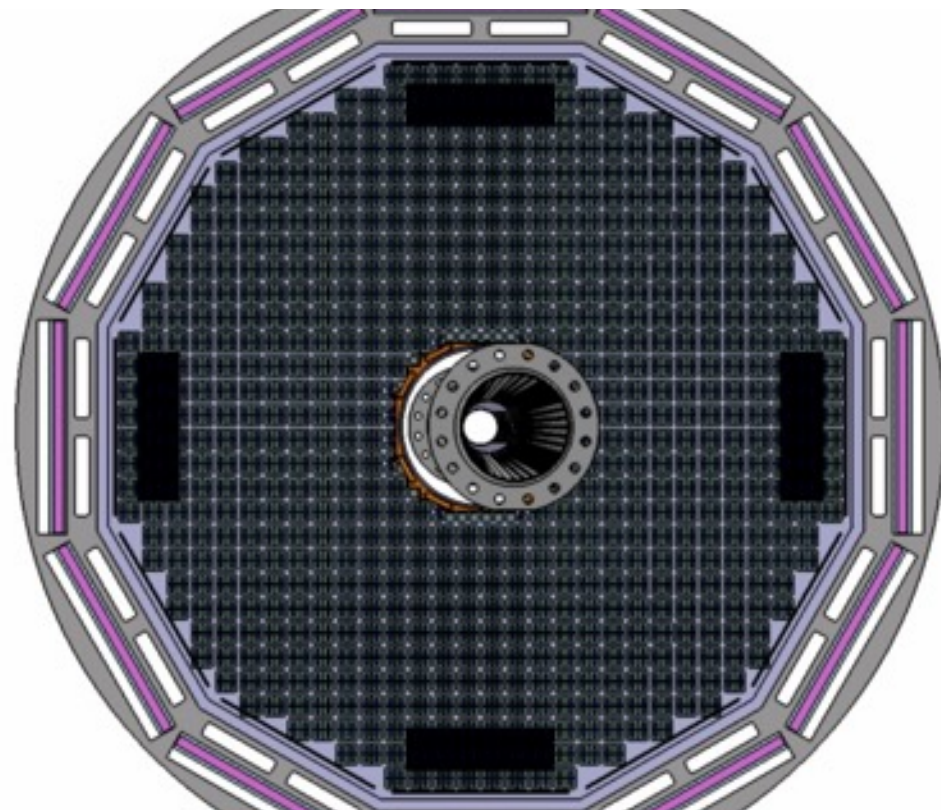


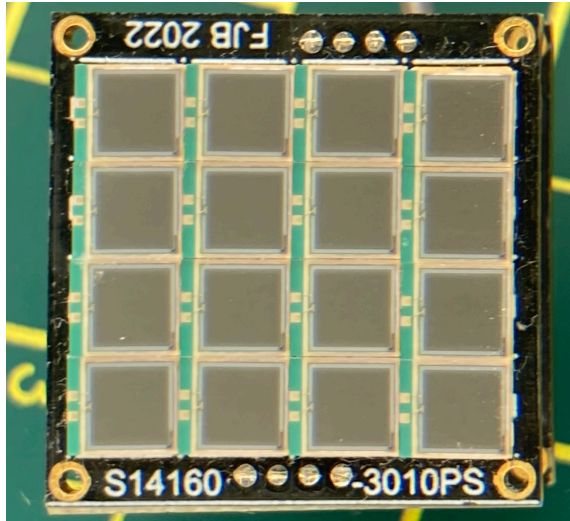
# EEEMCAL SiPM readout prototype



F. Barbosa, V. Berdnikov, T. Horn, A. Somov

Wednesday, October 5, 2022

# Lead tungstate crystals SiPM readout



- 3x3 mm<sup>2</sup> SiPMs Hamamtsu S14160
- 10 um SiPM pixel pitch, number of pixels 89984
- PDE 18%, Geometrical fill factor 31%
- Surface mount type package
- 16 SiPMs per crystal
- Compact PCB

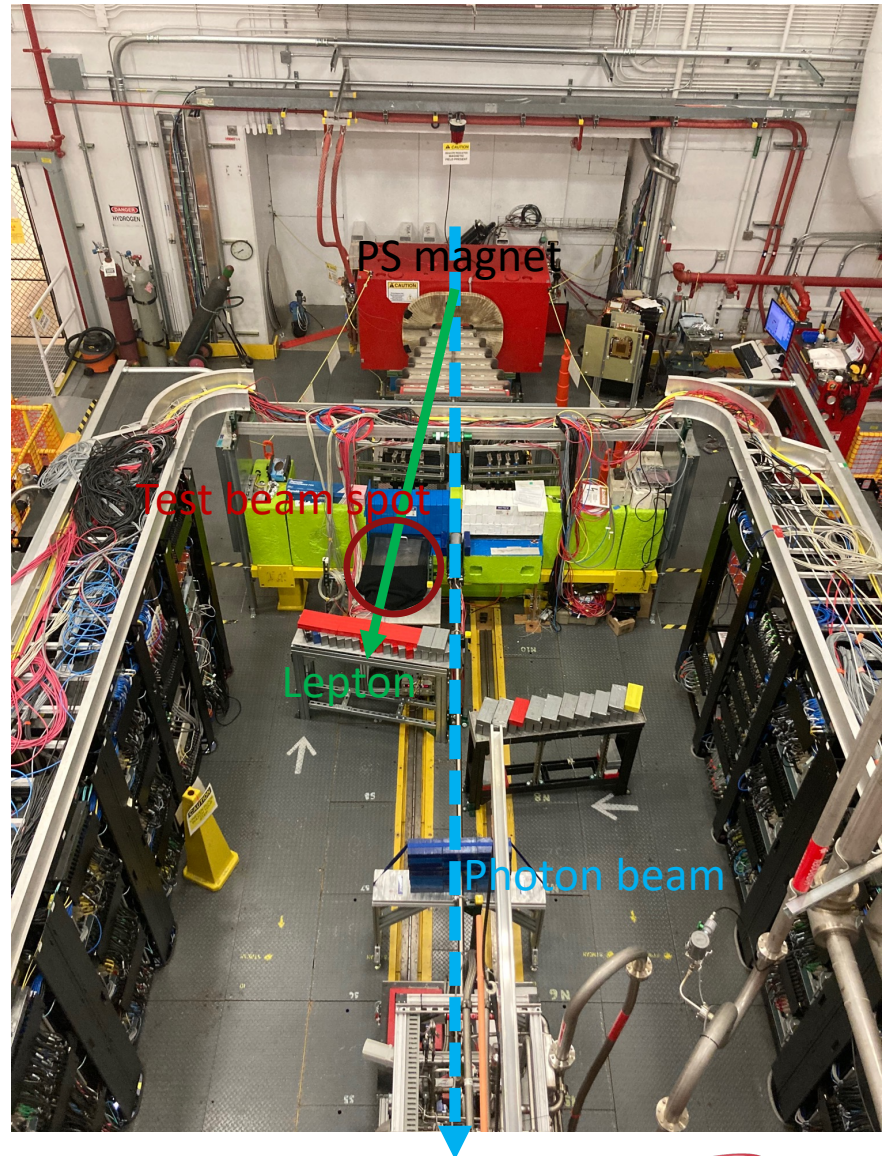


## Planned studies:

- Energy resolution
- Linearity
- Light collection
- Dark rates/noise as a function of temperature

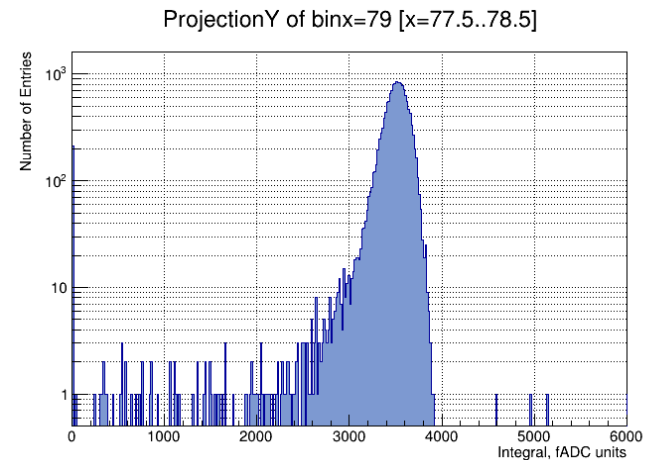
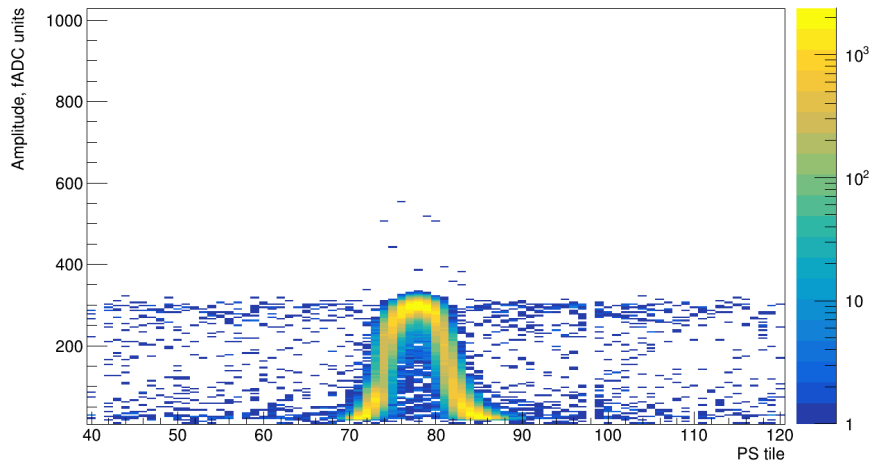
# Test beam facility behind Pair Spectrometer in Hall D

- The prototypes/test stand installed in Hall-D downstream of the pair spectrometer (PS)
- Electron-positron pairs are produced by the primary photon beam interacting with 750  $\mu\text{m}$  beryllium converter
- Lepton pairs are deflected in a 1.5 T dipole magnet and detected using two layers of scintillation counters positioned symmetrically around the photon beam line
- Each arm consists of 8 coarse counters and 145 high-granularity counters
- The high-granularity hodoscope is used to measure the lepton momentum; the position of each counter corresponds to the specific energy. Each detector arm covers the lepton momentum range of (3–6) GeV/c
- The energy resolution of the PS is estimated to be better than  $\sim 0.6\%$
- The position of the prototype was surveyed and aligned with respect to the beamline and the center of the pair spectrometer magnet, such that the lepton beam's spot is focused on the center row of the prototype, perpendicular to the front face of the calorimeter tower



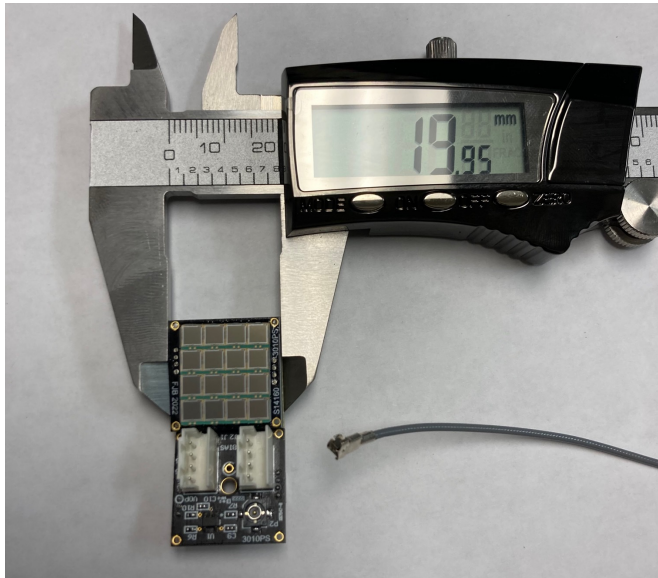
# First test beam results

- Electron energy from pair spectrometer  $4.75 \pm 0.13$  GeV
- Individual PWO calorimeter tower energy resolution  $\sim 3.2\%$



# The readout PCB technical details

- The readout PCB is a stack of two: the first holds the SiPMs and the second holds the preamp and connectors
- The crystal assembly with wrapping is 20.8 mm while the PCB size 19.9 mm which provides for a gap of ~1.0 mm between the modules
- The package of the -3010 devices shows the  $V_{op}=43V$  and the spec sheets state that all devices within a reel will have the same  $V_{op}$  within 0.1 V. This means less than a few % gain variation, so all 16 SiPMs will have a common bias, which is temperature compensated with the thermistor
- The signal output SMT low profile small coaxial connector with 1.5 mm diameter shielded cable



# Summary

- EEEMCAL SiPM readout board prototype fabricated
- Cosmic and beam tests ongoing
- 3x3 prototype under construction and beam tests planned for late fall 2022
- First test beam results with SiPM matrix encouraging
- Same readout concept considering for SciGlass readout