P8-24

~~Improving the Thomson scattering Diagnostic installed on the Large Helical Device~~

(changed)➔

Validity Check of Thomson Scattering Data of Very High Density Plasmas in LHD

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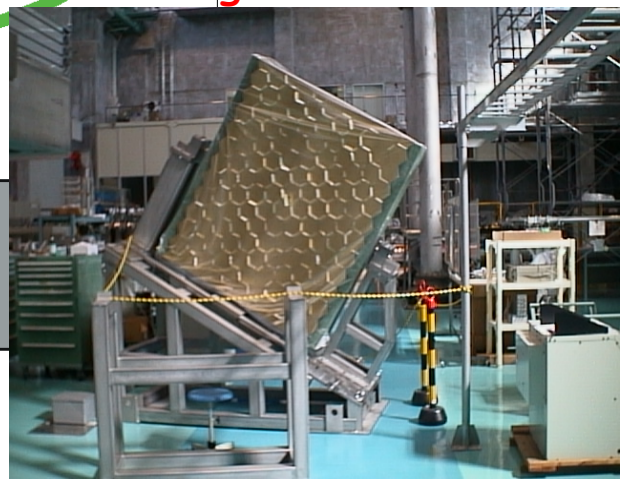
Motivations

- How confident is the Thomson scattering data for a very high density plasma, which accompanies very intense back/fore-ground plasma light?
- We examined the effect of back/fore-ground plasma light on the performance of an avalanche photodiode (APD) used for the detecting the Thomson-scattered light, and established a criterion for the validity.
- We newly installed thirteen 80-channel scanning ADCs to monitor the DC level of APDs, which is a measure of the intensity of the plasma light.

Scattering Configuration of LHD TS

Tips of fiber array

Segmented mirror

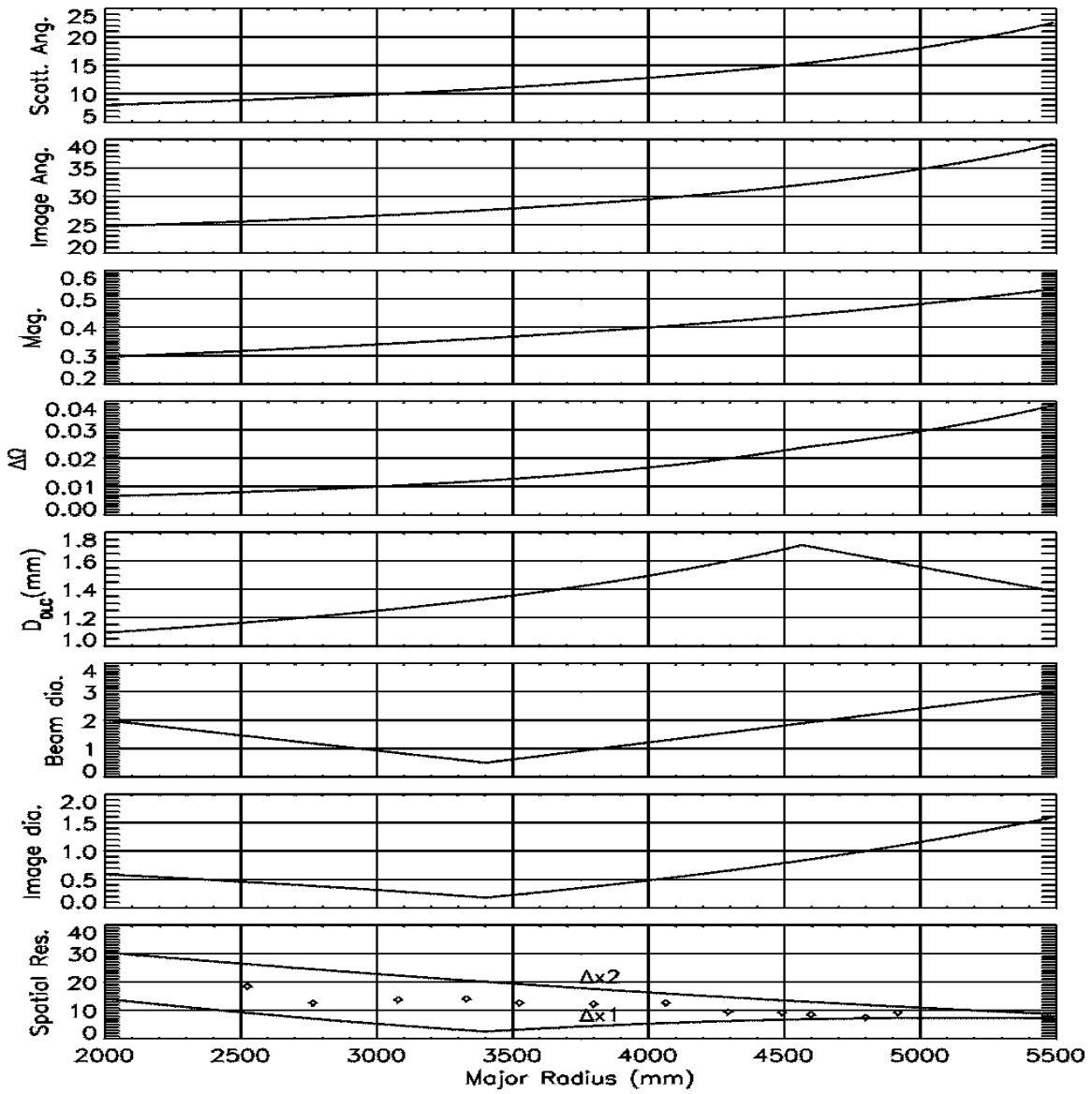


Highly oblique back scattering

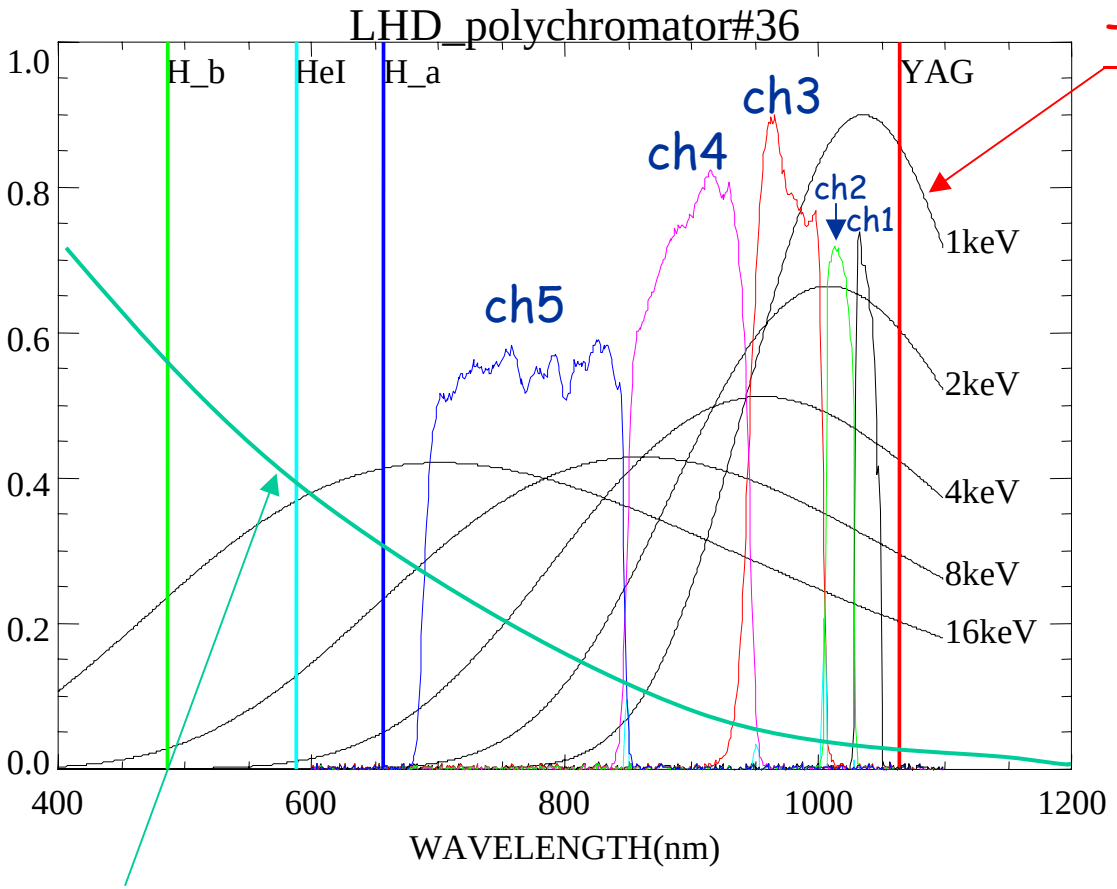
Whole plasma region along a major radius on the mid plane

200-spatial channels (the plasma is covered by 130 channels)

Scattering Parameters as a Function of the Scattering Position



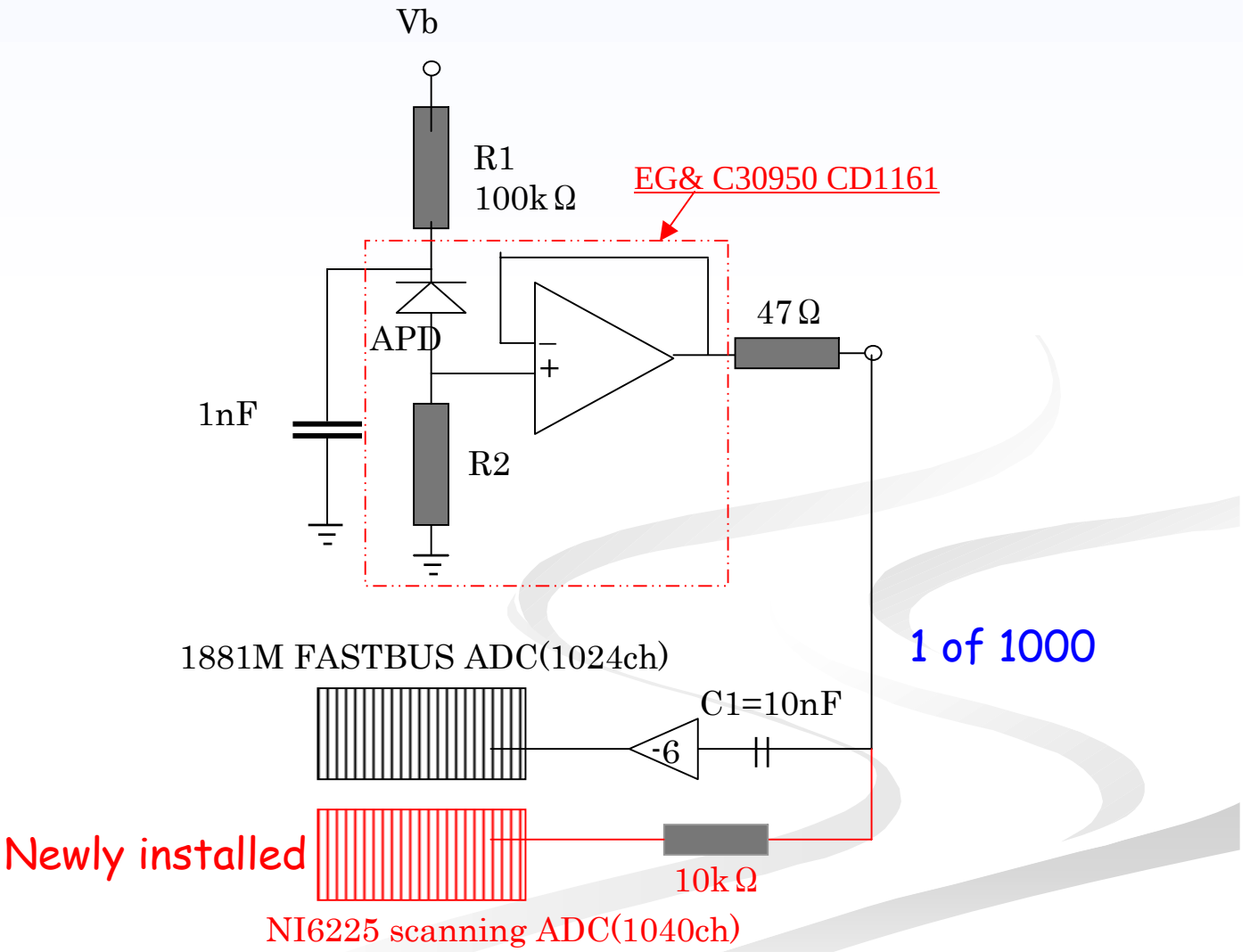
Polychromator



Thomson scattered light

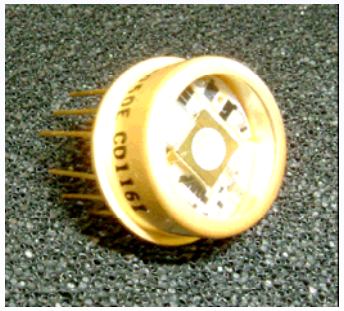
Expected Plasma light

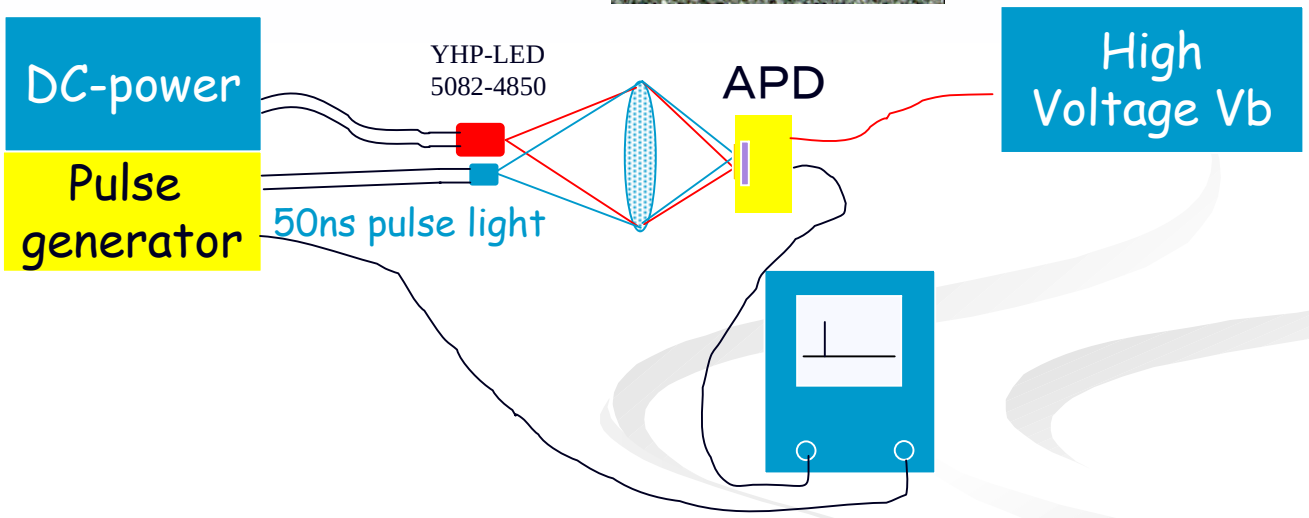
Circuit Diagram of APD and Data Acquisition System



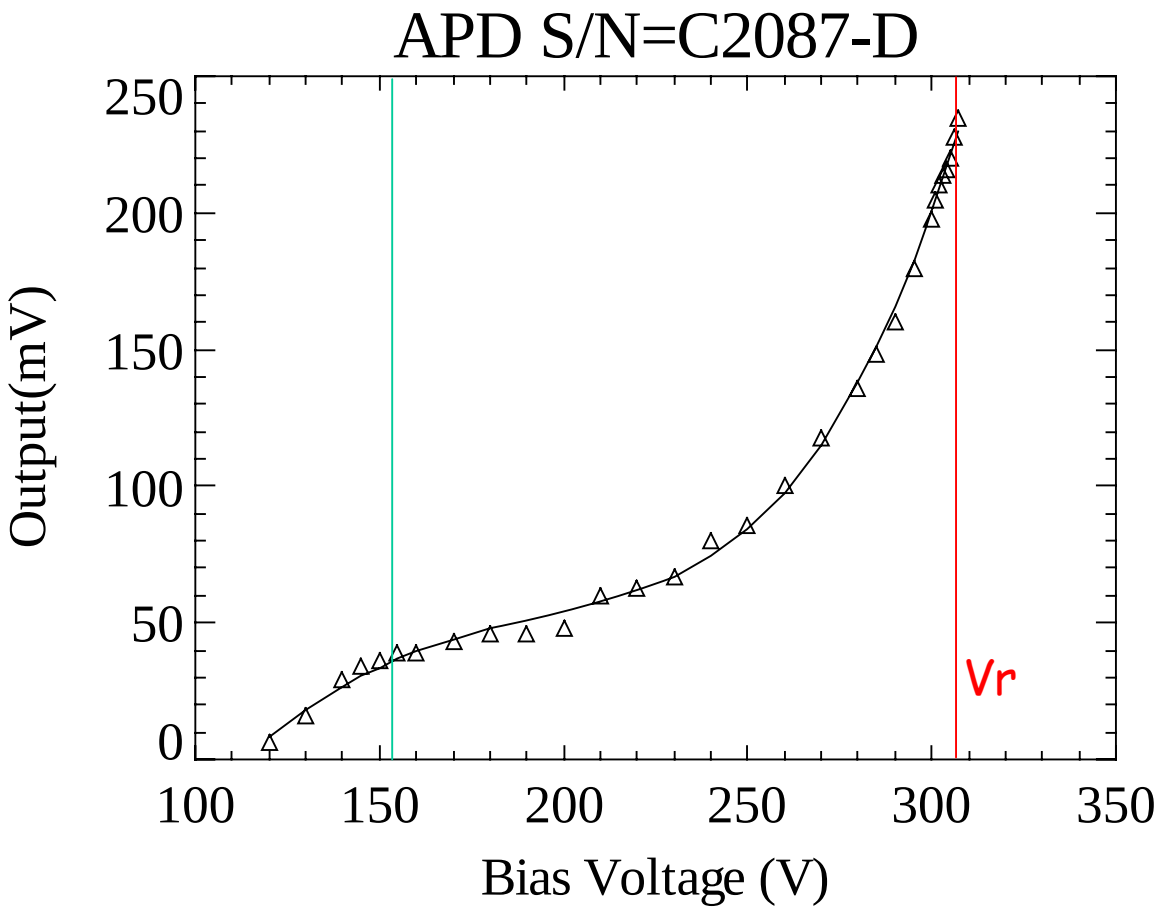
Setup for Test Measurement

APD: EG&G C30950-CD1161 S/NC2087D
Operating Voltage Vr=307V @ R=675kV/W
Dark current Id= 140 nA
Band Width BW=25 MHz

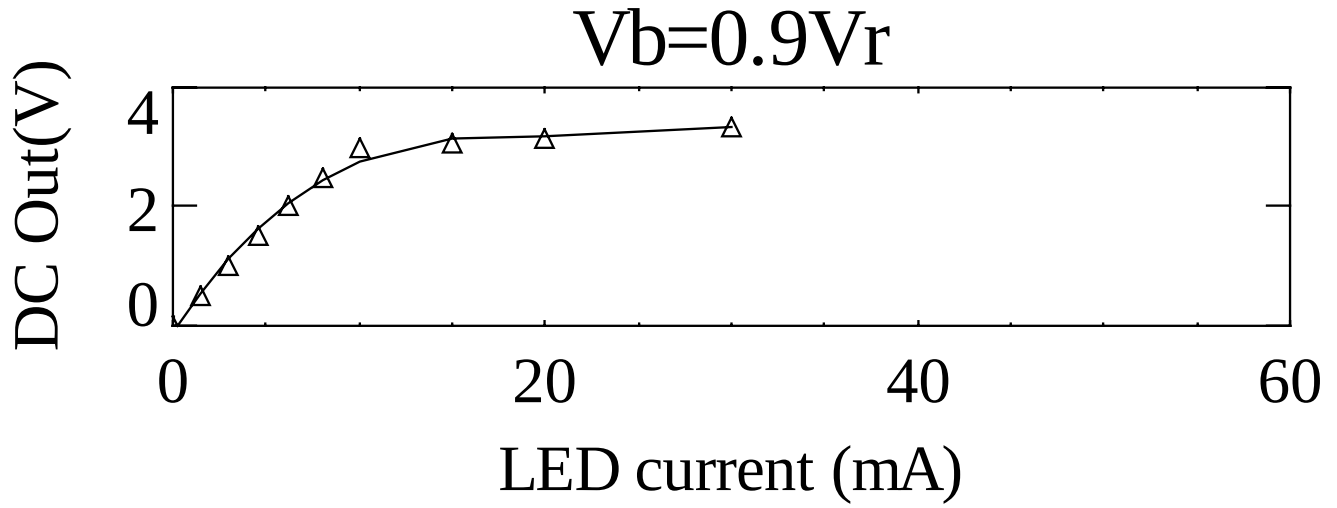


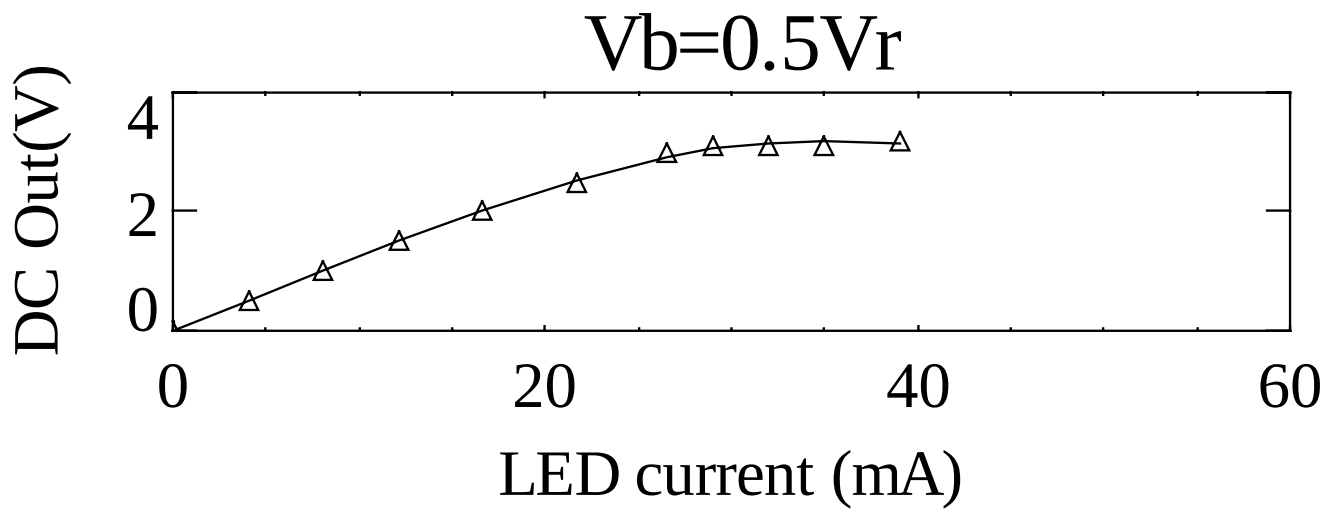


Output Voltage as a Function of Bias Voltage

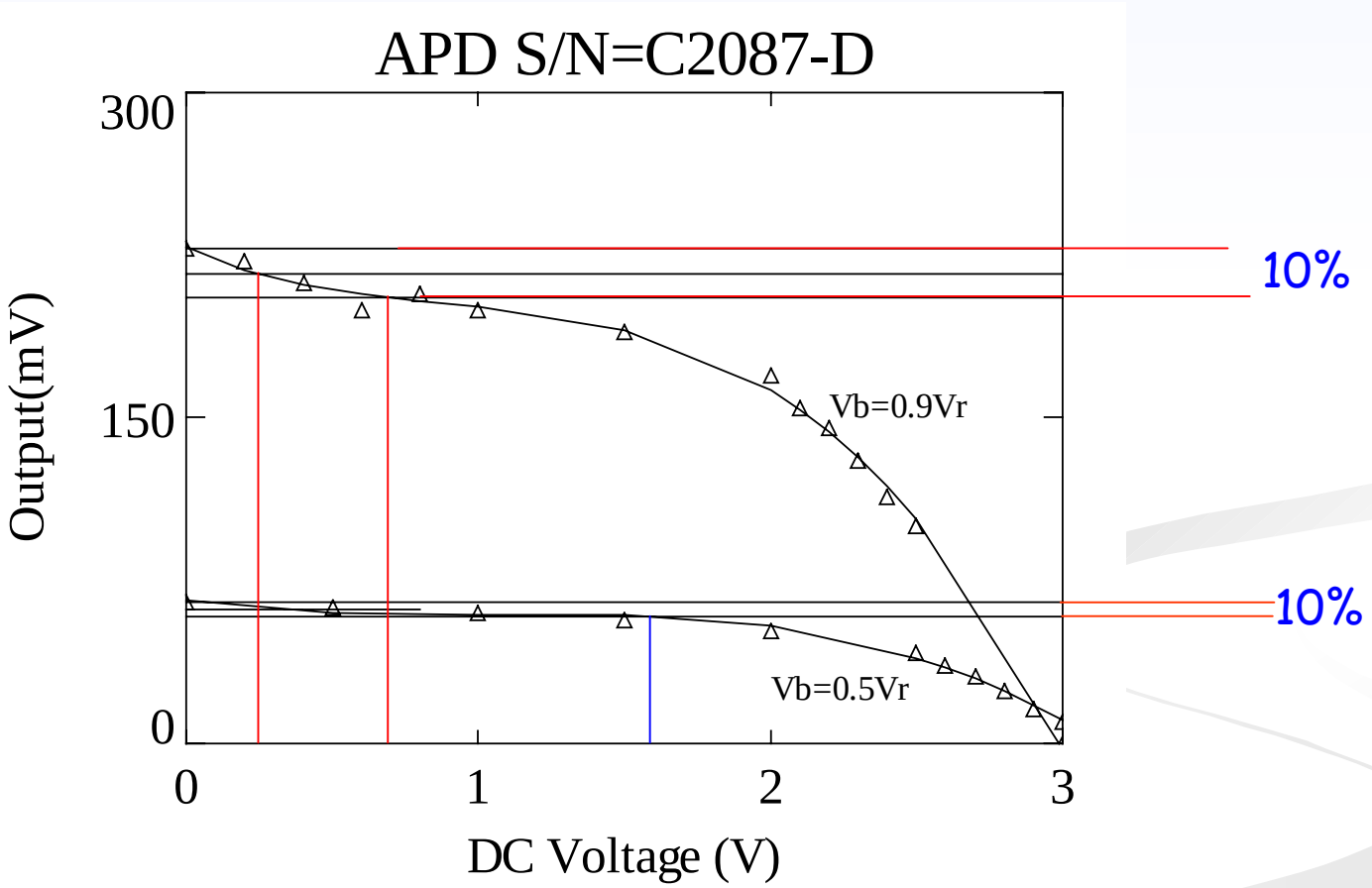


LED—CURRENT vs DC-OUTPUT for two different high voltage



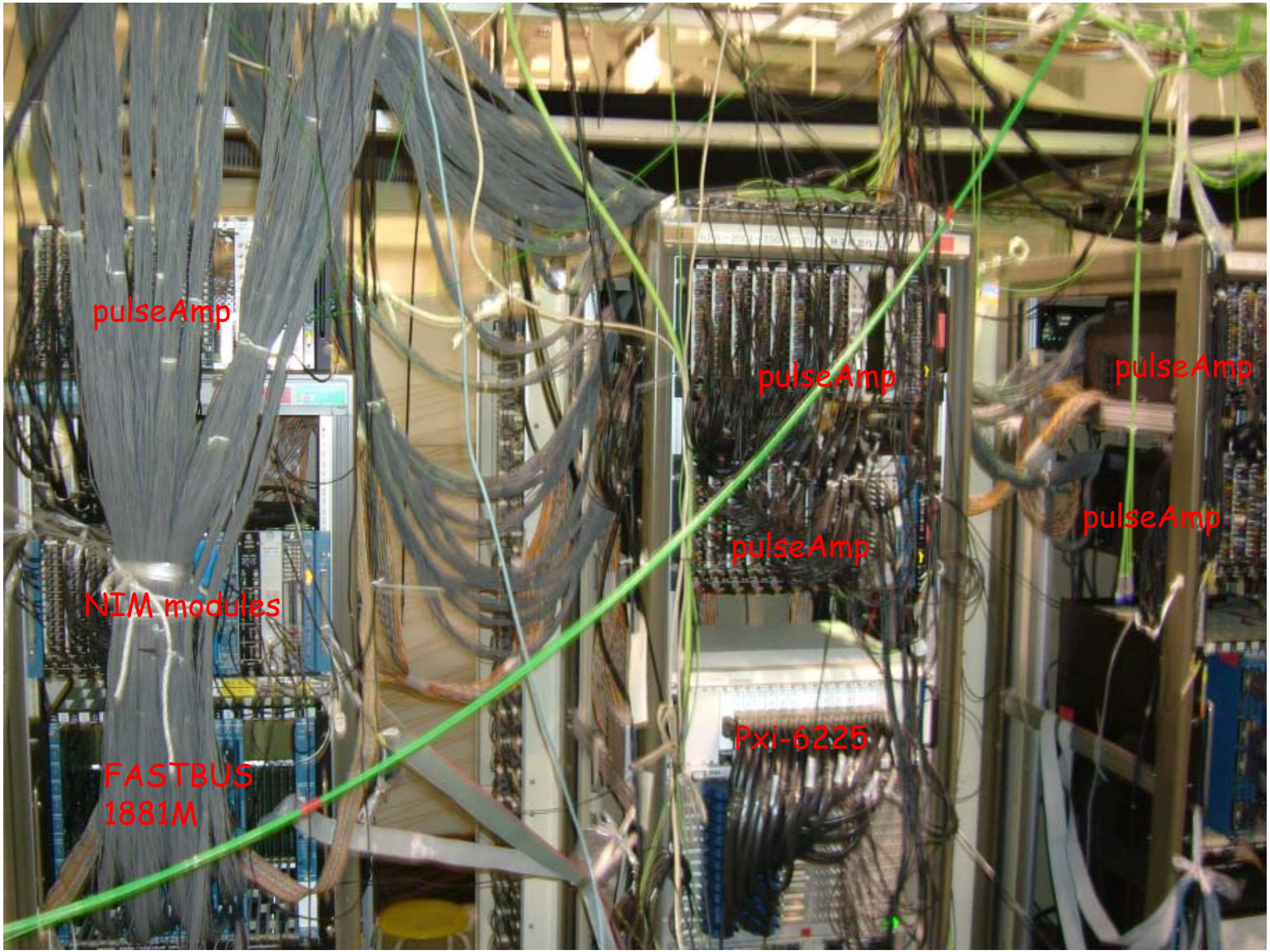


Pulse Output as a Function of DC-level for a Fixed Pulse Light Intensity:



Lower Vb is favorable for measuring denser plasma:

But too low Vb (eg. 0.4 Vr) causes the frequency response of the APD slow (the depression layer width becomes narrower and the APD has a higher capacity.)

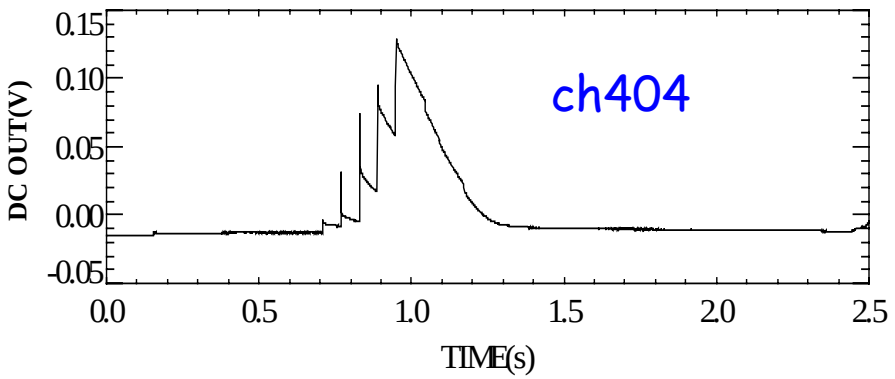

pulseAmp
pulseAmp
pulseAmp
pulseAmp
pulseAmp
NIM modules
Pxi-6225
FASTBUS
1881M

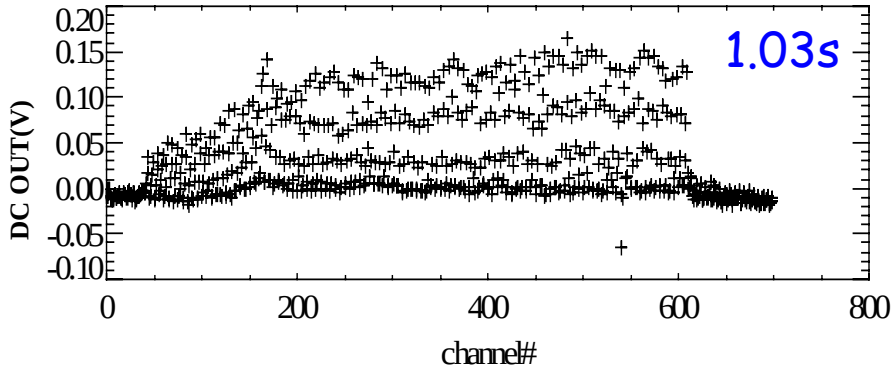
Example #69360:

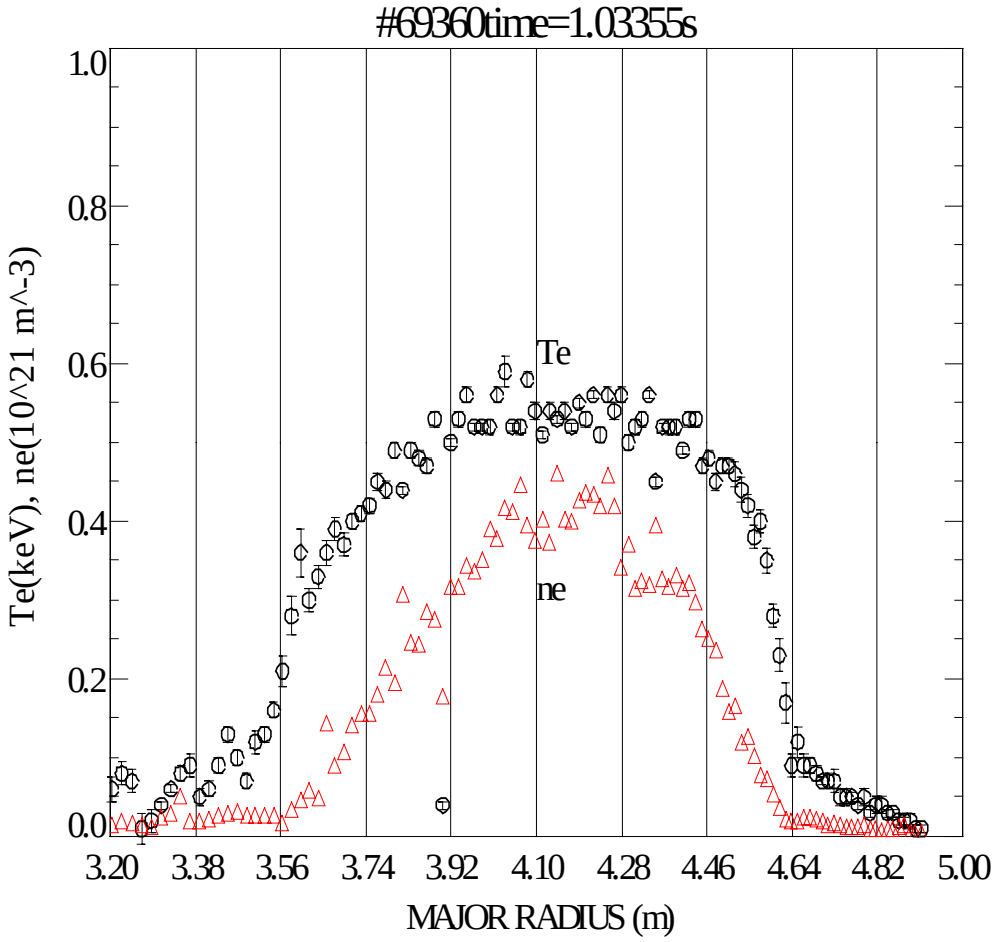
DC-level of all APDs are low enough to guarantee the linearity.

Vb=0.5 Vr: Window fully opened.

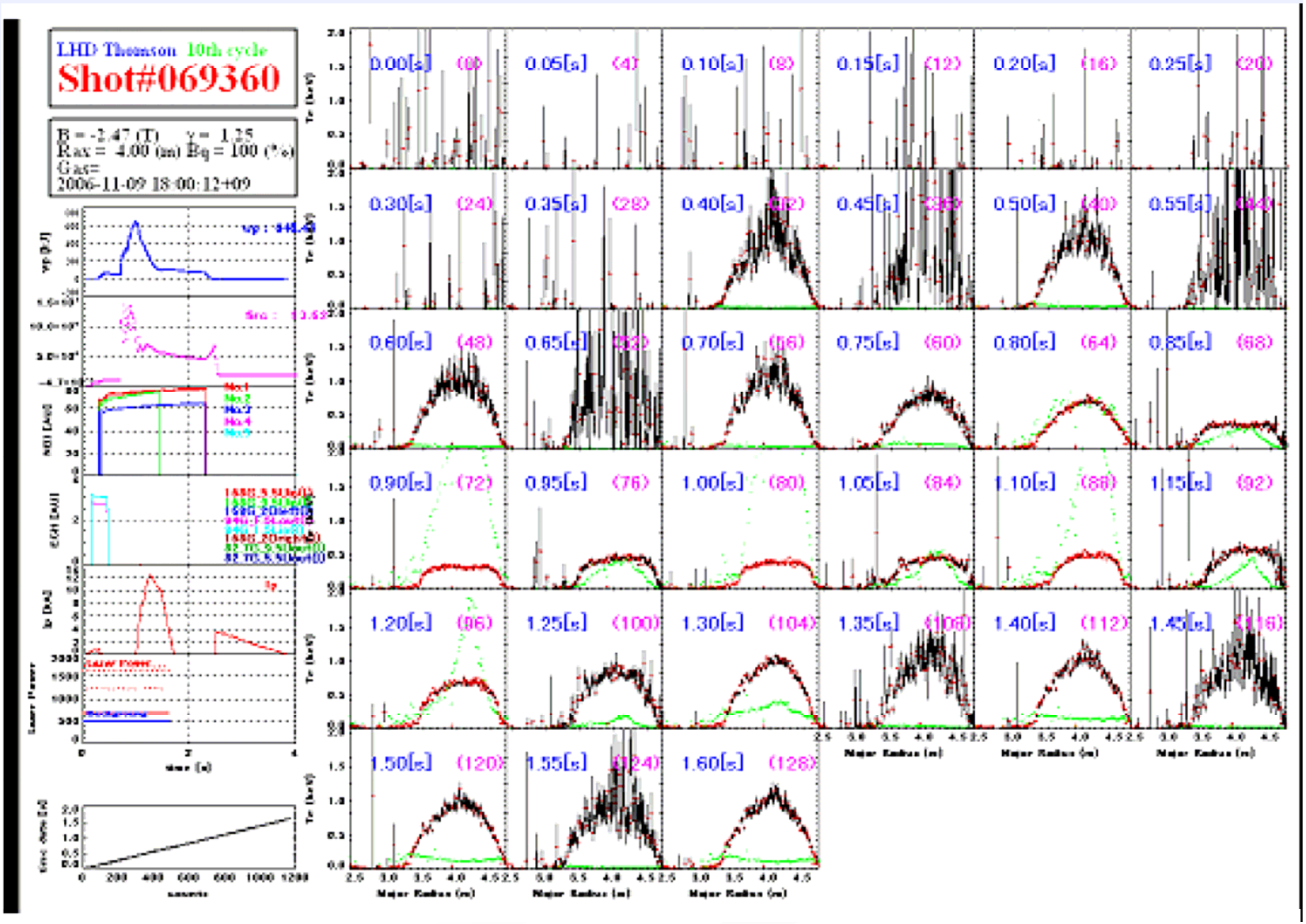
Time evolution of DC-level



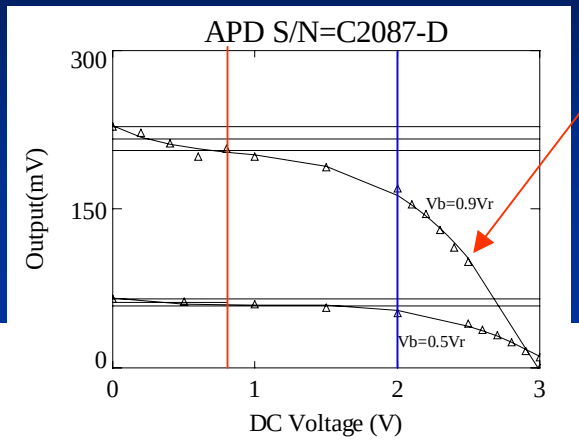




We assumed that all APD's gain depend on Vb/Vr similarly, which is not yet checked.
Density calibration is not yet completed.


LHD Thomson 10th cycle
Shot#069360
B = -2.47 (T) γ = 1.25
Rax = 4.00 (m) Bq = 100 (%)
Gas=
2006-11-09 18:00:12+09
0.00[s] (0)
0.05[s] (4)
0.10[s] (8)
0.15[s] (12)
0.20[s] (16)
0.25[s] (20)
0.30[s] (24)
0.35[s] (28)
0.40[s] (32)
0.45[s] (36)
0.50[s] (40)
0.55[s] (44)
0.60[s] (48)
0.65[s] (52)
0.70[s] (56)
0.75[s] (60)
0.80[s] (64)
0.85[s] (68)
0.90[s] (72)
0.95[s] (76)
1.00[s] (80)
1.05[s] (84)
1.10[s] (88)
1.15[s] (92)
1.20[s] (96)
1.25[s] (100)
1.30[s] (104)
1.35[s] (108)
1.40[s] (112)
1.45[s] (116)
1.50[s] (120)
1.55[s] (124)
1.60[s] (128)
Te (keV)
Major Radius (m)

Comment on the 9th Campaign Data



Vb=0.9Vr; window 10% open

We have no information on interferometer and V_{DC}

Suppositions:

1: if V_{DC}<0.8V for all APD: error on ne & Te would be less than 30% ::OK

2. If V_{DC} > 2.5V for most APD: Te profile would be irregular and unnatural➔ We would disregard it:: OK (We would not be deceived).

3. If V_{DC} < 2 V for all APDs: signal error <30%; ne & Te profile may be smooth in shape but have error 60~90%; highly deformed profile. We should be much careful not to be deceived.

Conclusions

- 1. We evaluated the effect of the plasma light on the pulse-response of APDs used for detecting the Thomson scattered light.
- 2. For accuracy better than 10%, the DC-outputs induced by plasma light should be less than ~0.8 V, for Vb=0.9Vr; and ~1.6V for Vb=0.5 Vr.
- 3. The newly installed 13-80ch scanning ADCs routinely monitor the DC-levels of all APD outputs, thus enabling the linearity-check on the acquired data.
- 4. For measurement under super bright radiation, combined optimization of Vb and the windows' aperture will be needed.