Introduction
Temperature and humidity monitoring
Tests of the THMP
Summary and Outlook

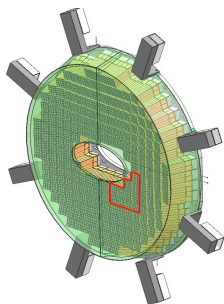# Temperature and Humidity Monitoring for Proto192

Florian Feldbauer

Experimental Hadron Physics
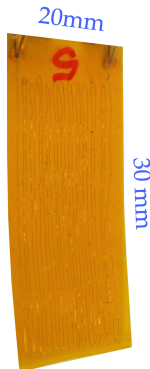Ruhr-Universität Bochum

March 3rd, 2009

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The Proto192

- Prototype of the forward endcap of the EMC consisting of 192 PWO crystals
- Change of light yield: $4\%/K$ at $-25^\circ C$ $\Rightarrow$ guarantee temperature gradient of < 0.1 K/cm
- Avoid formation of ice
- Tests of degradation of light yield by ice are running
- Monitor the temperature and humidity with the THMP (**T**emperature and **H**umidity **M**onitoring Board for $\overline{P}ANDA$)

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Sensors
General description of the monitoring board

Features of the Temperature Sensors

- Temperature sensors developed by Jan Schulze
- 60 cm platinum wire fixed in Kapton foil with a resistance of 100 Ω at $0°$C
- Dimensions: (30×20) mm^2
- To be mounted along the crystals
- Sensitivity of 0.05 K necessary
  $\widehat{=} 0.2\%$ change of light yield
- First sensors are produced and calibrated
- 0.05 K $\widehat{=} 0.02$ Ω

20mm

30 mm

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Sensors
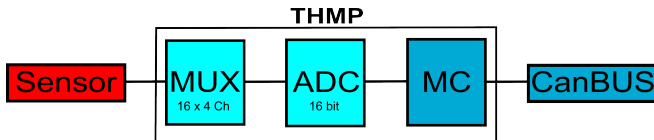General description of the monitoring board

Humidity Sensors HIH-4000

- Tested by Patrick Friedel
- Linear voltage output $\propto$ relative humidity (RH)
- Size of the sensor without pins (4.2×8.6) mm^2
- Operating range down to -40°C and 0% RH
- Accuracy of 3.5% RH
- Radiation hardness tested with 60 Gy
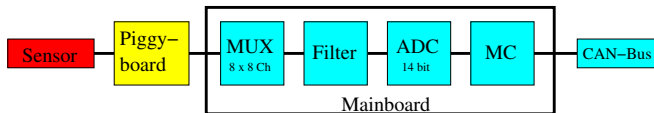 by Rainer Novotny; no change could be observed
- Further tests will be done

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Temperature and Humidity Monitoring Board for $\overline{P}$ANDA (THMP)

- THMP developed by Patrick Friedel and F. Feldbauer
- Designed THMP as mainboard with connectors to 8 piggyback boards
- 64 channels
- Design as presented at last meeting:

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Current Design of the THMP

- Redesigned multiplexing $\Rightarrow 8 \times 8$ channels
- Included filter between multiplexers and ADC to reduce noise
- Use new ADC (14 bit)
- Redesigned piggyback boards (exchanged nearly all parts)
- $\Rightarrow$ Reduced power consumption, much higher accuracy and lower drifts of individual ICs
- Current Design:

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Features of the Current Source
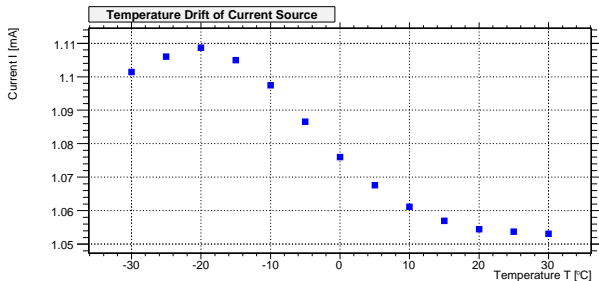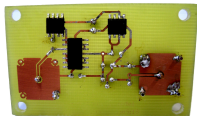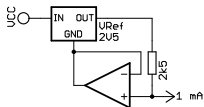First Tests of the Current Source

Current Source for the Temperature Sensors
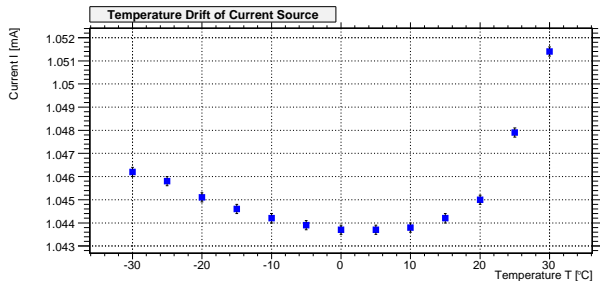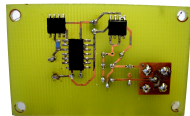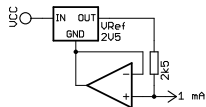
- Read-out via four-terminal sensing:
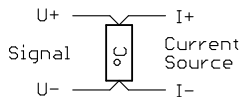
- Current source provides 1 mA
- Measurement range $-30°C$ to $+30°C$
- To reach required accuracy drift should be less then 10^{-4}
  $0.05°C$ at $0°C \Rightarrow 0.02\ \Omega$ at $100\ \Omega$

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drift $\sim 6 \times 10^{-2}$ mA

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drift $\sim 8 \times 10^{-3}$ mA

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Summary and Outlook

- Radiation hardness of the HIH-4000 tested with 60 Gy further tests with higher dose rates will be done
- Using piggyback boards to change number of temperature and humidity sensors
- Current temperature drift of current source is a bit too high
- Build prototype of THMP to test the other parts
- Use active or passive to reduce noise?
- Plan to build 5 boards for Proto192

Thank you for your attention