Rolling Filtering: A Method to Detect RFI and Single-Pulse

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Outline

1. Abnormal signals in time series

2. Detecting abnormal signals with rolling filter

3. Detecting single pulse with rolling filter

4. Discussions

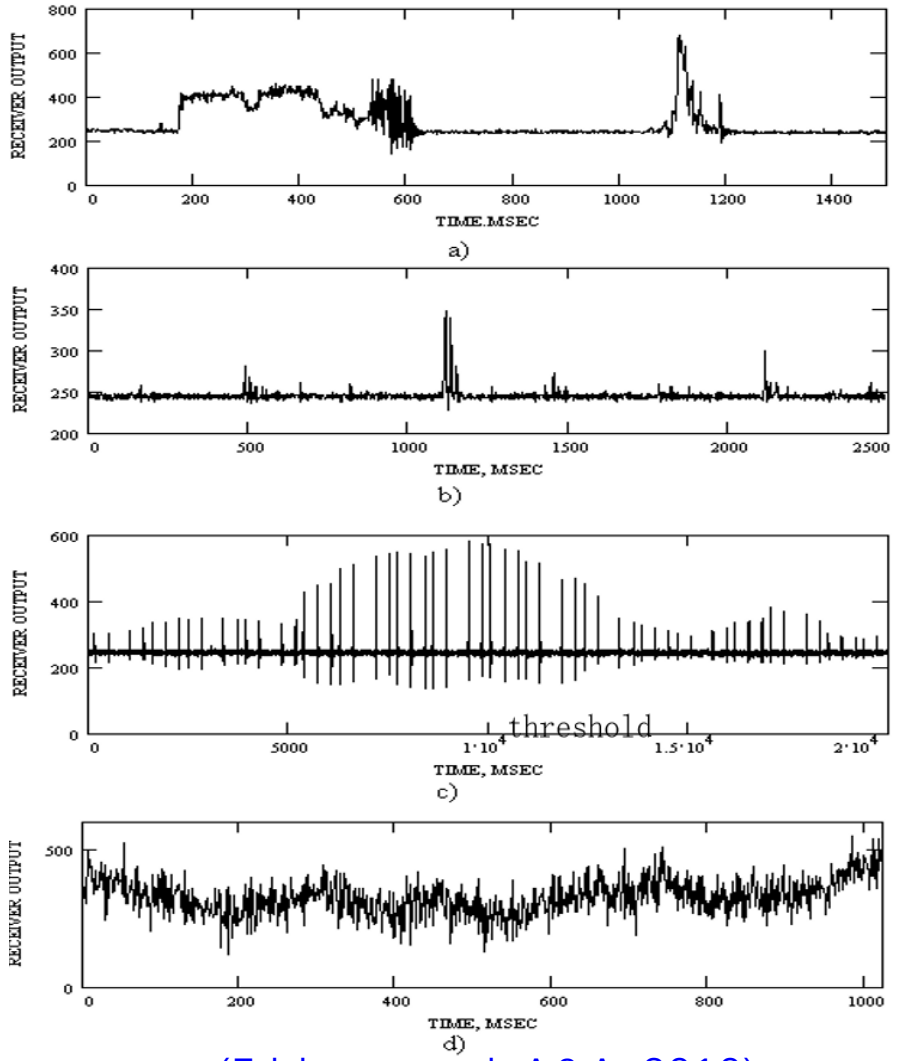
1. Abnormal signals in time series

Origin: abnormal fluctuations in the flow (or voltage) of the radio signal

Sources: cellphone, FM, TV, satellite, ……
spark discharge, circuit oscillation, noise, ……
celestial sources

Characters: impulse-like(wide- or narrow-band),
possible periodic, discrete……

Radio Frequency Interference (RFI)



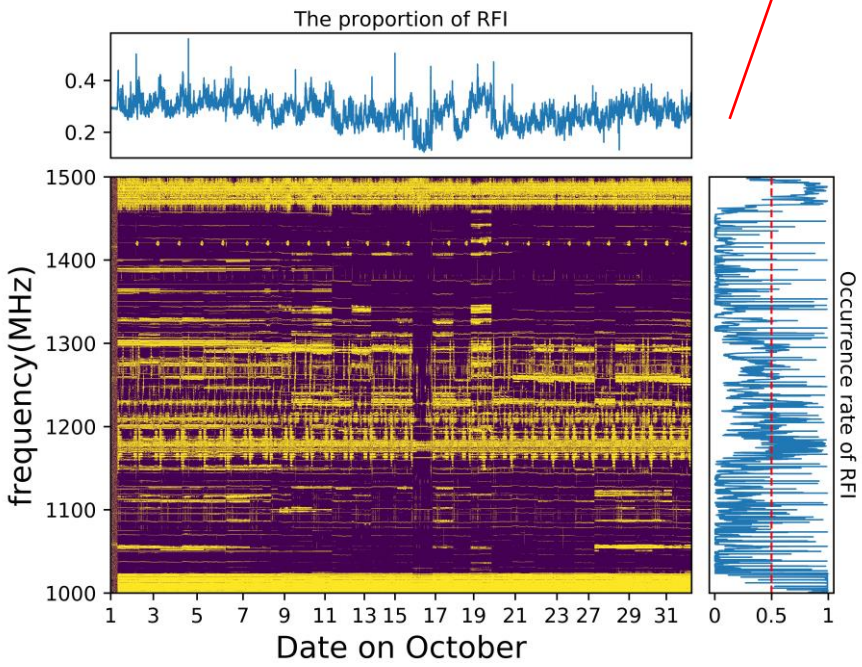
(Fridman et.al. A&A, 2010)

2.Detecting RFI with rolling filter

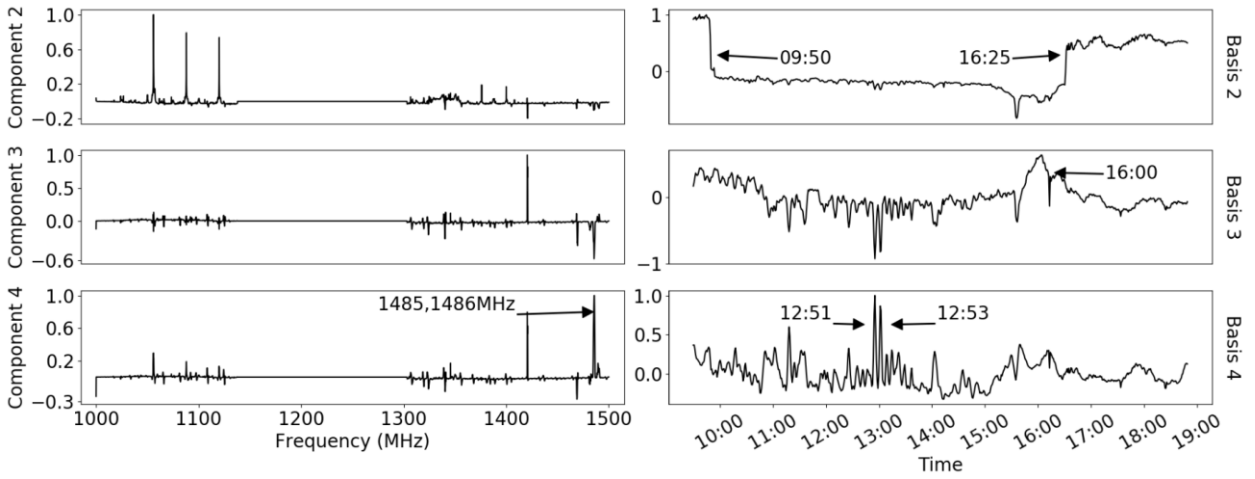
2.1 Why detecting RFI

- RFI mitigation;
- RFI data analysis.

①Monitoring electromagnetic environment ;



②identify RFI sources.



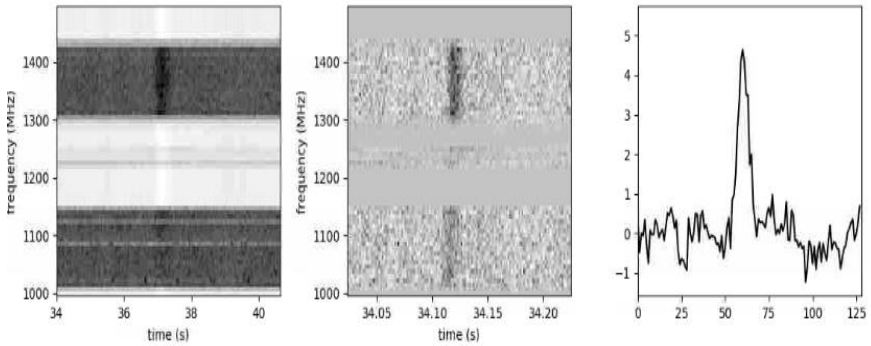
Precisely locate the frequency band and time at which RFI occurs.

2.Detecting RFI with rolling filter

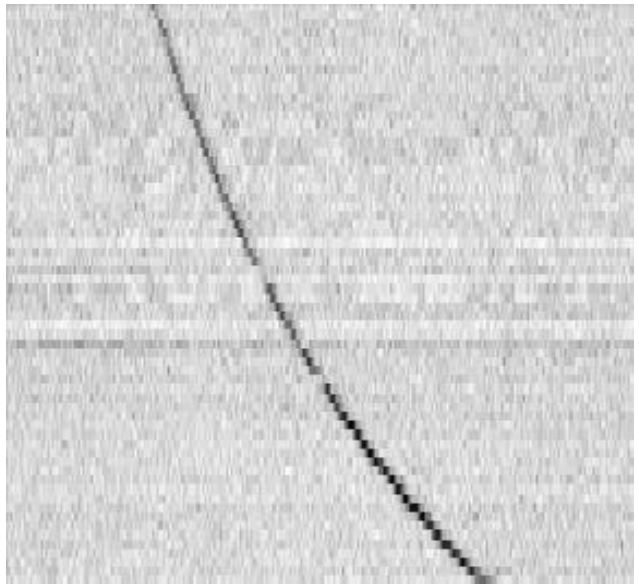
2.1 Why detecting RFI

- Finding some other interesting high-flux signals:

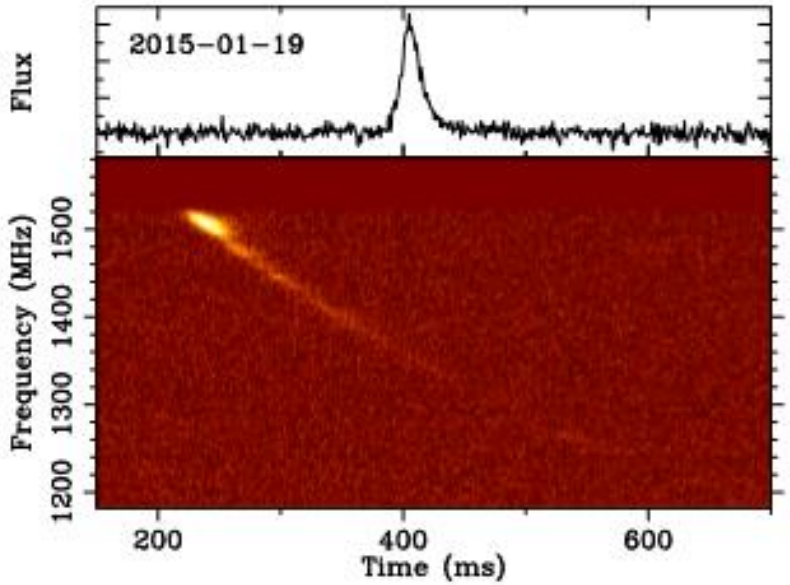
celestial radio point sources, radio spectral lines, and **single pulses, FRB** ……



Radio burst RFI
(by Zhu weiwei)



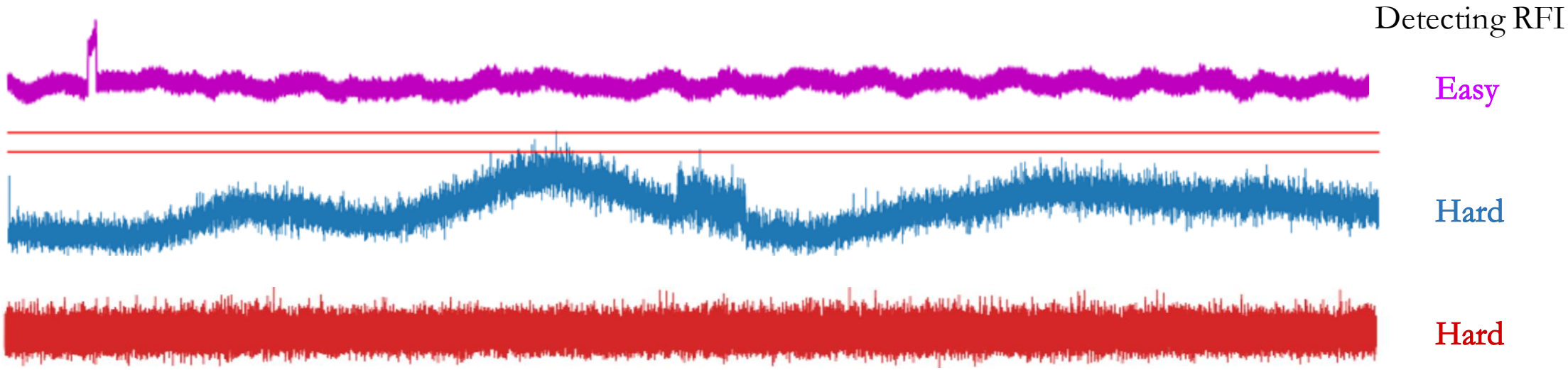
Single pulse from FAST
(by Zhu weiwei)



Perytons from Parkes
(E. Petroff et.al. , MNRAS, 2015)

2.Detecting RFI with rolling filter

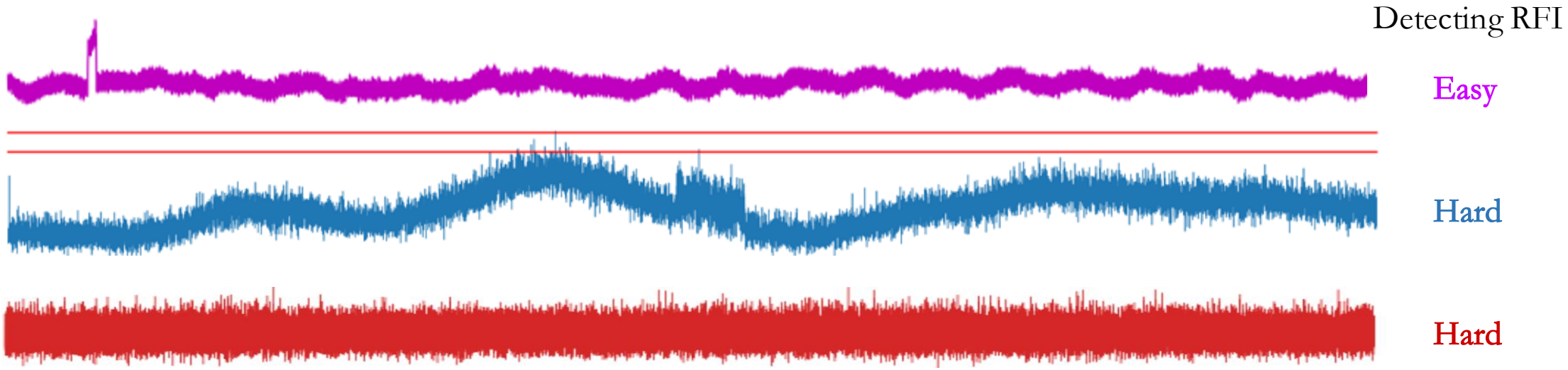
2.2 Method of rolling filter



correct baseline & decrease discreteness & enhanced abnormal signal

2.Detecting RFI with rolling filter

2.2 Method of rolling filter



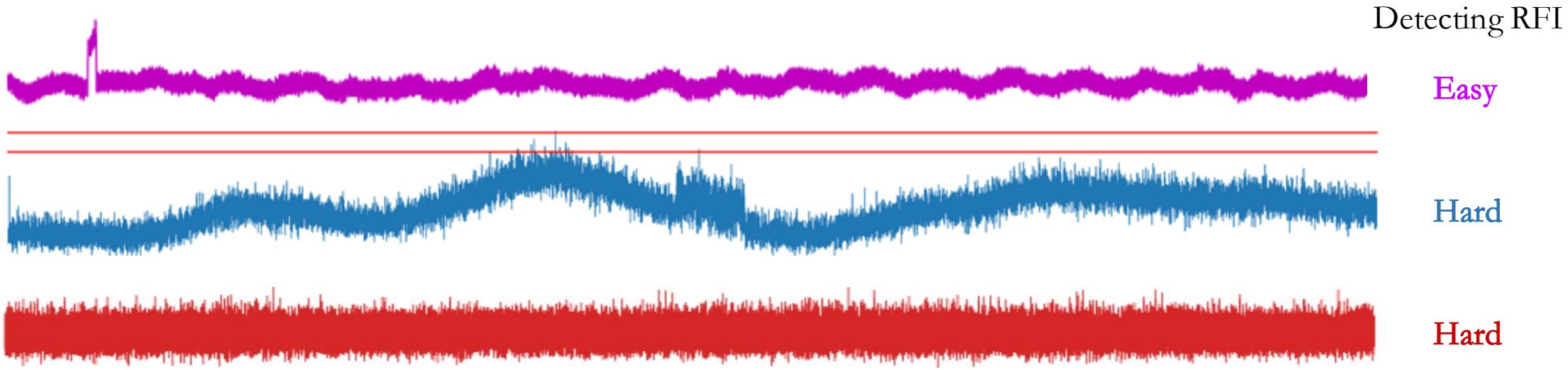
correct baseline & decrease discreteness & enhanced abnormal signal

Rolling average

Rolling variance

2.Detecting RFI with rolling filter

2.2 Method of rolling filter



correct baseline & decrease discreteness & enhanced abnormal signal

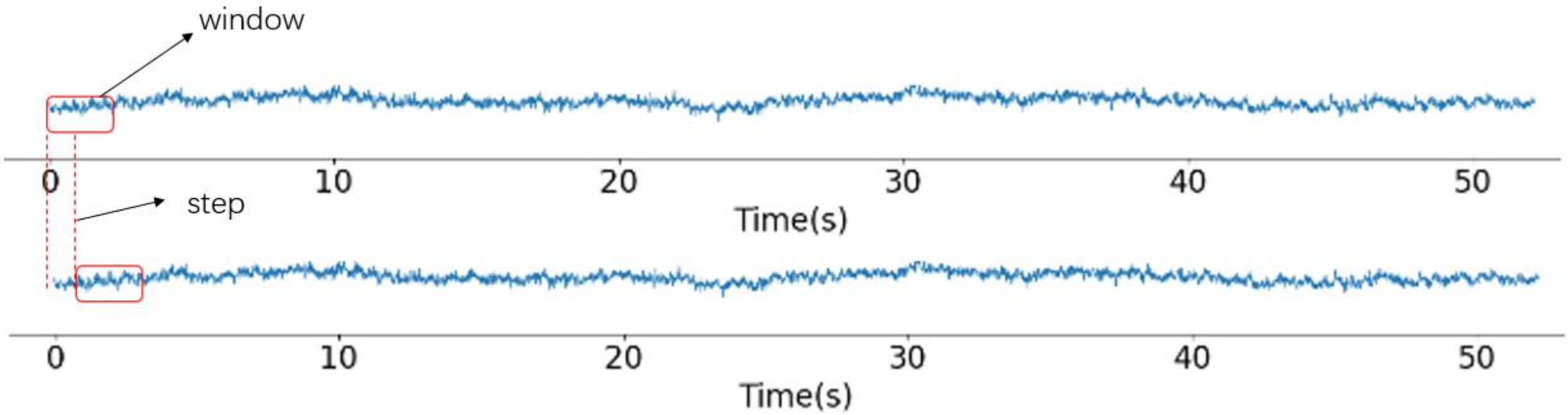
Rolling average

Rolling variance

Rolling Filter

2.Detecting RFI with rolling filter

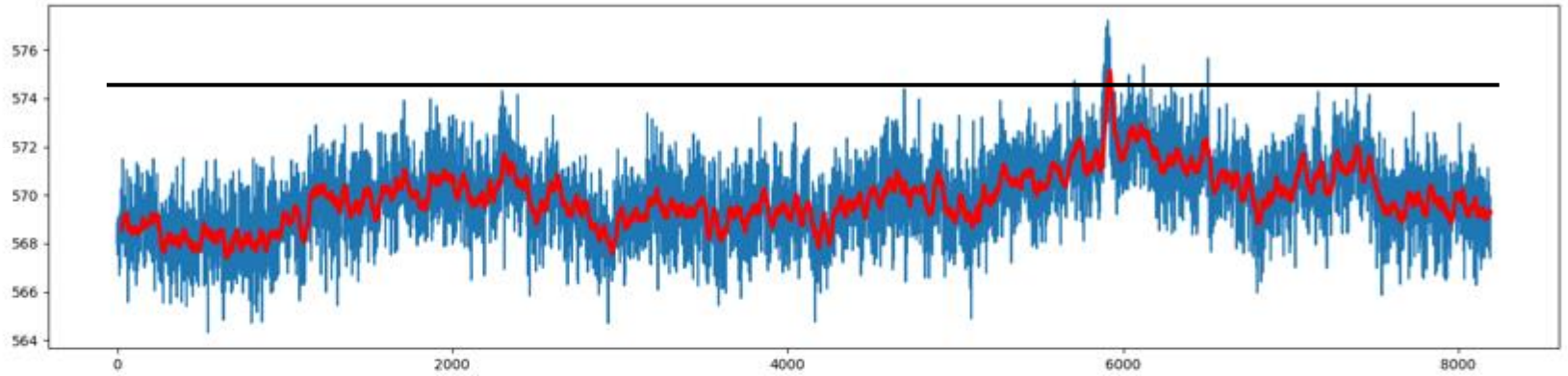
2.2 Method of rolling filter



2.Detecting RFI with rolling filter

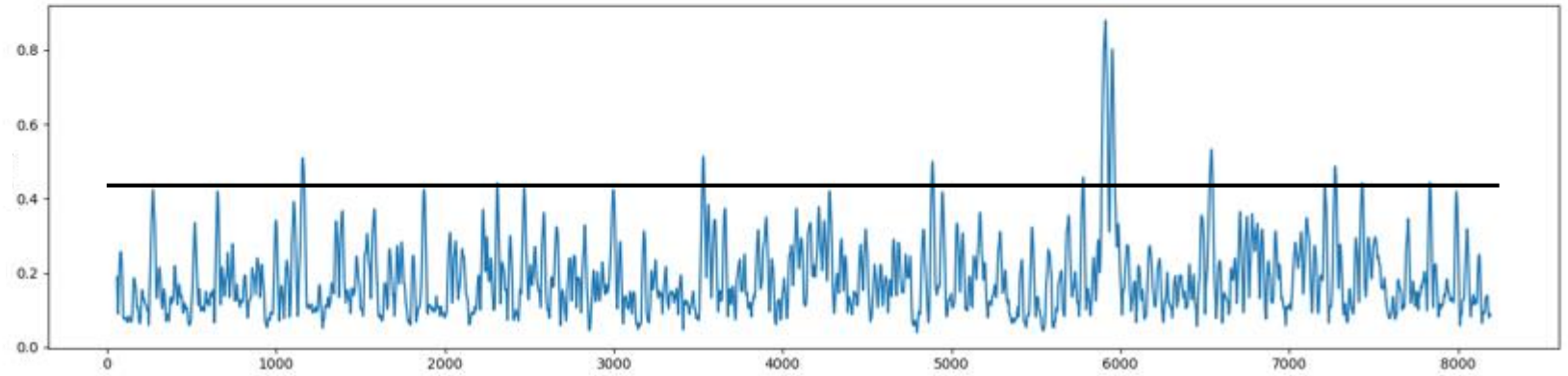
2.3 RFI detecting result by rolling filter

Rolling average



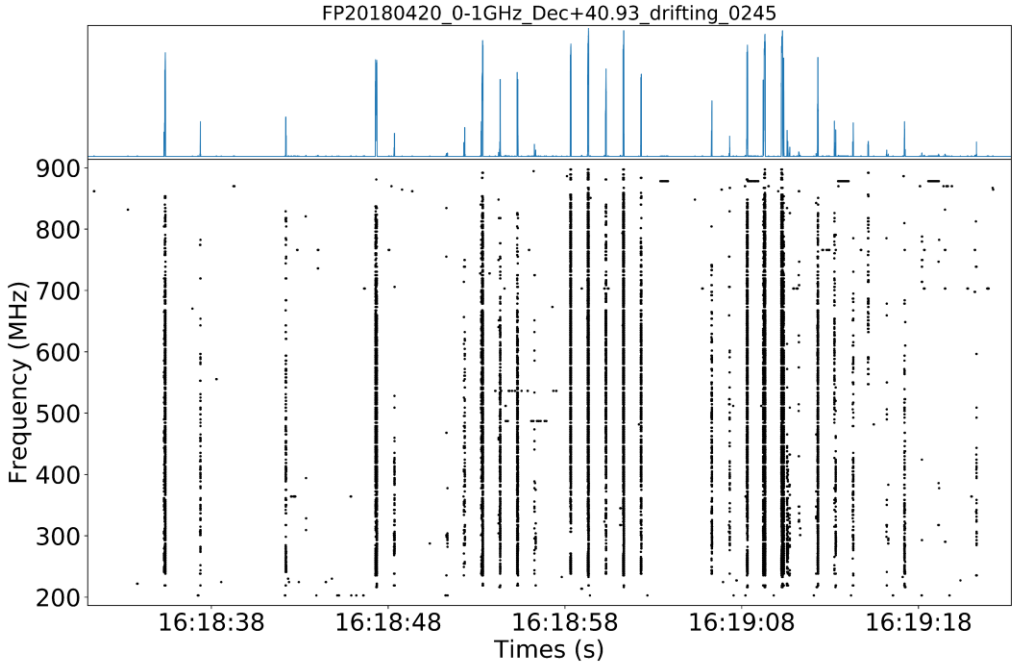
Rolling variance

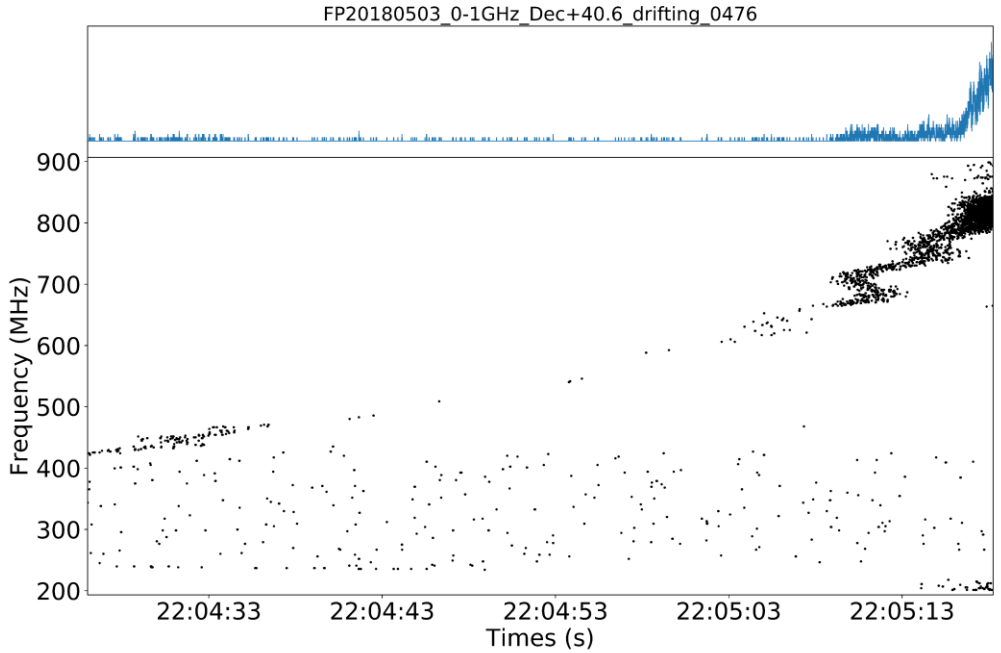
Black line: threshold



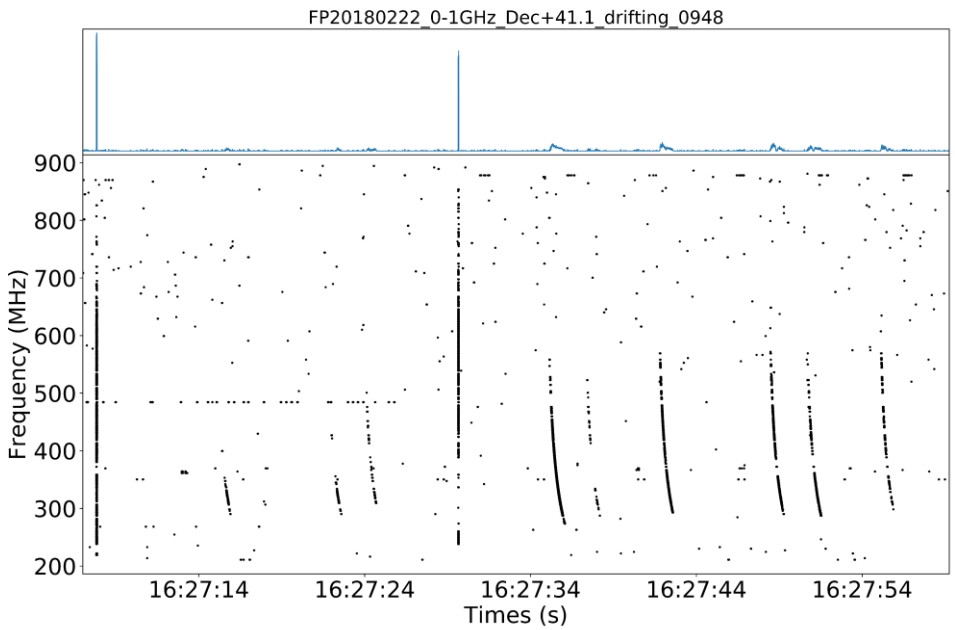
2.Detecting RFI with rolling filter

2.3 RFI detecting results

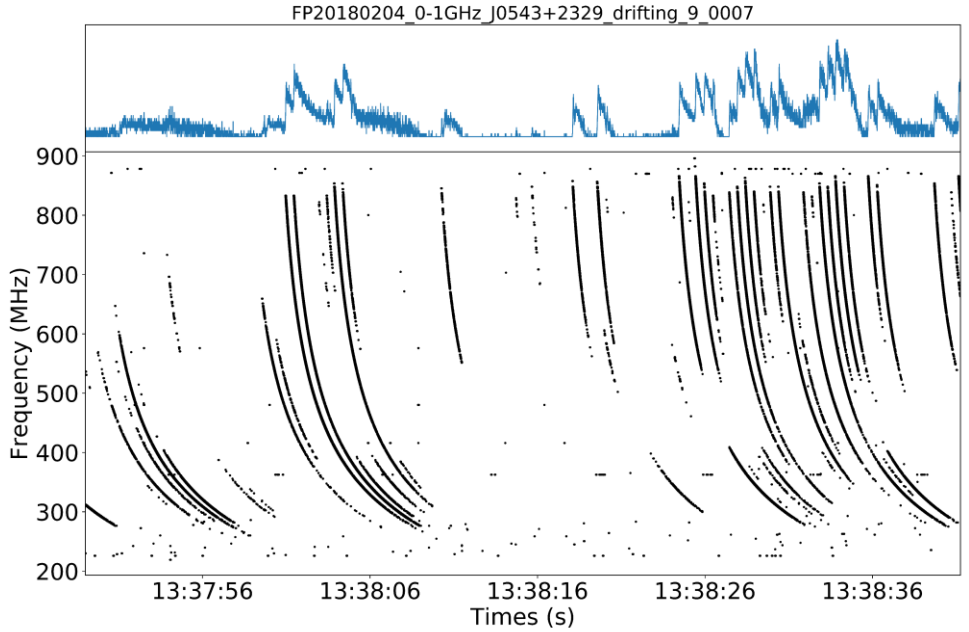




3.Detecting single pulse with rolling filter



RFI & Pulsar signals

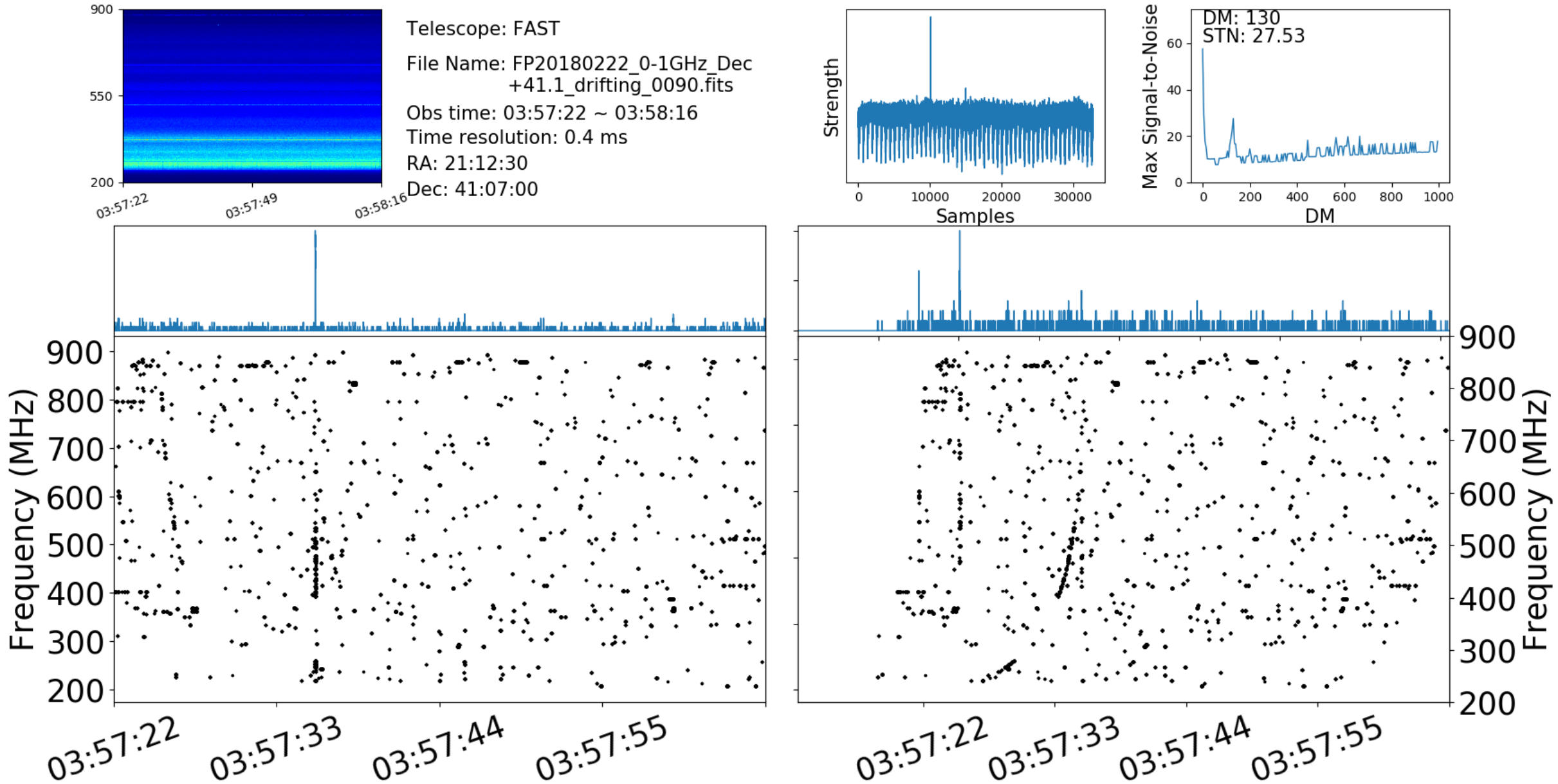


J0543+2329

Too many images for FAST CRAFTS project

➡ Need to develop it as a single-pulse detecting system to select pulsar signals from RFI!!!

A single-pulse detecting software based on Rolling Filtering



4.Discussions

- ✓ Detecting temporal RFI efficiently;
- ✓ Can detect pulsar signals;
- ✓ Can be further developed.

- ☐ Small delay of the accurate time of detected signals (<1 ms);
- ☐ An extension to the pulse width or to the duration time of RFI;
- ☐ Losing information about signal flux.

We are looking forward to other interesting signals ……

Thank you !!!