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FNAL Calorimeter and Precision Timing Generic R&D Introduction

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FNAL Detector R&D Review

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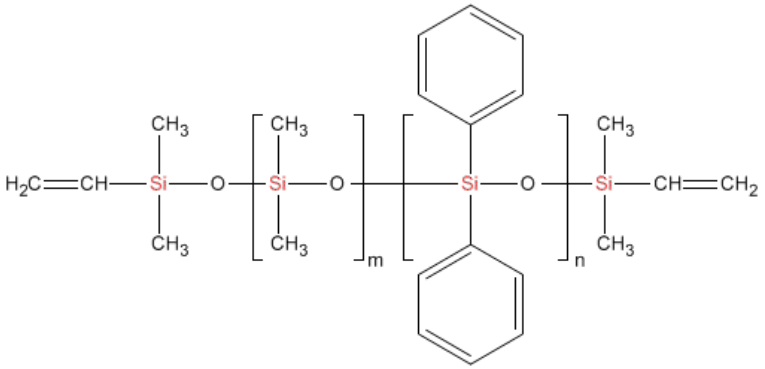
Main Themes

- FNAL has been very active in R&D in this area
- Detector R&D relies on strong Fermilab facilities
  - Scintillator chemistry lab and world expert chemist
  - Scintillator extrusion facility
  - Thin film lab with world-class ability to deposit wide variety of thin films
  - Optics lab to prepare fibers, splices, assemblies for calorimeters.
  - Picosecond timing laboratory and world expert able to explore state-of-the-art timing detectors.
  - ASIC design engineers that create state of the art calorimeter front-end ASICs
  - System design electrical engineers that build calorimeter optical-electrical-thermal-control systems for calorimeter readout.

New Scintillators

- Ongoing effort to develop new scintillators
  - Have all facilities needed to prepare and quantify new materials
  - Chem lab
  - Photospectrometer
  - Fluorescence spectrometer
  - Dark rooms/ readout systems
- Recent new scintillators
  - Example: Doped diphenyl polysiloxane

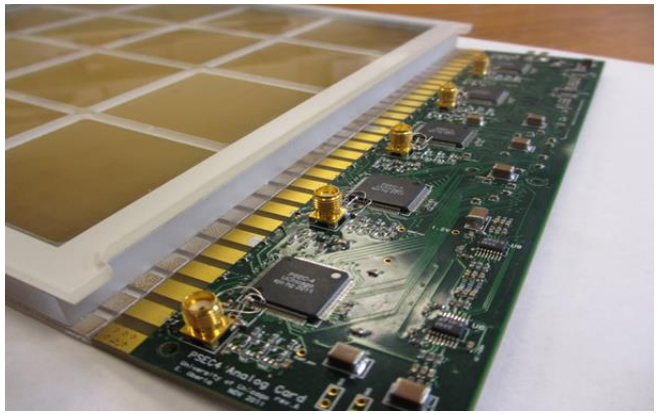


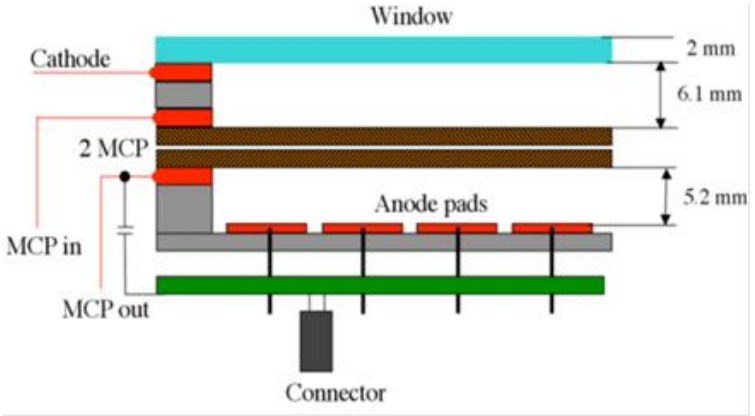
Scintillator Extrusion R&D

- Lab 5 Extrusion Facility
- Continual experimentation with new techniques and designs for extrusion
- Example: Co-extrusion of white polyethylene reflective coating on scintillator extrusions, protects optical surface and eliminates need for reflective (tyvek) wrapping
- R&D has led to adoption of extrusions by many experiments, most recently Mu2e for instance.

Fast Timing R&D

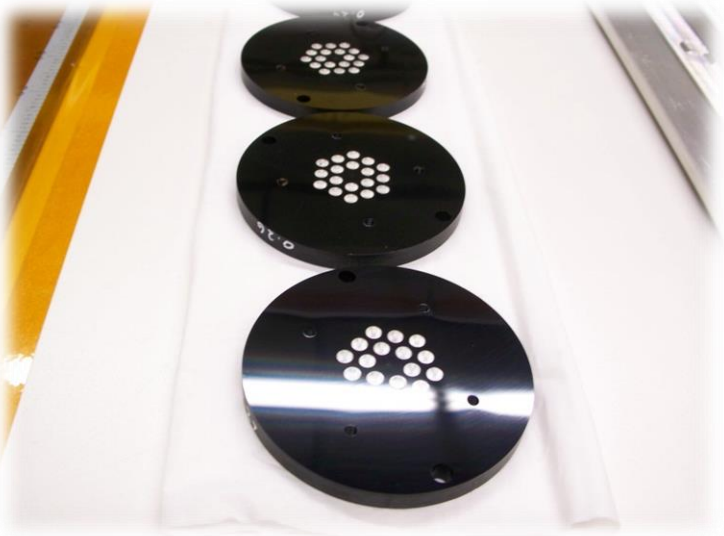
- Very active field of R&D.
- Studies for shower max timing detector for new generation sampling calorimeters
- Example microchannel plate array
- Study timing characteristics of many photodetectors
- Industrial collaboration with SIPM manufacturers to improve SIPM timing

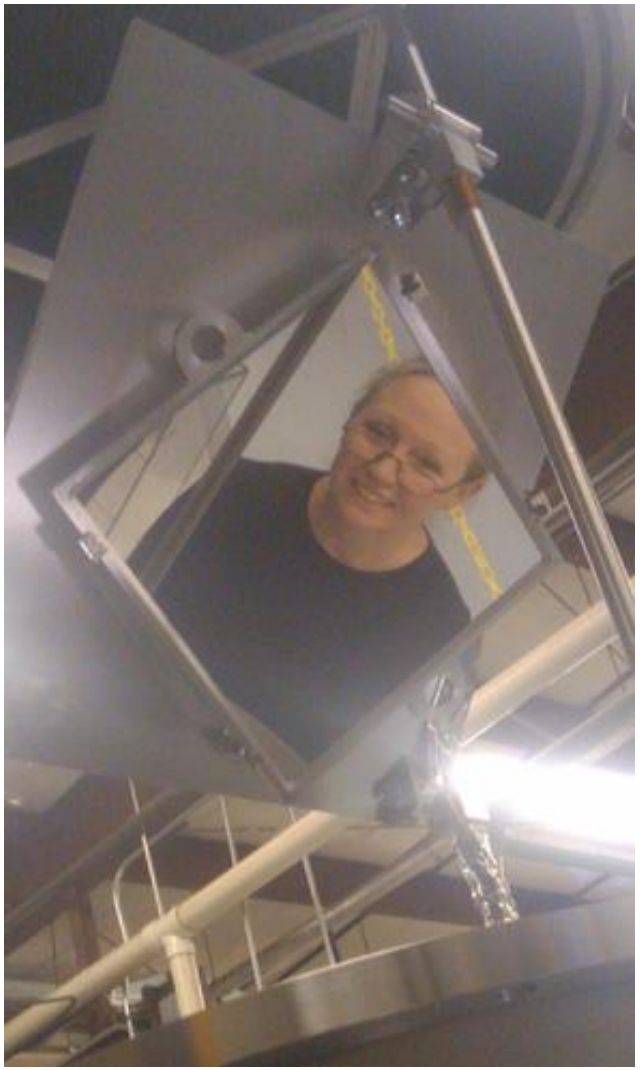




Thin Film Deposition

- Lab 7 Thin film deposition facility
- Detector R&D on fast timing detectors such as MCPs
- Thin film preparations for many experiments
- Optical preparation of R&D detectors



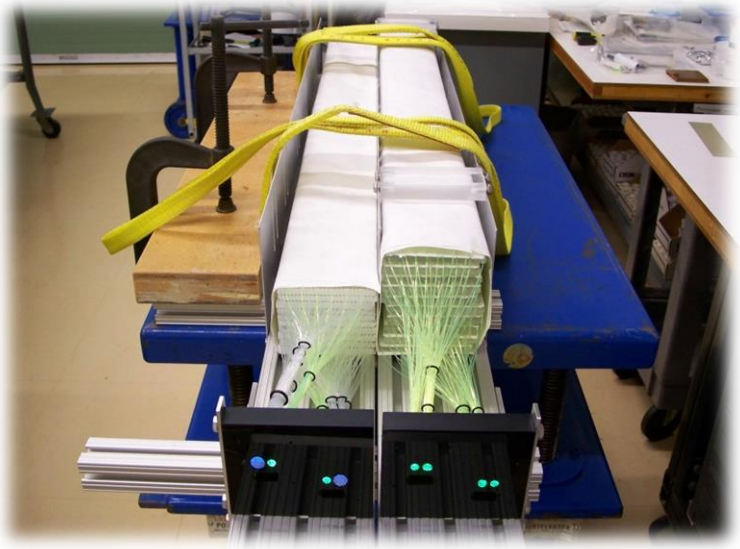


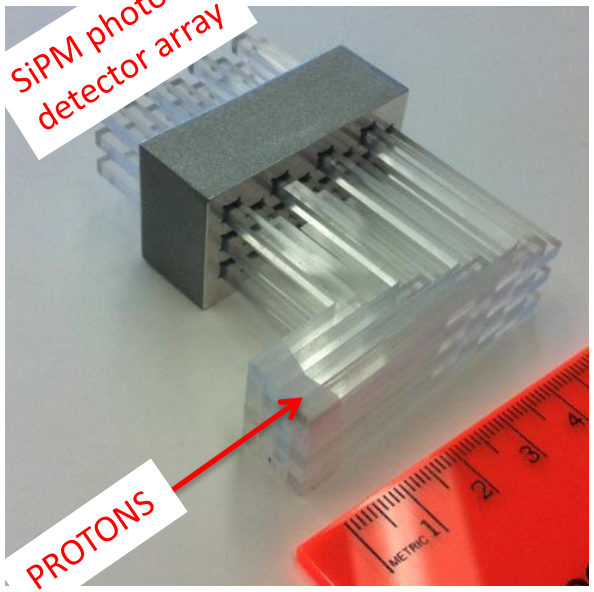
Calorimeter Front End Electronics

- QIE10, 11, 12, …
- Each QIE version tailored for generic application
  - QIE10 phototube readout of Hadron Cal with precision timing
  - QIE11 SIPM readout of HCAL with ability to shunt excess signal
  - QIE12 tailored for ATLAS
  - …
- SIPM electrical/thermal/control system
  - First developed for CMS HCAL
  - Forms the model for other experiments such as CMS phase II ECAL, GRAPES experiment in Ooty, India, …
- PADE
  - High bandwidth readout for SIPMs, many applications in calorimeter R&D at FNAL test beam.

Other Areas of R&D

- Collaborations with other universities/labs to develop new calorimeters, detectors:
  - Dual readout Calorimetry
  - Quartz bar timing detectors





Agenda of Talks

- QIE and Calorimeter Front End Electronics: Jim Hirschauer
- Fast Timing: Anatoly Ronzhin
- Scintillators:Anna Pla-Dalmau
- Thin Films and Optic: Eileen Hahn
- Quartz bar fast detectors – Mike Albrow
- Dual Readout Calorimeter – Anna Mazzacane
- Looking Forward: Jim Freeman