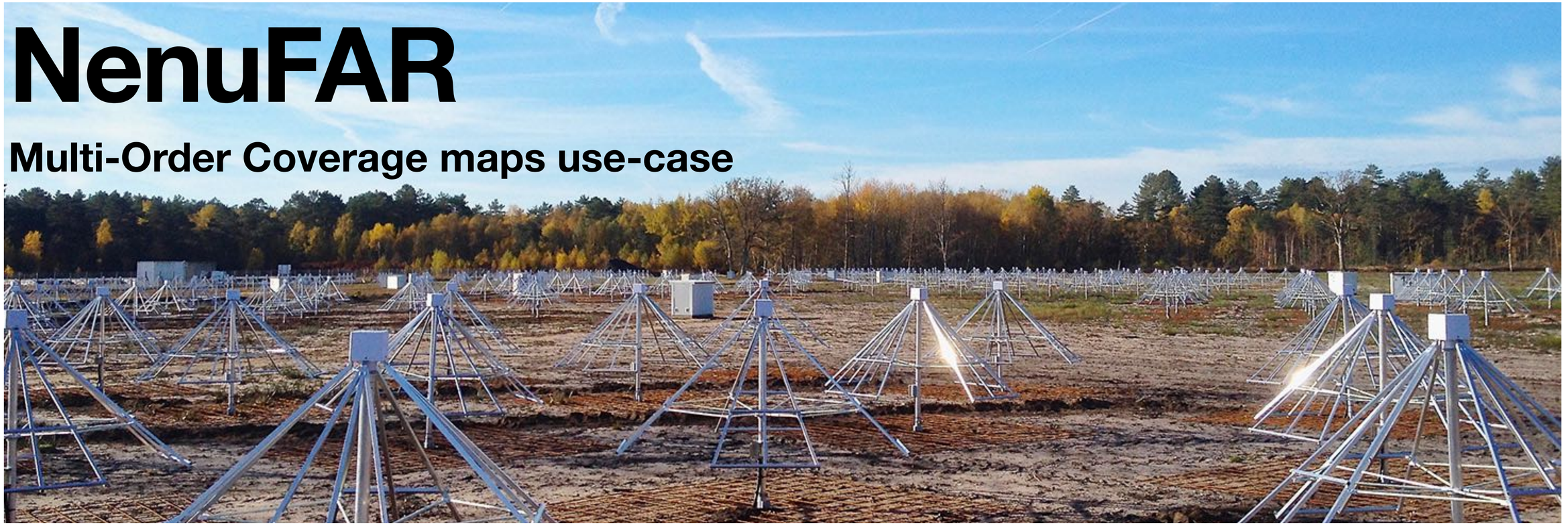
l'Observatoire de Paris | LESIA

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

NenuFAR

Multi-Order Coverage maps use-case



Alan Loh, Lucile Coutouly, Christophe Taffoureau, Jordy Marlier, Baptiste Cecconi

2022-04-28, IVOA

Overview

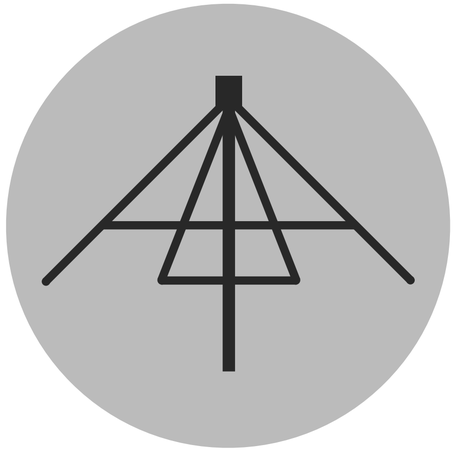
NenuFAR phase array simulations

- NenuFAR
  - Phased-array: dipole antenna → Mini-Array → core array
  - Sensitivity pattern (simulation with *nenupy*, Loh et al. 2020)
- Contamination in beamformed observations
  - Sky at low-frequency
  - Time/frequency dependency of the beam pattern
  - *MOCpy* (Fernique et al. 2014, *https://cds-astro.github.io/mocpy/*)
    - Multi-Order Coverage maps, IVOA standard
    - Description of sky regions (HEALPix sky tessellation)
  - Identification of time/frequency 'contaminated' regions
- NenuFAR observation database
  - ElasticSearch implementation
  - Plans for Obs/EPN-TAP and ObsLocTAP service release

NenuFAR at Nançay Radioastronomy Observatory

NenuFAR

Hierarchical view: from antenna to core array



Antenna

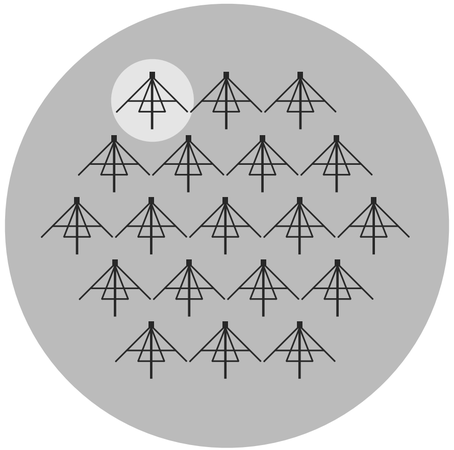
1938 LWA-like radiator antennas

Dual-polarizations inverted V shape elements

Low-Noise Amplifier

~**All-sky** field of view

Broadband response at **10-85 MHz**



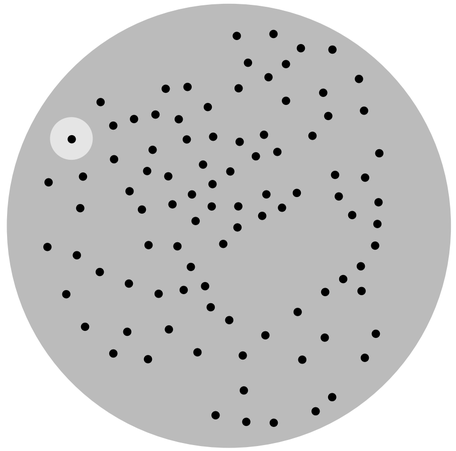
Mini-Array

Hexagon tile of **19 antennas**

Analog beamforming with delay lines

16384 pointable directions on the sky

Beam width: 46° at 15 MHz, 8° at 85 MHz



Core

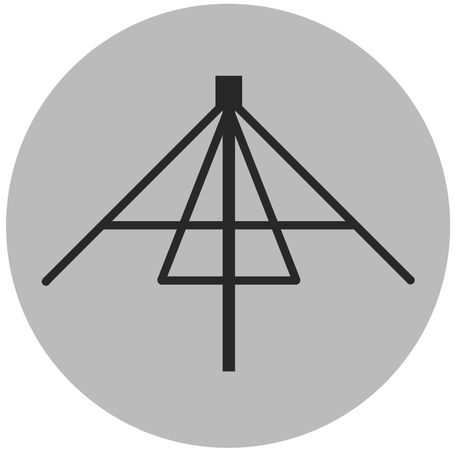
96 mini-arrays (400m core) + 6 remote (up to 3km)

Optimal uv plane coverage for snapshots

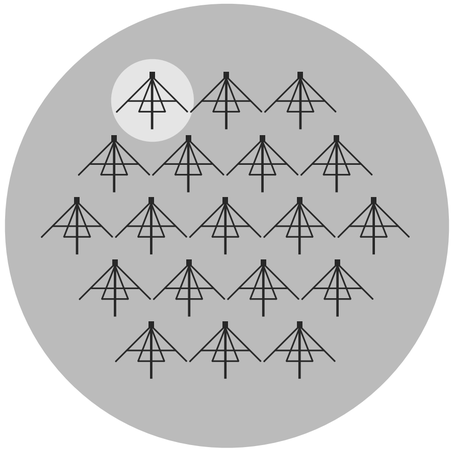
Relative **MA rotations**: dampen grating lobes

NenuFAR

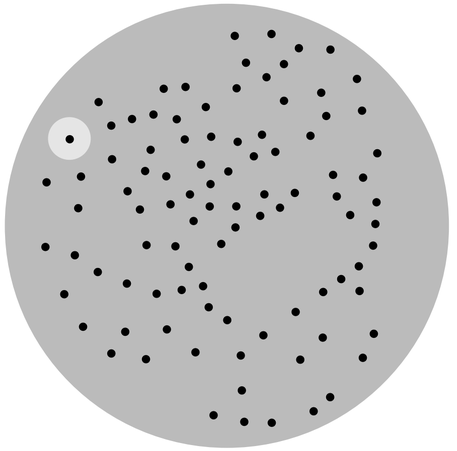
Hierarchical view: from antenna to core array



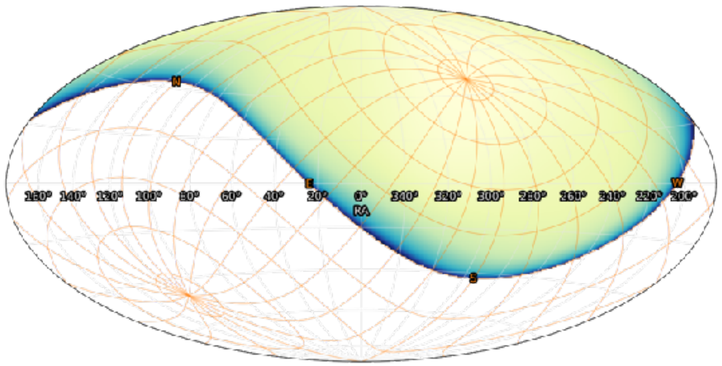
Antenna

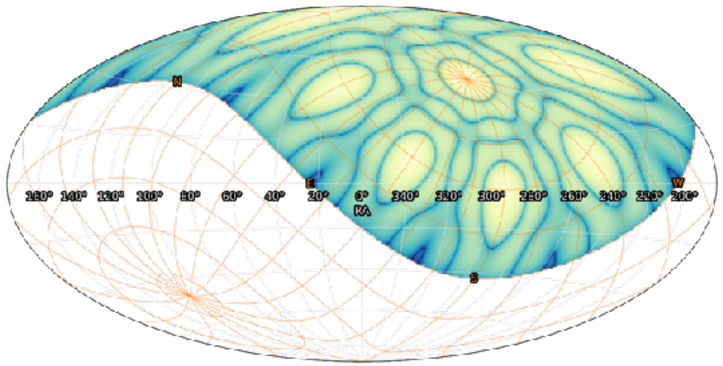


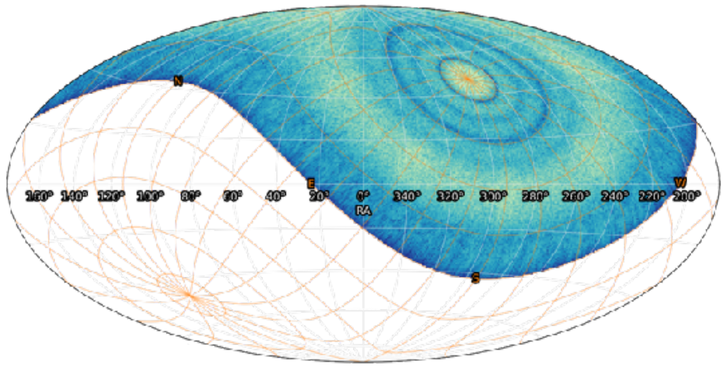
Mini-Array



Core

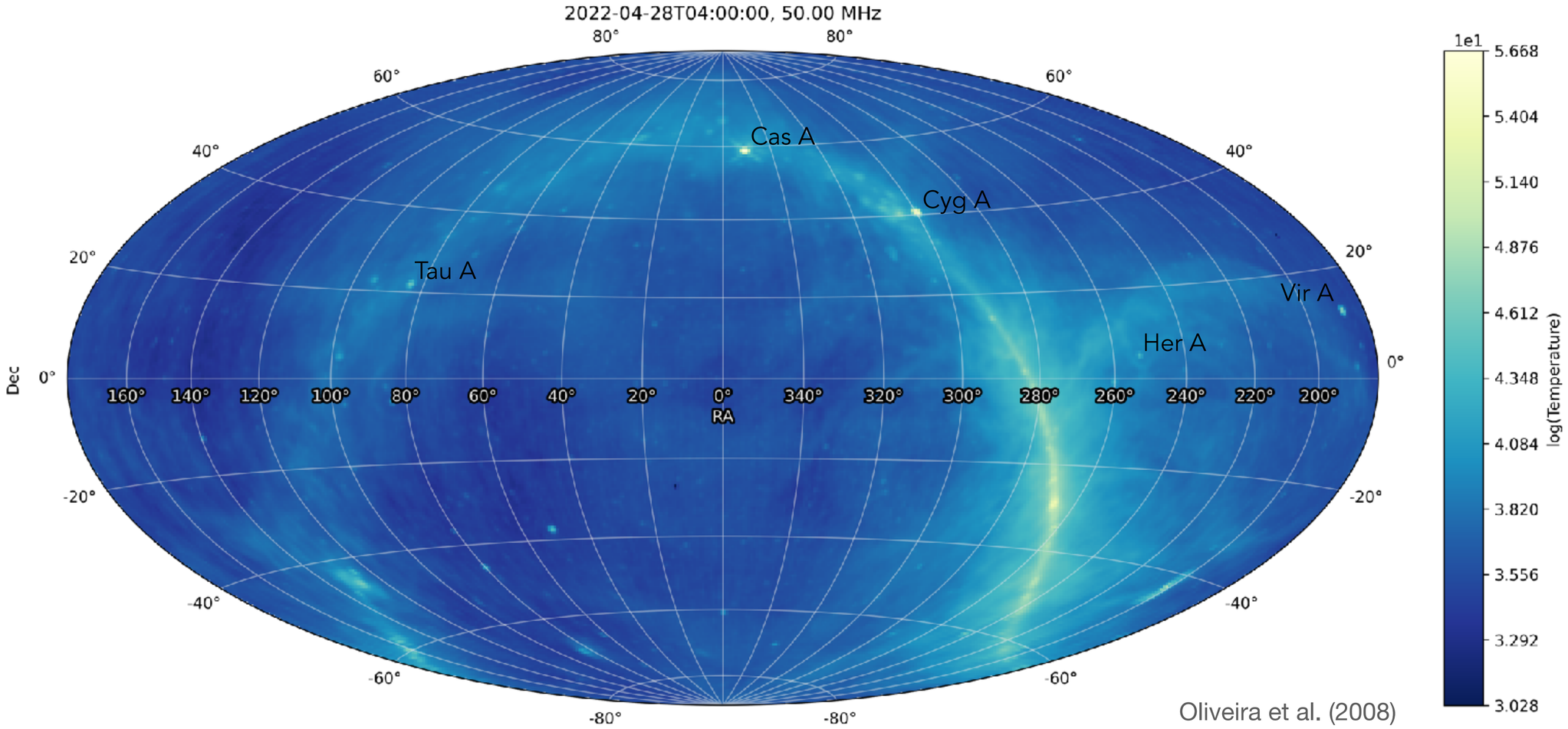






Bright radio emission at low frequency

Global Sky Model to Multi-Order Coverage map



Oliveira et al. (2008)

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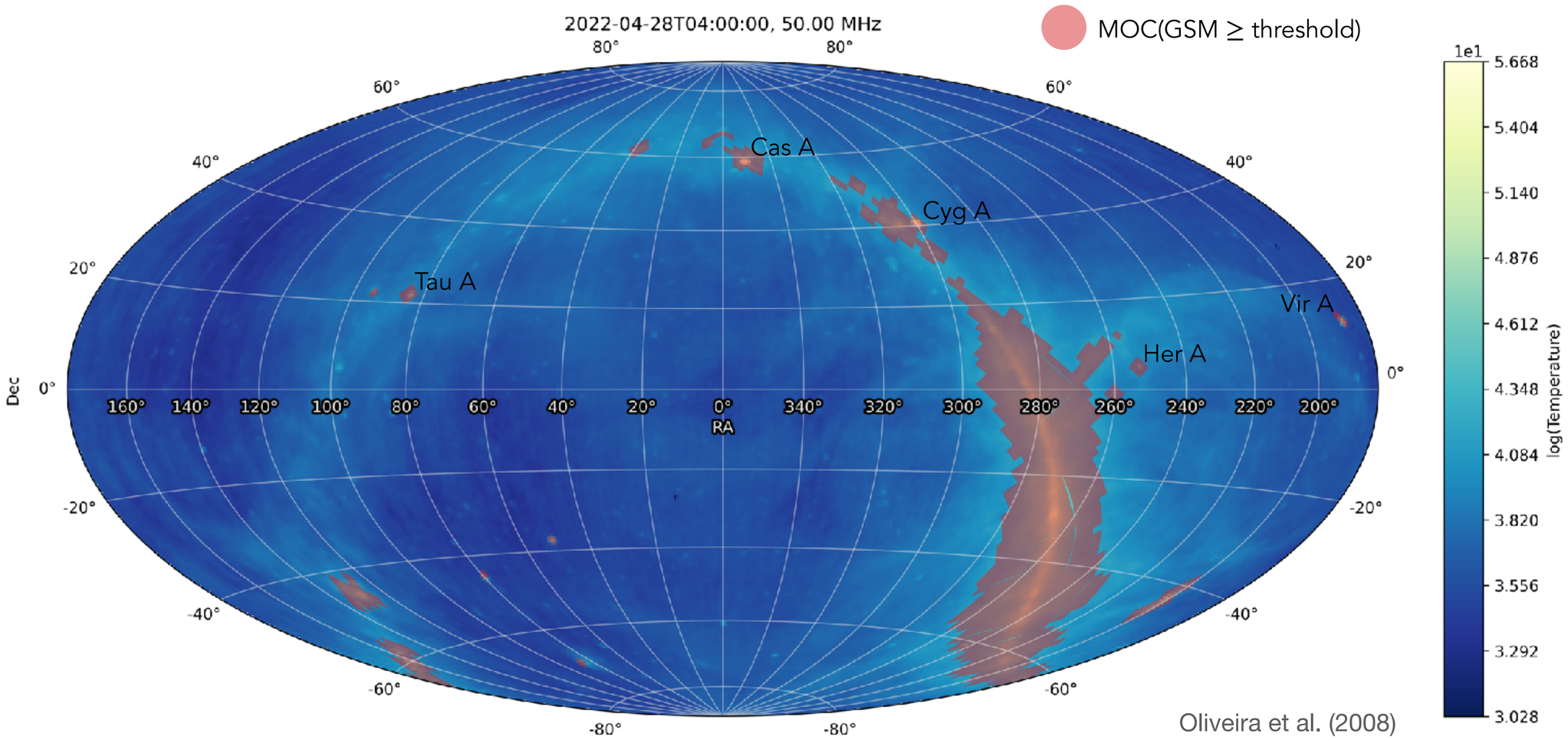
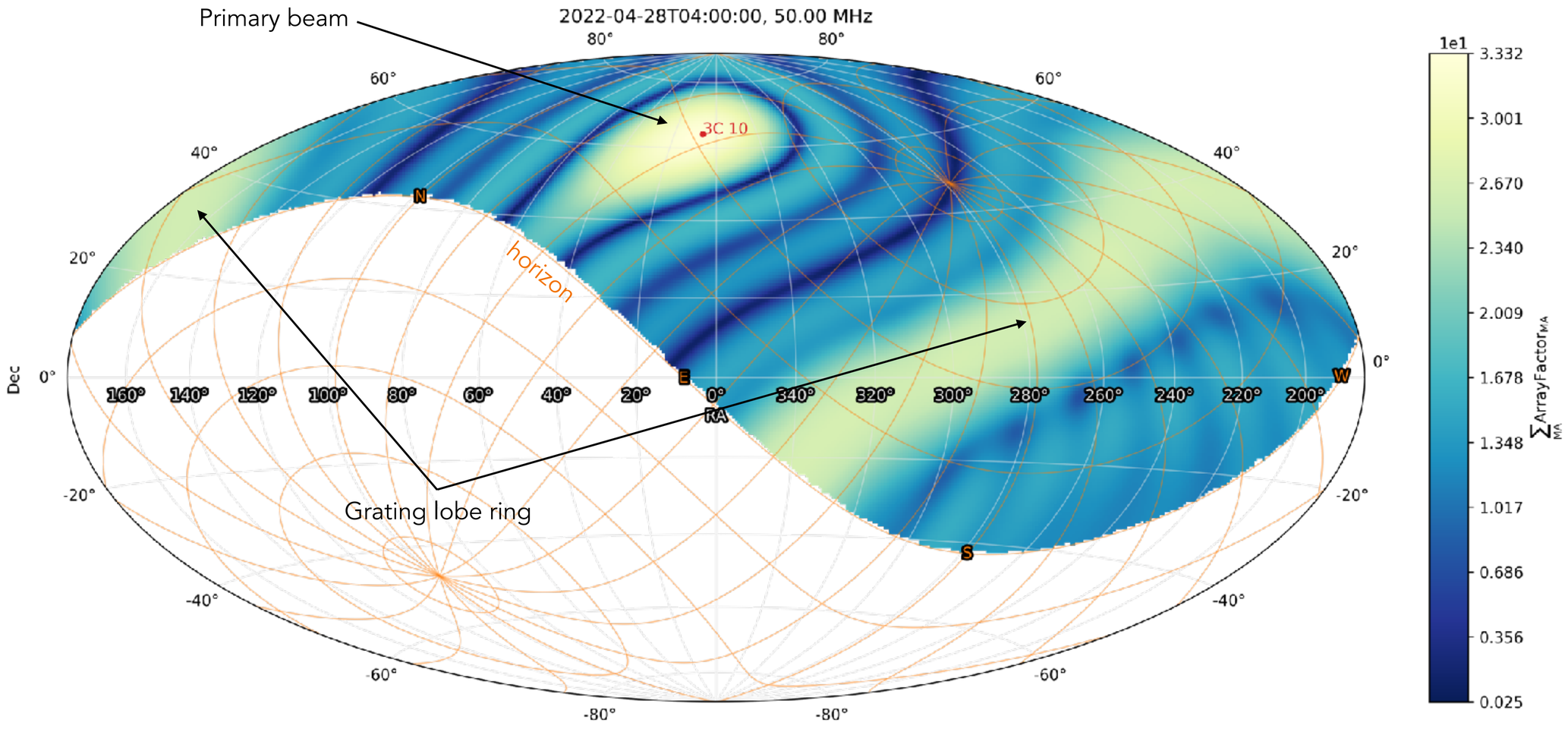
Global Sky Model to Multi-Order Coverage map



Oliveira et al. (2008)

NenuFAR direction-dependent sensitivity

Array Factor to Multi-Order Coverage map



NenuFAR direction-dependent sensitivity

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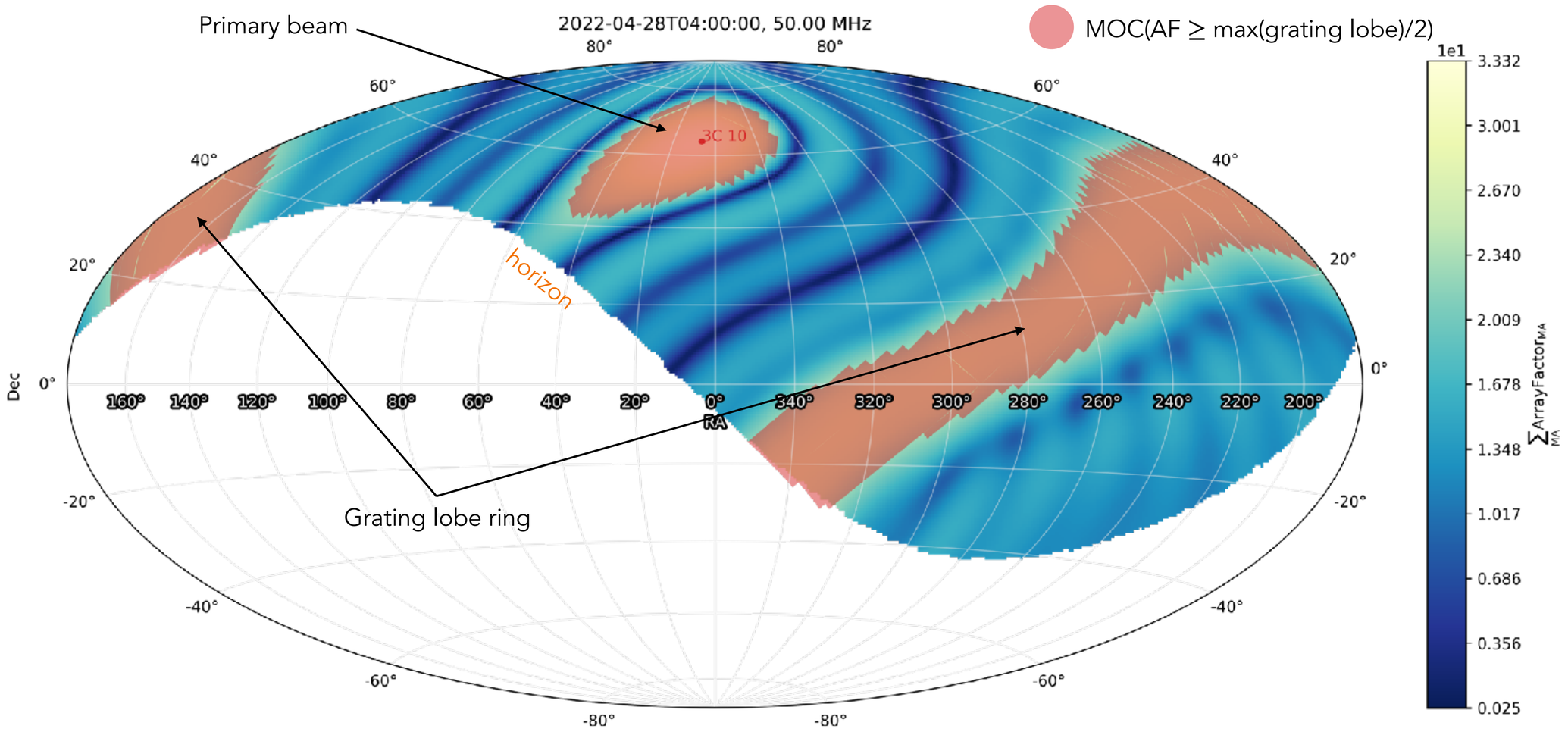
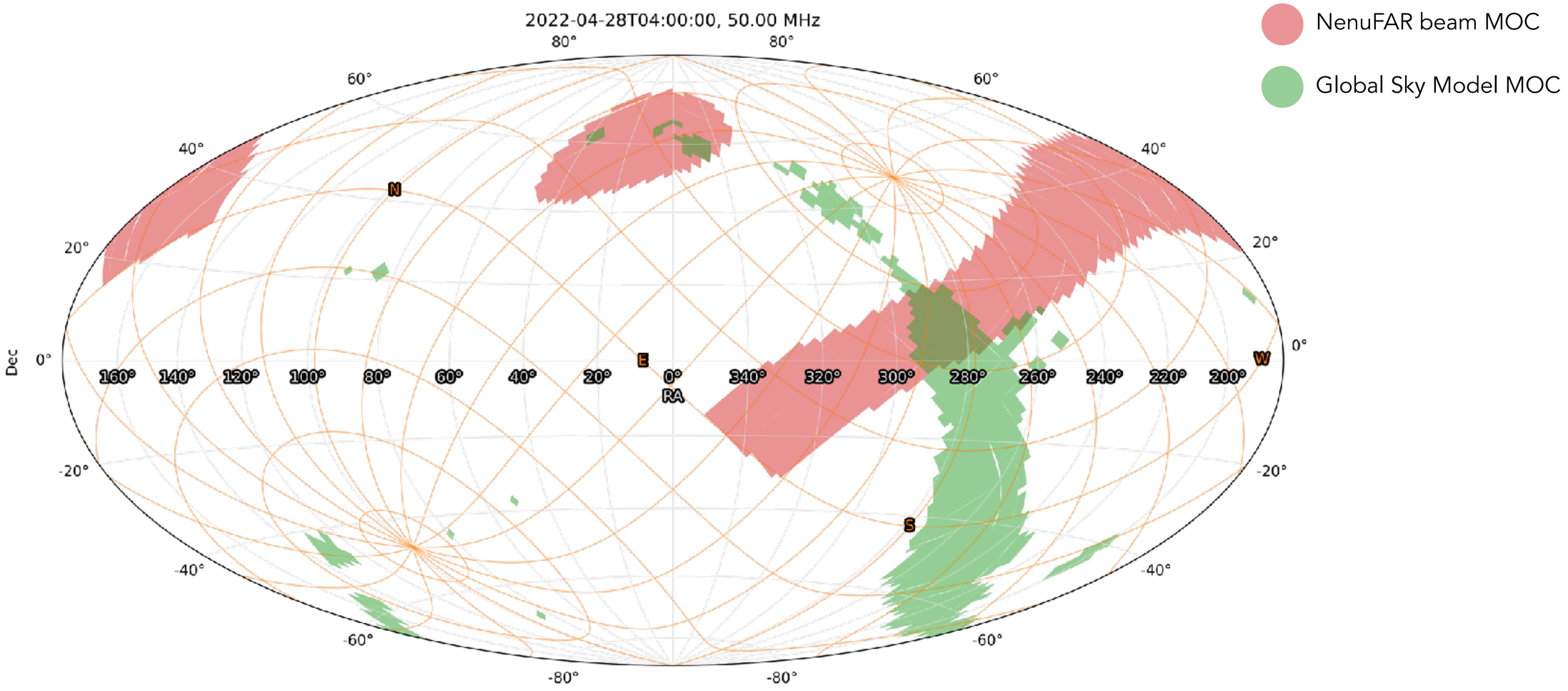


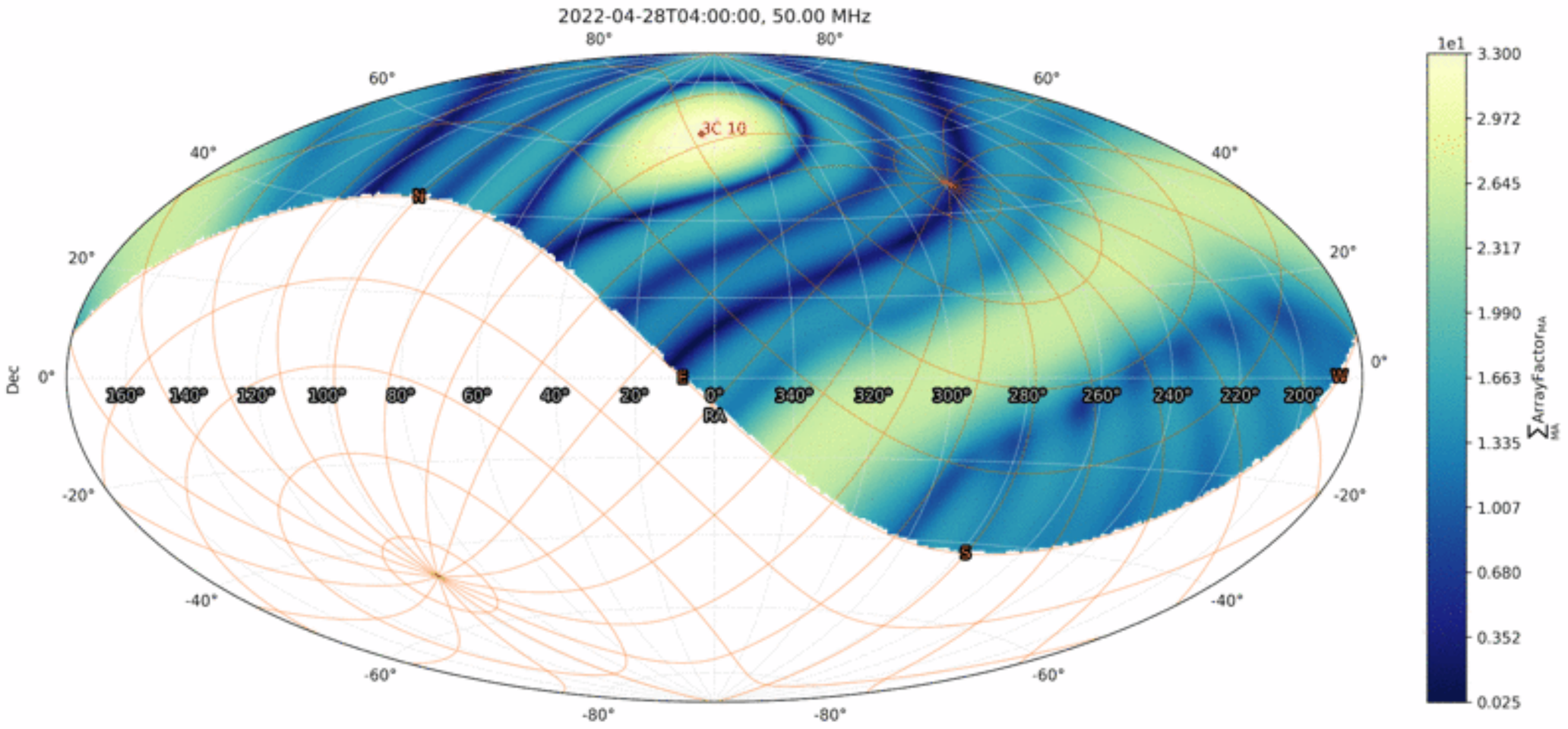
Bright emission within NenuFAR beam?

→ MOCs intersections



NenuFAR response pattern

Time dependency (3C10 tracking, 8 hours)



NenuFAR response pattern

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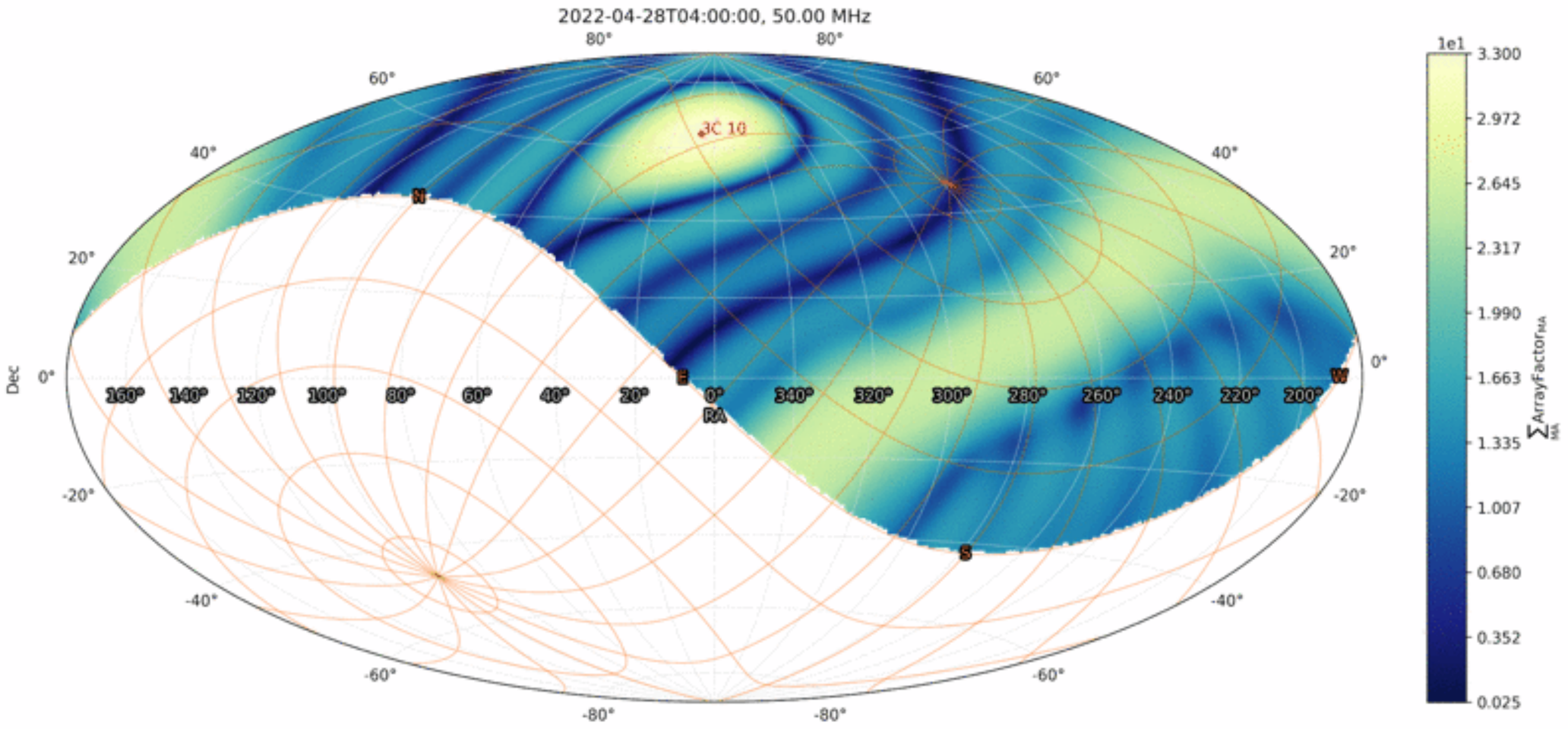
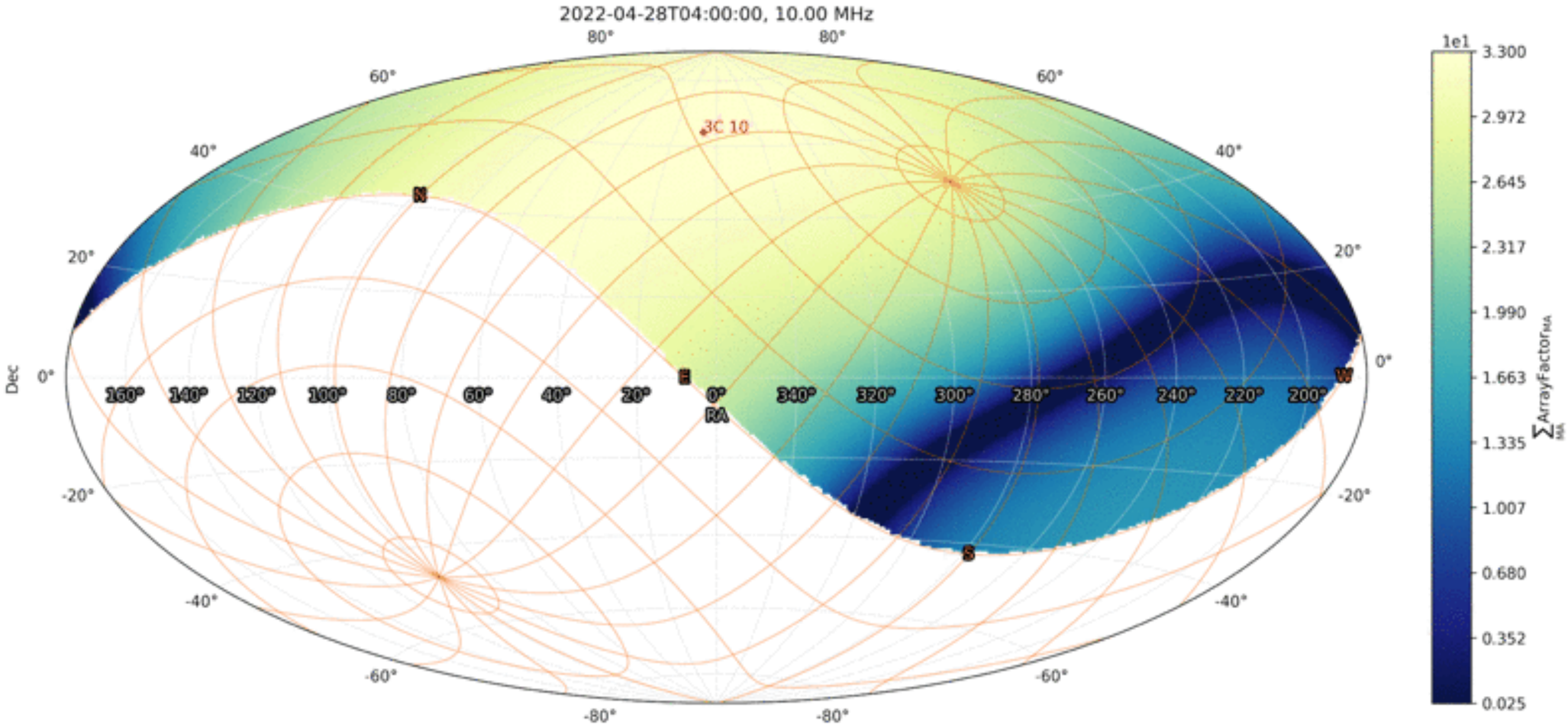


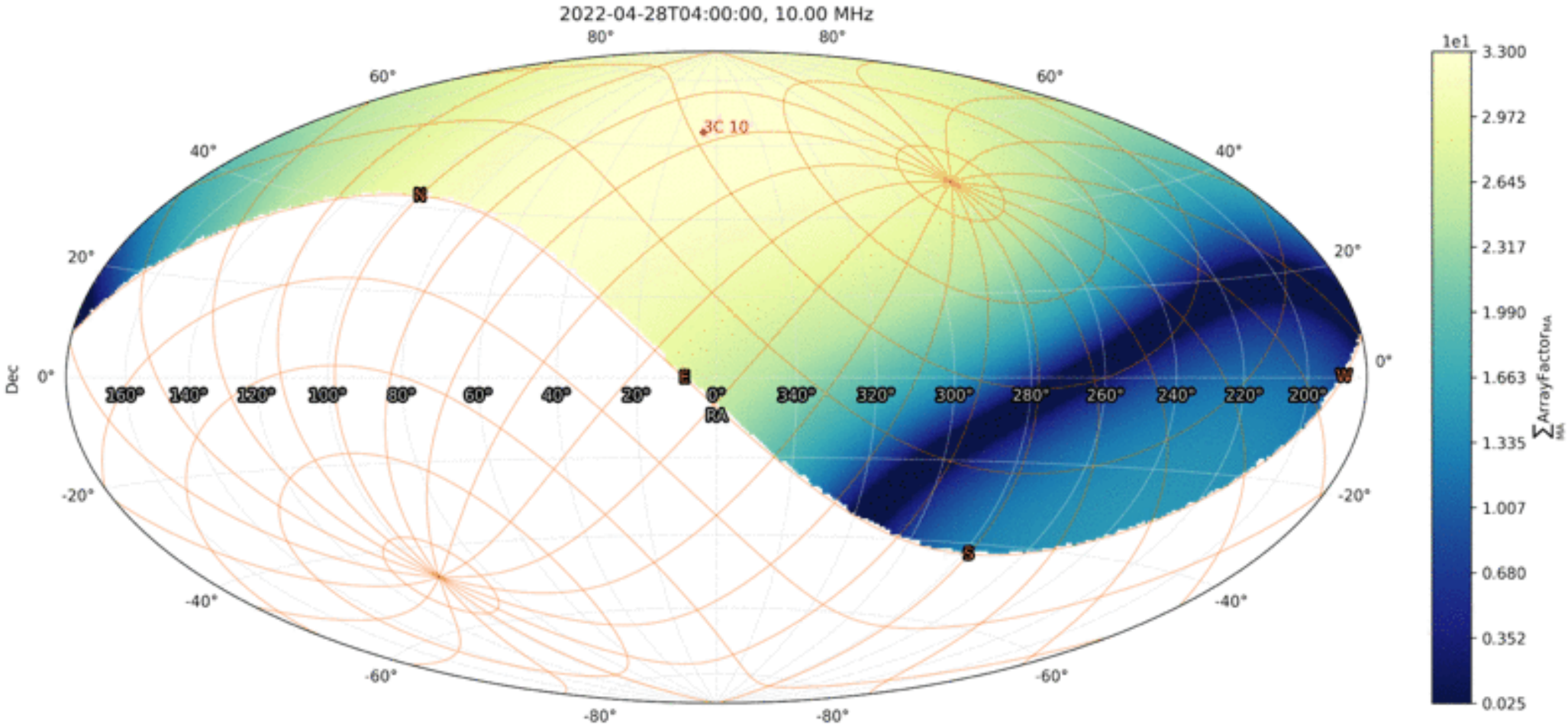
NenuFAR response pattern

Frequency dependency (from 10 to 85 MHz)



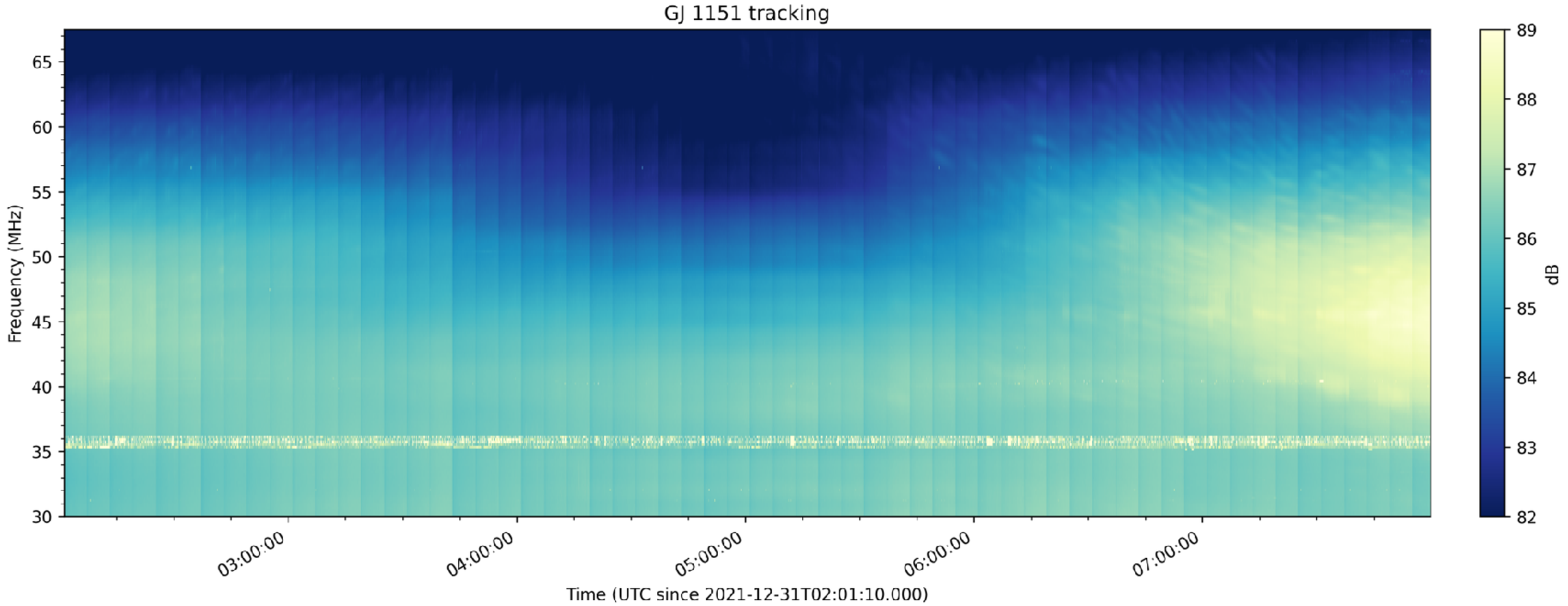
NenuFAR response pattern

Frequency dependency (from 10 to 85 MHz)



Source contamination identification

Intersecting NenuFAR beam with sky model spatial coverages (at various (ν, t))



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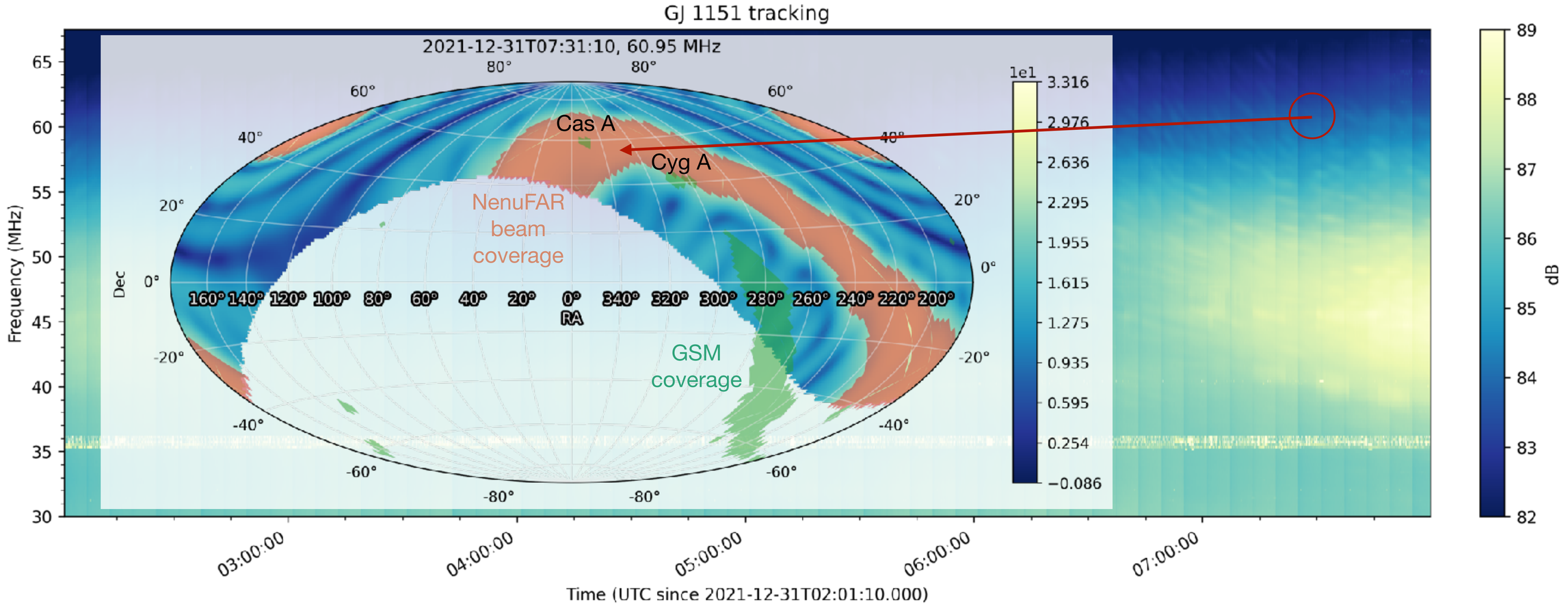

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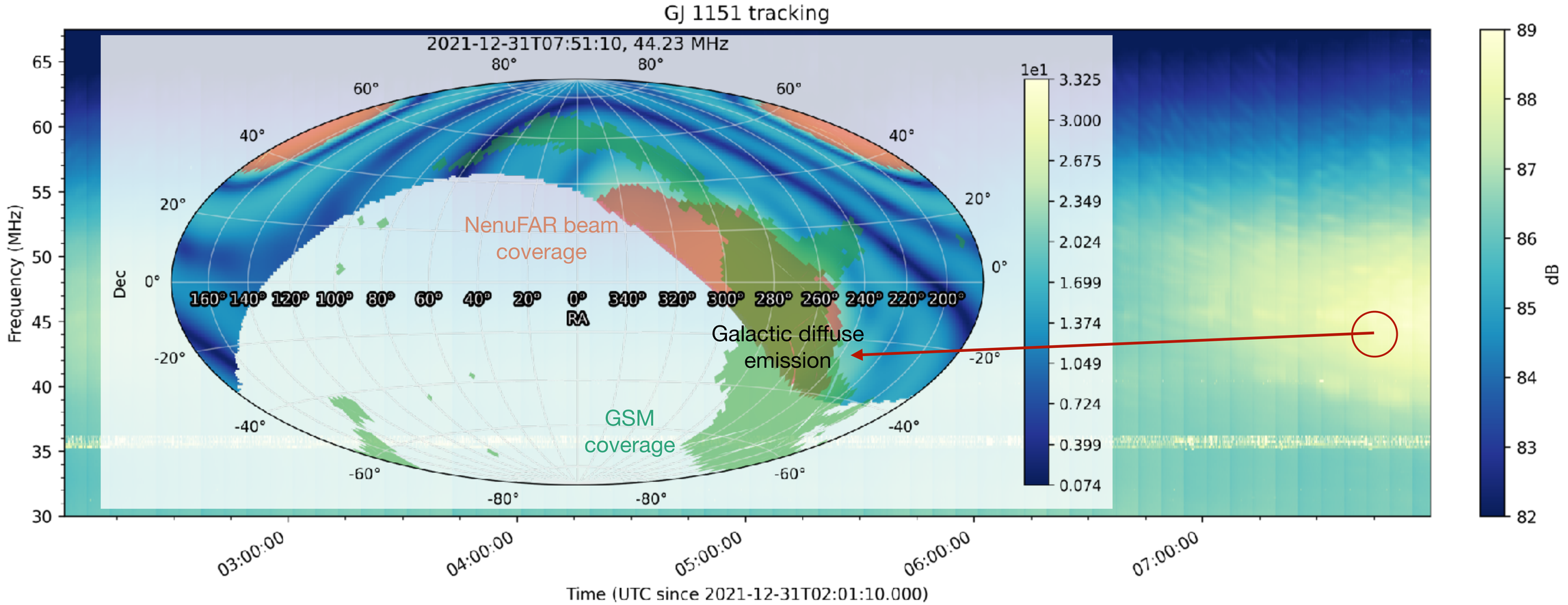
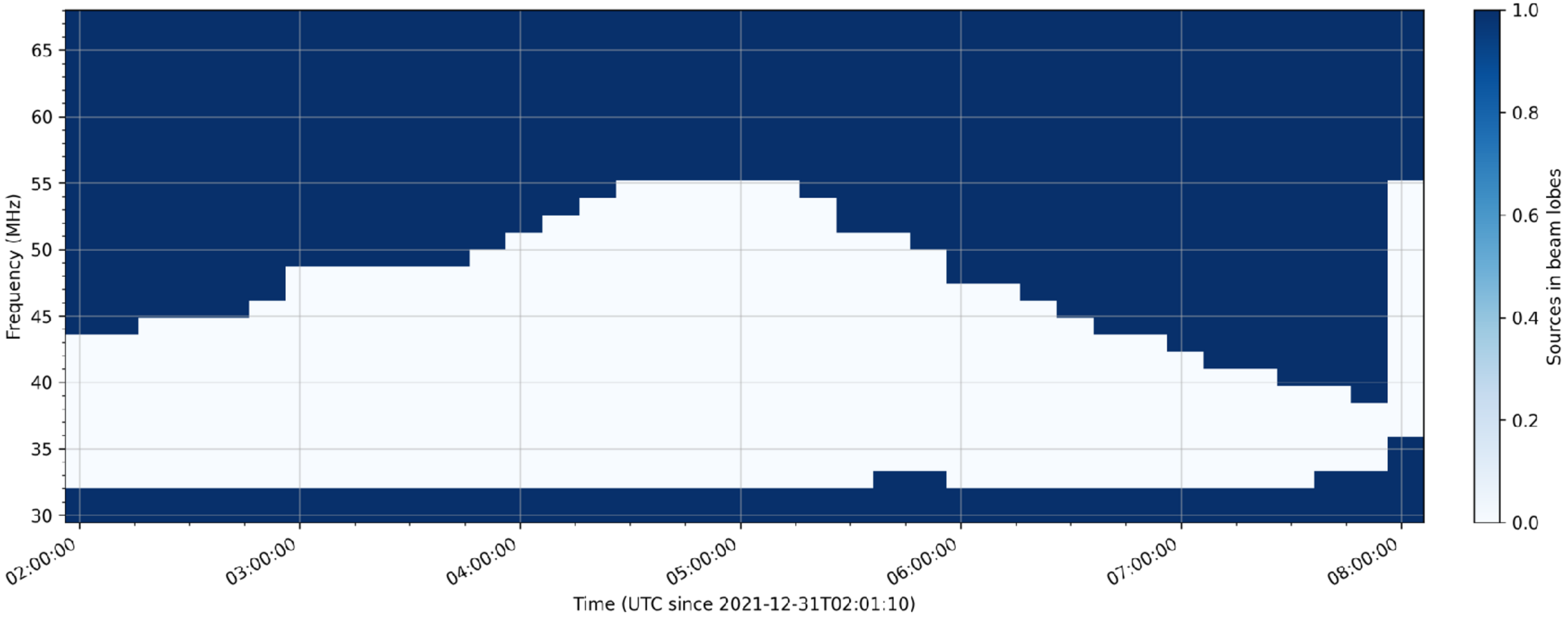


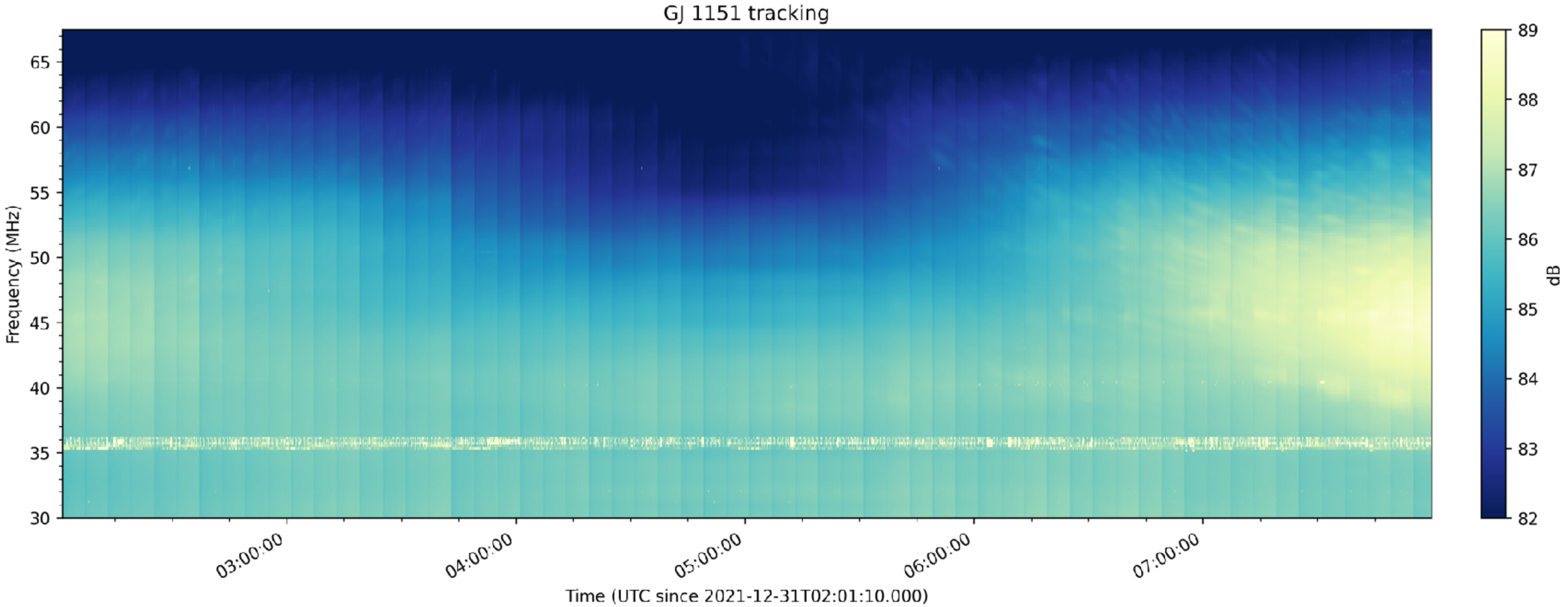
Bright source contamination

Constructing a (ν, t)-diagram



Data artefact identification

Bright sources, diffuse Galactic emission through NenuFAR grating lobes



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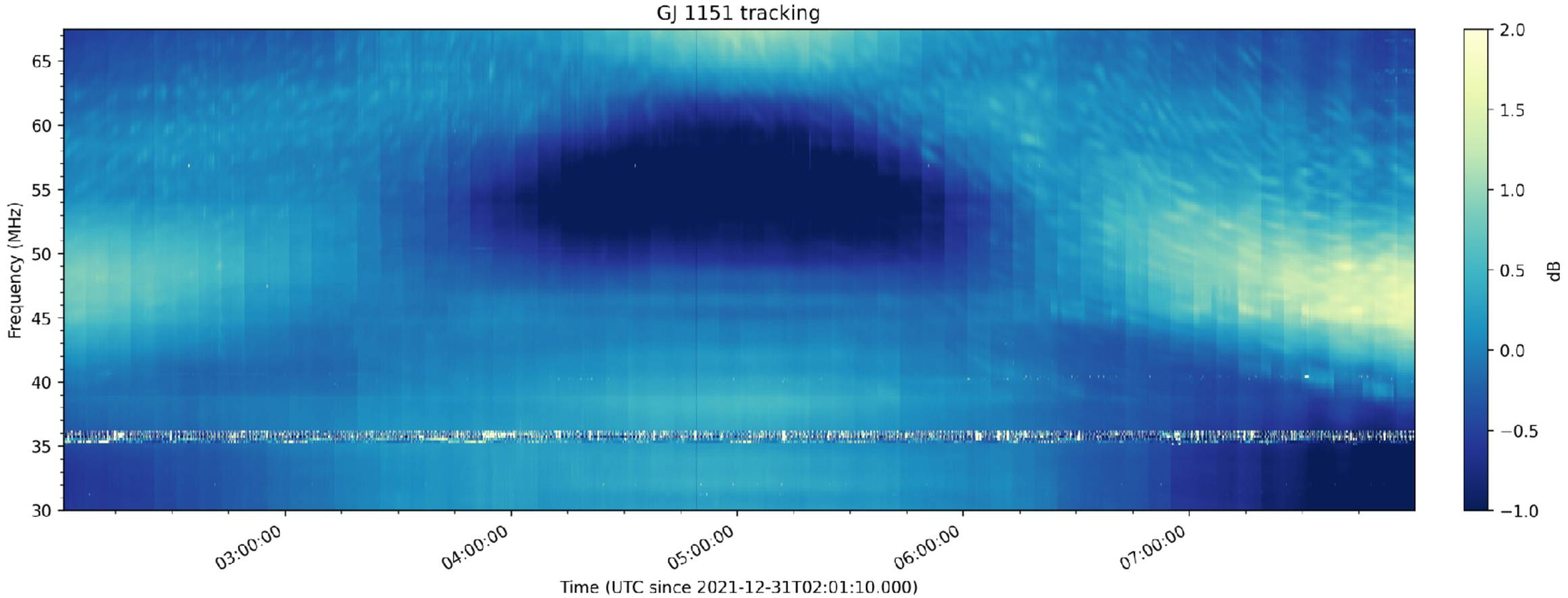

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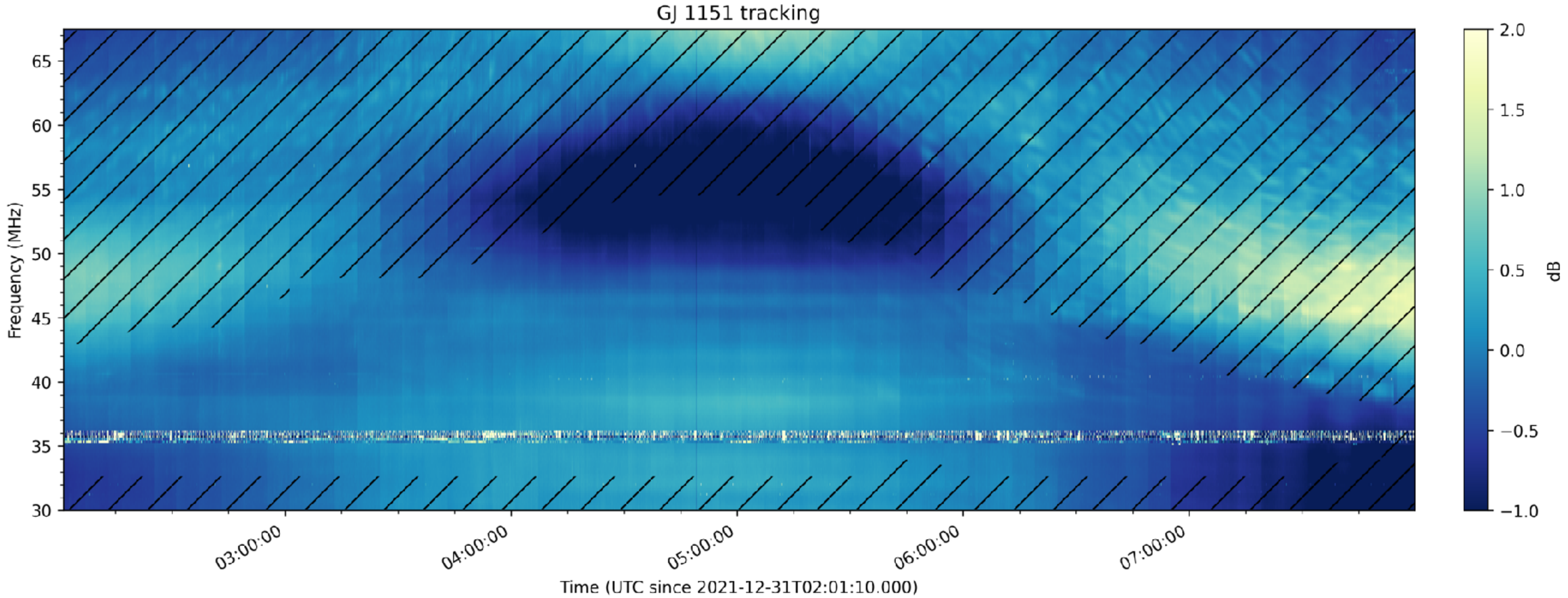
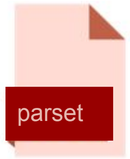


Work in Progress: NenuFAR observation database

Observation instrumental configuration files



↓

Data processing: json file conversion (*nenupy*)

↓

Storage: *ElasticSearch*

↓

Visualization: *Kibana*

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Observation.contactEmail="alan.loh@obspm.fr,nenufar-survey@obs-nancay.fr"
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Observation.stopTime=2022-04-20T02:00:00Z


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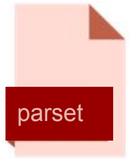
Work in Progress: NenuFAR observation database

Observation instrumental configuration files



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Storage: *ElasticSearch*

↓

Visualization: *Kibana*

JSON


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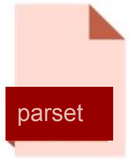
Work in Progress: NenuFAR observation database

Observation instrumental configuration files



↓

Data processing: json file conversion (*nenupy*)

↓

Storage: *ElasticSearch*

→

↓

Visualization: *Kibana*

Fields (72) | Scripted fields (0) | Field filters (0)

Search | All field types | Add field

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@timestamp	date		●	●		✎
_id	_id		●			✎
_index	_index		●	●		✎
_score						✎
_source	_source					✎
_type						✎
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contact_name.keyword	keyword		●	●		✎
field_of_views.antennas.value	long		●	●		✎
field_of_views.beamsquint.correction	boolean		●	●		✎

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Work in Progress: NenuFAR observation database

Observation instrumental configuration files

↓

Data processing: json file conversion (*nenupy*)

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Storage: *ElasticSearch*

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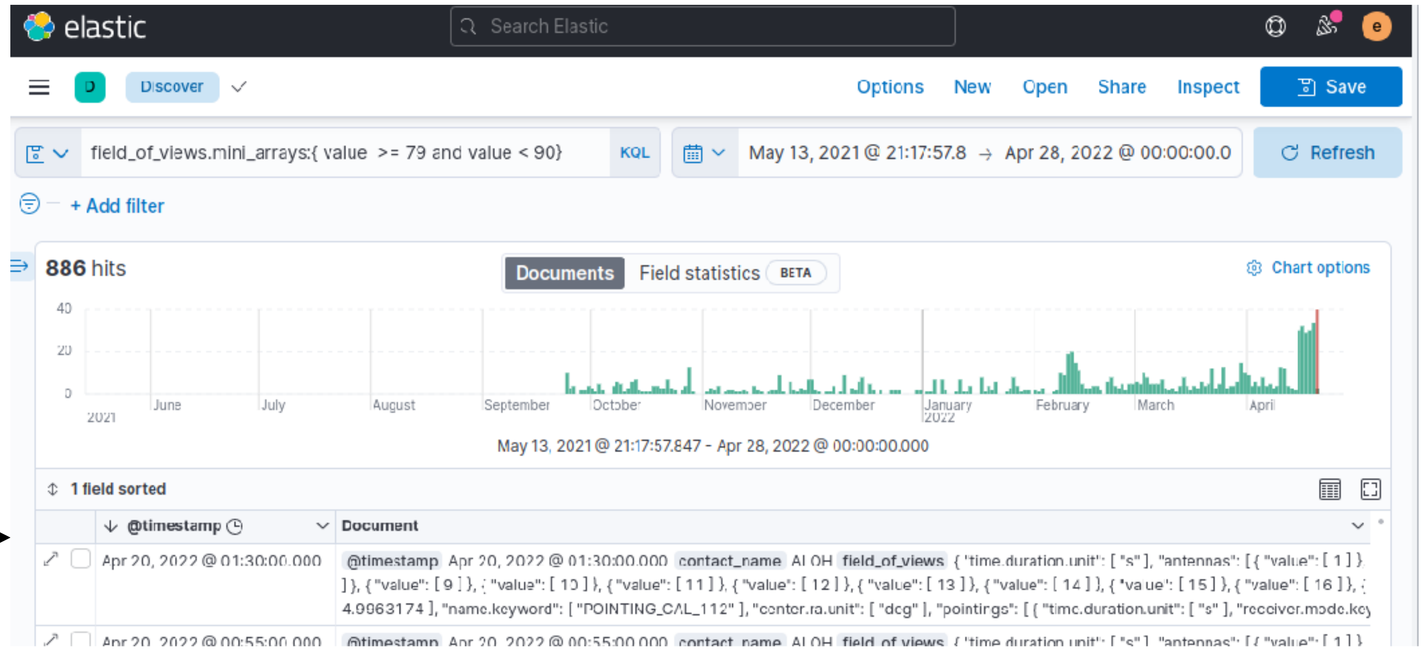

Work in Progress: NenuFAR observation database

In the 'near' future...

- ObsTAP / EPN-TAP
  - From the instrument configuration ElasticSearch database
  - Possibly more than one target per observation
  - Solar System objects included (mainly Sun and Jupiter)
  - Data quicklooks (low-rate dynamic spectra)
  - NenuFAR ~FoV TMOCs (files at various frequencies)?
- ObsLocTAP (Observation Locator Table Access Protocol)
  - Access to the NenuFAR public planning
  - Multi-wavelength/instrument coordinated observations

Thanks!