

# The LOFAR LBA Sky Survey



Second data release

Francesco De Gasperin

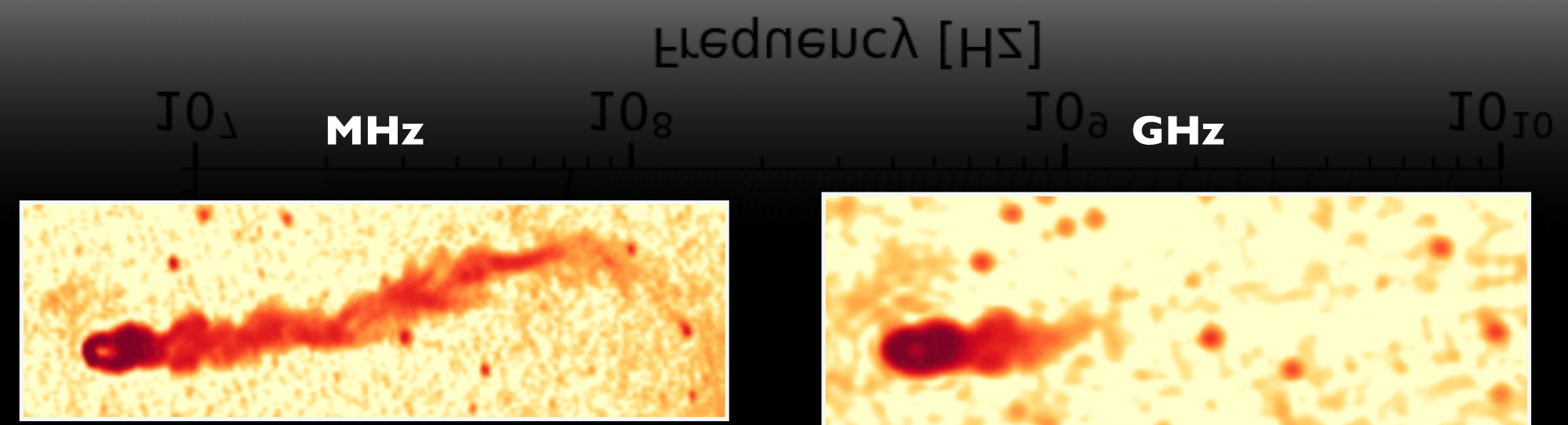
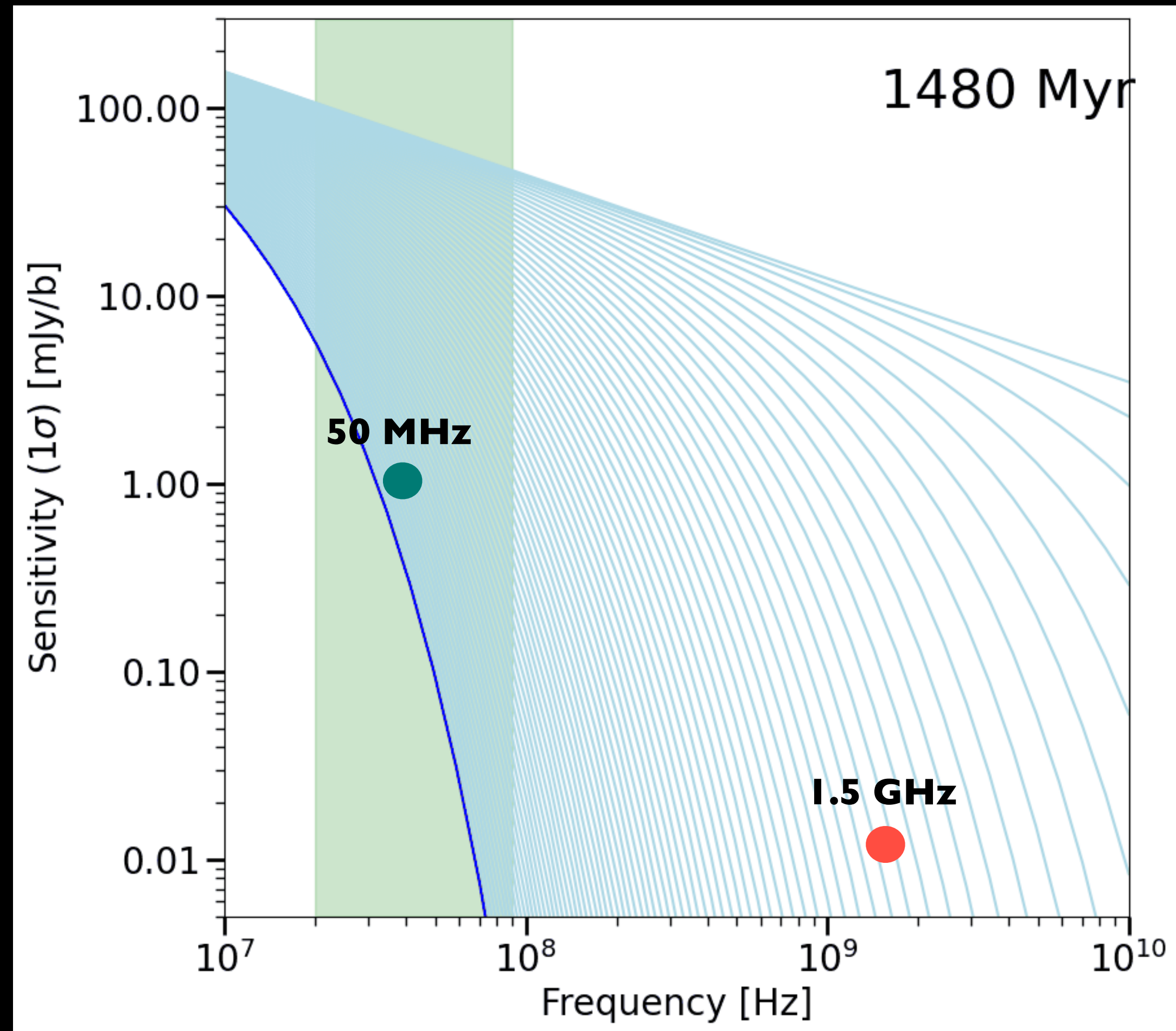
LOFAR Annual Meeting - Dublin 8/6/26



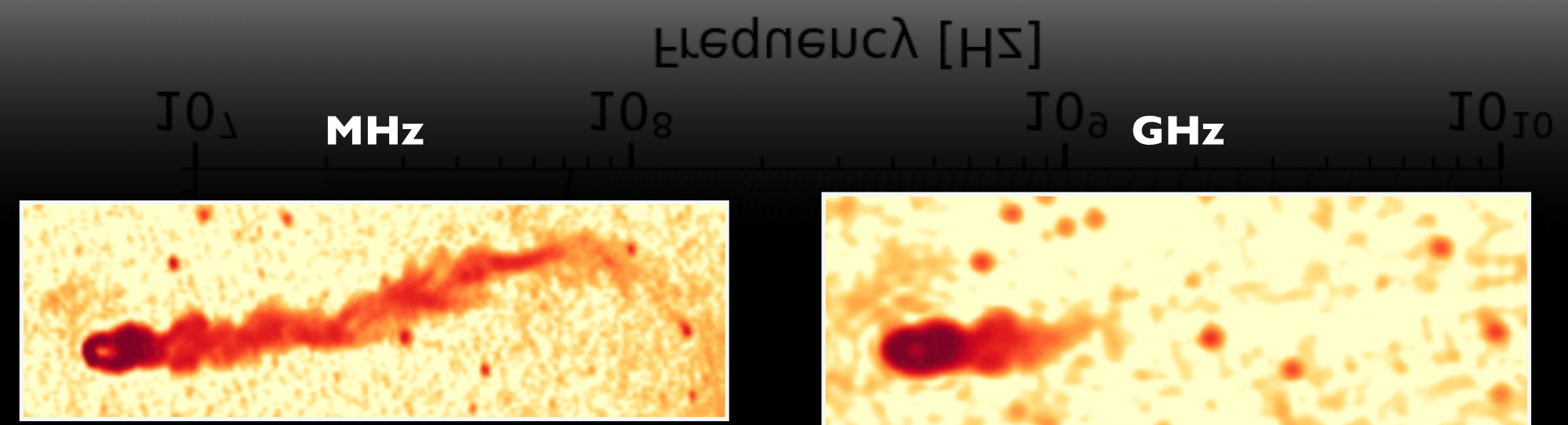
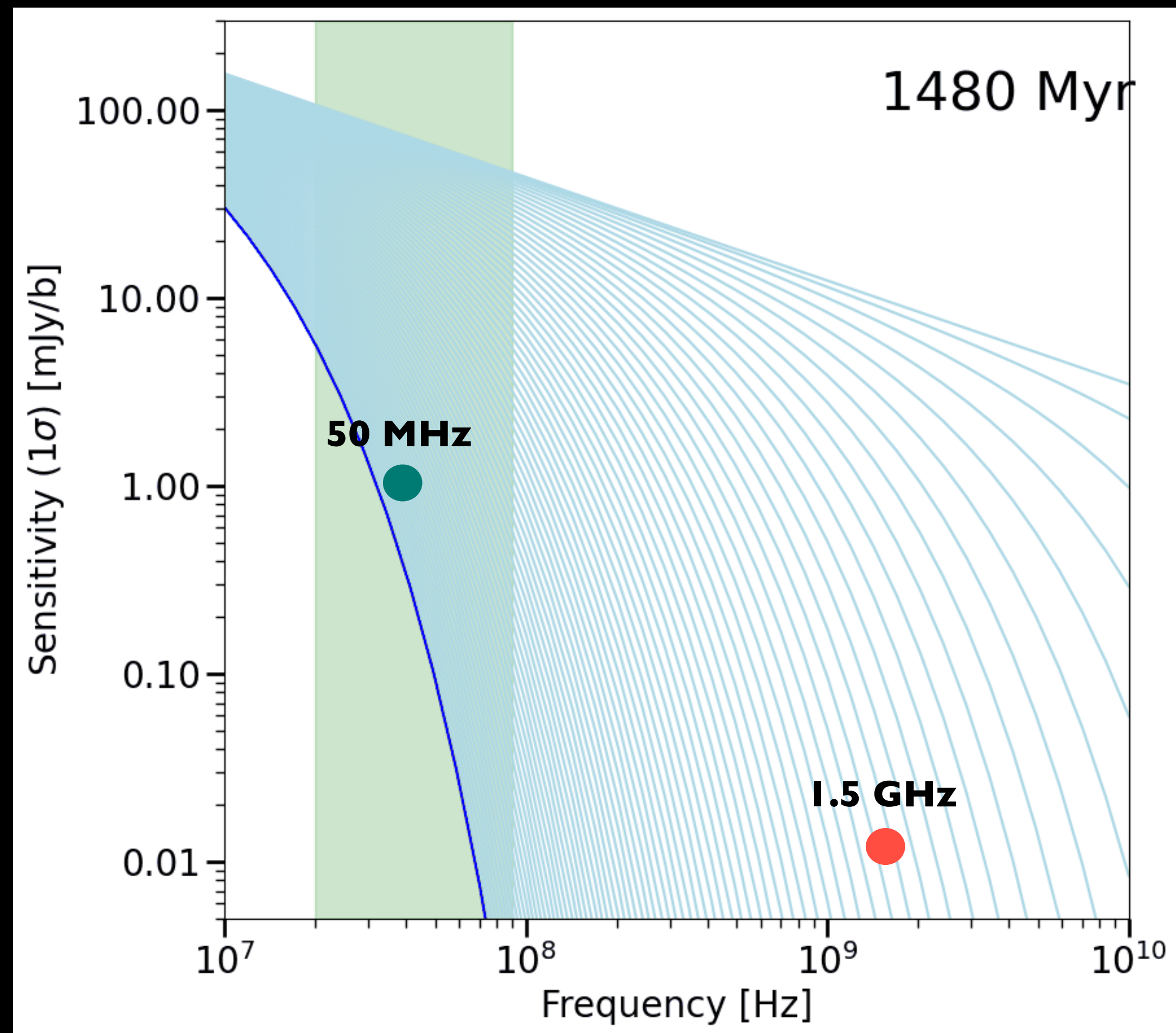
European Research Council  
Established by the European Commission



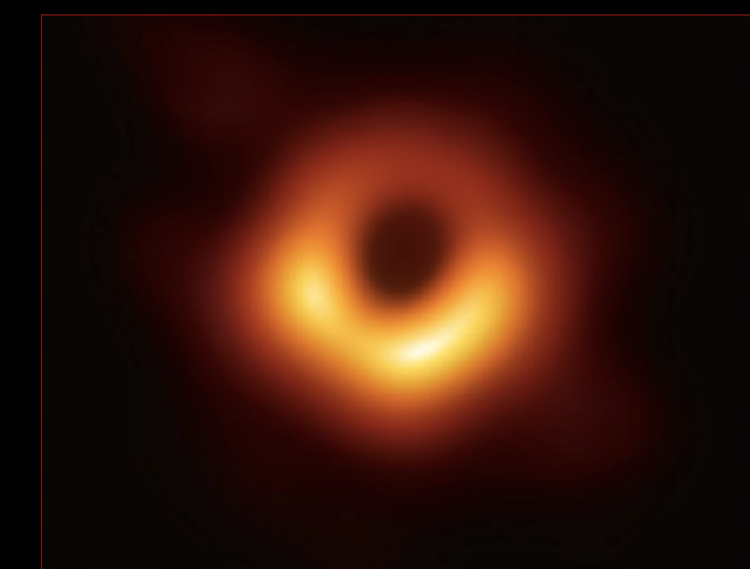
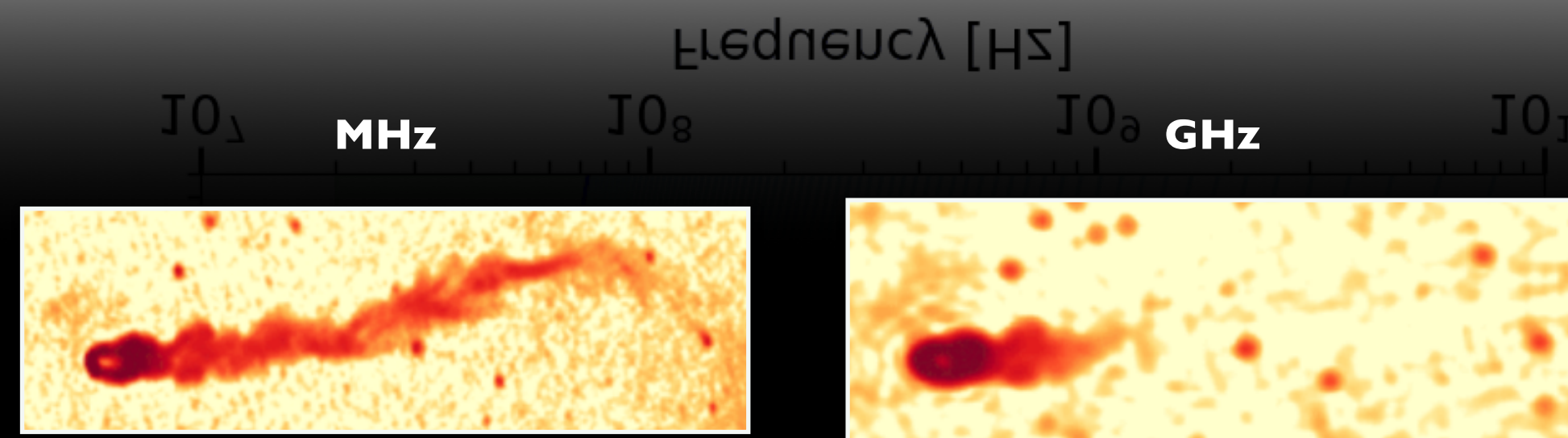
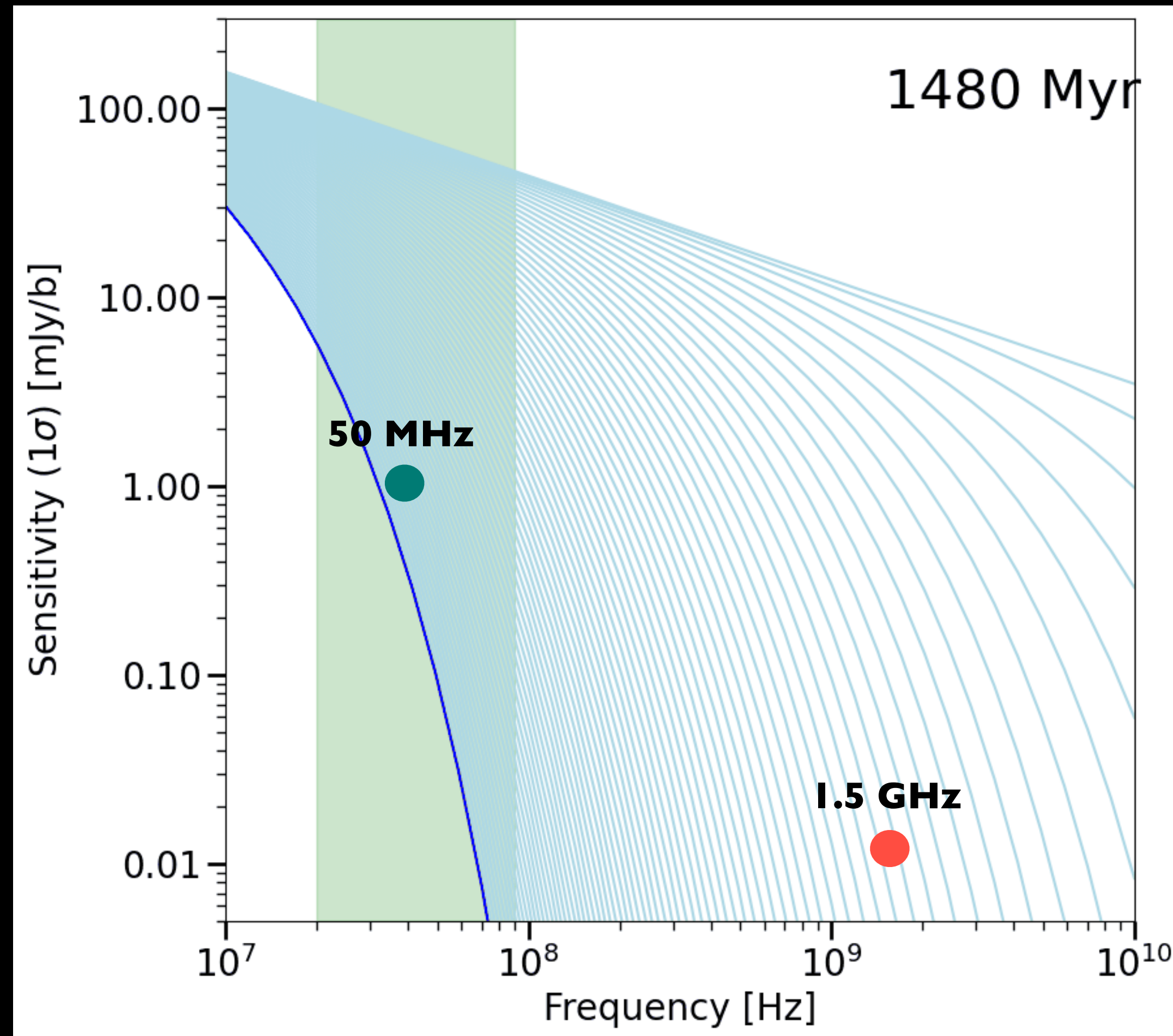






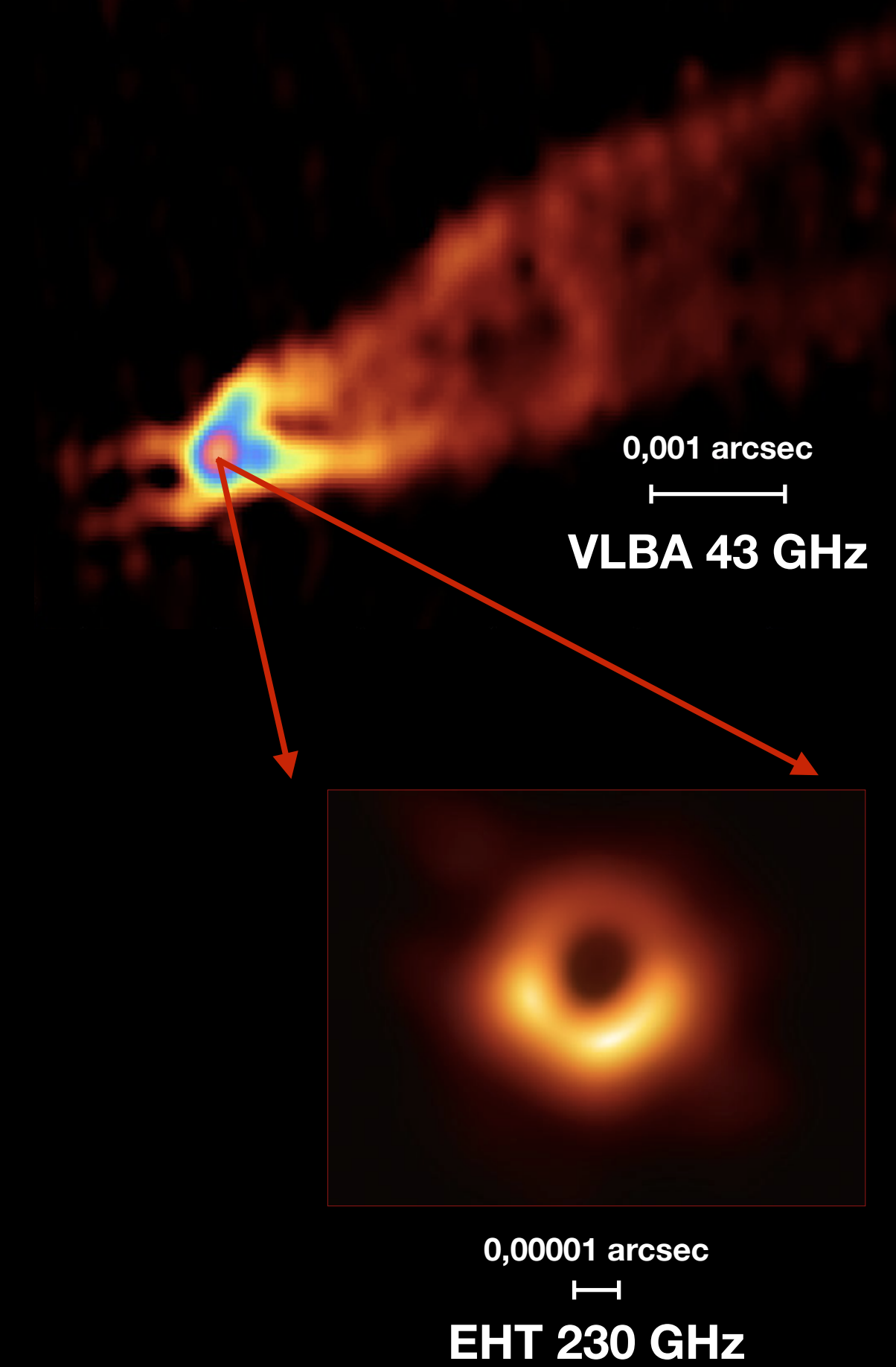
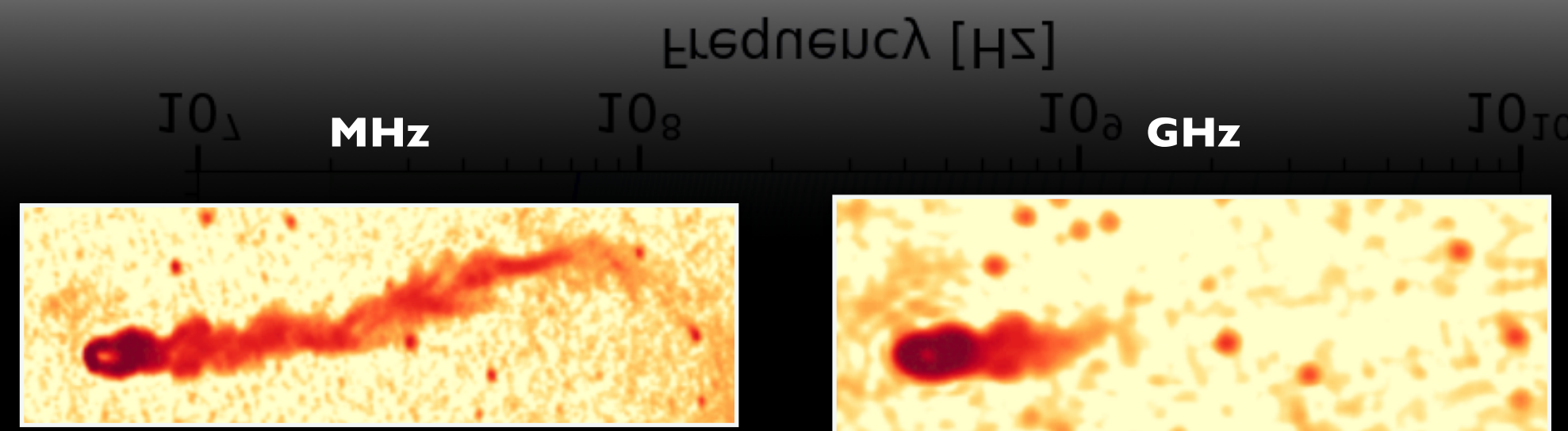
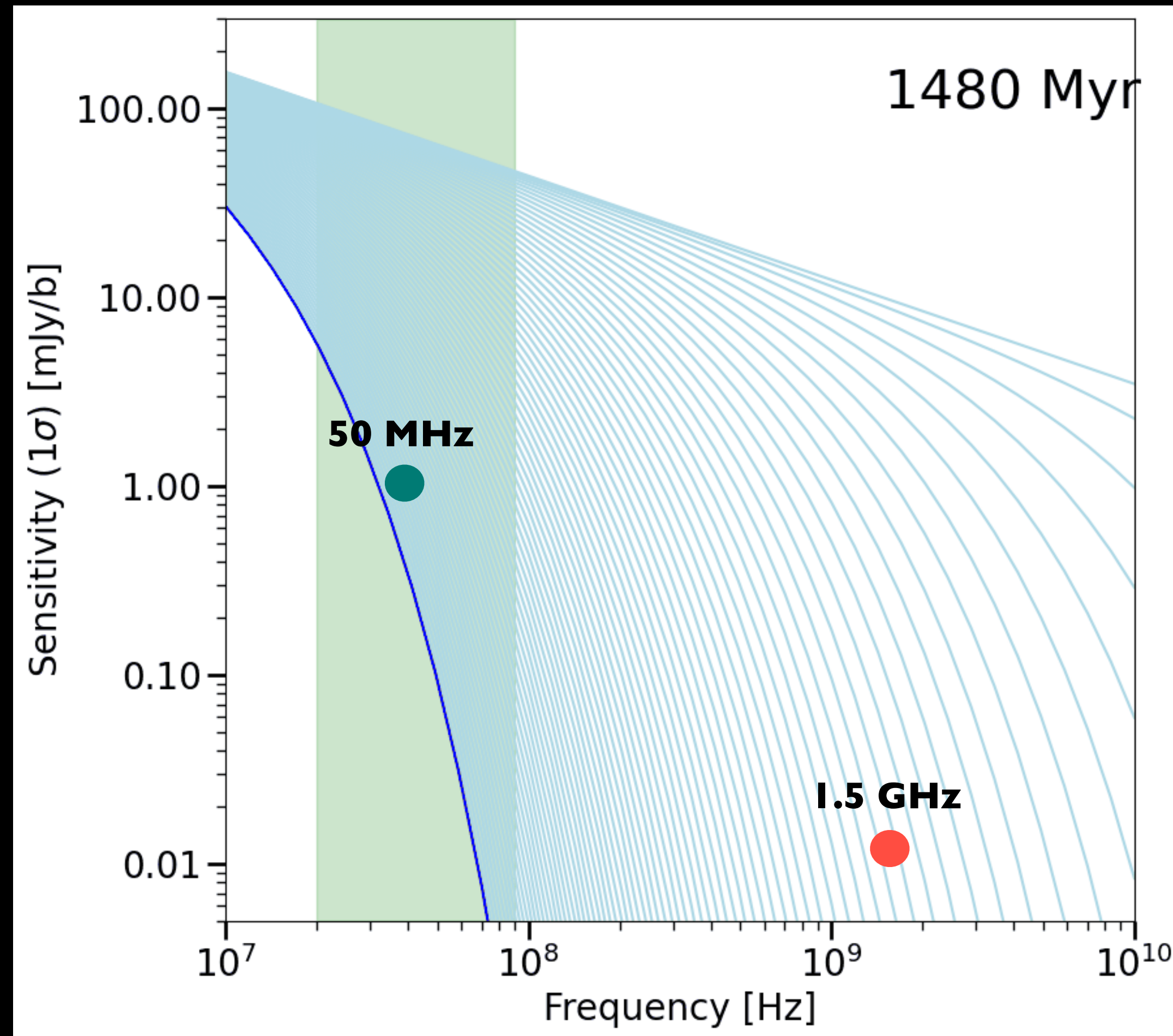






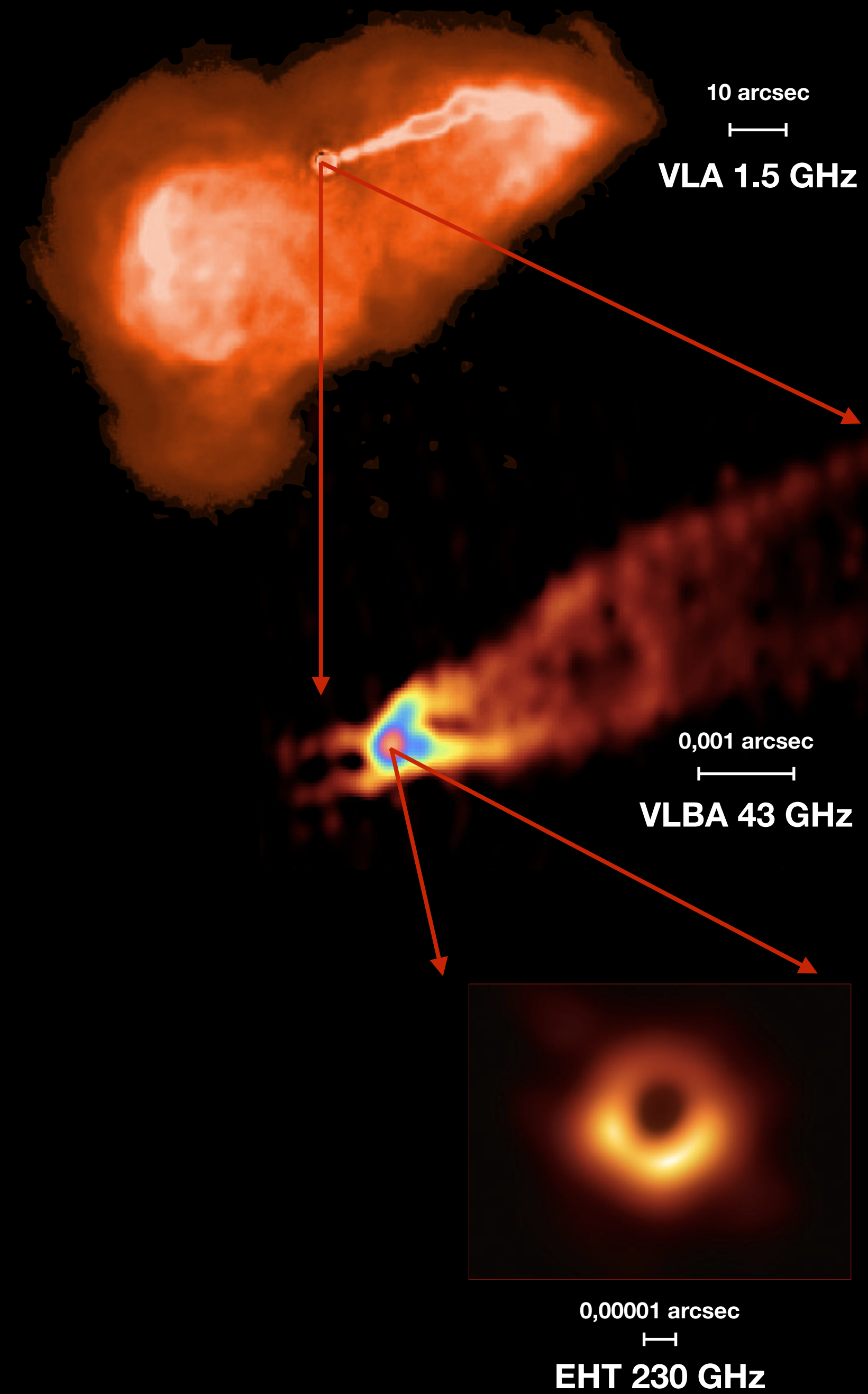
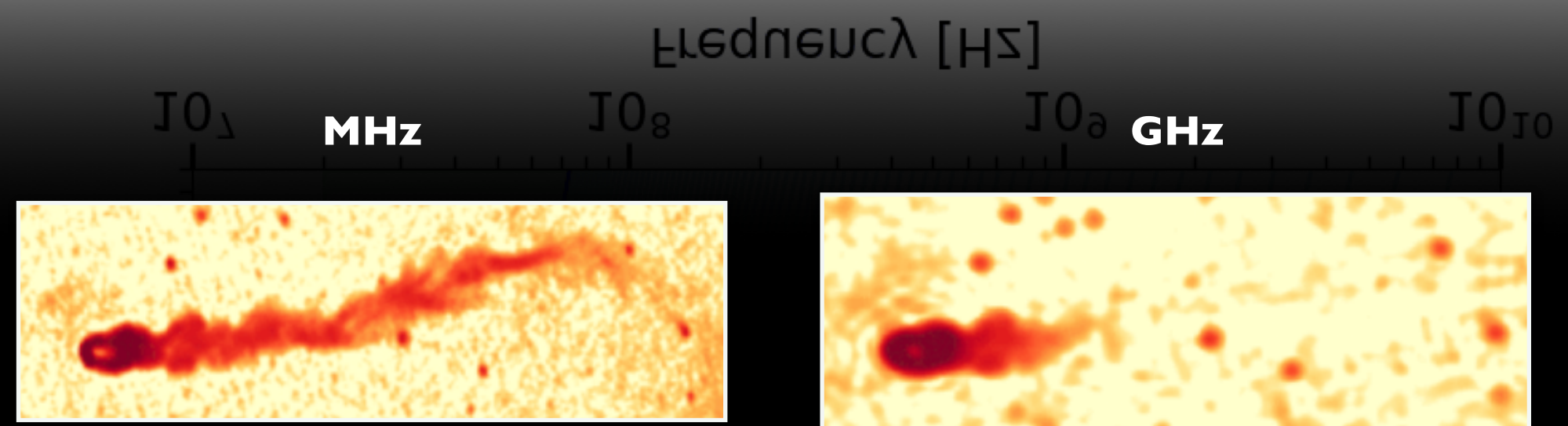
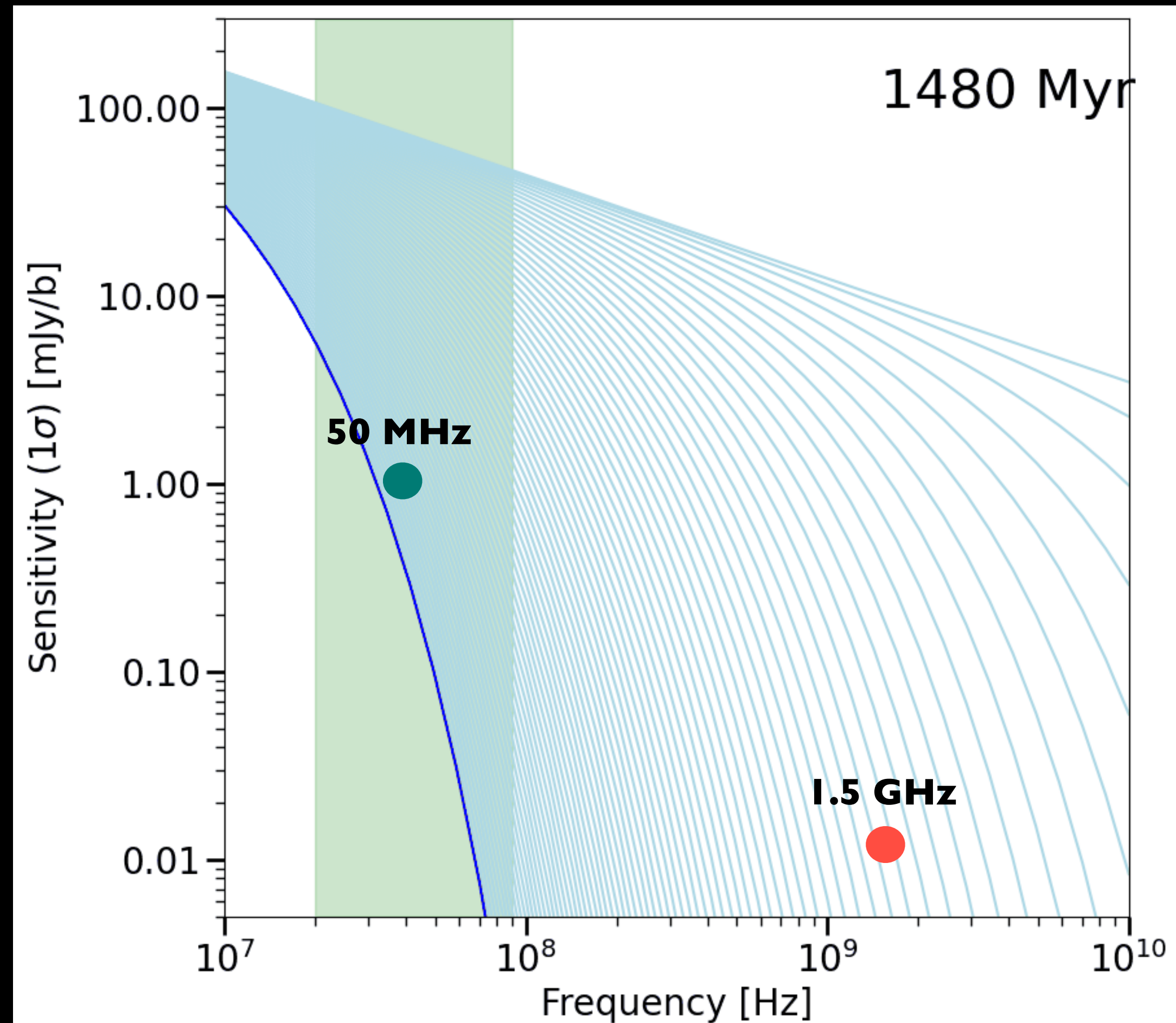
0,00001 arcsec  
EHT 230 GHz





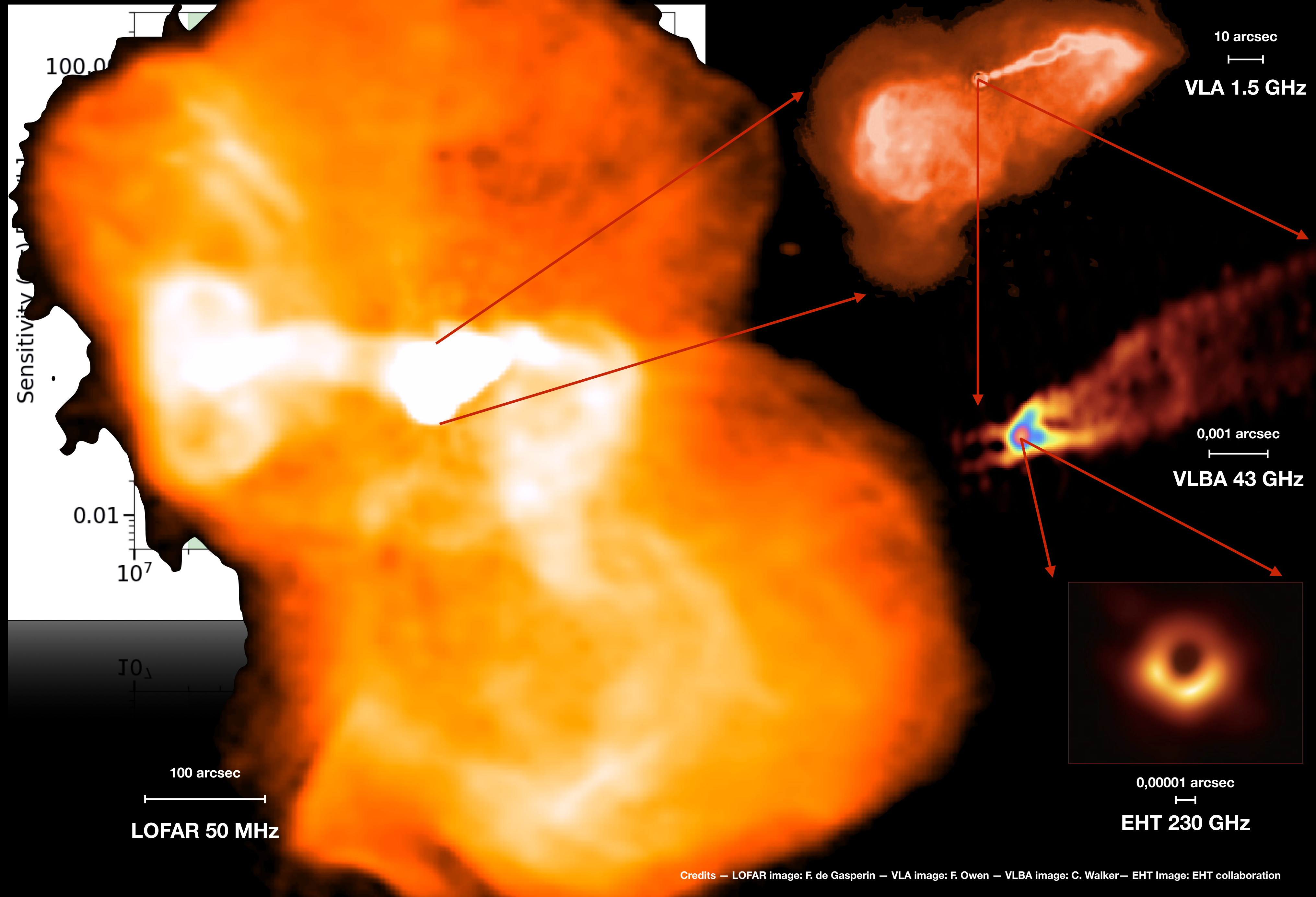


# Why ULF are able to reveal the sea of submerged CR?



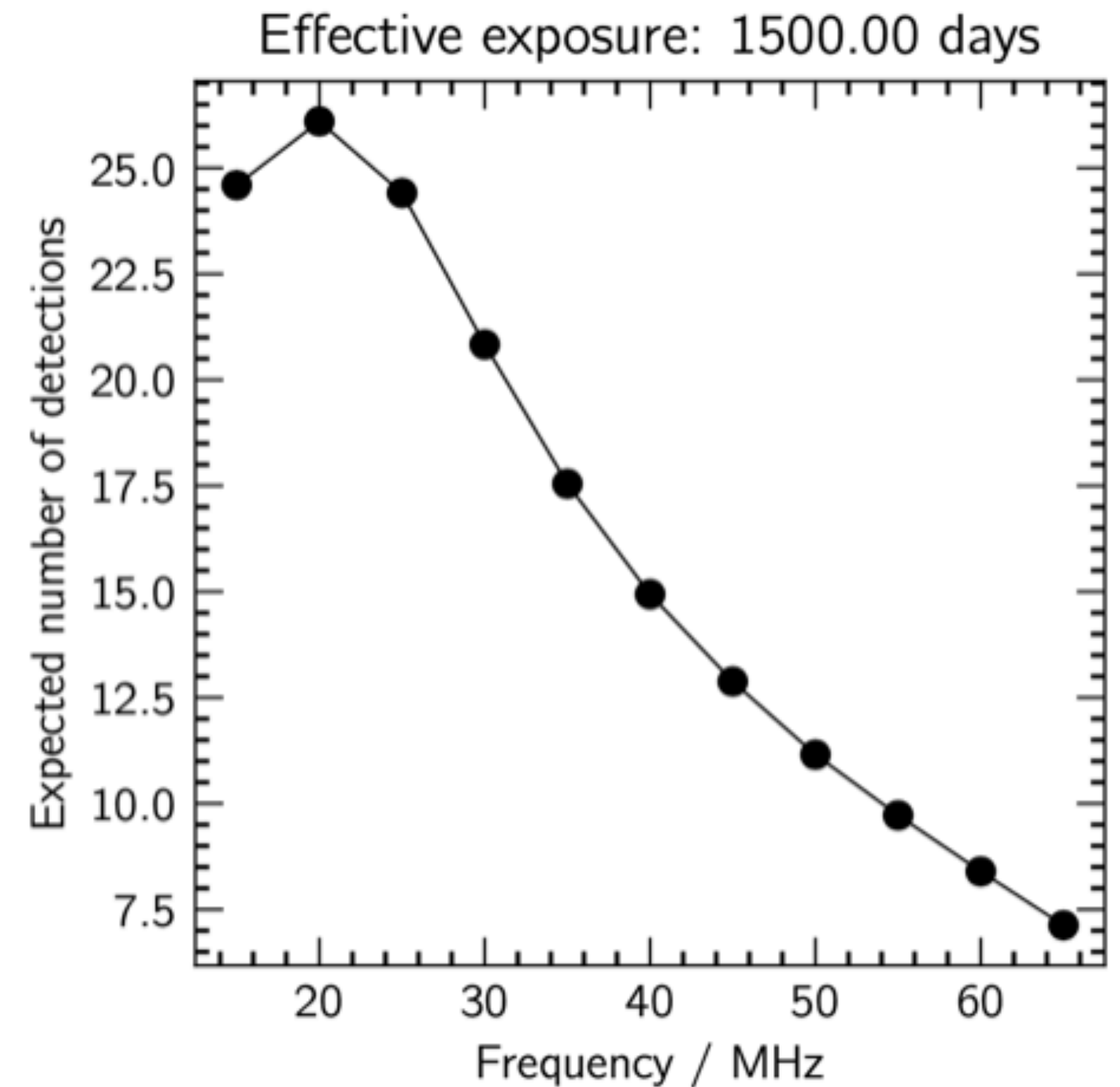


Why ULF are able to re



Credits — LOFAR image: F. de Gasperin — VLA image: F. Owen — VLBA image: C. Walker — EHT Image: EHT collaboration



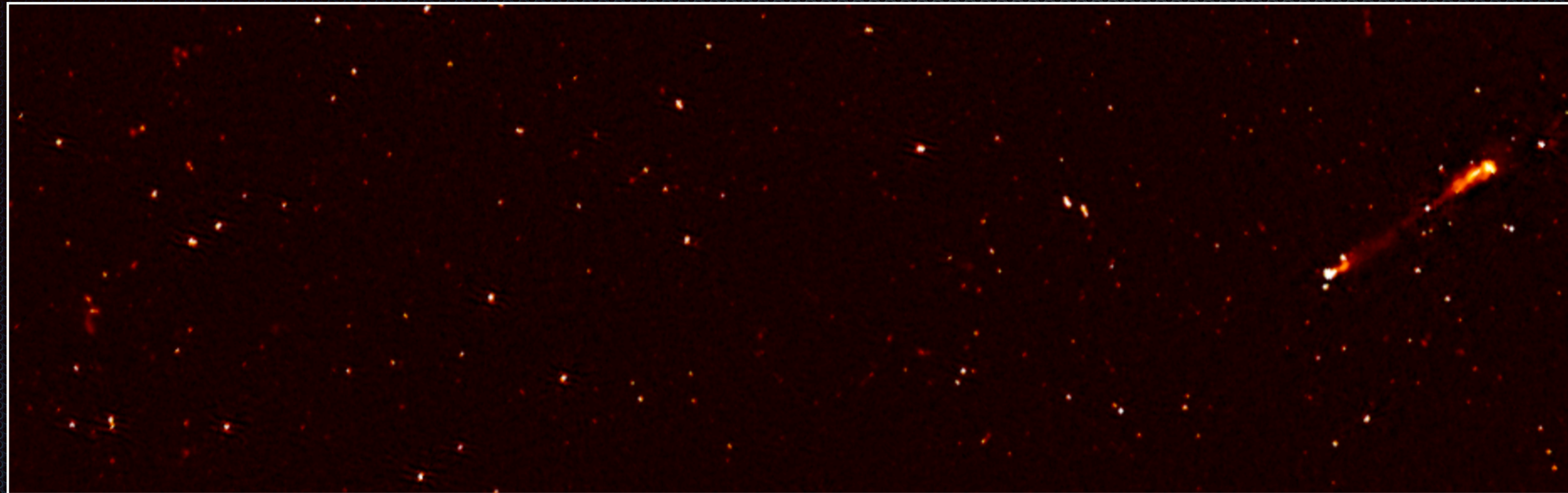


Detection of cyclotron emission and therefore magnetic fields in gas-giant exoplanets and even some super-Earths

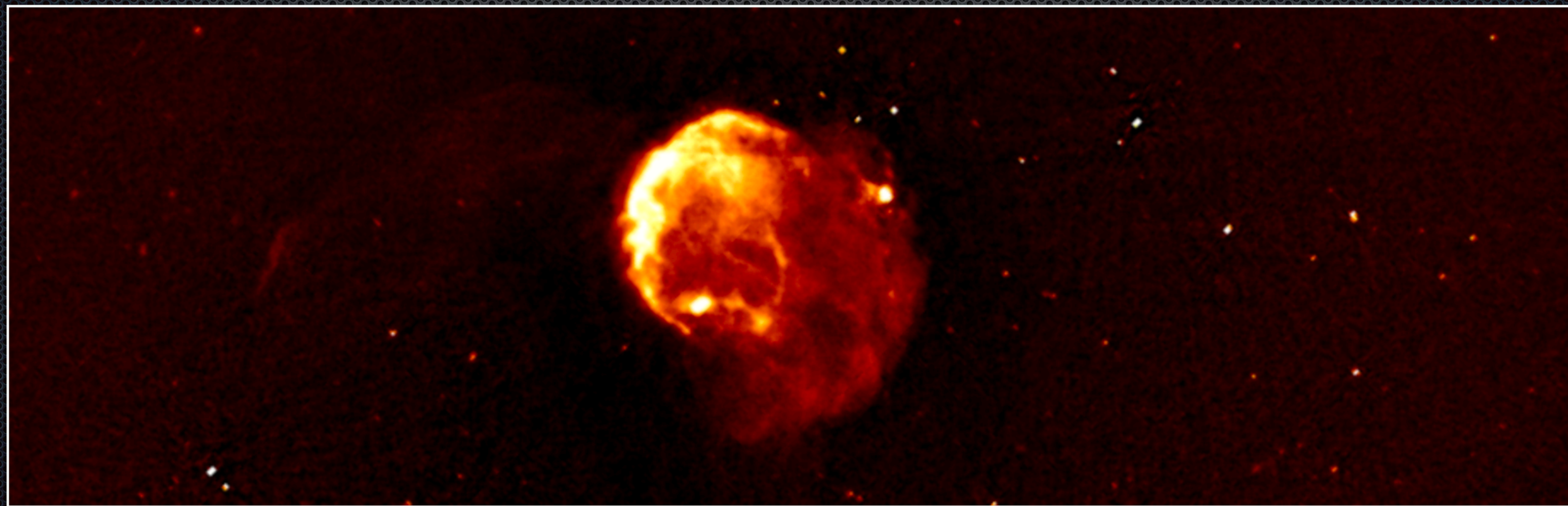
Direct detection of Type III coronal ejections on a Sun-like star



# The LOFAR LBA Sky Survey



Extra Galactic



Galactic

[lofar-surveys.org](http://lofar-surveys.org) / [lolss-dr2-fields.html](http://lolss-dr2-fields.html)

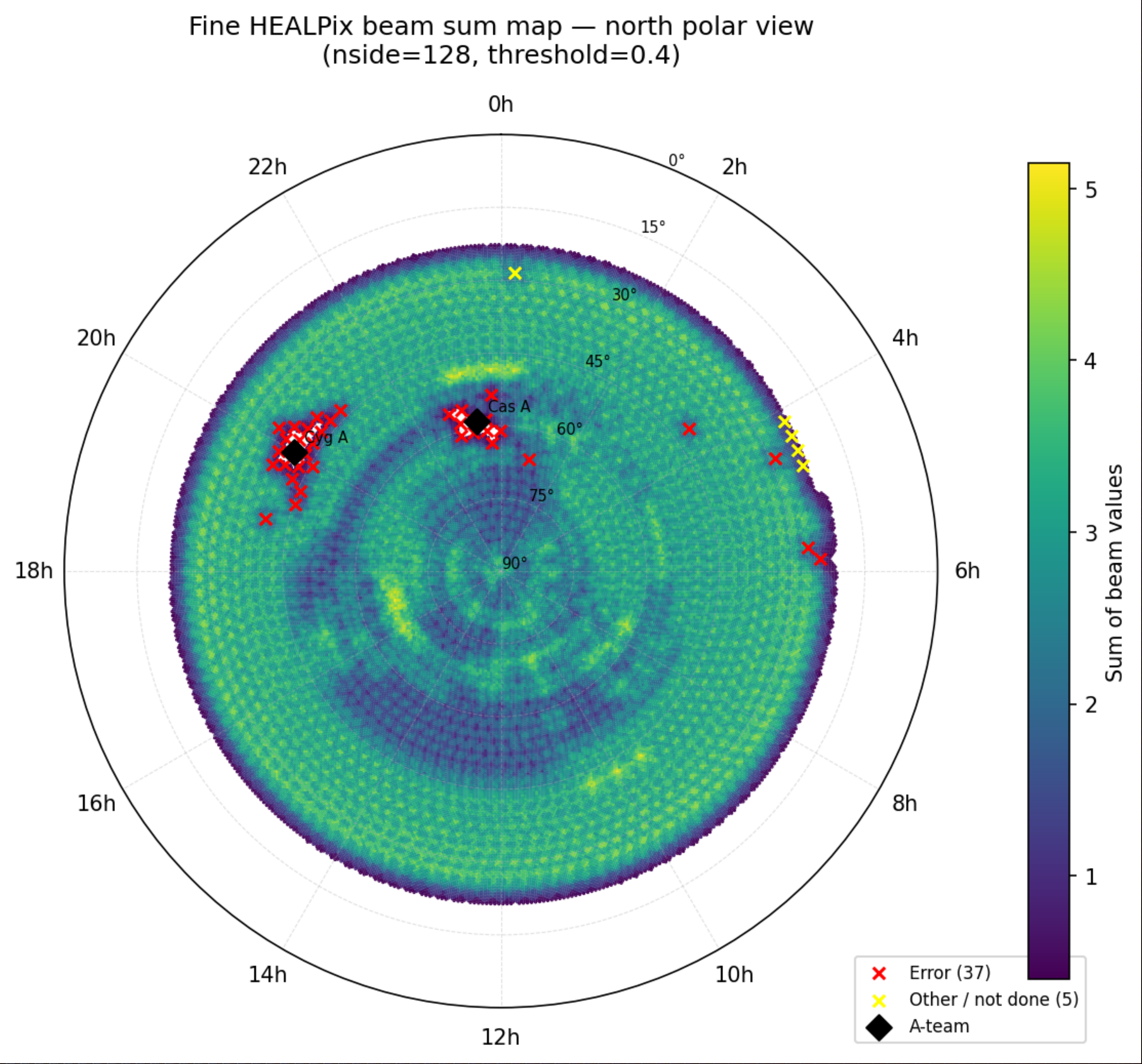
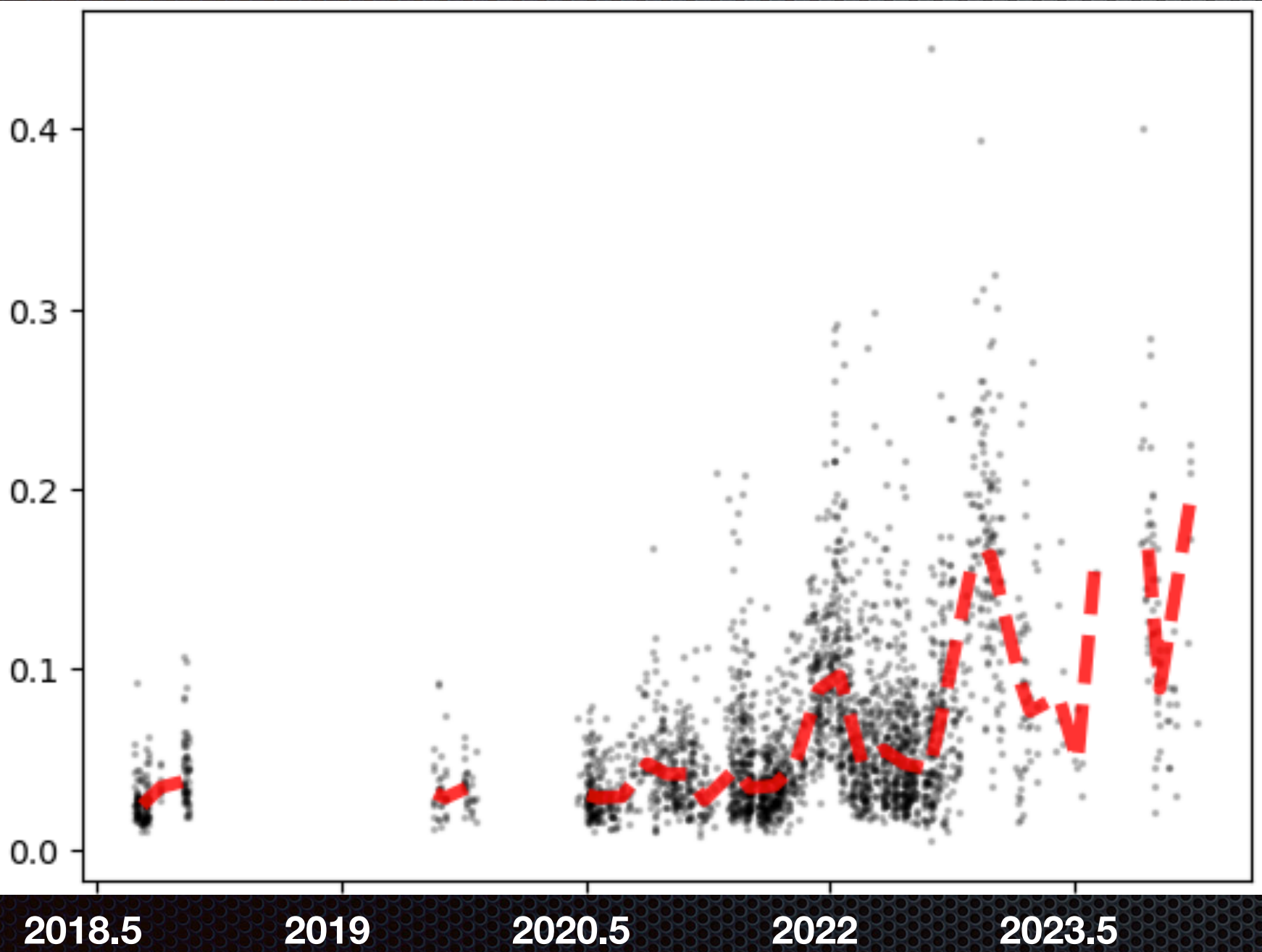


# Status

1974 pointings processed (<2% failure rate)

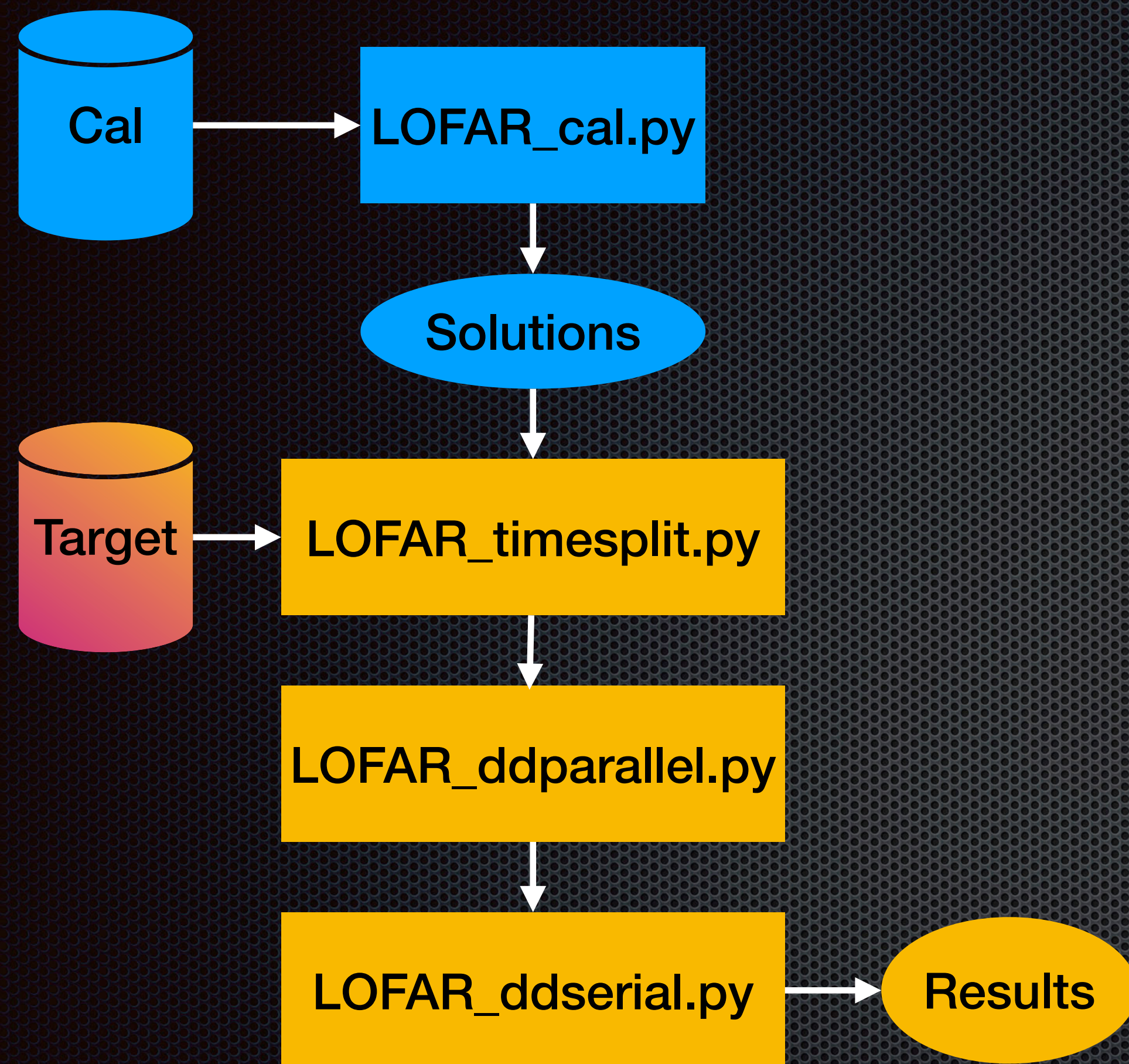
Observing strategy:

- >3 hrs per pointing
- 3 beams + calibrator
- maximise uv-coverage & elevation
- robust to bad ionosphere
- highly efficient (1h blocks)





# LiLF (library for low-frequency)



## LBA OUTER:

copy: 0.18 h

timesplit: 0.11 h

dd-serial: 15.61 h

dd-parallel: 13.46 h

quality: 0.19 h

## LBA SPARSE:

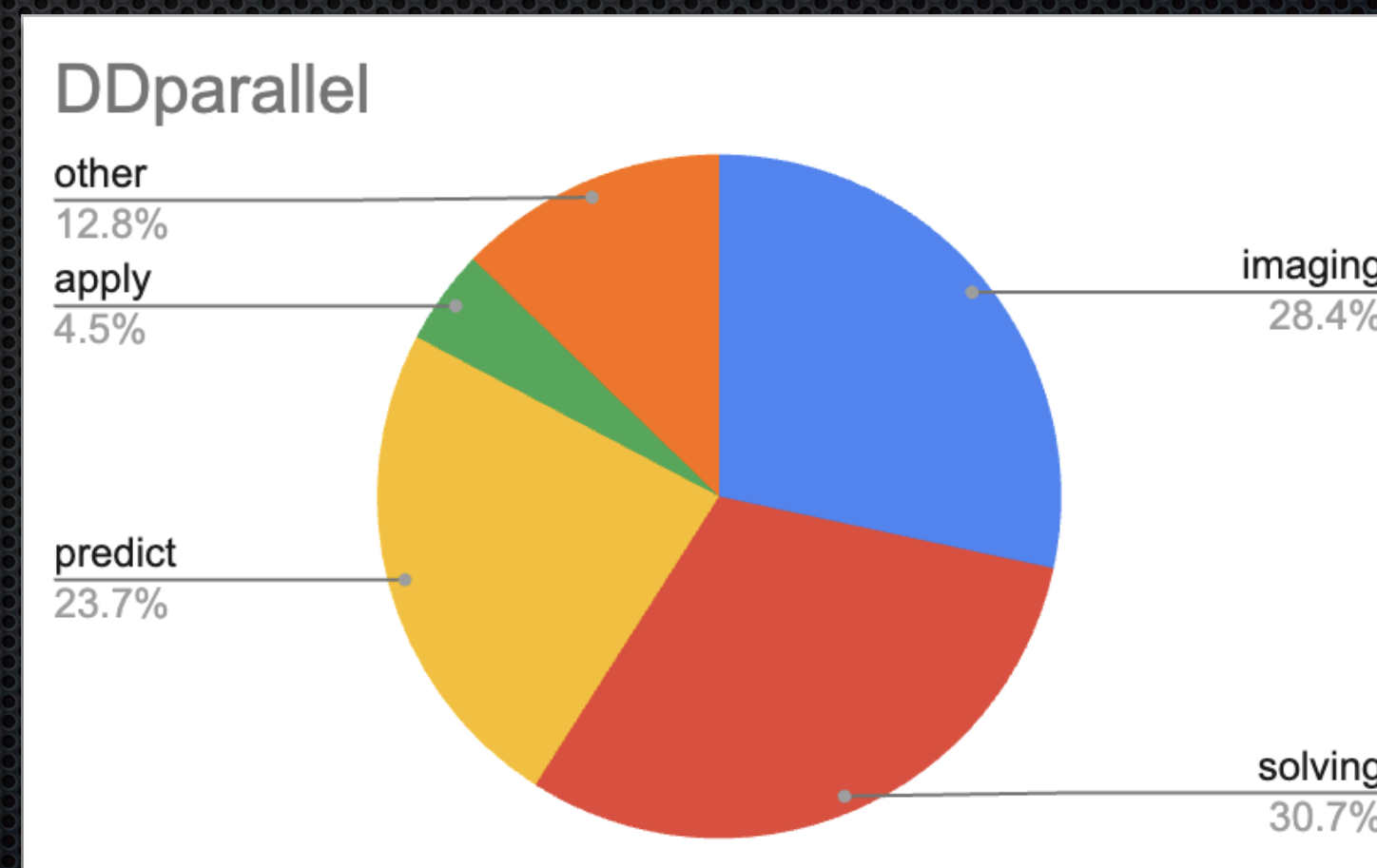
copy: 0.18 h

timesplit: 0.24 h

dd-serial: 33.78 h

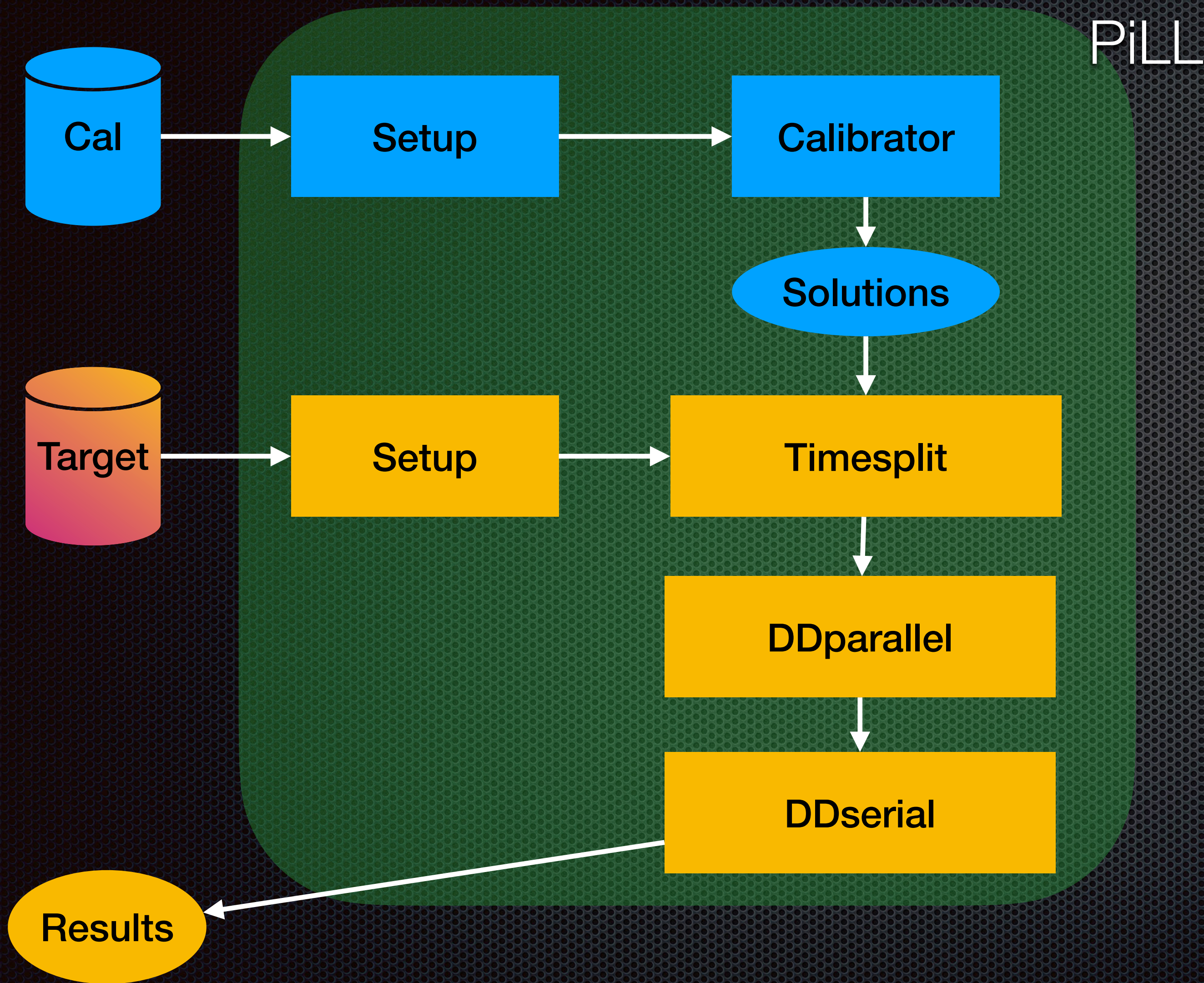
dd-parallel: 30.10 h

quality: 0.15 h





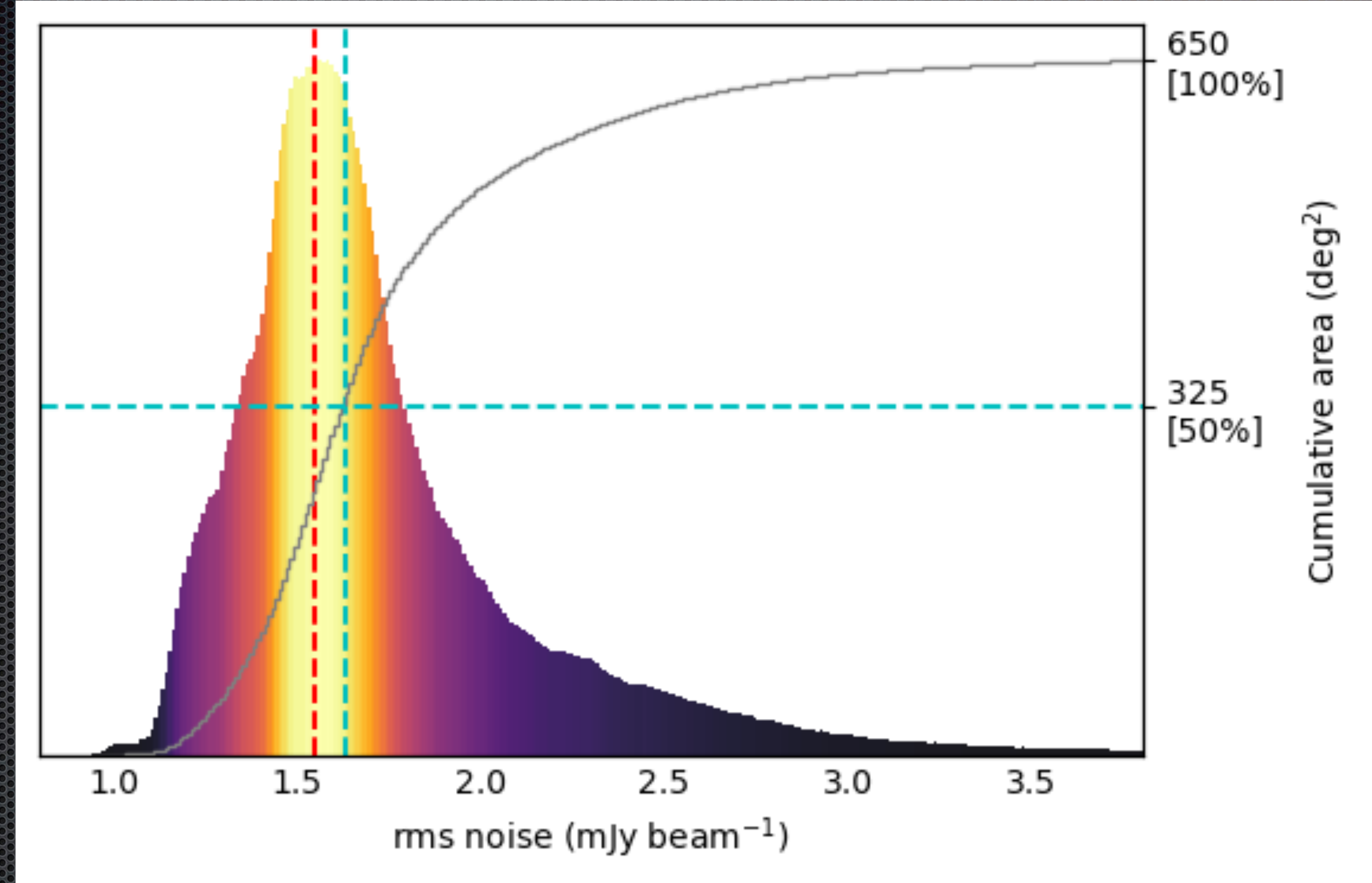
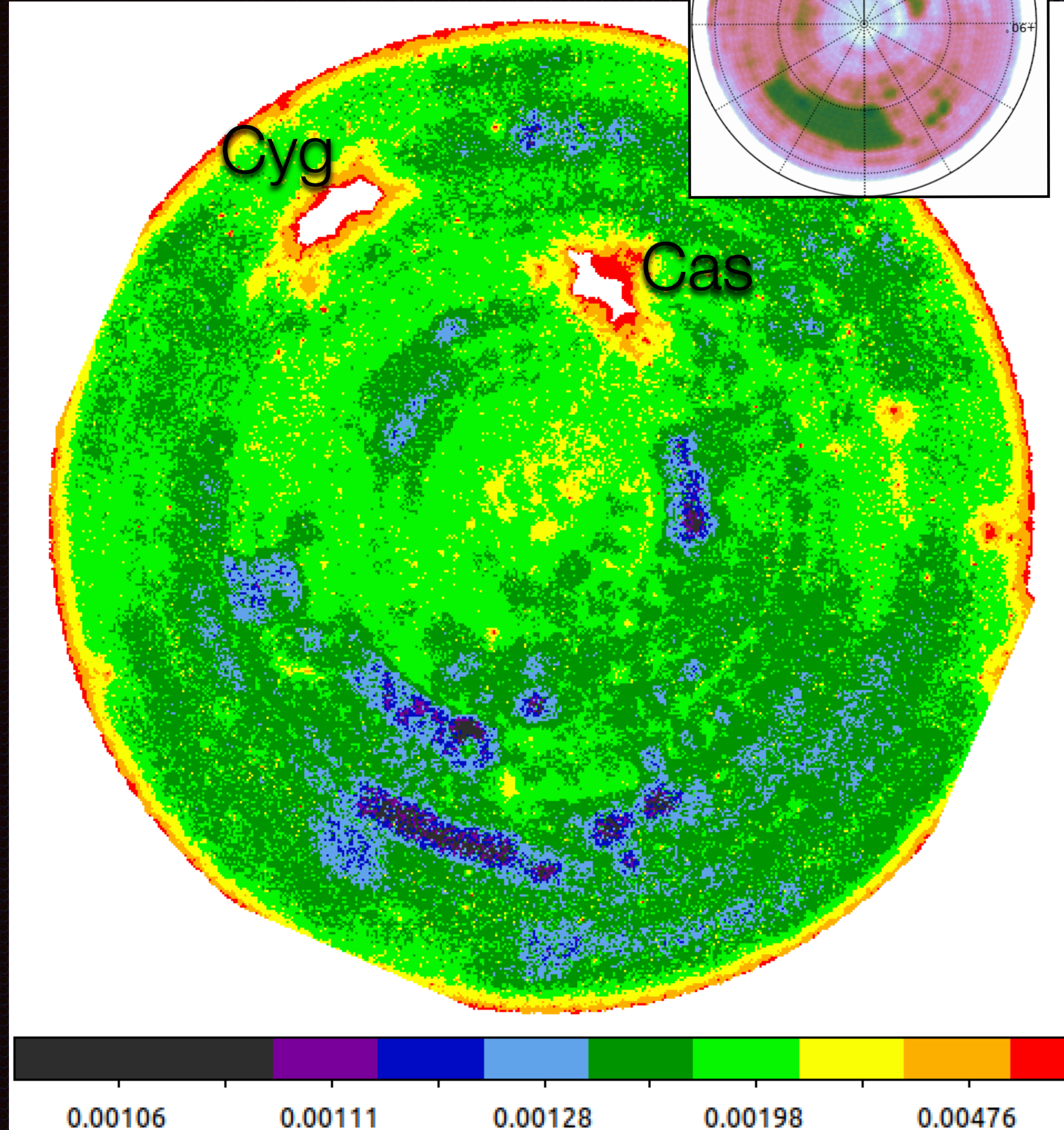
# LiLF (library for low-frequency) 2.0



- One pipeline, many configurable steps
- Each step can be run in parallel or series
- Well defined input/output of each step
- Ready for decametre and VLBI



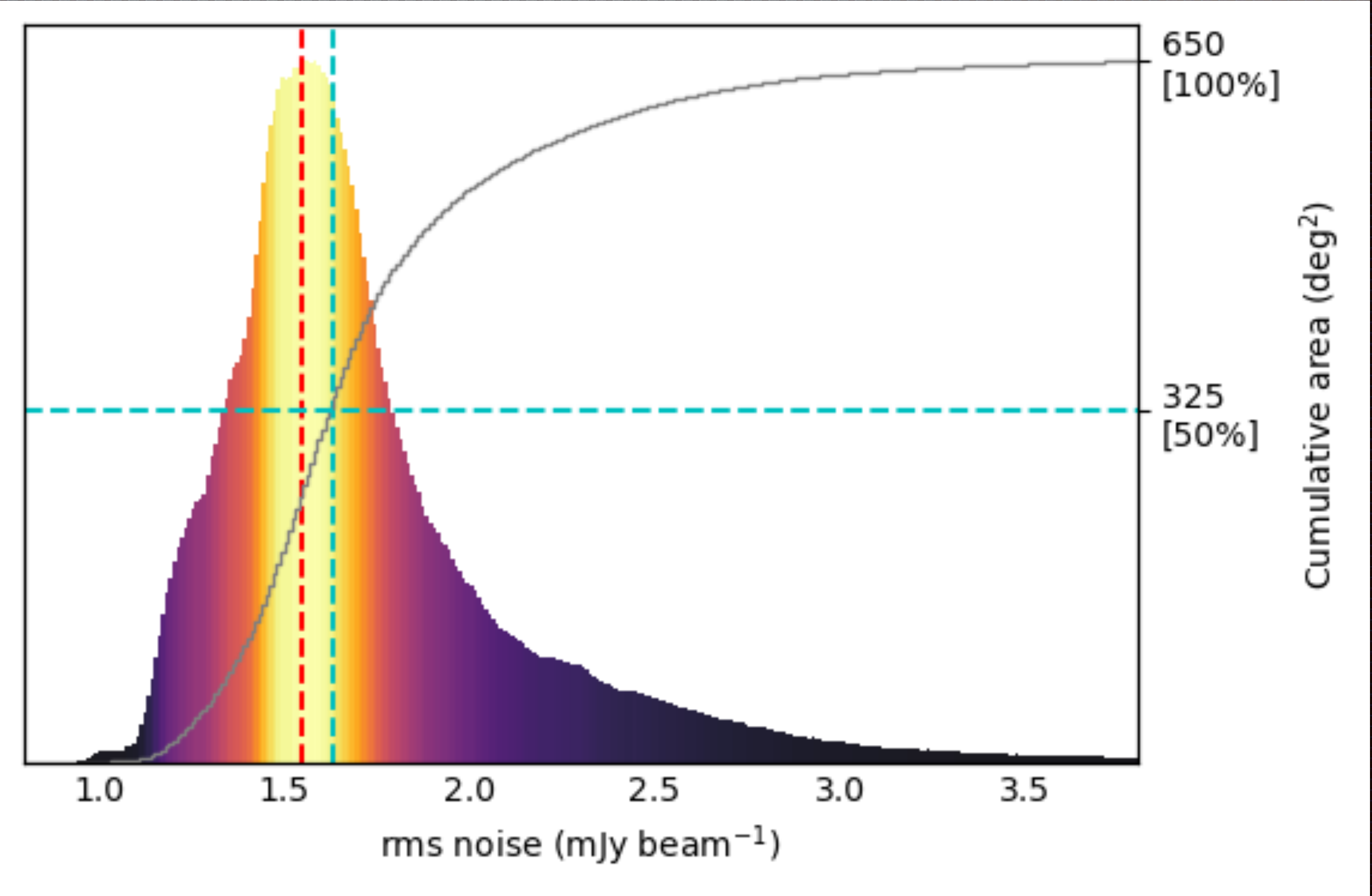
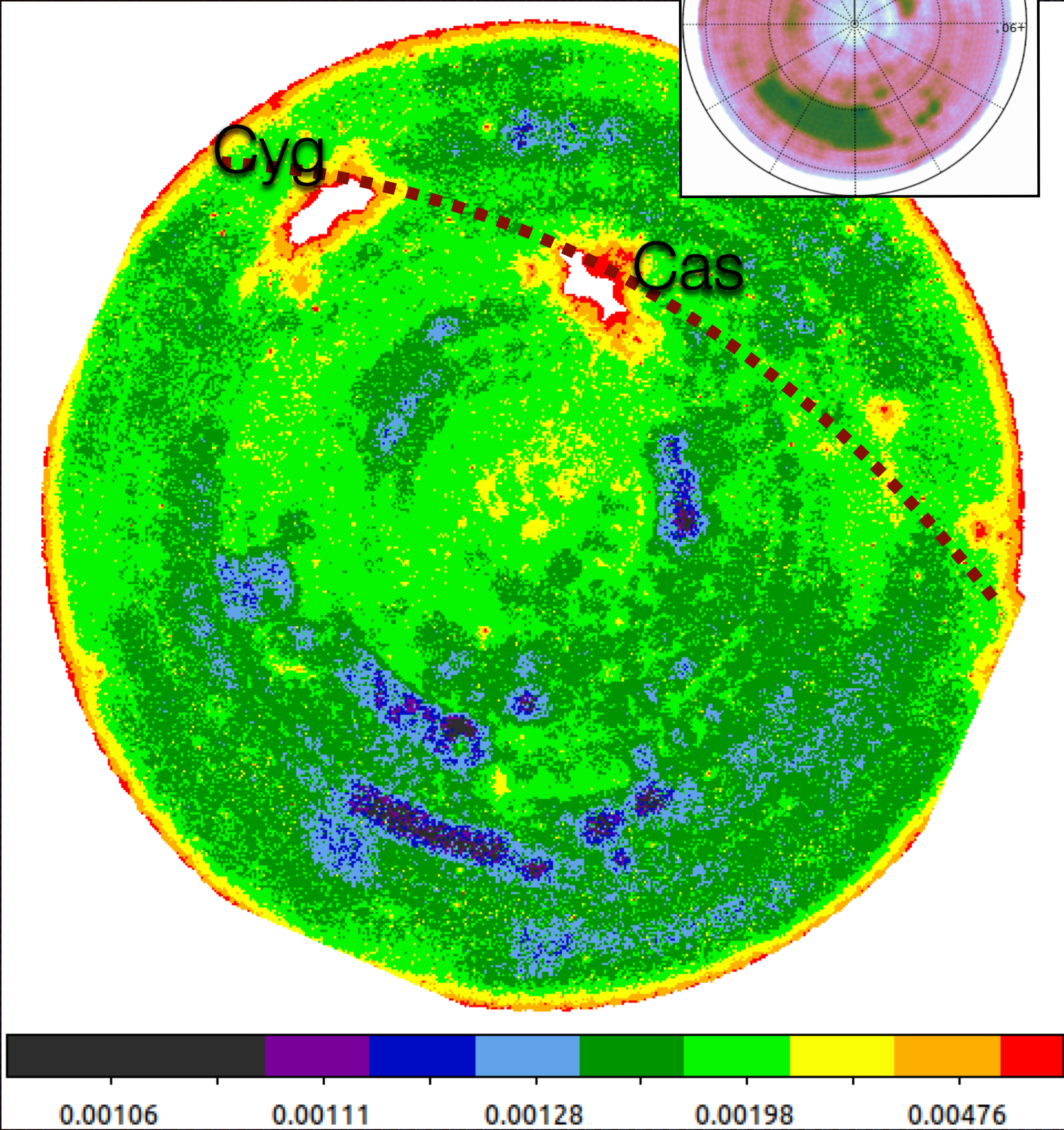
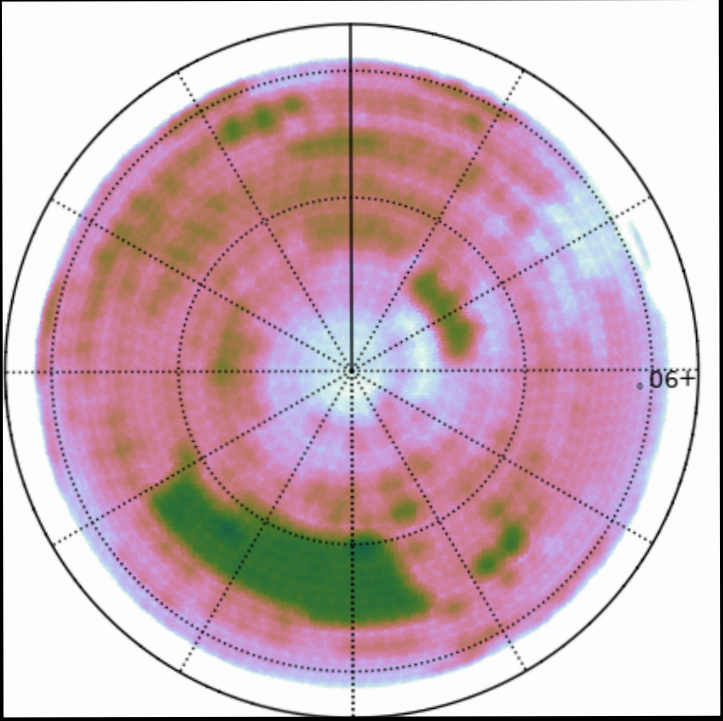
# Sensitivity



- Median rms: 1.6 mJy/b
- Most common value: 1.55 mJy/b



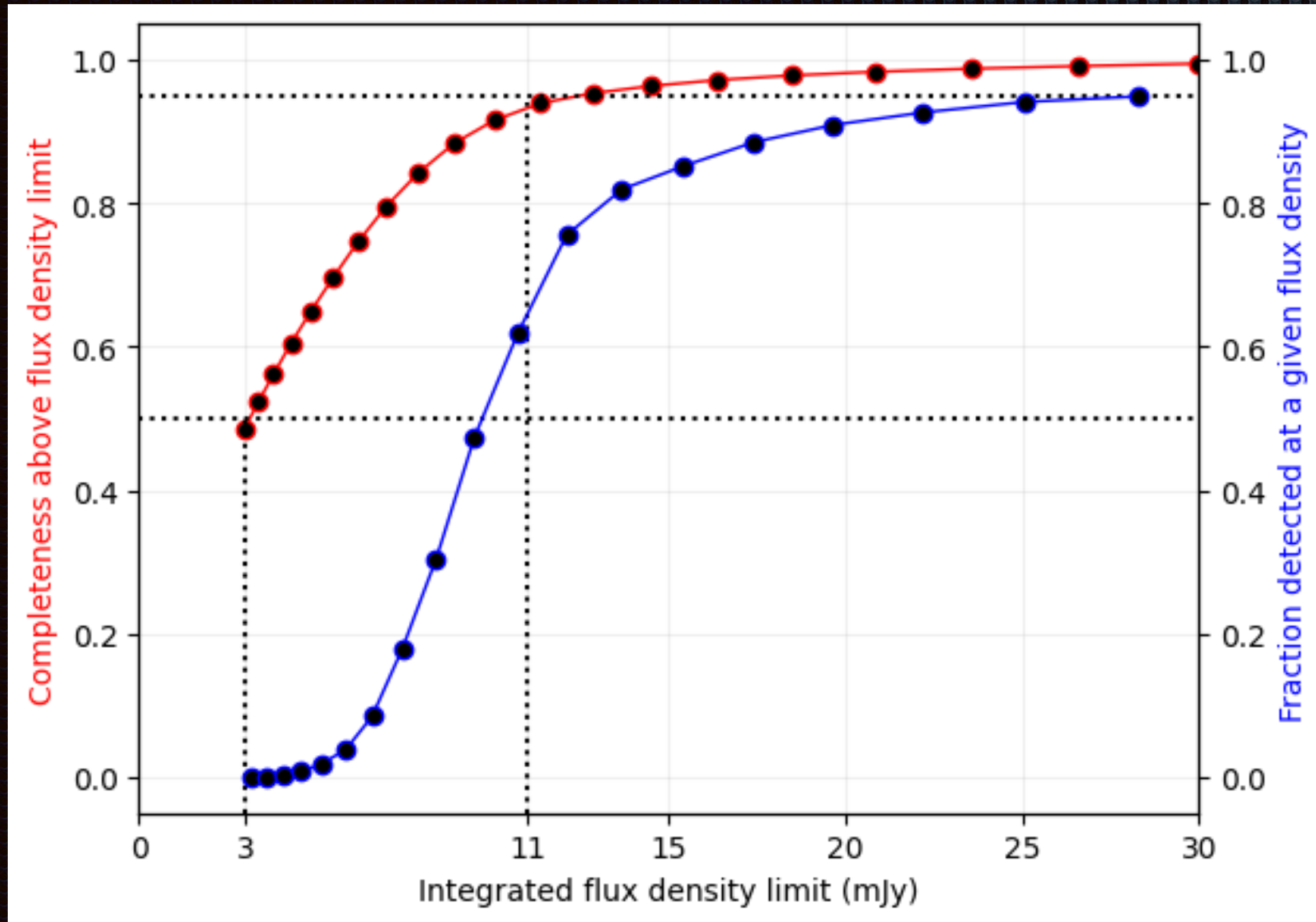
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# Completeness and false positives

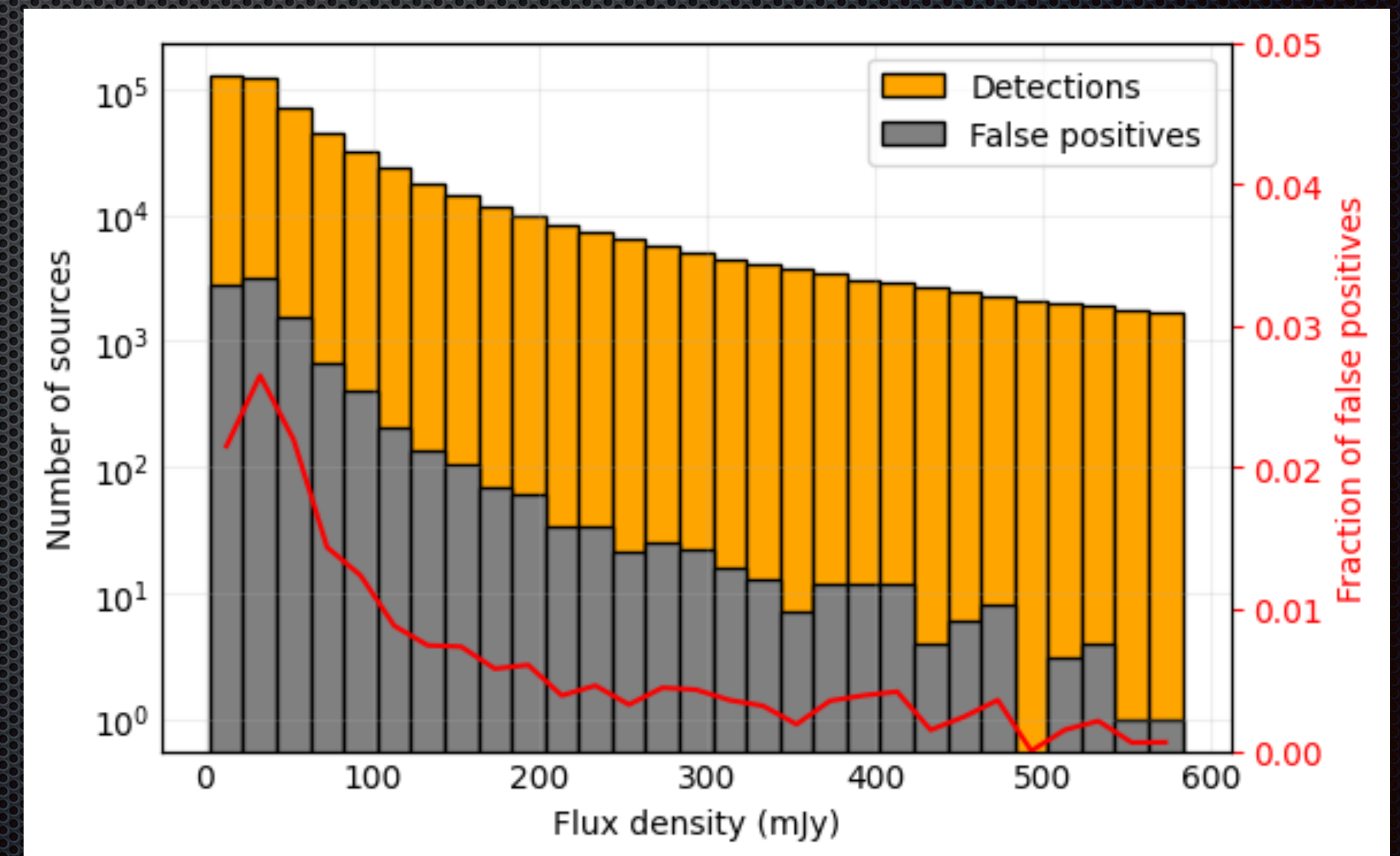


Completeness:

- 50% complete at 3 mJy
- 90% complete at 11 mJy

False positives:

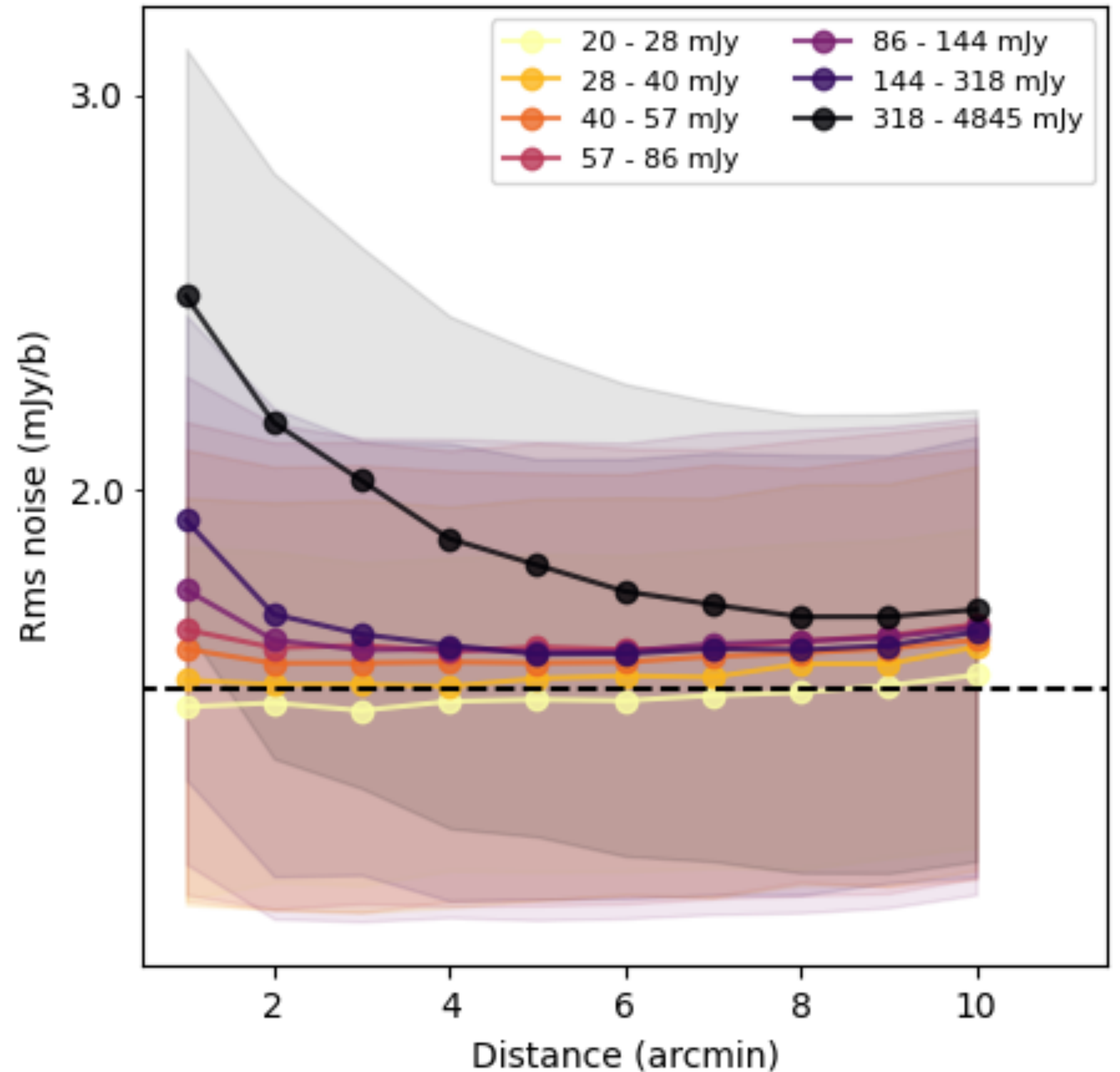
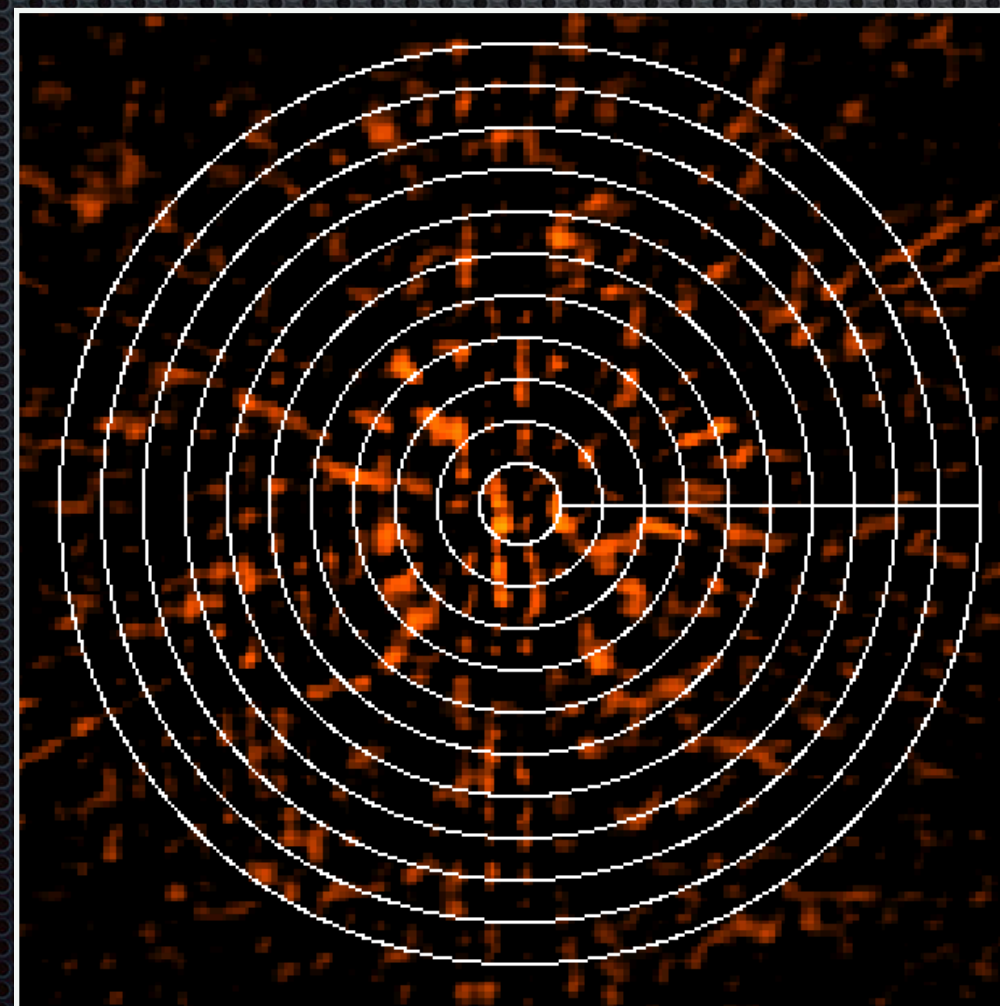
- <1% down to ~50 mJy
- <3% at the lowest fluxes





# Dyn range

- Dynamic range limitation around bright sources
- $< 300$  mJy limited to 2 arcmin
- No sensible effect  $< 50$  mJy

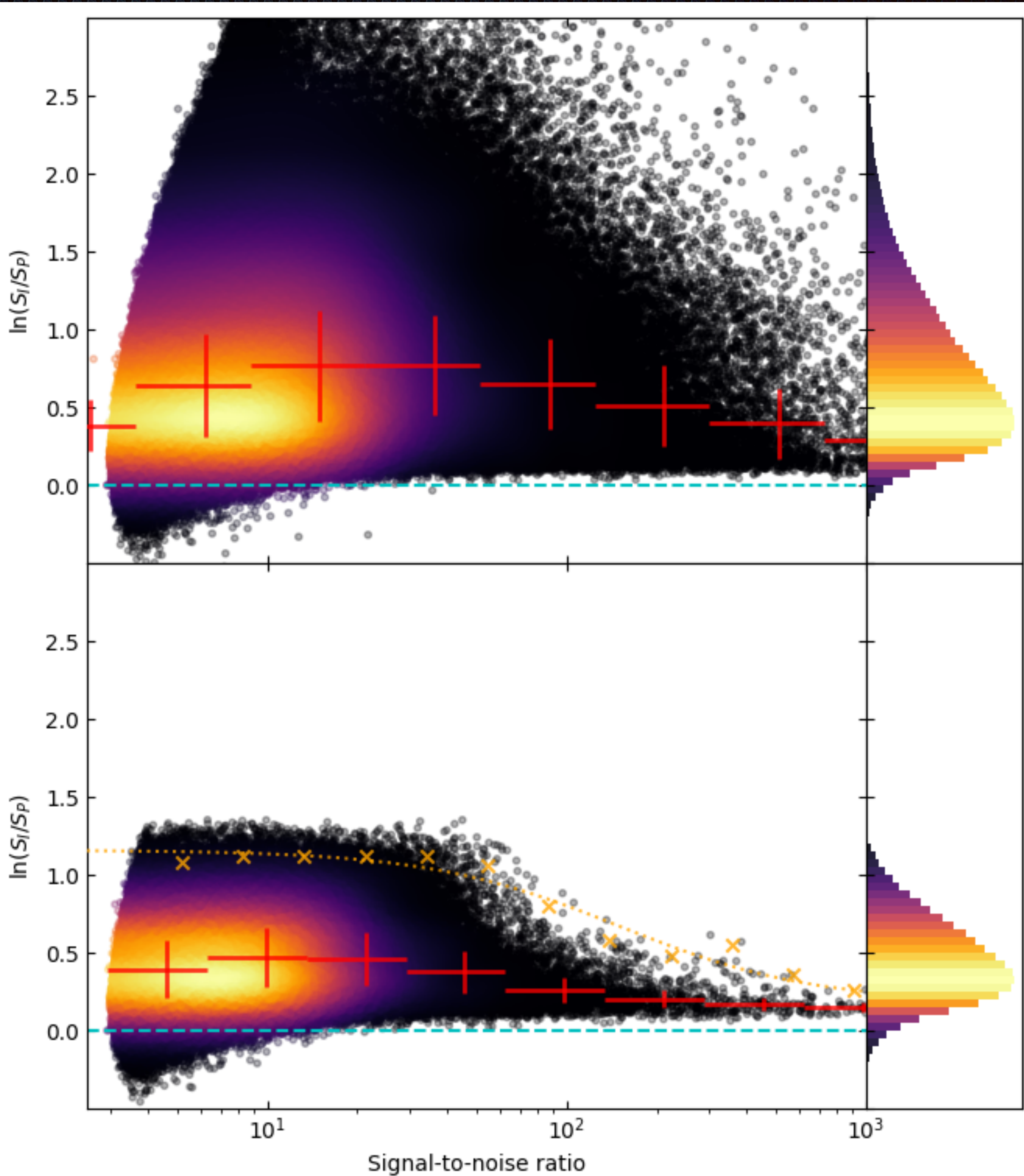




# LoLss Catalogue

- 594,574 sources
- 23.9% of the sources are statistically resolved
- astrometry:  
mean = 0.03" -0.03"  
std = 1.45" 1.12"

|    | Source_Name           | RA      | E_RA    | DEC      | E_DEC   | Total_flux | E_Total_flux | Peak_flux | E_Peak_flux | Maj      | E_Maj   | Min     |
|----|-----------------------|---------|---------|----------|---------|------------|--------------|-----------|-------------|----------|---------|---------|
| 1  | LoJ000000.16+361625.1 | 0.00066 | 1.24653 | 36.27366 | 0.87845 | 41.22125   | 5.29277      | 14.70972  | 1.44045     | 28.25701 | 2.94766 | 22.3335 |
| 2  | LoJ000000.16+511724.1 | 0.00068 | 0.30285 | 51.29005 | 0.37277 | 117.17039  | 7.71671      | 50.39203  | 1.69457     | 23.34065 | 0.97869 | 17.0036 |
| 3  | LoJ000000.47+321231.6 | 0.00198 | 2.21808 | 32.20879 | 1.161   | 23.53835   | 5.45154      | 10.40805  | 1.74351     | 27.55539 | 5.22355 | 18.4673 |
| 4  | LoJ000000.86+810257.6 | 0.00358 | 0.1779  | 81.04934 | 0.18718 | 201.88047  | 6.95646      | 128.65898 | 2.93929     | 19.11541 | 0.44473 | 18.5022 |
| 5  | LoJ000000.98+374517.4 | 0.00409 | 1.01141 | 37.75486 | 0.95013 | 53.54711   | 6.56859      | 19.77509  | 1.8391      | 26.01405 | 2.48929 | 23.4233 |
| 6  | LoJ000001.00+515259.7 | 0.00418 | 1.43244 | 51.88325 | 0.9631  | 12.76149   | 3.56757      | 11.26833  | 1.87021     | 18.57443 | 3.54949 | 13.7290 |
| 7  | LoJ000001.14+681001.9 | 0.00475 | 0.38358 | 68.16721 | 0.43239 | 1661.37304 | 26.98765     | 96.48322  | 1.4835      | 66.42558 | 1.02766 | 58.3942 |
| 8  | LoJ000001.19+515909.4 | 0.00494 | 0.38417 | 51.98595 | 0.36448 | 64.22845   | 4.77124      | 44.15843  | 2.1255      | 19.24166 | 0.97341 | 17.0213 |
| 9  | LoJ000001.35+760528.9 | 0.00562 | 0.24072 | 76.09137 | 0.22981 | 79.11413   | 4.37546      | 66.35897  | 2.24261     | 16.62217 | 0.56852 | 16.1514 |
| 10 | LoJ000001.62+402102.2 | 0.00677 | 1.24358 | 40.35061 | 1.06899 | 20.55608   | 4.21986      | 12.14984  | 1.68718     | 20.51633 | 2.95695 | 18.5625 |
| 11 | LoJ000001.65+425559.8 | 0.00686 | 0.39511 | 42.93329 | 0.25192 | 126.39496  | 5.87265      | 57.90054  | 1.93612     | 25.52879 | 0.93259 | 19.2560 |
| 12 | LoJ000001.76+421557.5 | 0.00732 | 1.77035 | 42.266   | 1.70071 | 28.82026   | 6.60881      | 11.4546   | 1.96017     | 24.73436 | 4.32428 | 22.9034 |
| 13 | LoJ000002.46+415441.7 | 0.01023 | 0.14396 | 41.91159 | 0.09285 | 341.01389  | 6.23785      | 172.42357 | 2.21443     | 24.2158  | 0.34005 | 18.3885 |
| 14 | LoJ000002.69+391055.0 | 0.01121 | 1.49731 | 39.18197 | 1.04112 | 68.19465   | 7.95723      | 16.986    | 1.61652     | 35.90506 | 3.67192 | 25.1595 |
| 15 | LoJ000002.89+385950.8 | 0.01203 | 0.12954 | 38.99747 | 0.11665 | 938.79169  | 17.00217     | 272.10124 | 2.58389     | 31.20256 | 0.34598 | 23.0434 |
| 16 | LoJ000002.90+470558.0 | 0.01209 | 0.46225 | 47.09946 | 0.28377 | 193.27329  | 7.22324      | 53.74714  | 1.60691     | 33.83829 | 1.09248 | 23.9424 |

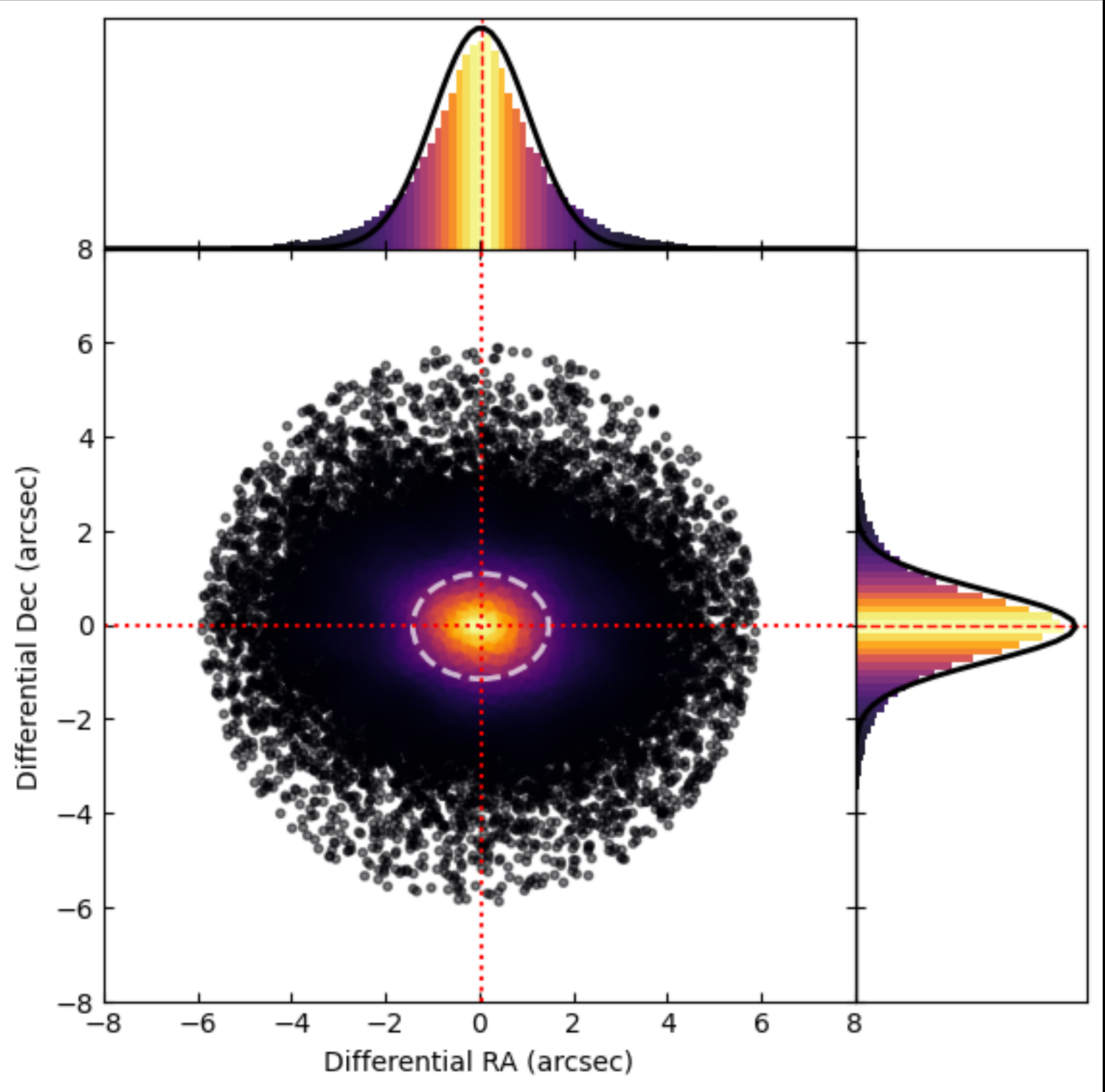




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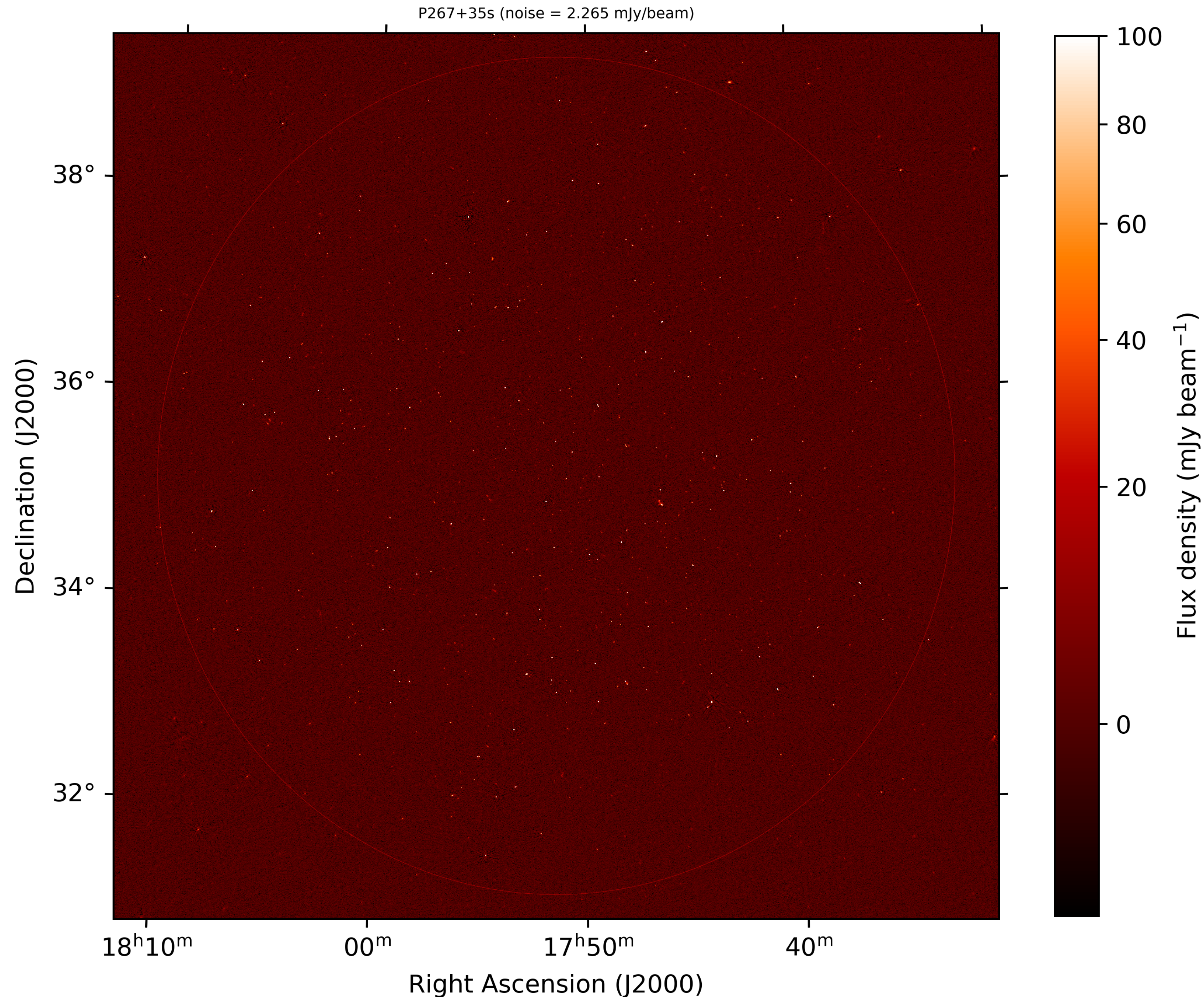
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# Products

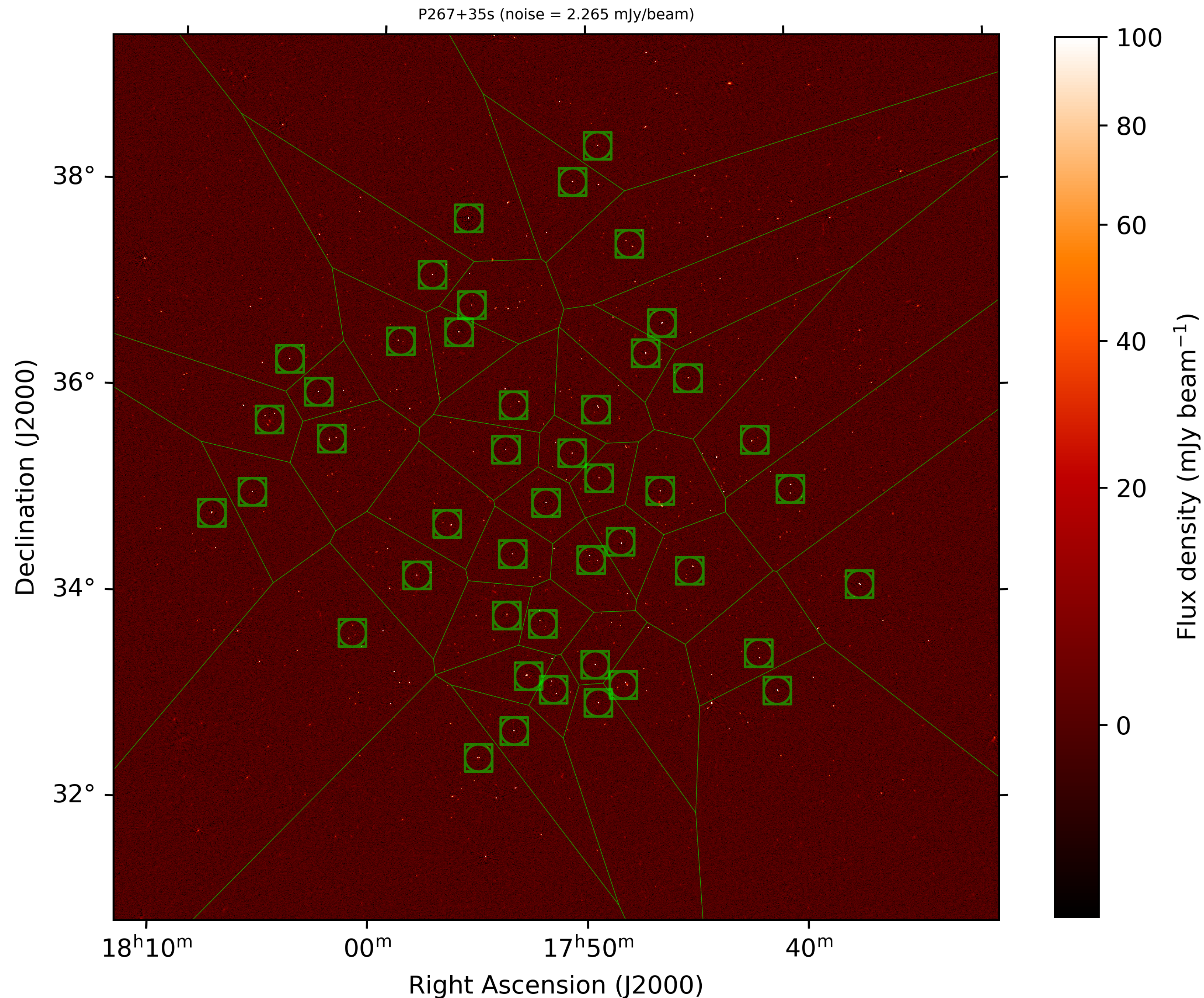
- I-Stokes images high-resolution images (15")
- Corrected vis + solutions ready for extraction
- I-Stokes low-resolution images (60") + source subtracted
- V-Stokes images
- 1-h I/V-Stokes images
- Files necessary for stacking
- Source/Gauss catalogues





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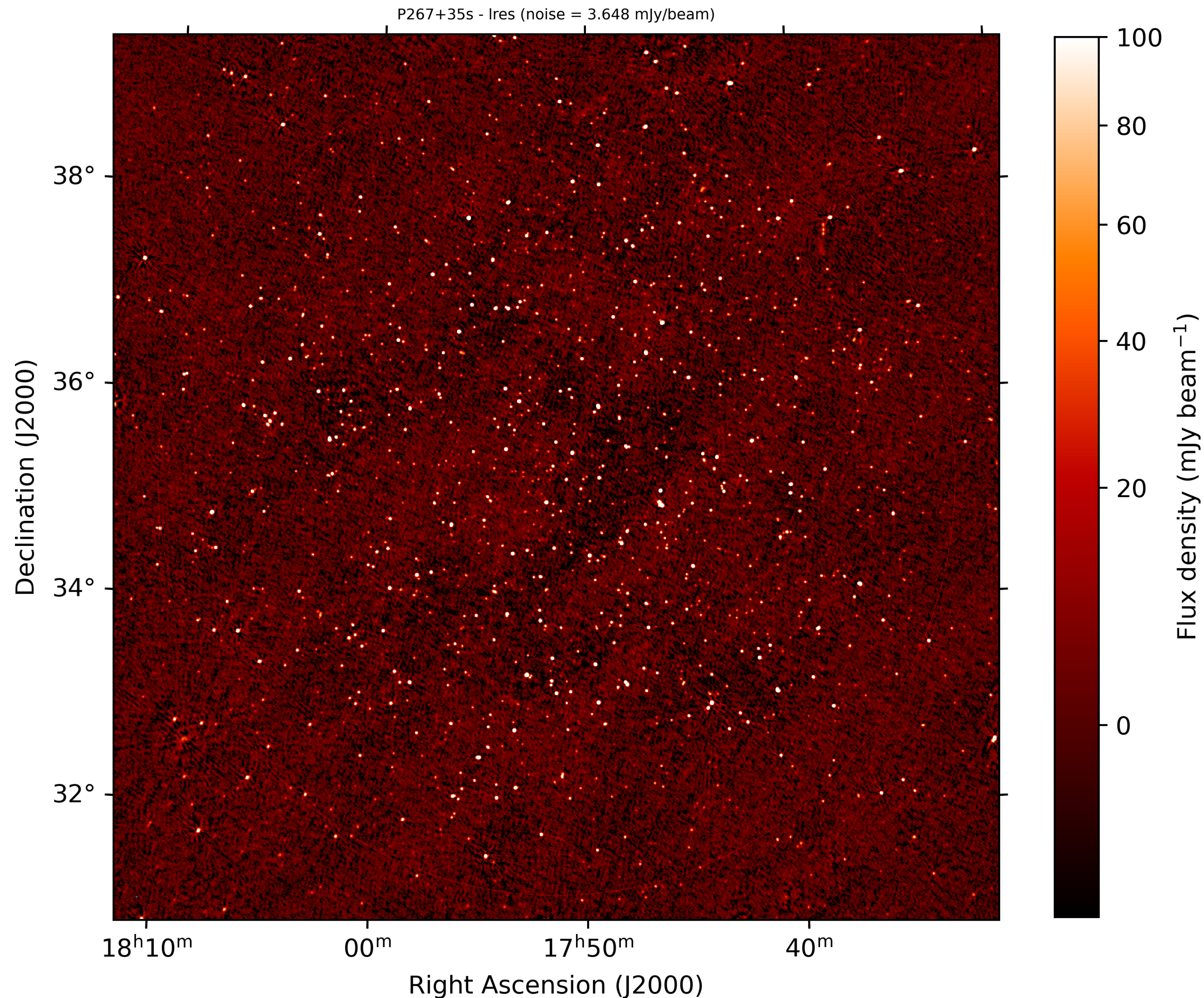
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# What's next?

- Deepest fields with LOFAR LBA (100 hrs) reached  $\ll 1$  mJy/b
- With LOFAR 2.0 we should reach that depth in 10 hrs
- A large deep survey of the northern sky at 16-64 MHz and 1" resolution



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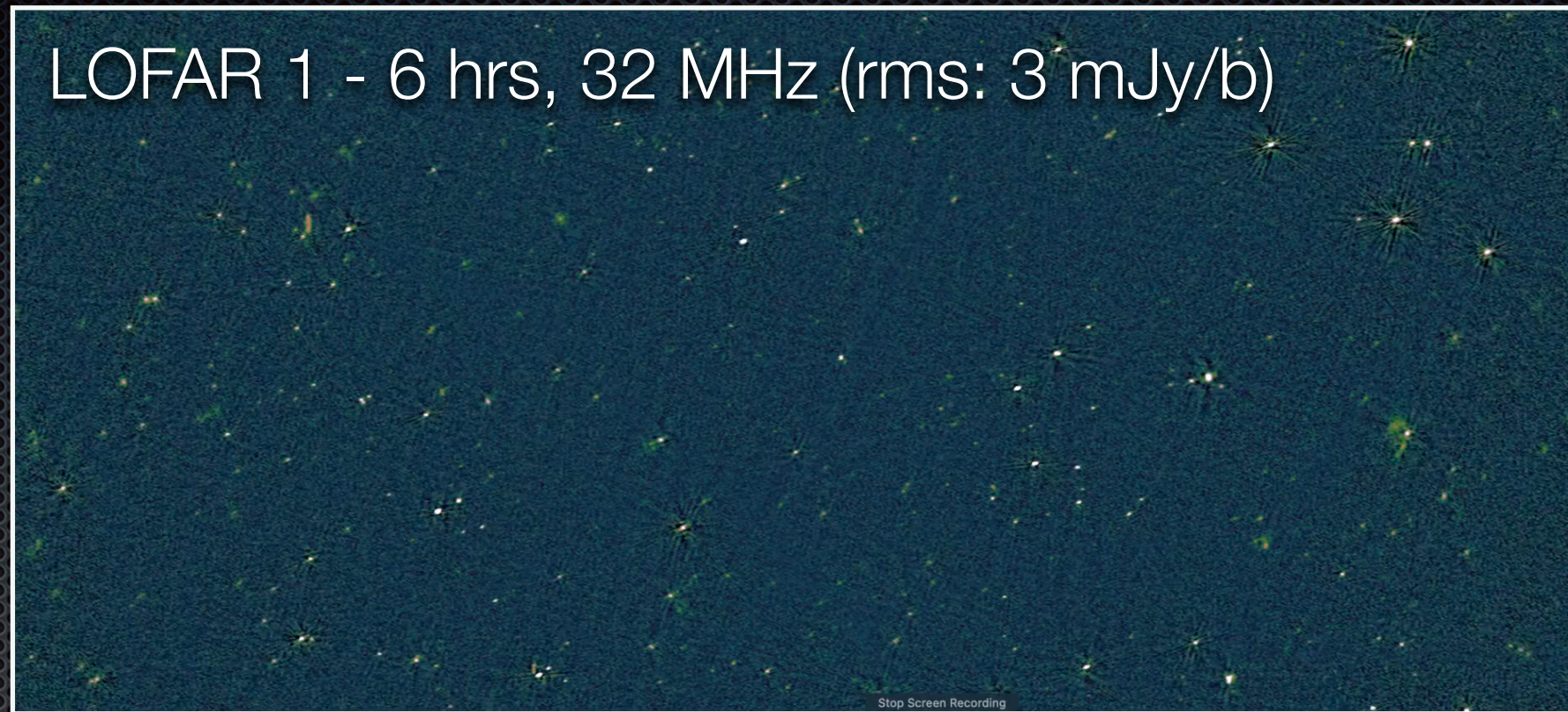




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LOFAR 1 - 6 hrs, 32 MHz (rms: 3 mJy/b)



LOFAR 1 - 100 hrs, 32 MHz (rms  $\ll 1$  mJy/b)

No spoiler!

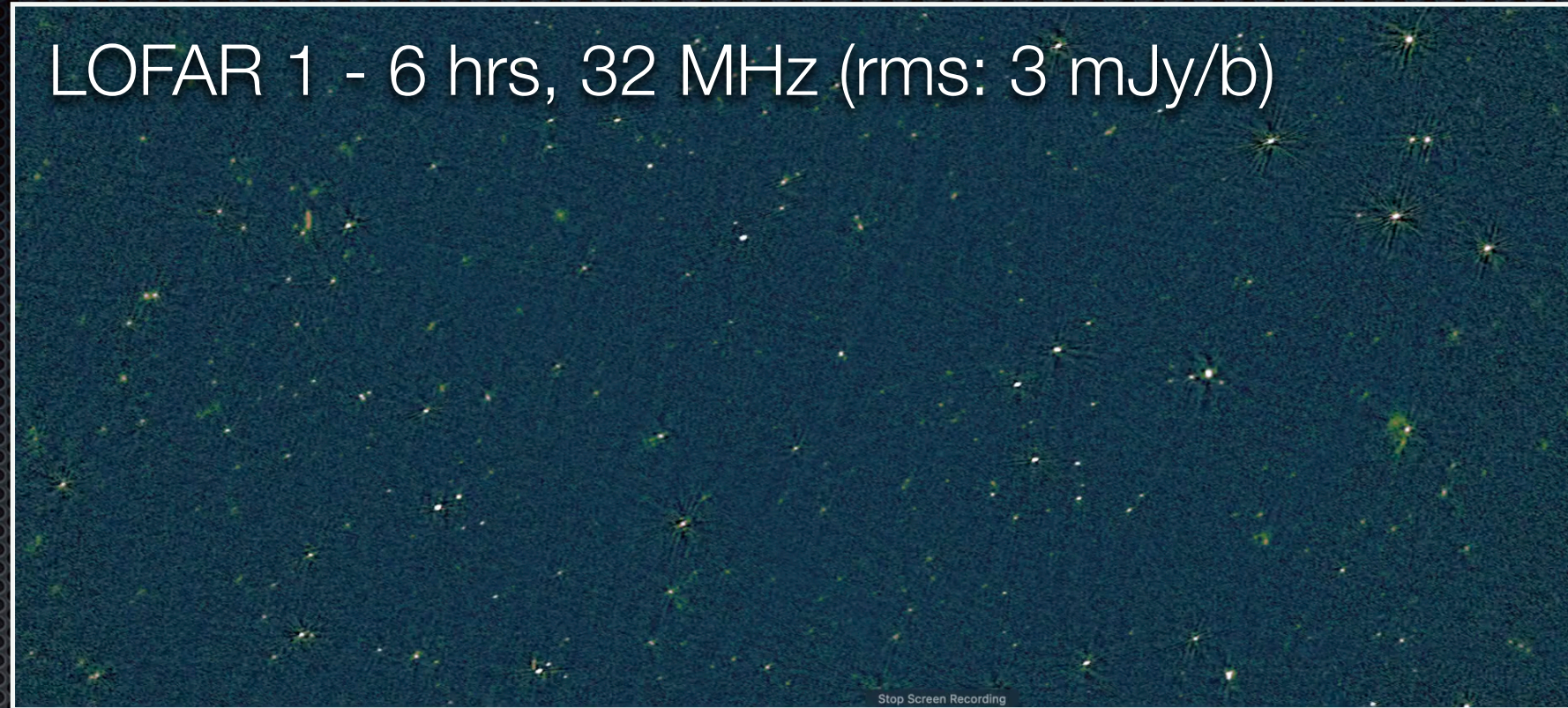
see Jort's talk Wednesday



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No spoiler!

see Jort's talk Wednesday

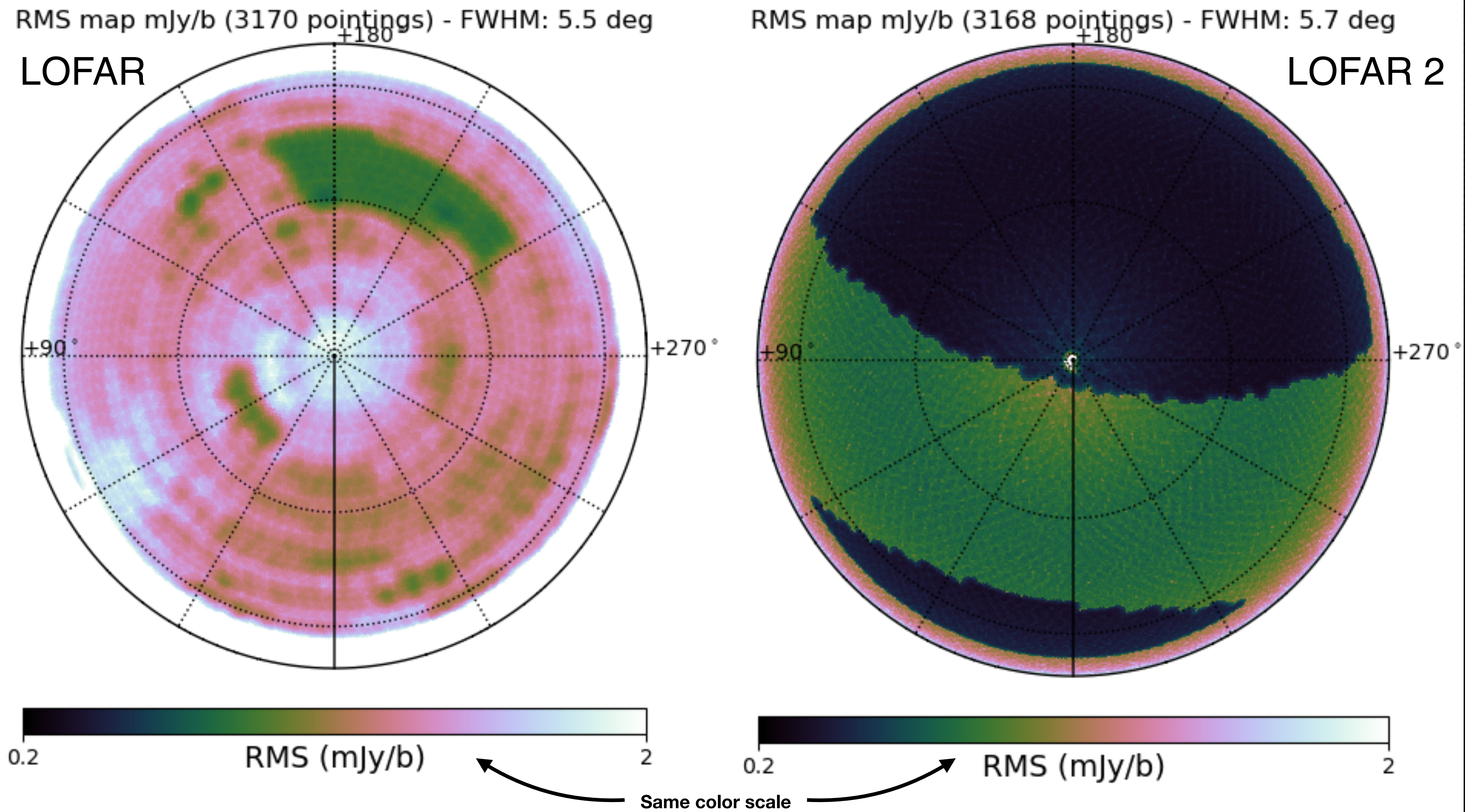
LOFAR 2 - 6 hrs, 32 MHz (exp. rms: 1.5 mJy/b)

No spoiler!

see Henrik's talk tomorrow



# The LBA LOFAR Community Sky Survey (LLoCuSS)





# Conclusions

- Two of the main LOFAR 1 surveys are complete: LoTSS and LoLSS

LoDeSS to come: see [Christian](#) and [Cristina's](#) talks

- The LOFAR 2 survey LLoCuSS will boost the sensitivity of the ultra-low frequency sky by a factor of 10 - and we know how to do it

