

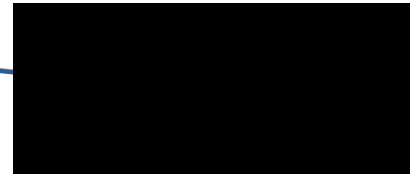
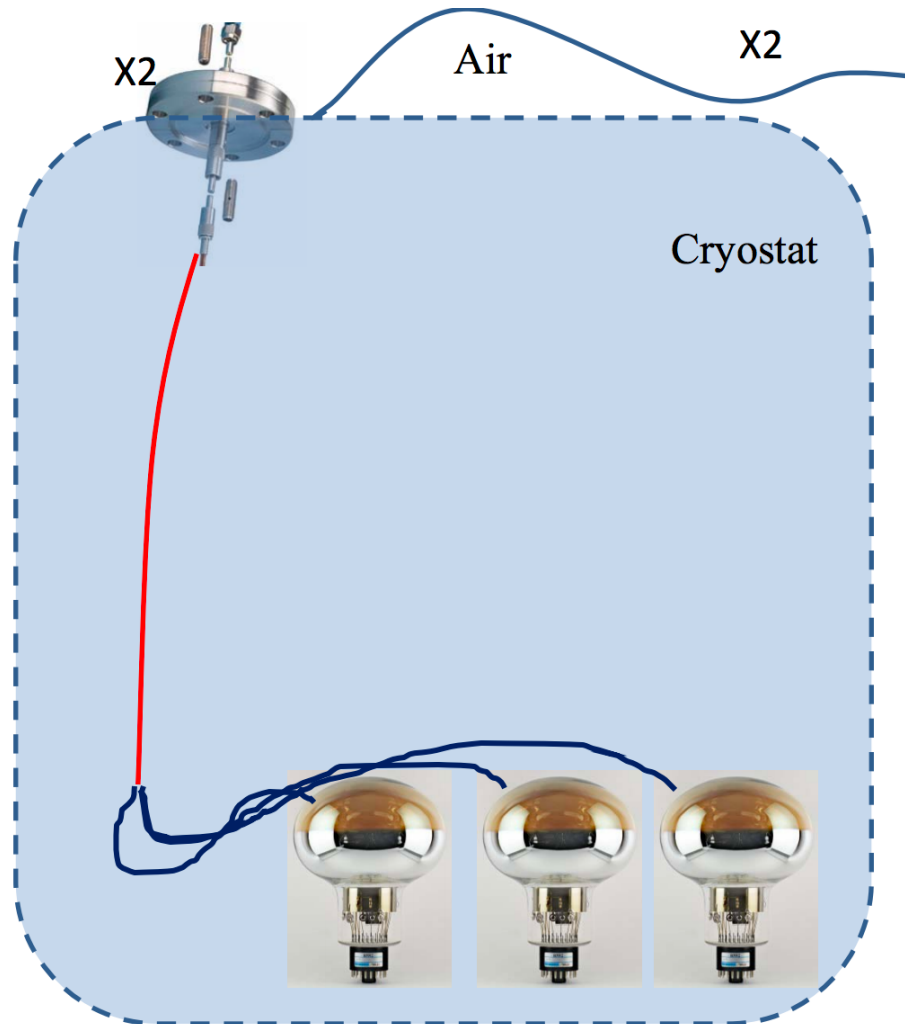
# Status of the light calibration system

Enrique Calvo, Clara Cuesta, Ana Gallego,  
Inés Gil-Botella, Sergio Jimenez

CIEMAT

July 17<sup>th</sup> 2017

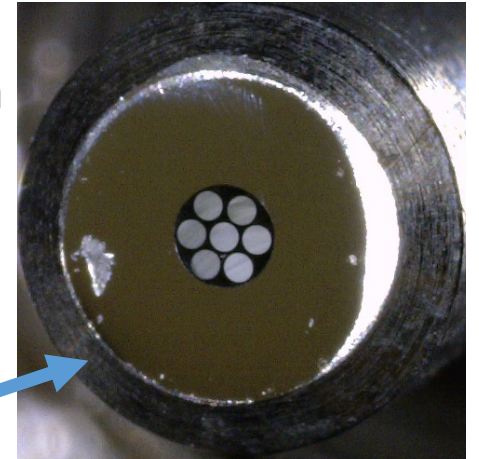
# Design



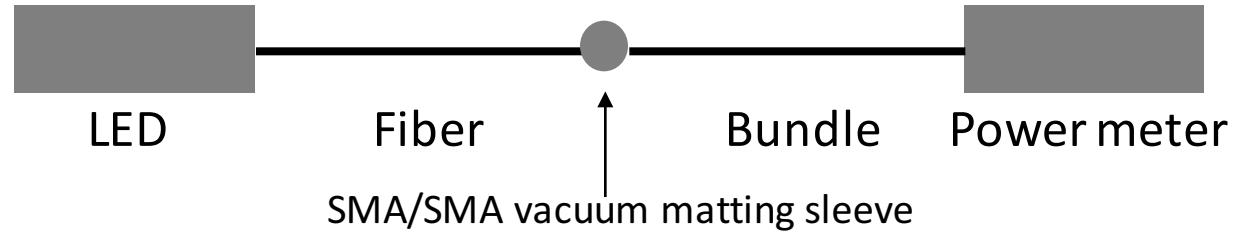
Black box  
(described by Thorsten Lux  
at previous meeting)

Inside the cryostat (6x):

- Flange: SMA (female ft) from Allectra
- **Fiber:** FT800UMT from Thorlabs  
22.5 m long, 800  $\mu\text{m}$  diameter  
Jacket FT05SS (Stainless steel tubing)  
SMA connectors
- **Bundle:** FG200UEA from Thorlabs  
1x7 fanout bundle  
2.5 m long, 200  $\mu\text{m}$  diameter (individual fibers)  
Common end: 25 m FT061PS (Stainless steel tubing)  
Split ends: 2.25 m FT030  
SMA connectors



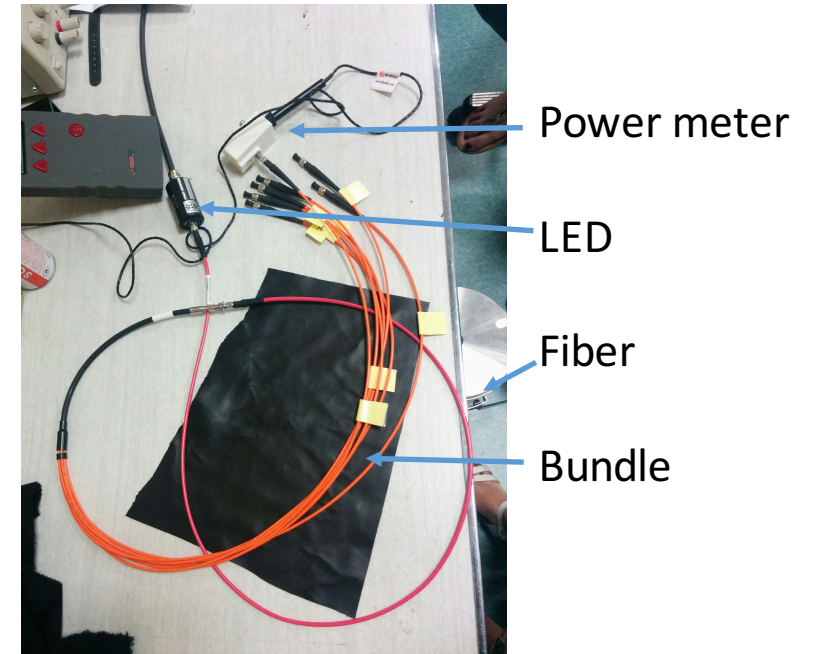
# Fiber + Bundle testing



- Fiber:
  1. FT600UMT from Thorlabs (1 m long, 600  $\mu\text{m}$  diameter)
  2. FT800UMT from Thorlabs (1 m long, 800  $\mu\text{m}$  diameter)
- Bundle: FG200UEA from Thorlabs  
1x7 fanout bundle  
1 m long, 200  $\mu\text{m}$  diameter (individual fibers)

(Same as final design, but shorter length)

Tests at RT and in  $\text{LN}_2$

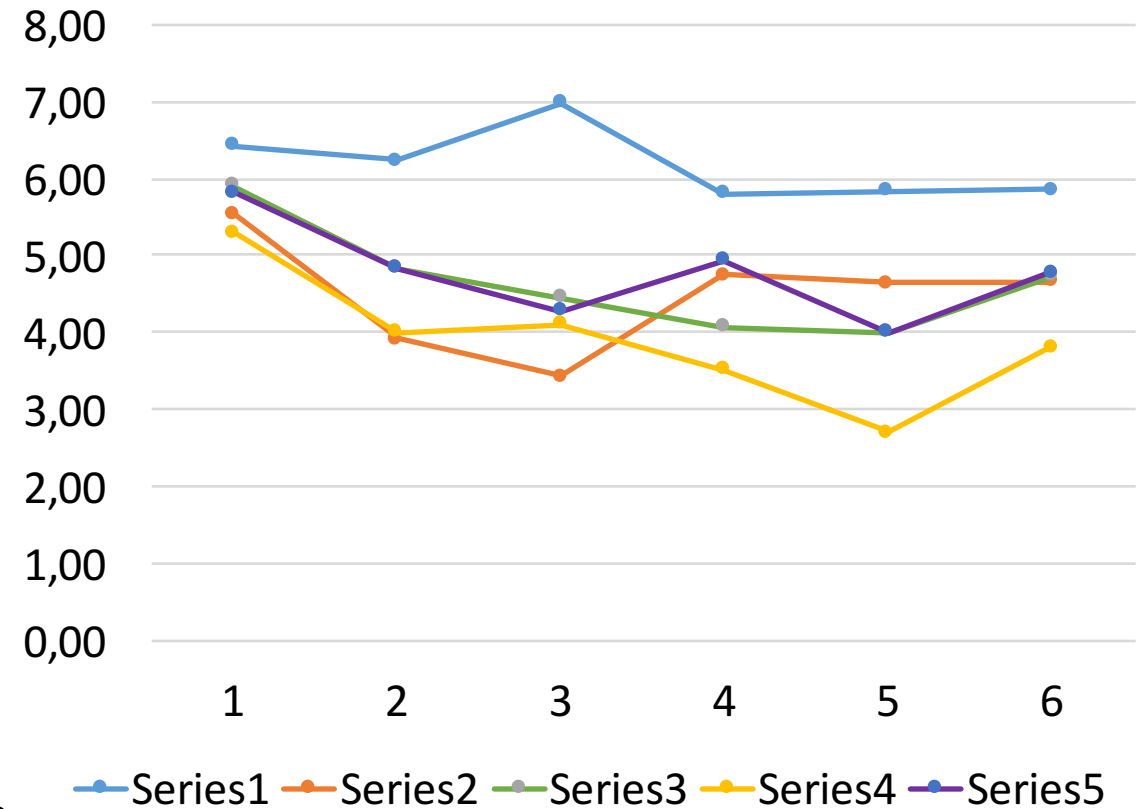


# 600-um fiber + Bundle

1. LED + bundle + PM (on the table) @ RT  
→  $(6.15 \pm 0.40)$  nW
2. LED + fiber + bundle + PM (table) @ RT  
→  $(4.37 \pm 0.69)$  nW
3. LED + fiber + bundle + PM (vessel) @ RT  
→  $(4.55 \pm 0.64)$  nW
4. LED + fiber + bundle + PM (vessel) @ CT  
→  $(3.90 \pm 0.72)$  nW
5. LED + fiber + bundle + PM (vessel) @ RT  
→  $(4.61 \pm 0.67)$  nW

2, 3 and 5 are equivalent measurements

30% light loss with 600-um fiber & matting sleeve  
15% additional light loss at RT



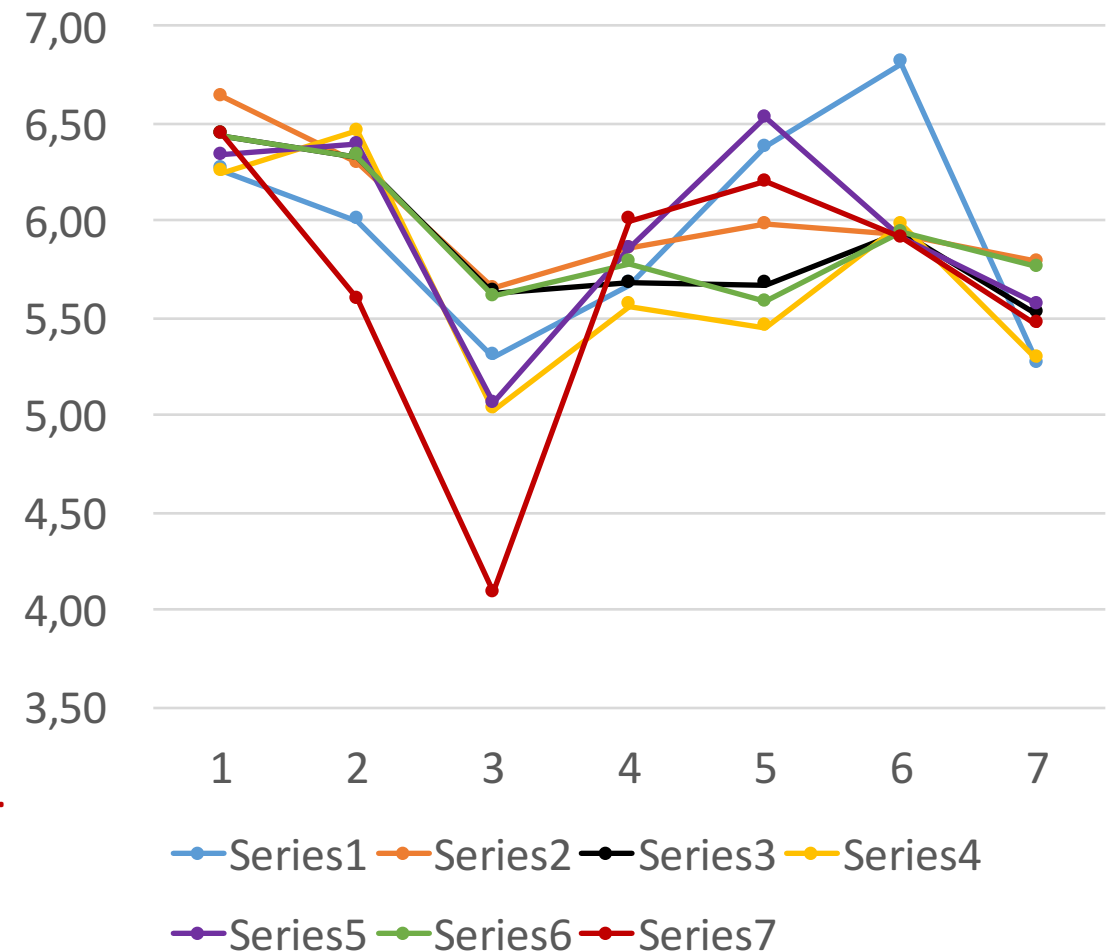
# 800-um fiber + Bundle testing

1. LED + bundle + PM (on the table) @ RT  
→  $(5.96 \pm 0.53)$  nW
2. LED + fiber + bundle + PM (table) @ RT  
→  $(6.02 \pm 0.31)$  nW
3. LED + fiber + bundle + PM (vessel) @ RT  
→  $(5.89 \pm 0.34)$  nW
4. LED + fiber + bundle + PM (vessel) @ CT  
→  $(5.72 \pm 0.49)$  nW
5. LED + fiber + bundle + PM (vessel) @ CT 1h  
→  $(5.95 \pm 0.48)$  nW
6. LED + fiber + bundle + PM (vessel) @ RT  
→  $(5.92 \pm 0.32)$  nW
7. LED + fiber + bundle + PM (vessel) @ RT after PMT meas.  
→  $(5.67 \pm 0.72)$  nW

2, 3, 6, and 7 are equivalent measurements

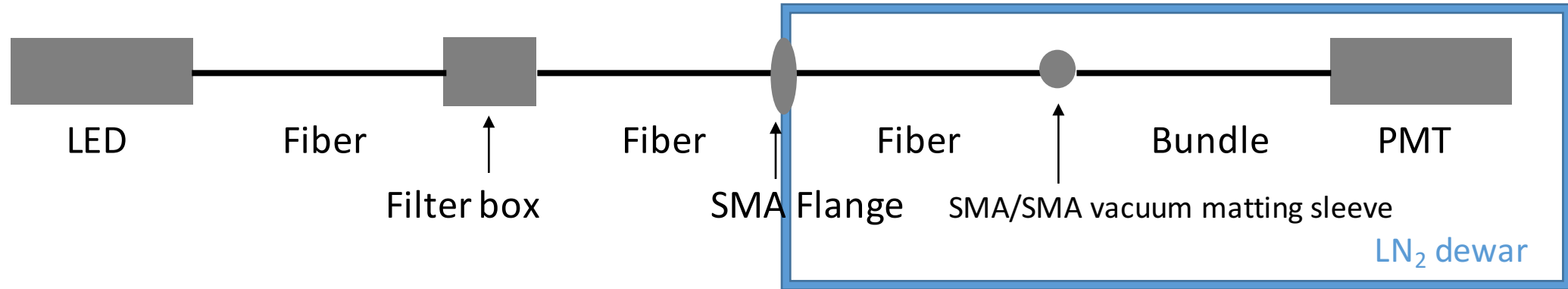
No light loss with 800-um fiber & matting sleeve.

More light output with central fiber



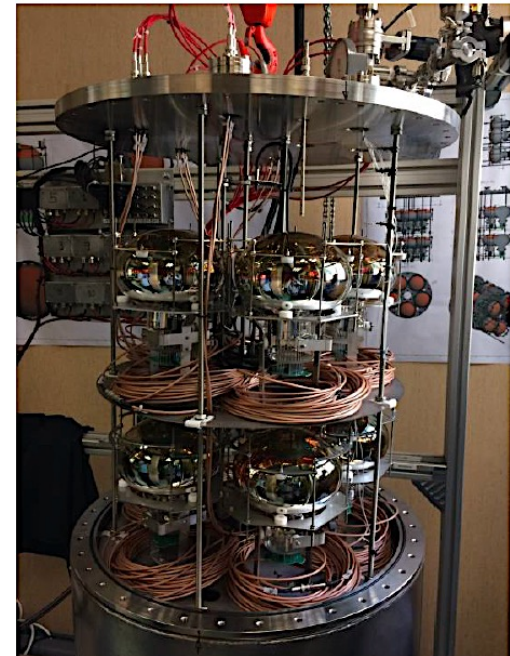
800-um fiber + Bundle selected for final design

# 800-um fiber + Bundle testing



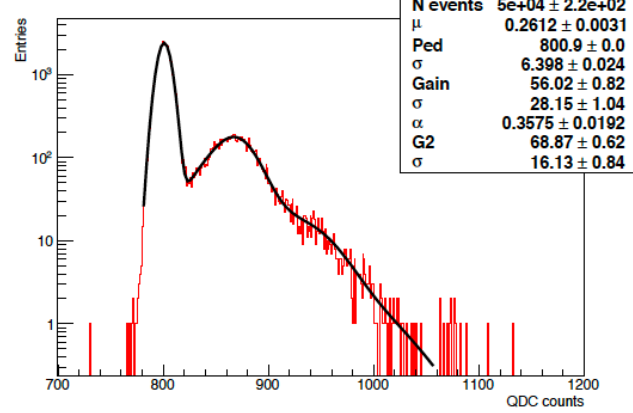
- Fiber: FT800UMT from Thorlabs  
1 m long, 800  $\mu\text{m}$  diameter
- Bundle: FG200UEA from Thorlabs  
1x7 fanout bundle  
1 m long, 200  $\mu\text{m}$  diameter (individual fibers)

(Same as final design, but shorter length)

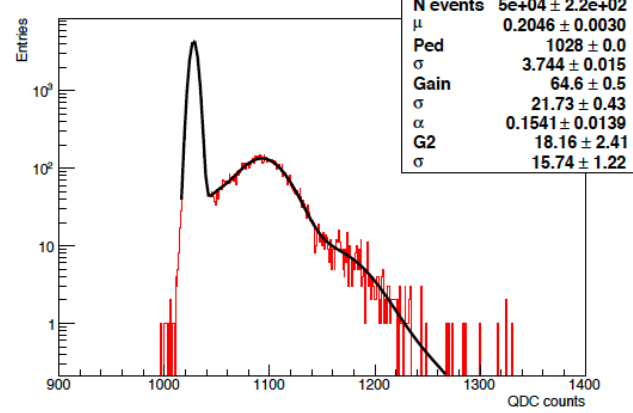


# 800-um fiber + Bundle testing

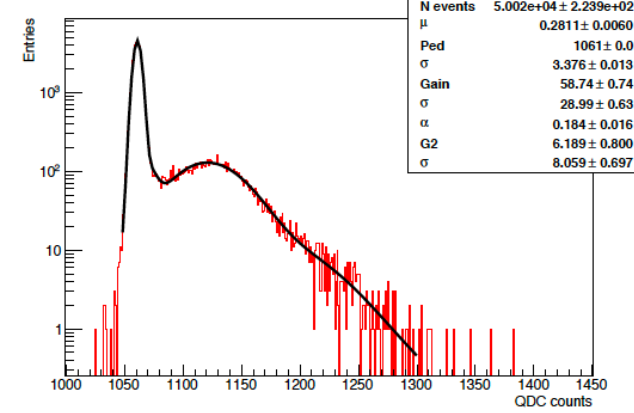
PMT 1 (FA0120). F20, 1317V (HR)



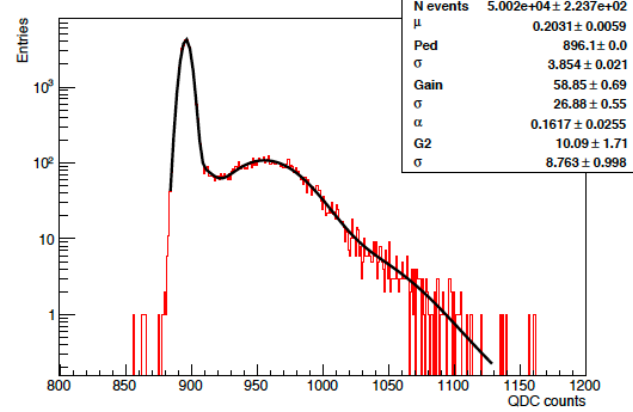
PMT 2 (FA0105). F20, 1409V (HR)



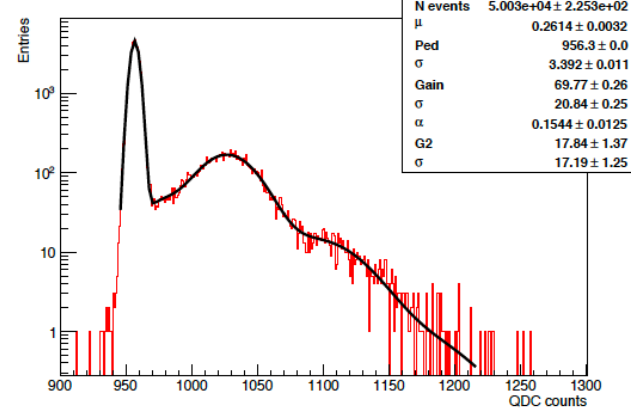
PMT 3 (FA0112). F20, 1286V (HR)



PMT 4 (FA0107). F20, 1320V (HR)



PMT 5 (FA0104). F20, 1264V (HR)



- SPE observed by all PMTs
- $10^7$  gain as expected
- Light linearity under study

# Conclusions

- 800-um fiber + 1x7 bundle tested successfully
  - Tests with LED and power meter → no light loss
  - Tests with PMTs in LN<sub>2</sub> → good SPE response
- 800-um fiber + 1x7 bundle selected for final design
  - No light loss due to connection
  - Considerable money saving than only 1x7 bundle
- A fiber and bundle with final length ordered, testing in August