Analysis of DESY testbem data starting from 16 : 45 local time on March 1.

Scope inputs are : 1) front APD 200 mV / div, 2) front APD 10 mV / div, 3) back APD 200 mV / div 4) back APD 10 mV / div

trigger is 4 mm ** 2 APD (trigger) with mean amplitude ~ 600 mV and threshold of 40 mV. Preamps are Cividec (2 GHz, 40 dB) for channels 1 and 2 and Wenteq (1 GHz, 50 dB) for 3.

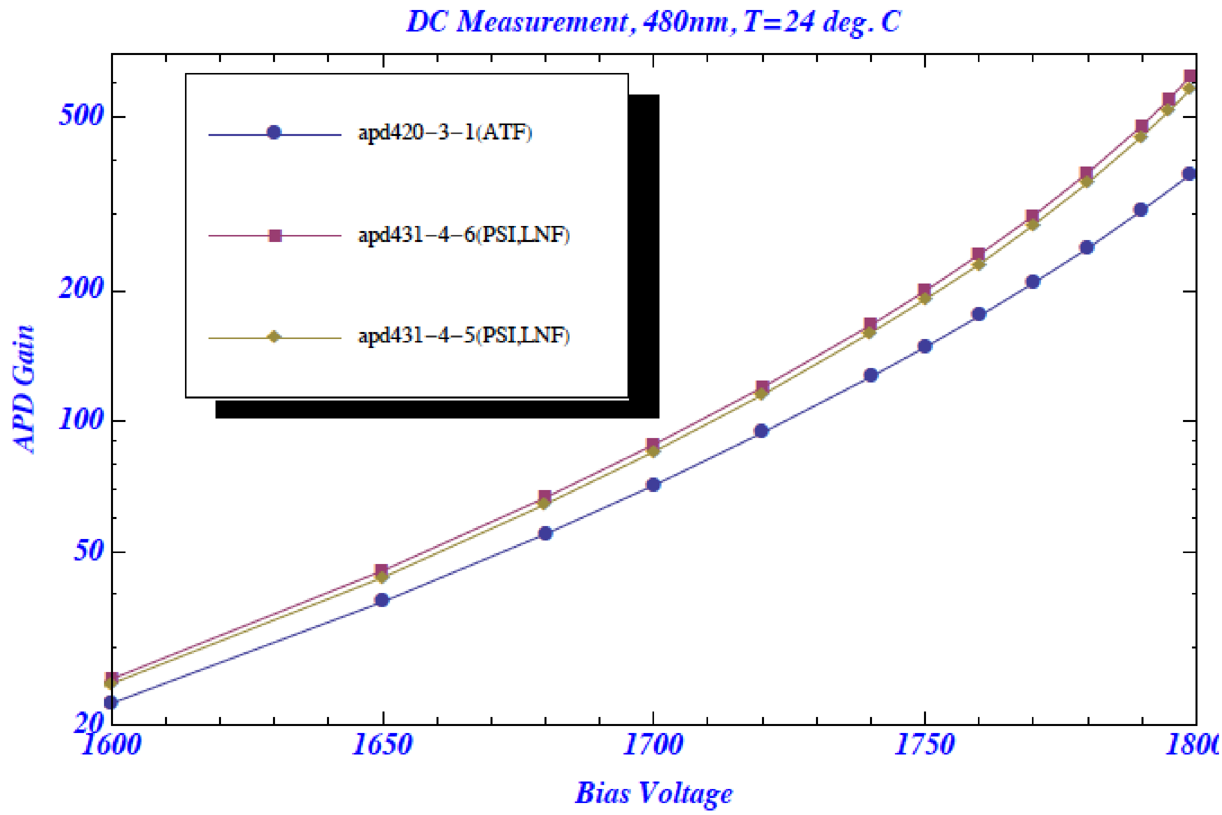
For all data the APD bias voltage was 1795 volts. (most likely gain ~ 520)

I noted on the morning of the 2 nd that (one of) the APDs was starting to draw current and that, as a result, the effective HV on all detectors was reduced. Tracing this down in the data themselves I find : - runs 32 - 37 are all ok with 10 k events / file

- run 38 is a short run (skip it)
- runs 39 and 40 seem also good with 10 k events
- but 41 and 42 (and possibly end of 40) look like gain has dropped.

=> So estimate ~ 80 k mip event to work with. SNW - Oct. 29 th, 2014

First calculate expected signal amplitude for min. ionizing particle in the 8 x8 m m^2 APDs (area enters because this has large capacitance leading to a loss in peak amplitude into a 50 Ω voltage amplifier - by a factor of ~ 5 in simulation).



Uncertainties on expected pulse amplitude : 70 e - h/micron is taken from paper of Meroli et al.40 Micron is given by Dick Farrell as effective thickness of high field region.From the above Gain curve, the expected gain at 1795 V is in range~320 to 520 but private communication from Dick Farrel says one device (464 - 6 - 1) would correspond to higher gain curve above.

```
In[456]:= ehpairs = 70;
          thick = 40;
          G_APD = 520.;
          t_pulse = 5 * 10^-9;
          Qe = 1.6 * 10^-19;
          R = 50.;
          Q = ehpairs * thick * G_APD * Qe
          i_peak = Q / (t_pulse / 2);
          v_peak = i_peak * R

Out[457]= 2.3296 × 10^-13

Out[459]= 0.0046592
```

```
dbamp = 20 Log[10, 100];
gamp_Cividec = 10^(40/20)
gamp_wenteq = N[10^(50/20)]
100

316.228
```

Conclusion :

We should expect an input signal with peak amplitude of about 4.5 mV into the preamp and should take into account a factor of about ~ 5 reduction for the capacitance of the 64 mm ^ 2 detectors ..
Inspection of the DESY data below shows a peak amplitude of about 600 mV,
roughly as expected for the low capacitance 2 * 2 m m^2 detector (using the Wenteq spec sheet w.50 dB nominal gain we would actually expect ~ 1.5 V). The data for the 64 mm ^ 2 detectors have a most probable p.h.of about 120 mV.Since Wenteq gain is about 3 times Cividec the pulse height difference is not as significant as expected (5 : 1 instead of 3 : 1). The 64 m m^2 detector has lower amplitude (but unlikely more than *a* factor of 2 reduction) & slower risetime than the 4 mm ^ 2 detector. This is in qualitative agreement with the circuit simulation we did.It also means that,
with a 2 nsec risetime signal the preamp noise at the output,
in order to have less than 20 picosecond contribution to the time jitter,
should be less than 4 mV - ie SNR = 100 : 1.

"iorder" specifies level of filtering. ie iorder=5 reduces 5 GHz to 1 GHz average of 5 pts. Expect noise reduction from sampling to be 1/sqrt(5).

Start by looking at dataset with trigger apd in chan3 to get full ph distributions.

4 channels of LRS 1 GHz scope with 5 GHz sampling.Ch1 = front, Ch2 = back 64 mm ** 2 APD.Ch3 = 4 mm ** 2 APD,
triggers scope at 40 mV.