NPS Calorimeter Prototype status

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1 Prototype cosmic tests

The Prototype is being tested with cosmics by utilizing electronic setup for the kaon aerogel detector for SHMS. Two $5 \times 10\ cm^2$ scintillator trigger counters sandwich the detector, providing 2 event/min rate. The detector works stable for days, albeit one channel is dead from the very beginning of tests, presumably because of a base problem.

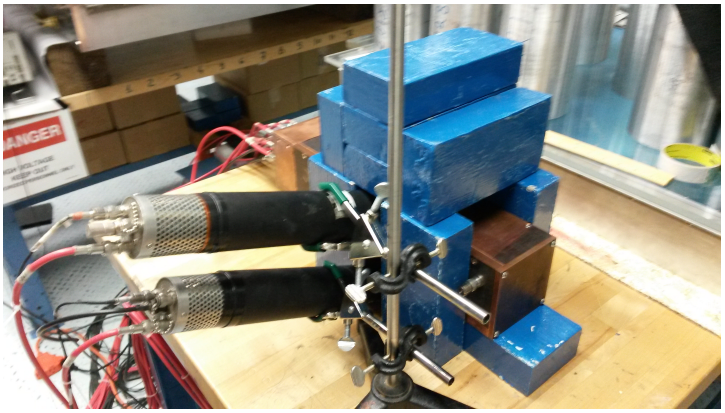

Figure 1: The Prototype NPS cosmic test setup.

Several runs have been taken already, with different orientations of the trigger counters relative to the detector, with and without lead shielding in order to understand shapes of signals. It is not clear what causes a shoulder (or a cusp) at the pedestals (fig. 2). The low energy background is ruled out by shielding the setup with 15 cm lead on top (fig. 1). The short tracks from

slanted rays in a block are ruled out by simple simulations which include sampling and tracking of cosmic muons, the geometry of setup, energy deposition in lead tungstate crystals and its conversion to PMT signals (p.e.).

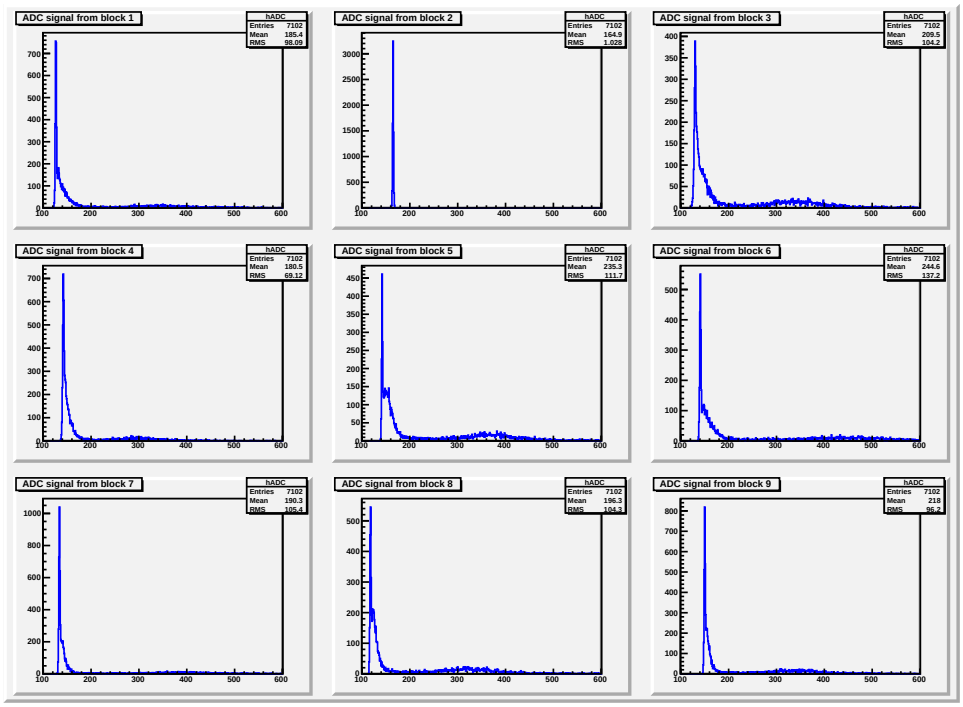

Figure 2: ADC signals from a cosmic test run.

A possible cause is cross talk between the channels, either due to light leak from one block to another, or of electronic origin. Tests with working GMS may shed light on this issue.

2 Accuracy of transmittance measurements

The accuracies of transparency measurements have been estimated at 2 distances of 1 cm and 5 cm from the radiated edge (fig. 4 and fig. 5). The 2 errors differ by factor ∼2. A more conservative estimate at 5 cm is used in the sequel.

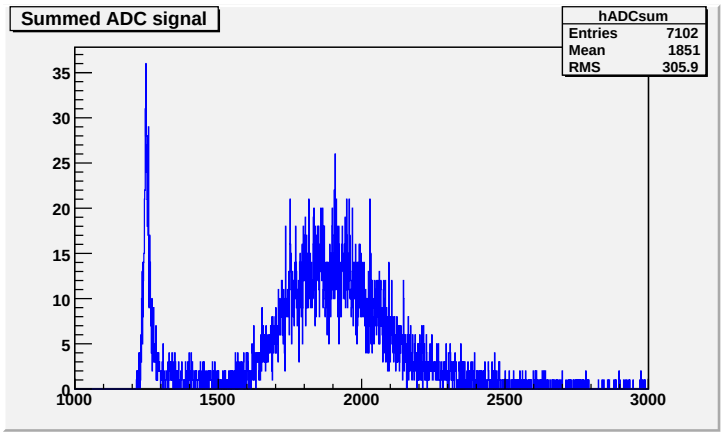

Figure 3: Summed ADC signal from a cosmic test run.

3 Crystal radiation and tests

Transmittance of $3 \times 3 \times 16\ cm^3$ crystal after 187 krad dose of radiation was re-measured, this time in the middle between the light source system and integrating sphere, in the position consistent with the measurements before the radiation (fig. 6). Results again suggest ∼4% reduction in transmittance after the radiation (fig. 7), despite of significant point to point variation.

The crystal was radiated at the RadCon facility for another 84 krad dose. Further reduction in transparency can be noticed after the 271 krad dose accumulation. Compare fig. 8 and fig. 7, also see fig. 9. The crystal was visually inspected and few scratched areas were found, at which results of the measurements should be considered with caution.

4 Plans for weeks ahead:

1. Get GMS of Prototype running. Use it to localize single photoelectron peak positions, which will allow express signals in p.e. units. Also, use it to clarify origin of low amplitude signals in the obtained cosmic test spectra.

2. Replace faulty base in the Prototype.

3. Optically isolate ends of the crystals in the Prototype assembly in order to exclude possible cross talk between channels (optional).

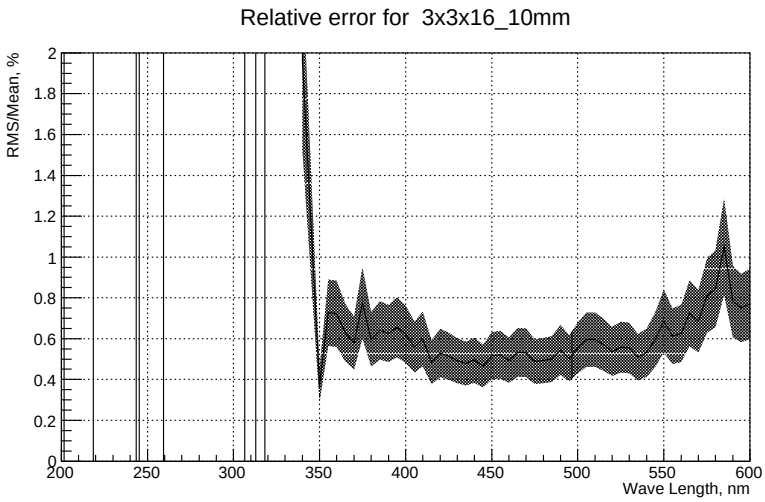

Figure 4: Relative error on the transmittance as measured at 1 *cm* distance from the radiated edge of the crystal.

4. Run tests in concurrent mode, with detection of signals from both cosmic rays and the GMS.

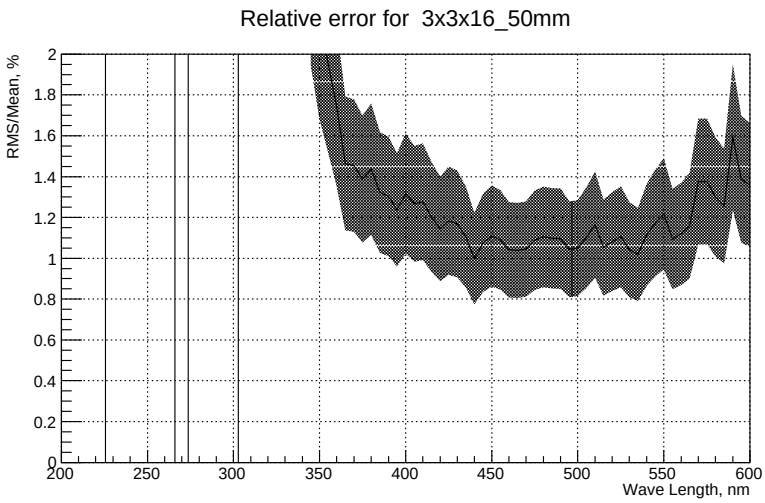

Figure 5: Relative error on the transmittance as measured at 5 *cm* distance from the radiated edge of the crystal.

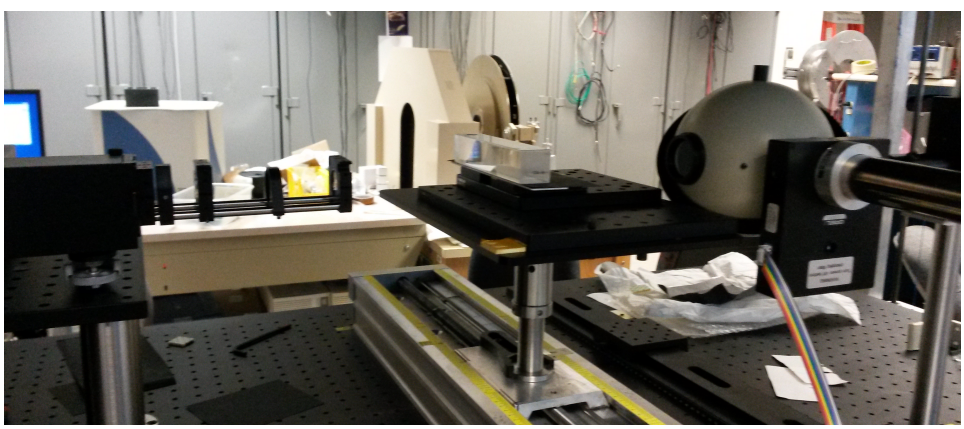

Figure 6: The optic setup for transparency measurements.

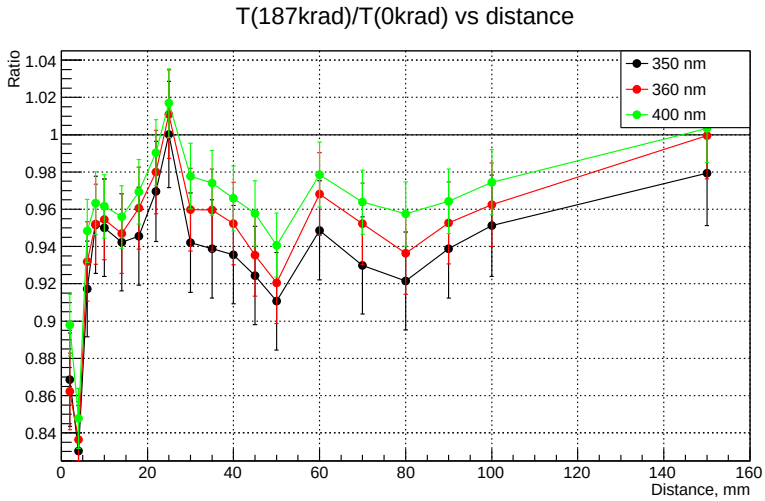

Figure 7: Ratio of transmittances after 187 krad radiation and before radiation versus distance from the radiated end of the lead tungstate crystal.

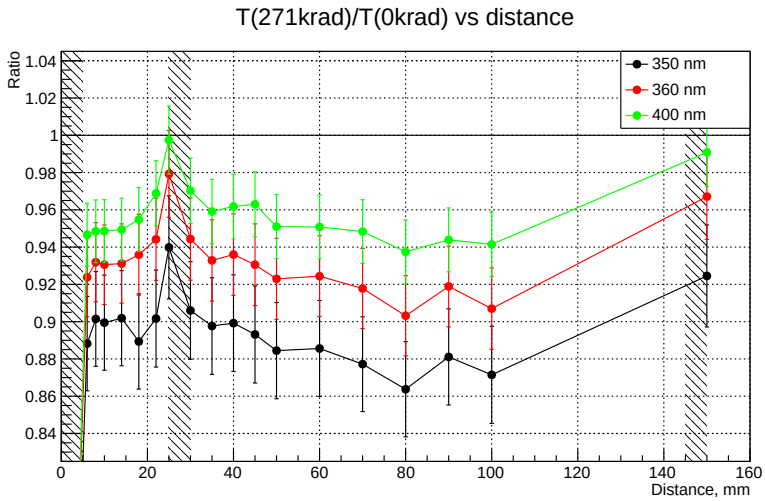

Figure 8: Ratio of transmittances after 287 krad radiation and before radiation versus distance from the radiated end of the lead tungstate crystal. The hatched bands indicate surface scratches.

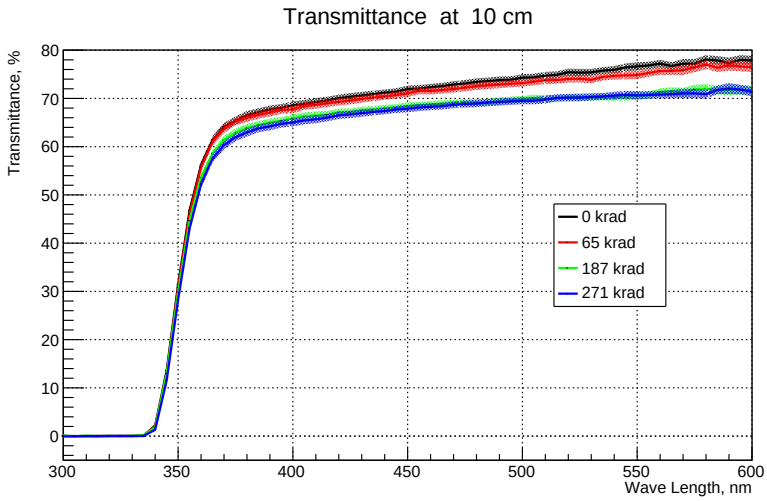

Figure 9: Transmittance of the PbWO crystal at 10 mm distance from the radiated facet after different doses of accumulated radiation.