If the arrows do not appear to open a problem, go to preferences. Under the interface make sure the "show open/close icon for cell groups" is selected.

Background Noise Integrated

In this section the slope and the y-intercept where taken from the custom gaussian (gaus) + first order polynomial (pol1) fit of the energy peak and integrating over an energy range determined by +/- 2σ the mean of the signal. The integral will give the area of the background noise under the signal.

898 keV

r6978

In[1]:=
```
μ = 897.416;
σ = 1.12141;
n1 = Integrate[-0.274308 * x + 256.727, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[3]=
```
47.36213176
```

r6980

In[4]:=
```
μ = 895.417;
σ = 1.19573;
n2 = Integrate[-0.466126 * x + 626.402, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[6]=
```
999.7491617
```

r7022

In[7]:=
```
μ = 897.481;
σ = 0.750439;
n3 = Integrate[0.00185989 * x + 17.1513, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[9]=
```
56.49459664
```

r7023

In[10]:=
```
μ = 896.893;
σ = 1.00875;
n4 = Integrate[-0.148602 * x + 184.187, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[12]=
```
205.4093674
```

r7107

In[13]:=
```
μ = 897.581;
σ = 1.09091;
n5 = Integrate[-0.345539 * x + 323.534, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[15]=
```
58.40626907
```

r7108

In[16]:=
```
μ = 897.483;
σ = 1.24805;
n6 = Integrate[-0.0223200 * x + 82.6422, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[18]=
```
312.5635362
```

r7203

In[19]:=
```
μ = 897.352;
σ = 2.97881;
n7 = Integrate[0.0369262 * x - 23.8649, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[21]=
```
110.4649916
```

r7204

In[22]:=
```
μ = 903.99;
σ = 1.06558;
n8 = Integrate[1.02463 * x - 833.156, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[24]=
```
396.8188963
```

r7235

In[25]:=
```
μ = 903.390;
σ = 0.952662;
n9 = Integrate[-0.299602 * x + 282.736, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[27]=
```
46.02709943
```

r7236

In[28]:=
```
μ = 905.750;
σ = 1.09901;
n10 = Integrate[0.339331 * x - 219.879, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[30]=
```
384.5218529
```

1836.1 keV

r6978

In[31]:=
```
μ = 1837.6;
σ = 1.19410;
n11 = Integrate[-0.0367690 * x + 69.5478, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[33]=
```
9.46245726
```

r6980

In[34]:=
```
μ = 1833.39;
σ = 1.72362;
n12 = Integrate[-0.0289860 * x + 73.3522, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[36]=
```
139.3343897
```

r7022

In[37]:=
```
μ = 1837.72;
σ = 1.28517;
n13 = Integrate[0.00899005 * x - 15.1294, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[39]=
```
7.154771106
```

r7023

In[40]:=
```
μ = 1836.02;
σ = 1.63517;
n14 = Integrate[-0.0806490 * x + 155.393, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[42]=
```
47.87662003
```

r7107

In[43]:=
```
μ = 1838.56;
σ = 1.22172;
n15 = Integrate[0.0595069 * x - 107.776, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[45]=
```
7.970530914
```

r7108

In[46]:=
```
μ = 1838.12;
σ = 1.87659;
n16 = Integrate[-0.0245740 * x + 56.6525, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[48]=
```
86.19207235
```

r7203

In[49]:=
```
μ = 1839.05;
σ = 4.91678;
n17 = Integrate[-0.00212520 * x + 5.14499, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[51]=
```
24.32116576
```

r7204

In[52]:=
```
μ = 1824.15;
σ = 1.66372;
n18 = Integrate[0.295440 * x - 526.173, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[54]=
```
84.87551431
```

r7235

In[55]:=
```
μ = 1850.02;
σ = 1.13536;
n19 = Integrate[0.154287 * x - 281.948, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[57]=
```
15.83162215
```

r7236

In[58]:=
```
μ = 1854.44;
σ = 1.94463;
n20 = Integrate[-0.0468562 * x + 97.7438, {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[60]=
```
84.41085367
```

Integrating Gaussian

$$f = \frac{A}{\sigma * \sqrt{(2 * \pi)}} * \text{Exp}\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]$$

Used the equation for a gaussian with an unknown area along with values obtained from fitting the signals peak after the background noise had been subtracted to find the area under the curve. Values calculated are smaller than those given by the ROOT fit.

898 keV:

- **Singles:**

r6978

In[61]:=
```
μ = 897.416;
σ = 1.12141;
A = 292.5;
g1 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[64]=
```
279.1911727
```

r7022

In[65]:=
```
μ = 897.481;
σ = 0.750439;
A = 362.7;
g2 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[68]=
```
346.1970541
```

r7107

In[69]:=
```
μ = 897.581;
σ = 1.09091;
A = 130.5;
g3 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[72]=
```
124.5622155
```

r7203

In[73]:=
```
μ = 897.352;
σ = 2.97881;
A = 17.4328;
g4 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[76]=
```
16.63960299
```

r7235

In[77]:=
```
μ = 903.390;
σ = 0.952662;
A = 81.4;
g5 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[80]=
```
77.69627848
```

- **Coincidence:**

r6980

In[81]:=
```
μ = 895.417;
σ = 1.19573;
A = 4132.5;
g6 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[84]=
```
3944.470158
```

r7023

In[85]:=
```
μ = 896.893;
σ = 1.00875;
A = 1232.2;
g7 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[88]=
```
1176.134574
```

r7108

In[89]:=
```
μ = 897.483;
σ = 1.24805;
A = 707.85;
g8 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[92]=
```
675.6426379
```

r7204

In[93]:=
```
μ = 903.99;
σ = 1.06558;
A = 309;
g9 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[96]=
```
294.9404183
```

r7236

In[97]:=
```
μ = 905.750;
σ = 1.09901;
A = 519;
g10 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[100]=
```
495.3853628
```

1836.1 keV:

- **Singles:**

r6978

In[101]:=
```
μ = 1837.6;
σ = 1.19410;
A = 185;
g11 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[104]= 176.5824511

r7022

In[105]:=
```
μ = 1837.72;
σ = 1.28517;
A = 174.2;
g12 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[108]= 166.273854

r7107

In[109]:=
```
μ = 1838.56;
σ = 1.22172;
A = 71.8;
g13 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[112]= 68.53308102

r7203

In[113]:=
```
μ = 1839.05;
σ = 4.91678;
A = 6.75824;
g14 =
  A / (σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[116]= 6.450738294

r7235

In[117]:=
```
μ = 1850.02;
σ = 1.13536;
A = 28.9;
g15 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[120]=
```
27.58504236
```

- **Coincidence:**

r6980

In[121]:=
```
μ = 1833.39;
σ = 1.72362;
A = 2160.9;
g16 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[124]=
```
2062.578479
```

r7023

In[125]:=
```
μ = 1836.02;
σ = 1.63517;
A = 515.5;
g17 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[128]=
```
492.0446137
```

r7108

In[129]:=
```
μ = 1838.12;
σ = 1.87659;
A = 402;
g18 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[132]=
```
383.7088937
```

r7204

In[133]:=
```
μ = 1824.15;
σ = 1.66372;
A = 226.5;
g19 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[136]=
```
216.1941901
```

r7236

In[137]:=
```
μ = 1854.44;
σ = 1.94463;
A = 379.5;
g20 =
  A/(σ * √(2 * π)) * Integrate[Exp[-1/2 ((x - μ)/σ)^2], {x, μ - (2 * σ), μ + (2 * σ)}]
```

Out[140]=
```
362.2326497
```

Activity

Using the area of the gaussian for each peak found above, I divided by the time of counting run to get the activity. I also graphed the activity vs. the days since activation.

898 keV

Singles:

In[141]:=
```
a1 = g1 / 279 // N
a2 = g2 / 359 // N
a3 = g3 / 283 // N
a4 = g4 / 236 // N
a5 = g4 / 244 // N
```

Out[141]= 1.000685207

Out[142]= 0.9643371981

Out[143]= 0.4401491714

Out[144]= 0.07050679234

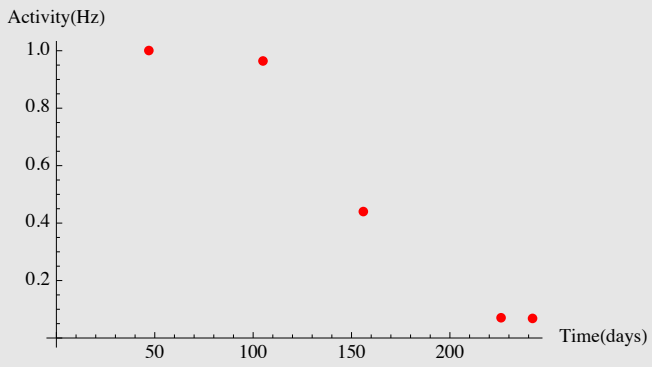
Out[145]= 0.06819509423

Decay Plot

In[146]:=
```
decay1 = {{47, a1}, {105, a2}, {156, a3}, {226, a4}, {242, a5}};
```

In[147]:=
```
ListPlot[decay1, AxesOrigin → {0, 0},
 PlotStyle → Directive[PointSize[Medium], Red],
 AxesLabel → {Time [days], Activity [Hz]}]
```

Out[147]=



Coincidence:

In[148]:=
```
a6 = g6 / 80 612 // N
a7 = g7 / 63 417 // N
a8 = g8 / 82 004 // N
a9 = g9 / 84 303 // N
a10 = g10 / 139 245 // N
```

Out[148]= 0.04893155061

Out[149]= 0.01854604561

Out[150]= 0.008239142455

Out[151]= 0.003498575594

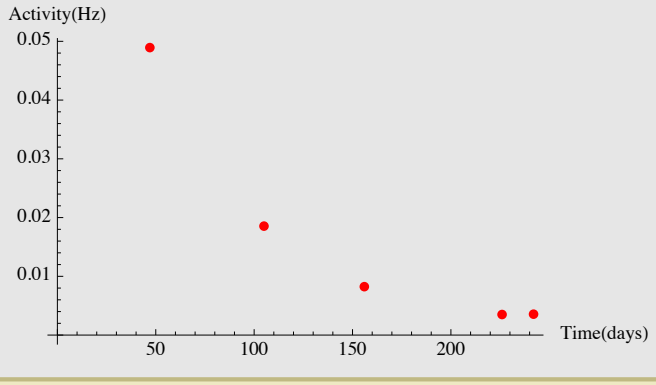
Out[152]= 0.003557652791

Decay Plot

In[153]:=
```
decay2 = {{47, a6}, {105, a7}, {156, a8}, {226, a9}, {242, a10}};
```

In[154]:=
```
ListPlot[decay2, AxesOrigin → {0, 0},
 PlotStyle → Directive[PointSize[Medium], Red],
 AxesLabel → {Time [days], Activity [Hz]}]
```

Out[154]=



1836.1 keV

Singles:

In[155]:=
```
a11 = g11 / 279 // N
a12 = g12 / 359 // N
a13 = g13 / 283 // N
a14 = g14 / 236 // N
a15 = g15 / 244 // N
```

Out[155]= 0.6329120111

Out[156]= 0.4631583676

Out[157]= 0.242166364

Out[158]= 0.02733363684

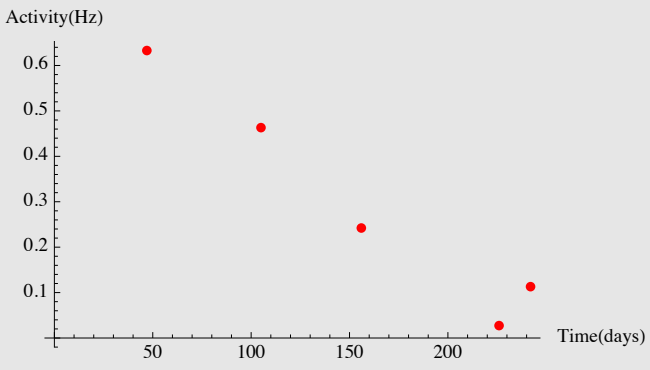
Out[159]= 0.1130534523

Decay Plot

In[160]:=
```
decay3 = {{47, a11}, {105, a12}, {156, a13}, {226, a14}, {242, a15}};
```

In[161]:=
```
ListPlot[decay3, AxesOrigin → {0, 0},
 PlotStyle → Directive[PointSize[Medium], Red],
 AxesLabel → {Time [days], Activity [Hz]}]
```

Out[161]=



Coincidence

In[162]:=
```
a16 = g16 / 80 612 // N
a17 = g17 / 63 417 // N
a18 = g18 / 82 004 // N
a19 = g19 / 84 303 // N
a20 = g20 / 139 245 // N
```

Out[162]= 0.0255864943

Out[163]= 0.007758875597

Out[164]= 0.004679148502

Out[165]= 0.002564489877

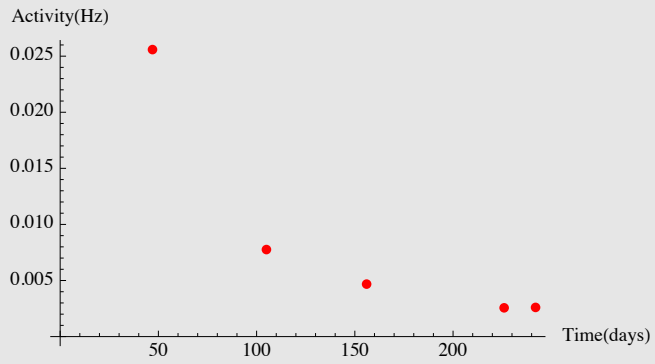
Out[166]= 0.002601405075

Decay Plot

In[167]:=
```
decay4 = {{47, a16}, {105, a17}, {156, a18}, {226, a19}, {242, a20}};
```

In[168]:=
```
ListPlot[decay4, AxesOrigin → {0, 0},
 PlotStyle → Directive[PointSize[Medium], Red],
 AxesLabel → {Time [days], Activity [Hz]}]
```

Out[168]=



Plots and Fits

Graphs of $\frac{\text{Signal}}{\text{Noise}}$ vs. Activity along with linear fits. After the first runs, 6978 and 6980, where taken, the base platform was changed from cinder blocks to poly-wax blocks to try to reduce background noise. This is a change of the set-up that would affect the area of the background. At the end of each subsection I removed these points to see how the fit changed.

Things to note. Some additional considerations may be needed for the last run, 7236, that has a broad peak that was shifted to higher energies during the run. The liguid nitrogen tank on the HpGe detector was refilled at some point during the run. Possibly a time cut will be needed. Errors also need to be included.

898 keV

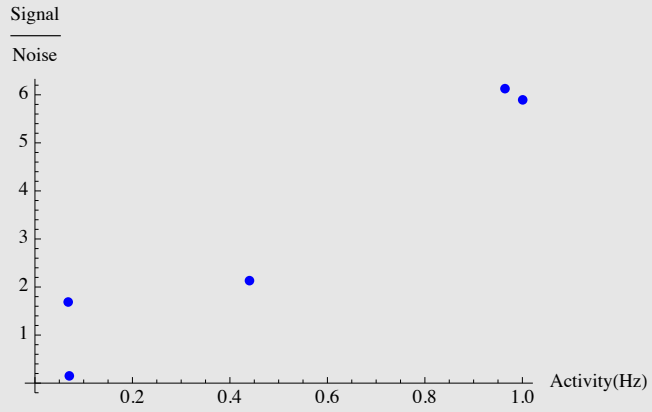
- **Singles:**

In[169]:=
```
signalnoise1 = {{a1, g1 / n1}, {a2, g2 / n3},
   {a3, g3 / n5}, {a4, g4 / n7}, {a5, g5 / n9}} // N
```

Out[169]=
```
{{1.000685207, 5.894818546}, {0.9643371981, 6.127967536},
 {0.4401491714, 2.132685711}, {0.07050679234, 0.1506323655}, {0.06819509423, 1.688055069}}
```

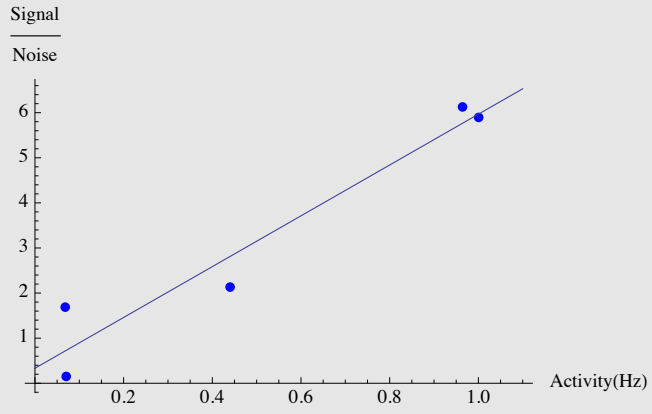
In[209]:=
```
p1 = ListPlot[signalnoise1, AxesOrigin → {0, 0},
  PlotStyle → Directive[PointSize[Medium], Blue],
  AxesLabel → {Activity [Hz], Signal/Noise}]
line1 = Fit[signalnoise1, {1, x}, x]
p2 = Plot[{line1}, {x, 0, 1.1}];
Show[{p1, p2}]
```

Out[209]=



Out[210]=
```
0.3321415348 + 5.634498635 x
```

Out[212]=



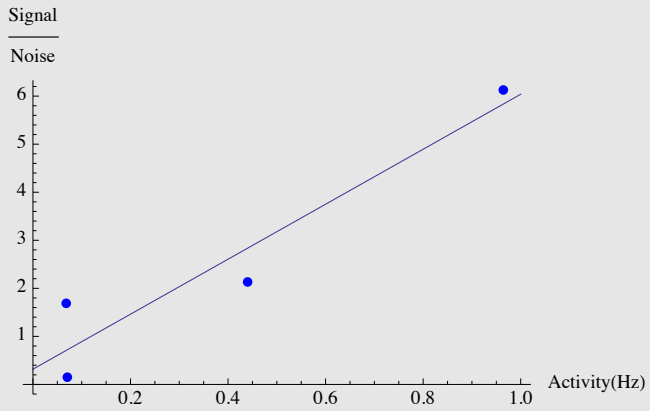
Removing first run (r6978)

In[213]:=
```
sn1 = {{a2, g2 / n3}, {a3, g3 / n5}, {a4, g4 / n7}, {a5, g5 / n9}} // N
plot1 = ListPlot[sn1, AxesOrigin → {0, 0},
    PlotStyle → Directive[PointSize[Medium], Blue],
    AxesLabel → {Activity [Hz], Signal / Noise}];
l1 = Fit[sn1, {1, x}, x]
plot2 = Plot[{l1}, {x, 0, 1}];
Show[{plot1, plot2}]
```

Out[213]=
```
{{0.9643371981, 6.127967536}, {0.4401491714, 2.132685711},
 {0.07050679234, 0.1506323655}, {0.06819509423, 1.688055069}}
```

Out[215]=
```
0.3176876412 + 5.721006547 x
```

Out[217]=



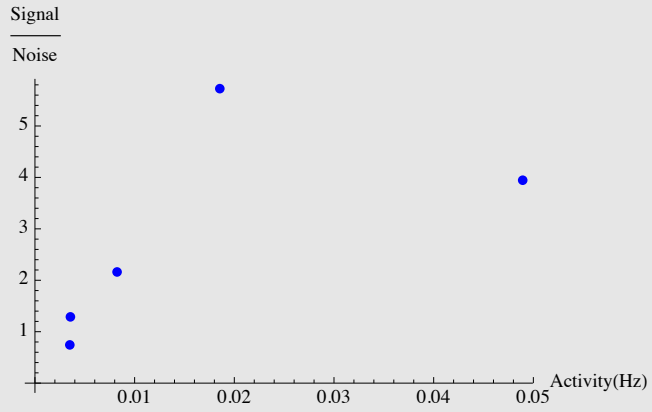
Coincidence

In[179]:=
```
signalnoise2 = {{a6, g6 / n2}, {a7, g7 / n4},
    {a8, g8 / n6}, {a9, g9 / n8}, {a10, g10 / n10}} // N
```

Out[179]=
```
{{0.04893155061, 3.94545983}, {0.01854604561, 5.72580788}, {0.008239142455, 2.16161695},
 {0.003498575594, 0.7432620298}, {0.003557652791, 1.288315239}}
```

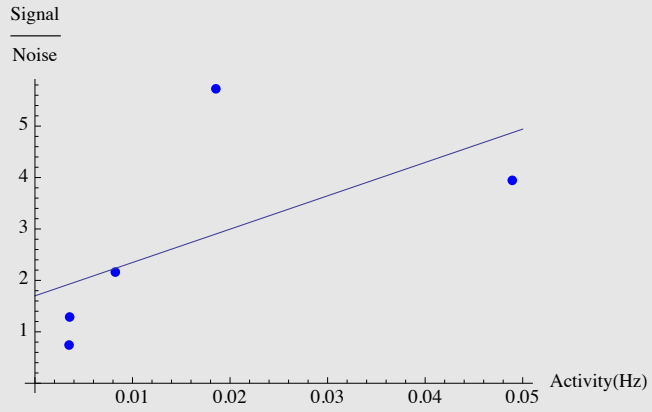
In[218]:=
```
p3 = ListPlot[signalnoise2, AxesOrigin → {0, 0},
  PlotStyle → Directive[PointSize[Medium], Blue],
  AxesLabel → {Activity [Hz], Signal/Noise}]
line2 = Fit[signalnoise2, {1, x}, x]
p4 = Plot[{line2}, {x, 0, 0.05}];
Show[{p3, p4}]
```

Out[218]=



Out[219]=
```
1.699425032 + 64.84407845 x
```

Out[221]=



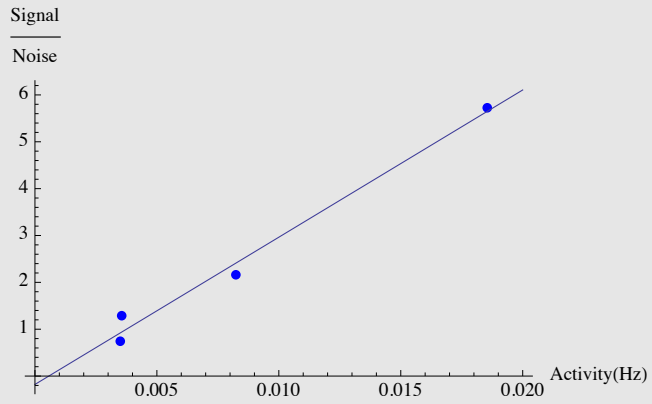
Remove first run (r6980)

In[222]:=
```
sn2 = {{a7, g7 / n4}, {a8, g8 / n6}, {a9, g9 / n8}, {a10, g10 / n10}} // N
plot3 = ListPlot[sn2, AxesOrigin → {0, 0},
    PlotStyle → Directive[PointSize[Medium], Blue],
    AxesLabel → {Activity [Hz], Signal / Noise}];
l2 = Fit[sn2, {1, x}, x]
plot4 = Plot[{l2}, {x, 0, 0.02}];
Show[{plot3, plot4}]
```

Out[222]=
```
{{0.01854604561, 5.72580788}, {0.008239142455, 2.16161695},
 {0.003498575594, 0.7432620298}, {0.003557652791, 1.288315239}}
```

Out[224]=
```
-0.1786408569 + 314.2175075 x
```

Out[226]=



1836.1 keV

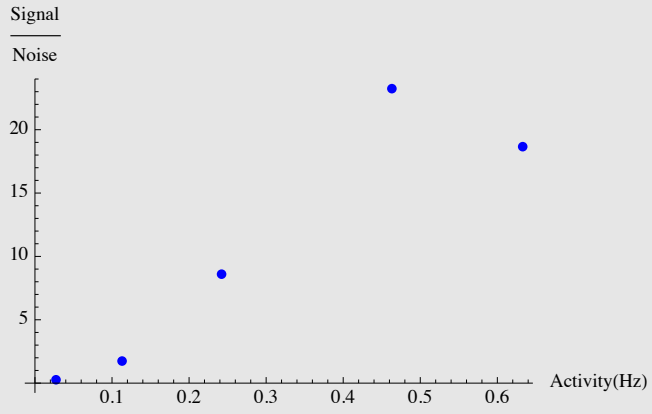
Singles

In[189]:=
```
signalnoise3 = {{a11, g11 / n11}, {a12, g12 / n13},
    {a13, g13 / n15}, {a14, g14 / n17}, {a15, g15 / n19}} // N
```

Out[189]=
```
{{0.6329120111, 18.66137371}, {0.4631583676, 23.23957699},
 {0.242166364, 8.598308163}, {0.02733363684, 0.2652314596}, {0.1130534523, 1.742401511}}
```

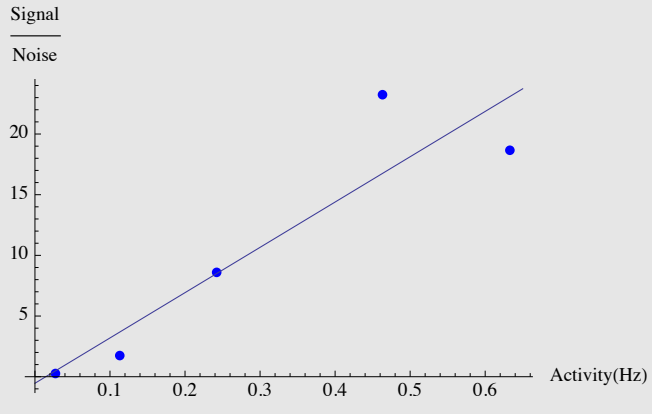
In[227]:=
```
p5 = ListPlot[signalnoise3, AxesOrigin → {0, 0},
  PlotStyle → Directive[PointSize[Medium], Blue],
  AxesLabel → {Activity [Hz], Signal/Noise}]
line3 = Fit[signalnoise3, {1, x}, x]
p6 = Plot[{line3}, {x, 0, 0.65}];
Show[{p5, p6}]
```

Out[227]=



Out[228]=
```
-0.5391694468 + 37.33386266 x
```

Out[230]=



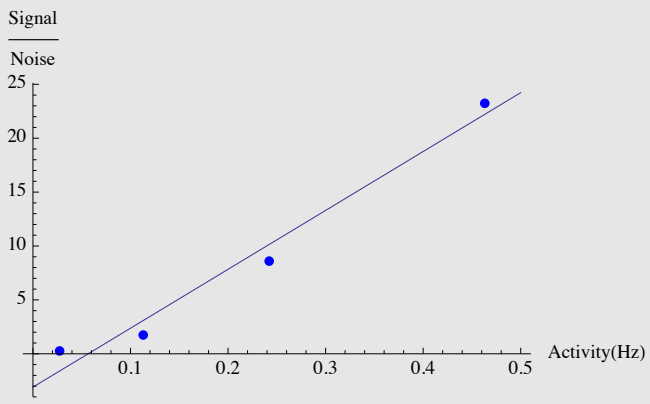
Remove first run (r6978)

In[231]:=
```
sn3 = {{a12, g12 / n13}, {a13, g13 / n15},
    {a14, g14 / n17}, {a15, g15 / n19}} // N
plot5 = ListPlot[sn3, AxesOrigin → {0, 0},
    PlotStyle → Directive[PointSize[Medium], Blue],
    AxesLabel → {Activity [Hz], Signal / Noise}];
l3 = Fit[sn3, {1, x}, x]
plot6 = Plot[{l3}, {x, 0, 0.5}];
Show[{plot5, plot6}]
```

Out[231]=
```
{{0.4631583676, 23.23957699}, {0.242166364, 8.598308163},
 {0.02733363684, 0.2652314596}, {0.1130534523, 1.742401511}}
```

Out[233]=
```
-3.090135136 + 54.63570158 x
```

Out[235]=



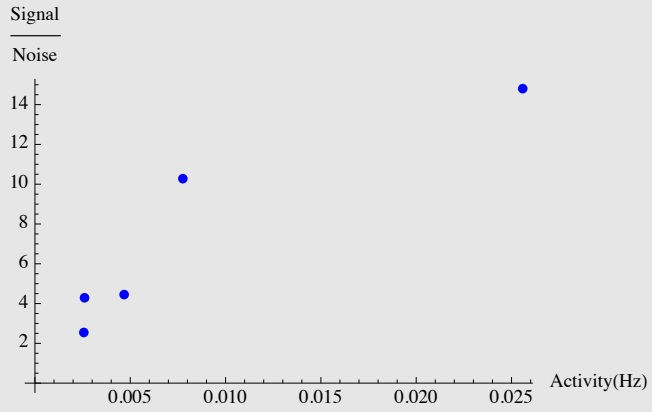
Coincidence

In[199]:=
```
signalnoise4 = {{a16, g16 / n12}, {a17, g17 / n14},
    {a18, g18 / n16}, {a19, g19 / n18}, {a20, g20 / n20}} // N
```

Out[199]=
```
{{0.0255864943, 14.80308259}, {0.007758875597, 10.27734651},
 {0.004679148502, 4.4517887}, {0.002564489877, 2.547191518}, {0.002601405075, 4.291304186}}
```

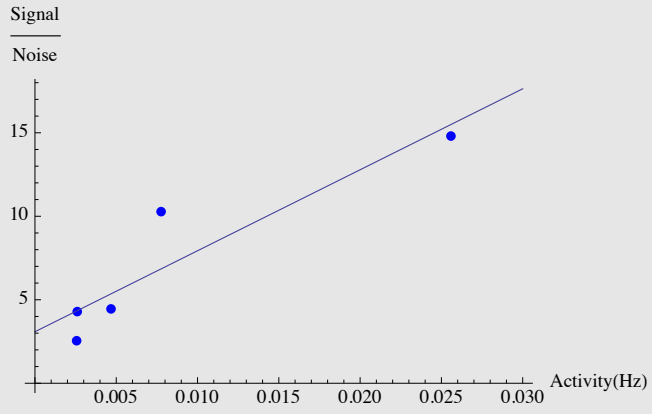
In[236]:=
```
p7 = ListPlot[signalnoise4, AxesOrigin → {0, 0},
  PlotStyle → Directive[PointSize[Medium], Blue],
  AxesLabel → {Activity [Hz], Signal/Noise}]
line4 = Fit[signalnoise4, {1, x}, x]
p8 = Plot[{line4}, {x, 0, 0.03}];
Show[{p7, p8}]
```

Out[236]=



Out[237]=
```
3.084773007 + 484.9883769 x
```

Out[239]=



Remove first run (r6980)

In[240]:=
```
sn4 = {{a17, g17 / n14}, {a18, g18 / n16},
    {a19, g19 / n18}, {a20, g20 / n20}} // N
plot7 = ListPlot[sn4, AxesOrigin → {0, 0},
    PlotStyle → Directive[PointSize[Medium], Blue],
    AxesLabel → {Activity [Hz], Signal / Noise}];
l4 = Fit[sn4, {1, x}, x]
plot8 = Plot[{l4}, {x, 0, 0.008}];
Show[{plot7, plot8}]
```

Out[240]=
```
{{0.007758875597, 10.27734651}, {0.004679148502, 4.4517887},
 {0.002564489877, 2.547191518}, {0.002601405075, 4.291304186}}
```

Out[242]=
```
-0.3281374087 + 1299.720845 x
```

Out[244]=