bECAL Fiber Tests @Regina - Update 3

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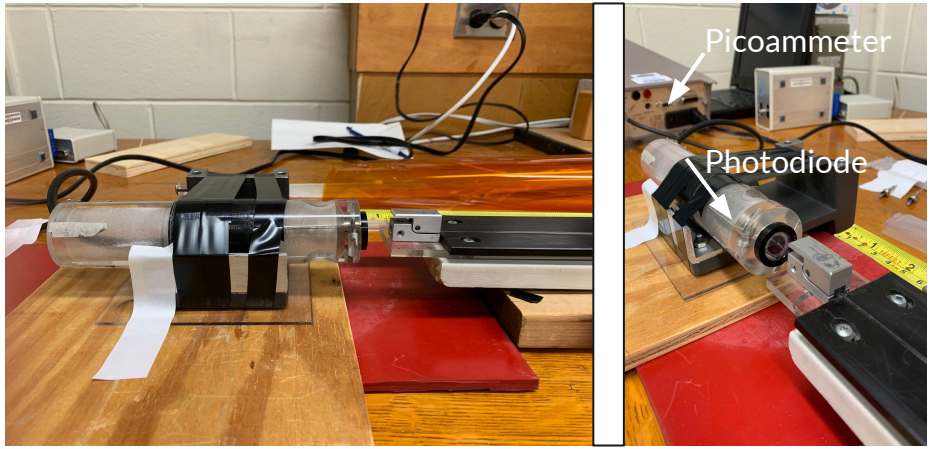
Presentation to the weekly Barrel ECAL Meeting, August 15, 2023

Timeline - August/September (review)

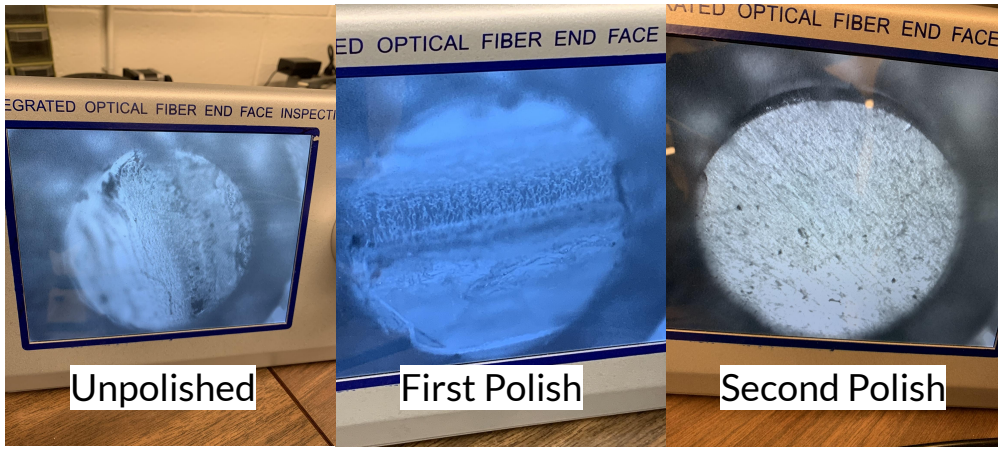
- August 14-18: **Kuraray** and **Luxium** fiber testing at **Photodiode Station**; Npe testing at **Npe station**; Group discussions; further polishing and tests as needed
- August 21-25: Further measurements and remeasurements as needed
- August 28-September 1: Finalize results for **September Review**

July 31 - August 4



- Continued measurements with **Photodiode/Picoammeter Setup**
  - Fiber laid in groove of polyethylene tray, polished end touching face of photodiode
  - LED powered by power crate at 3.8 V, which corresponds to ~0.041 A
  - Picoammeter readings taken at 10.0 cm intervals from 10.0 cm to 300.0 cm
- **A complete pouch of single and double clad fibers have now been polished and measured**
  - One pouch corresponds to five fibers

August 7 - August 11



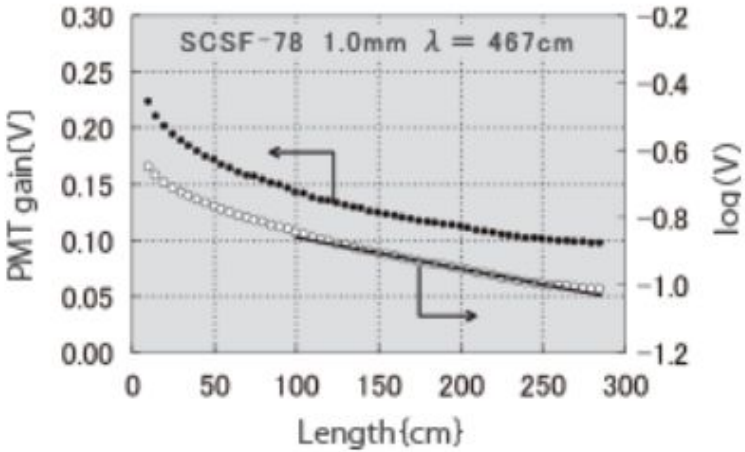
- **Luxium fibers** arrived!
  - Received **10 fibers**
  - **Unpolished**
  - **435 cm** long
- Luxium fibers were polished (x2) using previous **Fiber Polishing Station** and measurements were carried out using **Photodiode/Picoammeter Setup**
  - Measurements every 20.0 cm from 10.0 cm to 430.0 cm
- **Five Luxium fibers have been measured**

Attenuation Length Calculation

I - intensity
I_0 - initial intensity
x - distance along fiber
λ - attenuation length

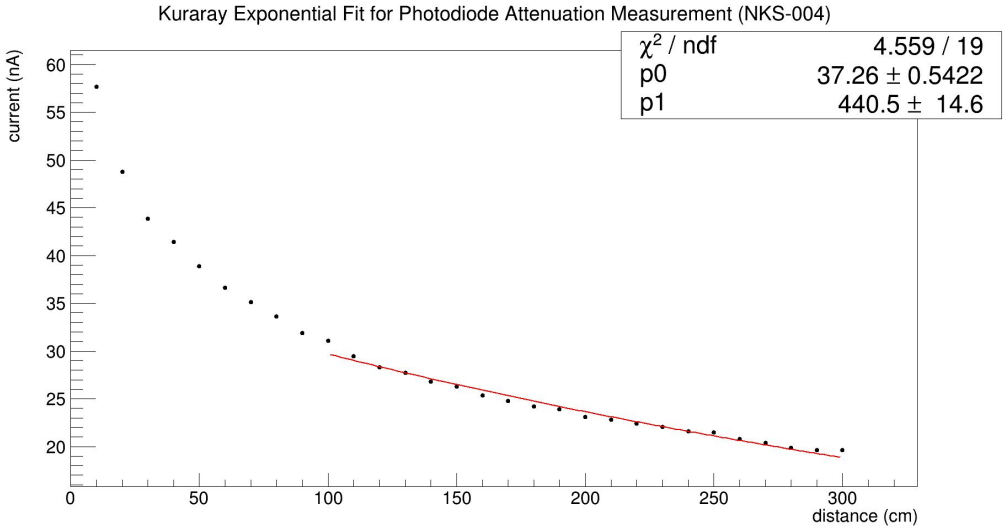
$$I = I_0 \cdot e^{\frac{-x}{\lambda}}$$

- **NEW**: Adjusted attenuation length calculation method to correspond with Kuraray's documentation:
- Attenuation length of single and double clad fibers should be > 400.0 cm when fit using a single exponential function between 100.0 and 300.0 cm



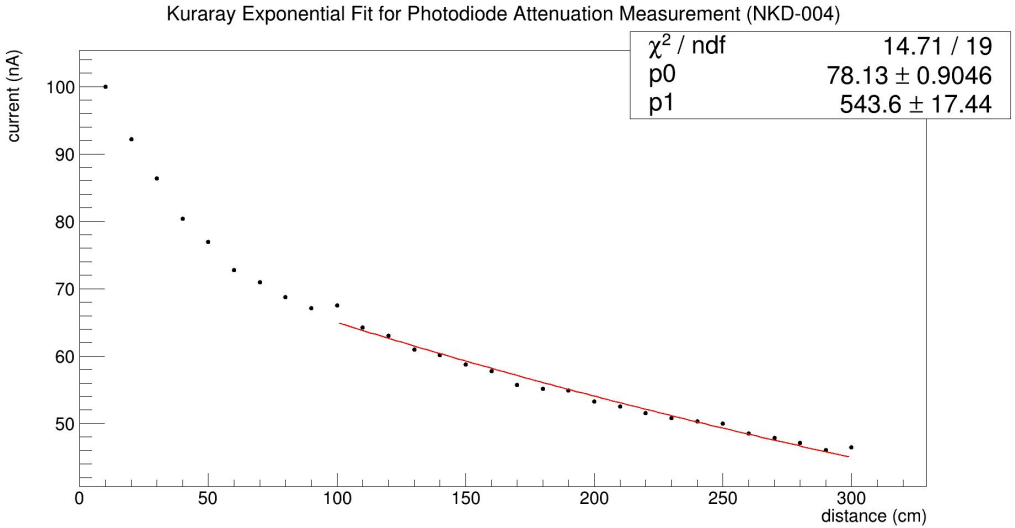
Attenuation Length Results - Kuraray Single Clad Fibers

- NKS-004
- **N**ew **K**uraray **S**ingle clad fiber **-004**
- Single clad attenuation lengths ranged from 430 - 490 cm
- ~3.0% error (LED fluctuations dominate)



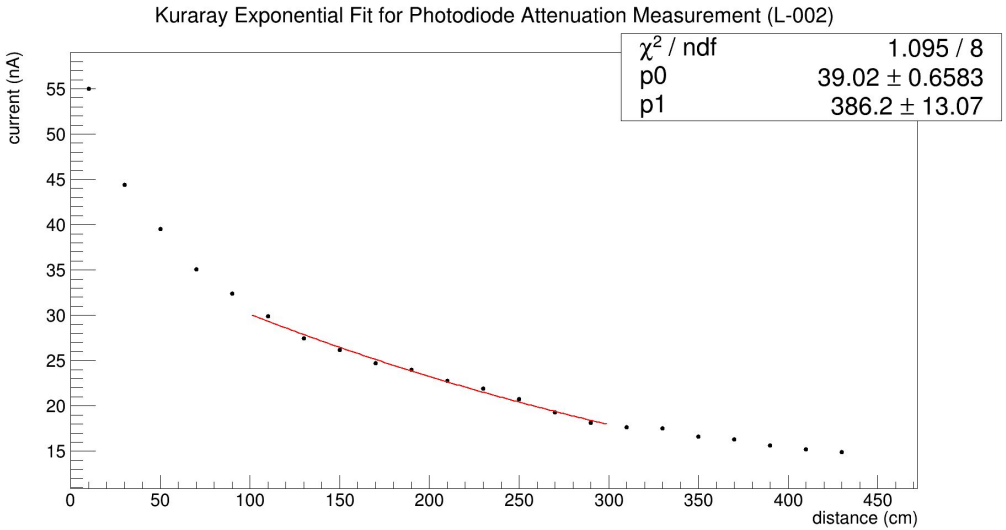
Attenuation Length Results - Kuraray Double Clad Fibers

- NKD-004
- **N**ew **K**uraray **D**ouble clad fiber **-004**
- Double clad attenuation lengths ranged from 500 - 620 cm
- ~3.0% error (LED fluctuations dominate)



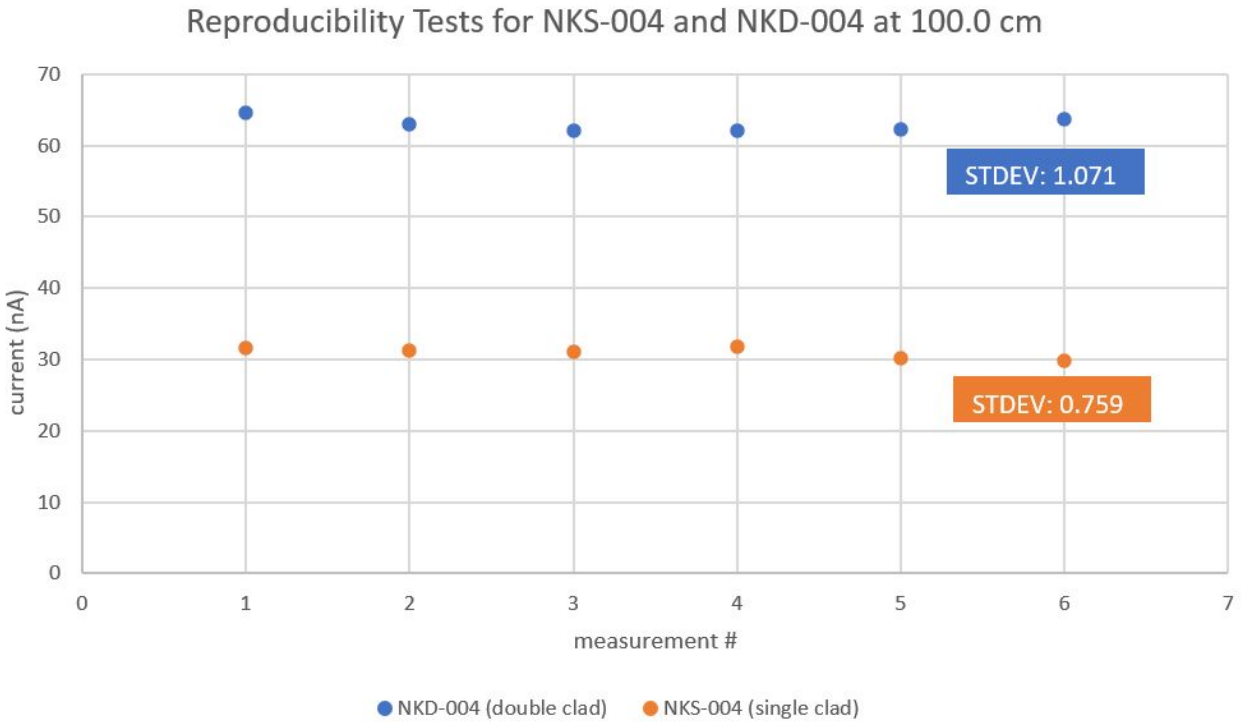
Attenuation Length Results - Luxium Fibers

- L-002
- **L**uxium fiber **-002**
- Attenuation lengths ranged from 375 - 440 cm
- ~3.0% error (LED fluctuations dominate)



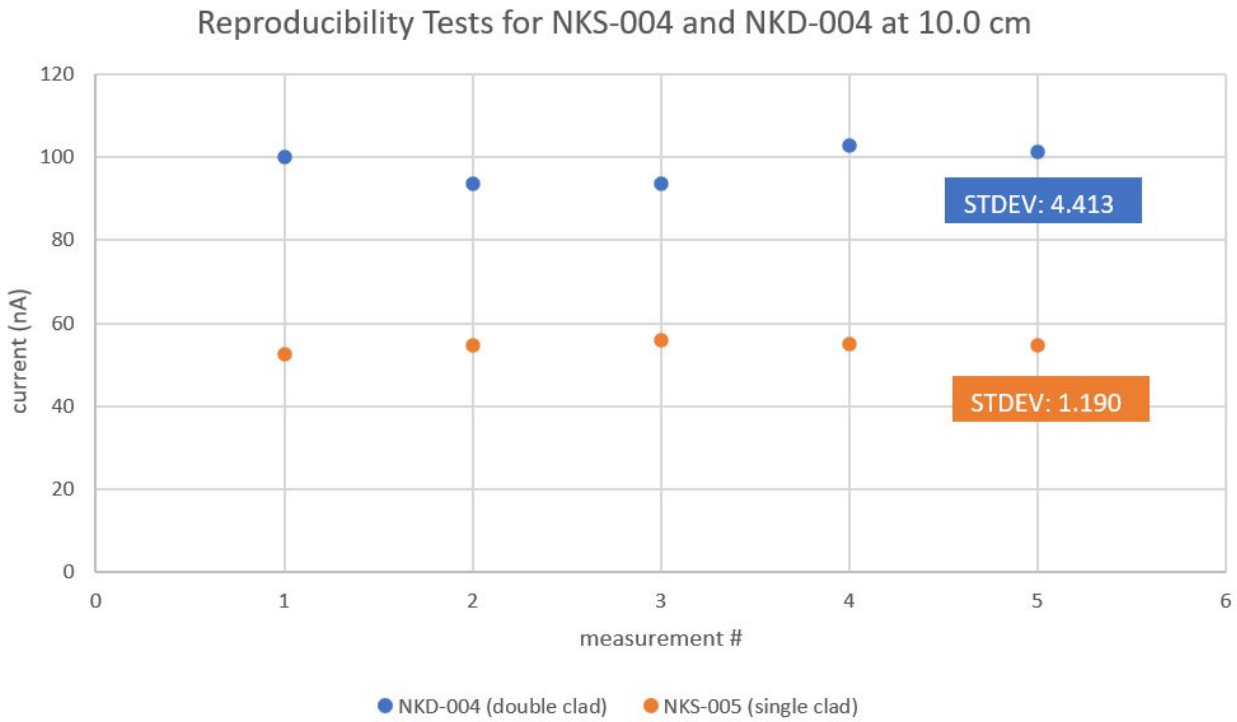
Reproducibility Tests - 100.0 cm

- 6 measurements @ 100.0 cm on NKS-004 and NKD-004
- Photodiode moved away from fiber and repositioned



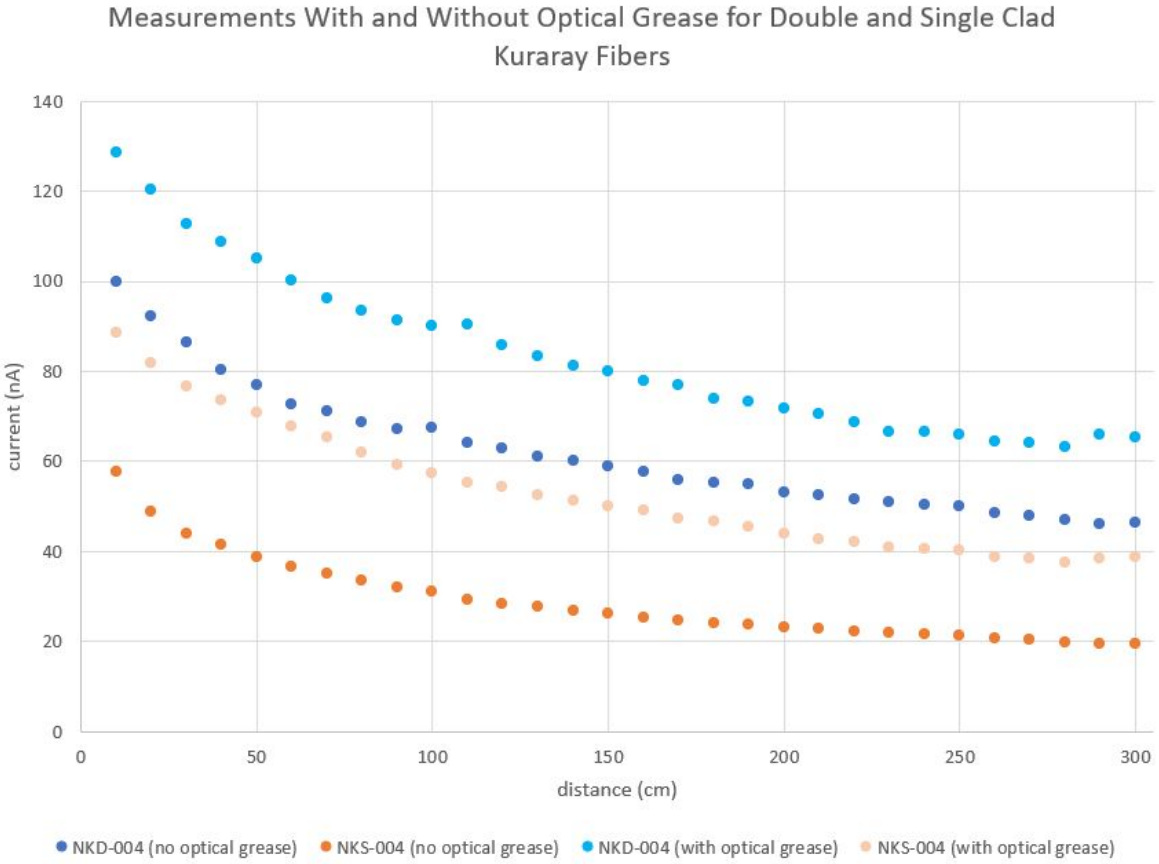
Reproducibility Tests - 10.0 cm

- 5 measurements @ 10.0 cm on NKS-005 and NKD-004
- Fiber moved away from photodiode and repositioned
- Less consistent at closer distance for both fibers



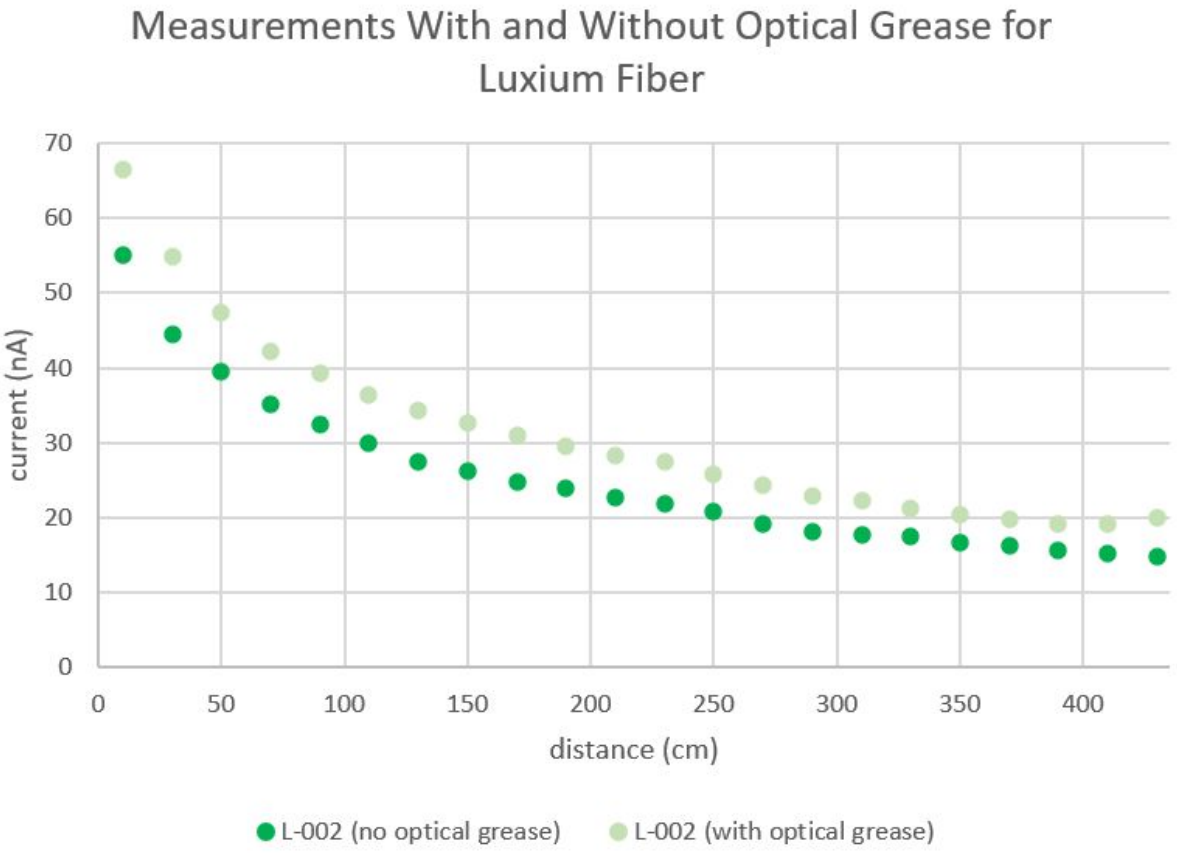
Optical Grease - Kuraray Fibers

- Coupled fiber to screen of photodiode with optical grease
- Increase in current readings
- Some fluctuations in attenuation length (<5%)



Optical Grease - Luxium Fibers

- Coupled fiber to screen of photodiode with optical grease
- Increase in current readings
- Some fluctuations in attenuation length (~5%)

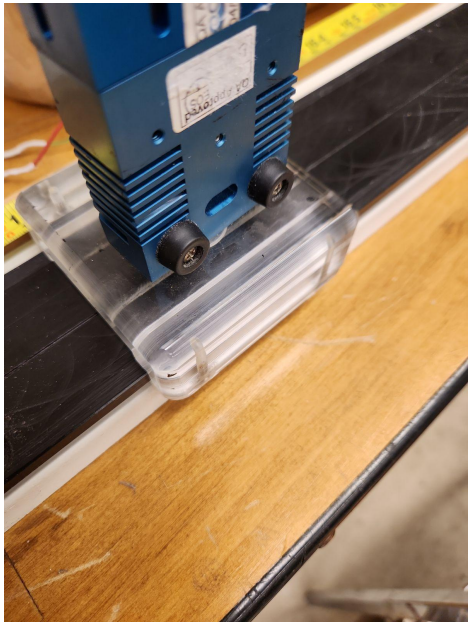


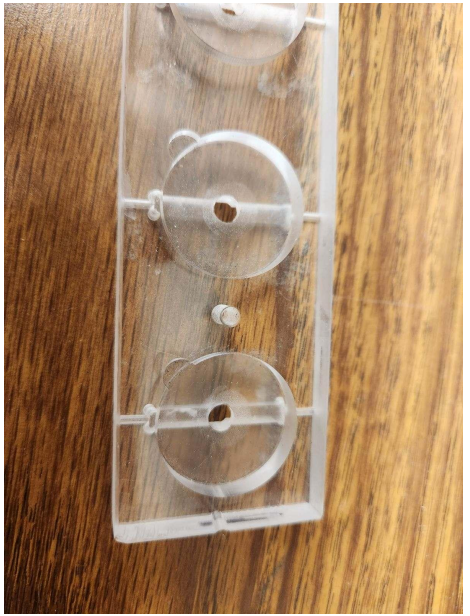
Issues

- Upwards “bump” at 300.0 cm distance on all Kuraray fiber measurements
  - End of fiber?
  - Fiber coming loose in grove?
- Inconsistent measurements closer to photodiode
  - LED pulses?
  - Light reflecting from photodiode screen, LED
  - Covered photodiode, and constructed screen around LED
  - Future measurement: recoupling near photodiode with optical grease

Npe Station

- Use photodiode puck board and runner in coffin, with modifications
- Easy positioning and moving ^{90}Sr
- Machined ^{90}Sr holder to be mounted on LED runner
- Measurements will start this week





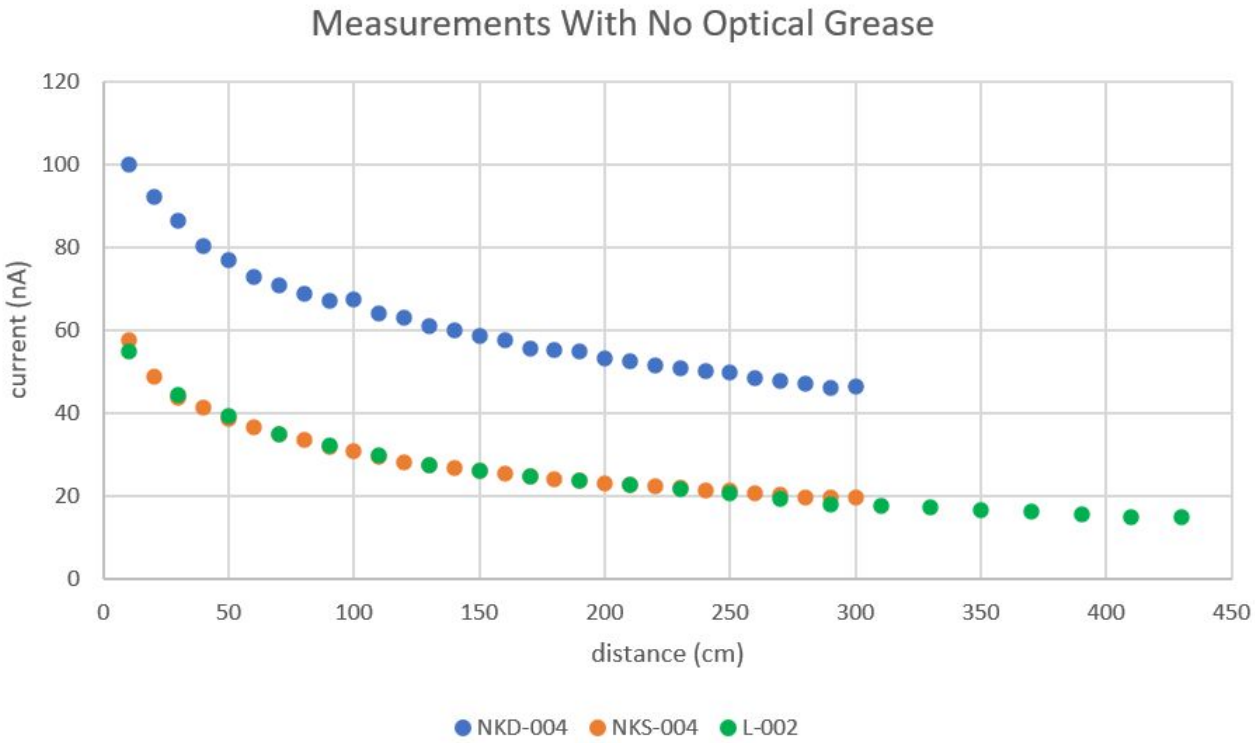
Next Steps

- Finish optical grease measurements; digest results
- Start Npe measurements (SiPM-PMT coinc) this week with SiPM setup
  - Develop fitting method; ^{90}Sr dE/dx modelled
  - Extract attenuation length from Npe station
  - Attempt absolute light output extraction (Npe)
- Technical report will be written, next week

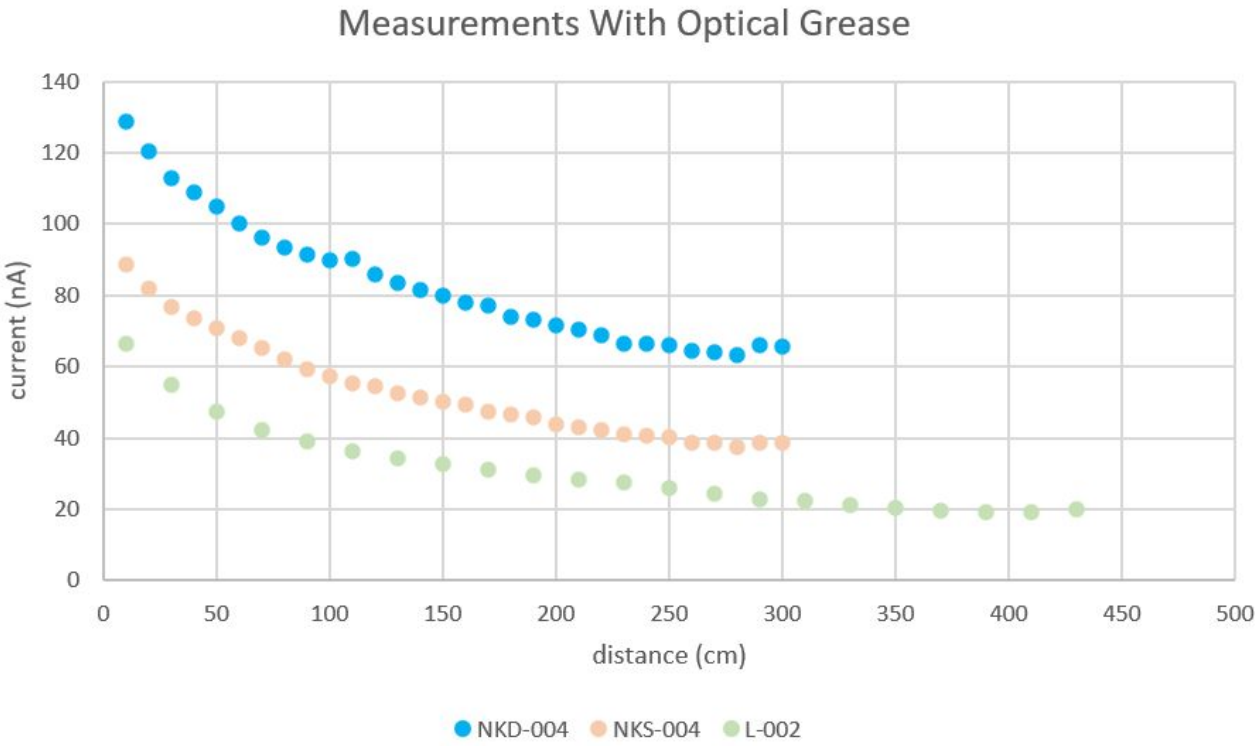
Additional Slides (Added After Meeting)

Additional Comparisons of Different Fibers

No Optical Grease



With Optical Grease

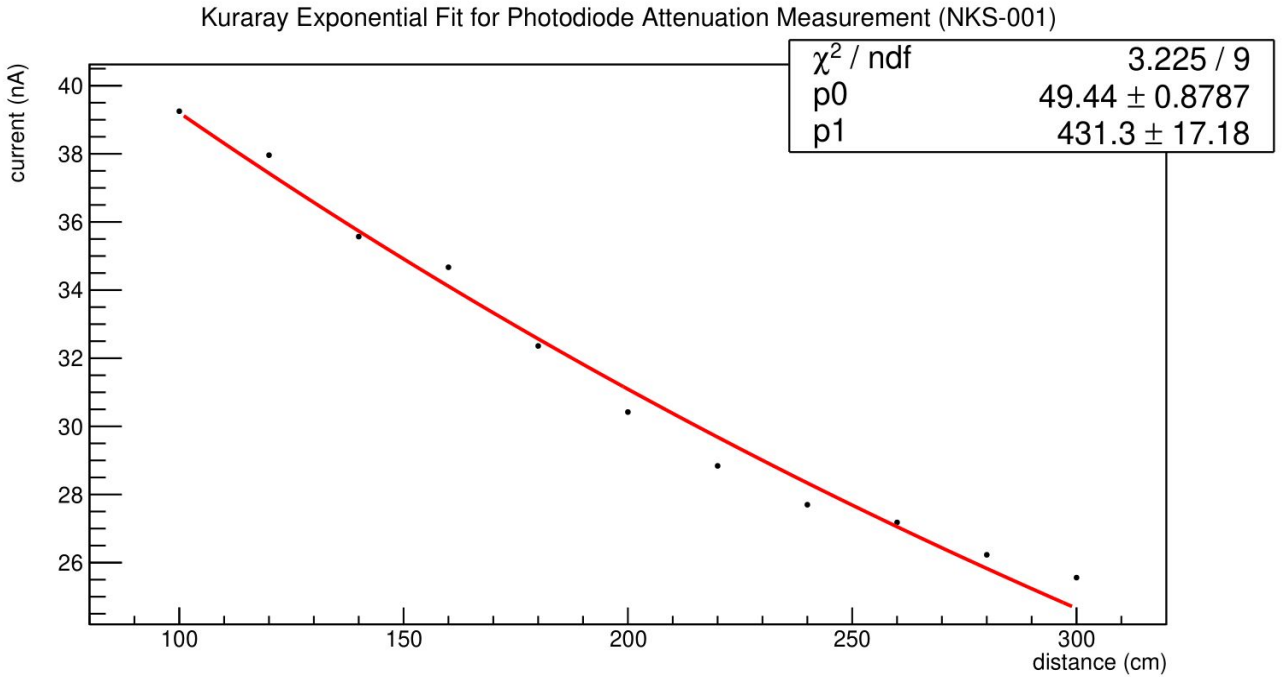


Results from Measurements of other Fibers

NKS-001

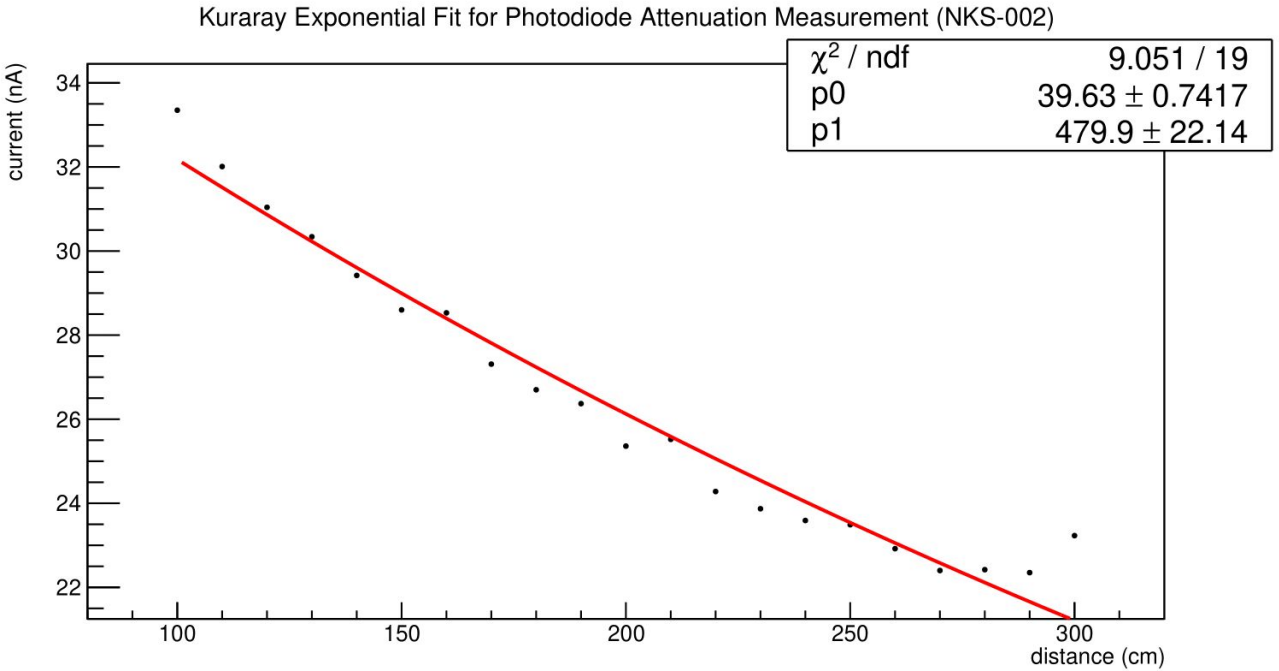
**Different measuring increments used for initial measurements (NKS-001 and NKD-001)

No measurement with optical grease taken



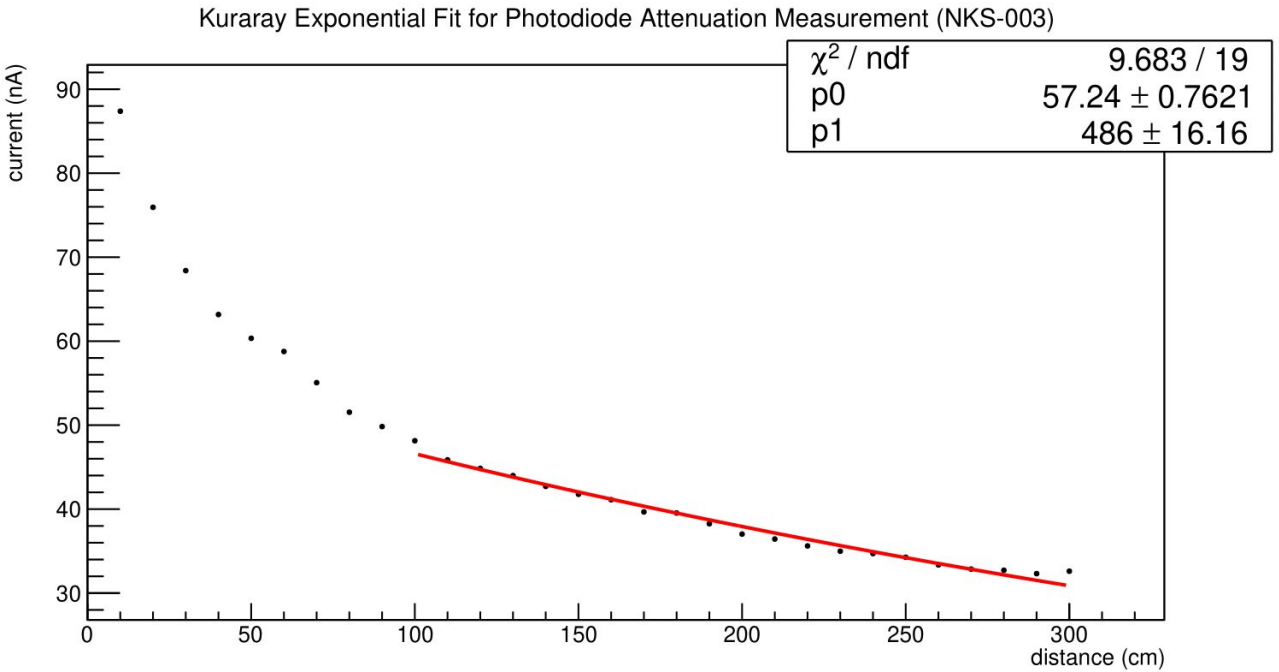
NKS-002

No measurement with optical grease taken



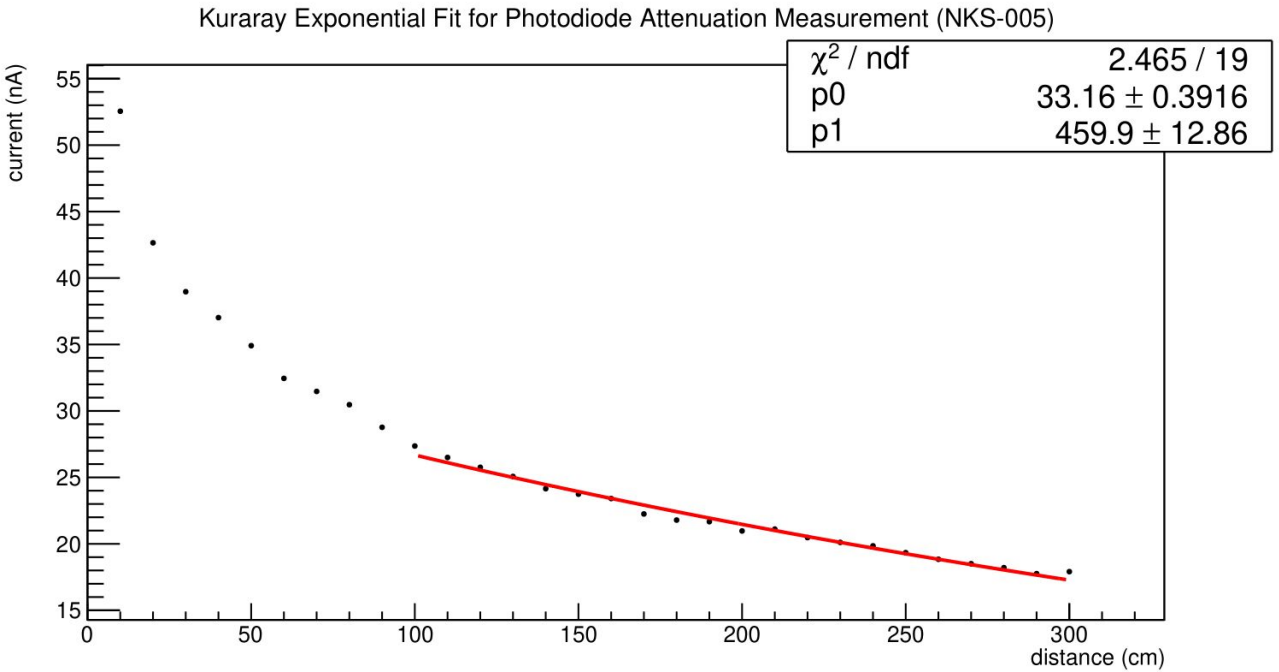
NKS-003

No measurement with optical grease taken



NKS-005

No measurement with optical grease taken

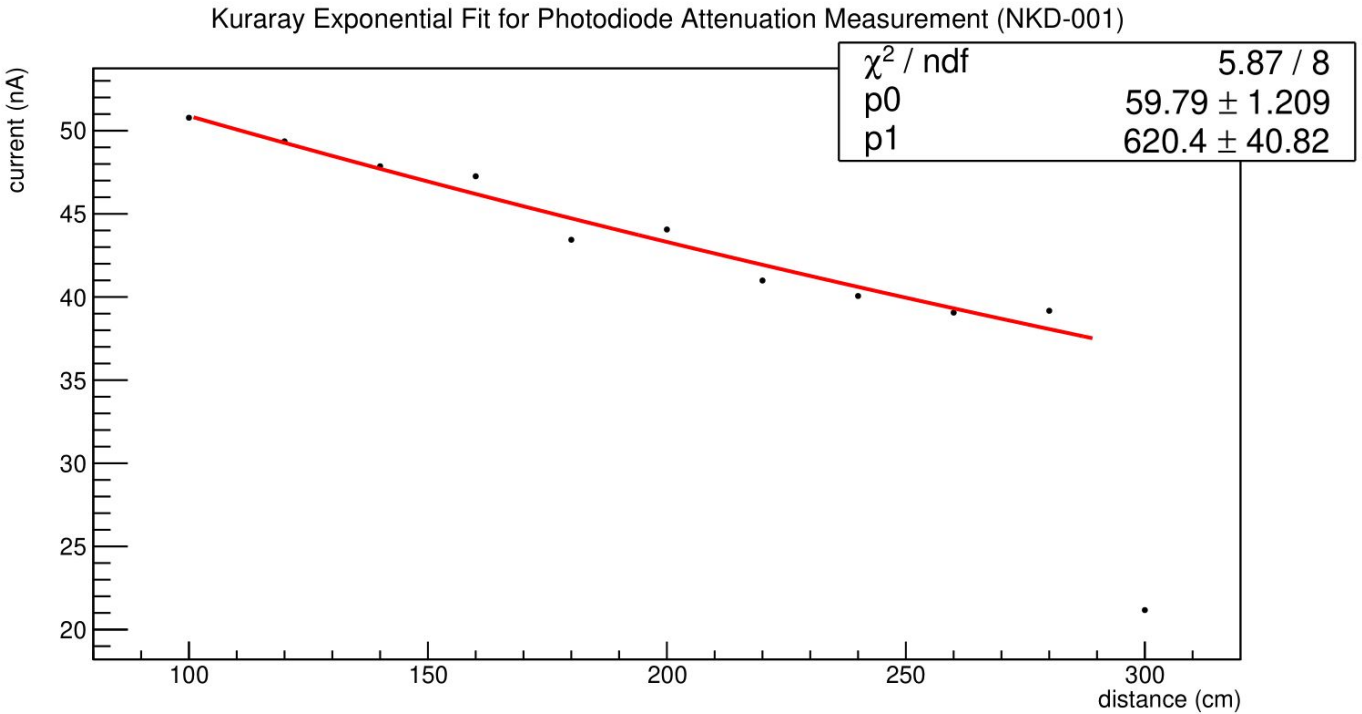


NKD-001

**Different measuring increments used for initial measurements (NKS-001 and NKD-001)

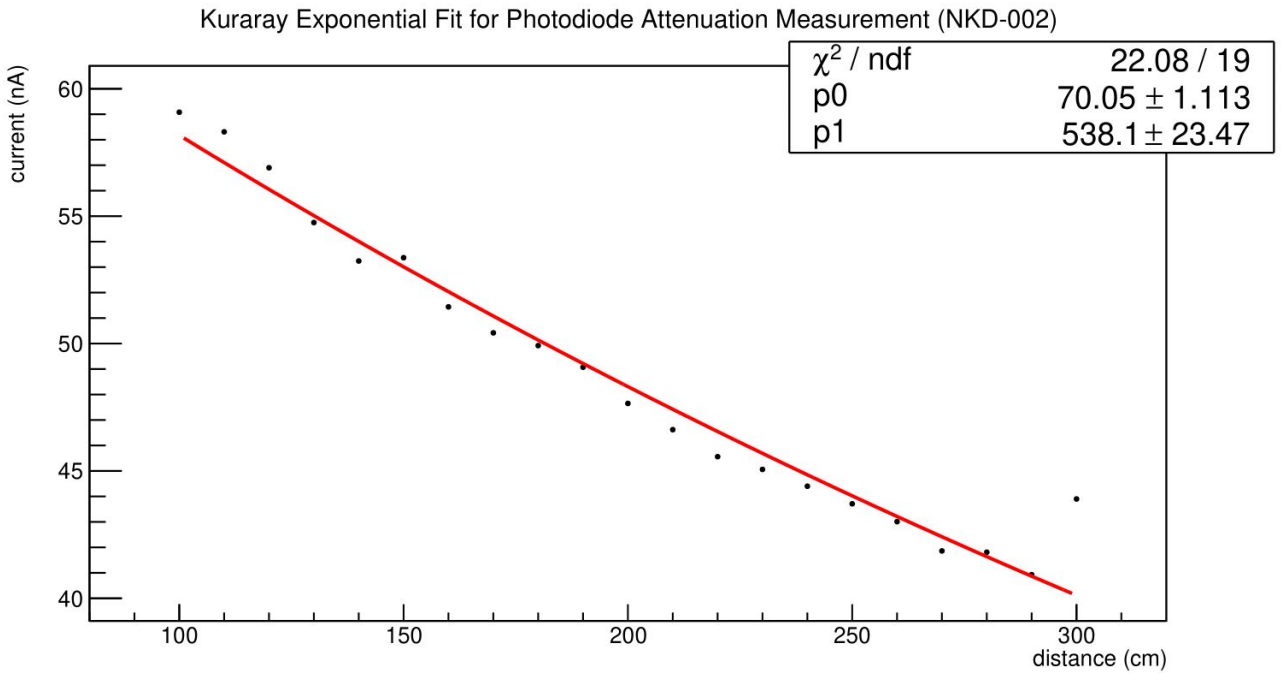
No measurement with optical grease taken

(The results for this measurement were poor; added for completeness)



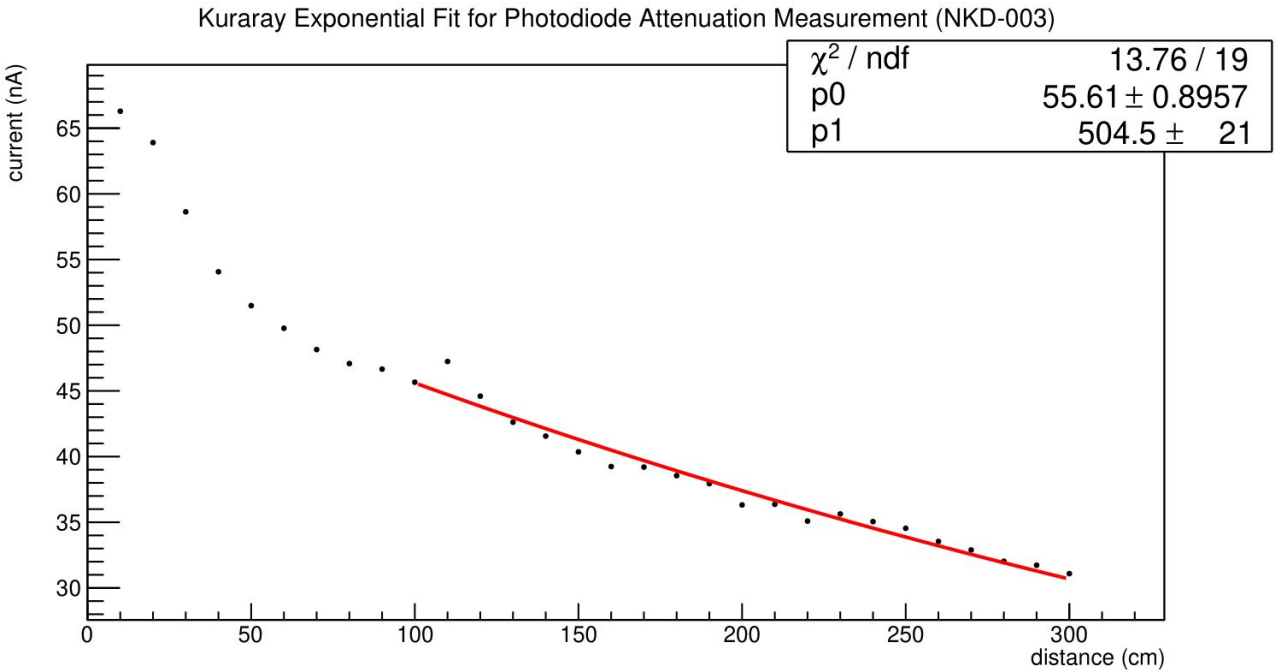
NKD-002

No measurement with optical grease taken



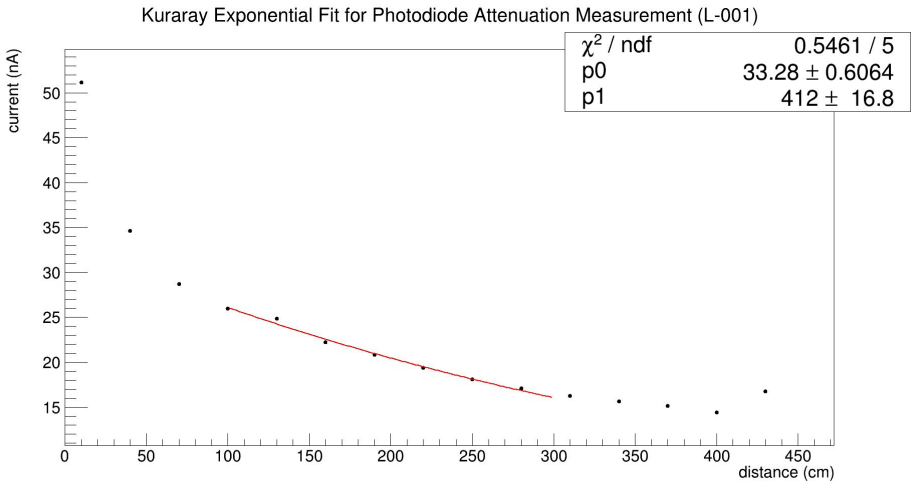
NKD-003

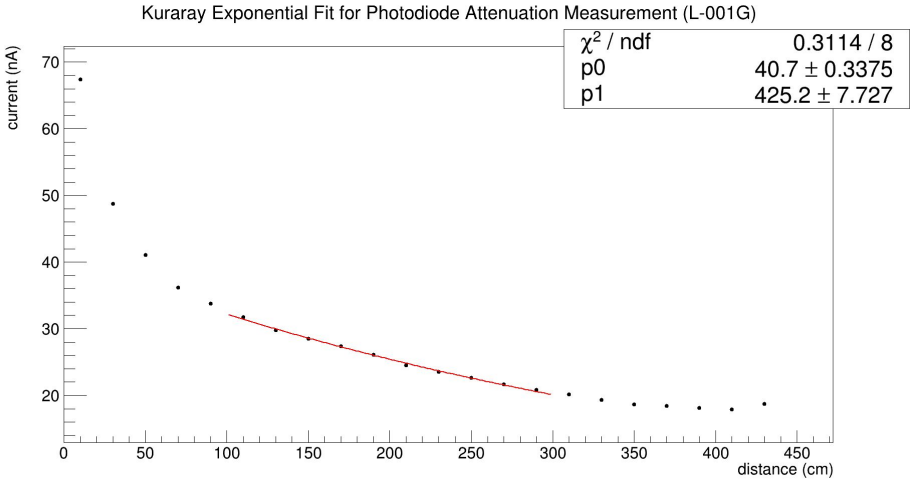
No measurement with optical grease taken



L-001

Without optical grease

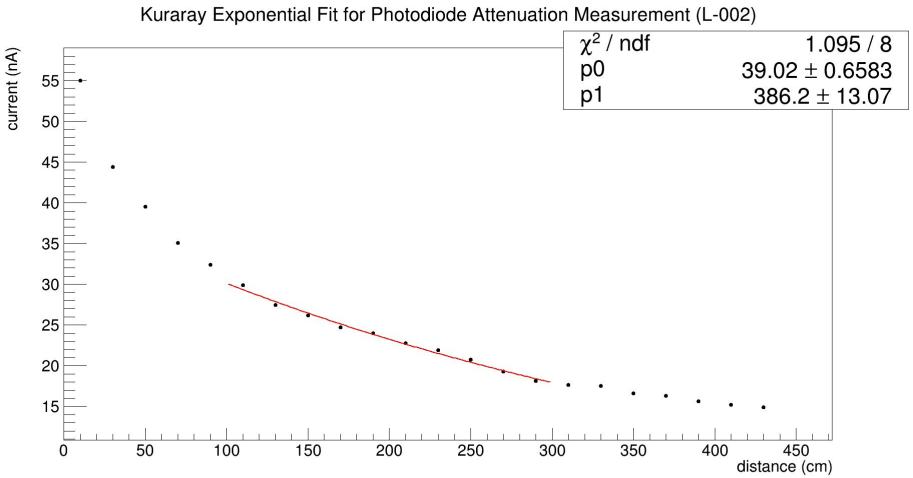


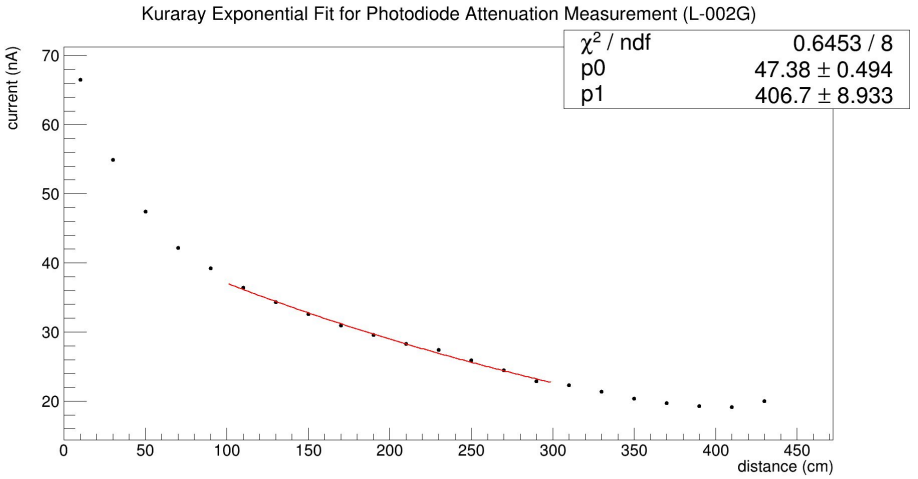


With optical grease

L-002

Without optical grease

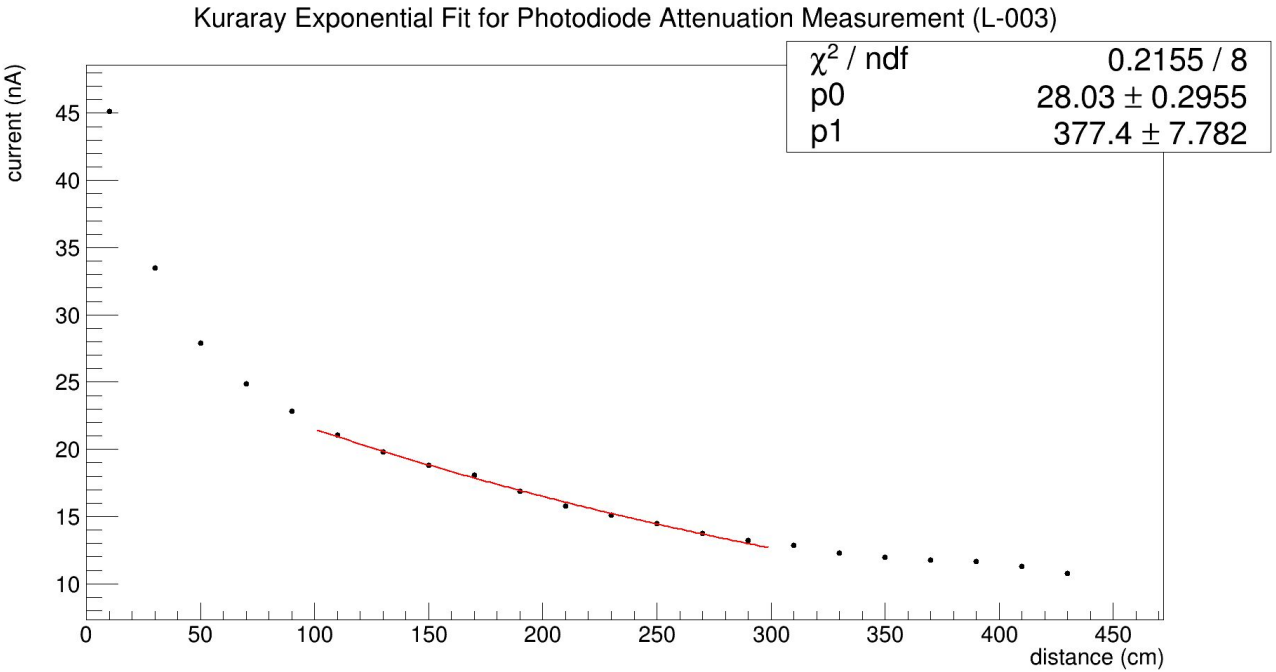




With optical grease

L-003

No measurement with optical grease taken



L-005

No measurement with optical grease taken