

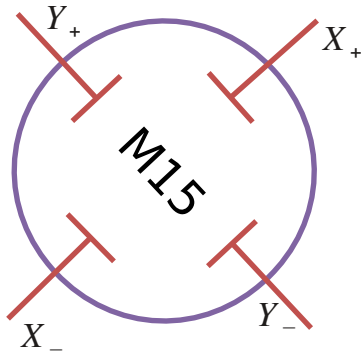
BPM resolution improvement status

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6/5/2013

- Low pass finite impulse response(FIR) filter added for bpm signal processing
- BPM resolution with filter

New BPM Receiver



Fixed rate trigger=960.015Hz
 Can be treated as a sampling ADC
 From the sampling theorem, it can perfectly reconstruct the signal for the frequency lower than 480Hz

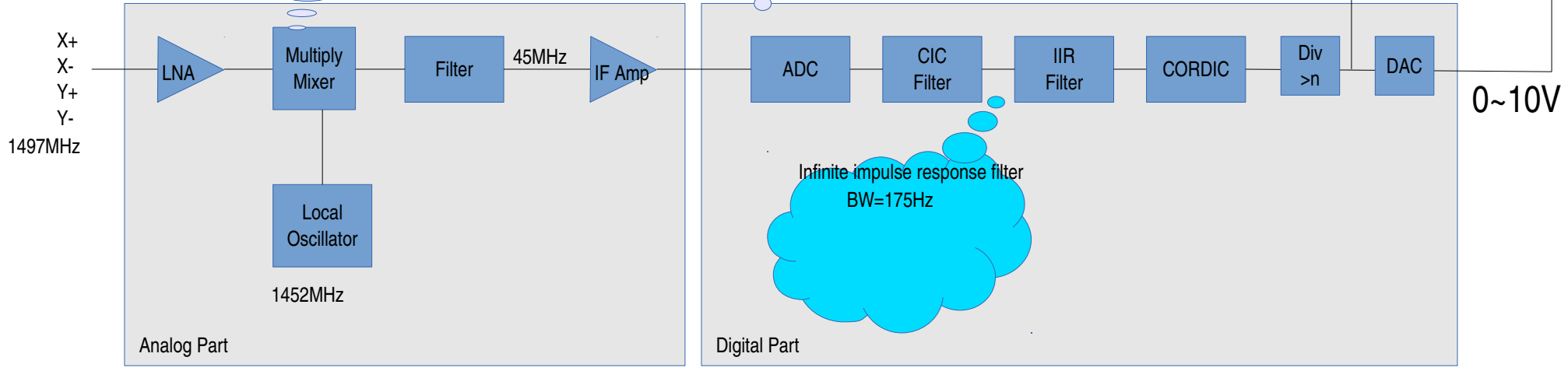
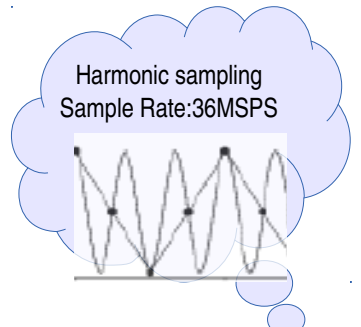
Happex ADC
 With helicity trigger

Fastbus ADC
 With event trigger

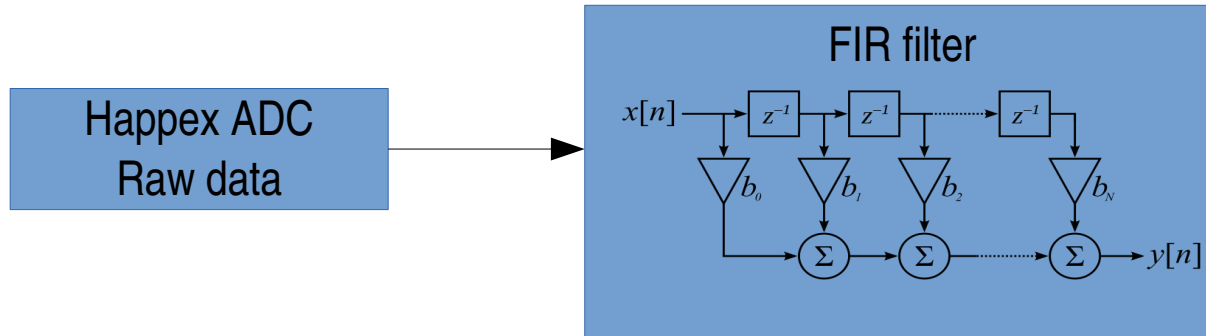
Random trigger,
 Can not be treated as a sampling ADC

Epics

$$\sin \theta \sin \varphi = \frac{1}{2} \cos(\theta - \varphi) - \frac{1}{2} \cos(\theta + \varphi)$$



Thanks for John Musson's help!



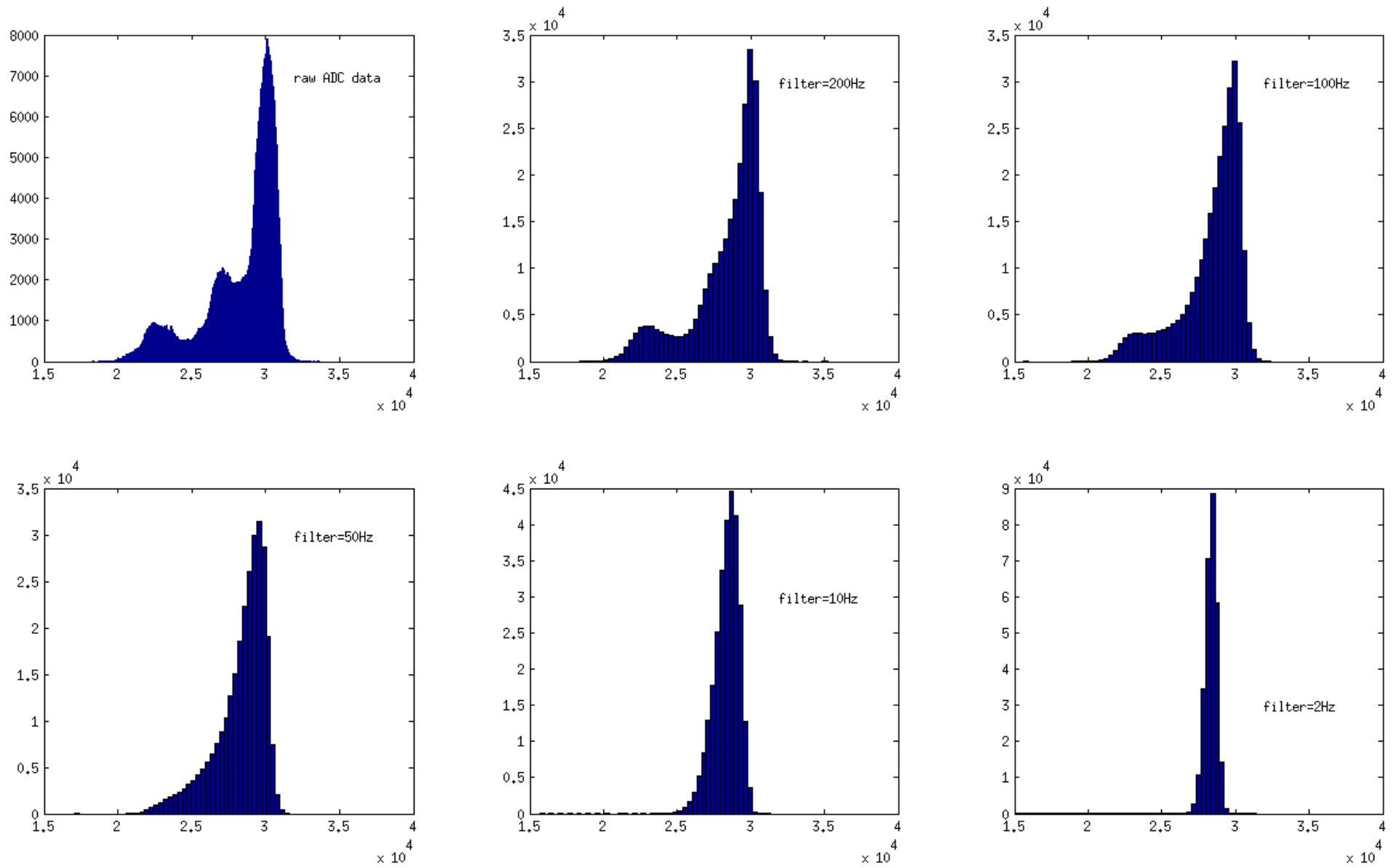
A software low pass FIR filter is added when processing the data

Using scipy filter module for python as the filter

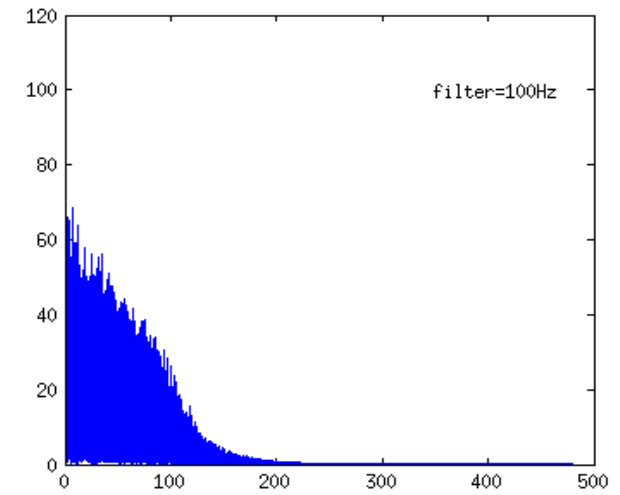
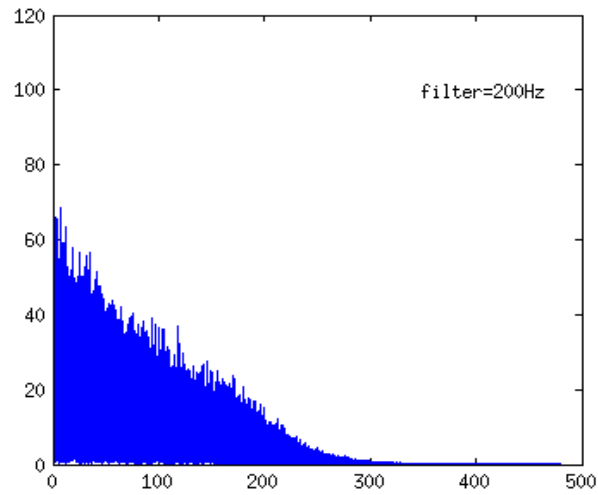
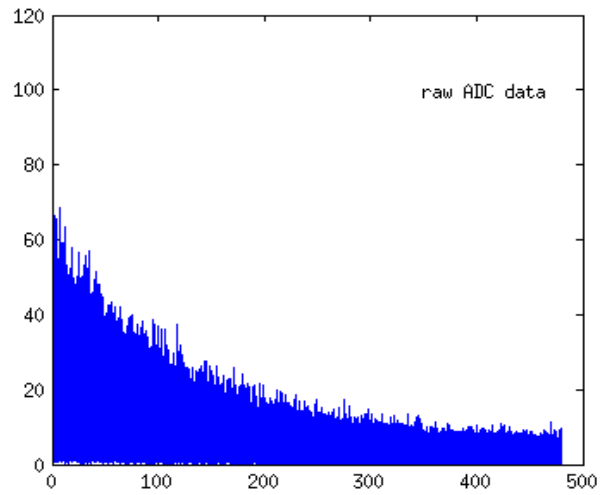
More detail can check:

<http://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.lfilter.html#scipy.signal.lfilter>

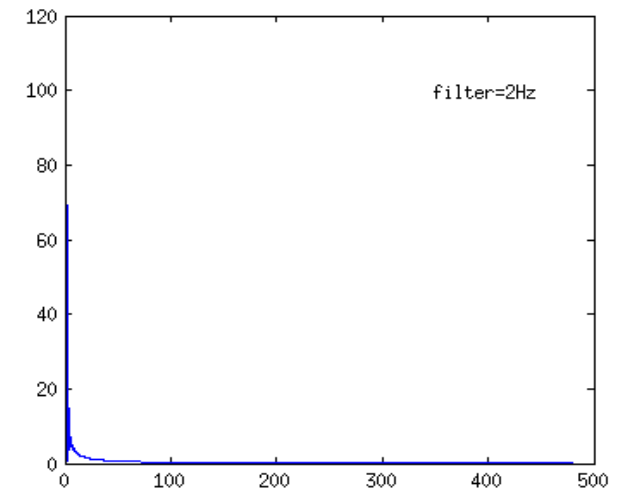
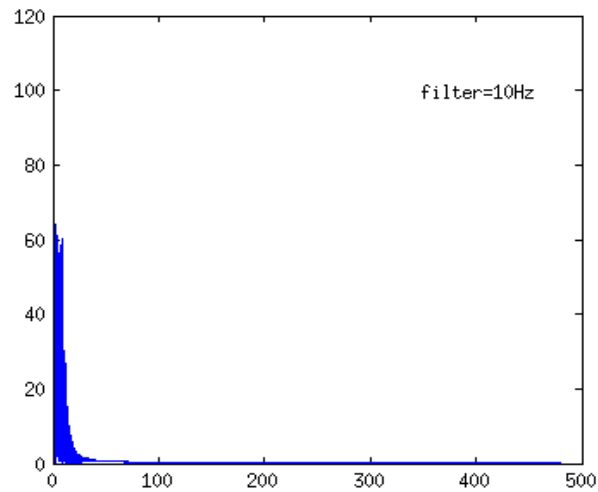
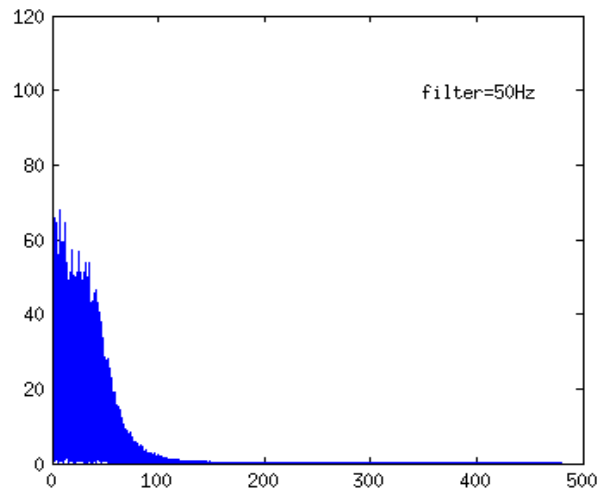
Pedestal signal by using different filter(using matlab filter function)



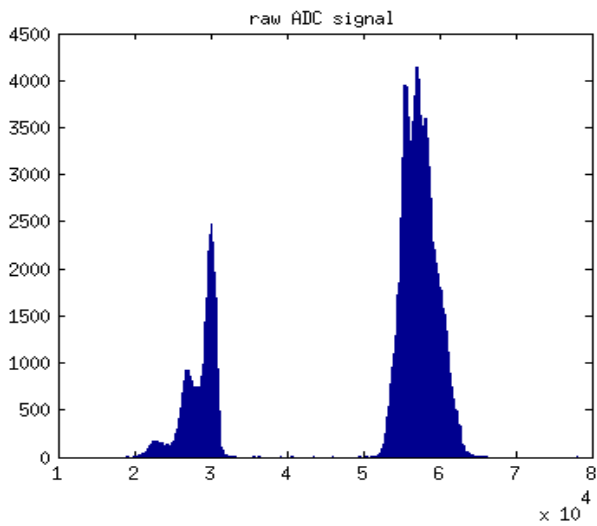
Pedestal signal by using different filter(using matlab filter function) after doing a fast fourier transform



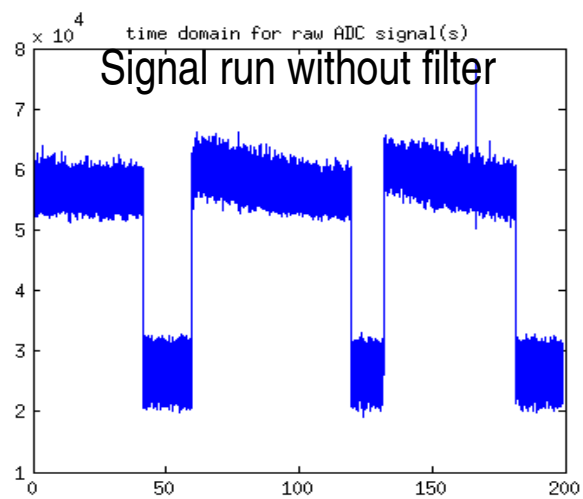
Xaxis unit: Hz



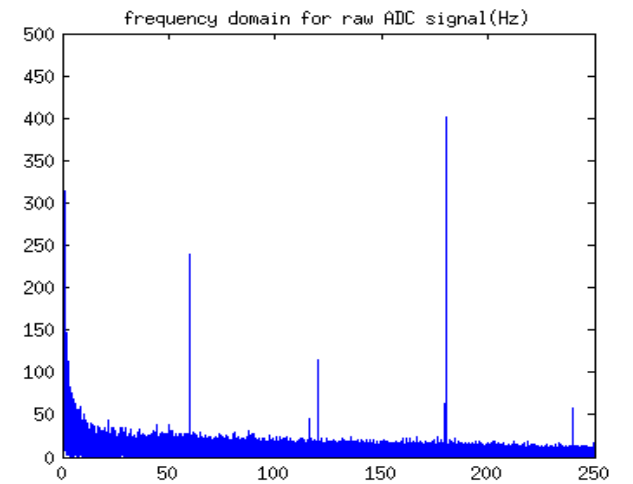
The filter is working !



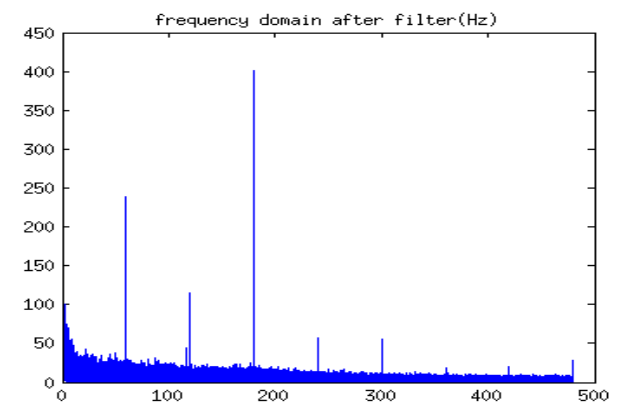
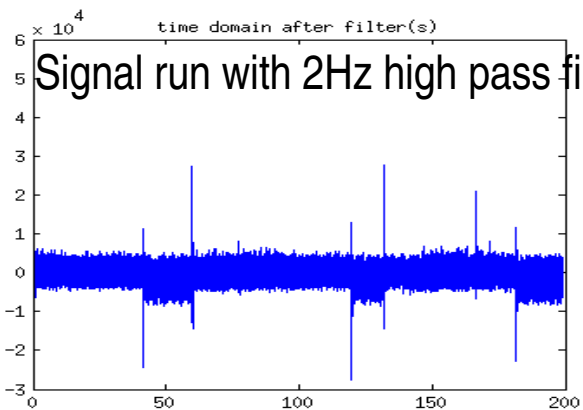
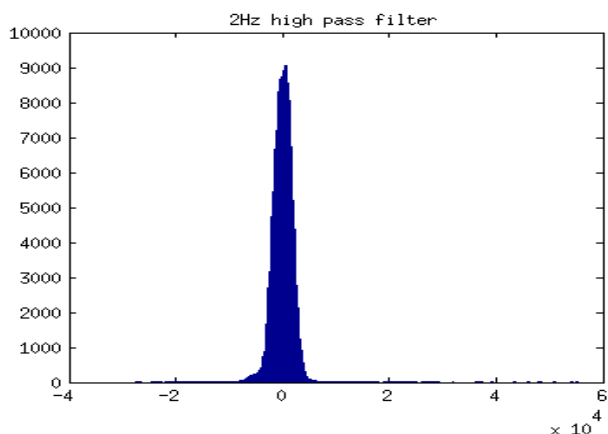
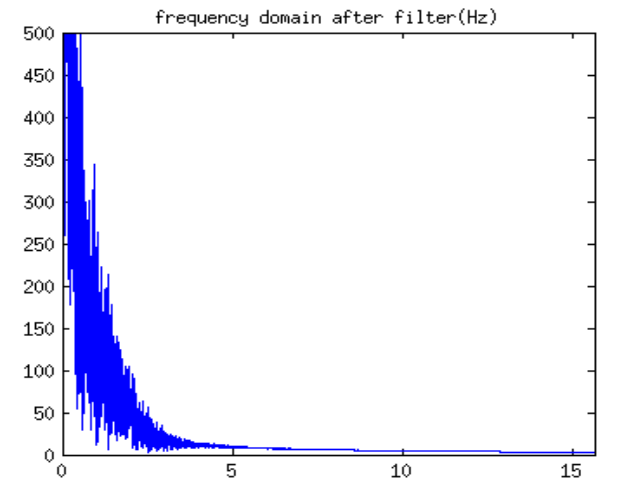
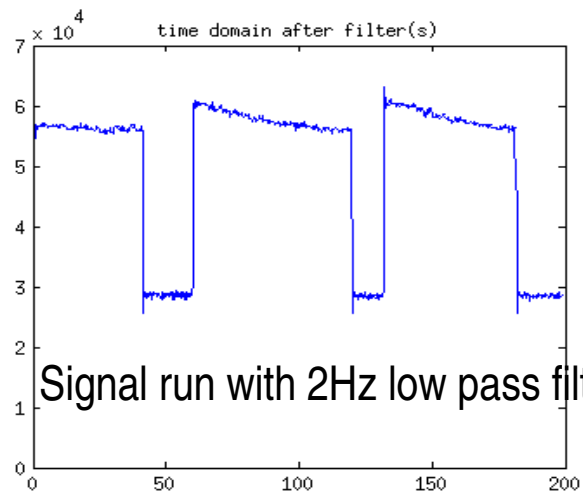
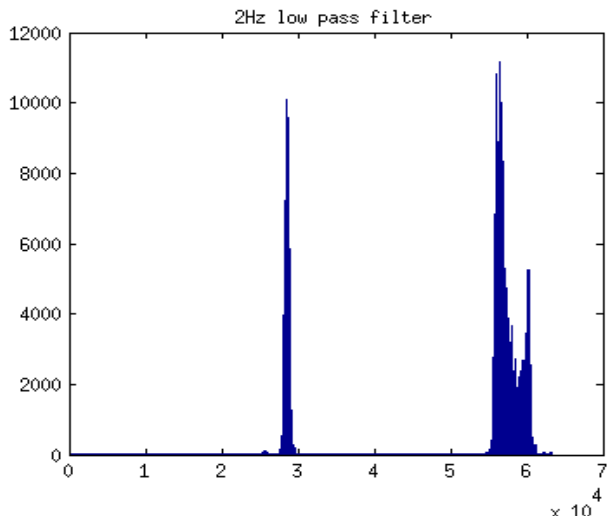
ADC signal



time domain



Frequency domain



First result for 100nA for position at bpm

With 2Hz low pass filter

Lrb.bpmax {Entry\$<140000&&Lrb.bpmax>0 && Lrb.bpmax<1}

h1

Entries	139994
Mean	0.7976
RMS	0.01902

Unit: mm

Lrb.bpmay {Entry\$<140000&&Lrb.bpmay>1 && Lrb.bpmay<1.2}

h3

Entries	139994
Mean	1.085
RMS	0.0145

Lrb.bpmbx {Entry\$<140000&&Lrb.bpmbx>-2 && Lrb.bpmbx<-1.5}

h2

Entries	139994
Mean	-1.732
RMS	0.02559

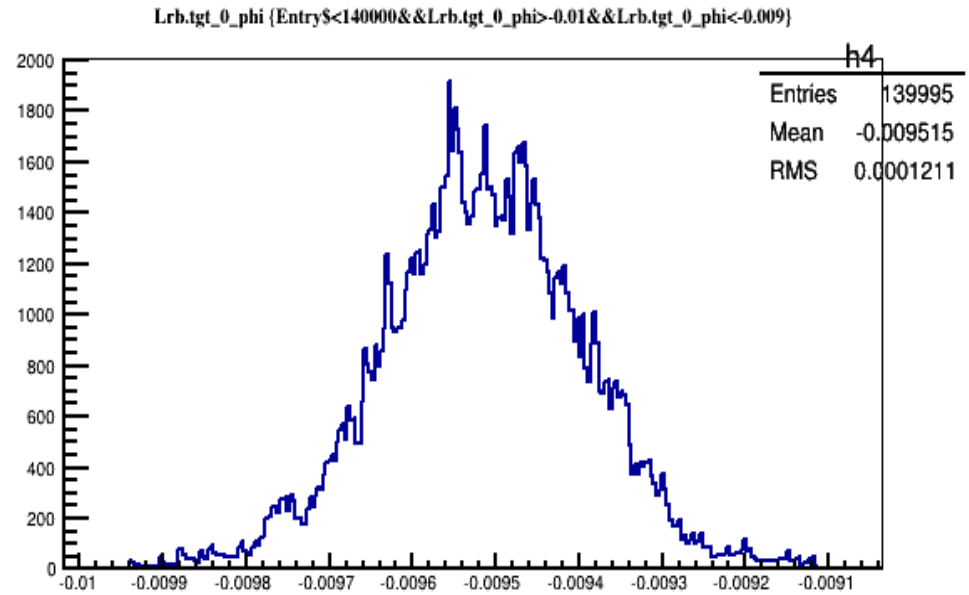
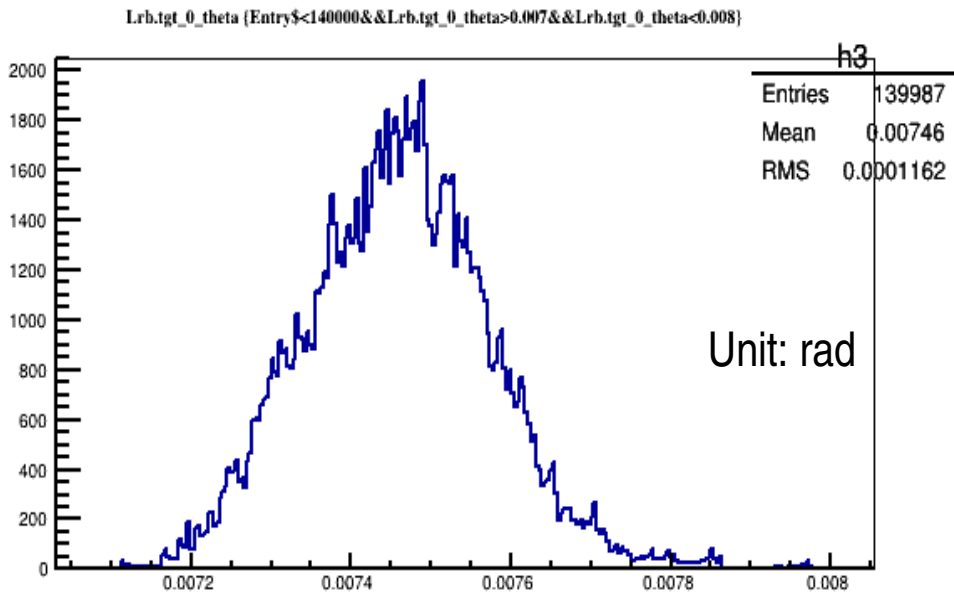
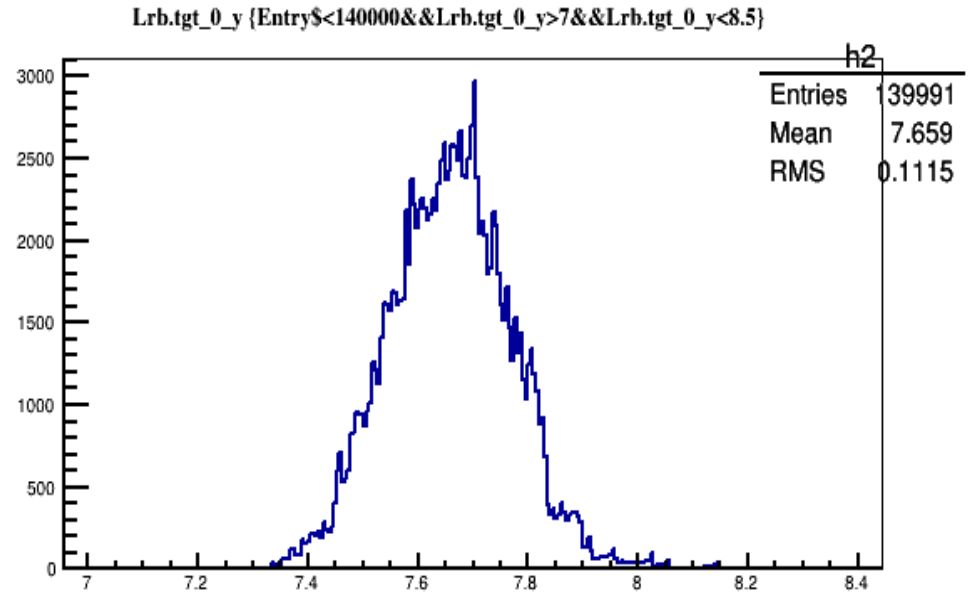
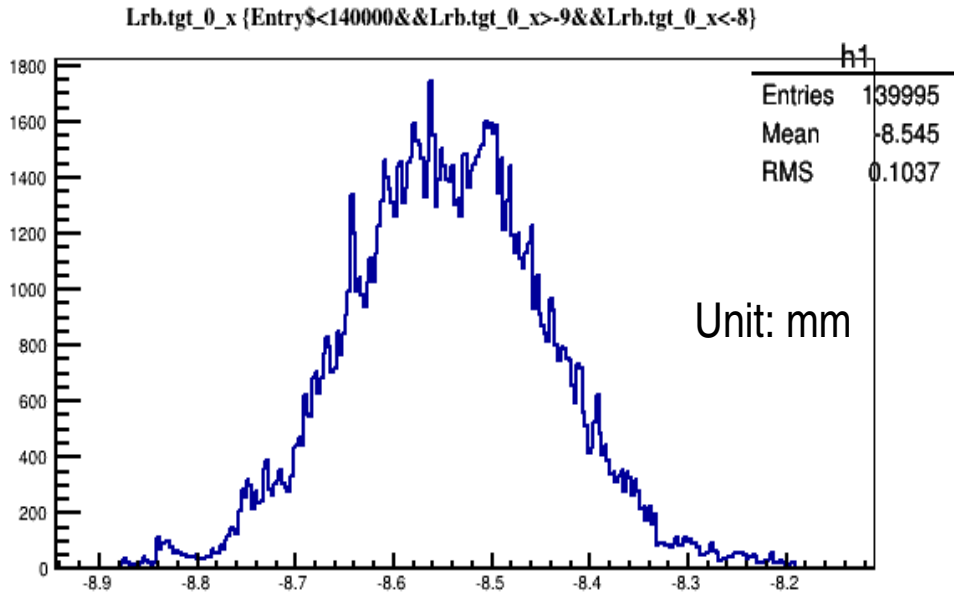
Lrb.bpmby {Entry\$<140000&&Lrb.bpmby>2.6 && Lrb.bpmby<3.2}

h4

Entries	139993
Mean	2.945
RMS	0.03497

First result for 100nA for position at target

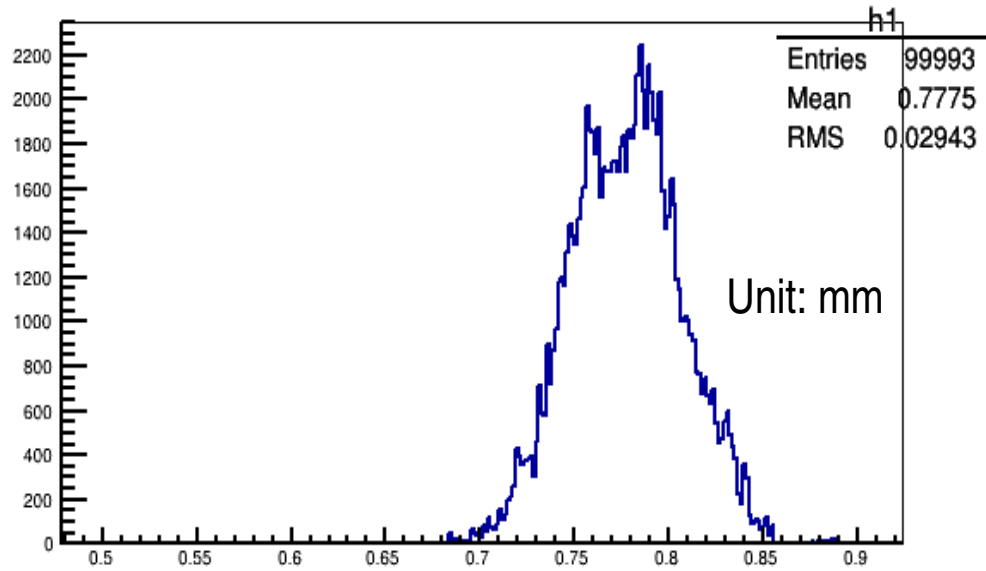
With 2Hz low pass filter



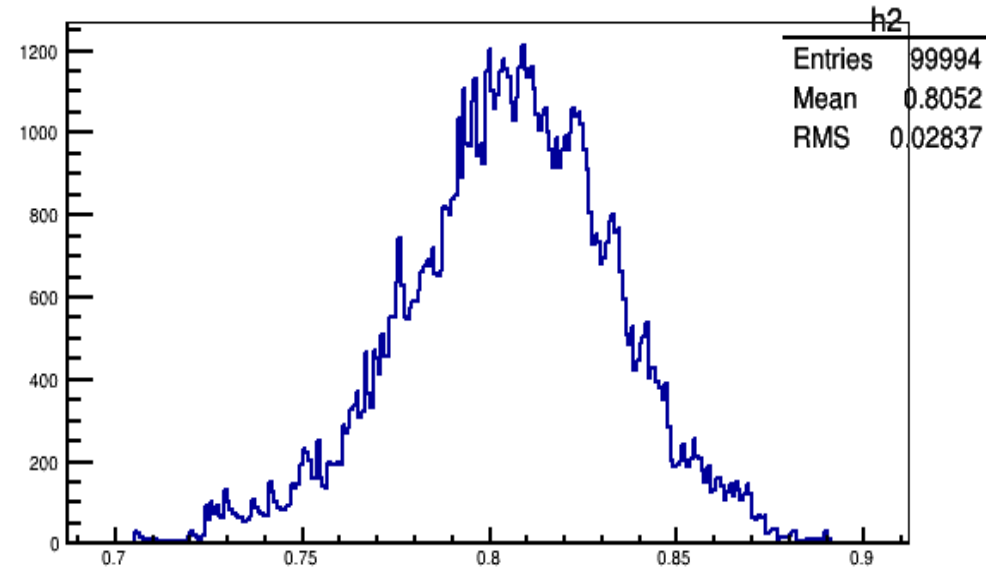
First result for 50nA for position at bpm

With 2Hz low pass filter

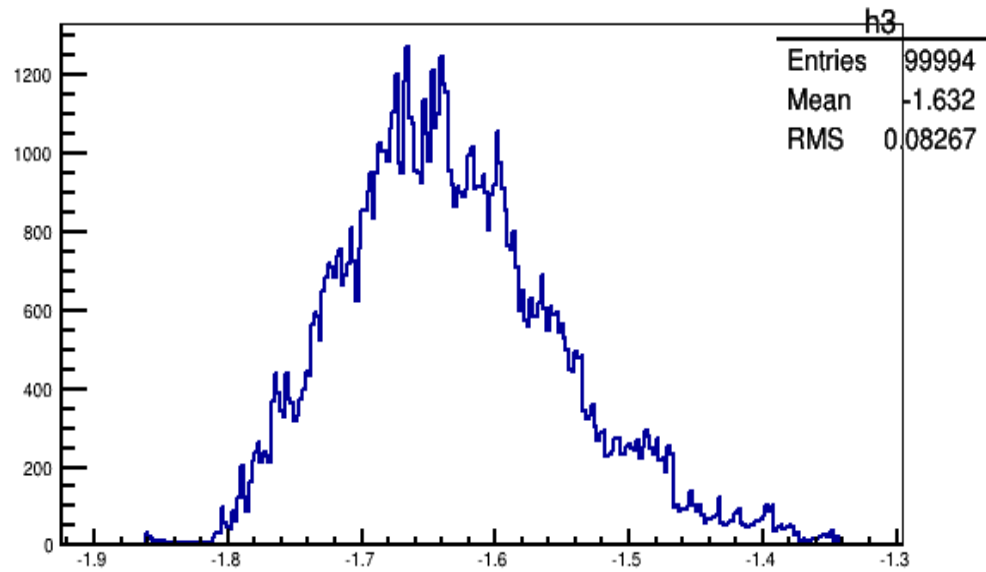
Lrb.bpmax {Entry\$<100000&&Lrb.bpmax>0.5 && Lrb.bpmax<0.9}



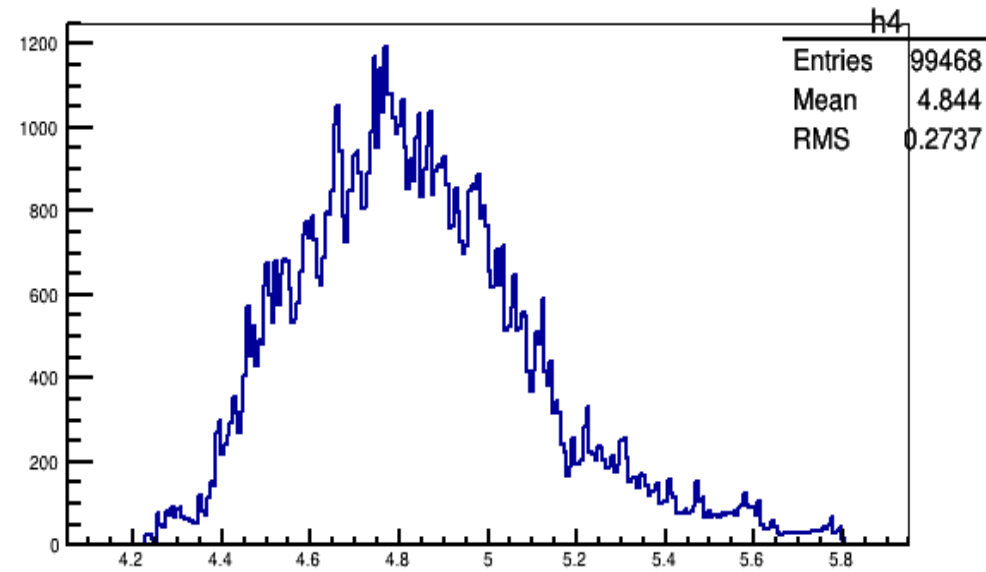
Lrb.bpmax {Entry\$<100000&&Lrb.bpmax>0.6 && Lrb.bpmax<0.9}



Lrb.bpmbx {Entry\$<100000&&Lrb.bpmbx>-1.9 && Lrb.bpmbx<-1.2}



Lrb.bpmbx {Entry\$<100000&&Lrb.bpmbx>4.2 && Lrb.bpmbx<5.8}



First result for 50nA for position at target

With 2Hz low pass filter

Lrb.tgt_0_x {Entry\$<100000&&Lrb.tgt_0_x>-9&&Lrb.tgt_0_x<-6}

h1

Entries	99994
Mean	-8.14
RMS	0.2904

Unit: mm

Lrb.tgt_0_y {Entry\$<100000&&Lrb.tgt_0_y>12&&Lrb.tgt_0_y<18}

h2

Entries	98790
Mean	15.09
RMS	0.8927

Lrb.tgt_0_theta {Entry\$<100000&&Lrb.tgt_0_theta>0.012&&Lrb.tgt_0_theta<0.02}

h3

Entries	99794
Mean	0.01568
RMS	0.0009875

Unit: rad

Lrb.tgt_0_phi {Entry\$<100000&&Lrb.tgt_0_phi>-0.01&&Lrb.tgt_0_phi<-0.0065}

h4

Entries	99994
Mean	-0.009065
RMS	0.0003123

Doing now:

- Still mixing it to my beampackage, need some more time, almost done
- Maybe can try 1Hz filter to improve BPM B at 50nA
- Will do noise study again with filter