Locking vs Wind Speed @LHO

Wind Speed Histogram

Wind Speed Probability Density Function

Duty cycle vs wind speed

Convolution of duty cycle and wind speed frequency

BNS range vs wind speed

Plots of BNS range vs wind speed in O3 are given in this elog entry:
https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=49682
(digitized from plots so approximate)

avg BNS range vs wind speed data

avg BNS range vs wind quantile data

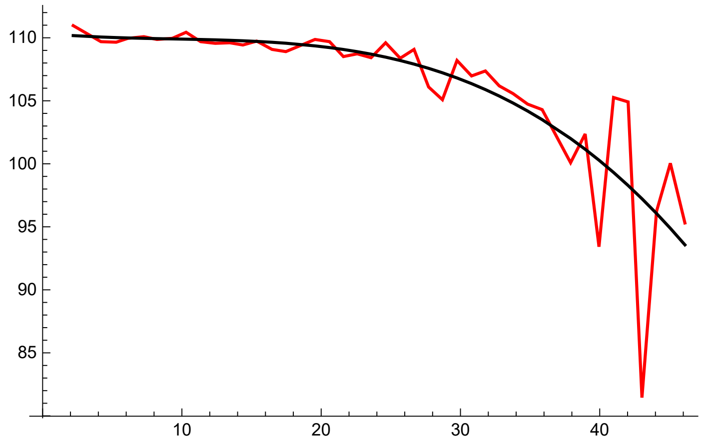
mean BNS range vs wind binned data

mean BNS range vs wind binned quantile data

locking vs wind speed approximation

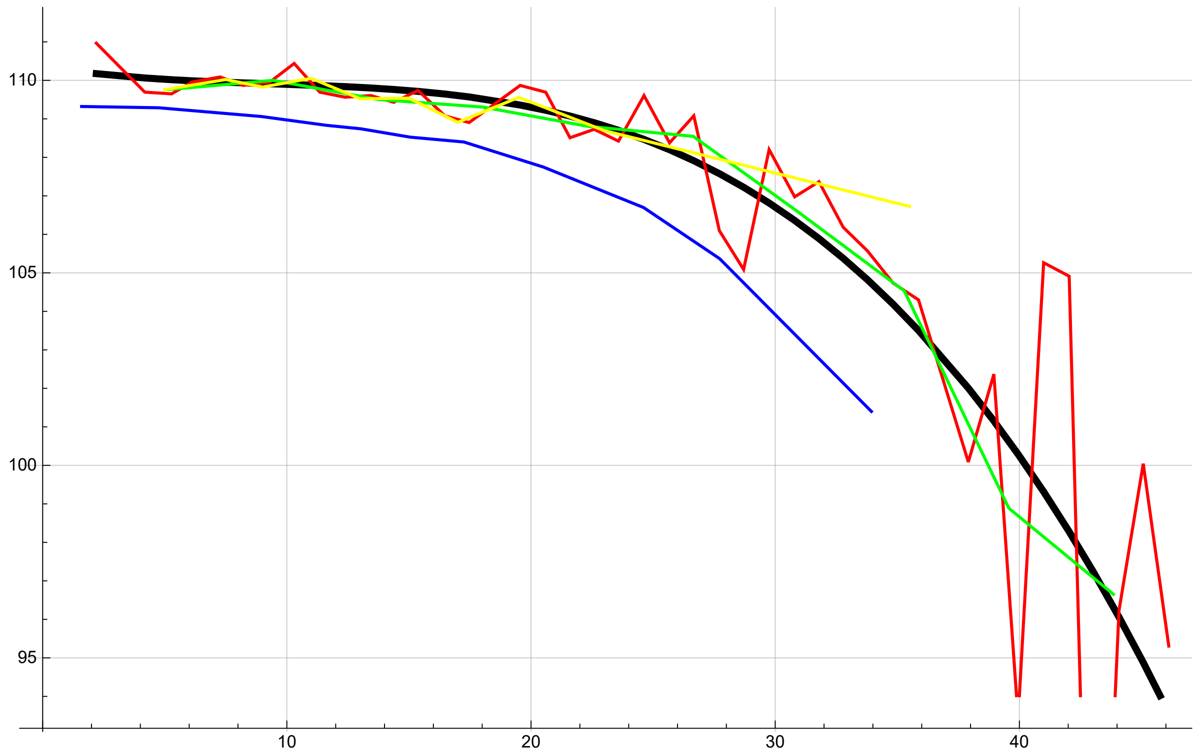
In[239]:=
```
Clear[BNS]
BNS[s_] := Fit[avgBNSrangeVsWindSpeed, {1, x, x^2, x^3}, x] /. x → s
ws = Transpose[avgBNSrangeVsWindSpeed][[1]];
ns = Dimensions[ws];
BNSlist = Transpose[Partition[Join[ws, BNS[s] /. s → ws], ns]];
ListLinePlot[{avgBNSrangeVsWindSpeed, BNSlist},
 PlotJoined → {True, True}, PlotStyle → {Red, Black}]
```

Out[244]=



```
In[245]:= ListLinePlot[{BNSlist, avgBNSrangeVsWindSpeed, avgBNSrangeVsWindQuantile,
            meanBNSrangeVsWindBinned, meanBNSrangeVsWindBinnedQuantile},
          PlotRange → Automatic, GridLines → Automatic,
          PlotStyle → {{Black, Thickness[.006]}, Red, Blue, Green, Yellow}]
```

Out[245]=



Convolution of BNS Range vs Wind Speed and wind speed frequency

```
In[276]:= z = Table[0, {npts}];
          For[i = 1, i < npts, i++,
            z[[i]] = PDFdataValues[[i]] BNS[s / c] /. s → windSpeeds[[i]]];

In[278]:= z

Out[278]= {5.83133, 32.5317, 26.9197, 16.6749, 11.3368, 6.78423, 4.24816,
           2.43234, 1.25831, 0.643338, 0.290008, 0.121377, 0.0704212, 0}

In[279]:= windSpeeds

Out[279]= {1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27}

In[280]:= windSpeeds / c

Out[280]= {2.23694, 6.71081, 11.1847, 15.6586, 20.1324, 24.6063, 29.0802,
           33.554, 38.0279, 42.5018, 46.9757, 51.4495, 55.9234, 60.3973}
```

In[281]:=
```
Total[z]
```
Out[281]=
```
109.143
```

In[282]:=
```
maxRange = BNS[s] /. s → 0
```
Out[282]=
```
110.36
```

In[283]:=
```
maxRange - Total[z]
```
Out[283]=
```
1.21727
```

If we were to make the interferometer sensitivity completely independent of wind speed, then the yearly averaged range would increase by ~1.2 MPc

The Volume x Time integral, and BNS detection rate, would grow ~3% faster if wind had no influence, this amounts to ~2 weeks out of a 1 year observing run.

In[284]:=
```
(maxRange / Total[z]) ^3 - 1
```
Out[284]=
```
0.0338335
```

Windy Season

In[336]:=
```
z = Table[0, {npts}];
For[i = 1, i < npts, i++,
  z[[i]] = PDFdataValues[[i]] BNS[s / c] /. s → windySeasonSpeeds[[i]]];
```

In[338]:=
```
z
```
Out[338]=
```
{5.82383, 32.5132, 26.8988, 16.6431, 11.2917, 6.73663, 4.20097,
 2.39249, 1.22929, 0.623056, 0.277718, 0.114501, 0.0650562, 0}
```

In[342]:=
```
windySeasonSpeeds
```
Out[342]=
```
{2.21, 4.21, 6.21, 8.21, 10.21, 12.21,
 14.21, 16.21, 18.21, 20.21, 22.21, 24.21, 26.21, 28.21}
```

In[340]:=
```
windySeasonSpeeds / c
```
Out[340]=
```
{4.94363, 9.4175, 13.8914, 18.3652, 22.8391, 27.313, 31.7869,
 36.2607, 40.7346, 45.2085, 49.6824, 54.1562, 58.6301, 63.104}
```

In[343]:=
```
Total[z]
```
Out[343]=
```
108.81
```

In[282]:=
```
maxRange = BNS[s] /. s → 0
```
Out[282]=
```
110.36
```

In[344]:=
```
maxRange - Total[z]
```
Out[344]=
```
1.54949
```

If we were to make the interferometer sensitivity completely independent of wind speed, then the yearly averaged range would increase by ~1.5 MPc

The Volume x Time integral, and BNS detection rate, would grow ~4% faster if wind had no influence, during this 3 month “windy season” period.

In[345]:=
```
(maxRange / Total[z]) ^ 3 - 1
```

Out[345]=
```
0.0433322
```