Comparisons of Scintillating Fiber, Diamond Particle Detector and Beam Current Transformer

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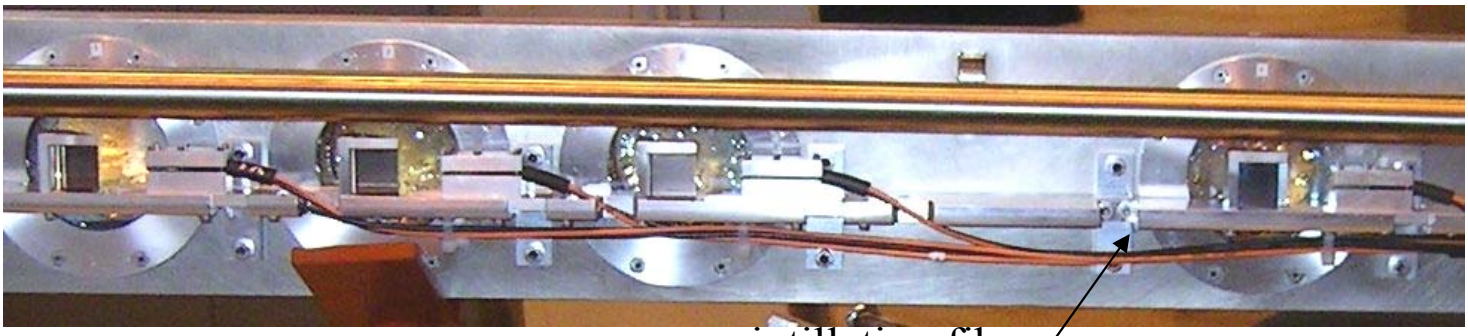
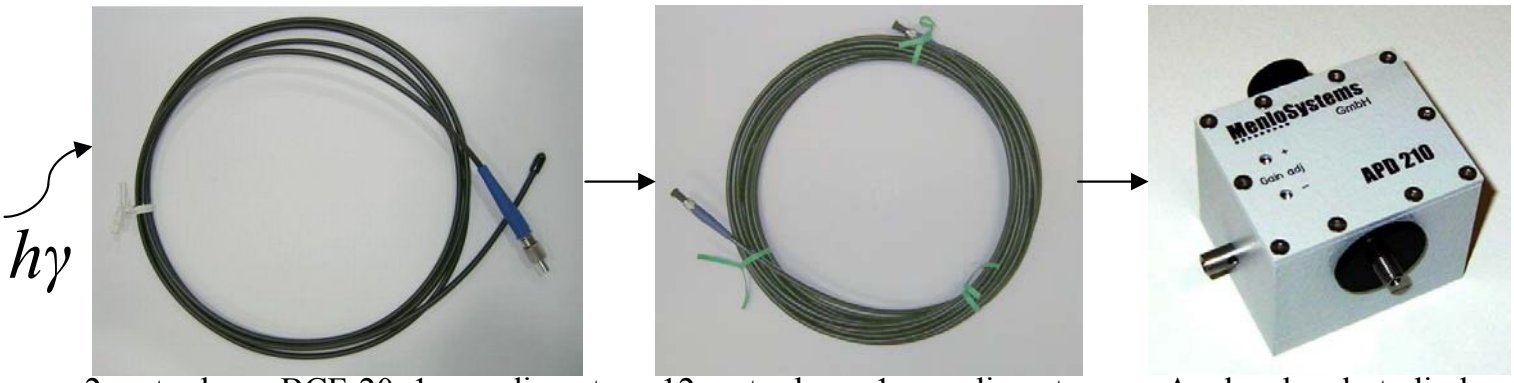
(Nov 24, 2009)

Scintillating fiber channel #0

Feb. 6, 2008

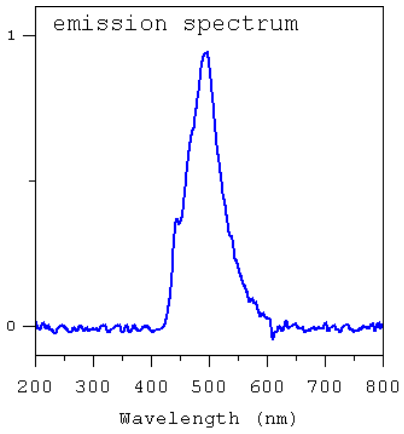


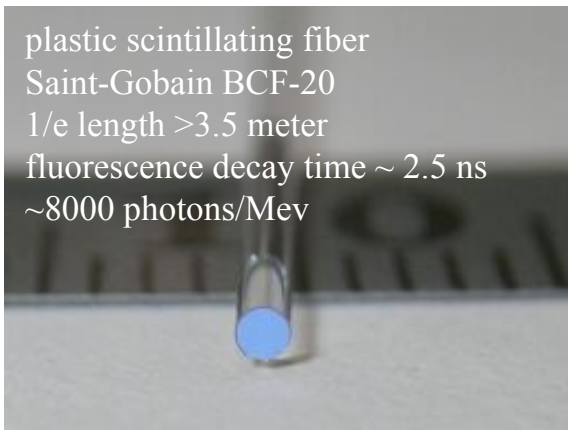


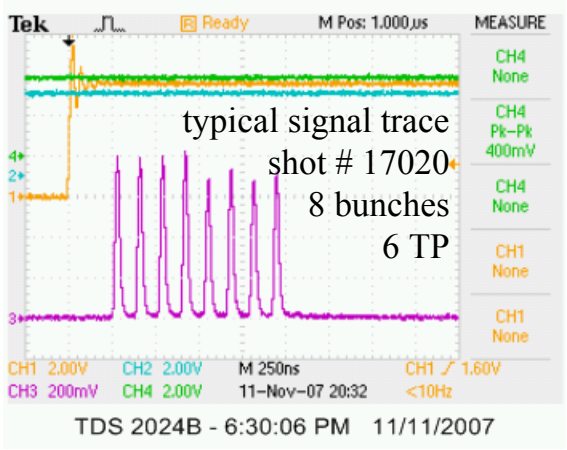
2 meter long, BCF-20, 1-mm diameter blue emitting scintillating fiber

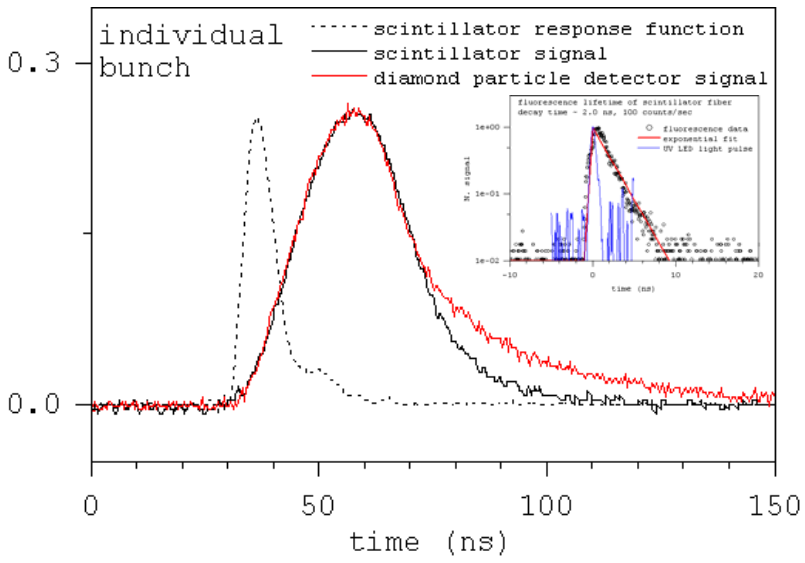
12 meter long, 1-mm diameter BFH37-1000 fiber, blue T=0.77

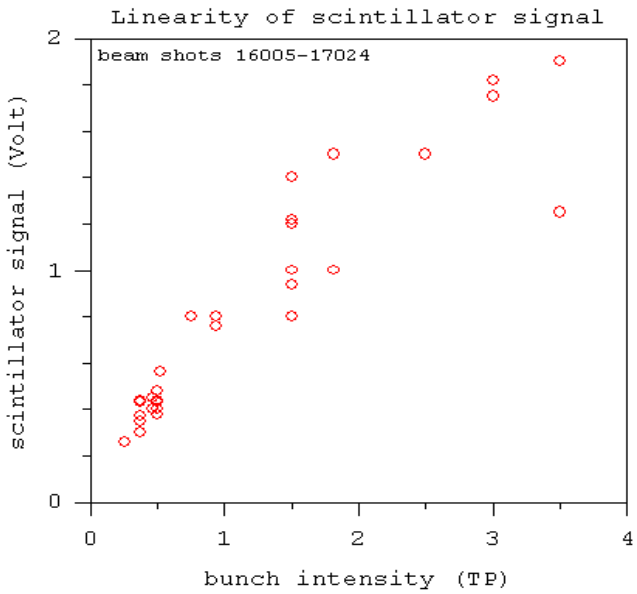
Avalanche photodiode



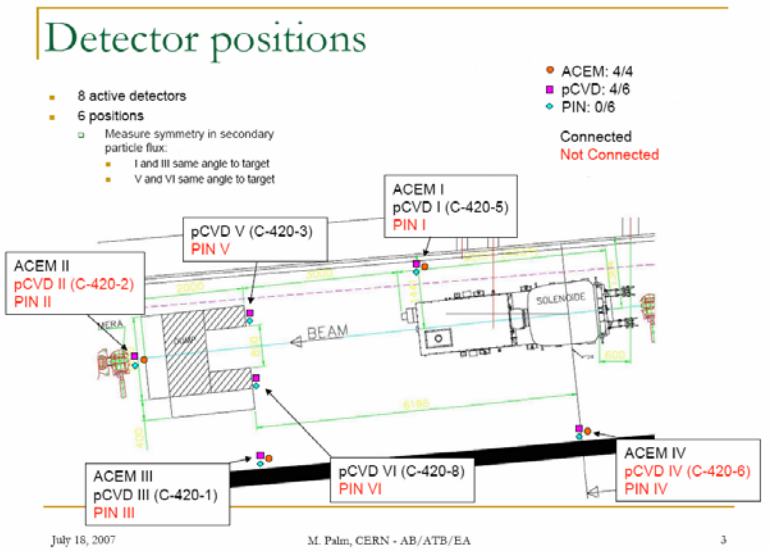


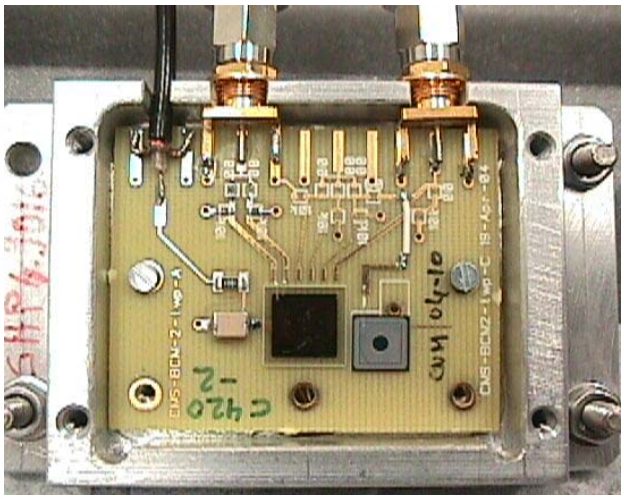


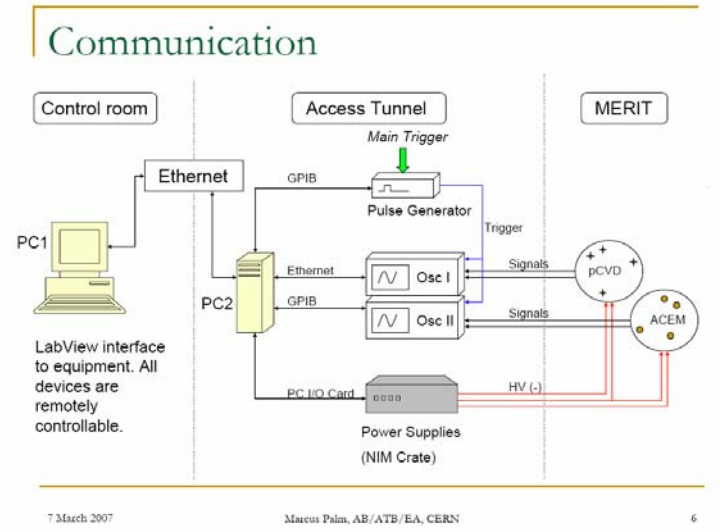


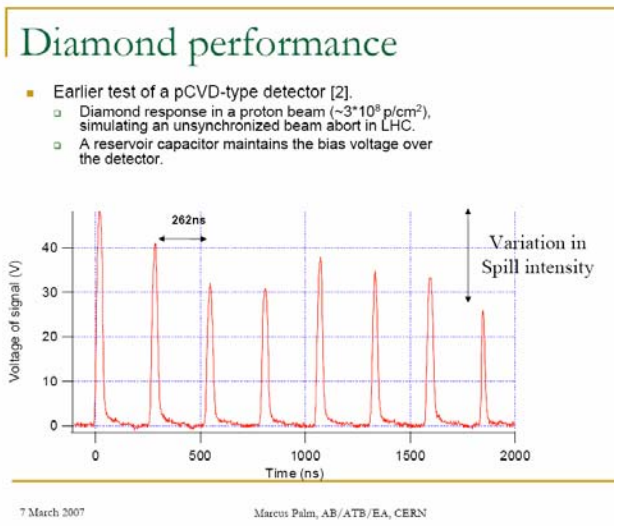


Diamond particle detector from Marcus Palm

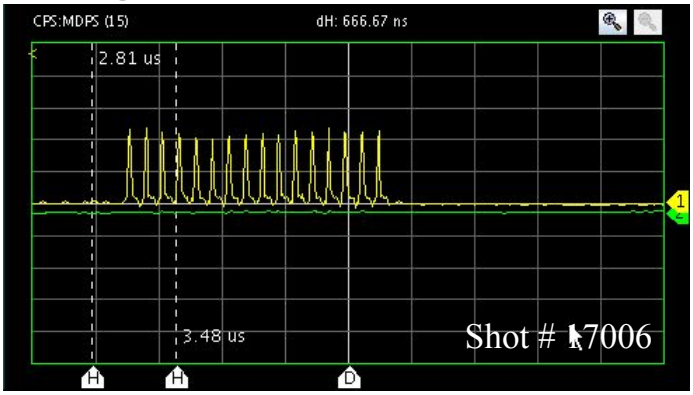








typical diamond detector signal trace



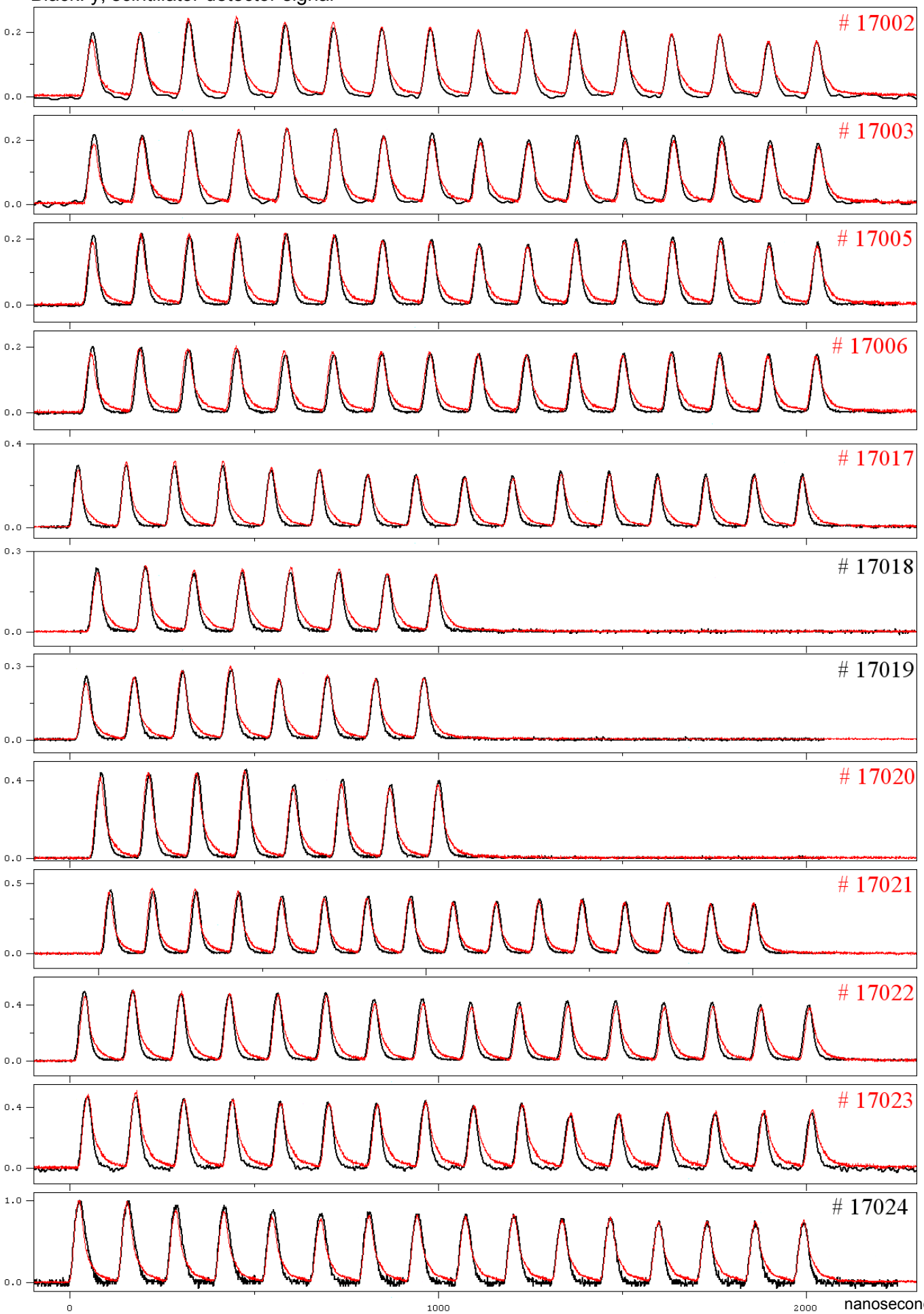
Correlation of Scintillator & Diamond Particle detector signal

Nov 4 2009

Nov. 11, 2007, 17000 series data
Red: x, diamond particle detector signal @ left 20°
Black: y, scintillator detector signal

calculated correlation of peak height
(data smoothed with 3 or 5 pts)

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

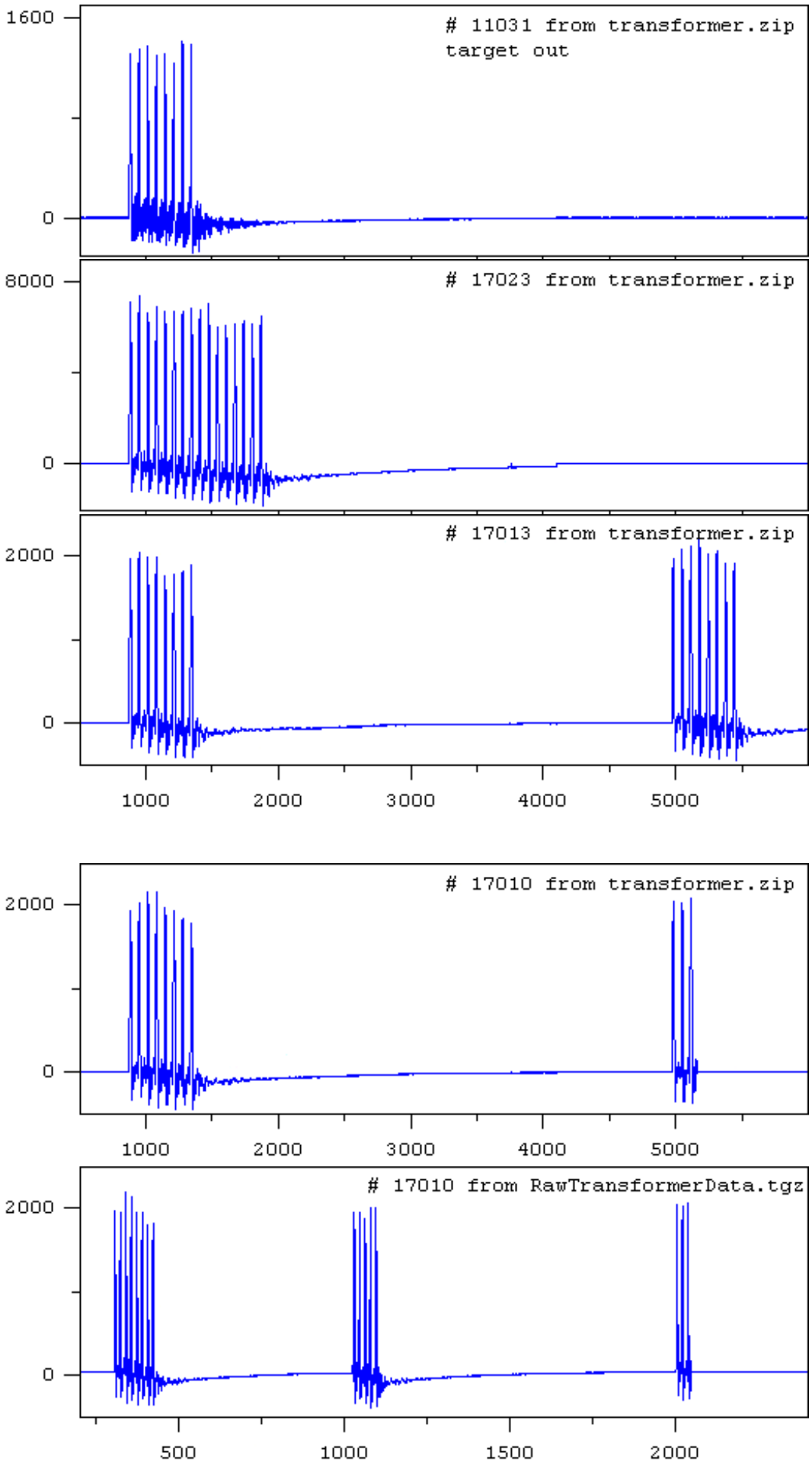


	P&S
# 17002	0.94
# 17003	0.90
# 17005	0.87
# 17006	0.47
# 17017	0.93
# 17018	0.56
# 17019	0.83
# 17020	0.97
# 17021	0.95
# 17022	0.89
# 17023	0.95
# 17024	0.92

typical transformer signal trace

transformer.zip – higher resolution data
RawTransformerData.tgz – lower resolution data

Beam current transformer summary.xls appear to be a file for adjusting the baseline shift



Correlation of Scintillator & Diamond Detector & Current Transformer Signals

Nov 13 2009

Nov. 11, 2007, 17000 series data

Red: x, diamond particle detector signal @ left 20°

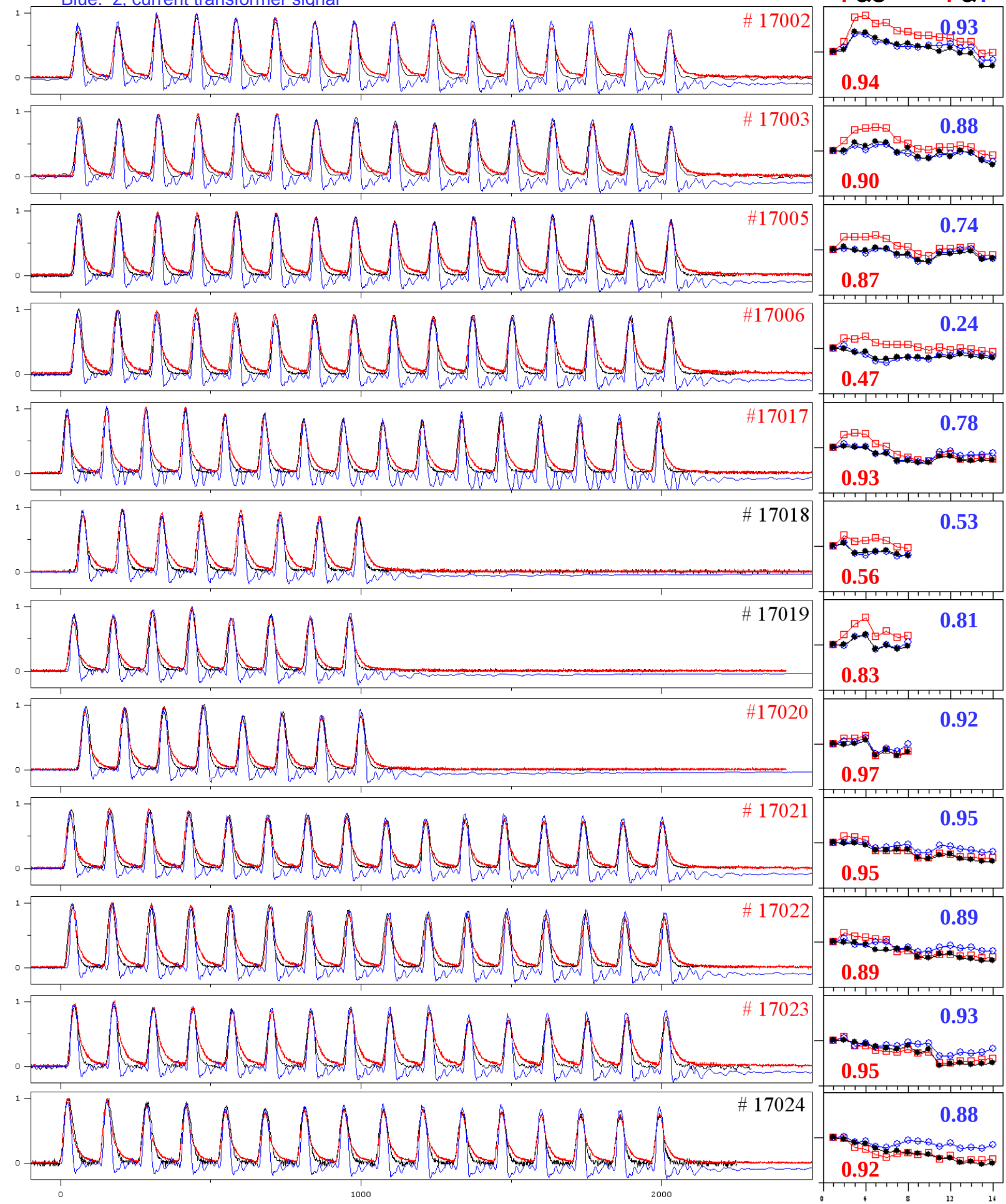
Black: y, scintillator detector signal

Blue: z, current transformer signal

calculated correlation of peak height

(data smoothed with 3 or 5 pts)

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$



Correlation of Scintillator & diamond Particle & current Transformer signal pump-probe studies

Nov 18 2009

Nov. 11, 2007, 17000 series data

Red: x, diamond particle detector signal @ left 20°

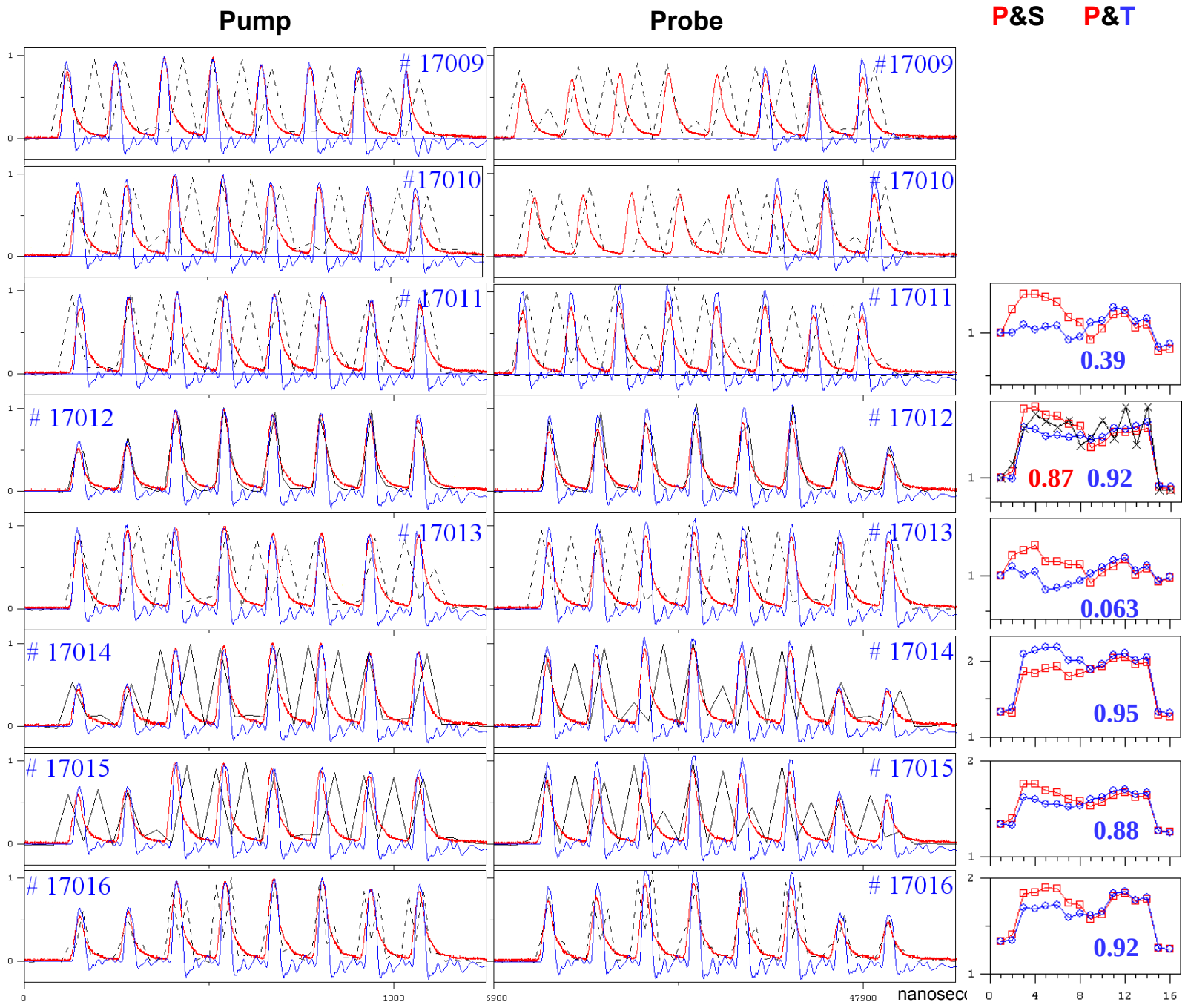
Black: y, scintillator detector signal

Blue: z, current transformer signal

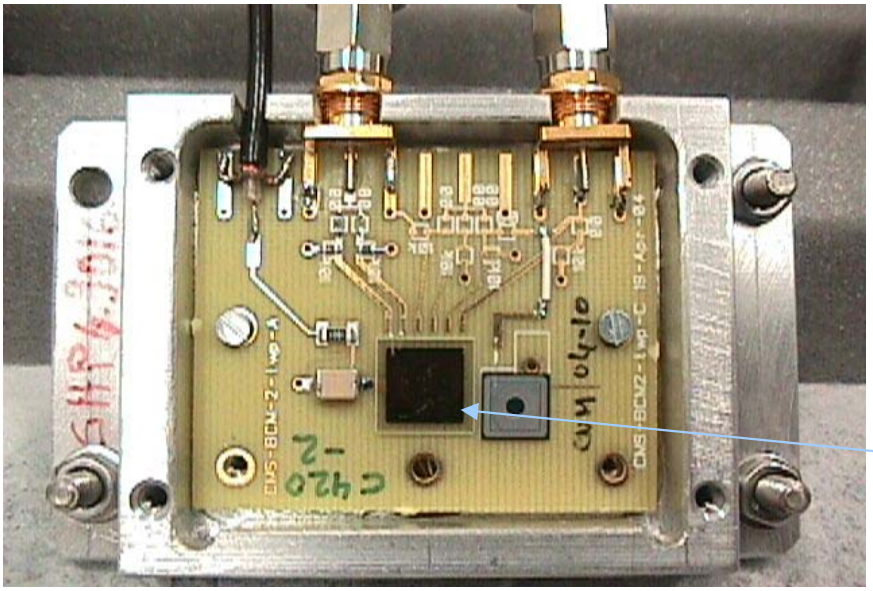
calculated correlation of peak height

(data smoothed with 3 or 5 pts)

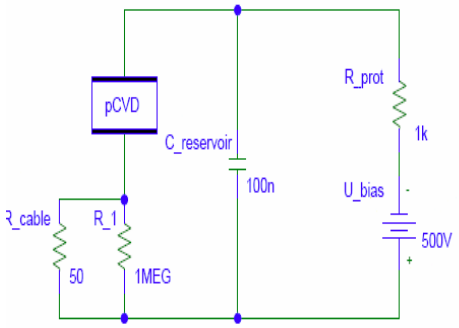
$$Correl(X,Y)=\frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-\bar{y})^2}}$$



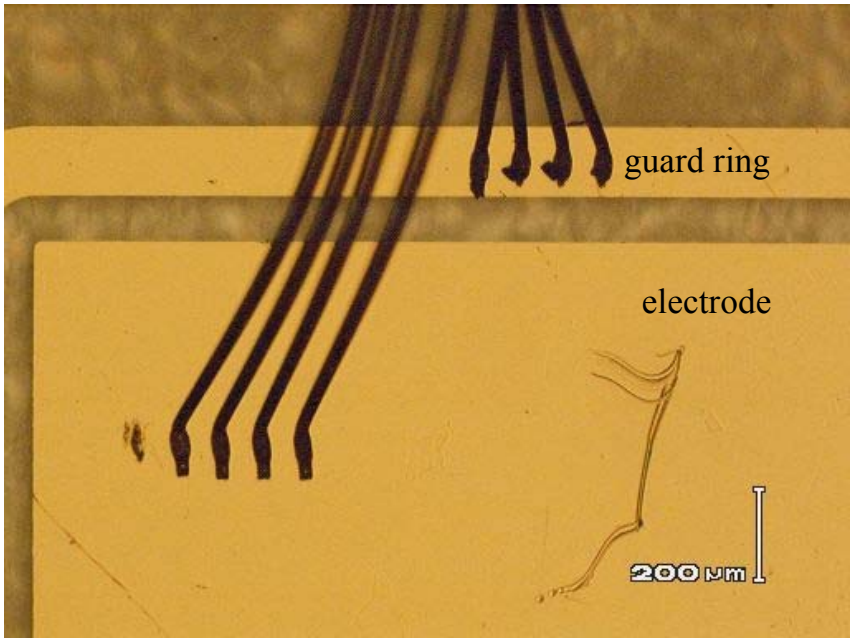
Details of diamond particle detector



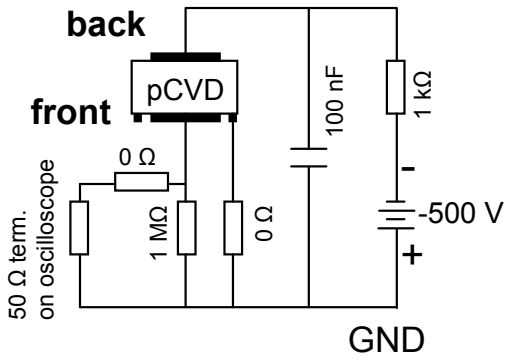
Marcus Palm's diagram



0.5x7.5x7.5 mm^3
Au padding 0.5 μm thick



Actual diagram

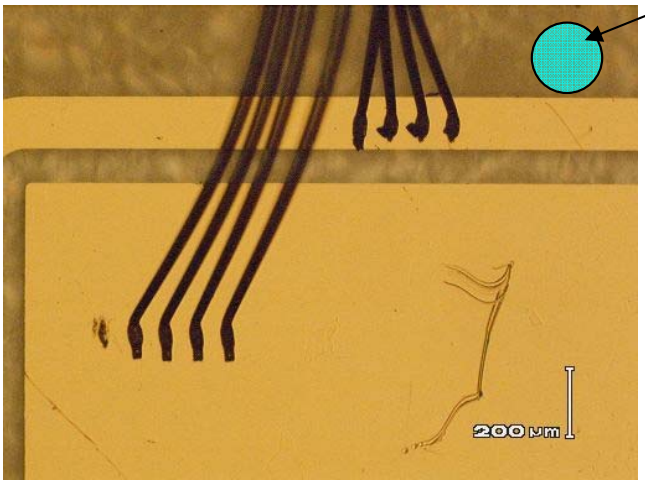


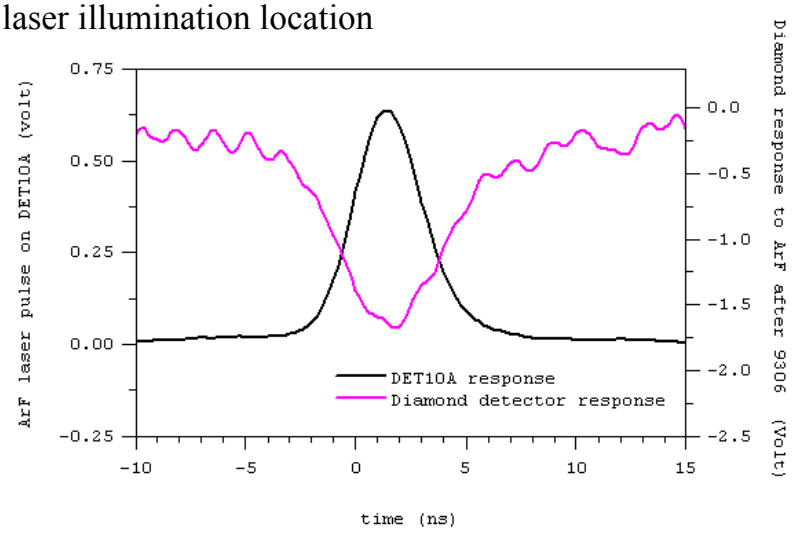
Property	Value	Symbol
Density	3.52 g/cm^3	ρ
Electron mobility	0.22 m^2/Vs	ν_e
Hole mobility	0.16 m^2/Vs	ν_h
Electron saturated velocity	$2.3 \cdot 10^5$ m/s	$\nu_{s,e}$
Hole saturated velocity	$1.0 \cdot 10^5$ m/s	$\nu_{s,h}$
Bandgap	5.45 eV	-
Energy to create one e-h pair	13 eV	E_{eh}
Average ionization density for a MIP (e-h pairs/μm)	36	ρ_{ion}

Table 4.2. Typical diamond characteristics[7]. From MPalm_AB_note.pdf

Nov. 6, 2009

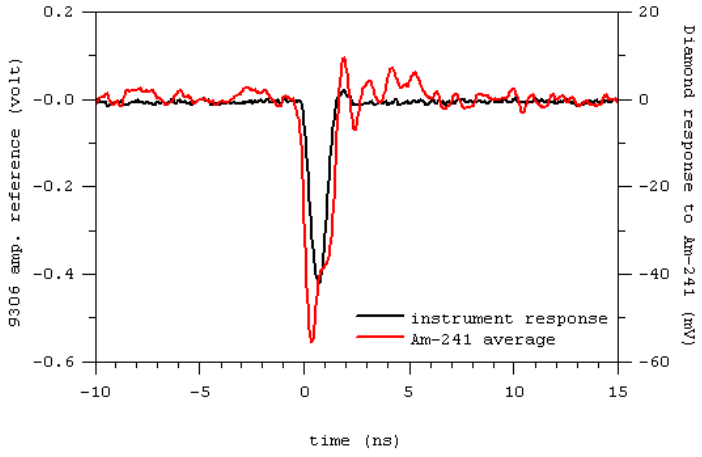
Response of diamond particle detector using 193 nm ArF laser



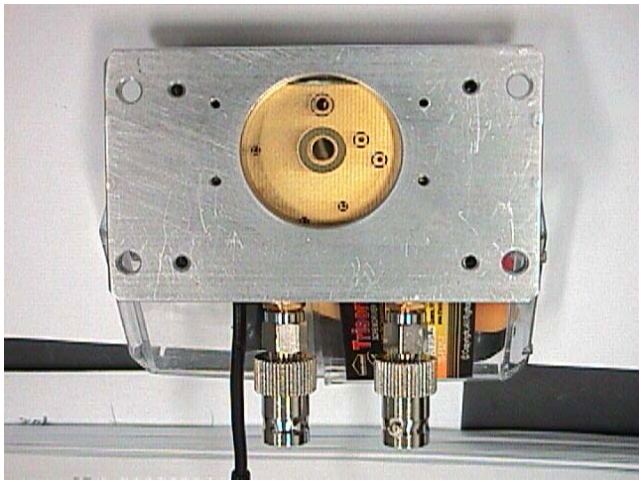


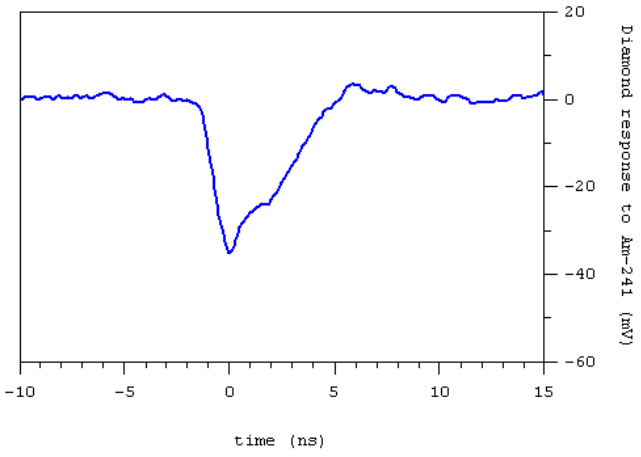
Response of diamond particle detector using α injection ^{241}Am @ 5.5 MeV

^{241}Am place in the front – hole draft induced



^{241}Am place in the back - electron drift induced





0.5 mm thick pCVD

Electron saturation velocity: 2.3 x 10^5 m/s → 2.2 ns pulse response

Hole saturation velocity: 1 x 10^5 m/s → 5.0 ns pulse response

contradicting our result here !

Response of diamond particle detector using x-ray injection @ NSLS-X15A (19 keV)

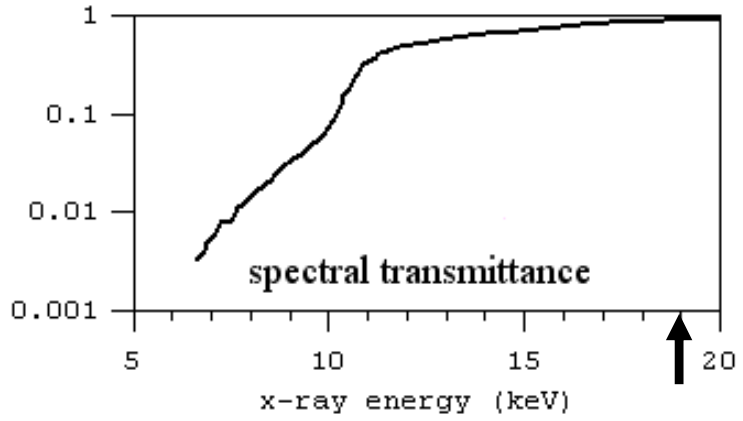
Nov. 19, 2009

NSLS parameters

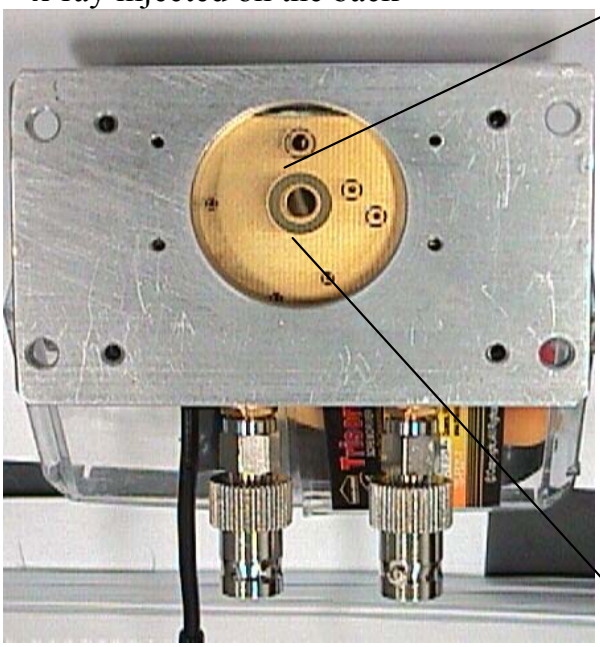
Bunch frequency:	52.88 MHz
Bunch spacing:	~19 ns
Bunch length:	287 ps
x-ray beam size:	0.2x0.2 mm^2

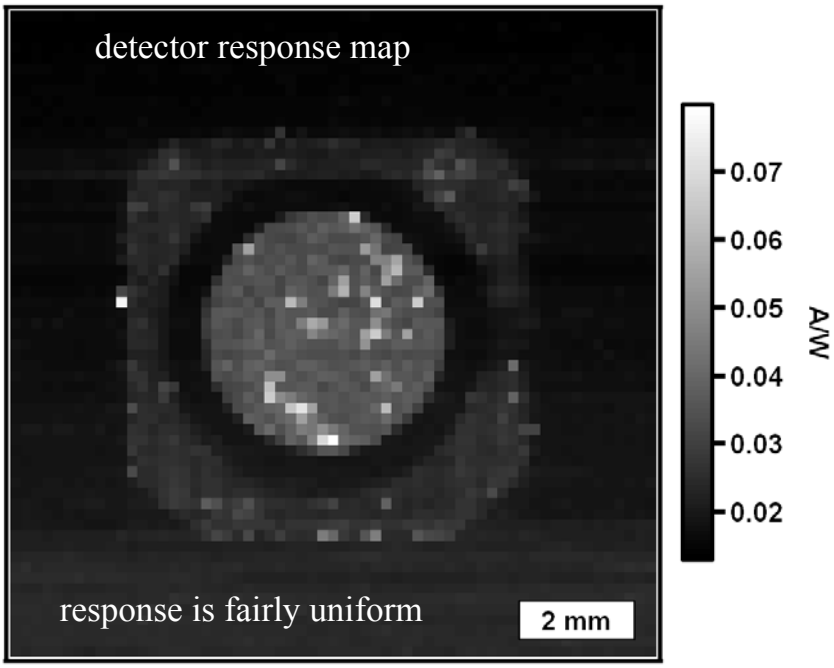
Measured results

Transmittance of Au pad:	0.92
Absorption of diamond:	0.0672
Typical photocurrent (ave):	~nA
Diamond responsitivity:	0.00464 A/W



x-ray injected on the back





To be examined on other (more intense) x-ray beamlines the drooping effect of diamond detector, if any