Cosmic Ray Tagger Studies-**Preliminary**

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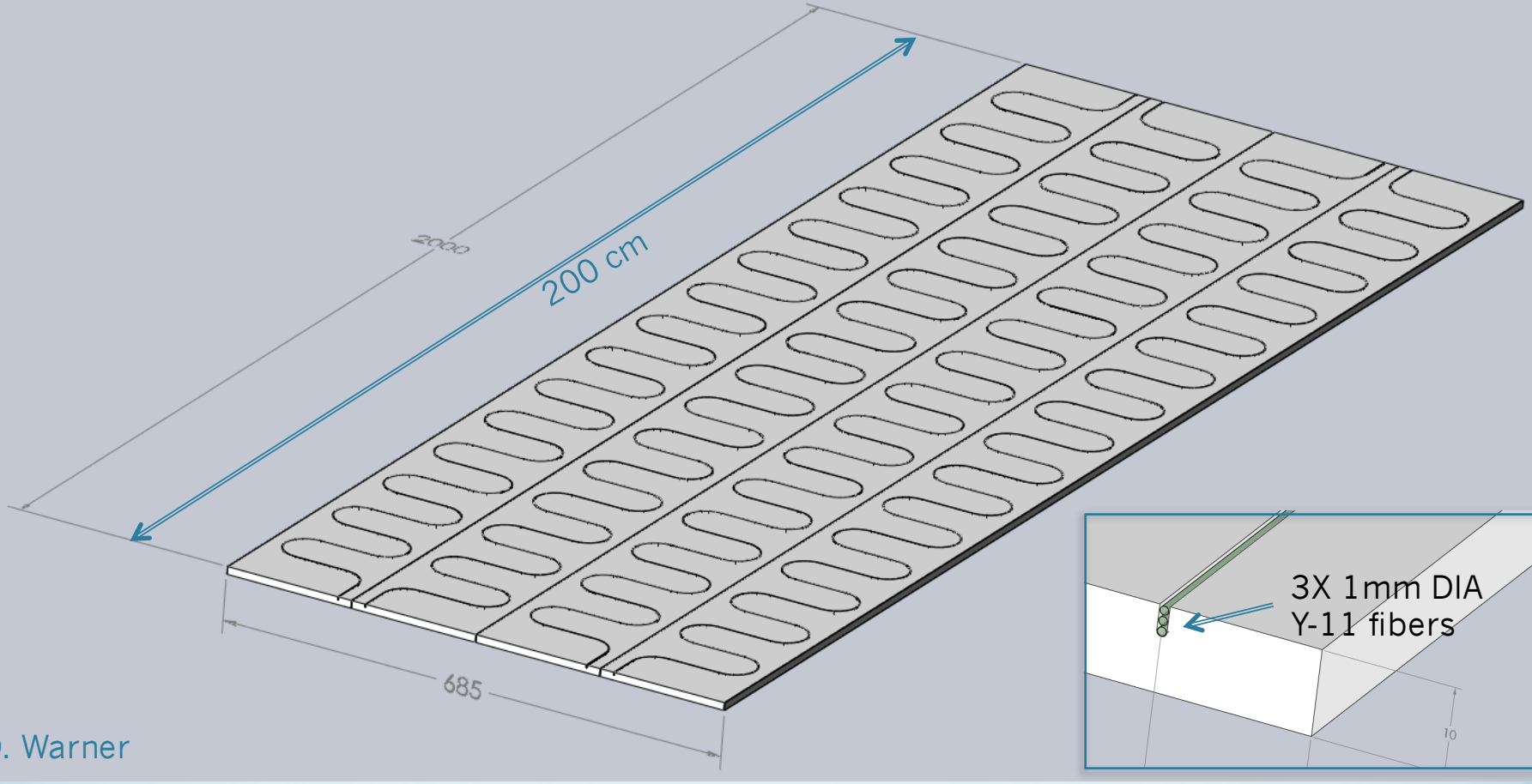
WA104 Meeting

Module Concept

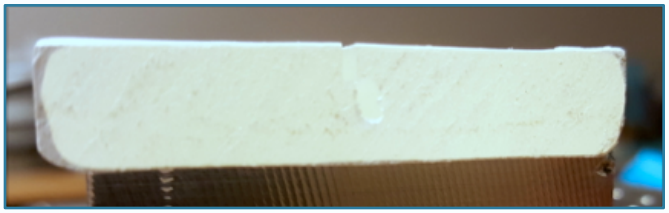
http://indico.cern.ch/event/395691/contribution/1/material/slides/0.pdf



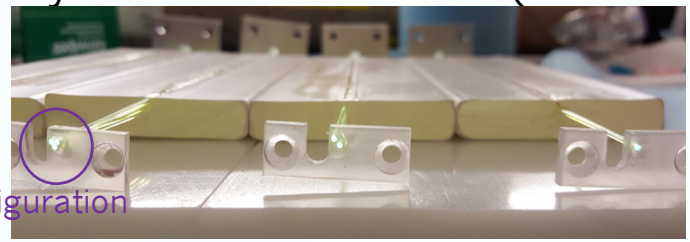
D. Warner

Use time/amplitude from each end to get longitudinal hit position
Based on T2K ND280 & WAGASCI counters
- 2 m counters w/ single fiber -> ~20pe near end / 4pe far end

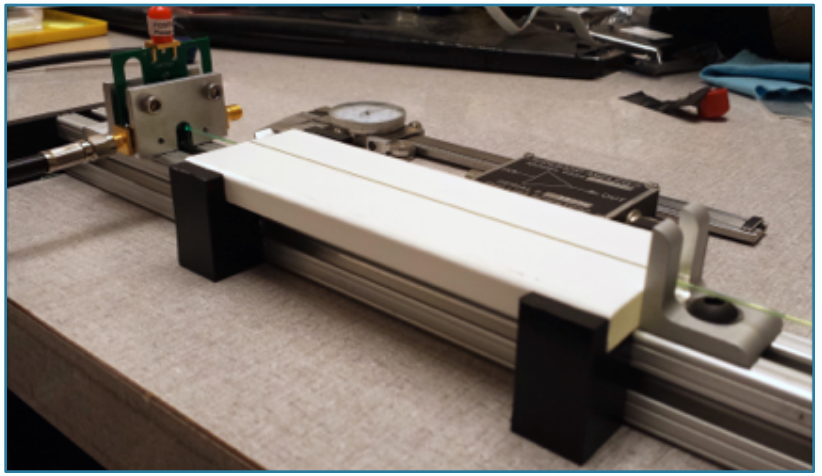
Multi-Fiber Light Yield

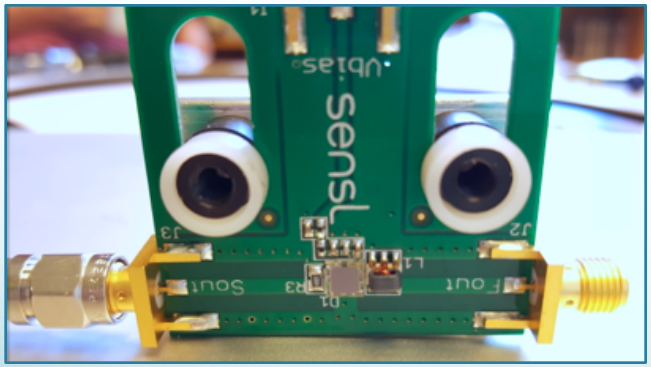


"Holey" extruded scintillator (5cm x 1cm)

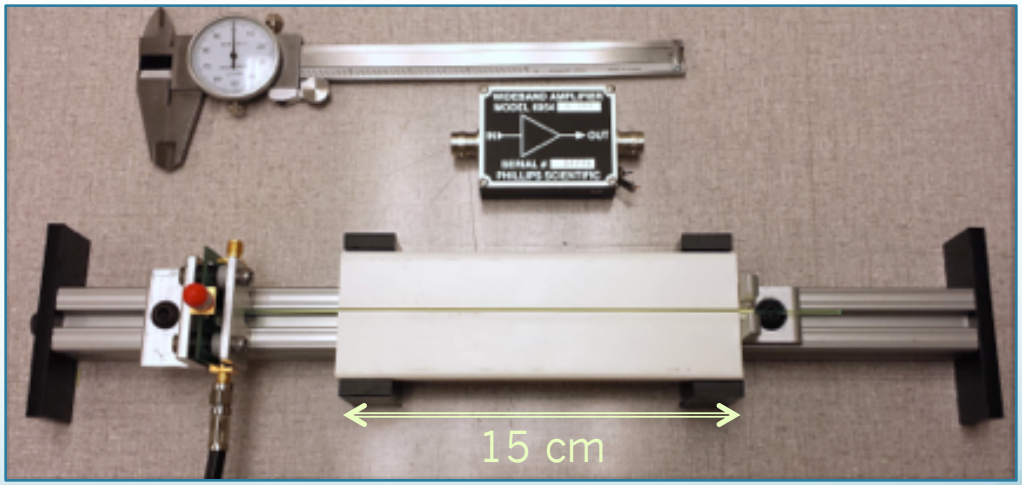


WLS fiber bundles

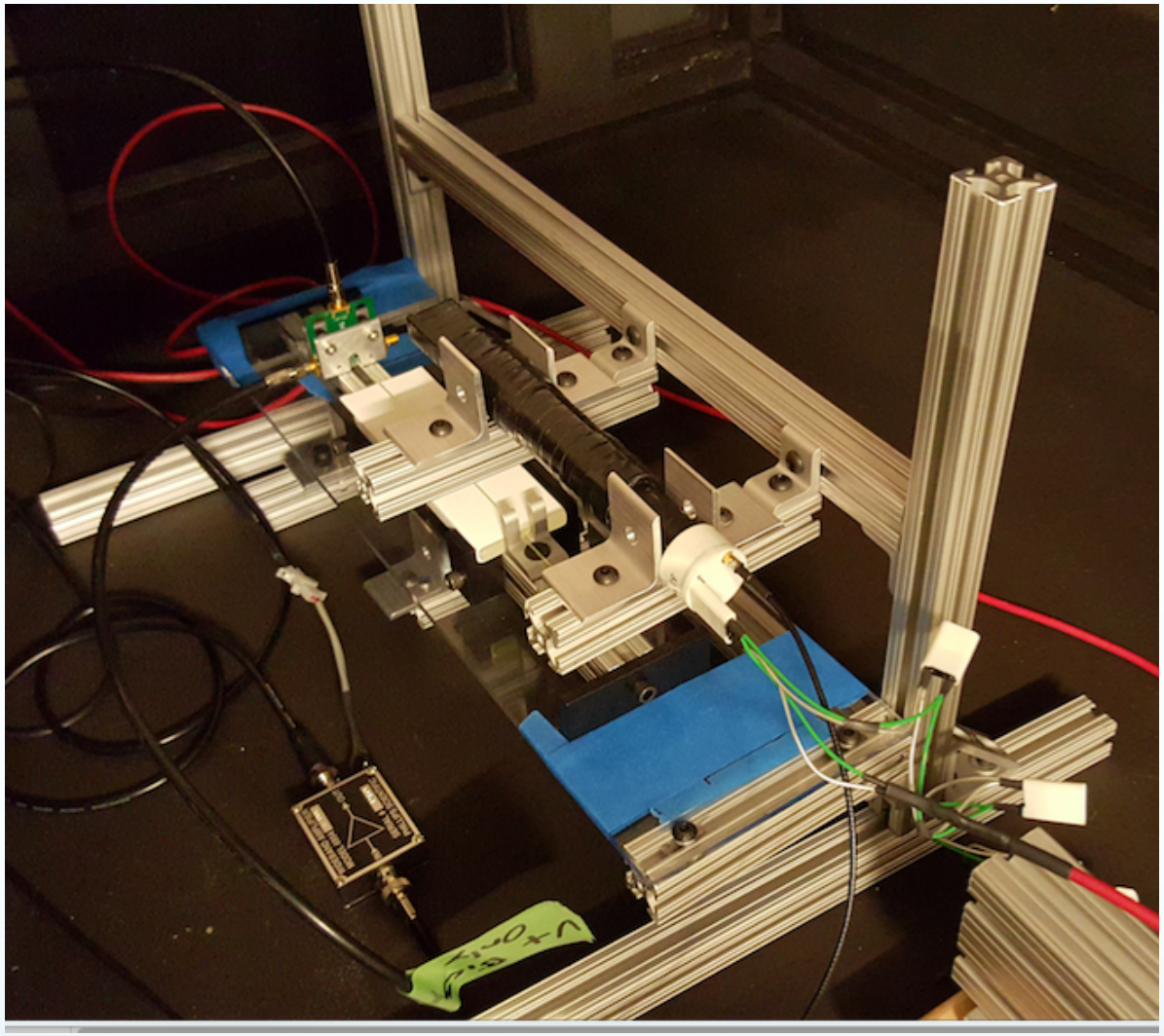




SensL 30035C-SMT
3x3 mm^2 SiPM; V_{op} ~27 V

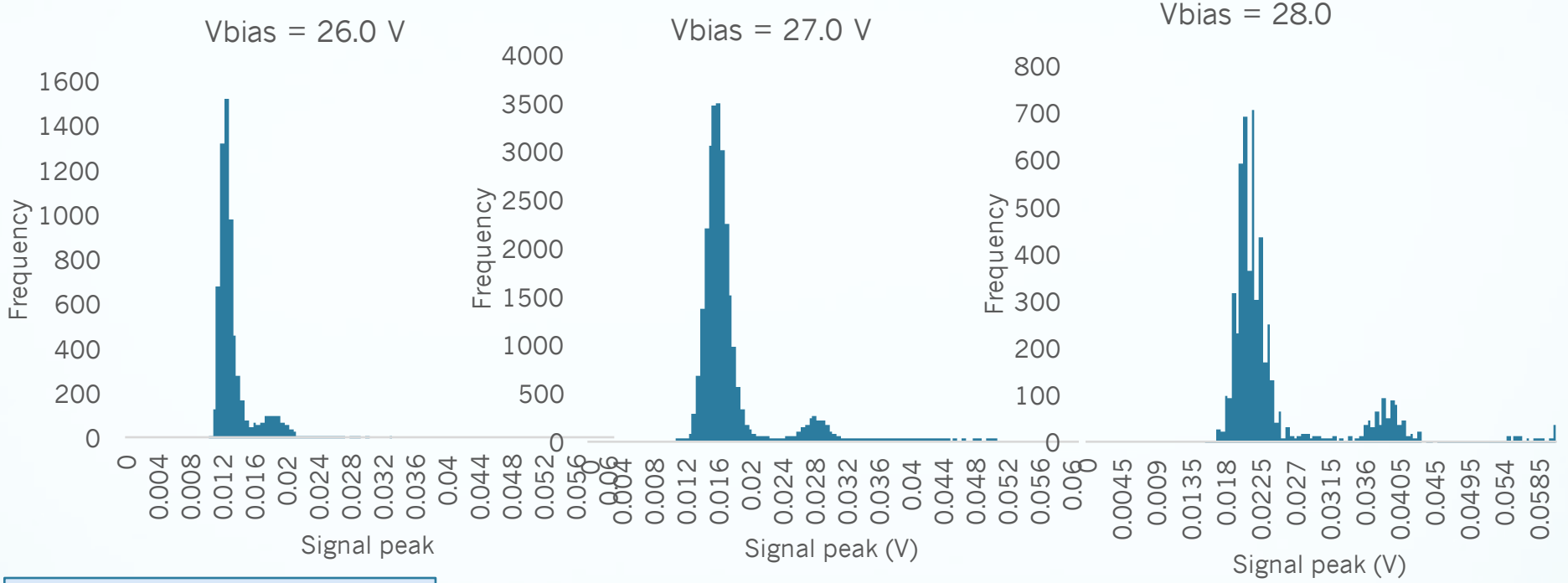


- 1-, 2-, 3-fiber test units assembled
- Hope to get non-holey samples from Fermilab

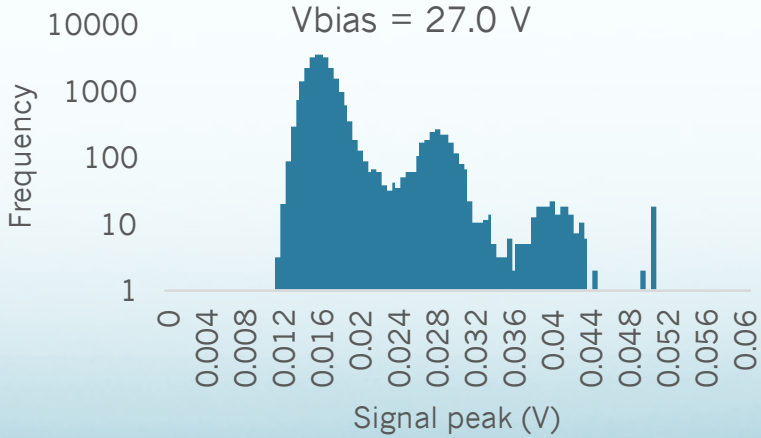


- Test detector 5 cm x 15 cm (x 1cm)
  - (un)potted in 1.2 mm (w) x 3.5 mm (d) groove
- Read out one end; 0.5 mm fiber-photosensor air-gap
- Two hodoscopes used
  - “Large CR” ~ 10 cm x 15 cm
  - “Small CR” ~ 2 cm x 4 cm

SensL 30035C: Dark Spectrum

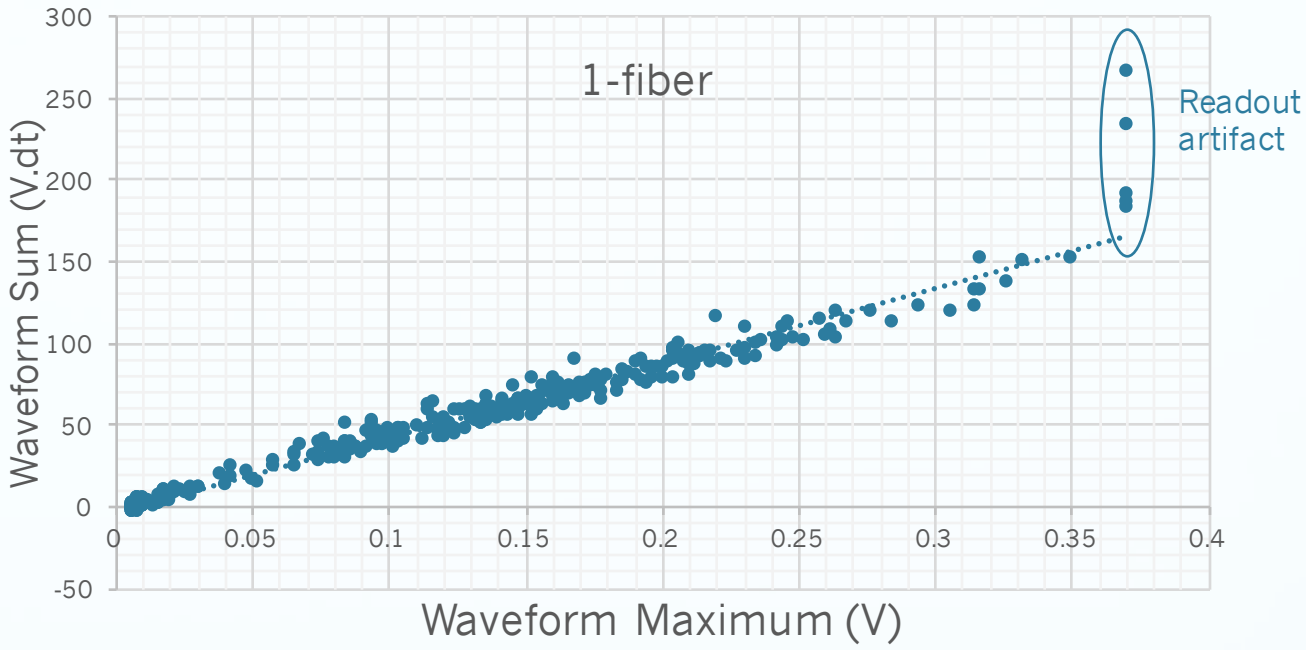


- 100X amplifier
- T_{lab} ~ 22°C
  ΔGain: -0.8 %/°C
- Clean 1, 2, 3, p.e. peaks
- DCR (spec sheet, typ.):
  > 0.5 pe ~ 300 kHz
  > 1.5 pe ~ 21 kHz
  > 2.5 pe ~ 1.4 kHz
  > 3.5 pe ~ 100 Hz



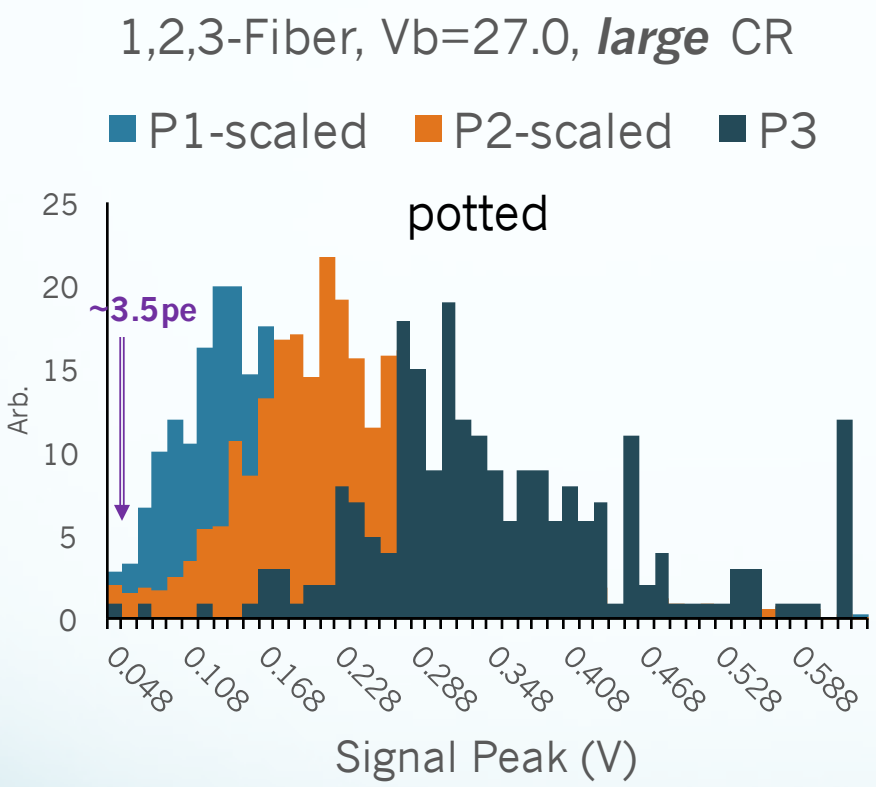
Vbias	26	27	28	V
1 p.e.	5.5	12.	17.	mV
2pe/ 1pe	0.06	0.07	0.13	

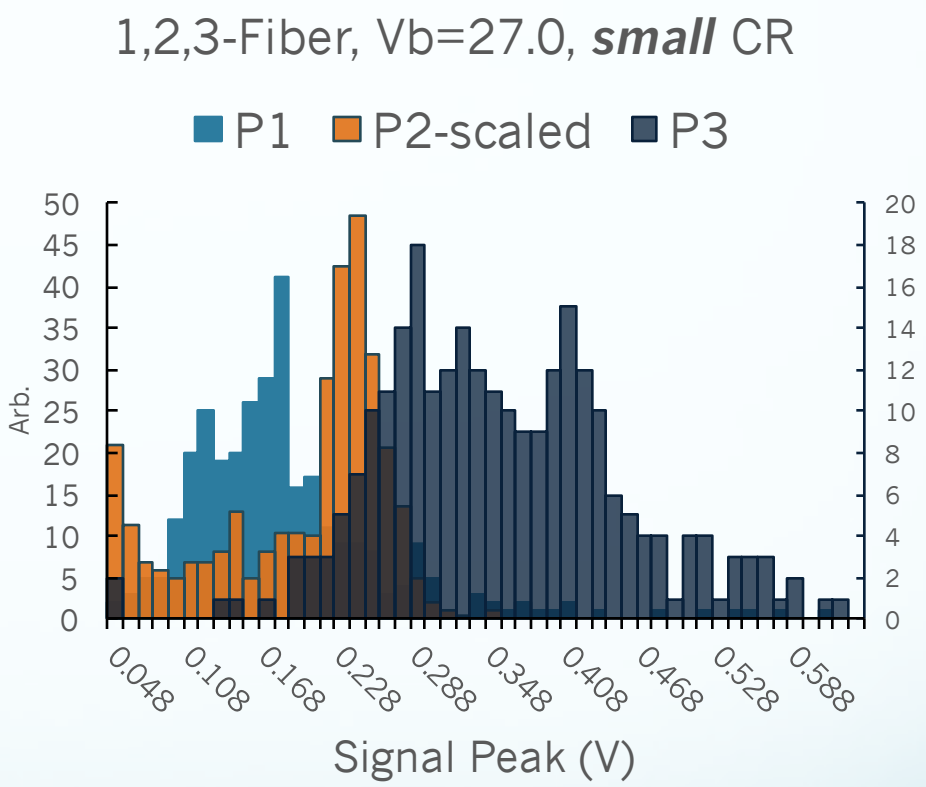
SensL 30035C: Peak vs. Charge



- Read out waveform with 2 Gs/s digital scope and SignalExpress s/w from National Instruments for now
  - will move to our VME system later
- SensL → maximum amplitude = signal
  - Verified good correlation between integrated waveform vs. maximum amplitude
- Following plots use maximum signal amplitude

Cosmic Ray Response





Median Signal (1pe ~ 12 mV):

P1 ~ 0.15 V ~~ 13 pe

P2 ~ 0.24 V ~~ 20 pe

P3 ~ 0.33 V ~~ 28 pe

PRELIMINARY Conclusions

- SensL 3 x 3 mm^2 sensors
  - dark spectrum has well-separated photoelectrons peaks at room temperature -> absolute signal calibration if Vbias/temp. stable
  - used dark spectrum to verify cross talk rate of ~0.07 for nominal operating gain
- Potting the fibers produced no noticeable difference in light yield
  - Potting was done "post facto" i.e. after initial fiber placement in the bars
  - Probably reasonably good coating for the 1-fiber, less good for the multi-fiber due to narrow slot.
- **Significant light yield increase for multi-fiber over single fiber**
  - **1 -> 2 ~ x1.5**
  - **1 -> 3 ~ x2**
- Single-fiber yield low compared to WAGASCI

Next Steps

- Higher statistics measurements
- Optical grease coupling
- Read out both ends
- Y-11 produces two dominant wavelengths with different attenuation lengths (35cm/450cm) – need to make measurements with longer fiber (~5m)
  - Ordered 120 m Y-11 fiber
  - Initially, w/ short scintillator (all we have) on end of long fiber(s)

- Mock up wide (17-20 cm) bars from narrow bars
  - Possibility to add on to a production run at Fermilab "soon"(?)
  - Needs extension to current Fermilab-CSU contract