Injection of the light from Athens micro-board LED

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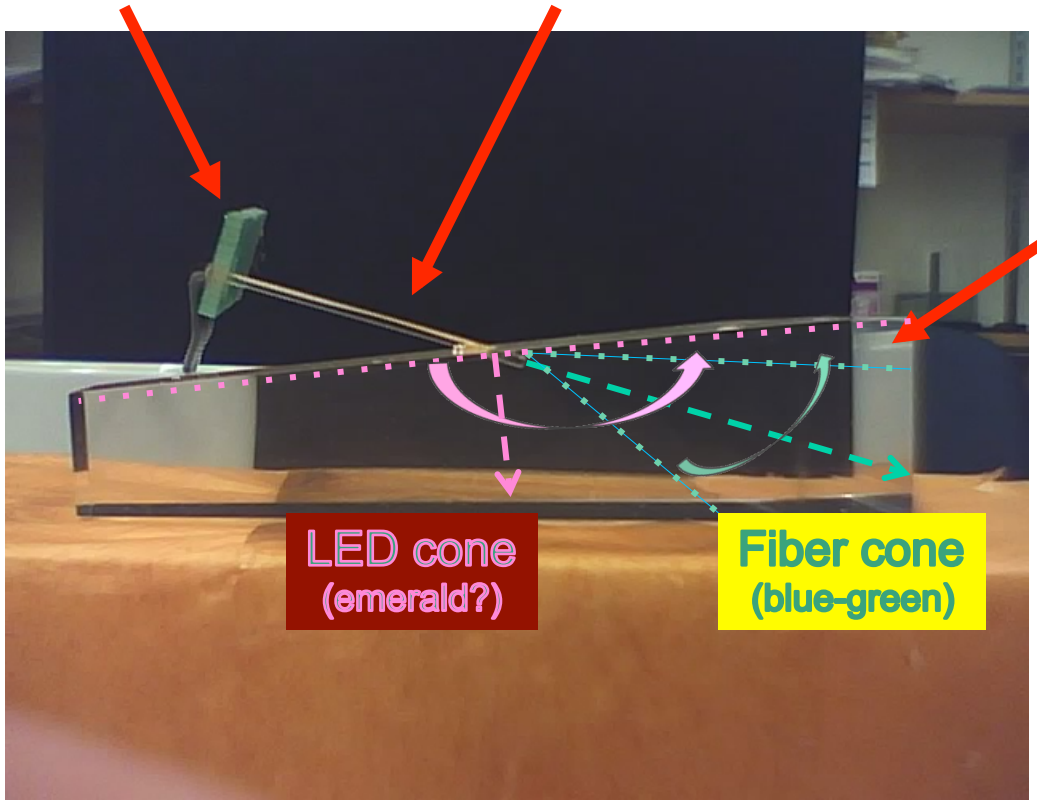
Goal: Balance the amount of light from Athens mini-board LED for both ("far" and "near") photodetectors that read-out the same cell of the calorimeter

Solution: **Inject the light into the light guide via short green-blue fiber:**

1. Direct the light cone from the fiber to the calorimeter (viz., to the "far" photodetector); via injection angle, we can control "far"/"near" signals ratio.

2. Match the spectrum of the light from the fiber with the transmission spectrum of the fibers in the calorimeter.

$$n \sin \vartheta_{\max} = N.A. = \sqrt{n_1^2 - n_2^2}$$

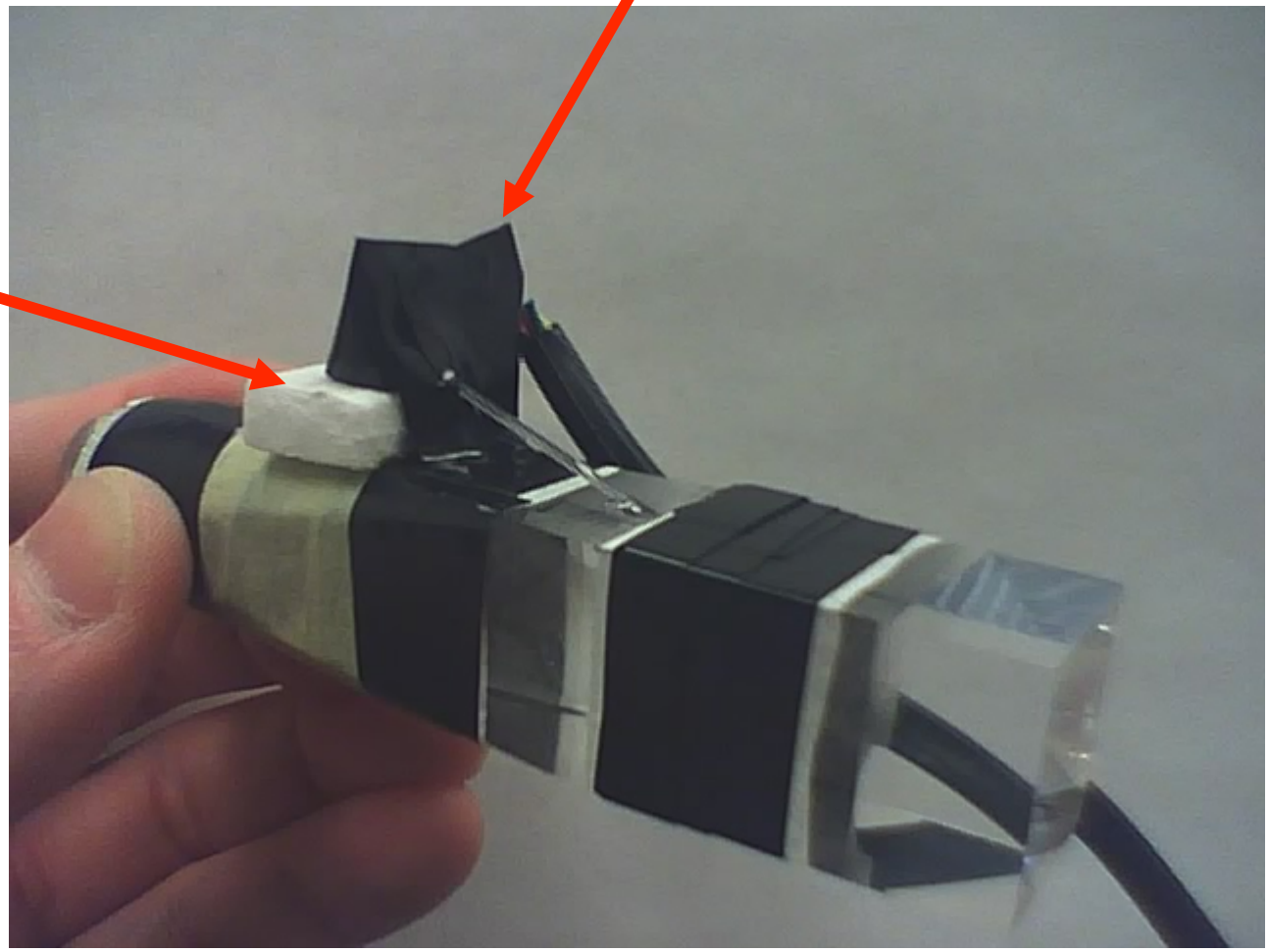


NB: In the actual measurements, the Winston cone (not the Chile light guide) was used as shown in the next slide.

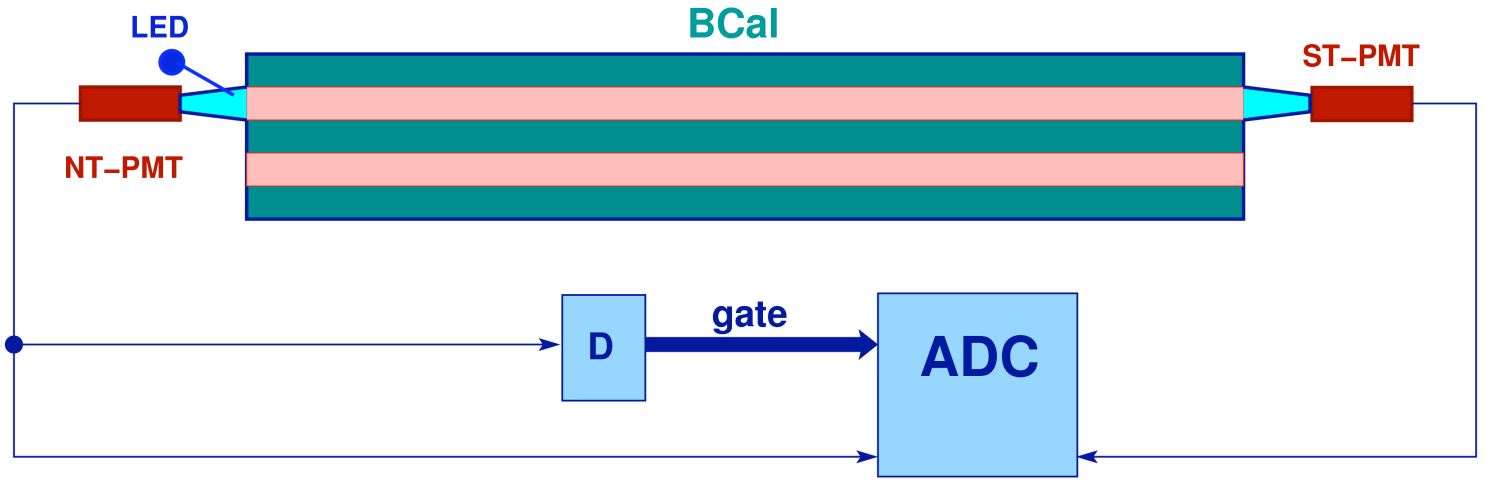
Large LED cone (direct coupling to light guide) led to overwhelming near PMT and large dynamic range.

Winston cone with the glued fiber and mounted LED mini-board (covered with black tape)

Sophisticated styrofoam support



Test Setup



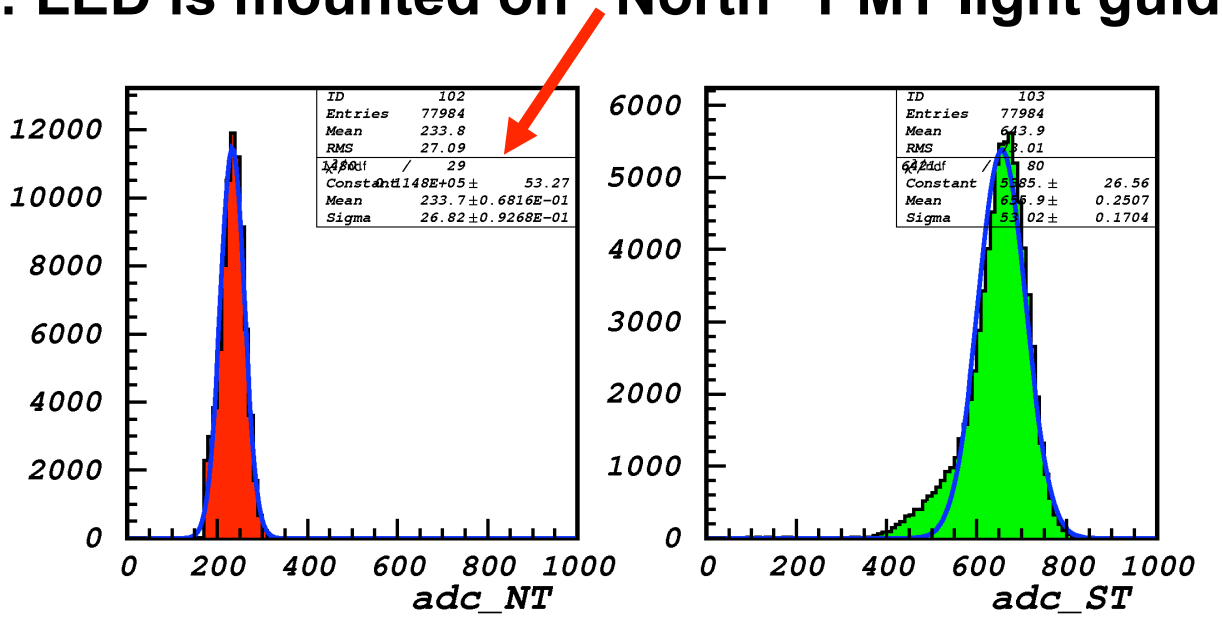
PMTs: non-calibrated Burle 8575 (used previously in the Bcal tests with cosmics)

LED is driven at the bias voltage of 9.3 V
(past tests used up to 16 V)

Central LED-light-injection angle is about 15^0

Optical grease used

Run #1: LED is mounted on "North" PMT light guide



Mean_ADC (North) ≡ ADC1 = (234-17) = 217 channels

Mean_ADC (South) = ADC1 * R_pmt * R_far_near = (656-17) = 639 ch

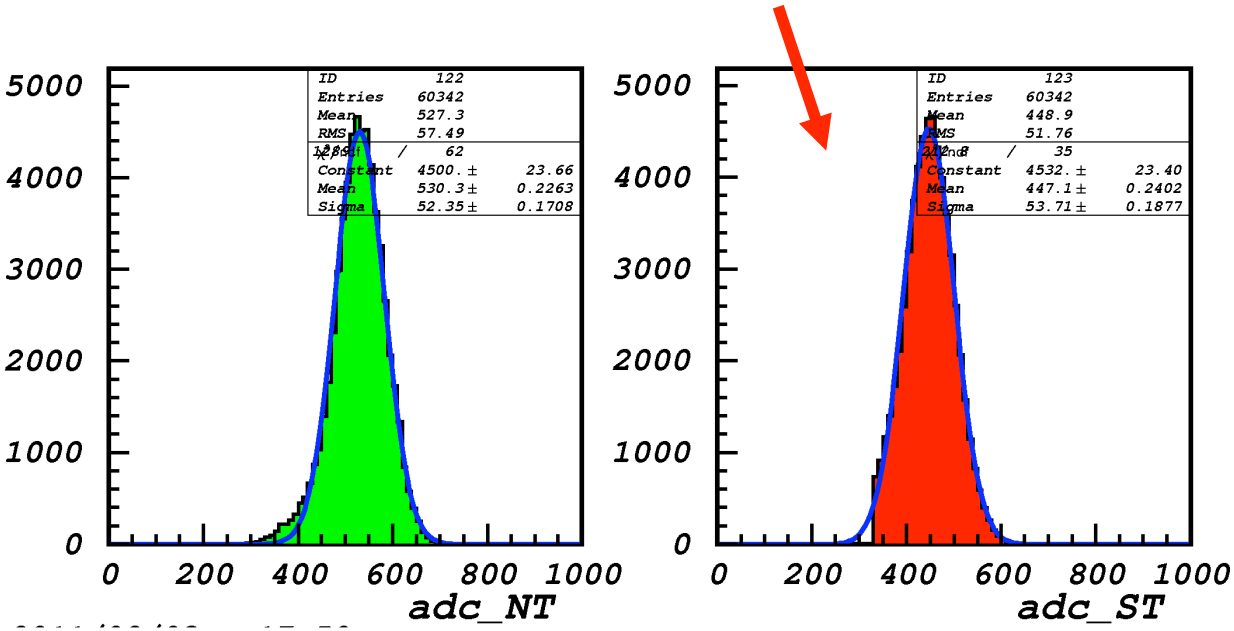
where R_pmt = PMT_gain (South) / PMT_gain (North)

(because PMTs are not perfectly balanced)

R_far_near = LED_light_at_far_end / LED_light_at_near_end

(the ratio of interest)

Run #2: LED is mounted on “South” PMT light guide



Mean_ADC (North) = ADC1 * R_led * R_far_near = (530-17) = 513 ch

Mean_ADC (South) = ADC1 * R_pmt * R_led = (447 - 17) = 430 ch

where R_led = LED_light_injected_in_run2 / LED_light_in_run1

(because we re-attached the light guide with the mounted LED, and re-set LED bias voltage)

We have 4 equations with 4 unknowns. After solving this system, we have:

ADC1 ≡ 217 ch

R_pmt = 1.57

R_led = 1.26

and for the ratio of interest:

R_far_near = LED_light_at_far_end / LED_light_at_near_end = 1.87

Conclusions and Comments:

1. We managed to inject more LED light to the "far" PMT compared to the "near" one with LED-light-injection angle of 15^0; increasing the injection angle, it's possible to balance LED light for both photodetectors. This achieves the simultaneous "flashing" desired for the monitoring system.

2. Drilling the hole in the light guide and gluing the fiber into it might make the LED replacement procedure quite difficult. Mechanical considerations are required.

3. Alternatively, we can try to use a small prism glued to the side of the light guide as an interface between the "short" fiber and the light guide OR use a flexible fiber transport guide OR LED can be lifted off board using short wires.