

Table 1

| email | SECTION | NUMBER | STYLE/ SUBSTANCE | COMMENT | Assigned to | Accept/Decline | Response |
|------------------------------------|------------|--------|---------------------|--|--------------|----------------|--|
| Jon U.(from private communication) | Sec. 5.3.1 | | substance | Add sentence in Sec. 5.3.1 - Efficiency: "In analogy with the above discussion for the two ARAPUCA cell sizes, the efficiency of light-guide modules is expected to be proportional to the number of suitably placed photosensors, and inversely correlated with the length of the optically active surface of a module with fixed width due to the attenuation of internally reflected optical photons. As a crude characterization, the smallness of the ratio of number of photosensors to optically active surface area of the light-guide modules relative to the ARAPUCA cells underlies the corresponding ratios of efficiencies. A factor of two can be gained by instrumenting both ends of the light guides, but improvement beyond that would require modification to the module design to enable effective deployment of additional photosensors." | FLC | | |
| Jon U.(from private communication) | Table 4 | | | My other problem with the table itself is the presentation of the uncertainties on the efficiencies. I don't think it's necessary to separate out the statistical and systematic errors since the ones labeled as systematic overwhelm the statistical ones, as is stated clearly in the text. To make matters worse, the statistical errors are given with an extra significant digit, and it is just silly to report an error as 0.000. Can't we just report the systematic error as the error, and dispense with reporting two errors? I don't think the error needs to be labelled as systematic in the table. It's described in the text what the dominant uncertainty is and how it was determined. That should be sufficient, and just reporting one error will make the efficiency results in the table more compact and readable. | FLC | | |
| | figure | 66 | substance and style | The fitting function should be shown in the legend, For the right side is not given in the caption either. Alternatively, the legends should provide the value of the fit parameters together with their physical units (GeV, GeV ^{0.5}). | FLC | | |
| | figure | 25 | substance | Figure 25 does not show all details, at least not recognizable for the uninitiated reader. Maybe "some details", or alike? | FLC | | |
| | figure | 32 | substance | legend or caption inclusion of blue vs red lines? In line 1088, blue ~ "noise contribution"? | FLC | | |
| | figure | 36 | substance | clarity on what "phi" sweeps out | FLC | | |
| | table | 4 | substance | What is the take away message for the reader? This is left a bit hanging. Our choice will be the ARAPUCA based on these (and perhaps other) results? Will these do the job for the experiment? One can forward reference to the excellent results in chapter 7. | FLC | | |
| adryanna.major@duke.edu | text | 884 | substance | "Fig 35" should be "Fig 25" | FLC | | |
| | text | 889 | substance | unclear where 4 larger cells are placed within the ARAPUCA module (Fig 25 seems to show only "8" cells design)... Center? Edges? Unclear on motivation for using difference optical areas | FLC | | |
| | text | 915 | substance | "Details are shown in Fig 25", but no details of the photosensors are shown there. Need such a fig added? (Slide 12 has example of this fig https://indico.fnal.gov/event/18460/contributions/47538/attachments/29623/36506/readiness_review_v4.pdf) | FLC | | |
| | text | 1076 | substance | Possibly more details on what this "portion of the waveform" is? | FLC | | |
| dmendezme@bnl.gov | text | 1923 | substance | Add general conclusions or summary from the information shown in table 6: does the performance meet DUNE's needs? | FLC, TRJ, TY | Accept | Added to the text introducing Table 6: "For each of the categories shown, the ProtoDUNE-SP performance meets or exceeds the DUNE specification, in some cases by large margins." |
| | text | | substance | The time resolution is 14 ns which looks very good. We should comment on that result. | FLC | | |
| etw@bnl.gov | figure | 64 | style | Note explicitly that this is a TPC event display in the caption | FLC | | |
| | text | 905 | style | "are employed" --> "are employed through the photon detection system" | FLC | | |
| | text | 909 | style | in "Vertical through-silicon via", what is "via"? | FLC | | |
| | text | 927 | style | Awkward grammatically. Suggest "... ADC that digitizes the output signal from photosensors into analog-to-digital units" | FLC | | |
| | text | 1001 | style | "in ADC counts - ADU" --> "in ADC "units" - ADU" to make term origin more clear | FLC | | |
| | text | 1050 | style | comma: "the SNR, as defined in equation 5.1 'comma', is directly proportional..." | FLC | | |
| | text | 1130 | style | Don't know if we have fixed style rules for out papers in DUNE, but eg in some other experiments we write Geant4 in In Latex as $\text{\textsc{Geant4}}$ \xspace | FLC | | |
| | text | 1130 | style | "Argon" --> "argon" | FLC | | |
| | text | 1251 | style | "regardless "of" | FLC | | |
| dmendezme@bnl.gov | text | 1256 | style | This a very subsection with only a small paragraph. I understand highlighting the event displays/topologies but this might be added to another section or somehow included at the beginning of section 6 instead of making it its own subsection. | FLC | | |
| etw@bnl.gov | text | 1793 | style | I guess this section is not "PD Response" to be symmetric with the title of the previous TPC Response section, but it's kind of jarring to read the intro and have it be all about calorimetry. Probably if I were writing the paper I would have organized it into TPC Performance and PD Performance - keeping the so-called characterization and response of each together. Which would allow you to call the "PD response" section "PD calorimetry" which is what it is. | FLC | | |
| etw@bnl.gov | text | 1793 | style | I ran out of steam on style comments for the PD response section as there were many. In general this section is less polished than the others and reads more like a tech report than a paper. I think most of the issues could be quickly corrected with an editing pass focused on turning everything into complete sentences. | FLC | | |
| | text | 1797 | style | degraded -> reduced ? | FLC | | |
| etw@bnl.gov | text | 1821 | style | "investigate on" -> investigate | FLC | | |
| etw@bnl.gov | text | 1846 | style | Capitalize Gaussian | FLC | | |
| etw@bnl.gov | text | 1854 | style | info in parenthesis is quite shorthand - usually for a paper one would write this out into more of a proper sentence | FLC | | |
| etw@bnl.gov | text | 1855 | style | Do not capitalize photons in photons/GeV. Also this sentence is kind of mangled - suggest moving "Ylight = 102.1 Photons/GeV" to end of sentence. | FLC | | |
| etw@bnl.gov | text | 1857 | style | diffused -> diffuse | FLC | | |
| | text | 1865 | style | Photons/GeV -> photons/GeV | FLC | | |

Table 4: Efficiencies of the detector technologies in the ProtoDUNE-SP PD system: median value among detectors of the same type, determined from the average of independent measurements with beam muons and electrons at different energies.

| Detector Type | N ^o of elements in PDS | Efficiency |
|----------------------------|-----------------------------------|--|
| ARAPUCA cell | 8 | $\bar{\epsilon}_A = (2.00 \pm 0.005_{\text{stat}} \pm 0.25_{\text{syst}}) \%$ |
| ARAPUCA cell (double area) | 4 | $\bar{\epsilon}_{A2} = (1.06 \pm 0.005_{\text{stat}} \pm 0.09_{\text{syst}}) \%$ |
| Double-shift module | 15 | $\bar{\epsilon}_{DS} = (0.21 \pm 0.000_{\text{stat}} \pm 0.03_{\text{syst}}) \%$ |
| Dip-coated module | 14 | $\bar{\epsilon}_{DC} = (0.08 \pm 0.000_{\text{stat}} \pm 0.02_{\text{syst}}) \%$ |

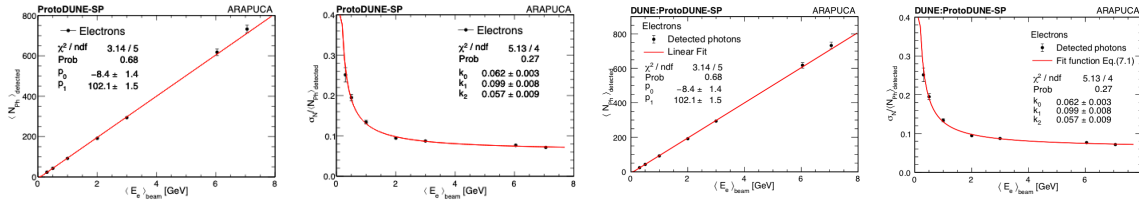


Figure 66: Number of detected photons (Gaussian fit mean value, from fig.65 right) as a function of incident electron energy (Gaussian fit mean value, from fig.65 - left) (left panel). Reconstructed energy resolution from the detected photon distributions (Gaussian fit standard deviation to the mean ratio) (right panel). A line of slope p_1 and intercept p_0 is fit to the data in the left-hand plot, and the function in equation (7.1) is fit to the data in the right-hand plot.

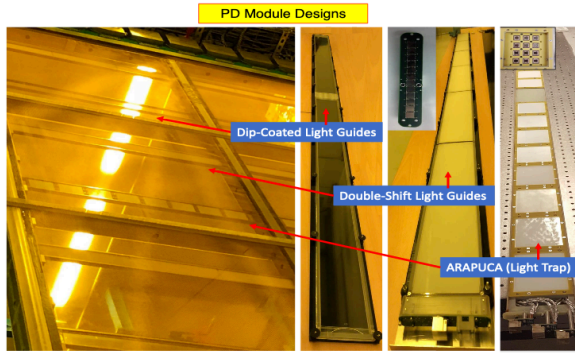


Figure 25: Picture of a ProtoDUNE-SP APA during assembly. Labels indicate the three types of PDS modules inserted into the APA frame (left). Pictures of the three technologies (right) with details of the photo-sensor arrays equipping the modules (insets). From left to right, they are a dip-coated light-guide module, a double-shift light-guide module, and an ARAPUCA module.

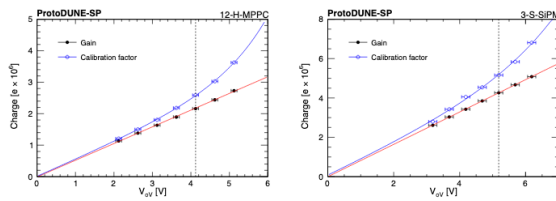


Figure 32: Charge signal per detected photon and charge signal per avalanche as a function of applied over-voltage V_{ov} for a typical 12-H-MPPC channel (left), and 3-S-SiPM channel (right). The vertical dotted line at the operation over-voltage set point indicates the calibration factor c_i (blue points) and the gain g_i (black points) of the channel.

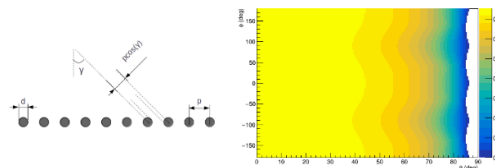


Figure 36: Schematic diagram illustrating photons impinging on a TPC wire plane (left) where the wire pitch p , the wire gauge d , and the incident photon angle (γ) are defined. On the right, the map of transmission - color scale from 0 to 1 - through the set of parallel planes (TPC wire planes and the mesh) as a function of the polar angles θ , ϕ of the incident photon direction (the planes lie on the (x, y) plane, $\theta = \gamma$ when $\phi = \pm\pi/2$).