Quantifying Light Loss in the Tagger Microscope for the GlueX Experiment

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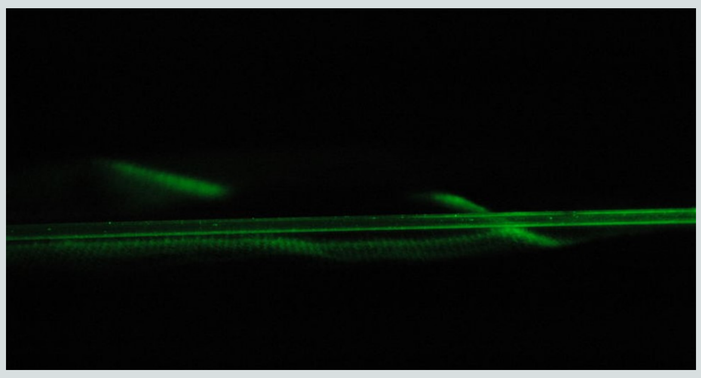
The Tagger Microscope in the Search for Exotic Mesons

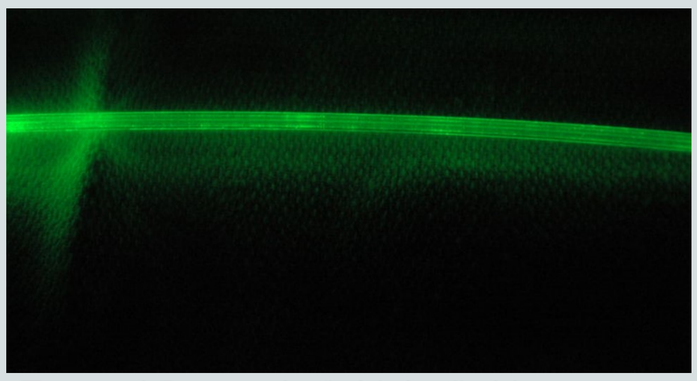
- Quantum Chromodynamics predicts the existence of many multiplets of exotic mesons, such as glueballs, hybrids, tetraquarks, etc. GlueX is looking for the hybrids.
- The LHC at Cern produces large numbers of tetraquarks, but hybrids have unique advantages for detailed study.
- The LHC is only able to study exotics with heavy quarks inside, whereas GlueX is designed to detect the lighter ones. We, too, can see light tetraquarks, but hybrids possess the most theoretically interesting structure due to the unique role of the gluon within.
- The Tagger Microscope catches scattered high-energy electrons in a scintillating fiber array.
- Fiber optics transmit the signal to electronics at which the energy and pulse time are recorded.

Damaged Fibers Lose Light

- Some fiber bundles are performing well; others transmit little to no light.
- **Goal**: fabricate at least 9 more bundles each yielding 20% more light to replace low performing bundles at JLab now.

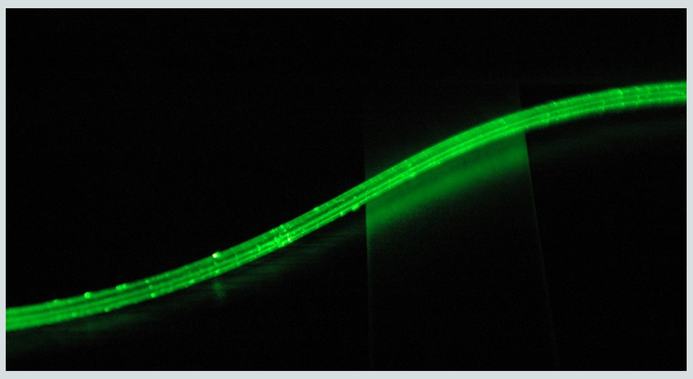
New 'Untouched' Fibers

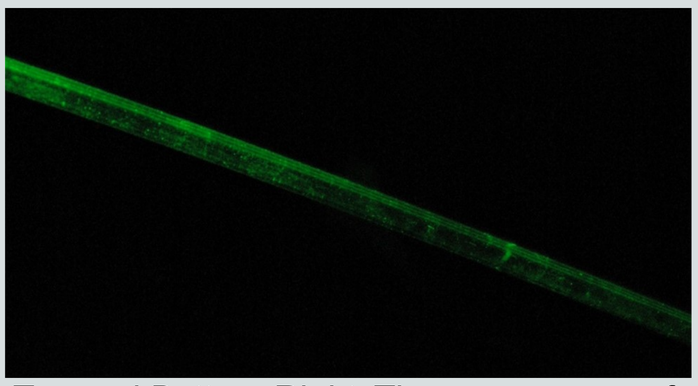




Top and Bottom Left: Light Guides recently cut from spool show exceptional clarity under laser light. (MFR Saint Gobain BCF -98).

Processed Fibers





Top and Bottom Right: The appearance of many surface imperfections in illuminated light guides. (Previously processed light guide. MFR: Saint Gobain BCF-98).

- **Goal**: Critique our procedures and materials by examining old fibers.
- Photos provide qualitative data.
- **Next step**: determine actual photon yield of processed fibers.

Testing Improves Methodology

Better Fibers Now

- **Double-Clad Fibers:** Original bundles used single clad fibers due to supplier error. Subsequent fibers are double-clad, which improves light transmission.
- **No Straightening:** 1st Generation fibers were straightened before they were assembled into bundles. We have eliminated straightening to reduce stress on fibers.
- **Improved Bending:** 1st Generation fibers were bent in a hot water tank. Rapid cooling and mineral deposits likely damaged the fibers. Procedure altered to bend fibers in hot air with more gradual temperature changes.

Acknowledgements

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The Dark Box

This pulsed laser testing apparatus uses electronic components identical to those in the tagger microscope at JLab. With it, we can test the performance of any fiber in any bundle.