Tagger Microscope Fiber Upgrade Results

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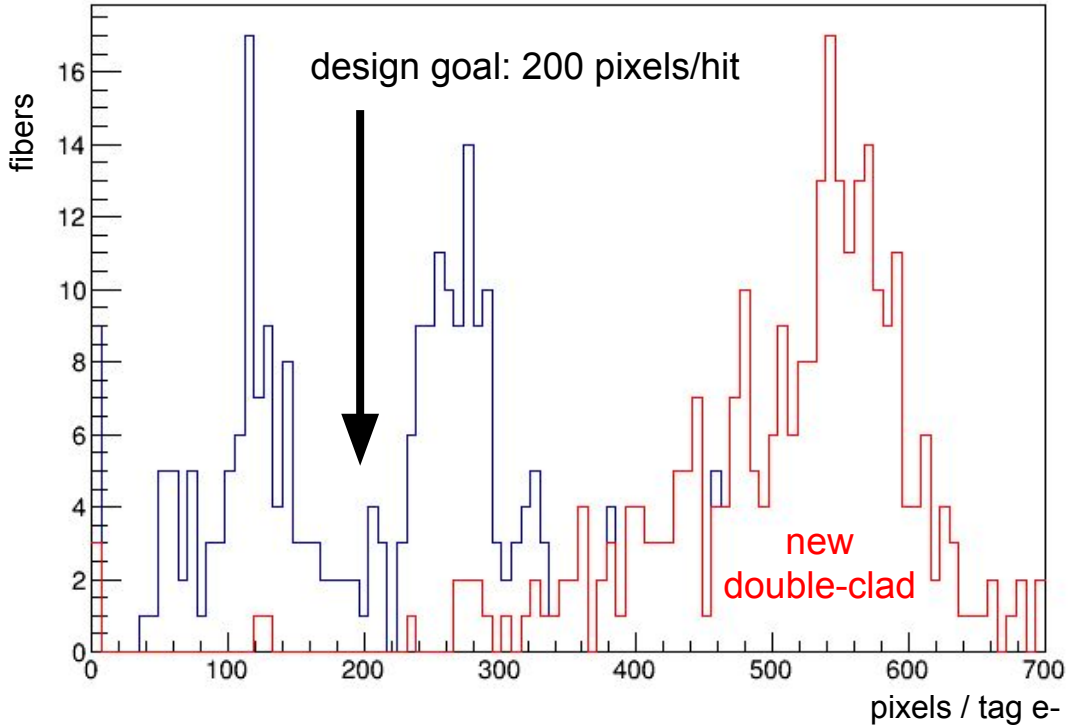
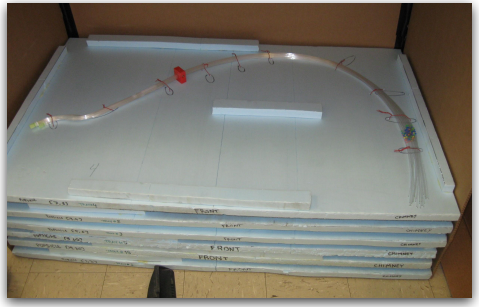
Tagger microscope upgrade

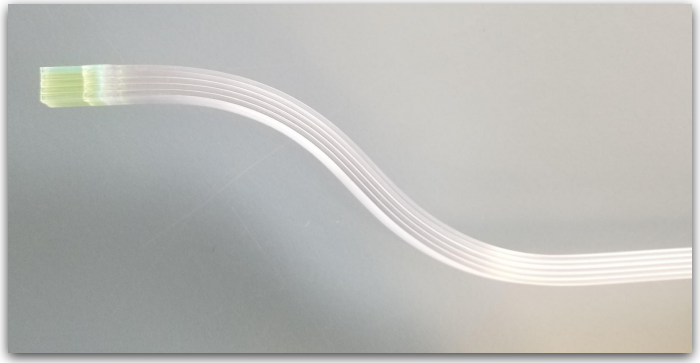
- Very large variation is seen in the transmission of the light guide fibers from St Gobain.
- Original production: some of the fibers met the design goal for light yield, *most did not.*
- *Numerous improvements in fab procedures has increased the average yield by factor ~3*

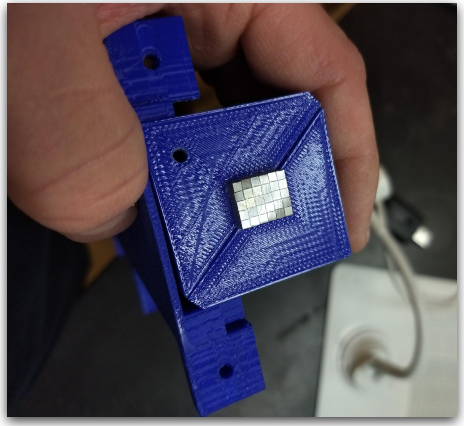
- *300 of 510 fibers were replaced in 1-2017*
- *remaining 7 replacement bundles are now complete*



Tagger microscope upgrade

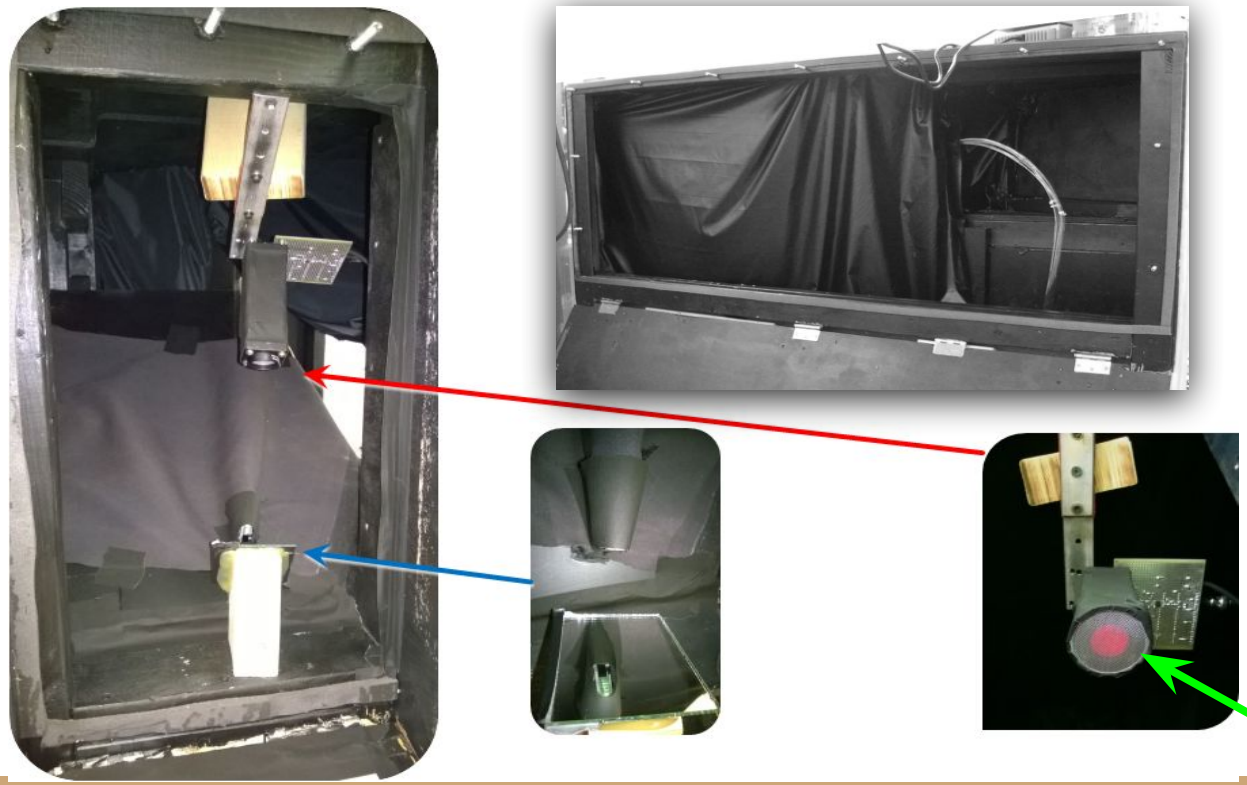






- Seven new fiber bundles produced (30 fibers per bundle)
  - Cut to length & polished ends (top left picture)
  - Fused SciFi to light guides
  - Light yield test (*Darkbox testing*)
  - Bent fiber bundle (top center picture)
  - Light yield test (*Darkbox testing*)
  - Packed for shipment to JLab (top right picture)
- Seven old bundles removed from the TAGM were tested for light yield (Darkbox)

Tagger microscope upgrade



Tests Performed

- After fusing SciFi
- After Bending

Additional Tests

- All 10 bundles removed from TAGM
- Normalization tests (*in progress*)

Additional filter added

(New fibers were so much better)

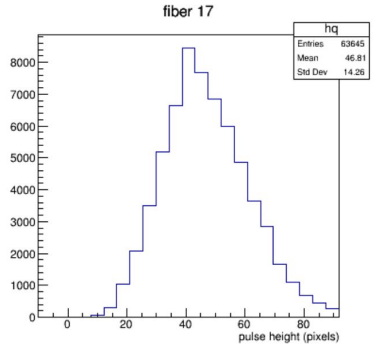
TAGM dark-box tests

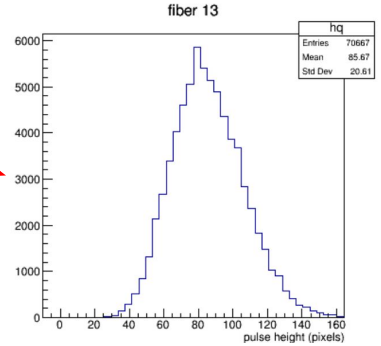
Bundles that have seen beam: (*Single-clad fibers*)

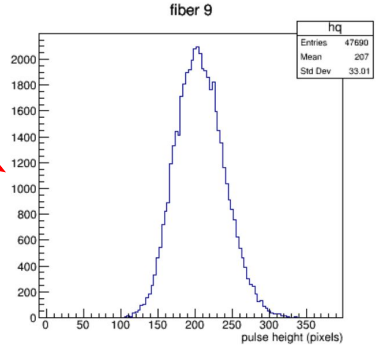
- Average of the six painted bundles ..... 41.0 pixels
- Average of the four unpainted bundles ... 81.0 pixels

New bundles ready for installation: *(Multi-clad fibers)*

- Average of the seven new bundles ..... **206.5 pixels**







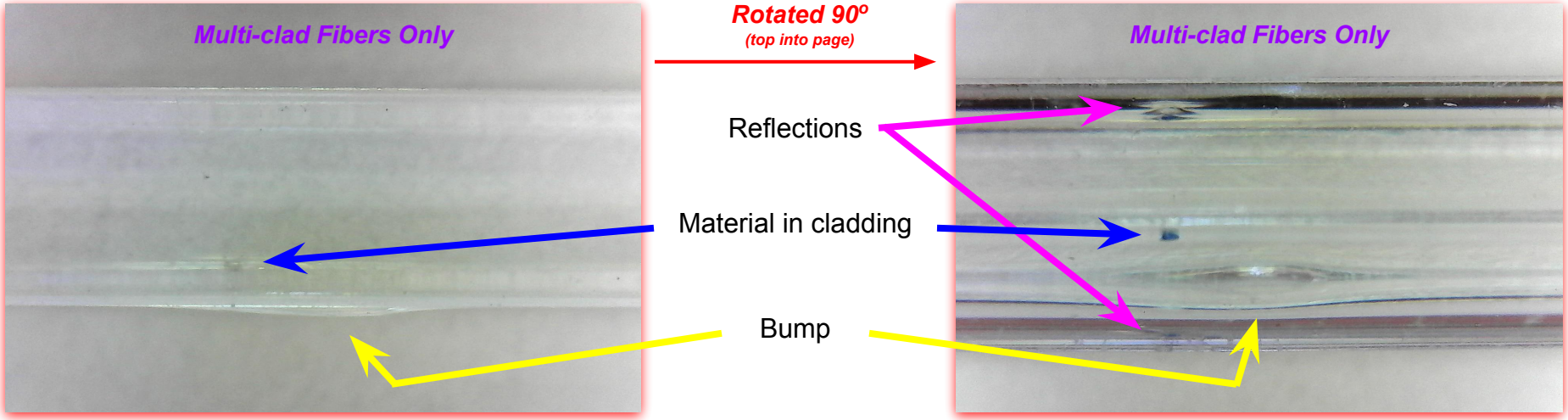
* Individual fiber outputs were averaged over the bundles specified above

TAGM dark-box tests

- What accounts for the low-yield tail on the upgraded fibers?
  - Material imbedded in the cladding

TAGM dark-box tests

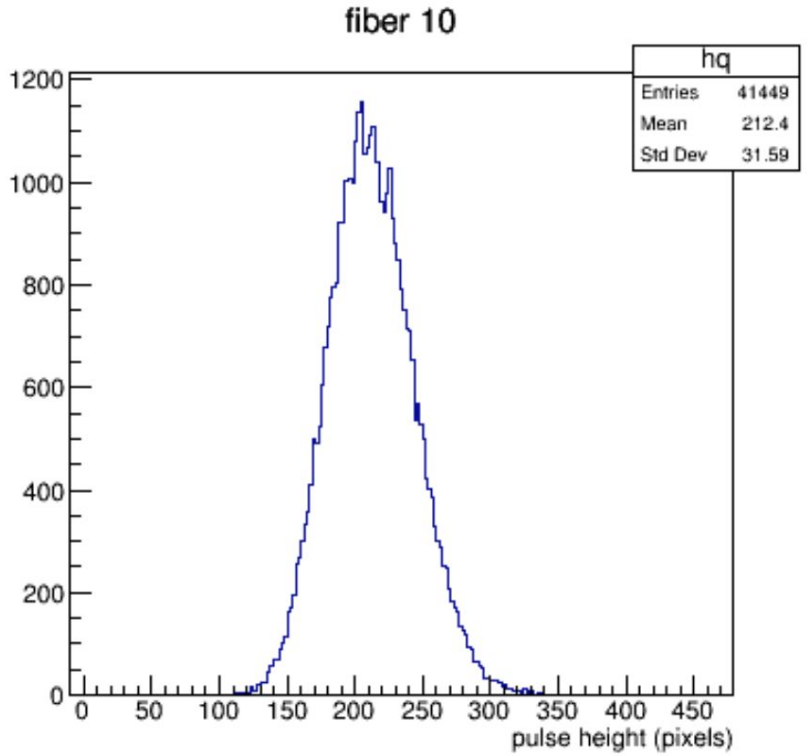
- What accounts for the low-yield tail on the upgraded fibers?
  - Other defects in the cladding

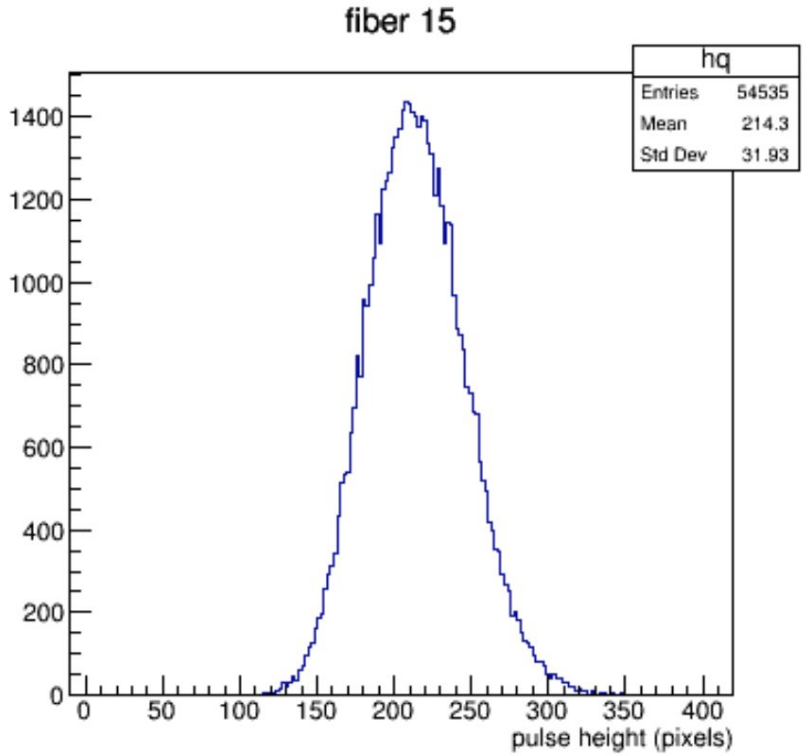


Tagger microscope upgrade

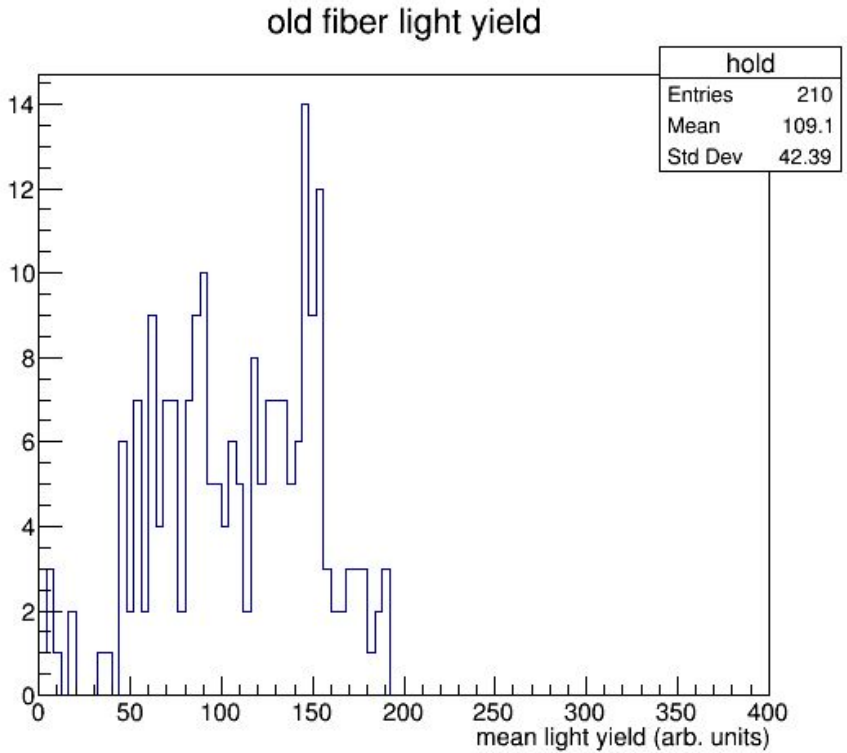
- Reasons for this large improvement factor
  - Multi-clad fibers
    - Less leaky modes
  - Use of a Hot-air Bending Unit
    - No thermal shock, releases internal stresses, & no exposure to hot water → No crazing or chance for fiber kinking
  - Better fusing of SciFi / light guide joint
    - Under a microscope we could not see the boundary between fibers when we fused two light guides together
    - Most fuses had no visible gap between the mating claddings
  - Better polishing technique → No rounding of the fiber ends
    - Motor operated wheel with a 3D printed jig for consistent alignment
  - New fusing ferrules have a slightly larger internal chamber, ↑ cross section

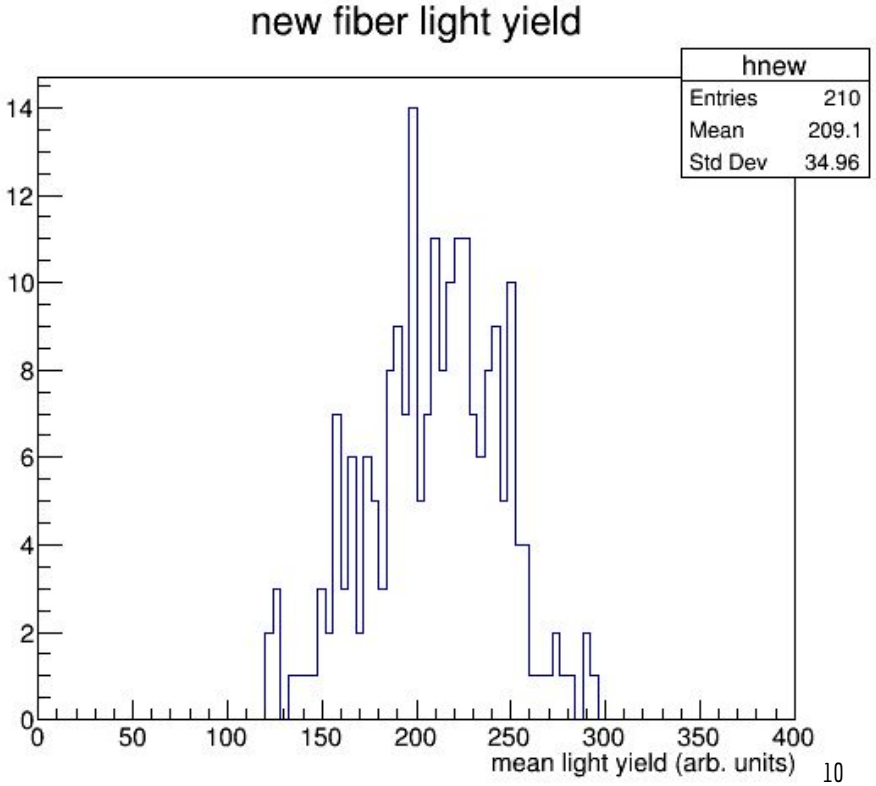
Two Best Pulled Fibers - Old Bundle 4





Summary comparison: old vs new

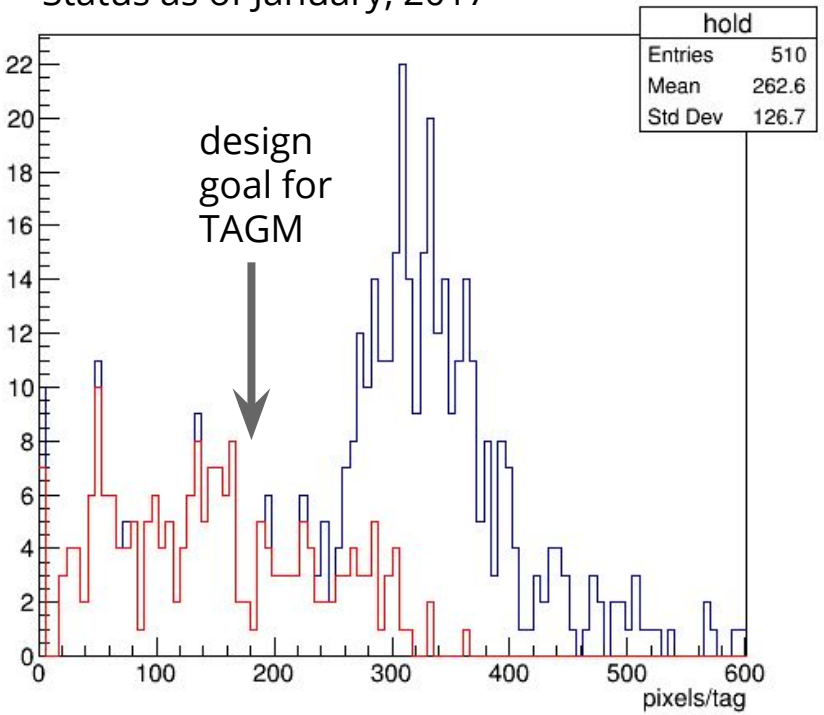




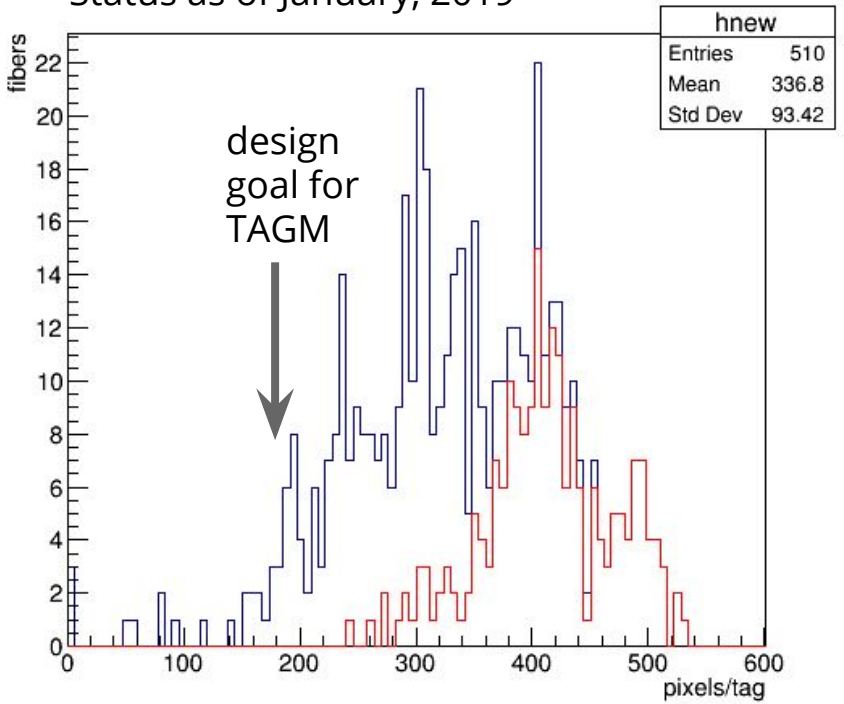
Summary comparison: old vs new

all 510 fibers in TAGM
replaced in Jan, 2019

Status as of January, 2017

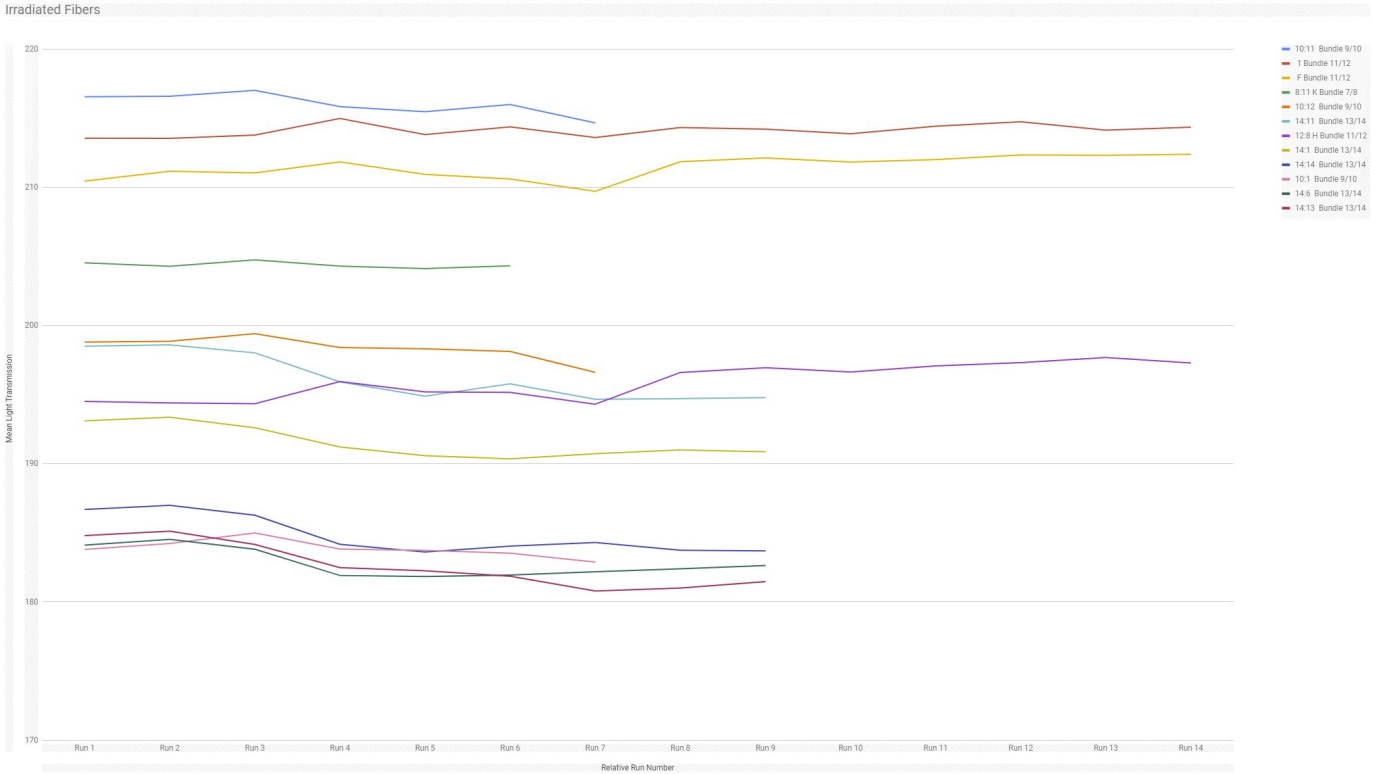


Status as of January, 2019



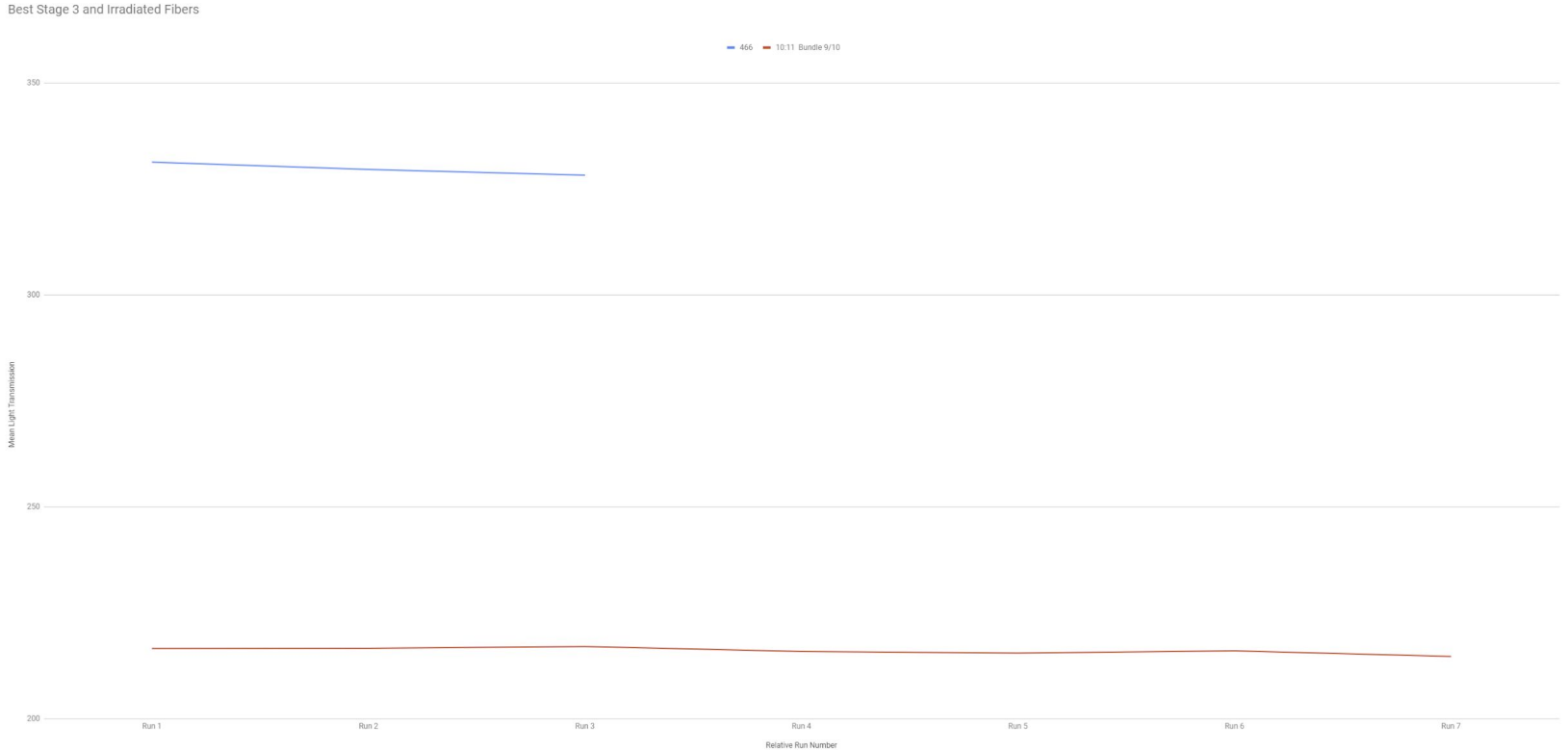
Backup slides

Top 12 Old Fibers

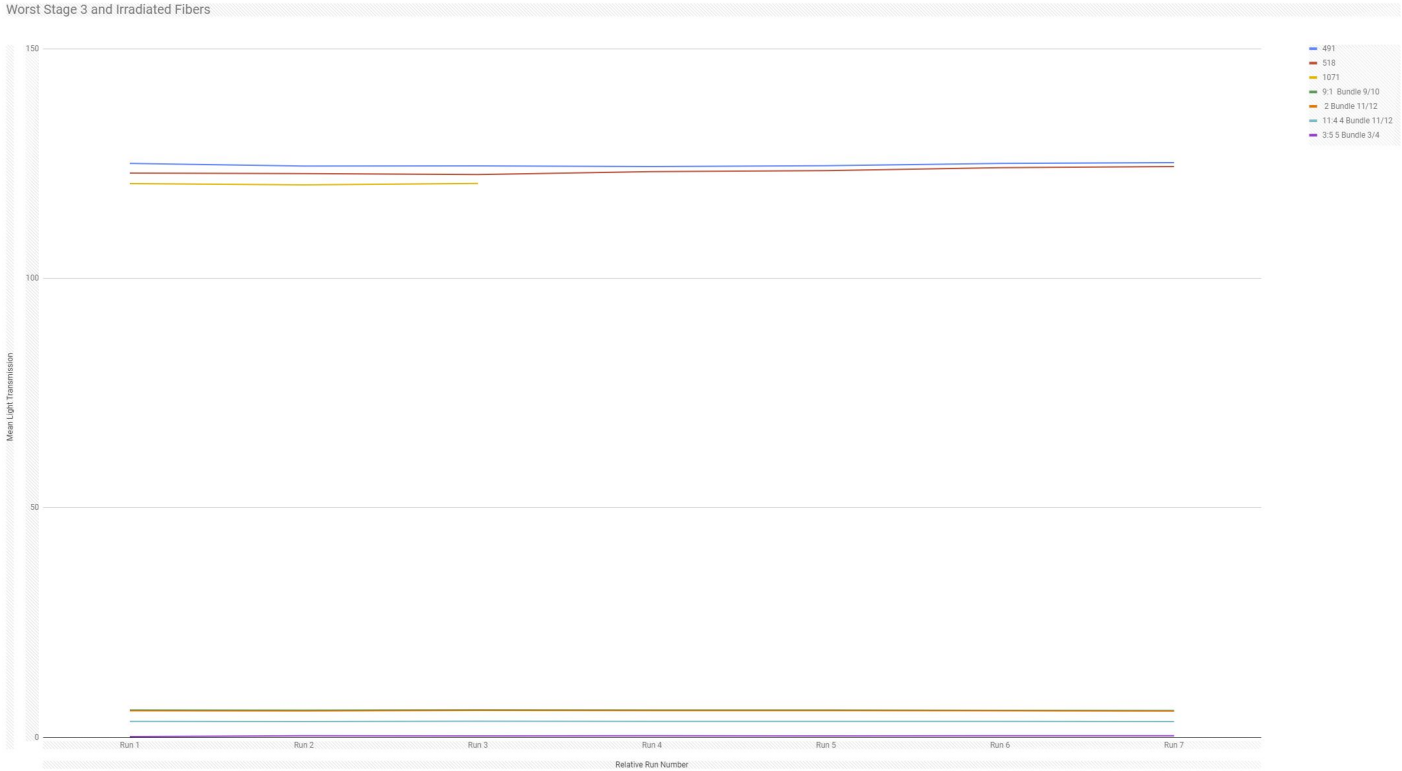


Two Bad Fibers from Old Bundles

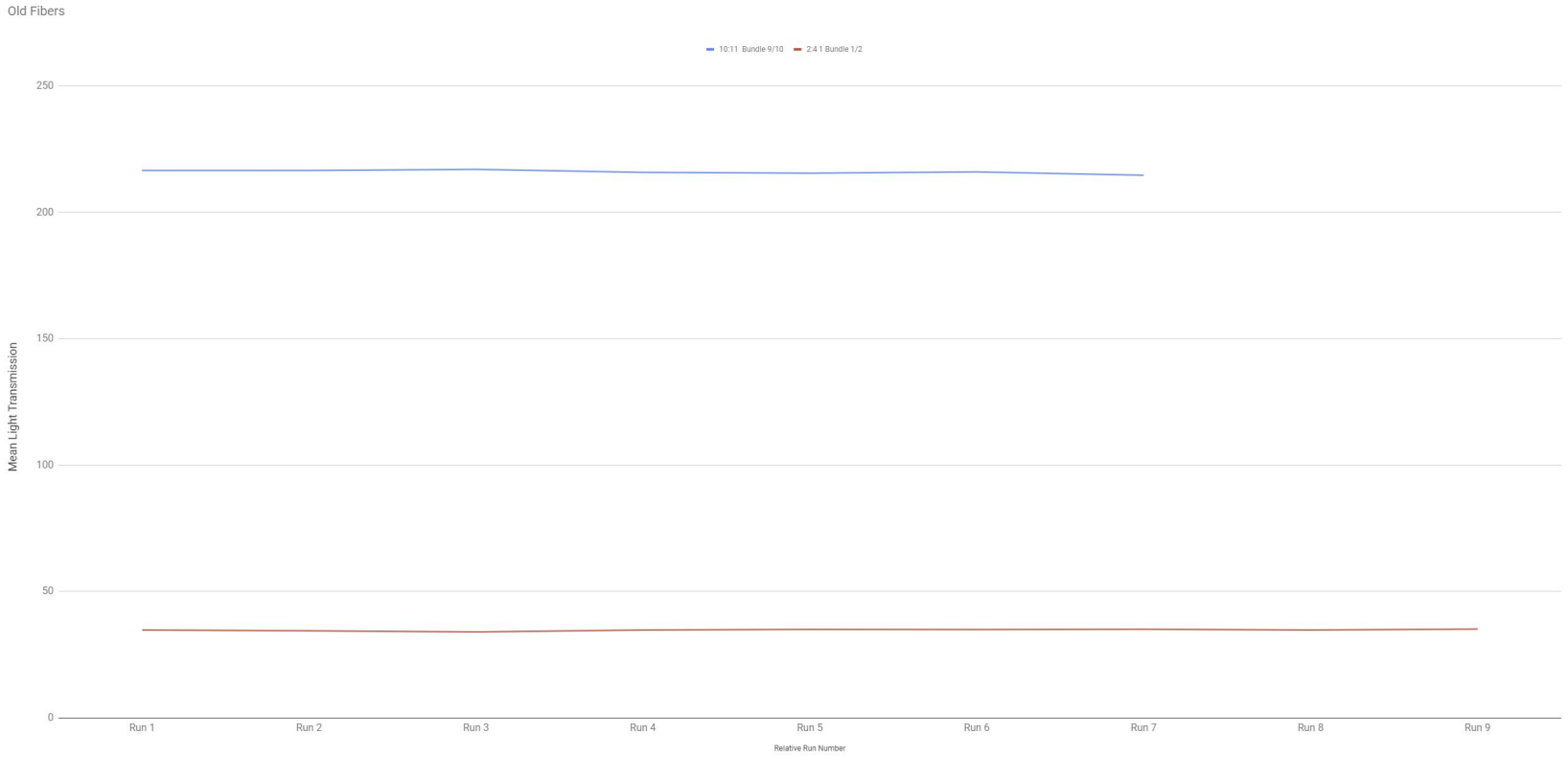
Best Stage 3 and Old Fibers



Worst Stage 3 and Old Fibers



Best and Almost Worst Old Fibers



Best Fibers All Stages