Measurements and preliminary results with 'Sunflower Configuration'

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Participants: (during tests)

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Test setup:

The test setup consisted of 7 PMTs located in a black box, with could be illuminated by 2 blue LEDs. One LED was used to simulate a small DC light level while the other was driven by a pulse generator. Generated light could be attenuated by a filter wheel (up to a factor 1:100). The PMTs were operated at 970 V corresponding to gains of the PMTs in the range of 1.-2.*10^5 and connected via the distribution board (of the old design) and a 4m shielded twisted pair cable to the front end crate. PMT signals were received on the analog board and digitized by the first level trigger (FLT). One second level trigger board (SLT) processed external trigger signals and allowed to access the readout bus of the crate. The readout was controlled by a PC under WindowsNT. The overall readout chain was tested with the setup.

Test and preliminary results:

1. First the noise, the crosstalk, the linearity and the influence of DC light (to simulate sky light) were measured with the 'virtual channel' (VC) analog board. Data of channels 1 to 8 were recorded together with the two virtual channels no. 23 and 24. The preliminary analysis showed a noise of less than 1 LSB (depending on the wiring, grounding etc.). If one assumes a night sky background of 2.7 p.e./100ns and a sensitivity of 1 LSB = 0.5 p.e., then the statistical (night) fluctuations are ca. 3.3 LSB. The total noise is \sqrt{1*1 + 3.3*3.3} = 3.45. --> the electronic noise increases the statistical noise by 4-5 %.

   We observed crosstalk of 2-3 per mill over several channels. The linearity measurement showed no anomaly at first view, a complete analysis will follow.

2. Above measurements were repeated with one channel modified to an ADC input range of 2V (instead of 4V). We hope to verify, that a reduced range of 2V can improve the noise and linearity even at lower power consumption.

3. All measurements were also repeated with the compressor (KO) version of the analog board, but with less recorded data. We found some problems with the KO board: Due to a short cut 3 channels had to be excluded from the measurements.

   A first analysis showed a higher noise level and more cross talk. The bilinear transfer characteristic will be derived from the data and a careful comparison of this option with the VC will be done.

4. The gain variance over the board channels was measured at a fixed gain setting. The access to the variable gain amplifier on the board was proofed: The gain can be changed by a factor of about 1.8 (max. to min settings).

5. Unfortunately there are some software or firmware problems with the readout of the current monitor. No tests could be done.
**Future tests:**

- The Italian side (Torino/Pavia/Milan) performs more tests (noise/ linearity..) to compare to VC and KO option.
- More test with the sigma-delta evaluation board plus DSP readout are needed to understand the synchronization and timing of the current monitor readout. S. Agiro will investigate the synchronization; his results will be used by FZK group to find the reason for the current monitor problem.
- Torino/Pavia/Milan group produce analog boards (VC and KO) with the on-board voltage regulators replaced by LC-networks. They will test, if the regulators can be replaced and the voltage can be supplied through the backplane by an external linear regulated power supply.
- FZK tests the full functionality of the FLT and SLT board. They implement a 'boxcar trigger' using the lower 10-bits of the ADC and allow thereby signal undershots.
- FZK tests time stamp feature and time resolution.
- FZK makes measurements with current monitor (e.g. comparison with statistical analysis of ADC data).
- Sunflower test setup is still working in FZK and can be used for further test from Italian or FZK group.

**Agreements:**

- P. Privitera will issue the final test results as a GAP-report.
- After all basic tests of functionality with the sunflower will be completed, we will start the test with 100 PMTs mounted on the camera body in Rome. We will test the camera response to different light sources (LEDs, Xe-lamps,..) and simulated tracks on the camera surface. We will need a front end crate equipped with 1 SLT and 5 FLT boards. We intend to use 4 analog boards with virtual channel and one board with compressor option. All boards must be functionally tested before shipped to Rome.
- The test could start in July. A definite date will be fixed once all the components which need to be produced and tested are ready.
- decision on VC against KO version of analog boards and other options will be made latest in Bad Liebenzell meeting in August.

Protocol by M. Kleifges, comments from P. Privitera, D. Camin, S. Menchikov included

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