Forward Endcap News

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Outline

- Preamplifier Gain
- Crosstalk of ADC modules
- Annealing LEDs
- Irradiation tests of THMP and LightPulser systems

Variation of Preamplifier Gain

- Yield of individual crystal-VPTT-preamplifier-units was measured in Bonn for the first completed submodules
- Spread of the measured yield is larger than expected
- $\rightarrow~{\rm Triggered}$ immediate investigations to find the cause

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- Spread of the measured yield is larger than expected
- $\rightarrow~{\rm Triggered}$ immediate investigations to find the cause
- 1. Gain measurement performed in Bochum shows large spread for the last \approx 150 measured VPTTs (as reported by Merlin)
 - \rightarrow Corresponding VPTTs have already been re-measured, new values show less spread and will be used for further matching/production
- 2. Preamplifier gain was always assumed to be constant per group of preamps
 - Tested several preamps of each gain group (0.7 V/pC, 0.82 V/pC, 0.89 V/pC) w/ charge injection

Spread of Preamplifier Gain

- Tested 15 preamps from each gain group w/ charge injection setup as proposed in preamp manual from Basel
- Maximum observed deviations from mean response of each group:
 - ▶ 0.70 V/pC: +17%/ 5%
 - ► 0.82 V/pC: +20%/ 10%
 - ▶ 0.89 V/pC: +3%/ 2.5%



- $\rightarrow\,$ We have to know the (relative) response for all remaining preamps and feed the values into the matching software!
 - Positions of already assembled crystal-VPTT-preamplifier units will be reassigned

Spread of Preamplifier Gain

In the meantime:

Measured 96 preamps of middle gain group (0.82 V/pC)

- ightarrow Spread of approx. +20%/ 10% confirmed
- Gain of preamps has been determined in test station in Basel ⇒
 Waiting for data from Basel for comparison



Test Setup at Bochum

- Upright submodule in climate chamber
- Supplied w/ light pulser via fibre bundle (final design)
- HV, LV, signal connections via PatchPanelPCB
- Two BC-408 plastic paddles for cosmics trigger
- Readout using final SADC module equipped w/ final components for shaping stage



Reminder: Final Version of the PANDA SADC



- Design by P. Marciniewski (Uppsala)
- 32 single-ended 50 Ω input signals
- Analog shaping and HIGH/LOW splitting
- $\rightarrow\,$ Input: Samtec high-density connectors
- \rightarrow Analog input range: 0... 2.2 V (max. preamplifier output)
- $\rightarrow\,$ ADC: 64 channels, 80 MS/s, 14-bit

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- $\rightarrow\,$ Readout: 2× optical interfaces (SFP, 2 Gb/s)
 - Component values for analog shaping stage have been fixed and all channels on prototype board were equipped accordingly



Malte Albrecht (RUB EPI)

Crosstalk

- ► Used APD submodule in climate chamber, Light Pulser generating large signals (→ clipping in High Gain!)
- Connected 31 of 32 APDs to SADC module (one channel left open)



Crosstalk

- Compared noise projection in signal window for disconnected channel with and without signal applied to all other channels
- $\rightarrow\,$ Probably worst case for ADC operation, only realistic during LP runs?
- $\rightarrow\,$ No effect visible in both high- and low-gain noise projections
 - Investigations ongoing; 'upper limit' of cross-talk influence on integral of signal is maybe a better measure?



Annealing LED for APD Readout Units

 Placement and mounting procedure for annealing LEDs was tested and fixed for VPTT units (in production)



- ▶ No final solution for APD units, tests are ongoing
- $\rightarrow~$ Less space available than for VPTT units
- $\rightarrow\,$ APDs could be more susceptible for HF pick-up noise
- Annealing LEDs will be operated in a serial chain of 16 pieces ⇒ U_{supply} ≈ 45 V but I_{supply} ≤ 20 mA
- Scenarios tested:
 - No LEDs
 - serial chain w/ decoupling capacitor and coaxial cable
 - serial chain w/ decoupling capacitor and standard flat ribbon cable
 - serial chain w/ flat ribbon cable connections



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Influence of Annealing LEDs

- Measured noise RMS values for all scenarios
- $\rightarrow\,$ Both scenarios with decoupling capacitor do not show any significant impact on the detector noise
 - Next step: Test LED-chain w/o mounting any capacitor still no influence?
 - Mounting only LEDs would make production of submodules a lot easier!



Irradiation of Light Pulser and THMP

- ► Various components on all PCBs in LightPulser and THMP systems have been irradiated with photons years ago ⇒ no damages observed
- Some components have been changed
- \rightarrow Necessity to perform a full-fledged irradiation test program (one B.Sc. thesis in progress)
 - Photon irradiation @ ⁶⁰Co source, Giessen (done)
 - Proton irradiation @ KVI, Groningen (done)
 - Neutron irradiation @ Am-Be source (thermal + fast neutrons), Giessen (in preparation)

Results so far

- Both devices were irradiated with more than a PANDA lifetime dose, both are still working (microcontrollers running, CAN-communication, voltage regulators, ...)
- → During irradiation THMP on-board temperature sensor (1-wire device) failed. BUT: returned to normal after power-cycle (\Rightarrow single-bit-upset or s.th. similar \Rightarrow not critical)
- 2. Devices could behave differently (LP: pulse shape of blue light, profile of LCDs; THMP: response to measured resistance)
- $\rightarrow~$ Characterization after irradiation is ongoing.





Neutron Irradiation

- Preparations are ongoing now
- Irradiation foreseen to take place in the next 4-8 weeks
- Due to spatial limitations LP and THMP devices cannot be irradiated as a whole
- $\rightarrow\,$ Special round PCBs were produced containing almost all parts used on LP and THMP boards + fitting exactly into irradiation chamber
- $\rightarrow\,$ Boards are interconnected, components will be powered and read out via CAN-bus



Summary

- ► VPTT submodules: Cause for variations in yield of VPTT submodules identified ⇒ solution is being implemented, quick re-matching procedure is needed
- SADC modules: No significant cross talk could be observed using realistic signals in worst-case scenario test
- ► APD units / Annealing LEDs: Different scenarios tested w/ fully equipped subunit in climate chamber → so far no electrical effects visible; feasibility of mounting is being investigated
- Irradiation of LP/THMP: Devices survive PANDA lifetime dose, changes in characteristic are being measured; neutron irradiation in preparation

Backup

Gain Measurements of VPTTs

