Tasks for AIDA SiPM Adaptive HV PSU

AIDA subgroup Prague 2013 meeting

Characterization of temperature influence to SiPM gain

Uni Bergen: G. Eigen, E. van der Kraaij

FZU Prague: J. Cvach, J. Kvasnička, I. Polák

Step 1

Chose **two** different SiPMs

Current **Russian SiPM** used in HBU (ask 3 + 3 pieces at DESY)

Hamamatsu **MPPC** (20 pieces available at UiB)

Ketek (3 pieces available at UiB)

…

Start with Russian SiPMs and Hamamatsu MPPCs

Measure at least 3 pieces of each type

Recherche of publications (some at IEEE NSS 2013)

Step 2 Temperature

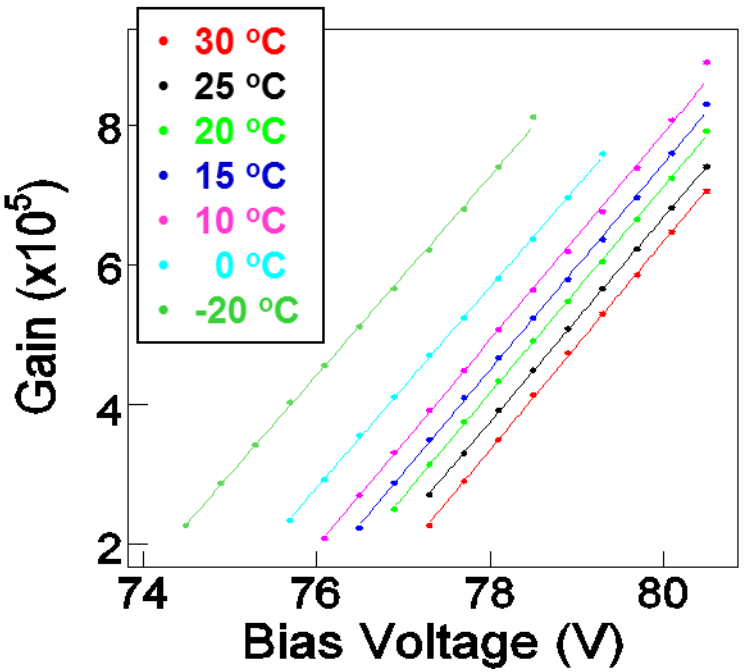
- Temp range of interest defined as 18 – 28 °C
- Stay close to real conditions & ease to measure (at the begining without cooling box?)
- Temperature steps of 1°C
- Somebody, producers also, are interested in frozen region (-10, -20°C)

Step 3 Test setup

- Temperature controlled box
  - Controller + Peltier element box w temp. sensor
  - SiPM run in pulse mode
  - external LED (temp dependence) + fibre to SiPM
  - One or two SiPM or more tested at once?
- Single/multichannel preamp/readout – ADC or digital scope, 1% of amplitude precision needed
- SiPM gain will be measured by the standard method – multi-gaussian fit to the single photon spectra at low LED intensity
- Power supply (HV PSU)
  - ISEG-HV or 6Q&Polak company
  - POWER module connected to HBU
  - More details in Step 7

Step 4 Data-taking, algorithm

- Stable HV PSU 18 to 85 V DC
- Measure G(T) in steps of 1°C at fixed voltage V (linear dependence with typical slope -3%/K
- Repeat the measurement at another voltage (steps of 5V?)
- Measurements done earlier (e.g. Satoru Uozumi) for MPPC

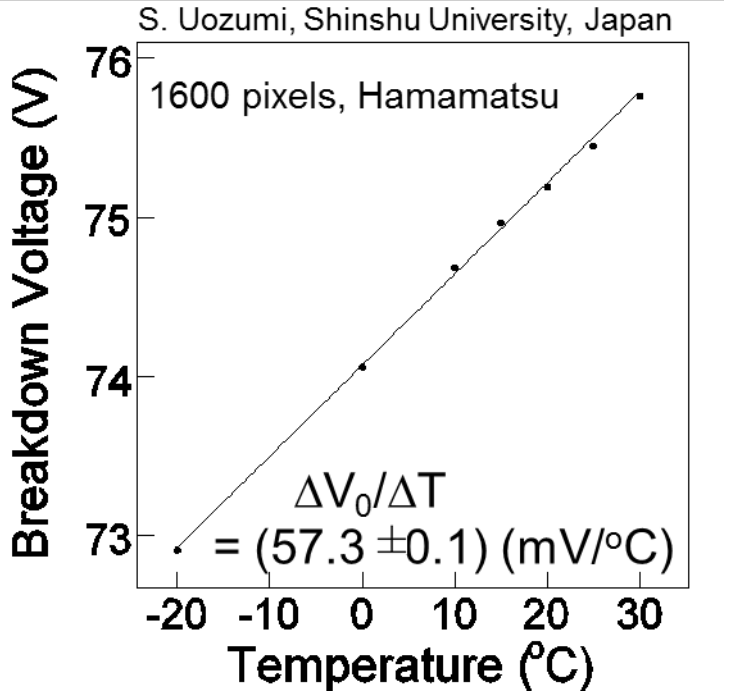


Step 5 Data analysis, formula

- How to find formula
  G = f(T, HV) = const?
  - Make two dimensional table G(Tj,Vk) and interpolate to G=const.
  - Draw a line through the set of measurement at G=const. and read V (graphically?)
- Satoru got a linear dependence (see plot) with slope for breakdown voltage:

à V/à T = (57.3 ± 0.1) (mV/°C)

Similar slope expected for the operating voltage



Step 6 code implementation

- Application into CALICE AHCAL, Labview control, for DIF (POWER board) at DESY
- C code? Universal routine
- Implementation to local Labview control system
- At HBU (CALIB module) analog / software linearisation of used PT1000 temperature sensors (6 per layer)
- Precise measurement of temparature is the key, it improves the loop stability of the compensation

Step 7 HV (HW) module

- Development of Universal compensative module
- Some features of the module
  - HV from bulk PSU in (max. 100V)
  - Implemented HV ramp-up, ramp-off
  - Module can consists:
    - Temp sensor input, op amplifier, compensation analogue or ADC/DAC, voltage regulator
  - TeREG <0; 2; 4 > Volts
  - Output voltage can be referenced to:
    - Input HV – tracking + trimming TeREG
    - Internal reference → Hvout + trimming TeREG

Timescale

- In WP9 milestone MS45 – Calibration and power supply has delivery date January 2014
- We agreed to have at the end of 2013 – proof of principles:
  - July 2013: decision if G(T,V) = const. is linear or quadratic function
- PRG tasks
  - Summer 2013: design of analogue control circuit (two possibilities for the reference voltage)
  - Autumn 2013 PCB development and construction
  - December 2013: PCB ready and first test (size of ΔV ripples?)
- Bergen tasks next slide

Timescale – Bergen tasks

Bergen – Erik @CERN

- Try to obtain a blackbox with temperature regulation / found one at CERN
- Need a pulsed LED. Will look at CERN what is available, else Ivo can perhaps provide one of the FZU drivers (QMB1A).

We discussed the gain vs temperature as measured by T3B:
http://twiki.mppmu.mpg.de/bin/view/T3B/GainTemperatureDependence

- They seem to reach accuracy of 1% on gain measurement. That is adequate for us.
- Erik has the same pre-amplifiers and digital oscilloscope (picoscope) T3B used.

- Will try to reproduce their gain measurements.
  - Ask Frank Simon / T3B how they measured the gain.
  - Try to obtain the Labview VI from T3B.
- Provide the Voltage vs Temperature functionality (its slope) by July.