NPS Calorimeter Prototype status

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1 Tests of the modified NPS Prototype

The Prototype was modified to prevent cross talks between modules because of the light leaks from blocks. The PMTs and the rear facets of the crystals were isolated with black Tedlar film, and the Tedlar insulation of the blocks was extended at the front by 5 mm. Also, 12 IR LEDs were mounted in front of 3 blocks in the middle row (4 per block), for the purpose of testing influence of the IR curing radiation on the PMT signals.

The Prototype was tested with cosmics (see fig. 1 and fig. 2), as previously. By comparison to the prior modification measurements several observations made:

- The fraction of pedestal events in the summed signal spectrum is increased from 10% to 24%. A simple simulation (no light tracing, PMT signal derived from the deposited energy estimates) predicts 14 – 18% of pedestal events.

- Amplitude of the summed signal from cosmic muons dropped from 150 p.e. to 100 p.e., presumably because of the loss of photons in the additional optical insulation.

- The fraction of pedestal signals in individual channels increased from 29% to 65%, while fraction of the low energy signals dropped from 40% to 12%, on average. In the mean time, the fraction of combined pedestal and low energy events increased from 69% to 77%. One can infer migration of the low energy signal events to the pedestal domain as a result of the modifications.

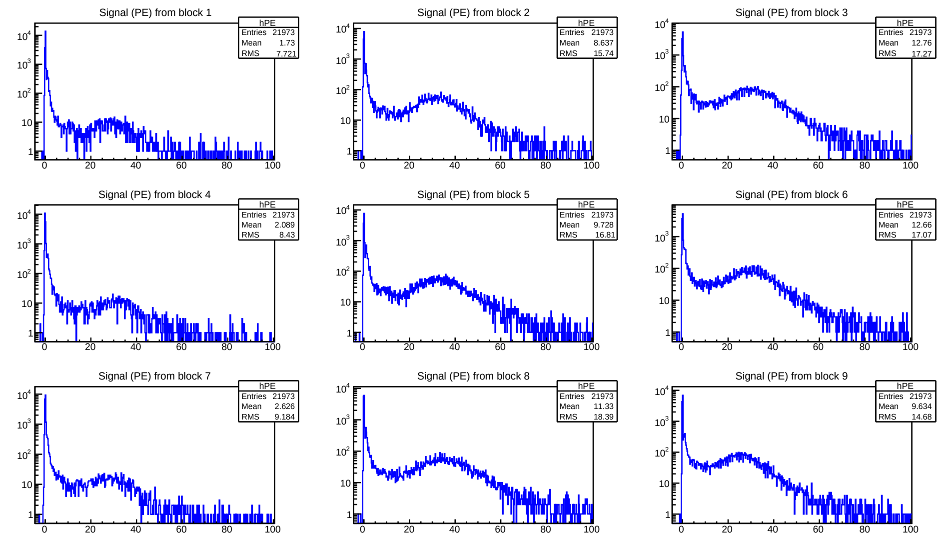

Figure 1: Per channel signals in p.e. units from a cosmic run after the modification of Prototype.

Note: presented above fractions are crude estimates and must be taken with caution.

Capability of the GMS system was demonstrated by taking data from cosmics and GMS in concurrently (fig 3). The GMS LED was driven by pulsar at a low rate below 1 Hz, and the trigger was set up accepting signals both from cosmic trigger scintillators and the pulsar trigger output. To distinguish signals from cosmics and the GMS, the LED signal was tuned at higher amplitudes.

Response of PMTs to the IR curing system was tested by driving the installed IR LEDs at different currents (fig 4). Significant change in pedestal widths of the exposed PMTs was observed (top panel). In contrast, resolution of signals generated from the operation of the GMS system was not changed. On a scope the signals became noisy as of PMT output exposed to a low intensity light.

2 Crystal radiation and tests

The SICCAS 01 spare crystal was radiated and measured twice. The fist time it was radiated for 18 krad with 260 rad/hr rate and measured longi-

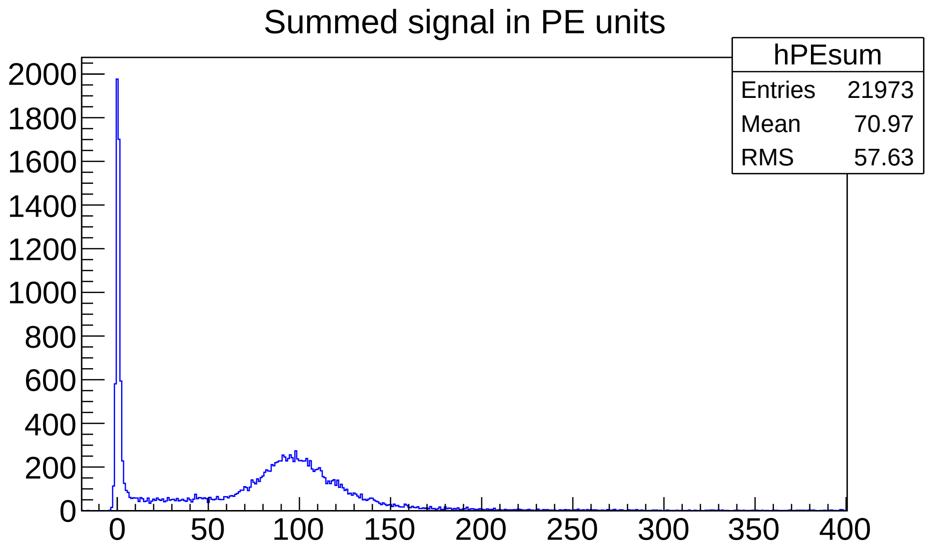

Figure 2: Summed Prototype signal from cosmic run after the modification of Prototype.

tudinally. No definite sign of radiation effect was found. The second time it was baked for 10 hours at 200°C, then radiated for 18 krad from one end, as previously. Measurements were taken before baking, after baking and after the radiation.

Carl Zorn had adjusted the optics before the second series of measurements, specifically for the needs of measurements of small size crystals. The beam of light was narrow collimated, the focal distance was adjusted and the integrating sphere moved closer to the focusing lenses.The setup remained unaltered trough the measurements.

A reference PbWO crystal of $3 \times 3 \times 20cm^3$ sizes, with light guide on one end has been measured longitudinally, in parallel with the main measurements in order to control accuracy. From the reference measurements the accuracy of ~0.5% was derived and applied to the main measurements.

Each time the SICCAS crystal was measured longitudinally (through 20 cm) at 3 points, with beam of light focused on its central longitudinal axis, and shifted by 2 mm to the left and right. Fig. 5 compares transparency before and after the baking, as measured at the center. Very similar results have been obtained at the 2 mm shifted spots. A marginal improvement from baking of ~1.5% can be seen (bottom panel).

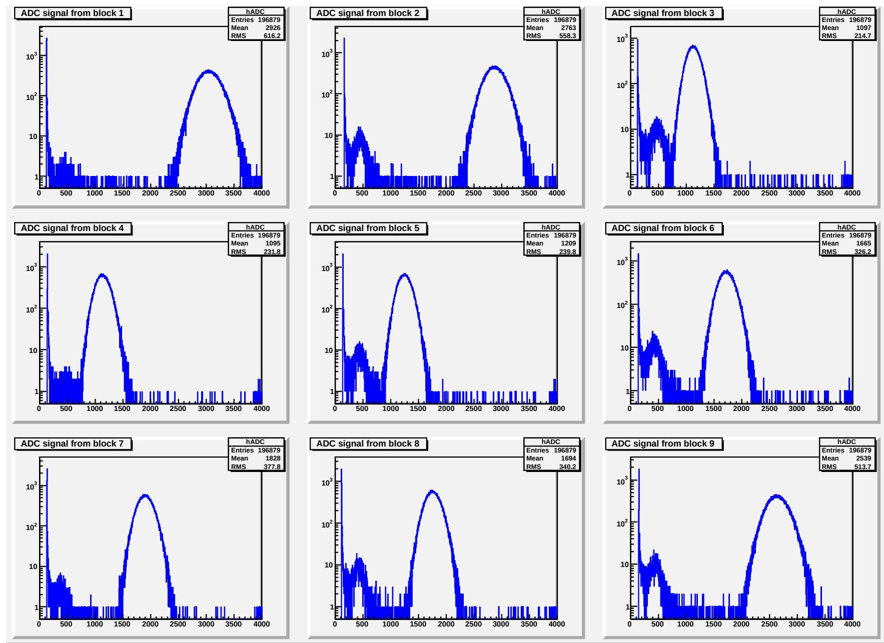

Figure 3: The Prototype signals from concurrent data taking from cosmic rays and the GMS. Pedestal and low amplitude signals are from cosmic rays, and the bell shape distributions at high amplitudes are from the GMS.

Comparisons of transparency before and after 18 krad radiation (see for instance fig. 6) show ∼3% radiation effect at 420 nm. However, the control measurement of the intact reference crystal also shows reduction in transparency, though of only 1.5% (fig. 7).

In conclusion, small effects from both baking and radiation of the SICCAS crystal have been noticed. Compared to the accuracy of our measurements, the effects are marginal.

3 Plans for weeks ahead:

1. Amend construction of the NPS Prototype in order to make it more rigid.

2. More tests with Prototype IR LED curing system in order to understand effects on the PMT signals.

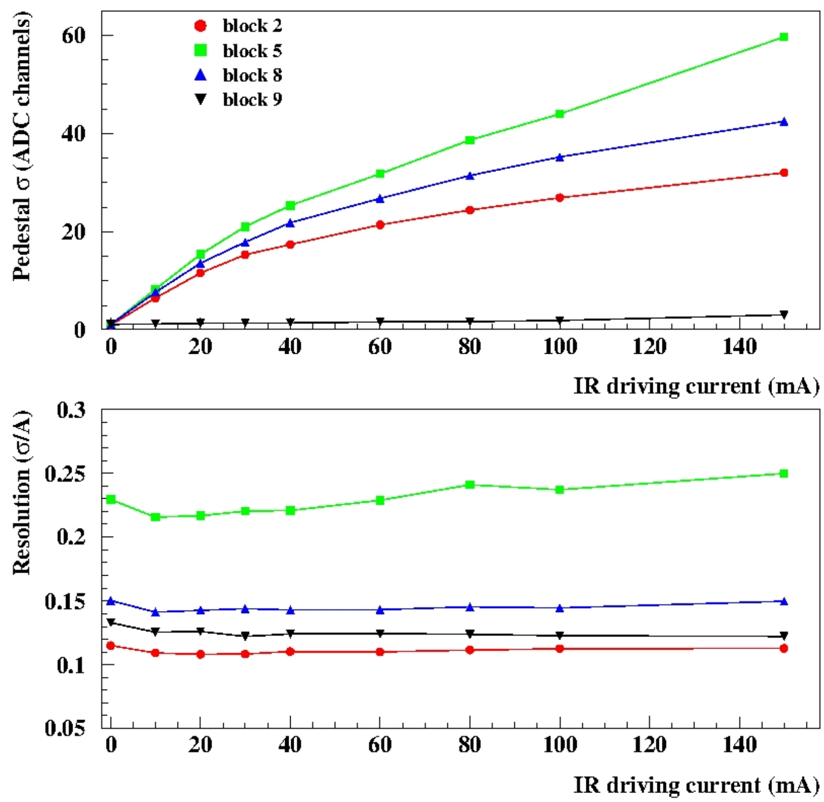

Figure 4: Testing response of the Prototype PMTs to IR light from the curing system. Shown are pedestal ADC widths (top) and the GMS signal resolution (bottom) versus driving current through the IR LEDs. The line and dots in black denote a PMT not exposed directly to the light.

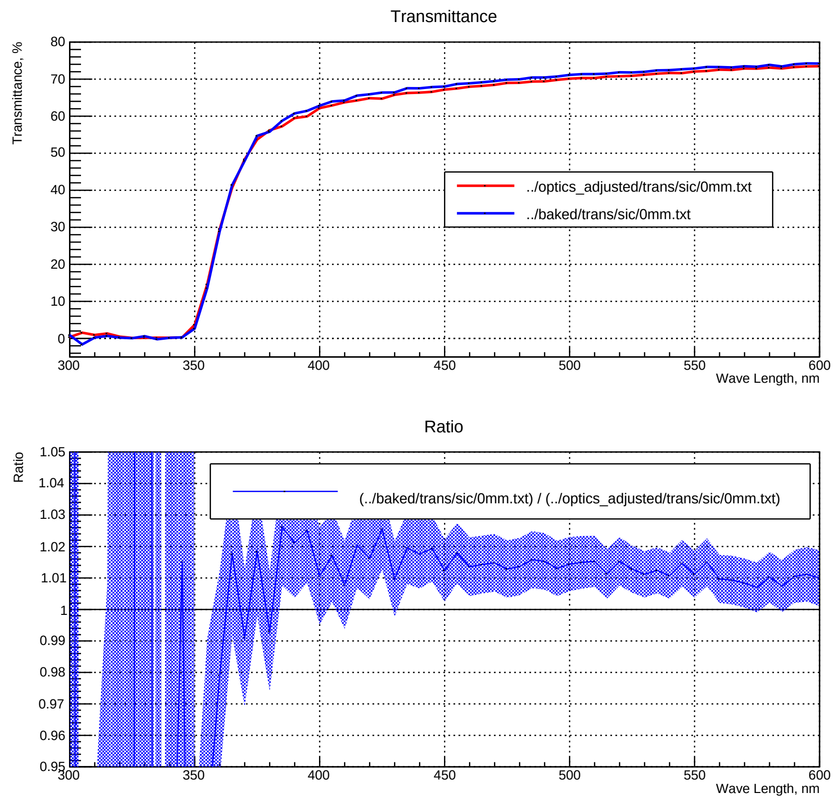

Figure 5: Top: transmittance of the SICCAS 01 crystal before (red) and after (blue) baking for 10 hours at 200°C. Bottom: ratio of transmittance after baking and before.

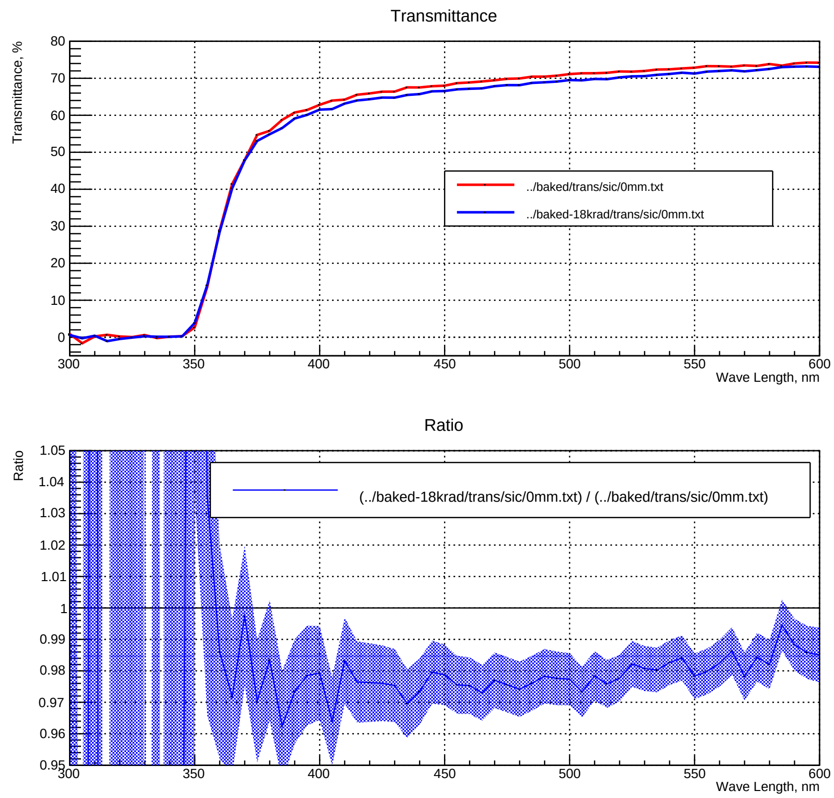

Figure 6: Top: transmittance of the SICCAS 01 crystal before (red) and after (blue) 18 krad radiation from one end, as measured longitudinally through the center. Bottom: ratio of transmittance after the radiation and before.

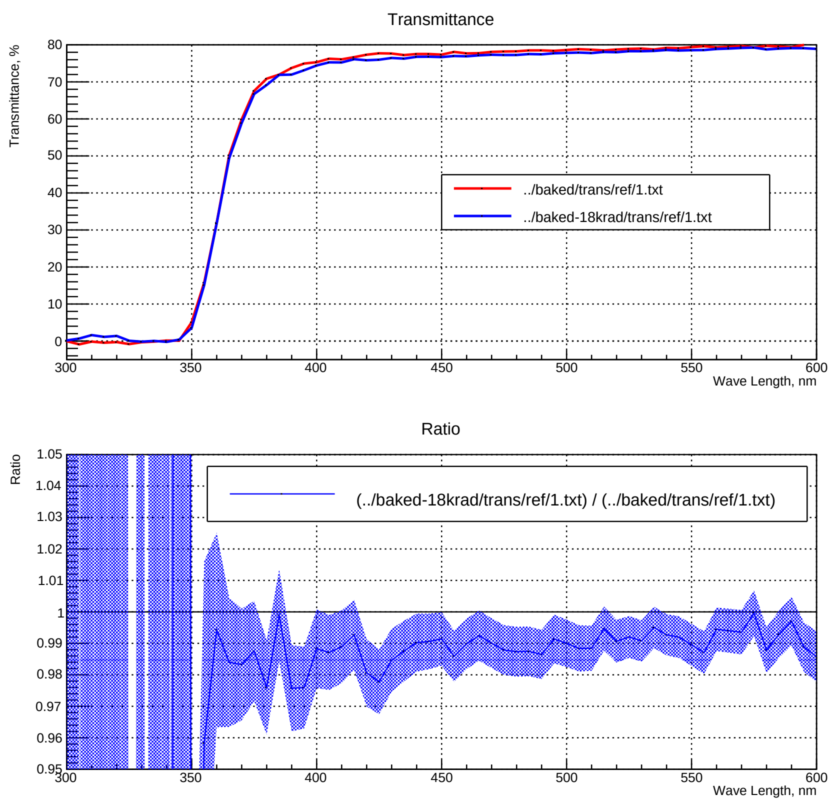

Figure 7: Top: transmittance of the Reference crystal as measured in parallel with baked (red) and radiated (blue) SICCAS 01 crystal. Bottom: ratio of transmittance from the second and the first measurements.