Results of Anode Preamp Burn-in and Radiation Tests

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$(http://www-hep.phys.cmu.edu/cms/)$

- **High temperature test**

- **Recovery of boards after neutron irradiation**

Temperature test

($www - hep.phys.cmu.edu/cms/btest/test.html$)

- **Conditions**
  - 99 boards AD16 with CMP16F chips
  - power ON, thresholds zero (oscill.)
  - 4 months of heating at T = 110 C degrees, equiv. to about 5 years at T = 30 C
- **Measurements**
  - tested on ASIC test stand once a week for 1 month, then every 2 weeks for 1 month, now once a month
  - measure threshold, noise, gain,discriminator offset, slewing and resolution time
  - monitor average per chip, max, min changes relatively to data before training (Fig.1-3)
- **Results (after 3 months)**
  - no dead channels
  - the board parameters are stable
- **Plans**
  - will continue testing the 99 boards for at least another 4 months - equivalent to 10 years at 30 C
  - plan to heat all anode boards during production for 1-2 weeks at 110 C

New irradiation test and board recovery

($www-hep.phys.cmu.edu/cms/RAD\_HARD/2000/rad\_test\_p\_63\_1.html$)

- **The highest radiation levels in the EMU region (ME1/1)**
  - **the 10-year period of LHC operation with a peak luminosity of 10^{34} cm^{-2}s^{-1}**
  - **up to 1.78 krad of total ionizing dose (TID)**
  - **up to 0.62 x 10^{12} n/cm^2 of neutron fluence**
  - **the goal is to test front-end electronics up to level of 3 times doses above (safety factor)**
  - **in non ME1/1 regions the doses are 10 times lower**

- **Previous test (July 2000)**
  - **4 unpowered boards AD16 with CMP16F chips**
  - **no preliminary exposure to the proton beam**
  - **2 survived at $\leq$1.8 x 10^{12} n/cm^2, γ TID$\leq$50 krad**
    2 damaged at $\geq$3.0 x 10^{12} n/cm^2, γ TID$\geq$80 krad
    (very high threshold, large noise)

- **New test (Aug - Oct 2000)**
  - **6 powered boards AD16 with CMP16F chips**
  - **TID of 5 krad (2.5 min) in 63 MeV p beam at the UC Davis (Aug 28), no effect on the board performance**
  - **15 min n irradiation in the OSU reactor (Oct 13)**
    2 x 10^{12} n/cm^2, γ TID = 50 krad
  - **2 were working in the test taken 40 days later,**
    4 were back to life after 1 week of heating
  - **the heating at 110 C brings parameters back to normal (Fig.4-7)**

New irradiation test and board recovery (continued)

- **Damage and recovery rates**
  - heating just speeds up the normal self-annealing process
  - for the test doses above the annealing time is about a few months at normal T
  - the LHC rate of real radiation exposure is much slower (same dose/30 years)
  - the boards should not show any radiation damage during LHC operations.

- **One more upcoming (final) test**
  - new (final) boards with CMP16G chip
  - TID of 5 krad in 63 MeV p beam at the UC Davis
  - neutron irradiation at the U of Massachusetts Lowell Radiation Laboratory

- **Advantages at Lowell**
  - Van de Graaff n source (0.5 MeV), no γ TID
  - testing boards during irradiation allows to measure the n radiation damage rate
  - ^{60}Co γ source is available too