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Fiber Placement, Gluing and Connector Repeatability Tests for 240 micron UV Fiber

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Objective: To measure any light output changes in CEBAF TOF detectors due to non-uniformities in fiber placement (either by direct insertion or gluing) and in the connector installations.

Equipment Used:

- One four (4) meter length of Fiberguide Industries SFS200/240B UV Optical Fiber (with black tefzel jacket)
- Tektronix TDS 620 Dual Channel Digital Oscilliscope
- HV supply (up to -2500 volts, 1 mA)
- One four (4) meter long piece of BC-408 scintillator (from Large Angle shipment, Item #8, strip A, scintillator 30 wrapped in aluminum foil and black Kapton)
- Thorn/EMI type 9754B 3" Photomultiplier Tube (hooked up to scintillator end directly and calibrated for cosmic ray pulses)
- Fiber Connectors (custom drilled for this size fiber)
- Manual Fiber Cleaver
- Hand Microscope (50 X)
- Methyl Alcohol
- Kimwipes
- 2" clear mylar tape
- 2" black electrical tape
- Exacto knife and Fiskar scissors
- Misc. items (black cloth, optical grease, BNC wire, SHV wire, black silicone, 5-min epoxy, etc.)

Fiber Placement Tests

Method: 1.) At the midway point of the scintillator, a small hole (< 5 mm diameter) was cut in both the Kapton and the aluminum, peeling them away carefully to expose the plastic underneath.
2.) A good cleave was verified at both ends of the fiber piece and on one end a connector was installed.
3.) When the connector glue dried, the other end of the fiber was placed in the hole in the wraps and allowed to slide approximately 2 cm. inside. The hole was then covered with a square of black tape, pressing around the fiber to seal out light.
4.) The fiber was connected to the output of our UV pulse laser (at approximately 7 hz.) and the oscilliscope trigger hooked up.
5.) The resultant output pulse on the PMT was recorded and compared to the standard cosmic ray reference.
6.) The fiber was moved to a different area on the midpoint of the scintillator and steps 4 and 5 were repeated each time.

Measurements:

Average Cosmic Ray Pulse: **-350** mV (± 20).

Fiber Location	Laser Output (mV)
midpoint, 2" side, centered	**-1000** (± 100)
midpoint, face, centered	**-1000** (± 100)
midpoint, face, corner edge	**-900** (± 100)
midpoint, face, between center and corner edge	**-1000** (± 100)

Conclusions: The location of the fiber on the surface of the scintillator changes light detection by no more than 10%, even when the light comes from a corner. If the light comes from a flat face (normal placement) the difference is not measureable in our tests. One can conclude that fiber placement in the wrappings is repeatable, effective without glue (although gluing adds certainty as to location of fiber) and has no consequential effects on UV laser induced pulse heights.

Fiber Gluing Variation Test

Method:

1.) Using 5-minute epoxy, a well cleaved fiber end was glued (1 cm. from the cleave) to the center face of the scintillator as in the Forward Angle detector construction.

2.) The holes in the wrapping layers were sealed with black tape.

3.) A pulse height was recorded from the UV laser/PMT setup.

4.) The process was repeated except that the fiber end was glued with the *end encased in the glue drop*. This was assumed to be the worse case gluing of the fiber onto the scintillator (never observed).

5.) The pulse height was recorded.

Measurements:

Pulse Height with fiber glued "normally" (1 cm from end):

-800 mV (± 100).

Pulse Height with fiber glued "badly" (directly on end):

-600 mV (± 80).

Conclusions:

Even a deliberately worst-case glue job on the end of a fiber causes only a 25% drop in light output. Since a correctly glued fiber has no glue near the exposed end, gluing should have no effect on laser output in the Large Angle TOF detectors (if gluing is done).

Fiber Connector Installment Tests

Method:

1.) Using the same piece of fiber and leaving it inserted into the detector from the last test, a new connector was installed on it (cutting off the old one and saving it for salvaging).
2.) When a good cleave was verified on the connector with the microscope, it was allowed to sit until the epoxy hardened.
3.) The new connector was hooked up to the UV laser and a pulse height was measured and recorded from the PMT.
4.) The process was repeated until 5 datapoints were recorded (using the last result from the previous test as the first result in this test).

Measurements:

Test #	Laser Output (mV)
1	**- 600** (± 100)
2	**- 900** (± 100)
3	**- 800** (± 100)
4	**- 900** (± 100)
5	**- 800** (± 100)

Conclusions:

From the data gathered, there appears to be a maximum difference of 33% in the light output from different connectors. Combining this data with previous data, one can conclude that the light output for the laser calibration pulses should vary by no more than about 50% due to the assembly inaccuracies in the LATOF construction.