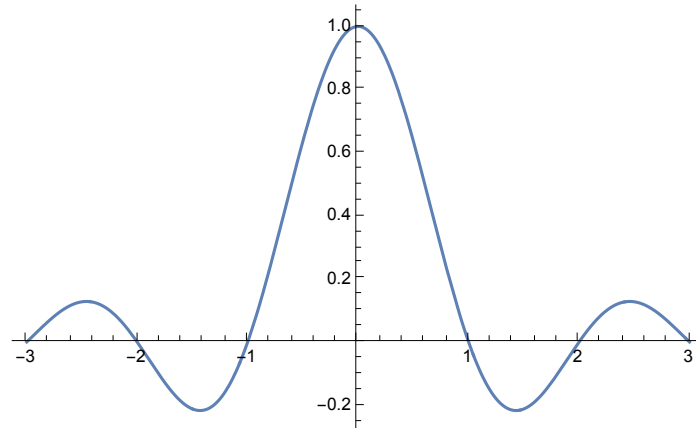


Now try for a fit function that will better scale with amplitude using the Sinc (wavelet) treatment.

This yields stable fits for the amplitude (ie Npe) but the earlier method using normalized waveforms

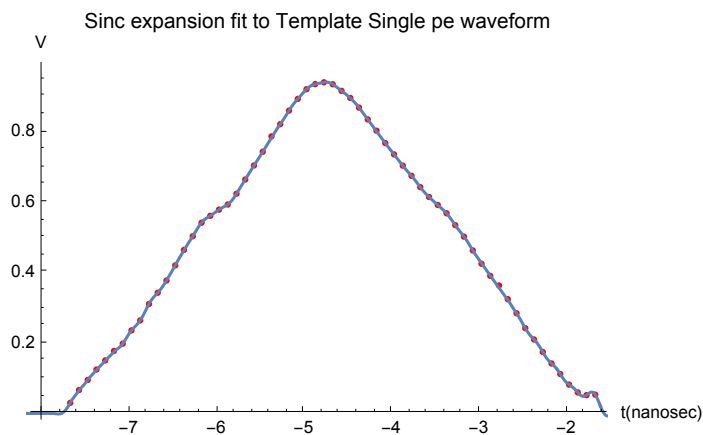
gives more stable fits for the phase, so I combine these methods.

```
Plot[Sinc[Pi * x], {x, -3, 3}]
```



```
avewave = (v01[[5]] + v01[[7]] (*v01[[15]]+v01[[16]]*)) / 2;  
templatefit[x_] := Sum[avewave[[i]] * Sinc[Pi * (x - ttt[[i]]) / 0.1], {i, 61}]
```

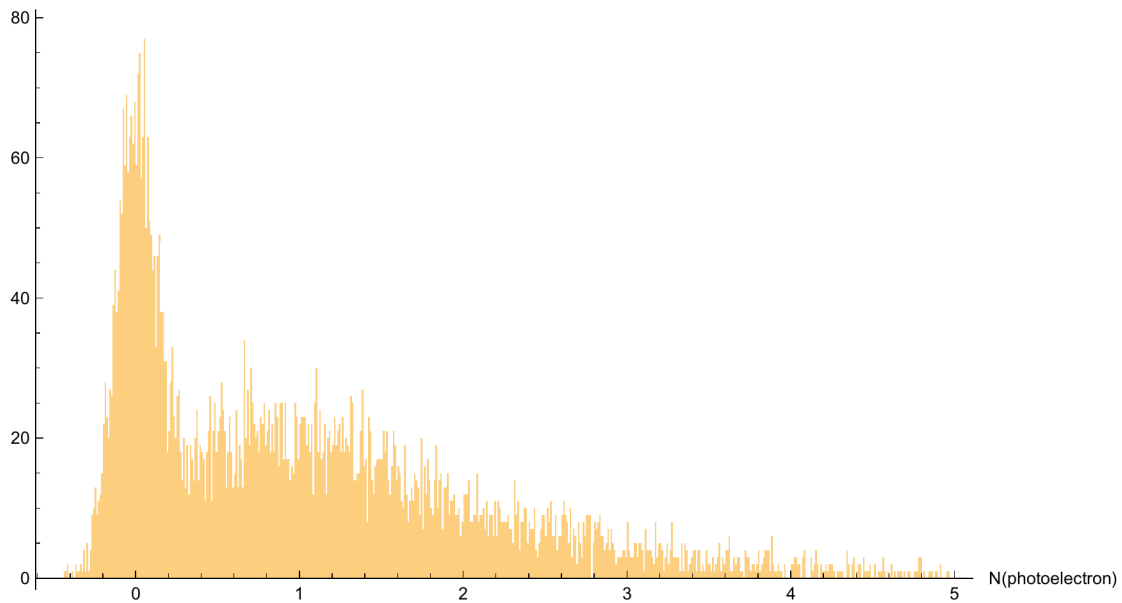
```
Show[ListPlot[Transpose[{ttt, avewave}], PlotStyle -> Red,  
  AxesOrigin -> {-8, 0}, AxesLabel -> {"t(nanosec)", "V"},  
  PlotLabel -> "Sinc expansion fit to Template Single pe waveform",  
  Plot[templatefit[x], {x, -10, 0}]]
```



```
npephs = ConstantArray[0, nevents];  
tft0s = ConstantArray[0, nevents];  
Do[  
  fit =  
    FindFit[Transpose[{ttt, v01[[i]] * peak[[i]]}], a * templatefit[x], {a}, x];  
  npephs[[i]] = a /. fit;  
  , {i, nevents}];
```

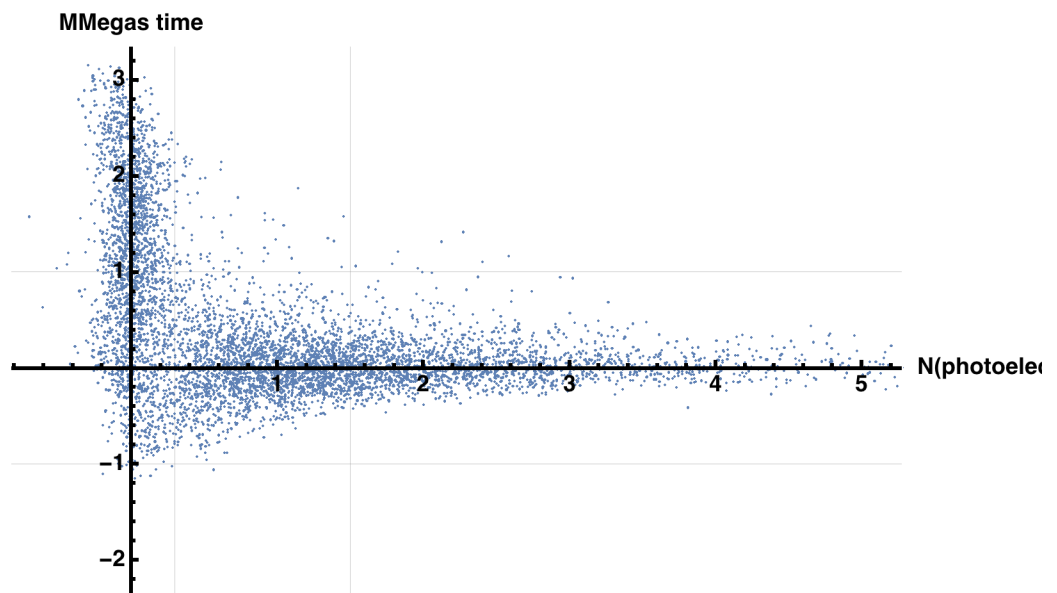
```
Histogram[npephs / .015, {- .5, 5, .01}, AxesLabel → {"N(photoelectron)", ""},
  PlotLabel → "Distribution in N(photoelectron from Template Fit",
  ImageSize → Large]
```

Distribution in N(photoelectron from Template Fit

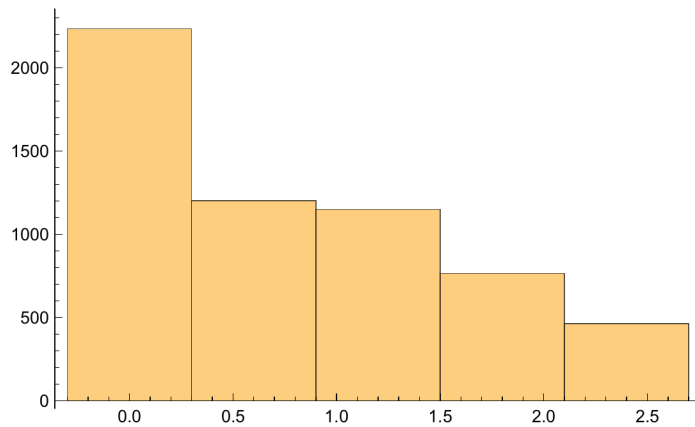


Based on Scatter plot of MMegas time vs. Npe, $Npe < 0.3$ looks like a safe cut for Zeroes.

```
ListPlot[Transpose[{npephs / .015, tft0}],
  GridLines → {{0.3, 1.5}, {-1, 1}}, AxesStyle → Thick,
  LabelStyle → Directive[Bold, Medium, FontFamily → "Helvetica"],
  AxesLabel → {"N(photoelectrons)", "MMegas time"}, ImageSize → Large]
```



```
Histogram[npephs / .015, {- .3, 3, .6}]
```



```
bincts = BinCounts[npephs / .015, {- .3, 3, .6}]
```

```
{2235, 1202, 1150, 767, 464}
```

```
n0 = bincts[[1]];
```

```
n1 = bincts[[2]] + bincts[[3]];
```

```
n2 = bincts[[4]] + bincts[[5]];
```

```
nphotoel = {n0, n1, n2};
```

```
GraphicsRow[
```

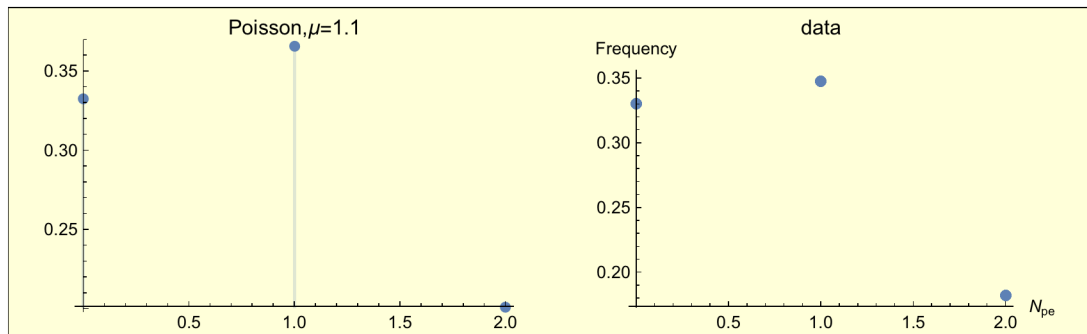
```
{DiscretePlot[Evaluate@Table[PDF[PoissonDistribution[ $\lambda$ ], k], { $\lambda$ , {1.1}}], {k, 0, 2}, PlotRange -> All, PlotMarkers -> Automatic, PlotLabel -> "Poisson,  $\mu=1.1$ ", ListPlot[Transpose[{0, 1, 2}, nphotoel / 6772], PlotStyle -> PointSize[0.03], PlotLabel -> "data", AxesLabel -> {"Npe", "Frequency"}]},
```

```
ImageSize -> Large, Background -> LightYellow,
```

```
PlotLabel -> "Best fit to Npe Distribution,  $\mu=1.1\pm0.1$ ",
```

```
LabelStyle -> {GrayLevel[0], Bold}, Frame -> True]
```

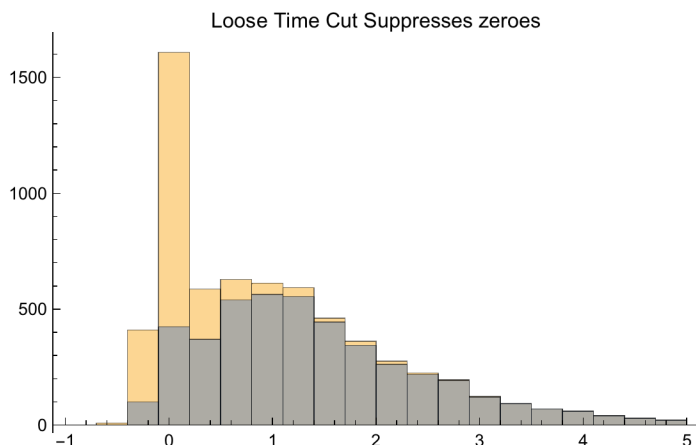
Best fit to N_{pe} Distribution, $\mu=1.1\pm0.1$



```

Histogram[{npephs / .015,
  Select[Transpose[{npephs / .015, tft0}], (#[[2]] > -0.7 &&#[[2]] < .5) &][[
    All, 1]]], {-1, 5, .3}, PlotLabel → "Loose Time Cut Suppresses zeroes"]

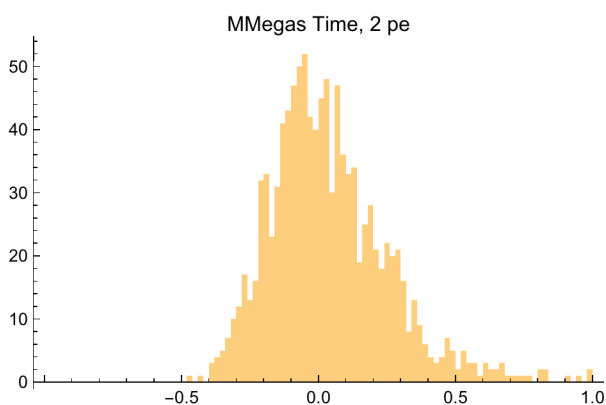
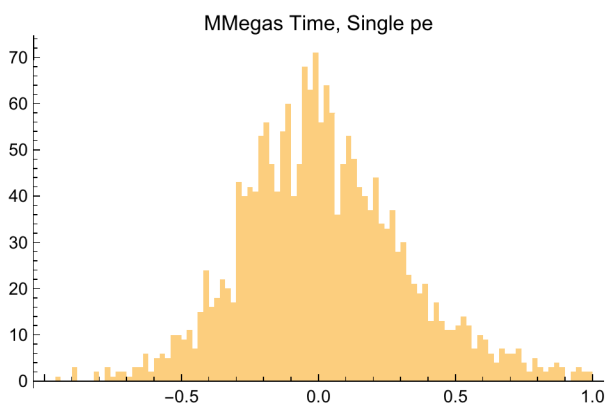
```



```

GraphicsColumn[{Histogram[
  Select[Transpose[{npephs / .015, tft0}], (#[[1]] > 0.5 &&#[[1]] < 1.5) &][[
    All, 2]], {-1, 1, .02}, PlotLabel → "MMegas Time, Single pe"], Histogram[
  Select[Transpose[{npephs / .015, tft0}], (#[[1]] > 1.5 &&#[[1]] < 2.5) &][[
    All, 2]], {-1, 1, .02}, PlotLabel → "MMegas Time, 2 pe"]}]]

```



Single pe jitter= 0.349468 nsec, Double pe jitter= 0.238033 nsec

Now try fitting the Distribution to get a better number for true rms.

```

bc = BinCounts[Select[Transpose[{npephs / .015, tft0}],
  ({#[[1]] > 0.5 && #[[1]] < 1.5}) &][[All, 2]], {-1, 1, .02}];
tbins = -1.01 + 0.02 * Range[100];
bc1 = Transpose[{tbins, bc}];
bcc = BinCounts[Select[Transpose[{npephs / .015, tft0}],
  ({#[[1]] > 1.5 && #[[1]] < 2.5}) &][[All, 2]], {-1, 1, .02}];
bc2 = Transpose[{tbins, bcc}];

ff1 = FindFit[bc1, {amp1 * s1 * PDF[NormalDistribution[m1, s1], x]},
  {{m1, 0}, {s1, 0.3}, {amp1, 10^3}}, x]
{m1 → -0.0114513, s1 → 0.266641, amp1 → 142.338}

fittedcurve1 = amp1 * s1 * PDF[NormalDistribution[m1, s1], x] /. ff1
slpp1 = Show[ListPlot[bc1], Plot[fittedcurve1, {x, -1, 1}, PlotStyle → Red],
  PlotRange → All];
56.7847 e-7.03261 (0.0114513+x)2

ff2 = FindFit[bc2, {amp2 * s2 * PDF[NormalDistribution[m2, s2], x]},
  {{m2, 0}, {s2, 0.3}, {amp2, 10^3}}, x]
fittedcurve2 = amp2 * s2 * PDF[NormalDistribution[m2, s2], x] /. ff2
slpp2 = Show[ListPlot[bc2], Plot[fittedcurve2, {x, -1, 1}, PlotStyle → Red],
  PlotRange → All];
{m2 → -0.00593907, s2 → 0.18623, amp2 → 112.675}

44.9509 e-14.4169 (0.00593907+x)2

```

```

pt1 = TableForm[{{m1, s1, amp1 * s1}} /. ff1,
  TableHeadings → {{ "peak 1"}, {"mean", "s.d.", "height"}}];
pt2 = TableForm[{{m2, s2, amp2 * s2}} /. ff2,
  TableHeadings → {{ "peak 2"}, {"mean", "s.d.", "height"}}];
GraphicsColumn[{Show[slpp1, Graphics[Inset[Column[{pt1}], {0.72, 65}]]],
  Show[slpp2, Graphics[Inset[Column[{pt2}], {0.71, 48}]]]},
  ImageSize → Large, Background → LightYellow,
  PlotLabel → "Best fit time jitter with 1,2 photoelectrons",
  LabelStyle → {GrayLevel[0], Bold}, Frame → True]

```

Best fit time jitter with 1,2 photoelectrons

