Characterization of GW150914 by RMSMon

2016/2/15 Tuesday @DetChar meeting, Yuzurihara

o Today's topic

- About RMSMon
- Result of GW150914 by RMSMon with several frequency ranges
  * LIGO Hanford
  * LIGO Livingston
- Comments imagined from the results.

Definition of RMSMon

[Classical and Quantum Gravity, Volume 21, Number 5]

RMSMon : RMS monitor tool
RMSMonitor can find the time affected by non-stationary transient noise.

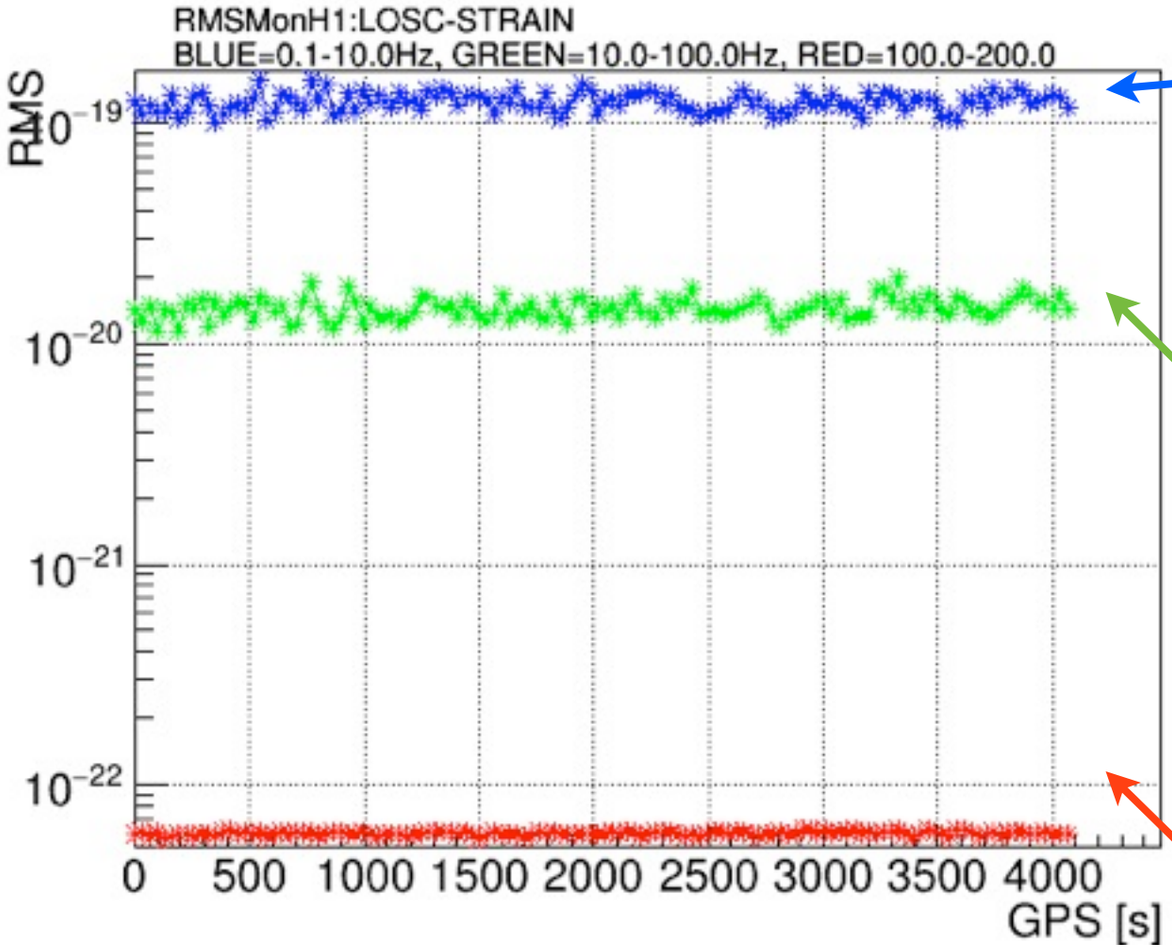
$$RMS = \left(\int_{f1}^{f2} |\tilde{s}(f)|^2 df \right)$$

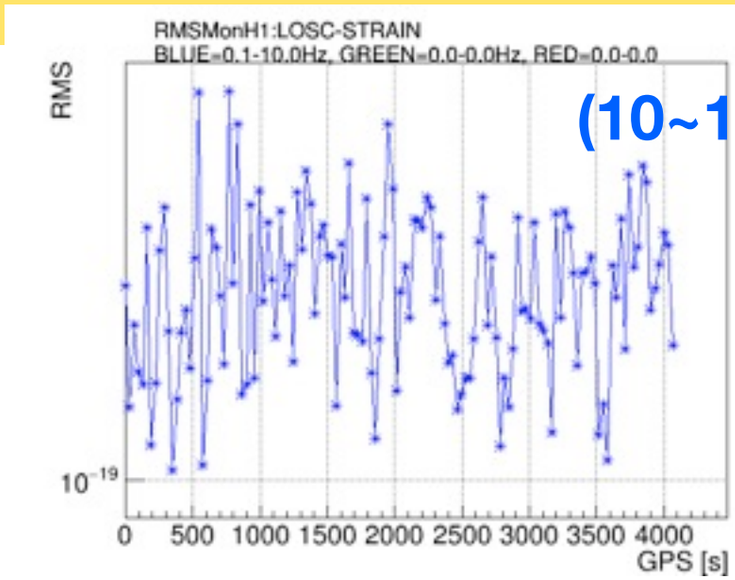
1. calculate the spectrum s(f)
from the time series s(t)

2. sum up the squared spectrum
between the frequency band

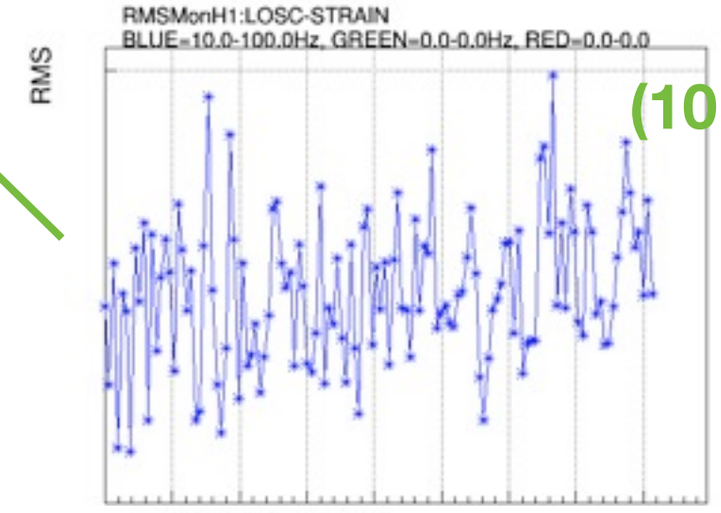
In following result, I calculated RMS from the data of GW150914.
The sampling rate of data is 4096[Hz].
The duration of data is 4096[s].
The duration of chunk is fixed as 32[s].
=> The number of samples is 4096/32 = 128 samples.

Result 0.1~10Hz, 10~100Hz, 100~200Hz (LIGO Hanford)

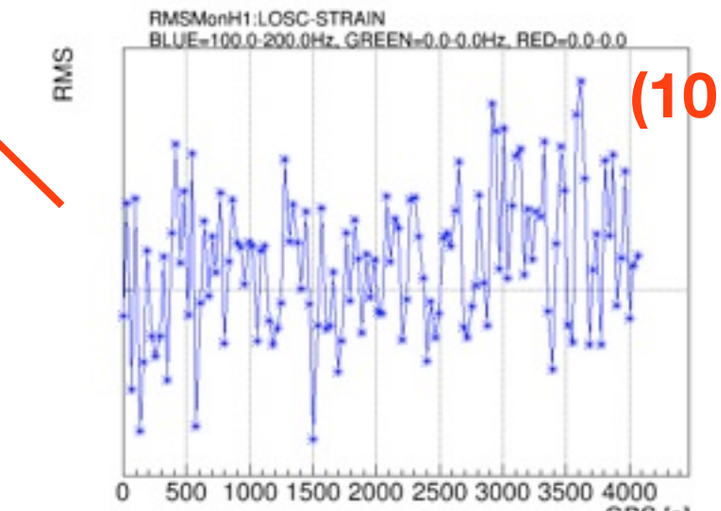




(10~100Hz)



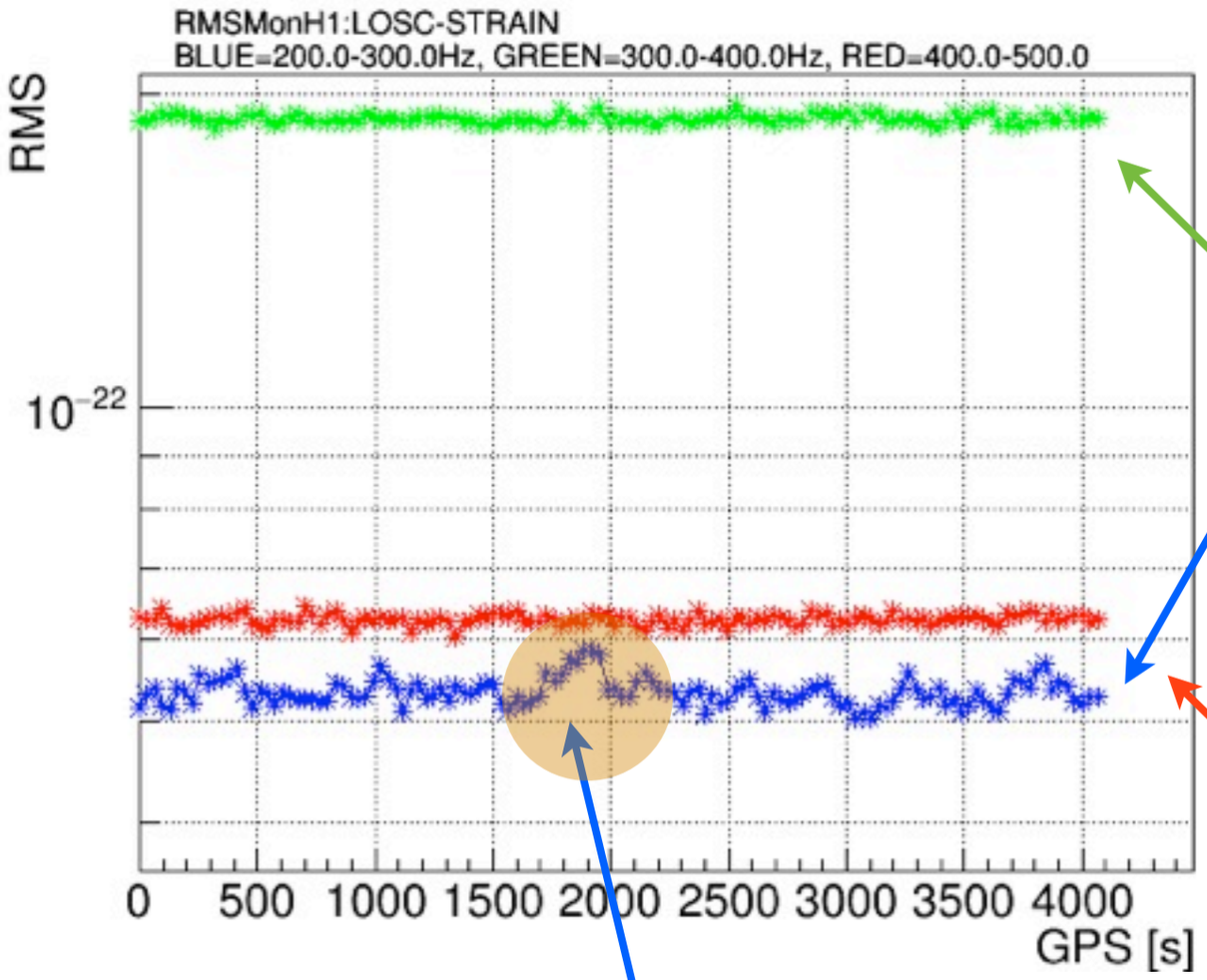
(10~100Hz)



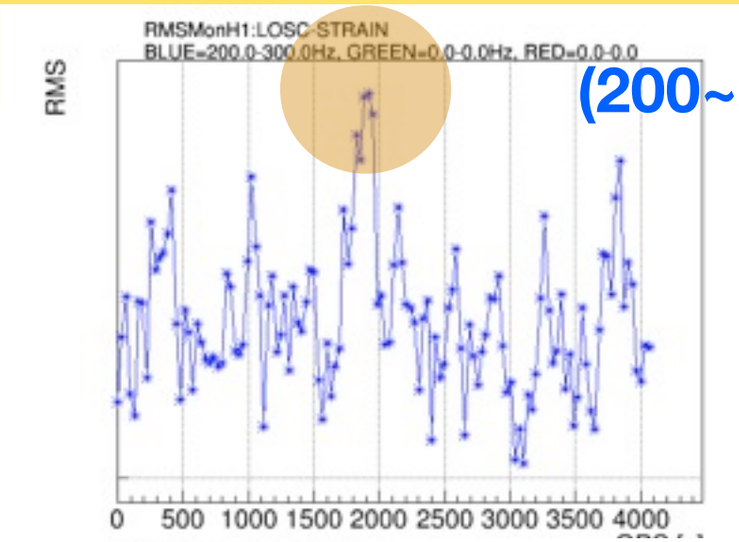
(10~100Hz)

・The RMS of these frequency bands looks almost stationary.

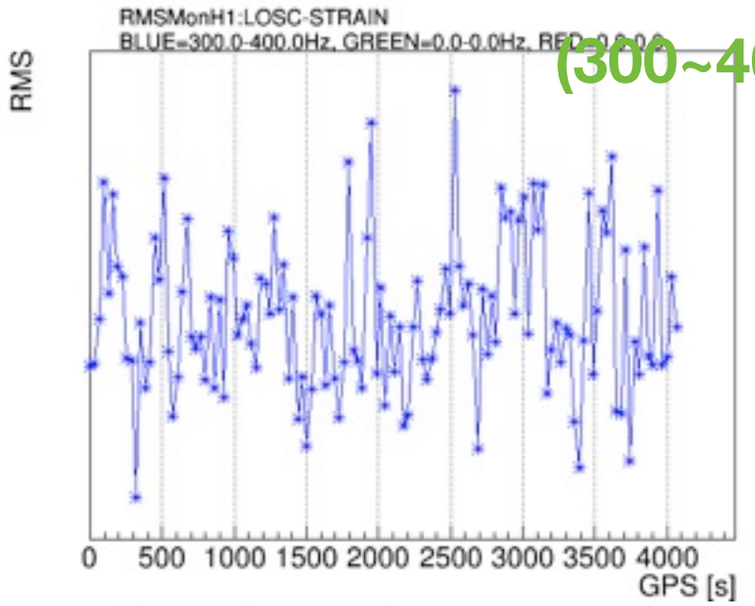
Result 200~300Hz, 300~400Hz, 400~500Hz (LIGO Hanford)



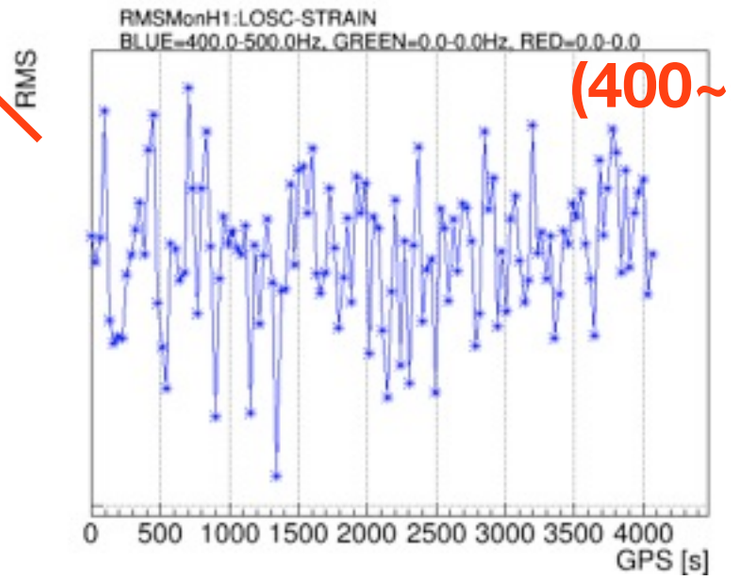
This looks the effect of glitch?



(200~300Hz)



(300~400Hz)

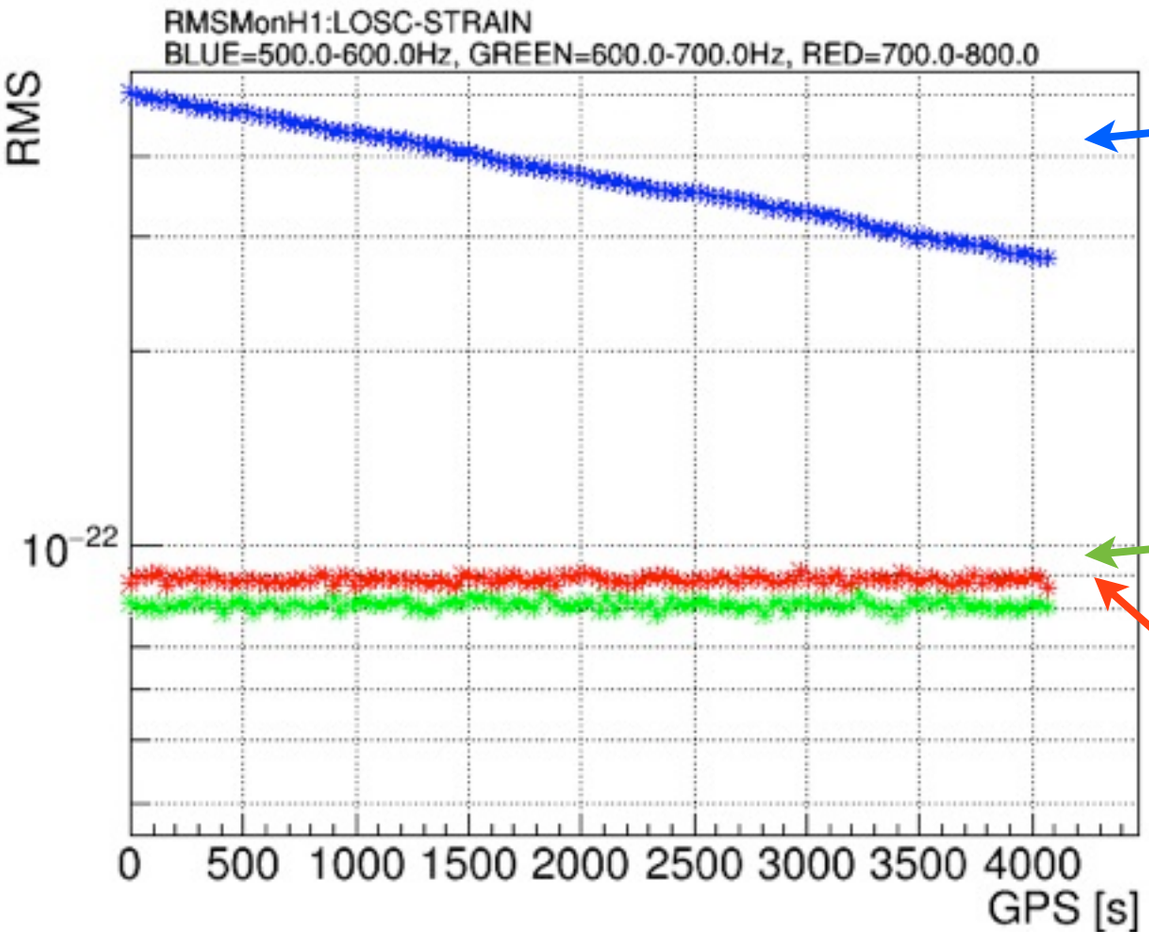


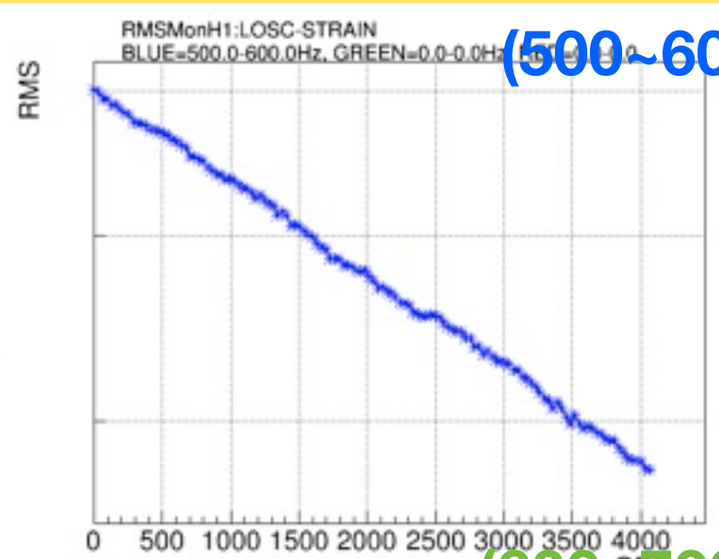
(400~500Hz)

- The RMS of other frequency bands and other time looks stationary.

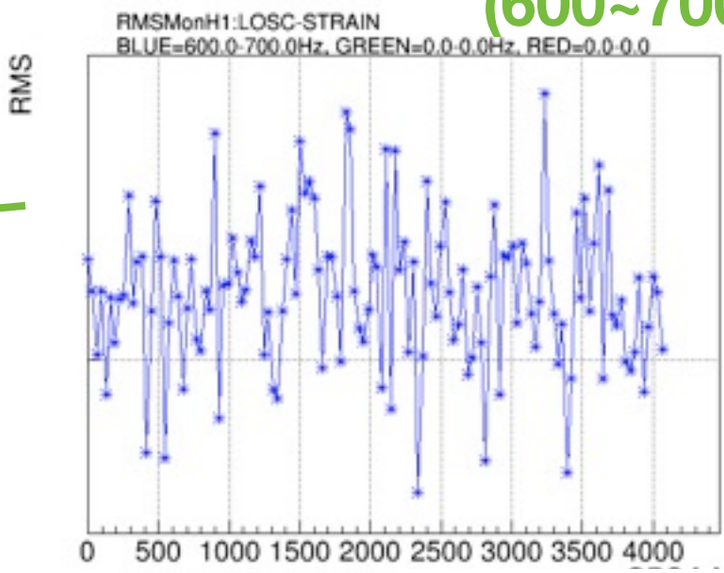
Result 500~600Hz, 600~700Hz, 700~800Hz (LIGO Hanford)

RMS(500~600Hz) looks continuously decreasing.
The excitation of violin mode is attenuating?

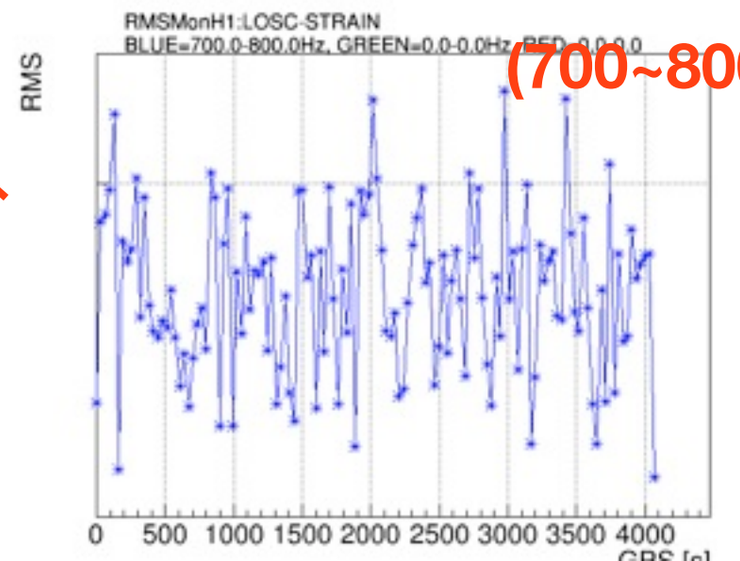




(500~600Hz)



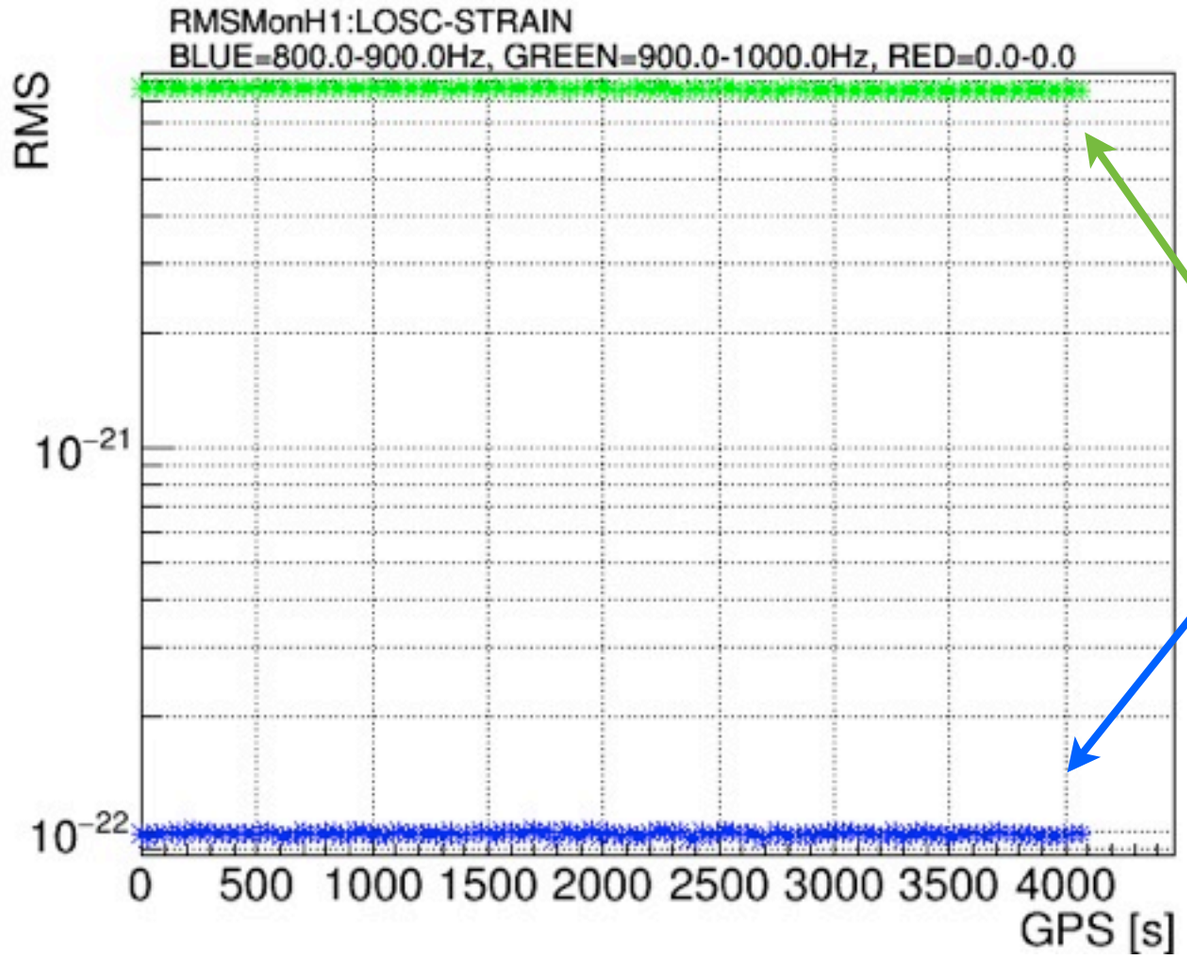
(600~700Hz)



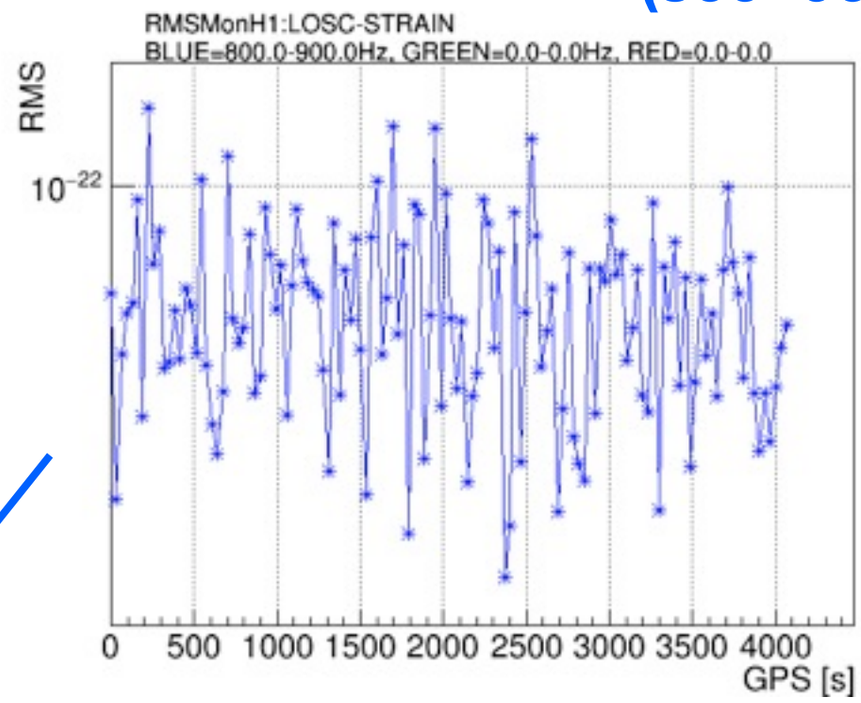
(700~800Hz)

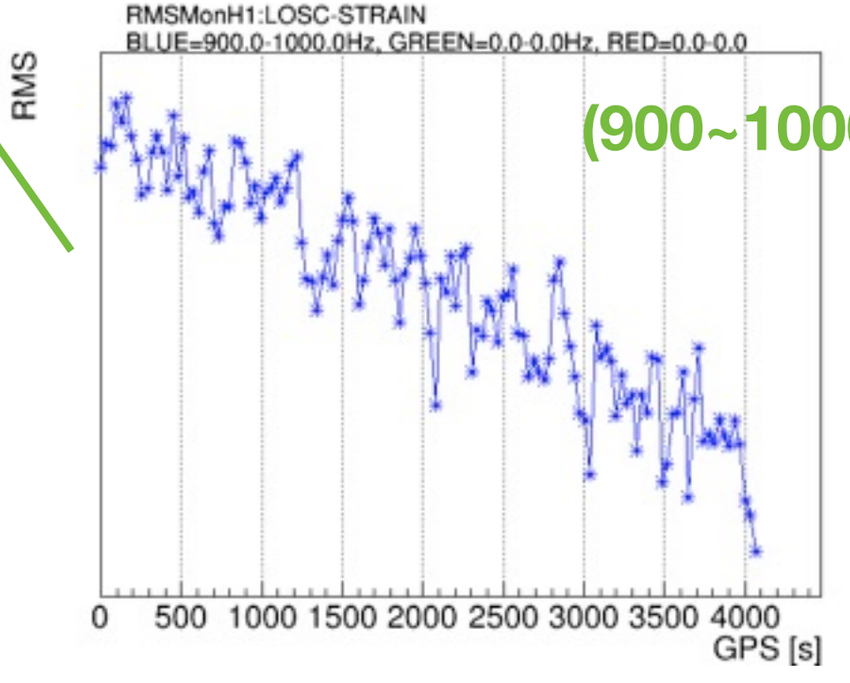
- The RMS of other frequency bands and other time looks stationary.

Result 800~900Hz, 900~1000Hz (LIGO Hanford)



(800~900Hz)

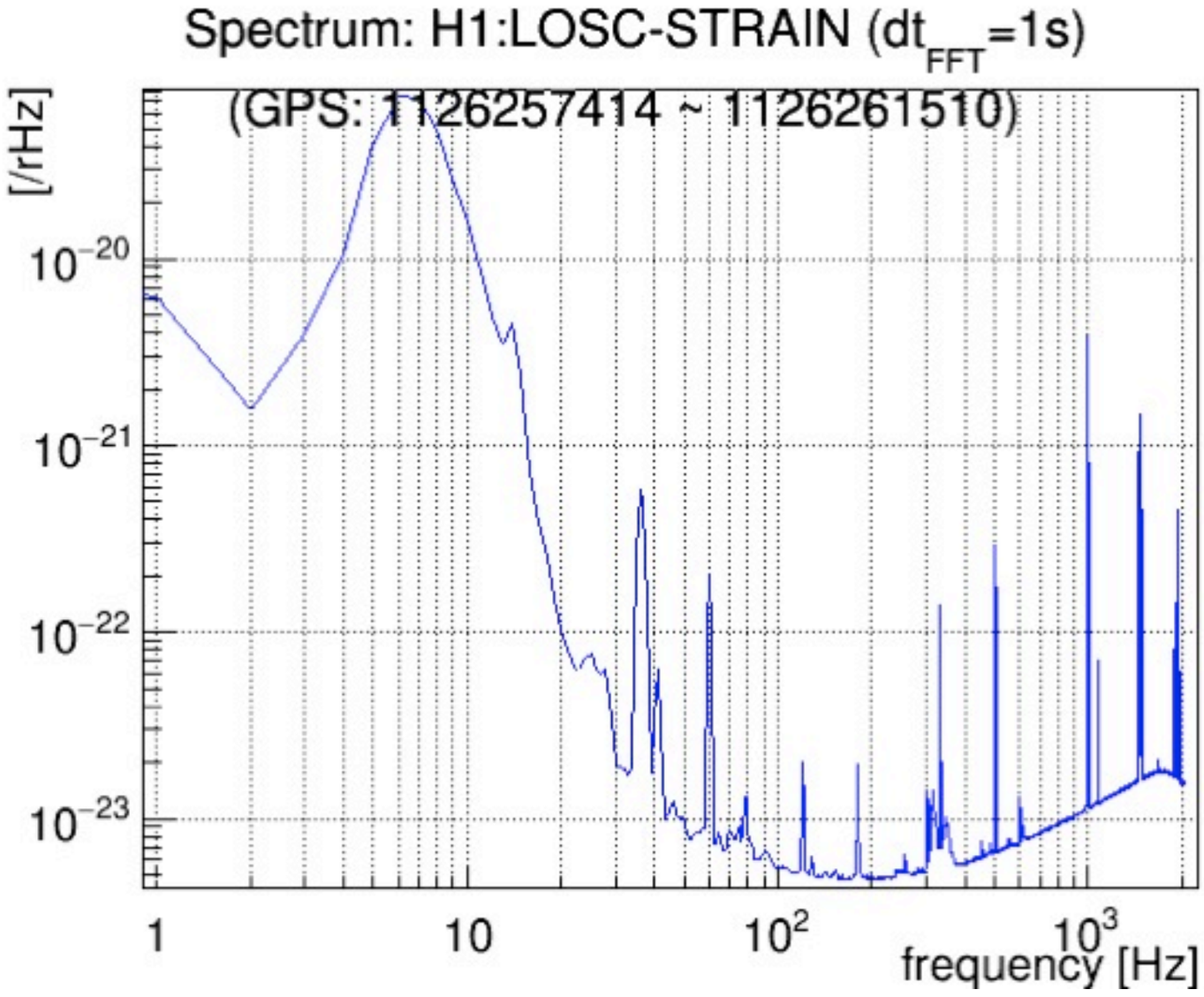




(900~1000Hz)

- The RMS of other frequency bands and other time looks stationary.

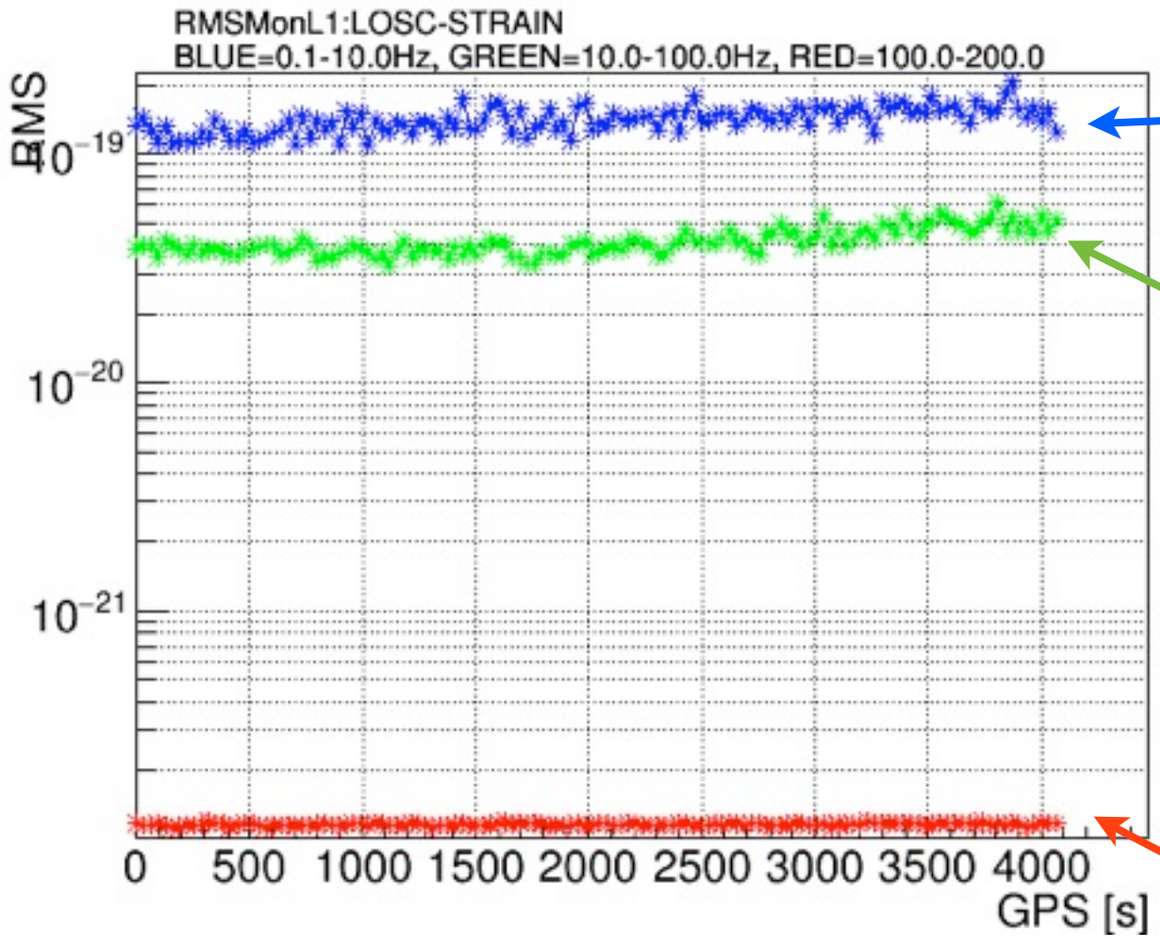
The spectrum estimated by Yamamoto-san

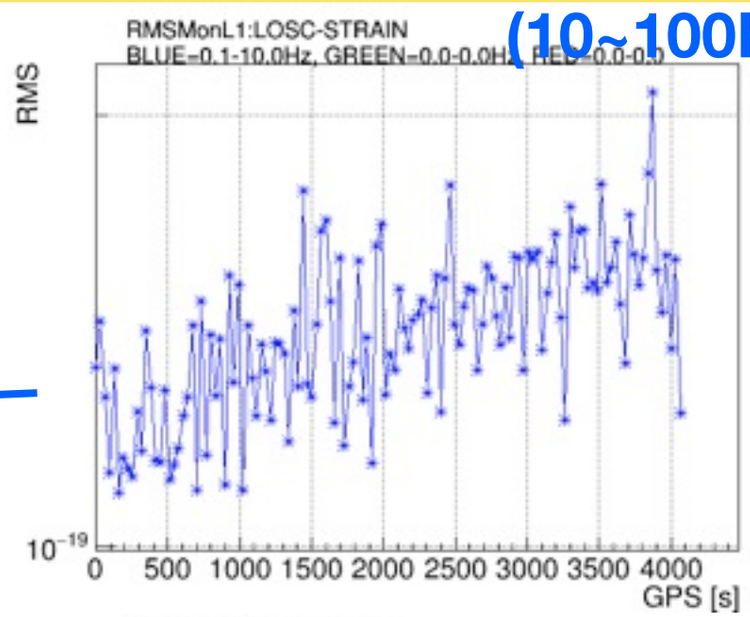


The duration and the sampling frequency of the whole data is 4096[s] and 4096[Hz].
This spectrum is estimated by taking the average(mean) of 4096chunk data (chunk duration is 1[s]).

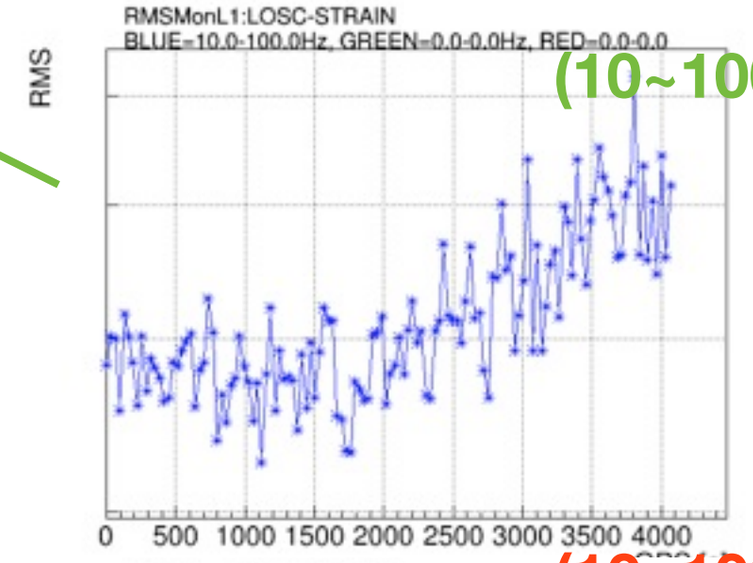
Result 0.1~10Hz, 10~100Hz, 100~200Hz (LIGO Livingston)

RMS(10~100Hz) looks continuously increasing.

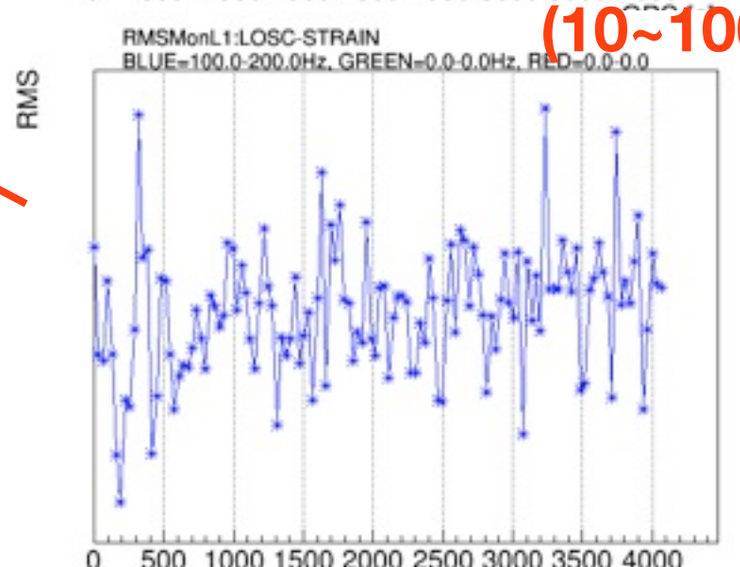




(10~100Hz)



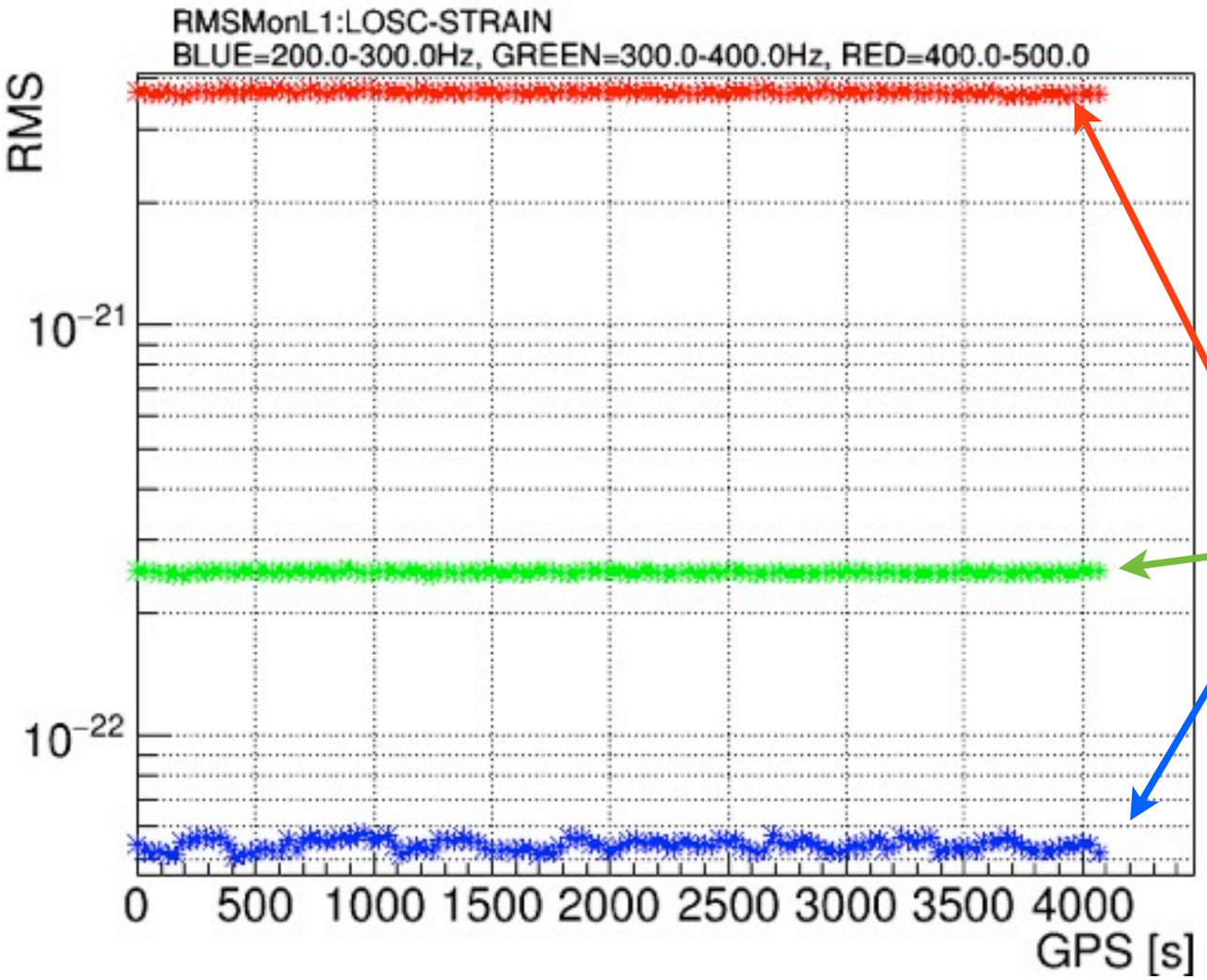
(10~100Hz)

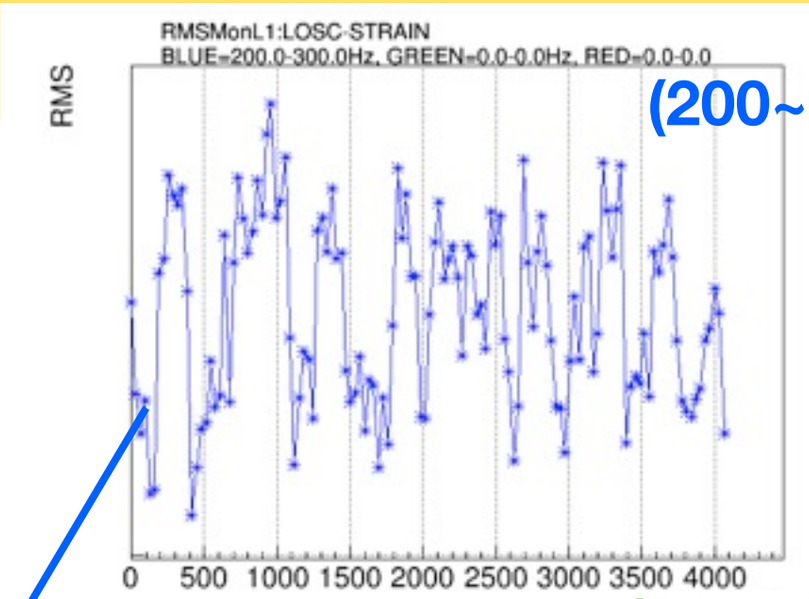


(10~100Hz)

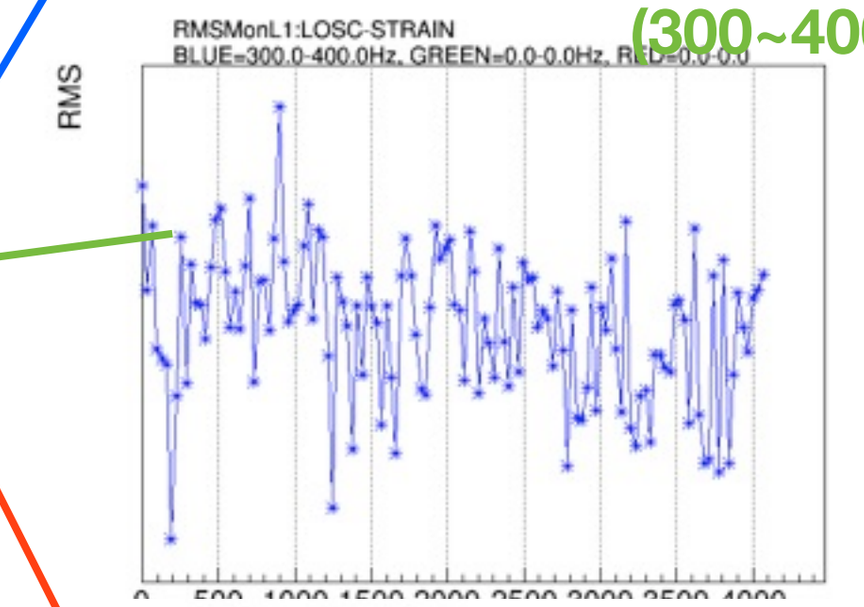
- The RMS of other frequency bands and other time looks stationary.

Result 200~300Hz, 300~400Hz, 400~500Hz (LIGO Livingston)

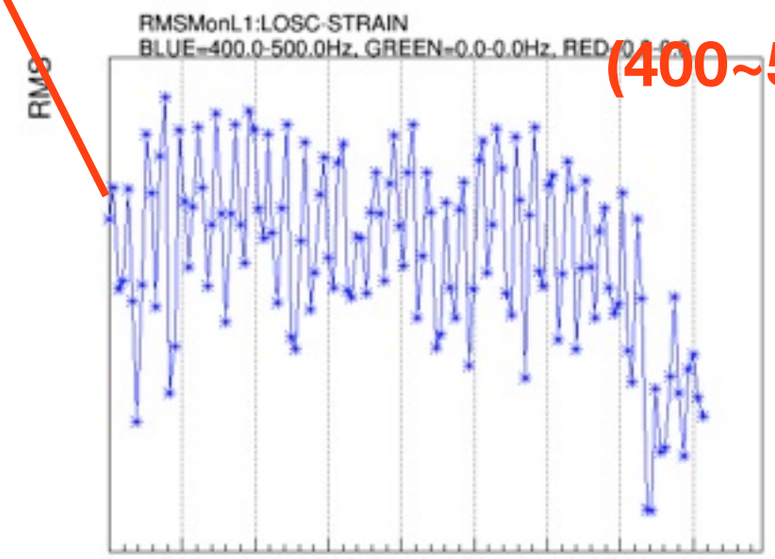




(200~300Hz)



(300~400Hz)

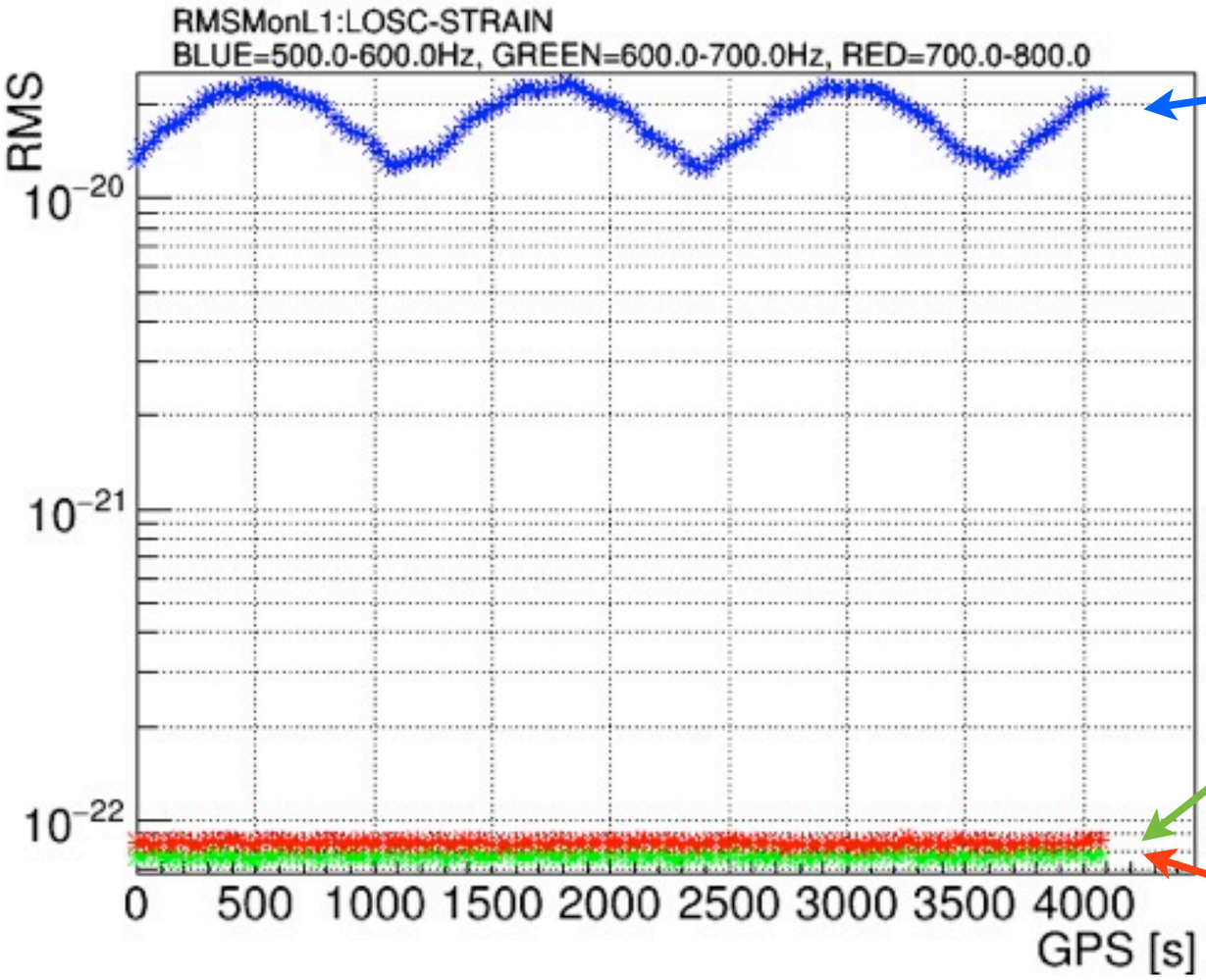


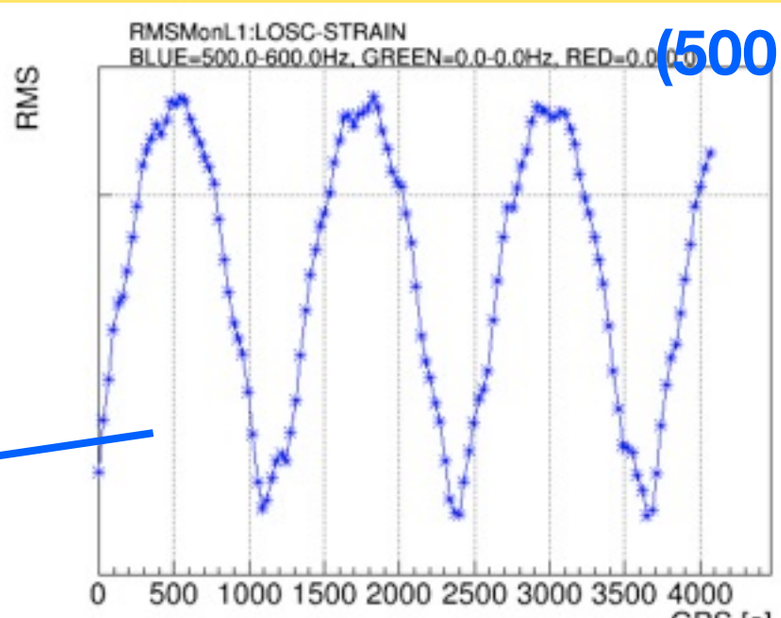
(400~500Hz)

- The RMS of other frequency bands and other time looks stationary.

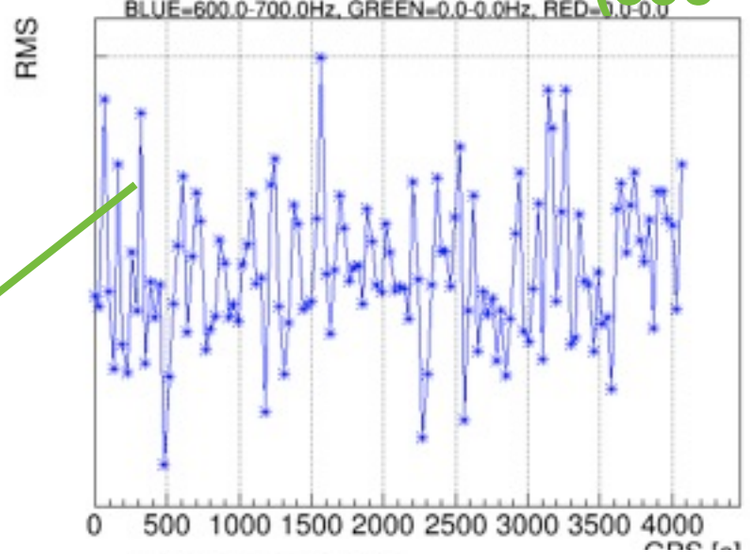
Result 500~600Hz, 600~700Hz, 700~800Hz (LIGO Livingston)

RMS(500~600Hz) looks oscillating.
The 3.5 cycles in 4096[s] => period is ~20min.

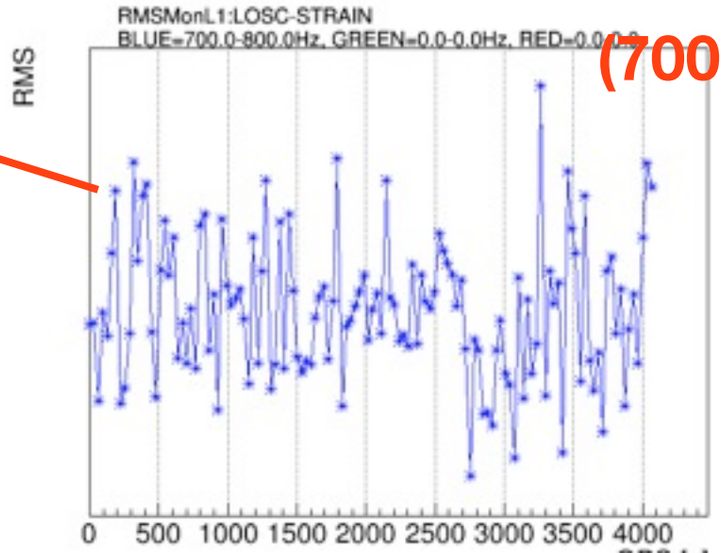




(500~600Hz)



(600~700Hz)

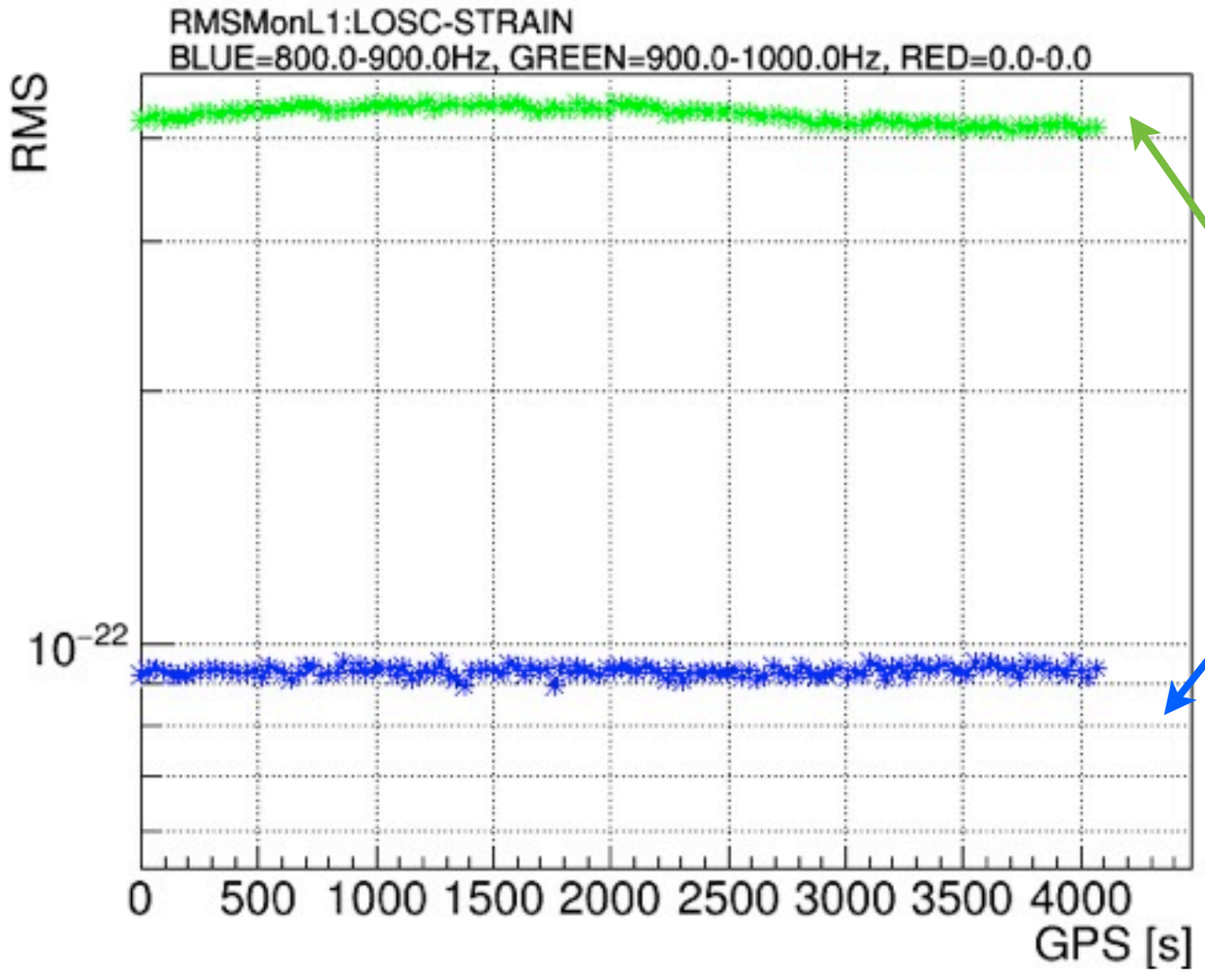


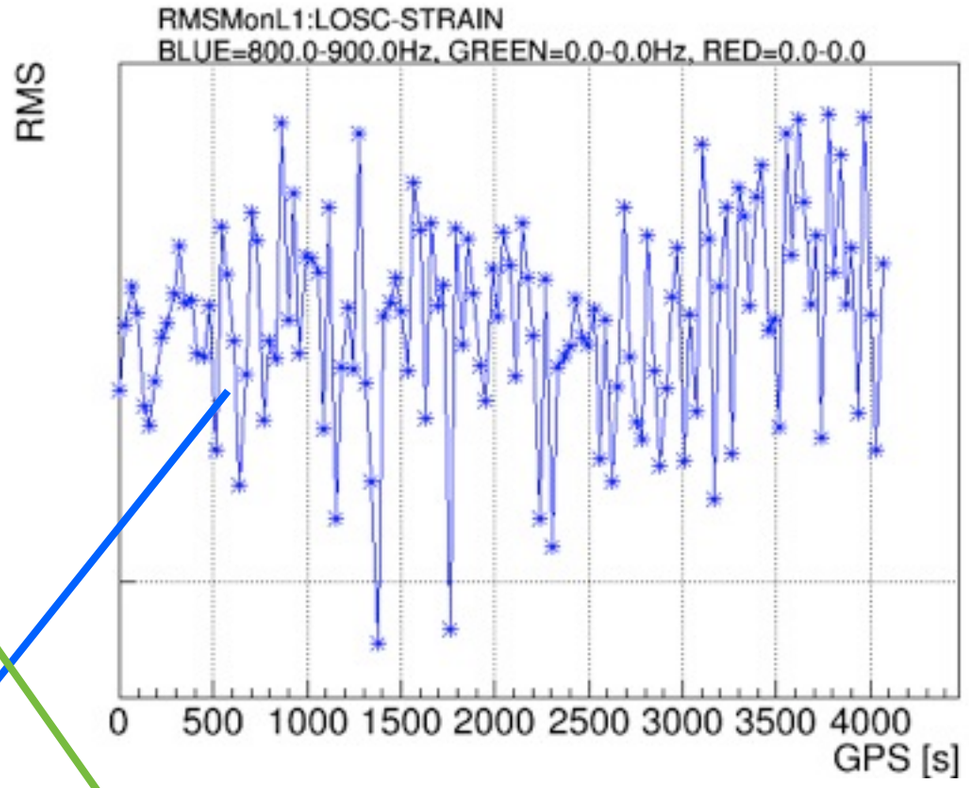
(700~800Hz)

- The RMS of other frequency bands and other time looks stationary.

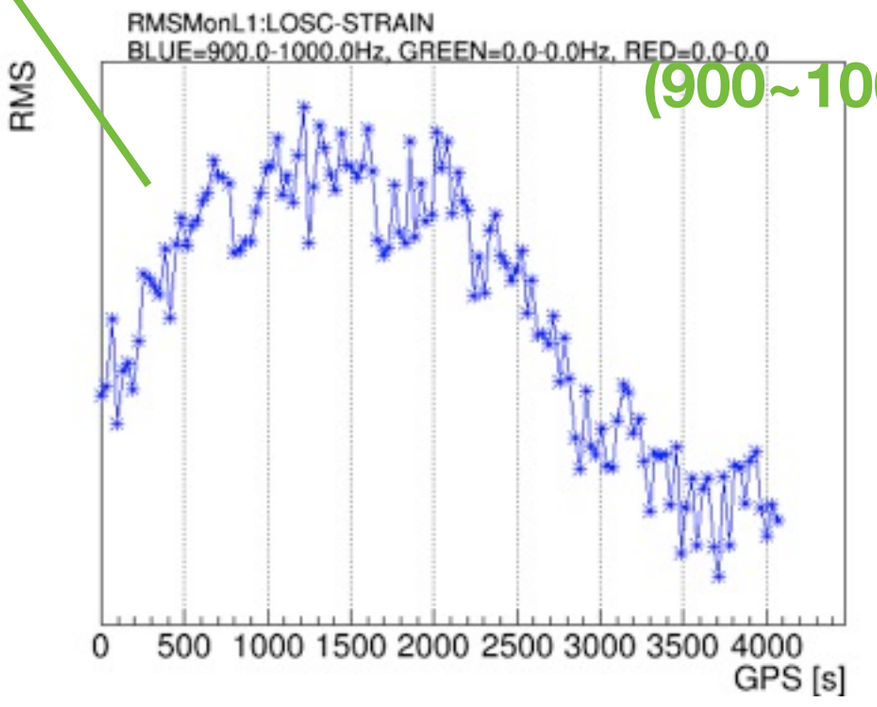
Result 800~900Hz, 900~1000Hz (LIGO Livingston)

RMS(800~900Hz) looks slowly changing.





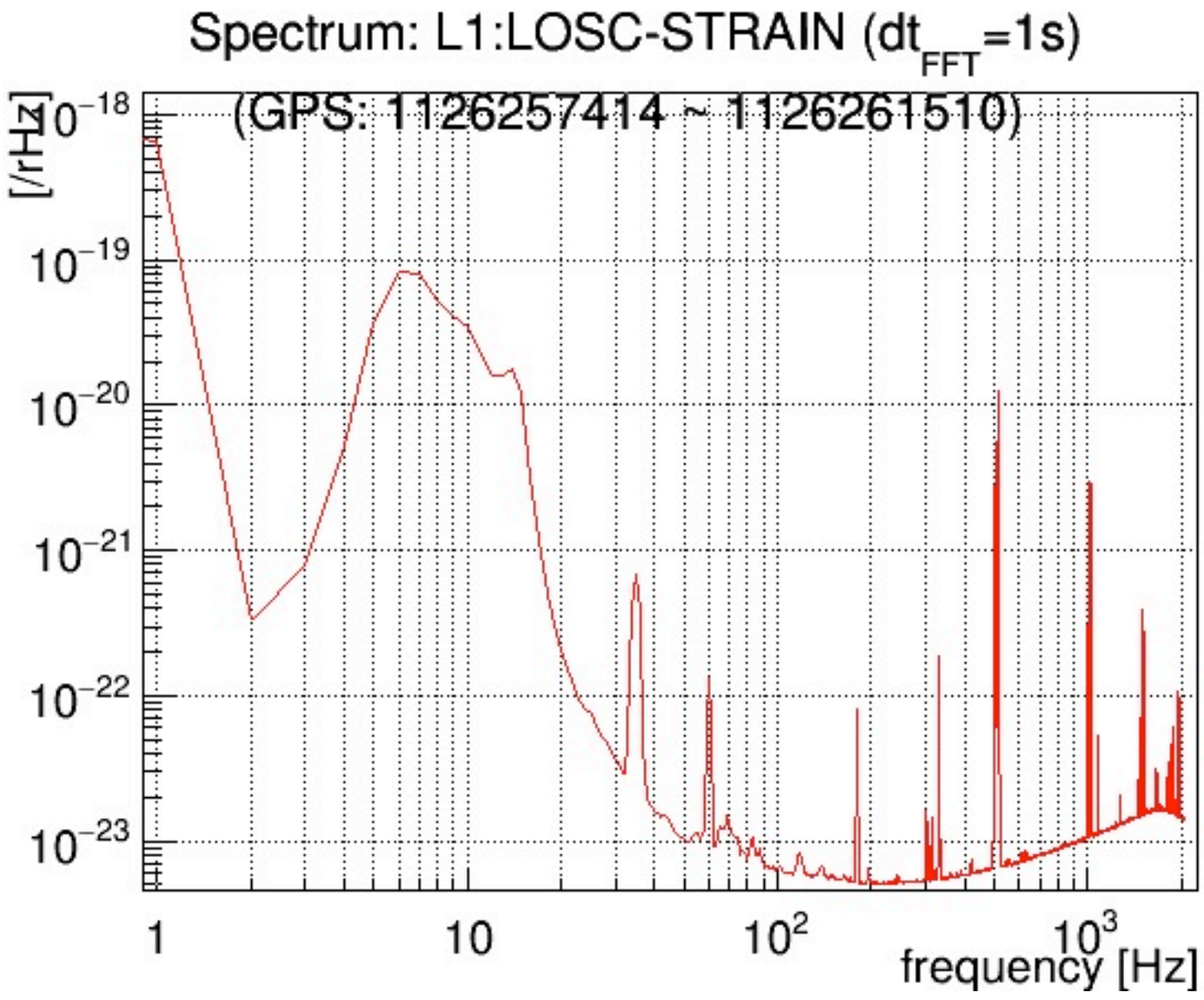
(800~900Hz)



(900~1000Hz)

- The RMS of other frequency bands and other time looks stationary.

The spectrum estimated by Yamamoto-san



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This spectrum is estimated by taking the average(mean) of 4096chunk data (chunk duration is 1[s]).