The most sensitive period search we can do on event data

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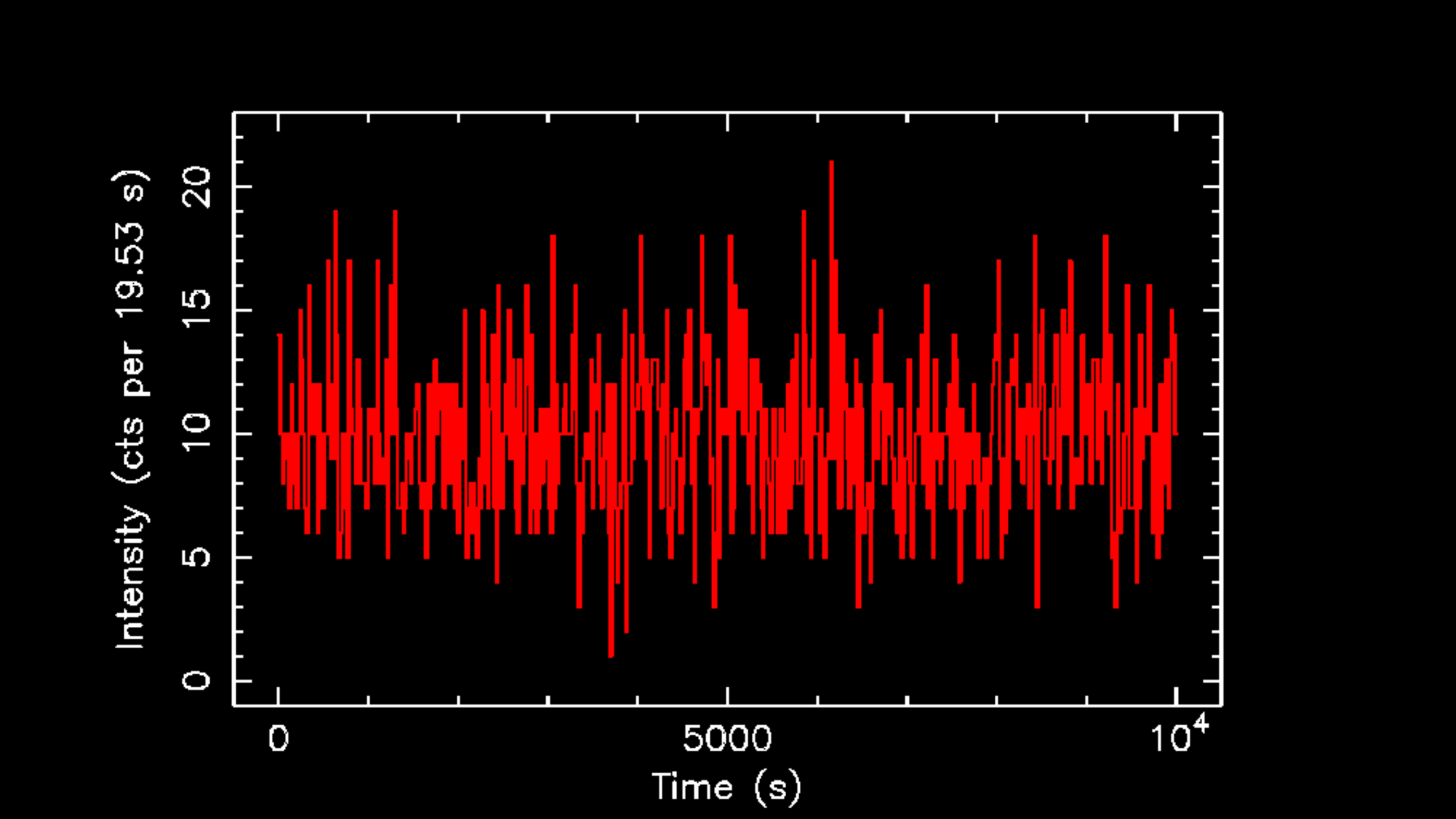
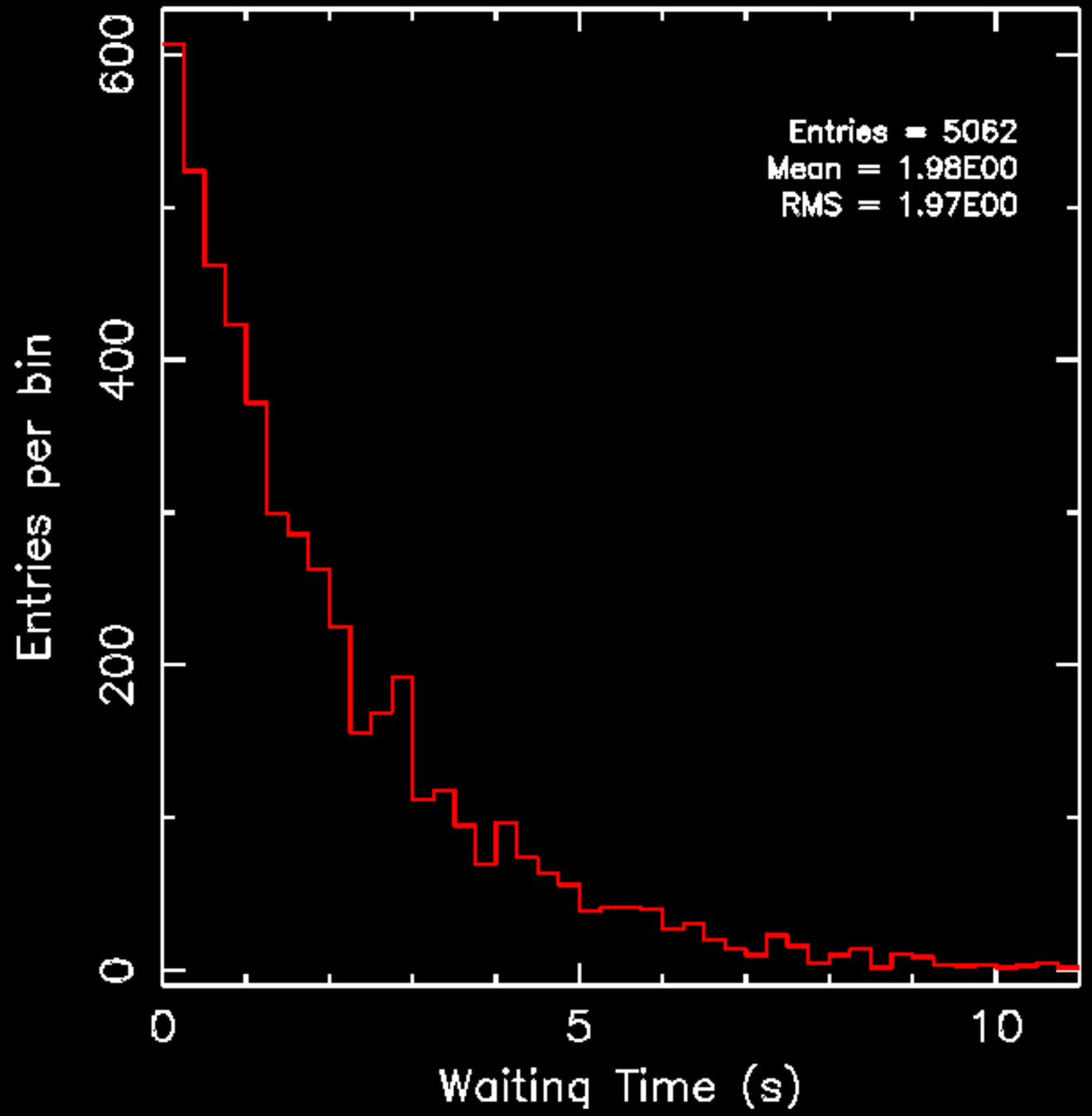
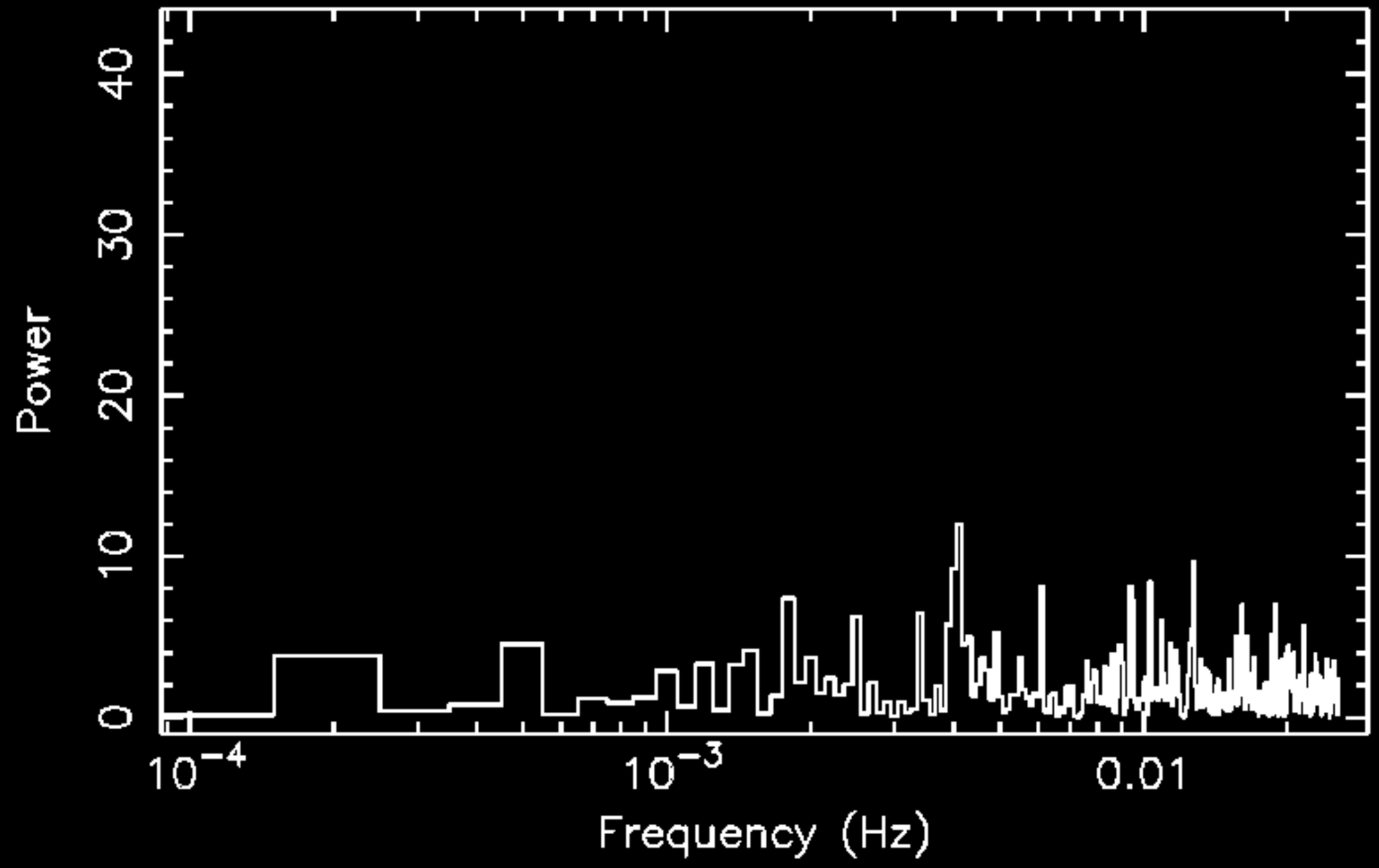
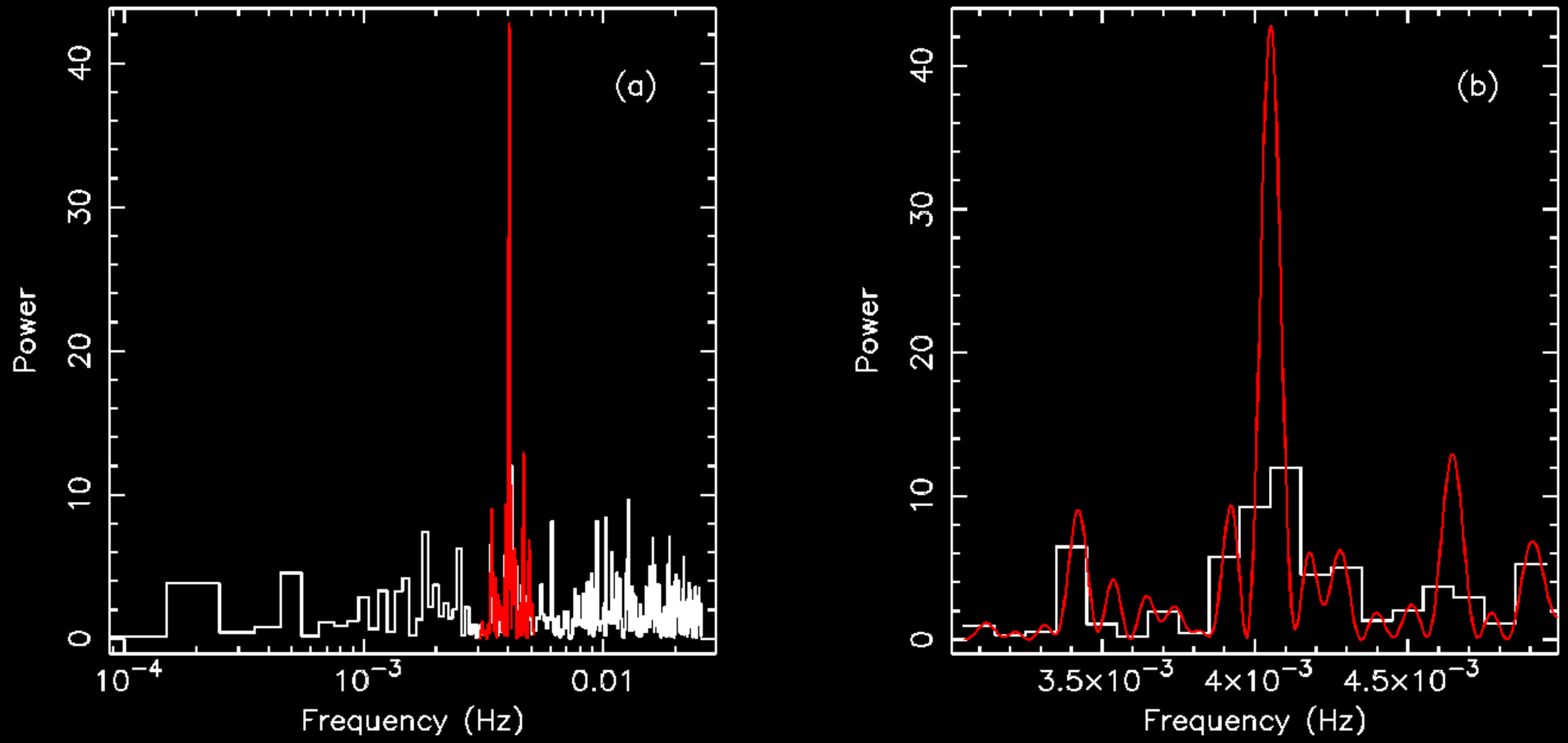
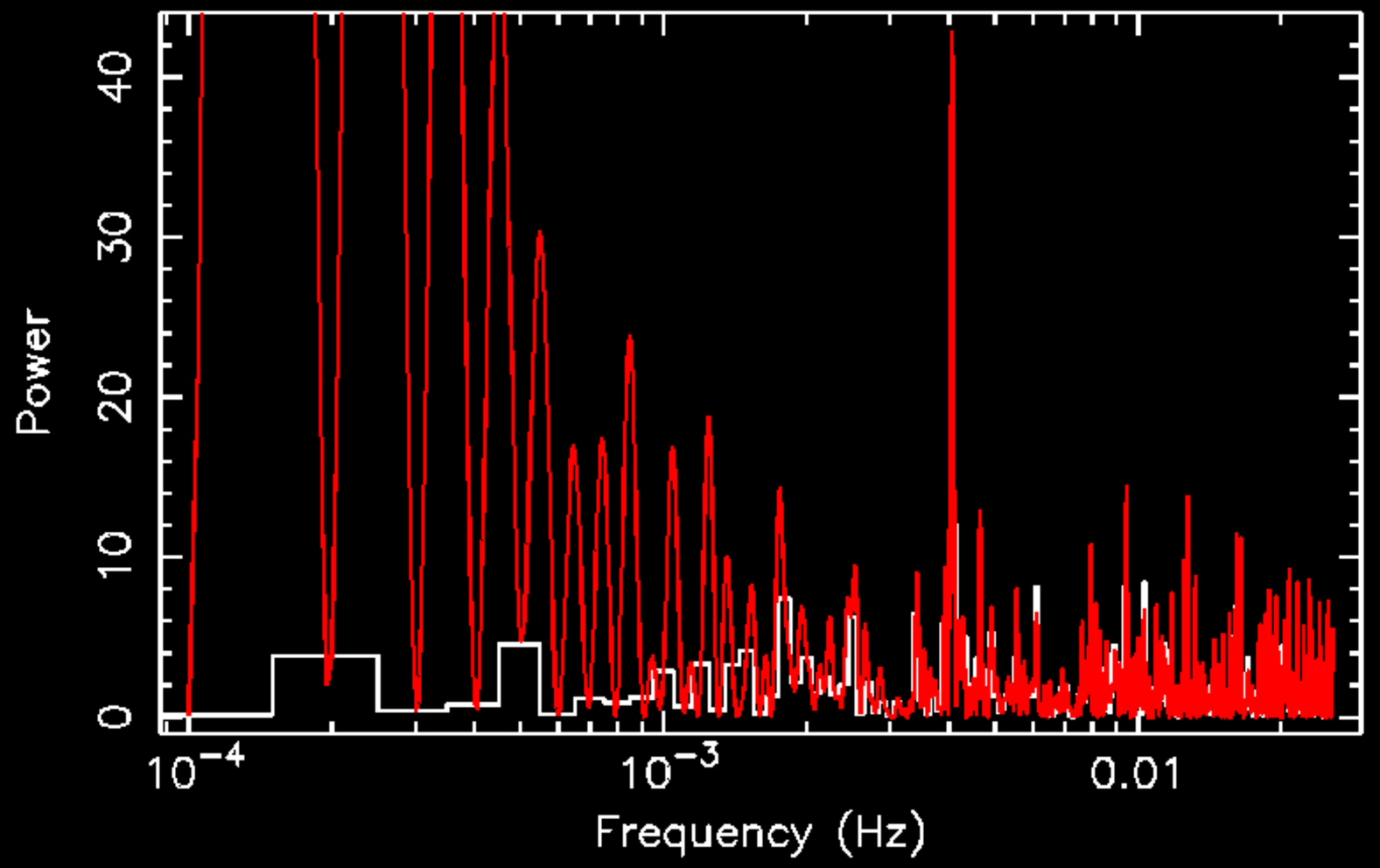
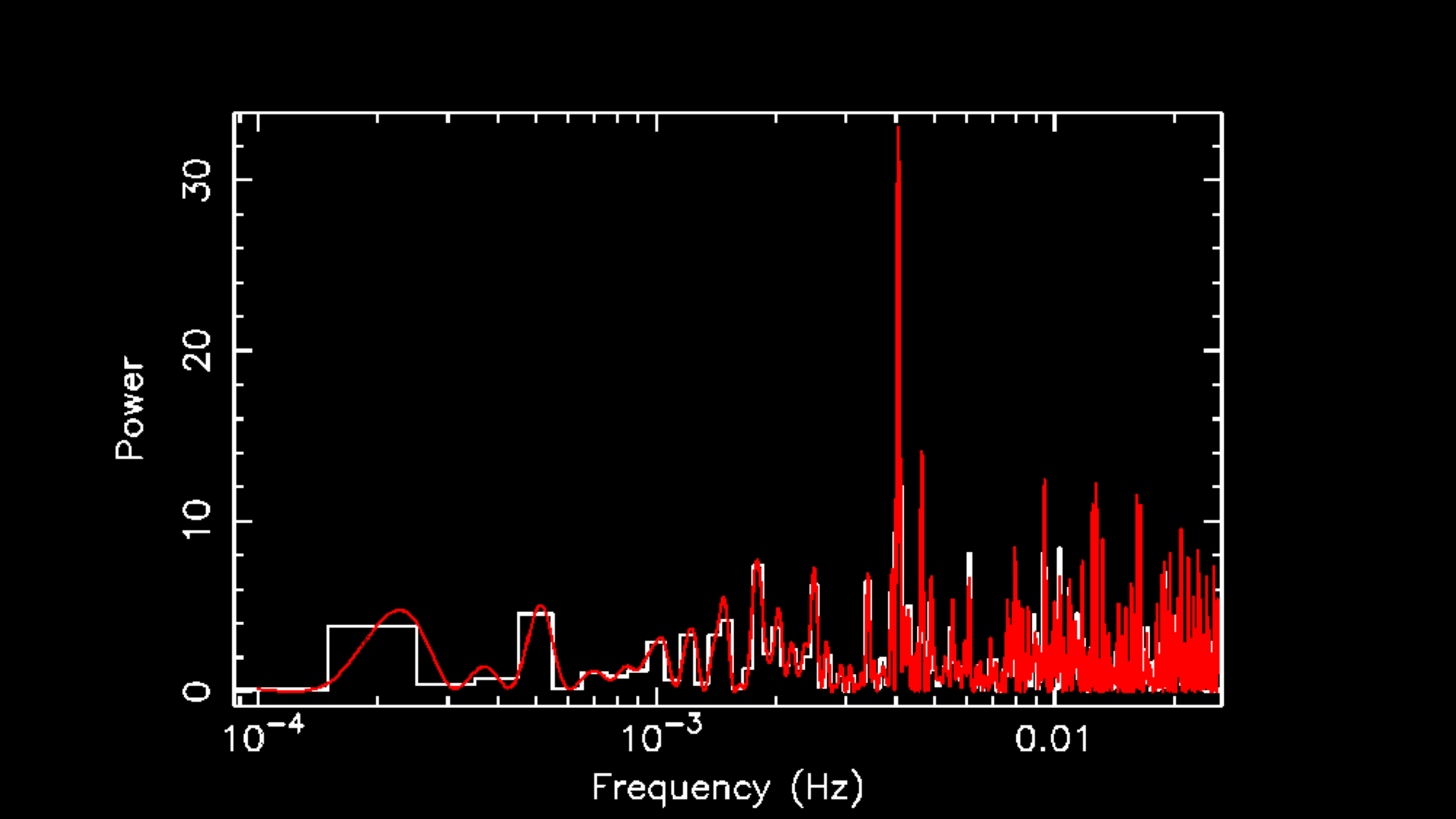

Intensity (cts per 19.53 s)
0
5
10
15
20
0
5000
10^4
Time (s)


Entries = 5062
Mean = 1.98E00
RMS = 1.97E00
Entries per bin
0
200
400
600
0
5
10
Waiting Time (s)


Power
0
10
20
30
40
10^{-4}
10^{-3}
0.01
Frequency (Hz)

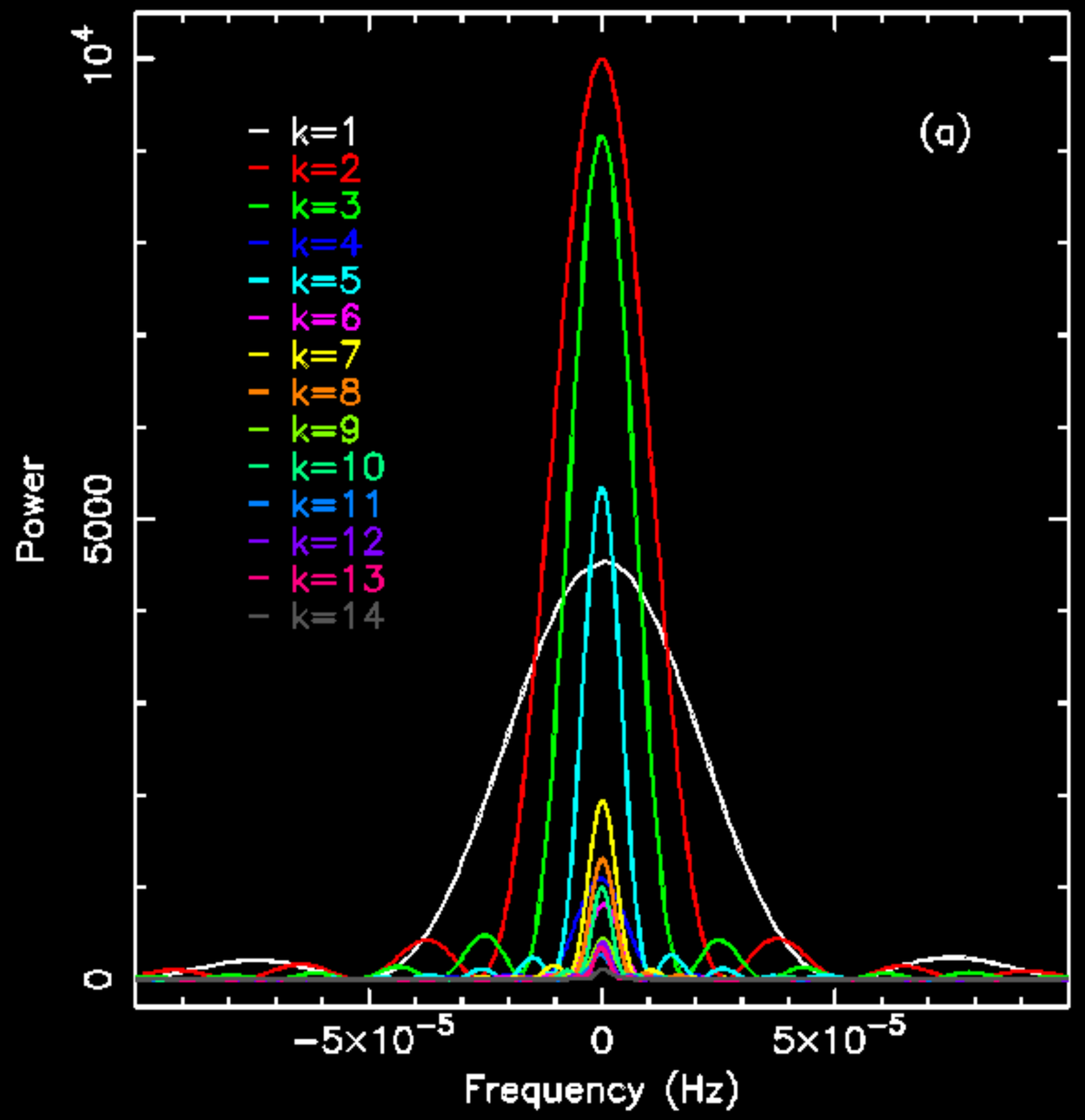

(a)
Power
0
10
20
30
40
10^{-4}
10^{-3}
0.01
Frequency (Hz)
(b)
Power
0
10
20
30
40
3.5×10^{-3}
4×10^{-3}
4.5×10^{-3}
Frequency (Hz)

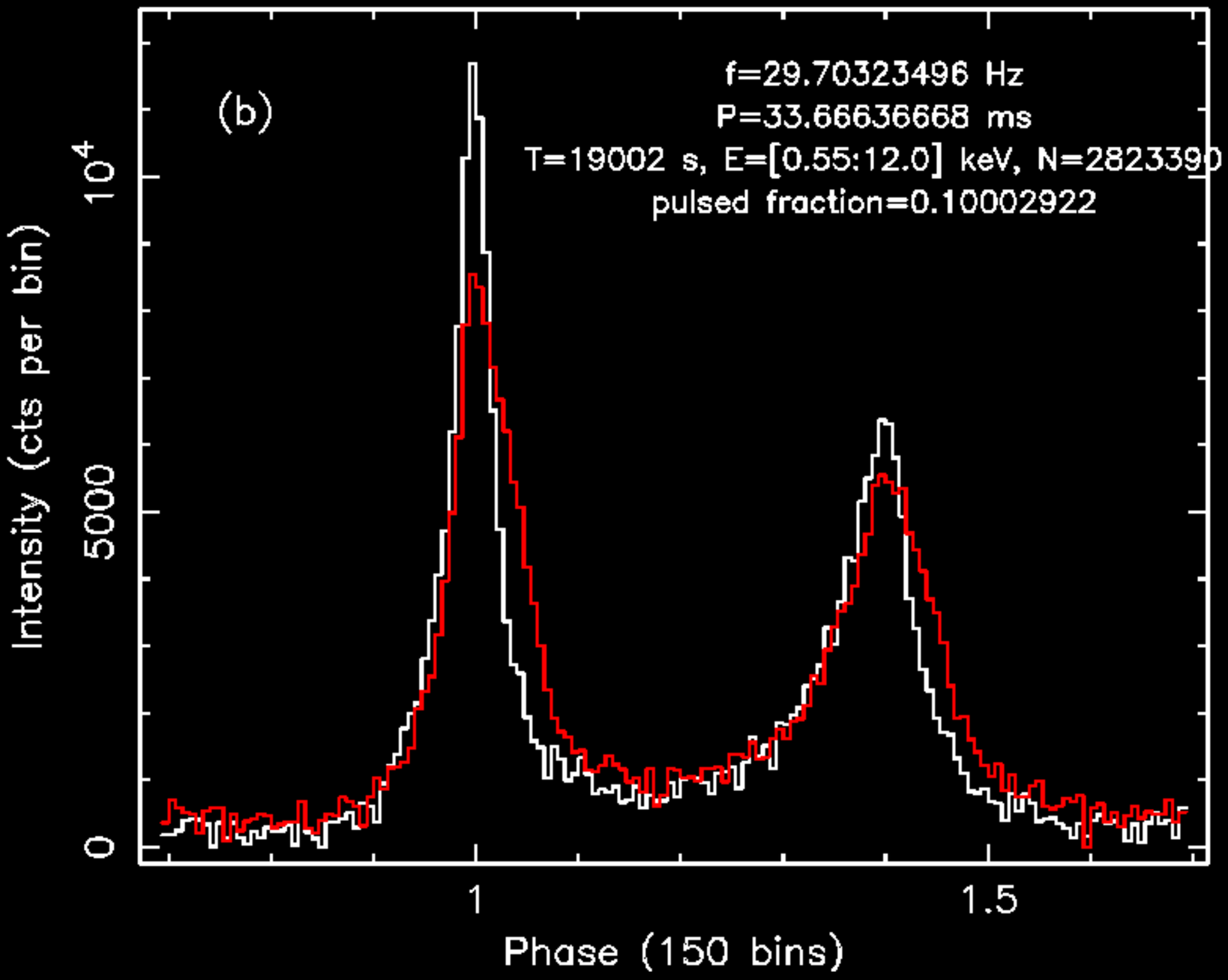

Power
0
10
20
30
40
10^{-4}
10^{-3}
0.01
Frequency (Hz)


Power
0
10
20
30
10^{-4}
10^{-3}
0.01
Frequency (Hz)

$$\mathcal{R}_k^2 = \begin{pmatrix} C_k - \langle C_k \rangle \\ S_k - \langle S_k \rangle \end{pmatrix}^{\mathrm{T}} \begin{pmatrix} \sigma^2{}_{C_k} & \sigma_{C_k S_k} \\ \sigma_{C_k S_k} & \sigma^2{}_{S_k} \end{pmatrix}^{-1} \begin{pmatrix} C_k - \langle C_k \rangle \\ S_k - \langle S_k \rangle \end{pmatrix}$$

$$\mathcal{Z}^2 = \sum \mathcal{R}_k^2.$$


k=1
k=2
k=3
k=4
k=5
k=6
k=7
k=8
k=9
k=10
k=11
k=12
k=13
k=14
(a)
Power
0
5000
10^4
−5×10^−5
0
5×10^−5
Frequency (Hz)


(b)
f=29.70323496 Hz
P=33.66636668 ms
T=19002 s, E=[0.55:12.0] keV, N=2823390
pulsed fraction=0.10002922
Intensity (cts per bin)
0
5000
10^4
1
1.5
Phase (150 bins)

- Event data are quantitatively different from a collection of measurements in which there is an inherent binning due to the measurement process or the quantity being measured. It carries temporal information.
- To extract as much as we can from this temporal information the events carry we need to use powerful and reliable tools, that include periodogram statistics.
- A powerful and reliable periodogram statistic must be able to use each event's arrival time in order to access all variability timescales; allow for oversampling in order to explore frequency space without restrictions; and correct for the testing of non-independent frequencies.
- In light of this, the periodogram statistics of choice are the new generalised modified Rayleigh $\mathcal{R}_k^2$ statistic and the $\mathcal{Z}^2$ test derived from it.

Thank you
for listening