In[44]:=
```
SetDirectory["~white/Desktop/H2datacomp/"];
Namelist = Drop[FileNames[], 8];
Namelist // Length;
nfiles = %
```

Out[47]= 3

In[48]:=
```
Print[Namelist]
```

```
{noisedata.csv, sigdata.csv, vcseldata.csv}
```

First Analyze a sample of the Noise.

In[49]:=
```
Print[Namelist[[1]]]
```

```
noisedata.csv
```

In[50]:=
```
scopedata = Import[Namelist[[1]], "csv"];
```

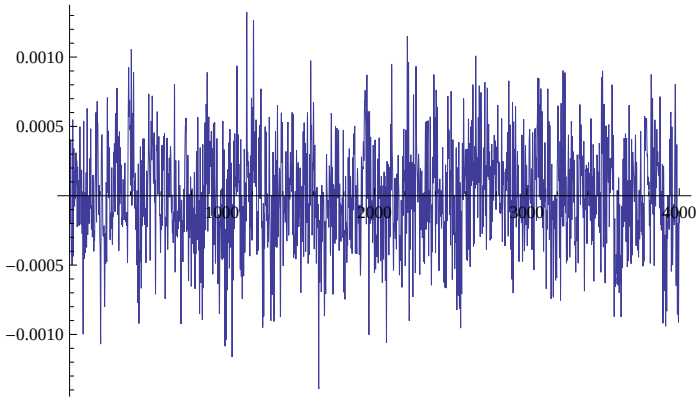
In[51]:=
```
Dimensions[scopedata[[1]]] ;
npts = %[[1]]
```

Out[52]= 40 002

In[53]:=
```
gain = Take[scopedata[[1]], 4000];
```

In[54]:=
```
lpg = ListPlot[gain, Joined → True]
```

Out[54]=



In[74]:=
```
noiserms = RootMeanSquare[gain];
Print["Noise Level=   ", 1000 * noiserms, " mV RMS"]
```

```
Noise Level=   0.351737 mV RMS
```

In[55]:=
```
slice = ConstantArray[0, 4000]; tfit = Range[0, 200 * 10^-9 - .05 * 10^-9, .05 * 10^-9];
Dimensions[tfit]
tfit[[2000]]
```

Out[56]= {4000}

Out[57]= 9.995×10^{-8}

In[58]:=
```
dt = tfit[[2]] - tfit[[1]]
```

Out[58]= $5. \times 10^{-11}$

Discrete Fourier Transform.

In[59]:=
```
Timing[ fftslice = Fourier[gain]; ]
```

Out[59]=
```
{0.003722, Null}
```

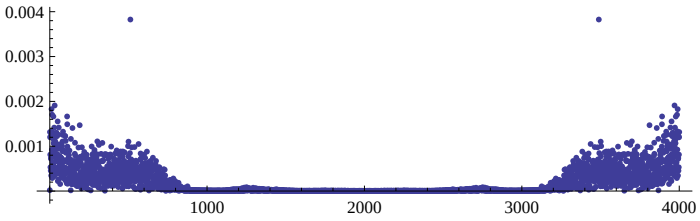
In[60]:=
```
Dimensions[fftslice]
```

Out[60]=
```
{4000}
```

This has zero frequency in element 1. The 2000-th element corresponds to 1/2 the sampling frequency. After that aliassing takes over and the frequency heads back to zero.

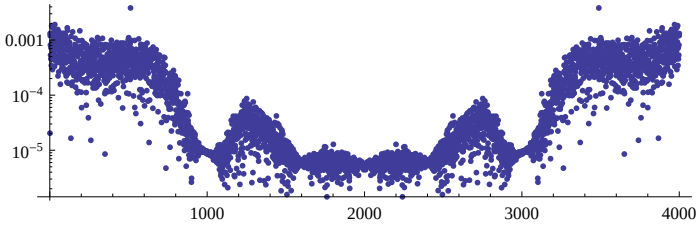
In[61]:=
```
ListPlot[Abs[fftslice], AspectRatio → 0.3, PlotRange → All]
```

Out[61]=



In[62]:=
```
ListLogPlot[Abs[fftslice], AspectRatio → 0.3, PlotRange → All]
```

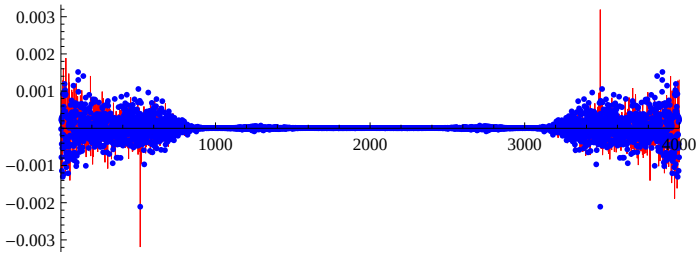
Out[62]=



Separate Real and Imaginary components.

In[63]:=
```
ListPlot[{Re[fftslice], Im[fftslice]},
 AspectRatio → 0.4, PlotRange → {{0, 4000}, All},
  PlotStyle → {Blue, Red}, Joined → {False, True}]
```

Out[63]=



We can reasonably assume evenly-spaced time samples.

In[64]:=
```
intervals = Rest[tfit] - Most[tfit] ;
```

In[65]:=
```
intvl = Mean[intervals]
```

Out[65]=
```
5. × 10^-11
```

In[66]:=
```
StandardDeviation[intervals]
```

Out[66]=
```
6.87332 × 10^-24
```

In[67]:=
```
samplFreq = 1 / intvl
```

Out[67]=
```
2. × 10^10
```

Frequency step per interval in the FFT.

In[68]:=
```
fspi = (samplFreq / 2) / 2000
```

Out[68]= $5. \times 10^6$

In[79]:=
```
fftbins = fspi * Range[0, (2000 - 1)];
```

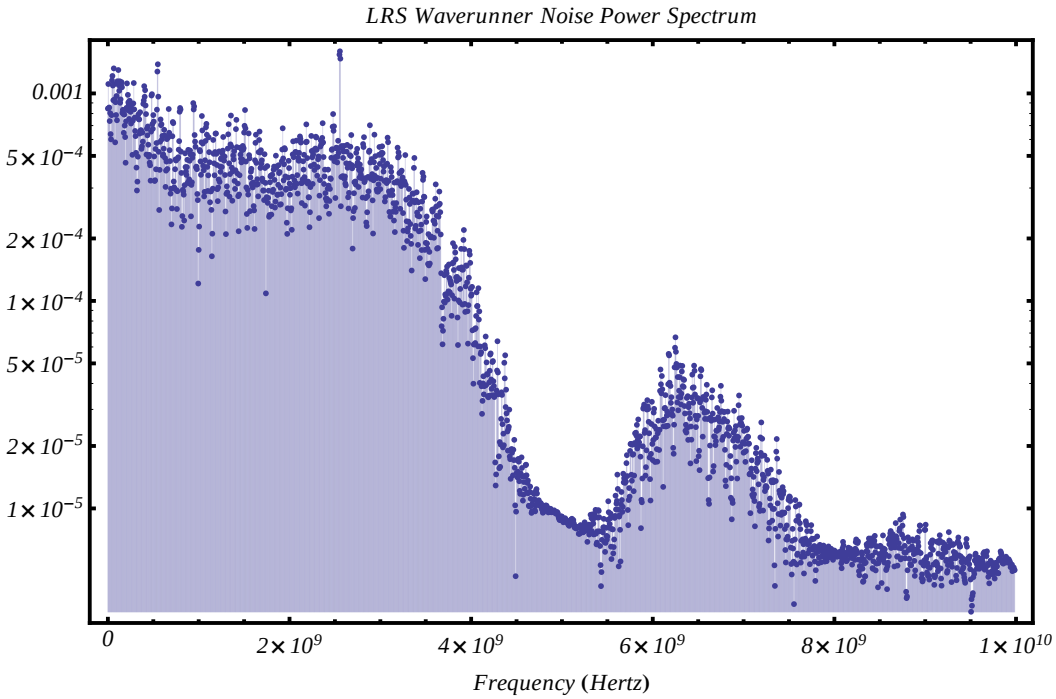
In[98]:=
```
splitfft = Take[Abs[fftslice], 2000];
smoothfft = MovingAverage[splitfft, 3];
Dimensions[smoothfft]
Dimensions[splitfft]
```

Out[100]= {1998}

Out[101]= {2000}

In[190]:=
```
ListLogPlot[Transpose[{Take[fftbins, (2000 - 2)], smoothfft}],
 Filling → Axis, Frame → True, FrameStyle → Thick, FrameLabel →
  {{, }, {"Frequency (Hertz)", "LRS Waverunner Noise Power Spectrum"}},
 LabelStyle → {Medium, Italic, Bold}, ImageSize → Large]
```

Out[190]=



Now examine typical signal waveform.

In[234]:=
```
SetDirectory["~white/Desktop/H2datacomp/"];
Namelist = Drop[FileNames[], 8];
Namelist // Length;
nfiles = %
```

Out[237]= 4

In[238]:=
```
Print[Namelist[[4]]]
```

```
vcseldata.csv
```

In[239]:=
```
Clear[scopedata];
Timing[scopedata = Import[Namelist[[4]], "csv"]];

ch2 = scopedata;
```

In[250]:=
```
Clear[scopedata]
Timing[scopedata = Import[Namelist[[3]], "csv"]];
```

In[252]:=
```
ch3 = scopedata;
Dimensions[ch3]
Clear[scopedata]
```

Out[253]= {51, 4000}

In[262]:=
```
ch2small = Table[Take[ch2[[i]], {1900, 2299}], {i, 51}];
ch3small = Table[Take[ch3[[i]], {1900, 2299}], {i, 51}];
```

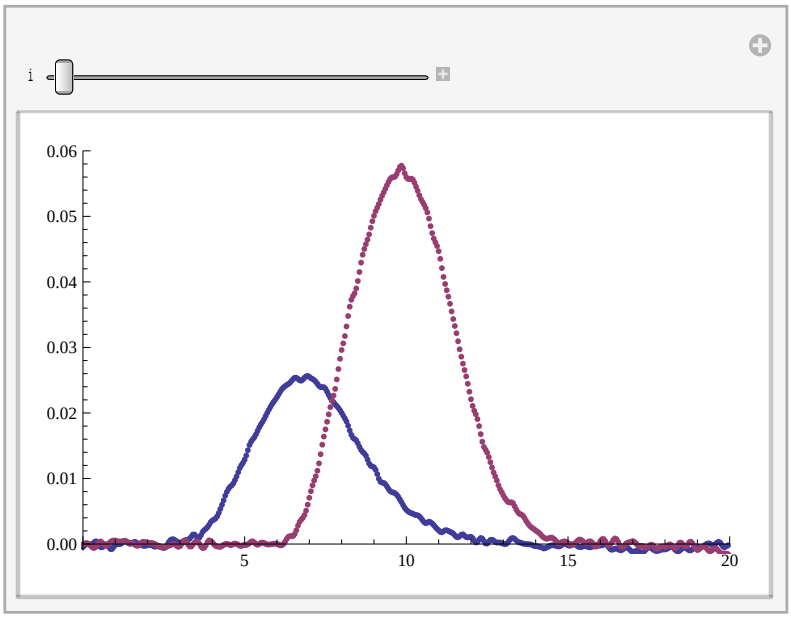
In[269]:=
```
timebin = 0.05 * Range[0, 399];
Dimensions[timebin]
Dimensions[ch2small]
```

Out[270]= {400}

Out[271]= {51, 400}

In[299]:=
```
Manipulate[ListPlot[
  {Transpose[{timebin, ch2small[[i]]}], Transpose[{timebin, ch3small[[i]]}]},
  PlotRange → {{0, 20}, {-.001, .06}}], {i, 1, 51, 1}]
```

Out[299]=



Frequency compostion of the signal.

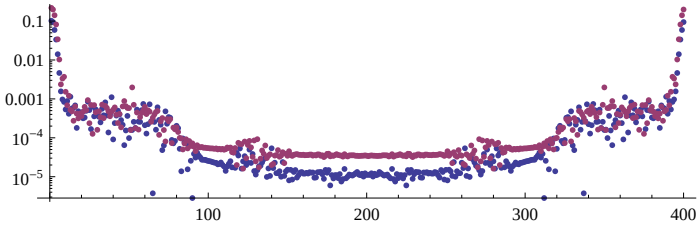
In[273]:=
```
Timing[ fftsig2 = Fourier[ch2small[[1]]]; ]
Timing[ fftsig3 = Fourier[ch3small[[1]]]; ]
```

Out[273]= {0.003858, Null}

Out[274]= {0.000054, Null}

In[276]:=
```
ListLogPlot[{Abs[fftsig2], Abs[fftsig3]}, AspectRatio → 0.3, PlotRange → All]
```

Out[276]=

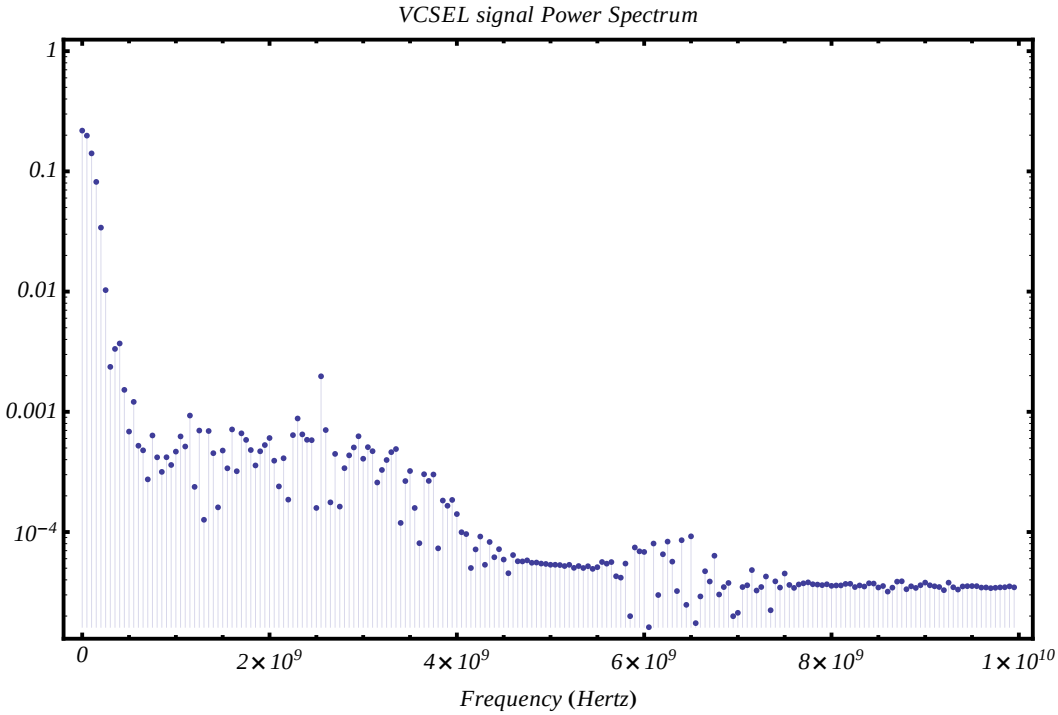


There are 1/10 th as many bins in the fft of the signal, since we are just looking at a narrow region of interrest.

In[293]:=
```
fspi = (samplFreq / 2) / 200;
Clear[fftbins];
fftbins = fspi * Range[0, (200 - 1)];
```

In[296]:=
```
ListLogPlot[Transpose[{fftbins, Take[Abs[fftsig3], 200]}],
 Filling → Axis, Frame → True, FrameStyle → Thick,
 FrameLabel → {{, }, {"Frequency (Hertz)", "VCSEL signal Power Spectrum"}},
 LabelStyle → {Medium, Italic, Bold}, ImageSize → Large]
```

Out[296]=



Crude Time jitter measurement.

```
peak2 = Table[Max[ch2small[[i]]], {i, 1, 51}];
peak3 = Table[Max[ch3small[[i]]], {i, 1, 51}];

time2 = Table[
  Root[(Interpolation[Transpose[{timebin, ch2small[[i]]}]] - peak2[[i]] / 2), 5],
  {51}]
time3 = Table[Root[
   (Interpolation[Transpose[{timebin, ch3small[[i]]}]] - peak3[[i]] / 2), 8], {51}]
```

In[72]:=
```
f = Interpolation[Transpose[{Take[tfit, 200], Take[gain, 200]}]];
```

In[73]:=
```
Plot[f[x], {x, 0, 10 * 10^-9}]
```

Out[73]=