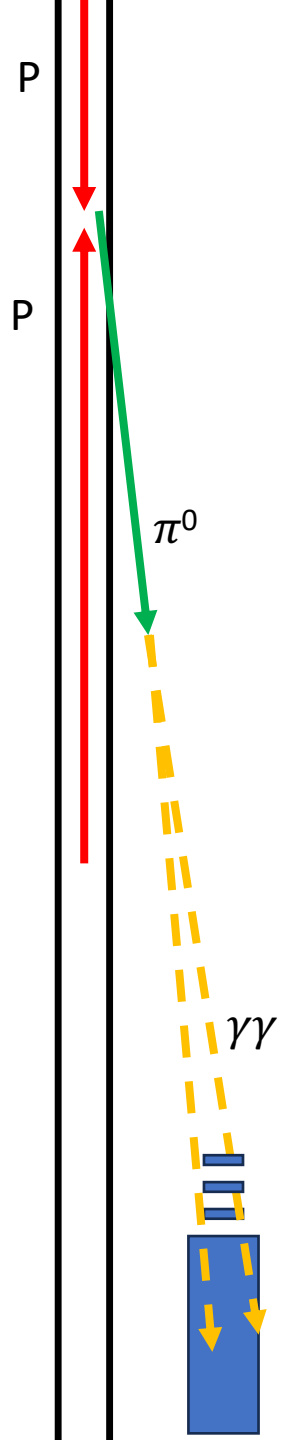


- Installed in STAR on Feb 23-28

Goals:

- Demonstrate in-situ calibration and operation under realistic radiation fluence
- Channel-by-channel calibration using MIPs
- Calibration with π^0 from pp collisions
- Monitor stability of physics quantities over time





- Will receive particles from interaction region of pp collisions with minimal material in front
- Last chance to run any realistic test at RHIC
- Neutron fluence will be determined from simulations and SiPM current

- Dark box consists of black-out canvas mounted over an 80-20 frame
- Hodoscope layers are encased in 3D-printed plastic, sufficiently light-tight



- PCBs require custom 3-pin cables, 25 were completed for the initial installation
- The channels were spread across the four CAEN units to continue testing our DAQ system

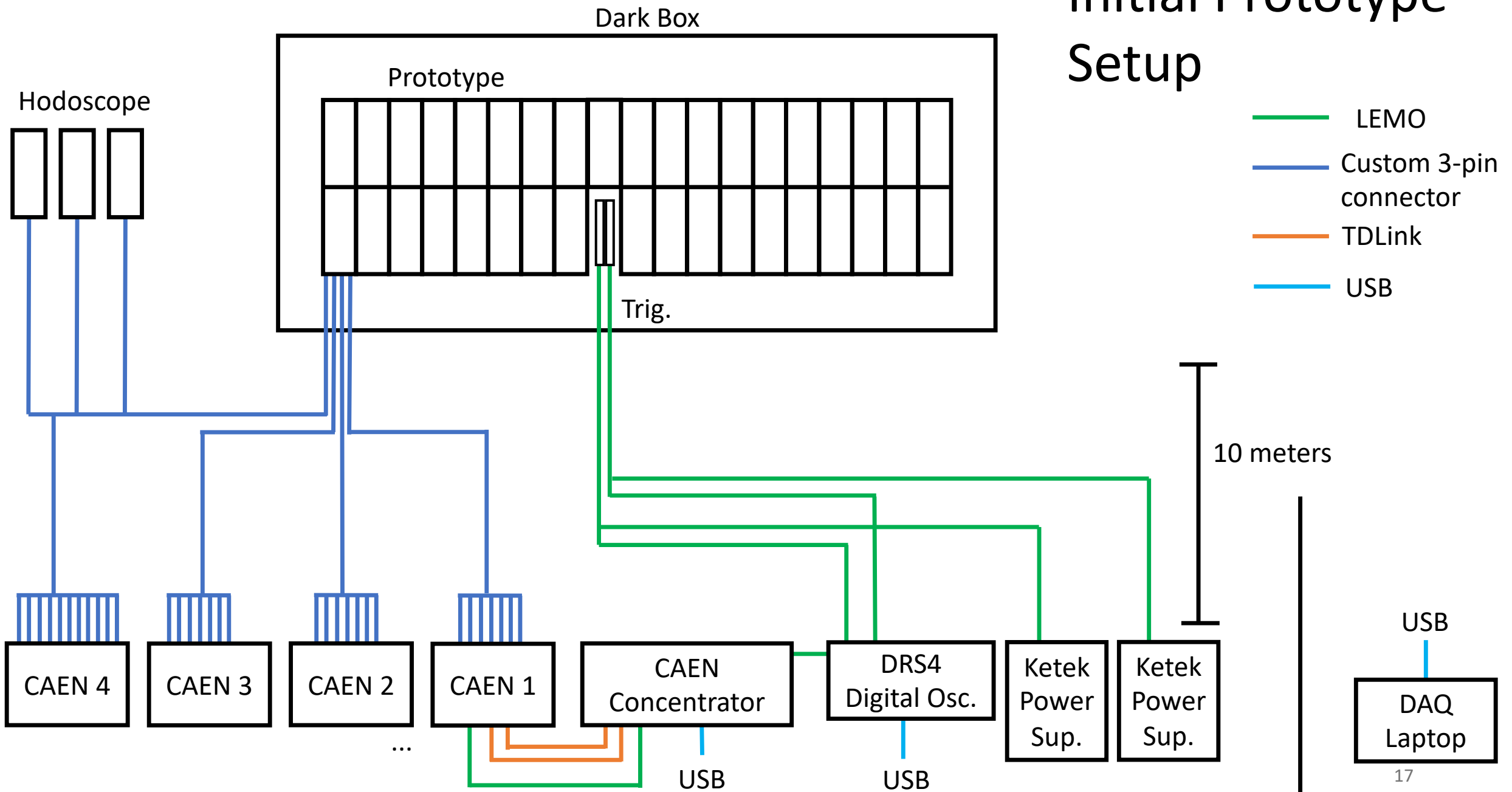


10 meters away from prototype

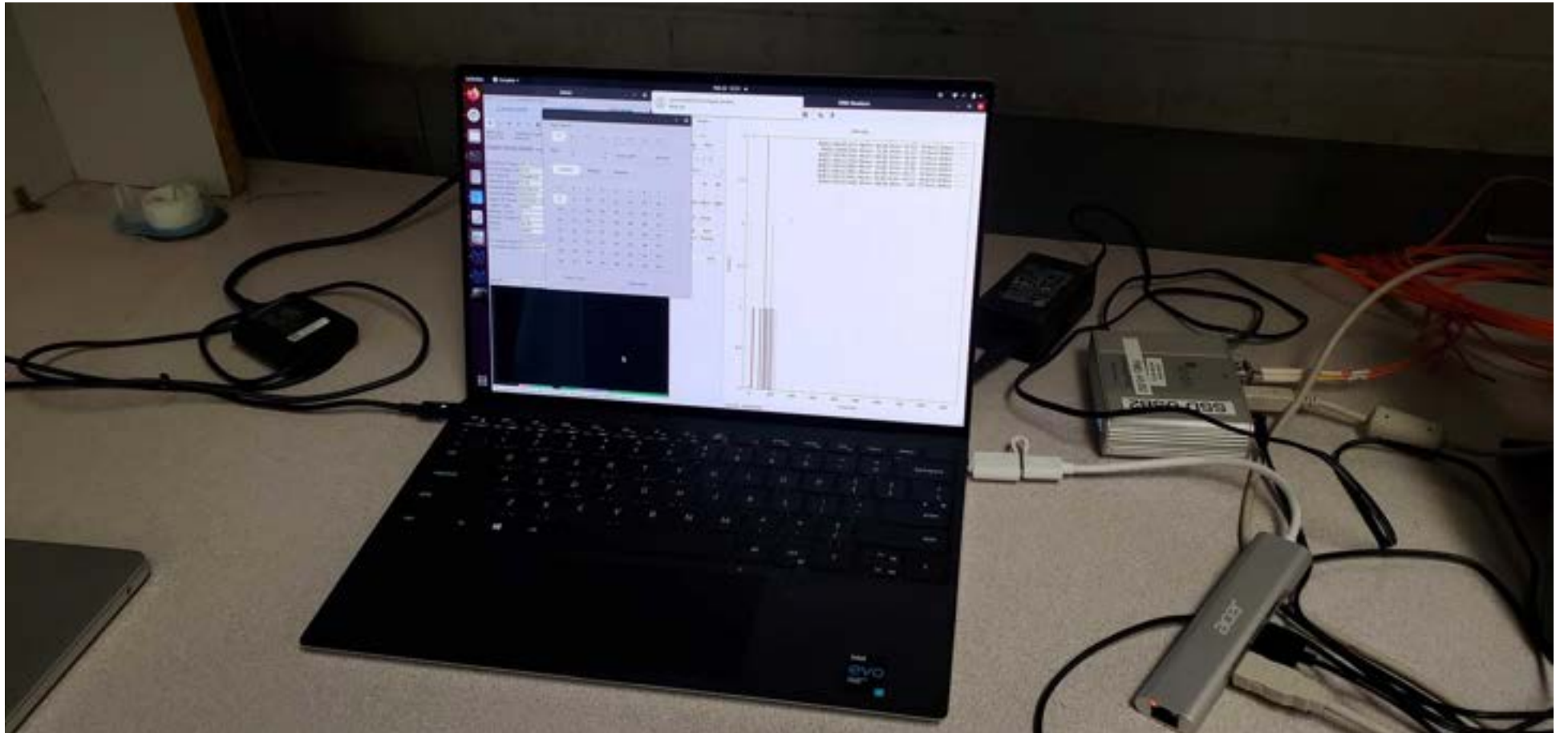
- Two trigger tiles currently installed at max shower position inside prototype, act as neutral particle trigger
- Two more trigger tiles will be installed in front to act as charged particle trigger



Initial Prototype Setup



- DAQ system is entirely decoupled from STAR

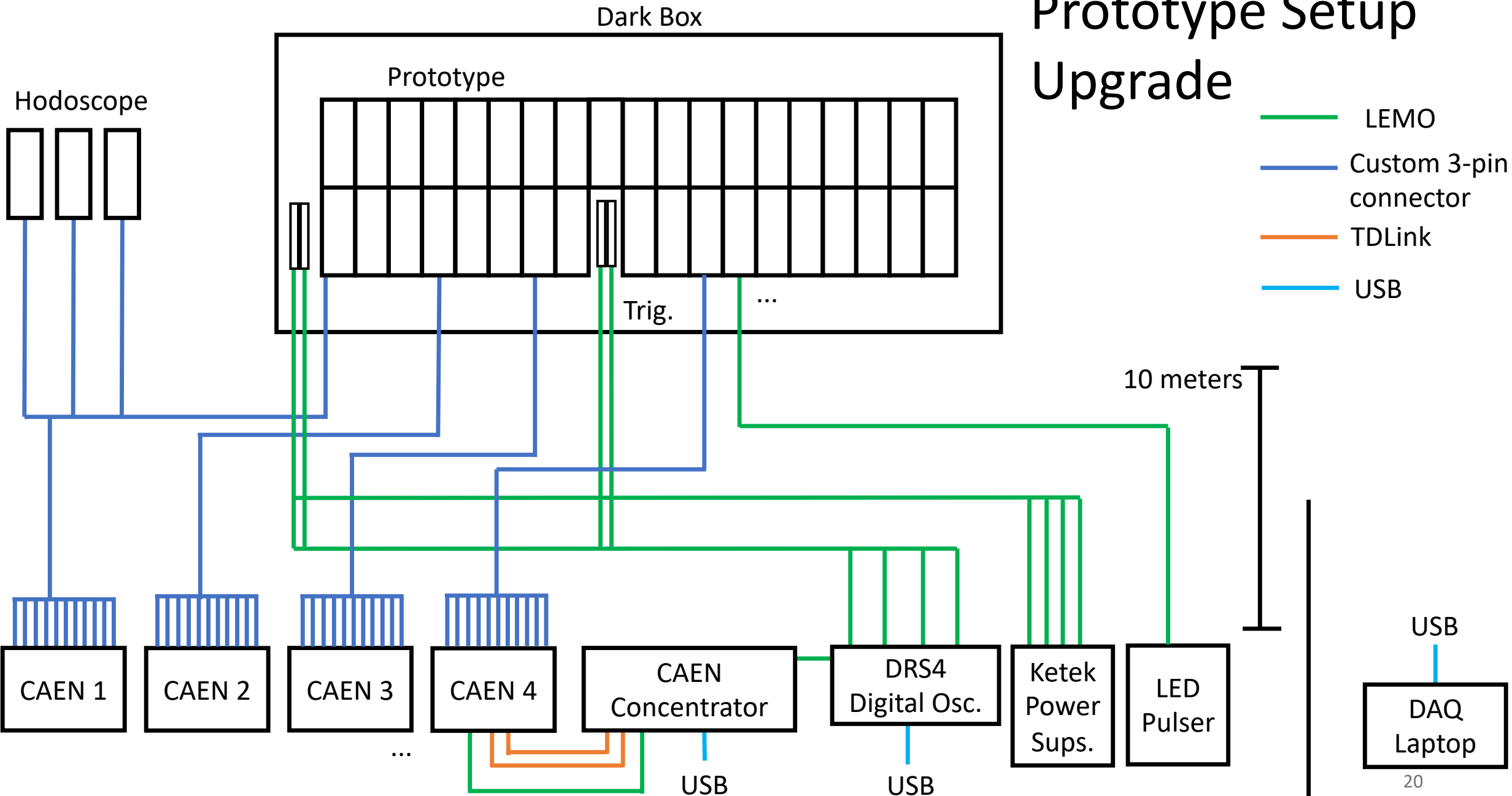


Upgrade Plans

- Install remaining layers (will require ~80 model 14160 1315PS SiPMs)
- Construct and install cables
- Install 2-3 more DAQ CAEN units
- Install 2 trigger tiles in front for charged particle trigger
- Pass final inspection and review by STAR



Prototype Setup Upgrade



Thank you!

