LOFAR Data Processing for Solar Physics and Space-weather

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LOFAR
Solar and Space Weather
KSP

Make the data processing easier

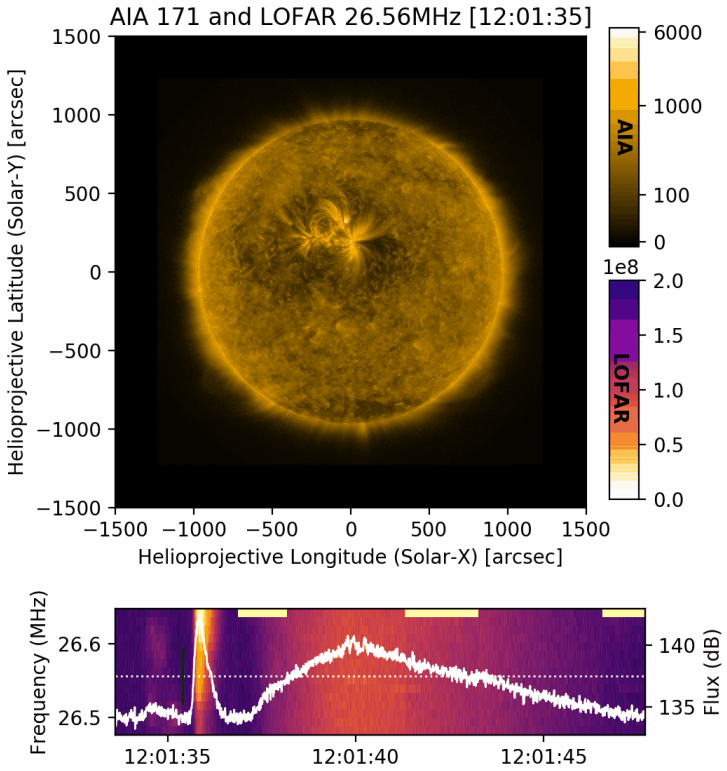
Long-Term Achieve

Measurement Set (.MS)
Beamformed (.h5)

LOFAR Solar and Space Weather KSP

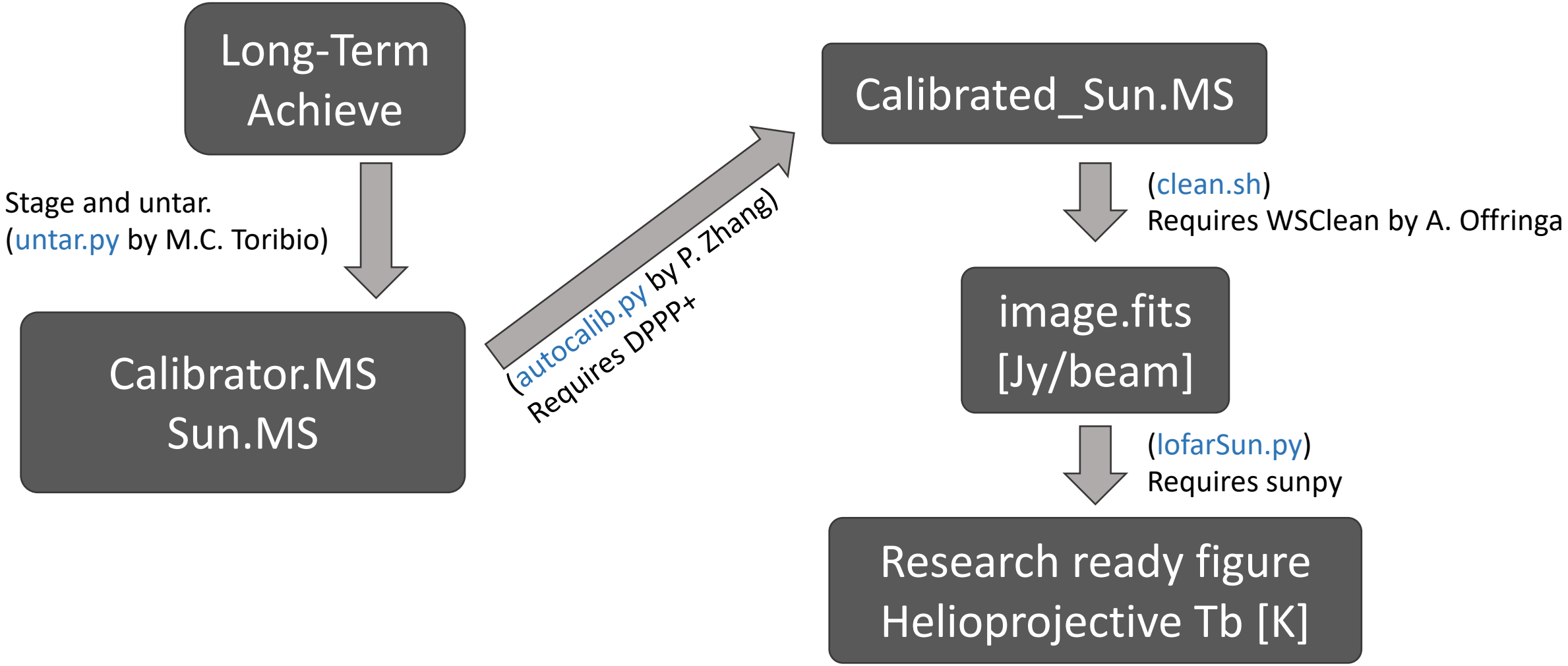
Scripts, Functions, Modules

Calibration
Clean
Unit conversion



[Zhang et al. 2020]

Interferometric data (Measurement Set)



From [Jy/beam] to Tb[K]

- Brightness temperature:

$$T = \frac{\lambda^2}{2k\Omega} S$$

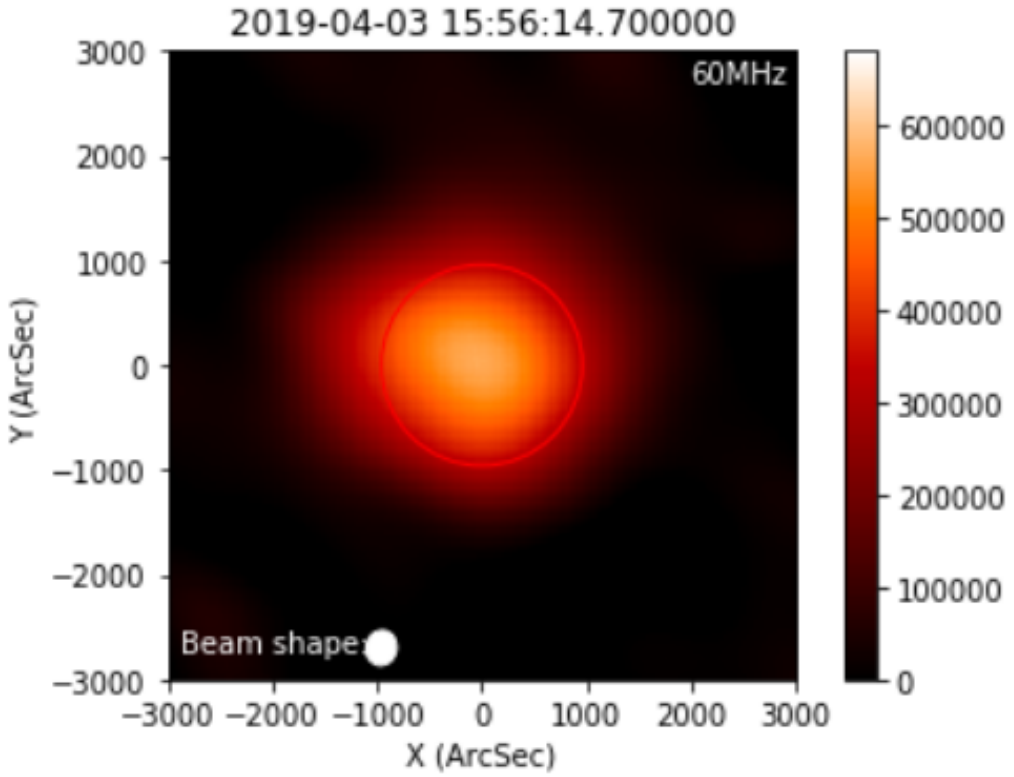
Interferometric maps

$$T = \frac{\lambda^2}{2k\Omega} S = \frac{\lambda^2}{2k} \boxed{\frac{S}{beam}} \frac{1}{\Omega/\mathrm{beam}}$$

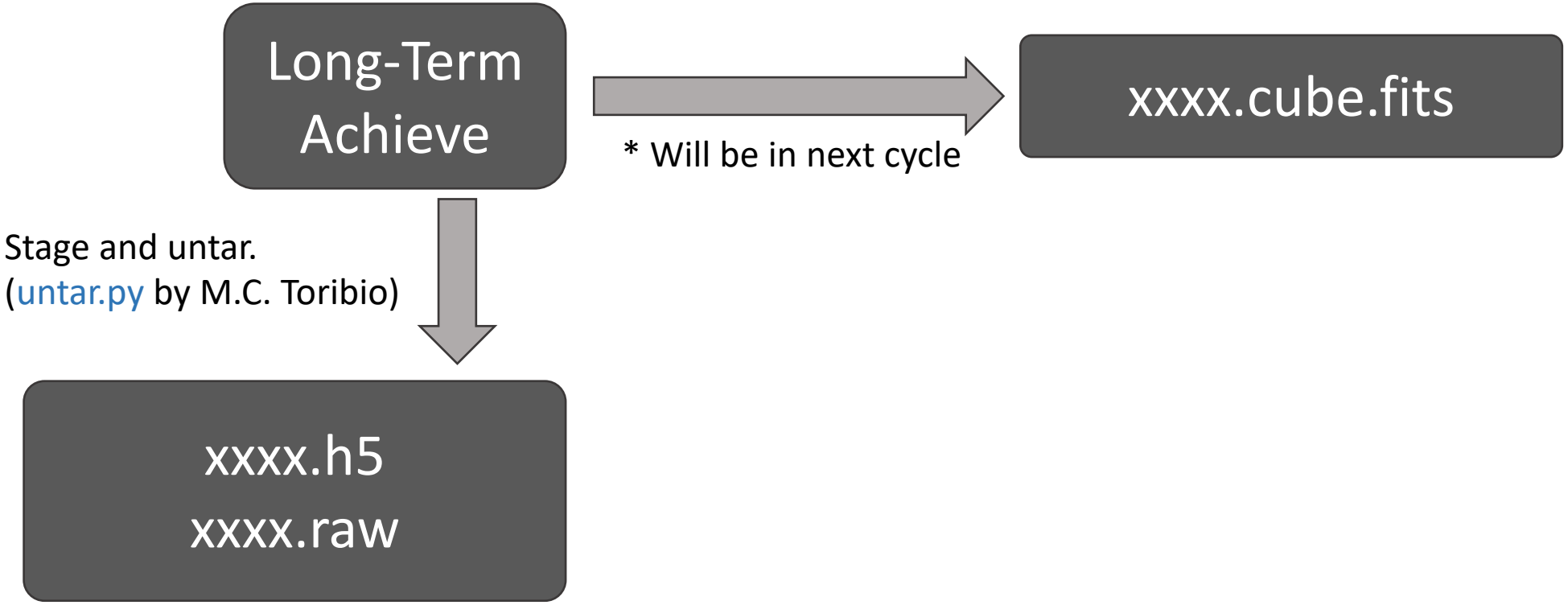
- The beam-size:

$$\Omega = \frac{\pi \theta_{\mathrm{maj}}\, \theta_{\mathrm{min}}}{4 \ln 2}$$

(included in lofarSun.py)

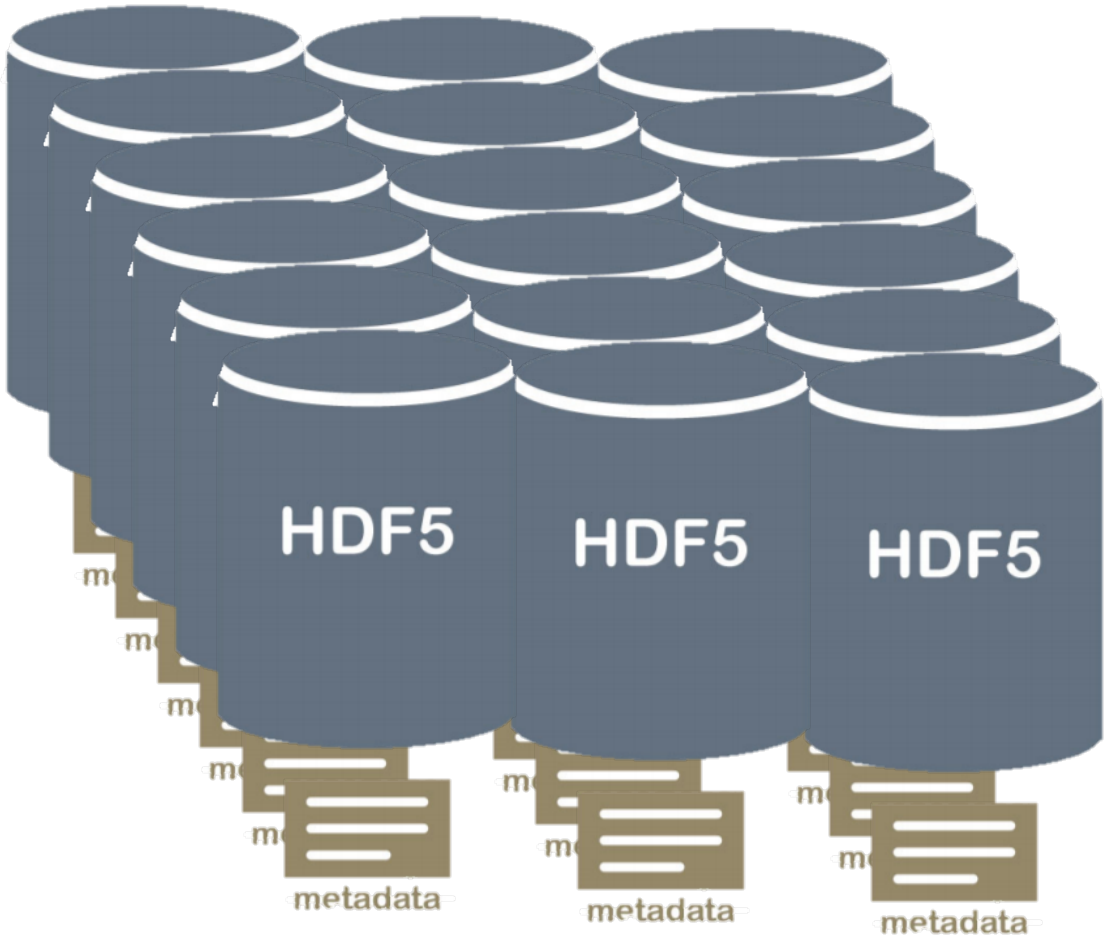


Beamformed data (HDF5)



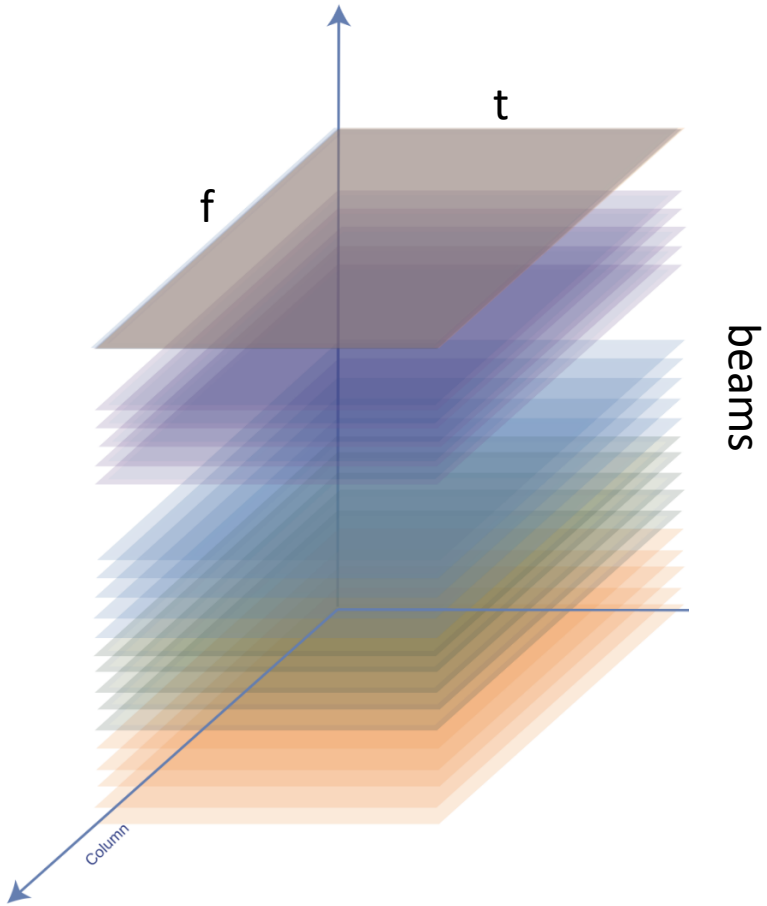
About cube.fits

Original data:

- 

Cube data:

Single fits:

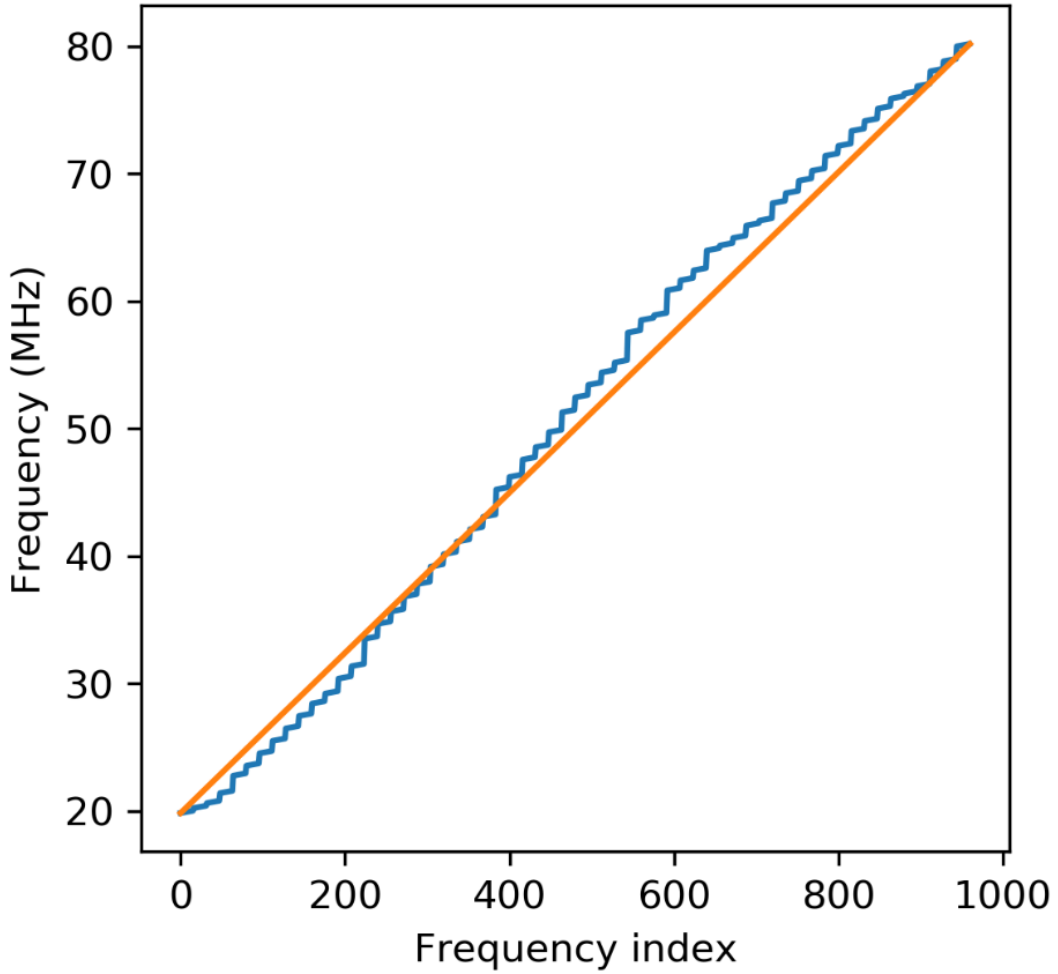


Demo

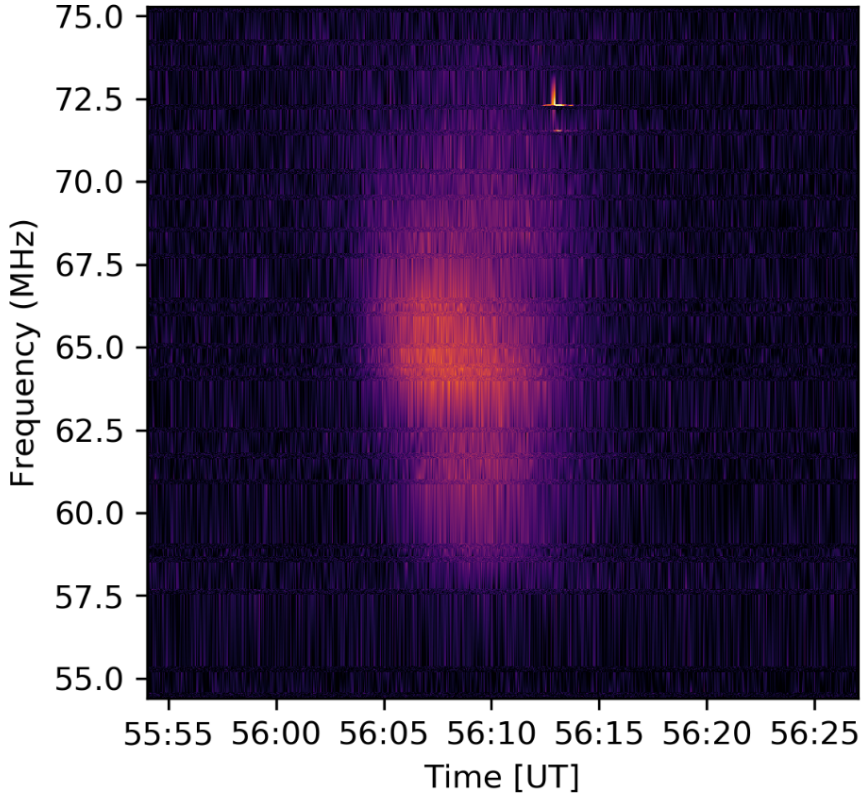
- How to use cube.fits

Beamformed data: Uneven frequency axis

- The dynamic spectrum is not continues sometimes

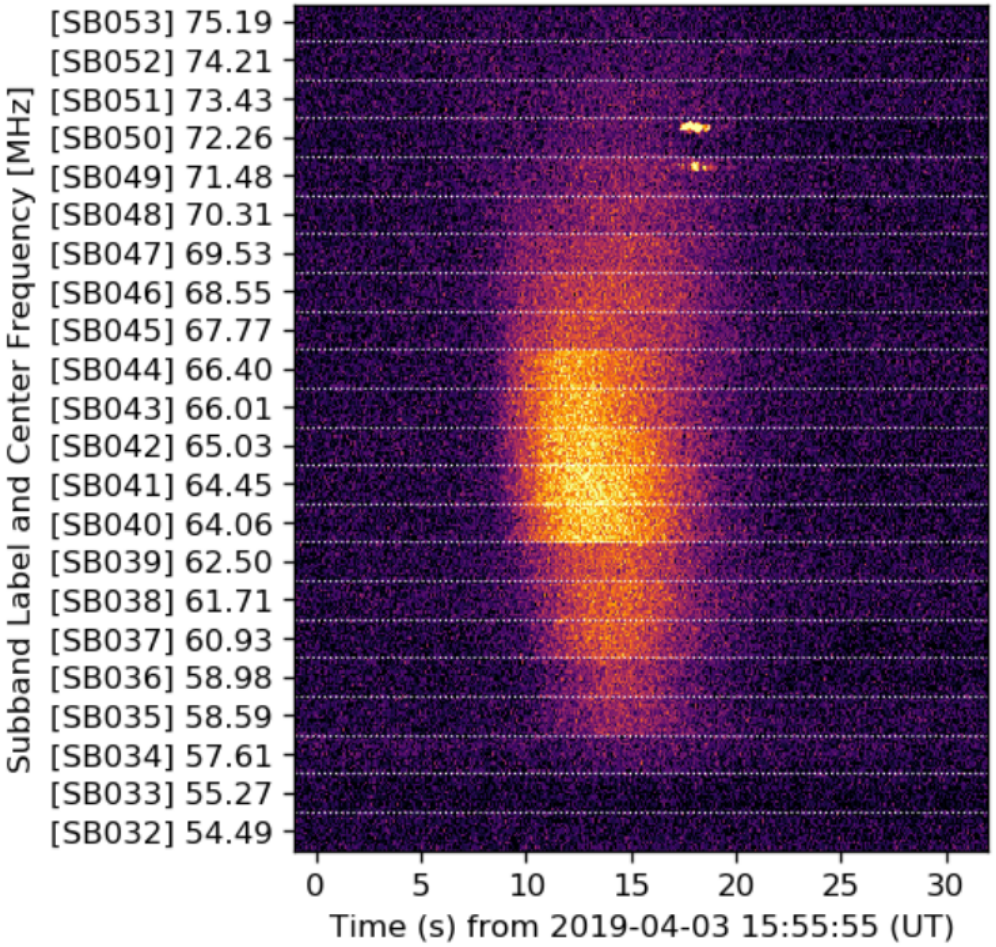


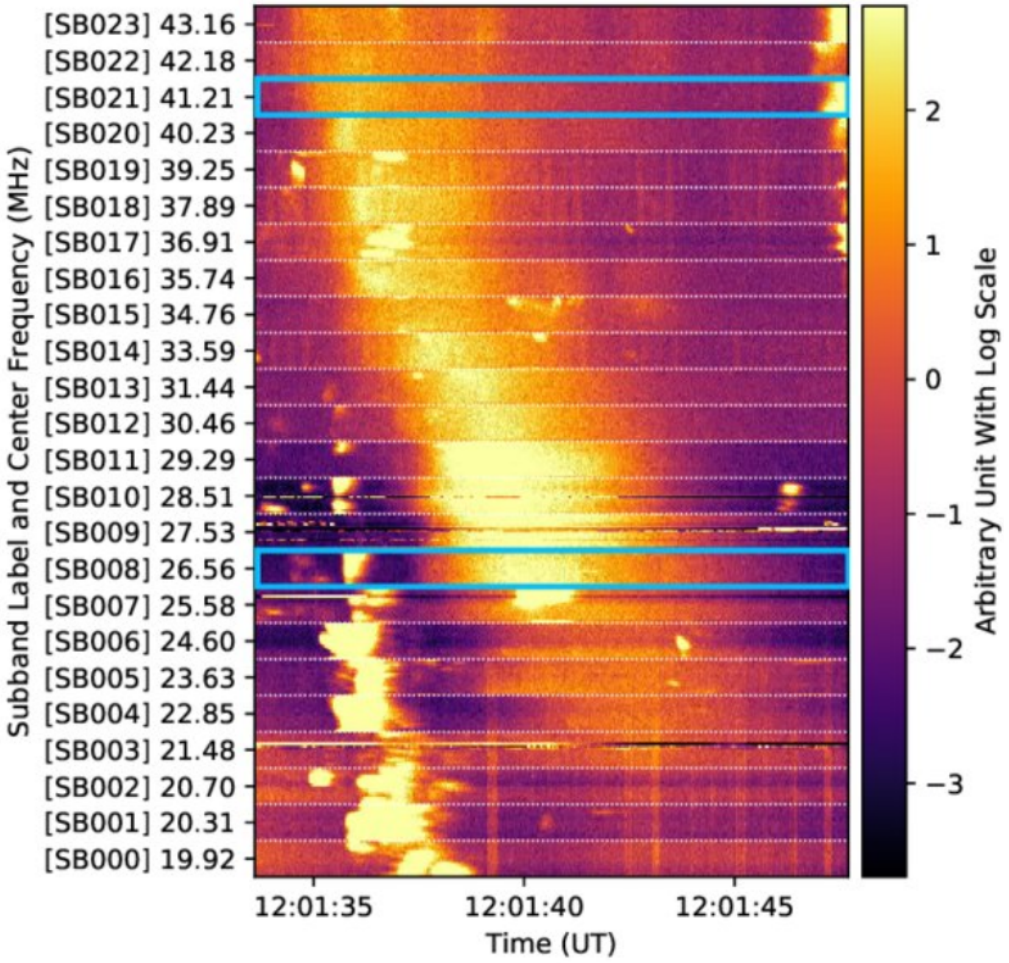
Solution #1 : interpolation.



Subband-stack Plot

- Solution #2 : label the y-axis according to subband property





Docker + Jupyter-lab + Sunpy

- Install docker

```
sudo apt-get install docker-ce docker-ce-cli containerd.io
```

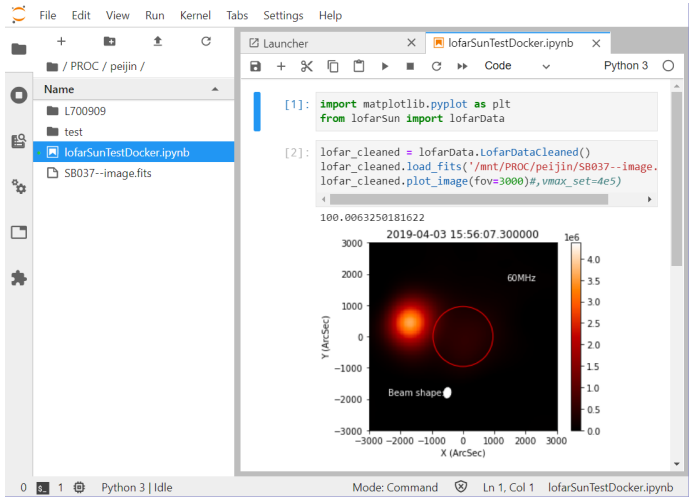
- Run image

Delete container after use

A pre-build image for users

```
docker run --rm -i -p 8998:8998 -u root -t peijin/lofarsun /bin/bash -c "jupyter-lab --notebook-dir=~ --ip='*' --port=8998 --no-browser --allow-root"
```

- Start a browser and work on data processing



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