

# Pushing the Precision of Fast Radio Burst Localisation with the CHIME/FRB Outriggers

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UNIVERSITY  
OF AMSTERDAM



European Research Council  
Established by the European Commission

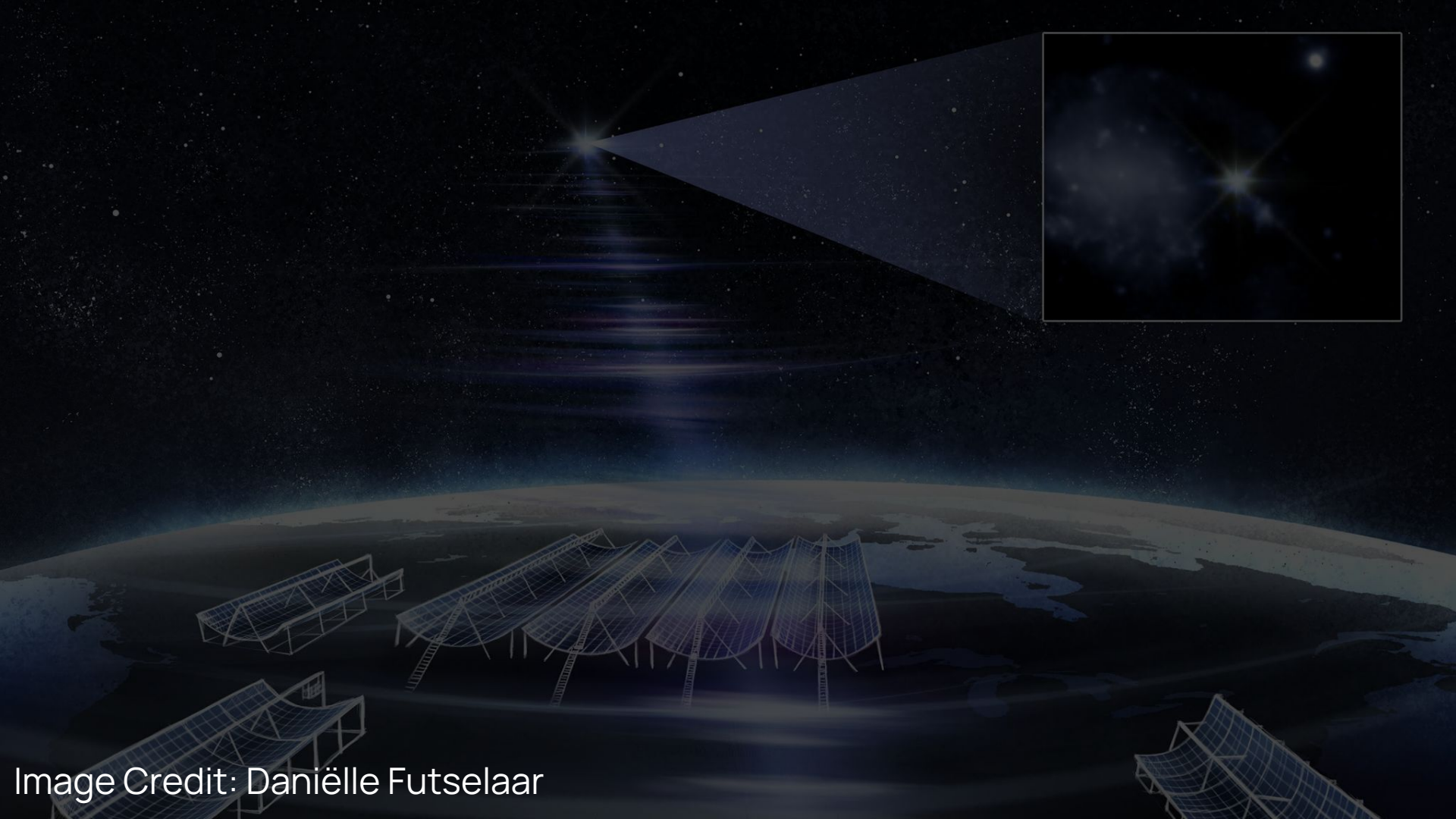
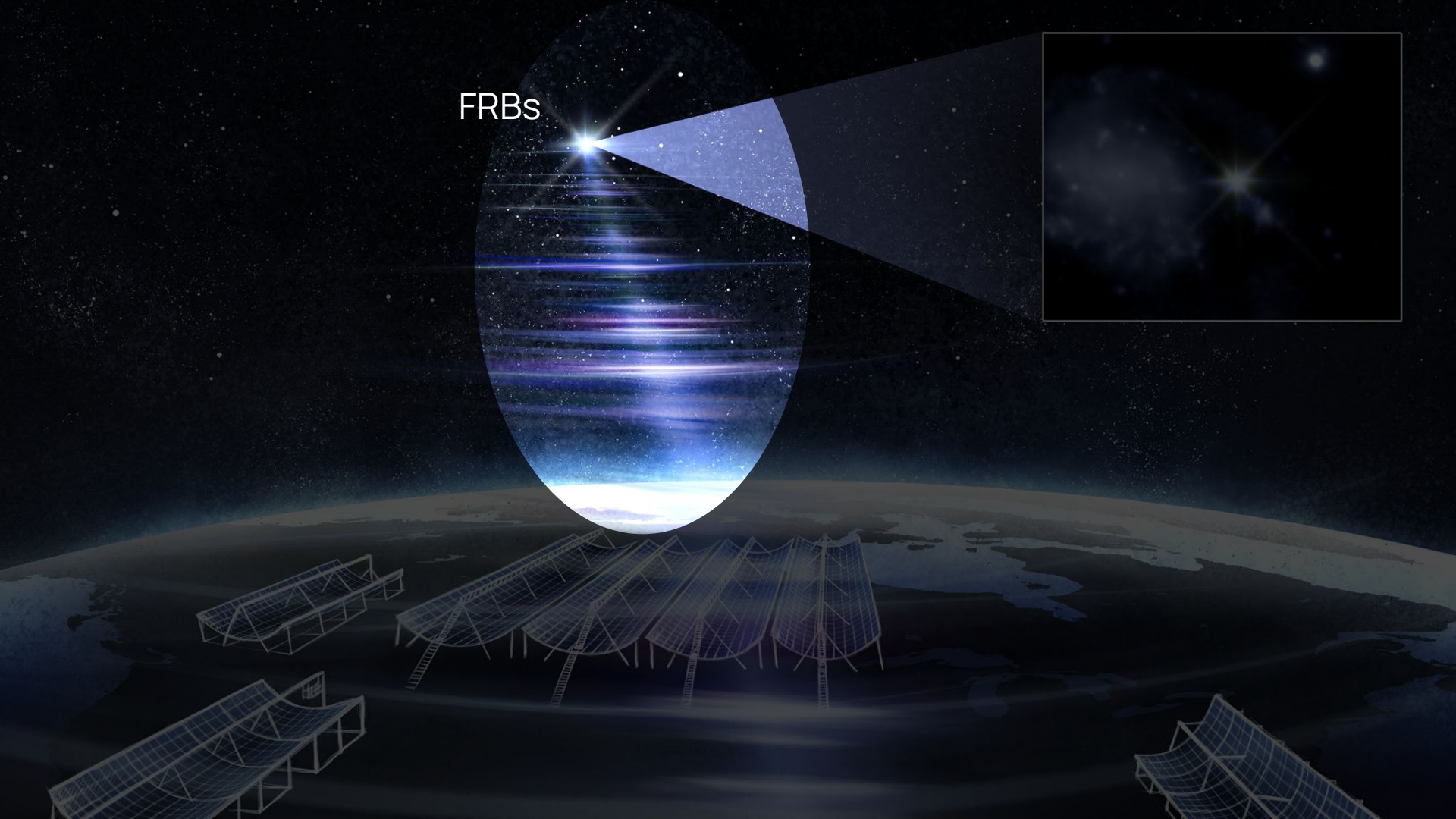
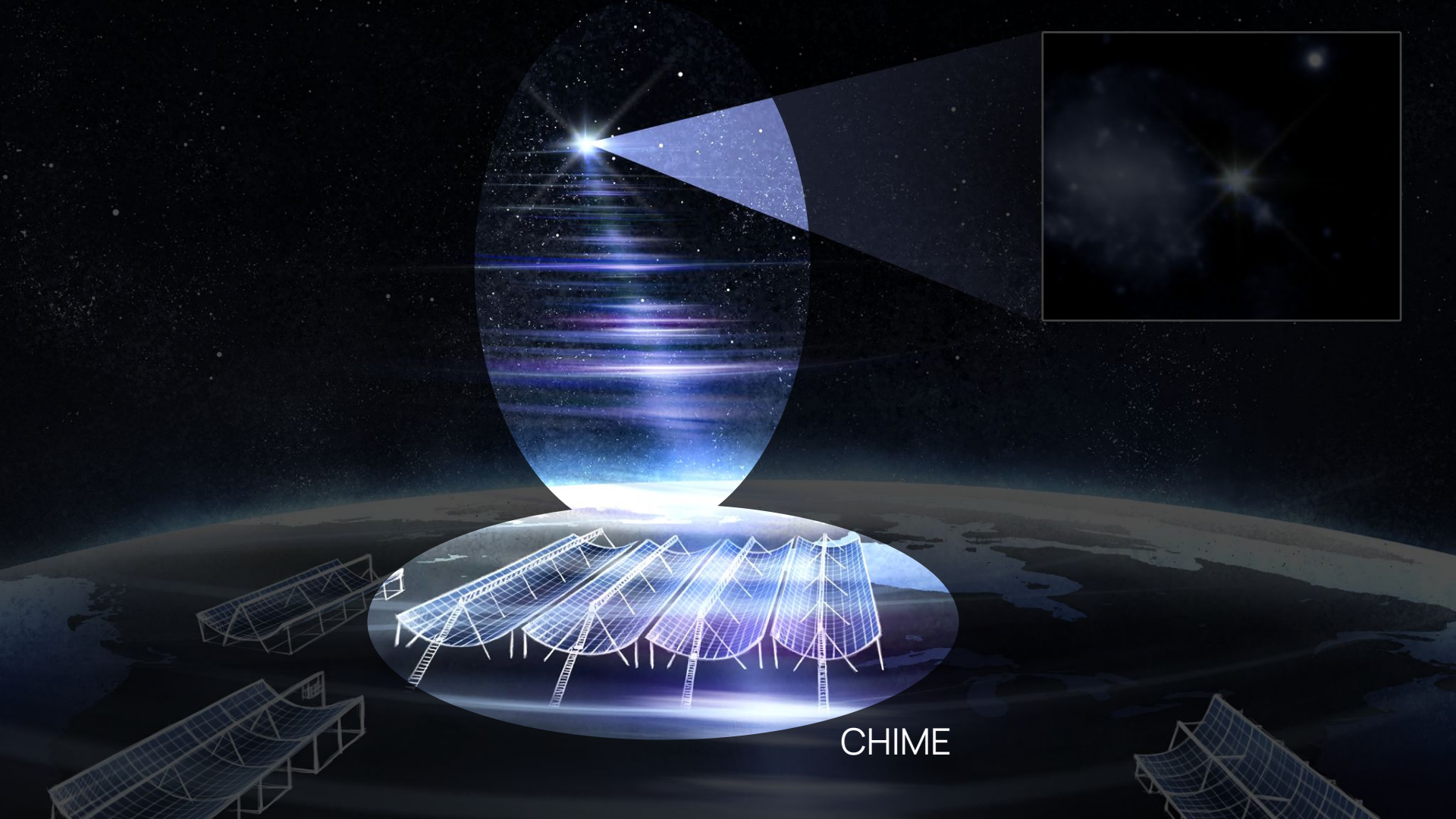


Image Credit: Daniëlle Futselaar

FRBs



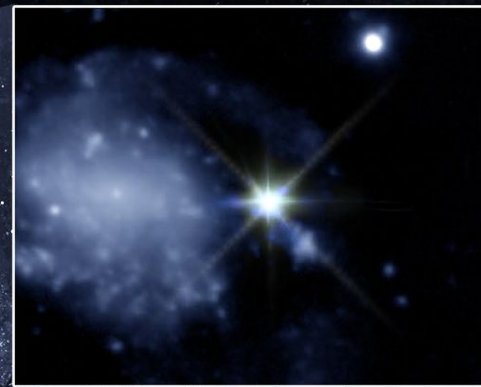


CHIME

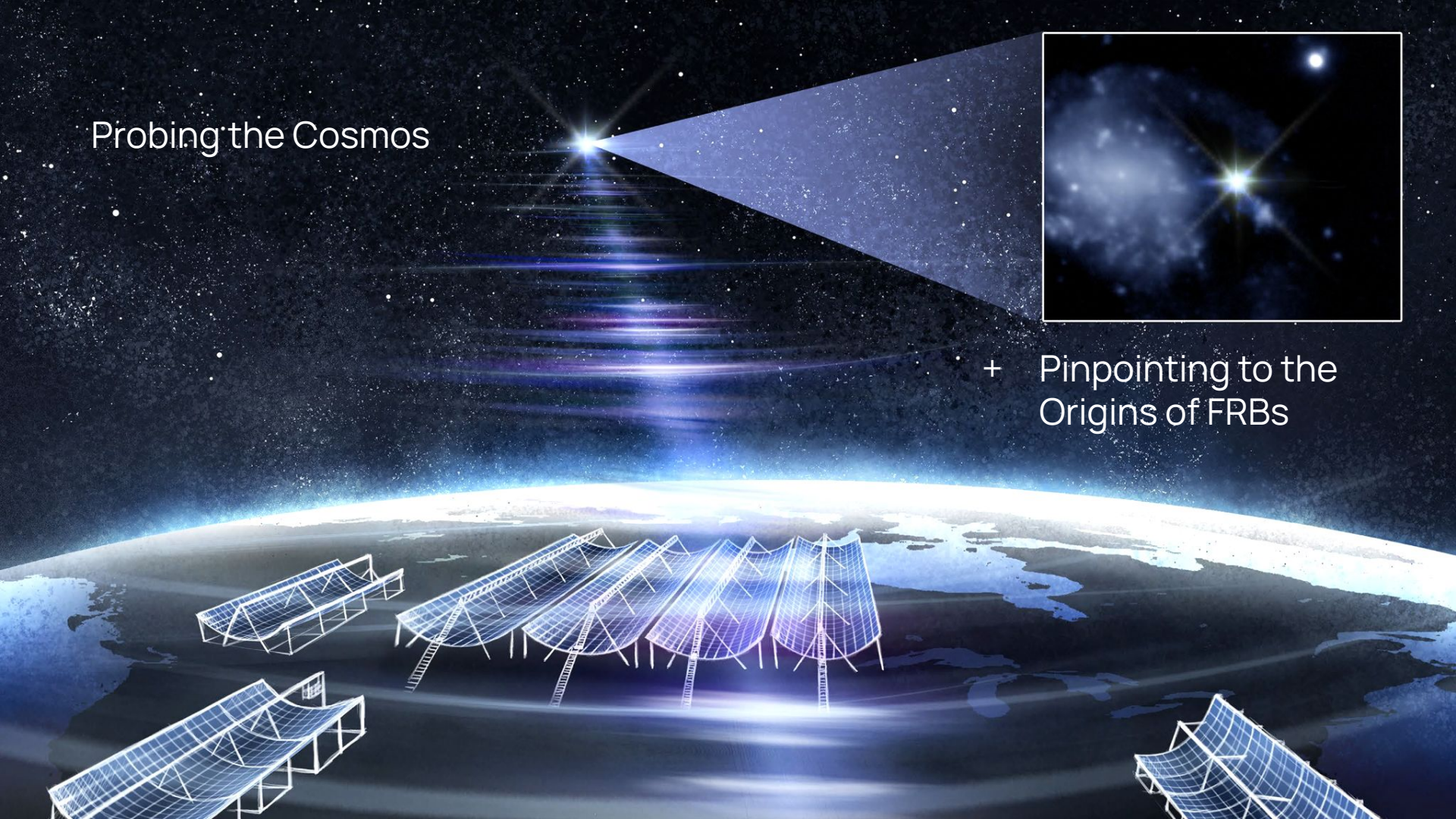
Outriggers



Probing the Cosmos



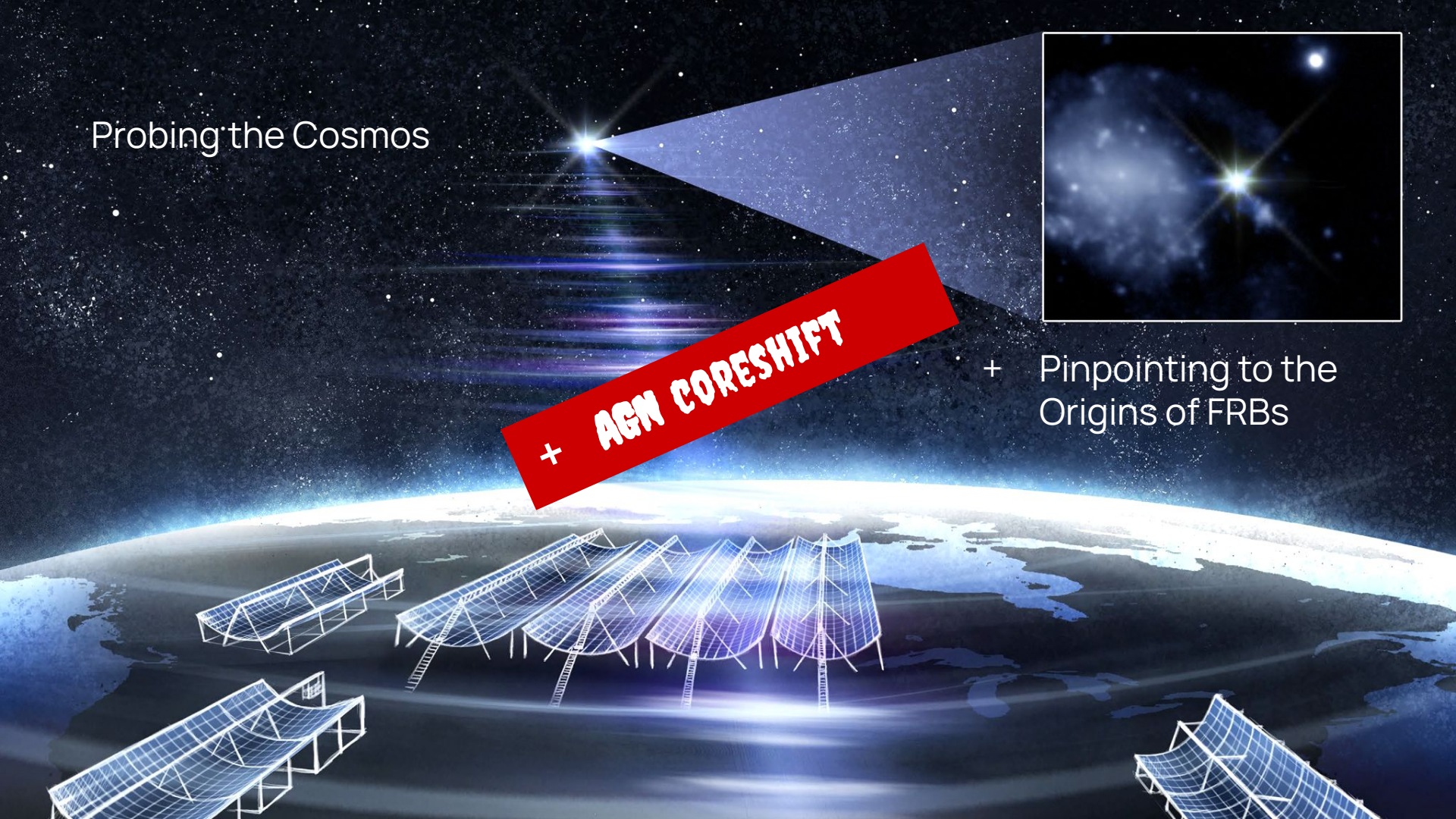
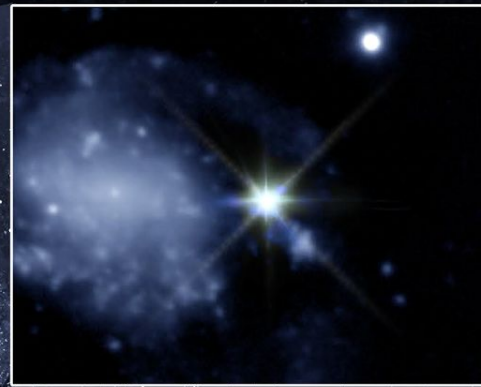
+ Pinpointing to the  
Origins of FRBs



Probing the Cosmos

+ AGN CORESHIFT

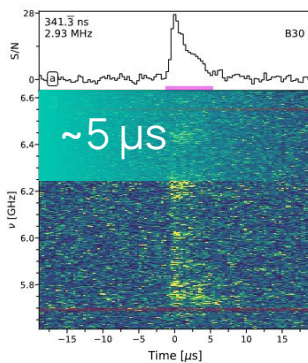
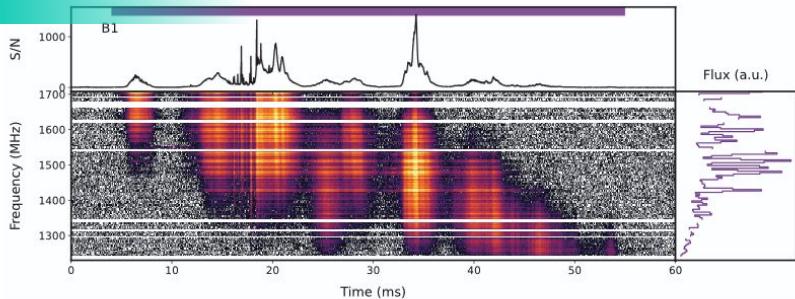
+ Pinpointing to the  
Origins of FRBs



# Fast Radio Bursts

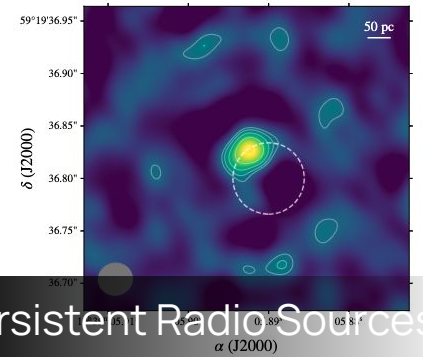
Hewitt+ 2023

~50 ms



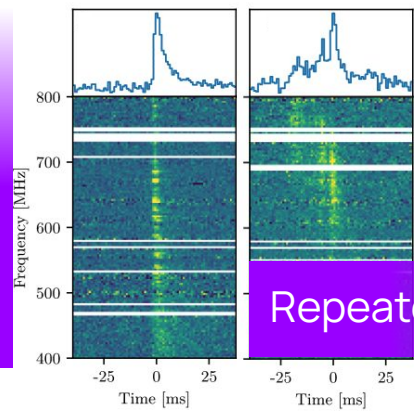
Snelders+ 2023

Moroianu+ 2026



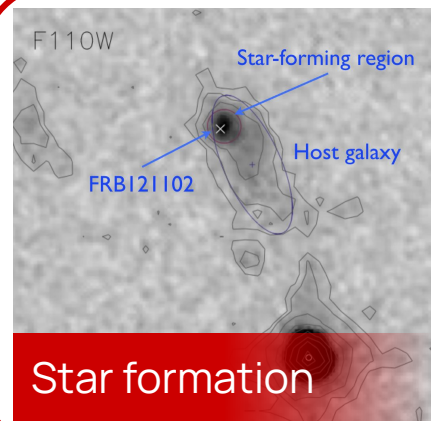
Persistent Radio Sources

Non-repeater



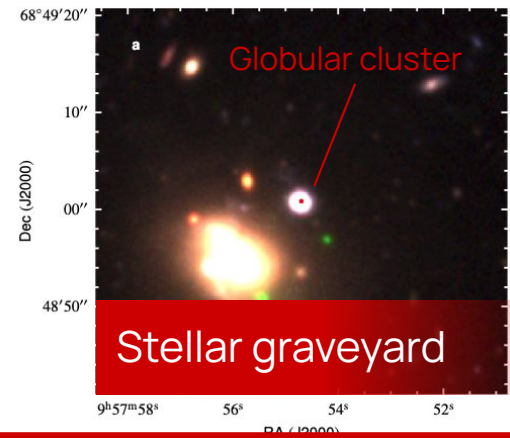
Pleunis+ 2021

Repeater



Star formation

Marcote+17, Bassa+17



Kirsten+ 2022

# Canadian Hydrogen Intensity Mapping Experiment

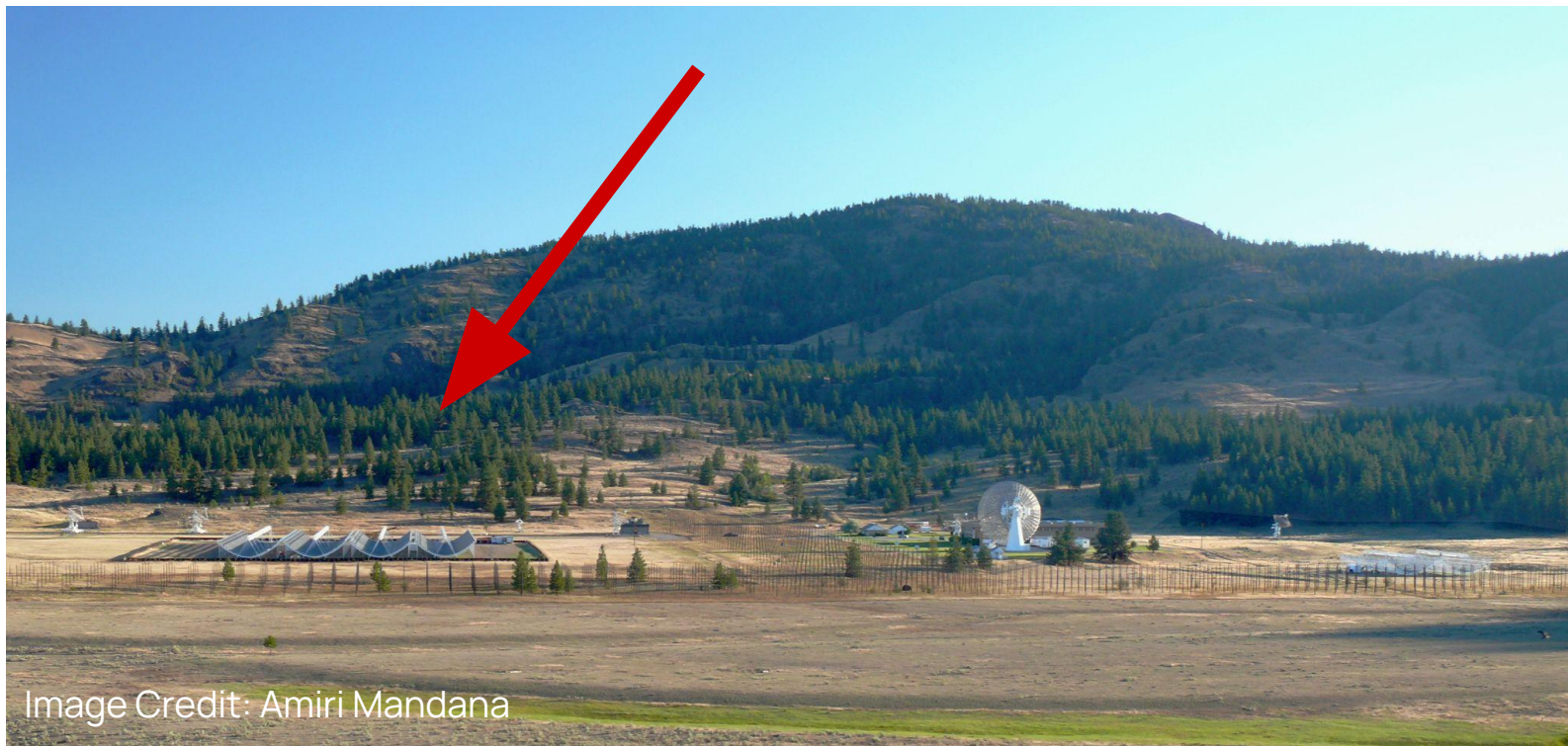


Image Credit: Amiri Mandana

# Canadian Hydrogen Intensity Mapping Experiment

- Four 20 x 100m cylinders
- 400-800 MHz
- Transit telescope
- 200 deg<sup>2</sup> FoV

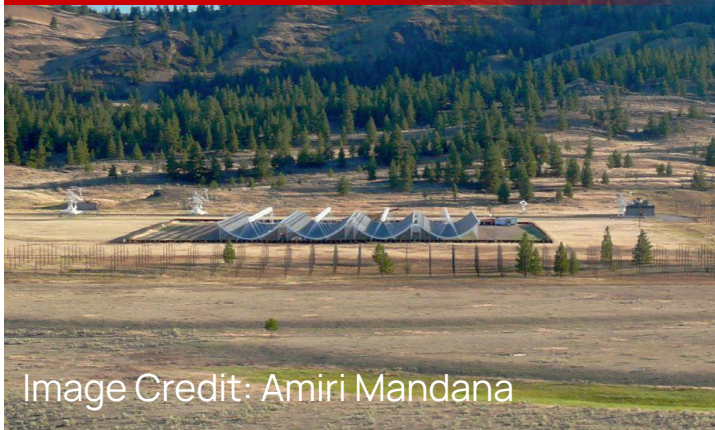
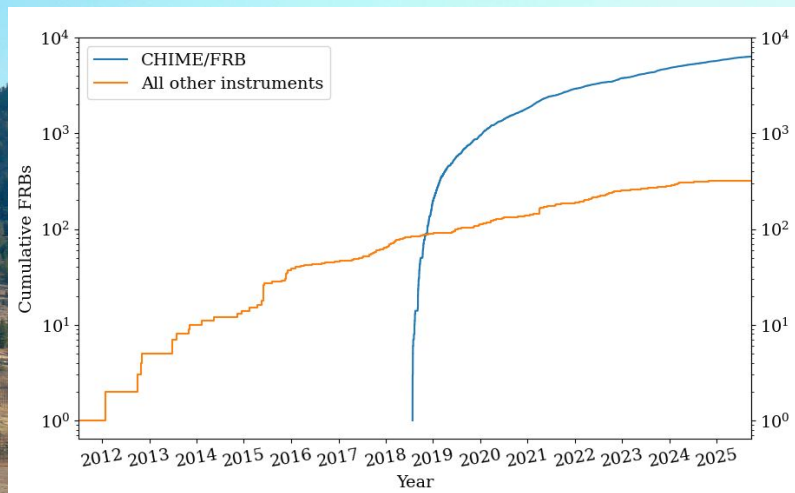


Image Credit: Amiri Mandana



# CHIME's primary beam

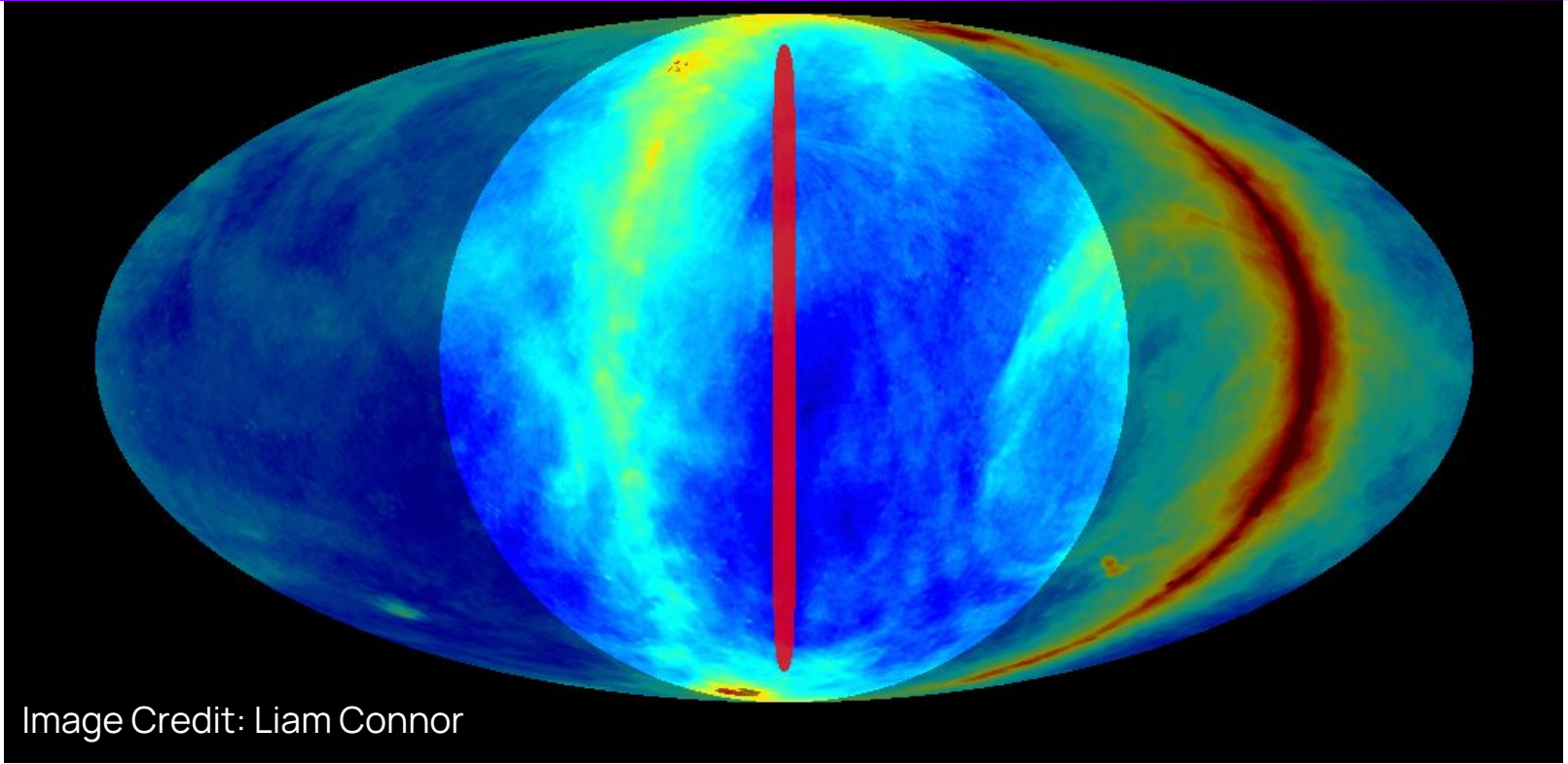
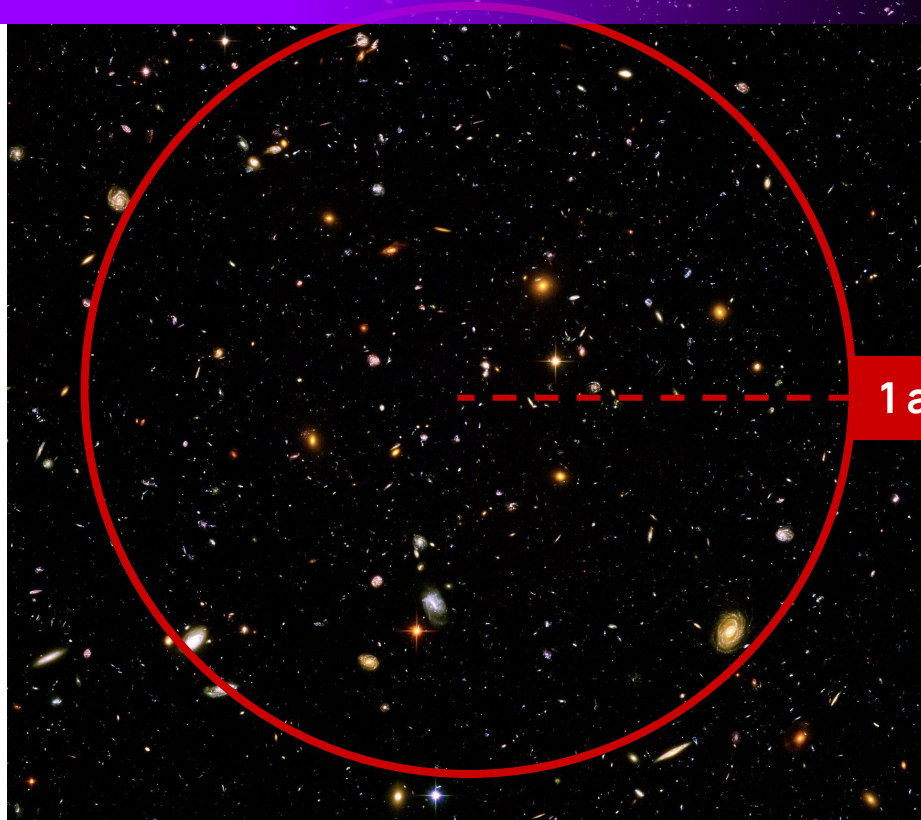


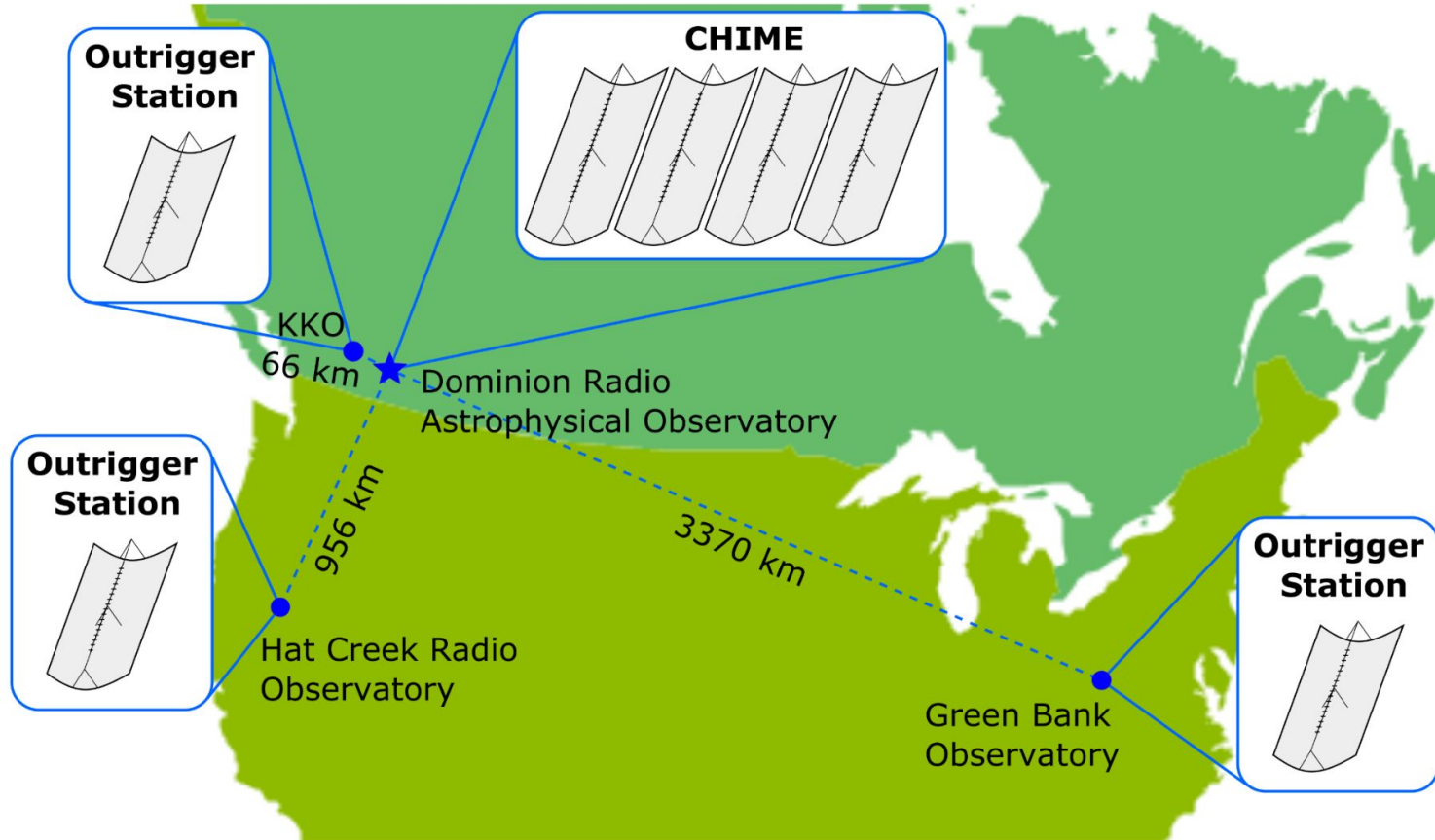
Image Credit: Liam Connor

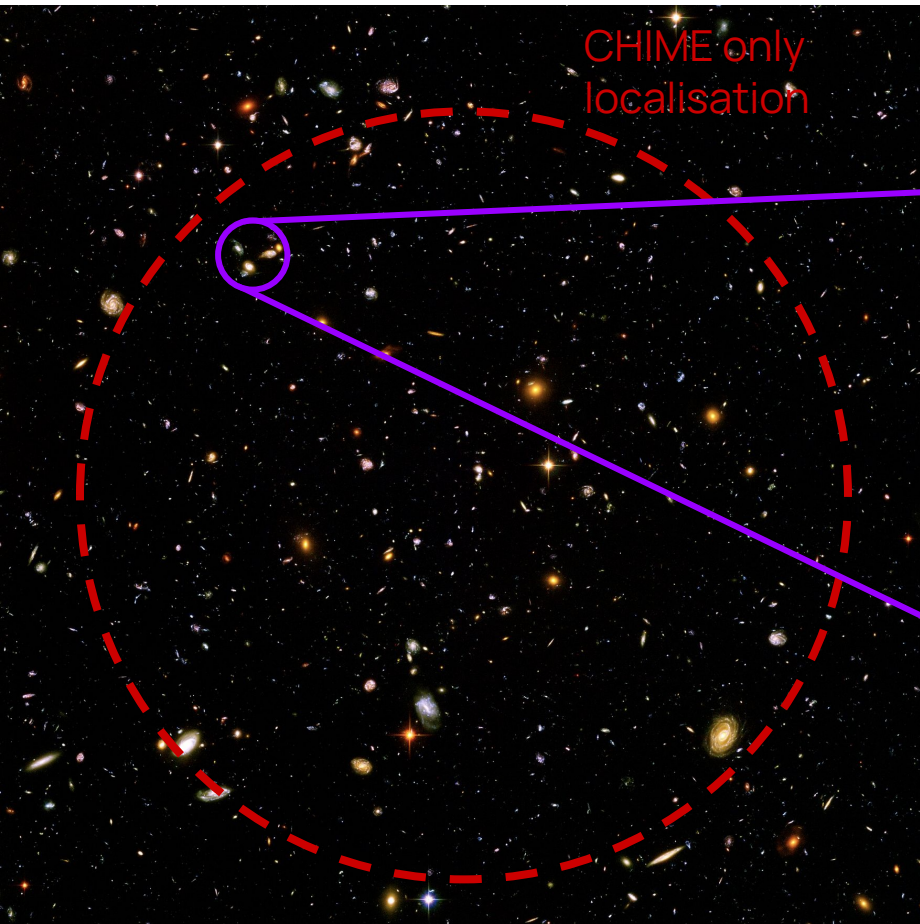
# Hubble Ultra-Deep Field



1 arcmin

# CHIME Outriggers

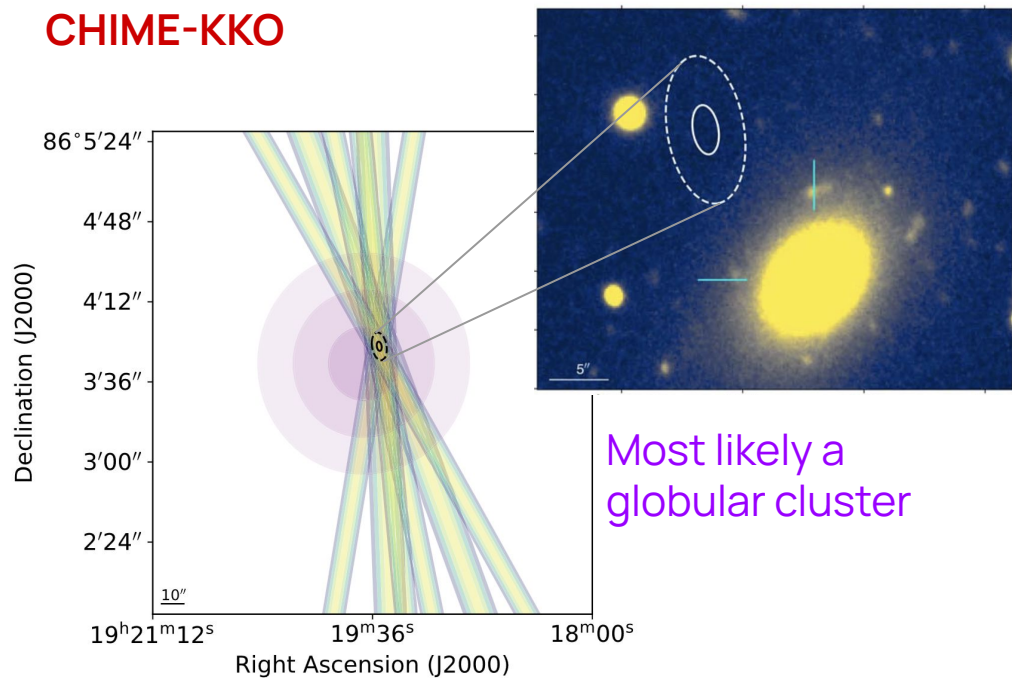




10 arcsec

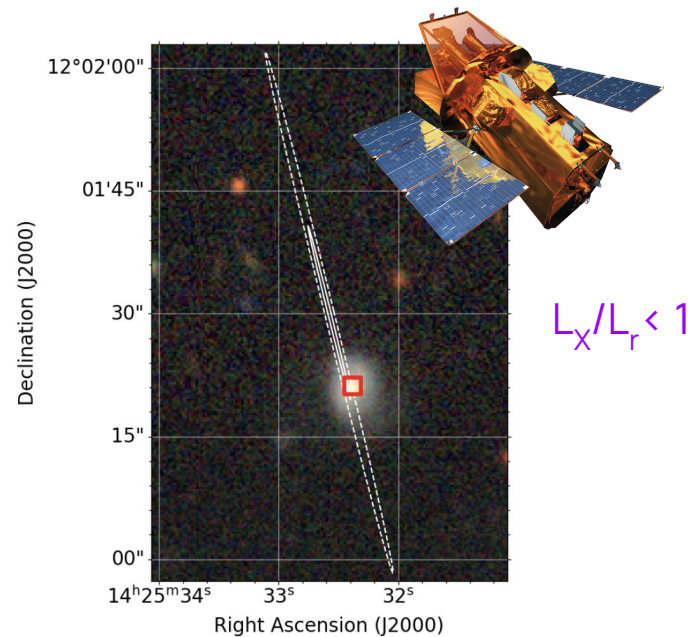
# Pinpointing to the Origins of FRBs

## CHIME-KKO



Shah+ 2025  
A Repeating Fast Radio Burst Source in the  
Outskirts of a Quiescent Galaxy

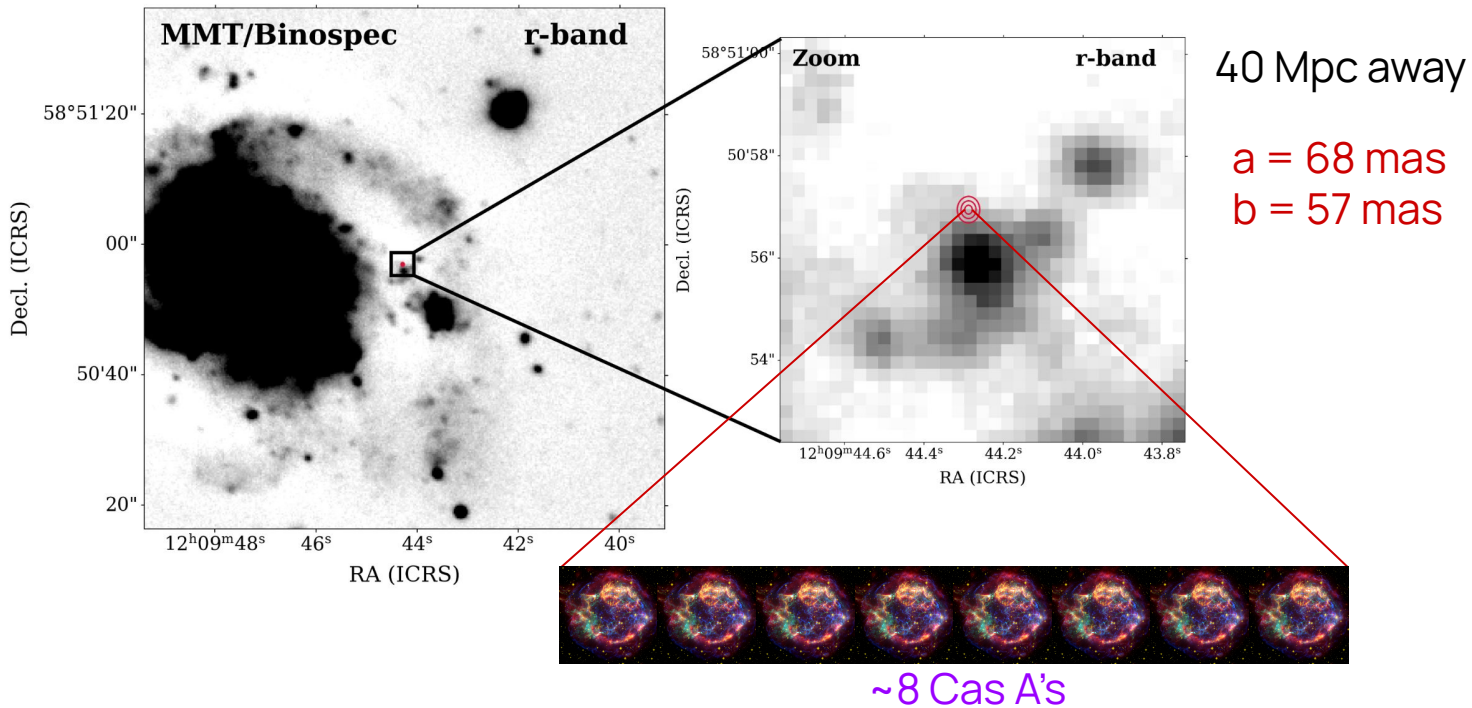
## CHIME-KKO + CHIME-GBO



Curtin+ 2026  
CHIME/FRB Discovery and Localization of the  
Swift-observed FRB 20241228A

# Pinpointing to the Origins of FRBs

**CHIME-KKO**  
+  
**CHIME-GBO**  
+  
**CHIME-HCO**

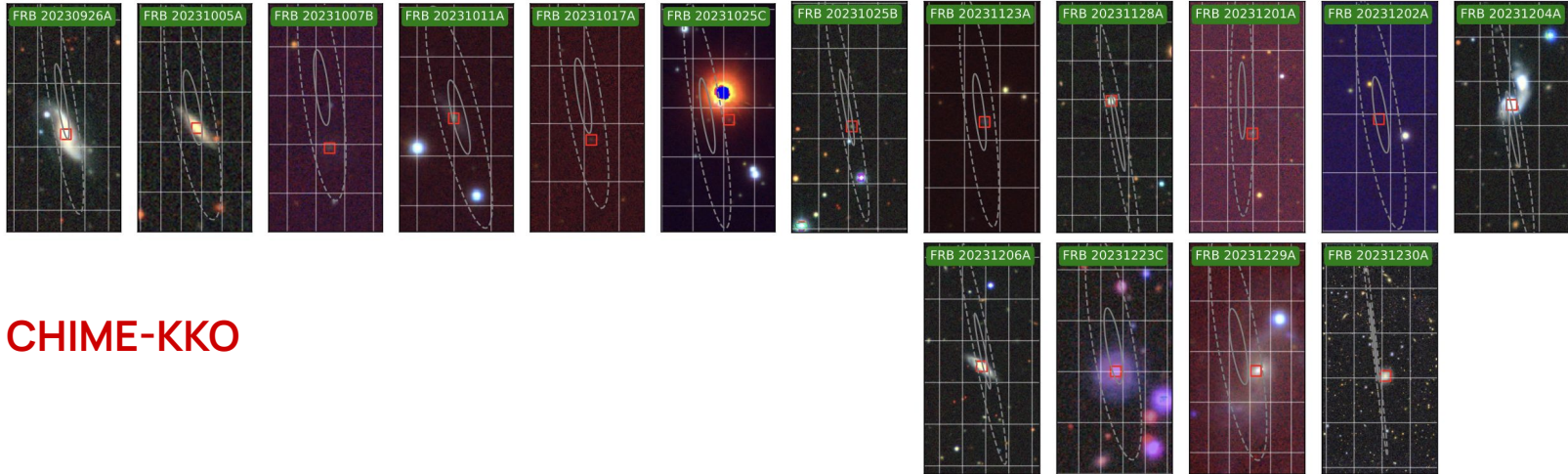
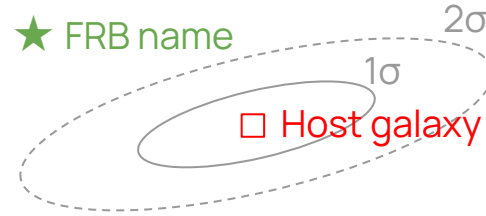
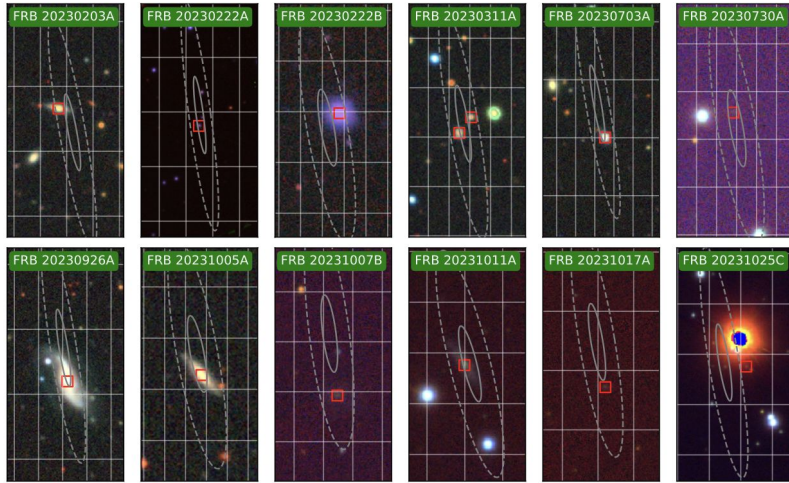


CHIME/FRB Collaboration+ 2025

FRB 20250316A: A Brilliant and Nearby One-off Fast Radio Burst Localized to 13 pc Precision

Slide Adapted from Mattias Lazda

# Probing the Cosmos



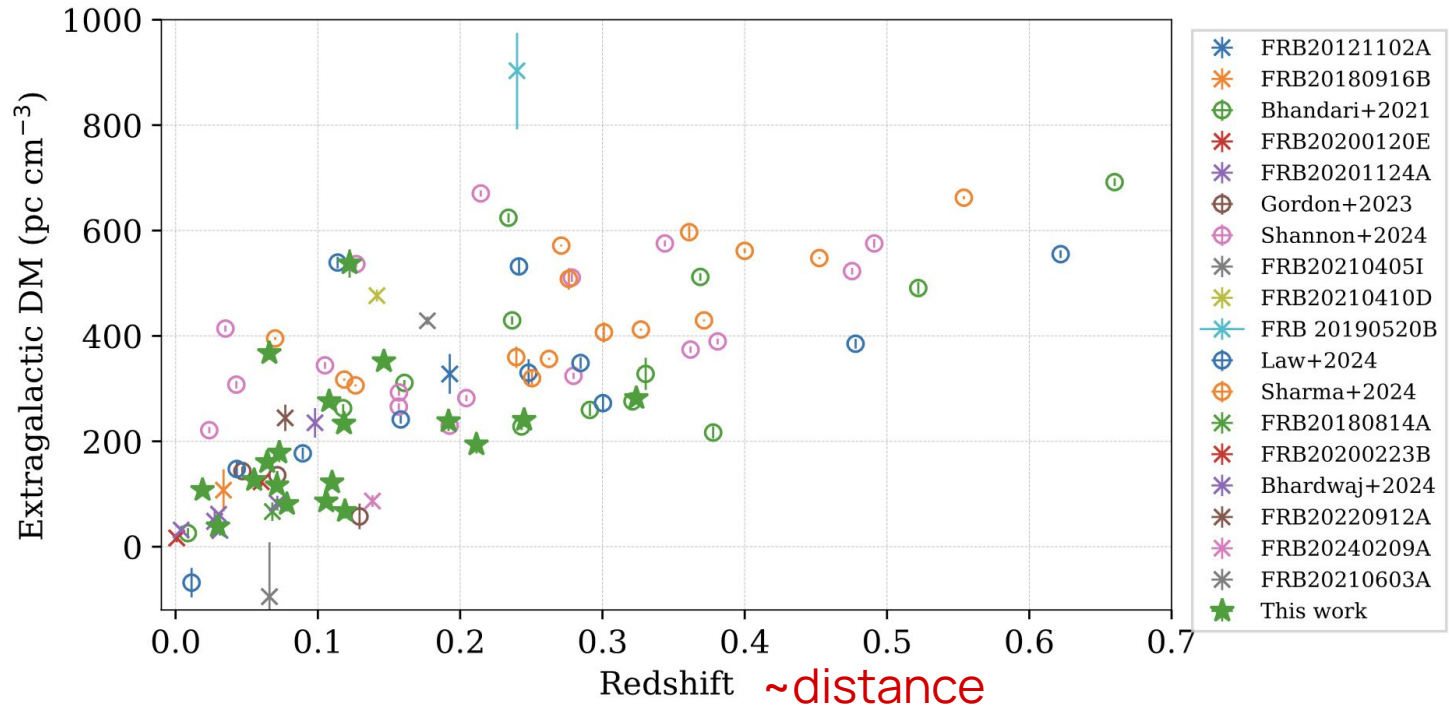
**CHIME-KKO**

CHIME/FRB Collaboration+ 2025

A Catalog of Local Universe Fast Radio Bursts from CHIME/FRB and the KKO

# Probing the Cosmos

~ionized matter along  
the line of sight



CHIME/FRB Collaboration+ 2025

A Catalog of Local Universe Fast Radio Bursts from CHIME/FRB and the KKO

# Towards better precision...

## Better radio frequency interference filtering

Andrew+ 2026

A spatial filter for mitigating radio interference and its application to CHIME/FRB Outriggers

## Building a calibrator grid at low frequencies

Andrew+ 2025

A Very Long Baseline Interferometry Calibrator Grid at 600 MHz for Fast Radio Transient Localizations with CHIME/FRB Outriggers

## Synchronizing clocks between CHIME and the Outriggers

Mena-Parra+ 2022

A Clock Stabilization System for CHIME/FRB Outriggers

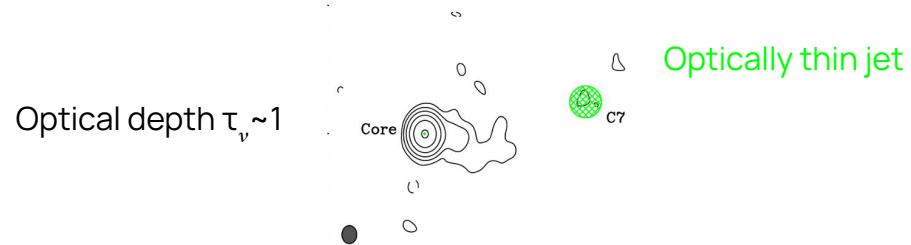
## Beamforming to “track” calibrators as they transit through the beams

## Assessing the Frequency-Dependent Nature of VLBI Calibrators

+++

# AGN Core-shift

10 mas

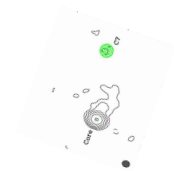


Adapted from Kutkin+14

# AGN Core-shift

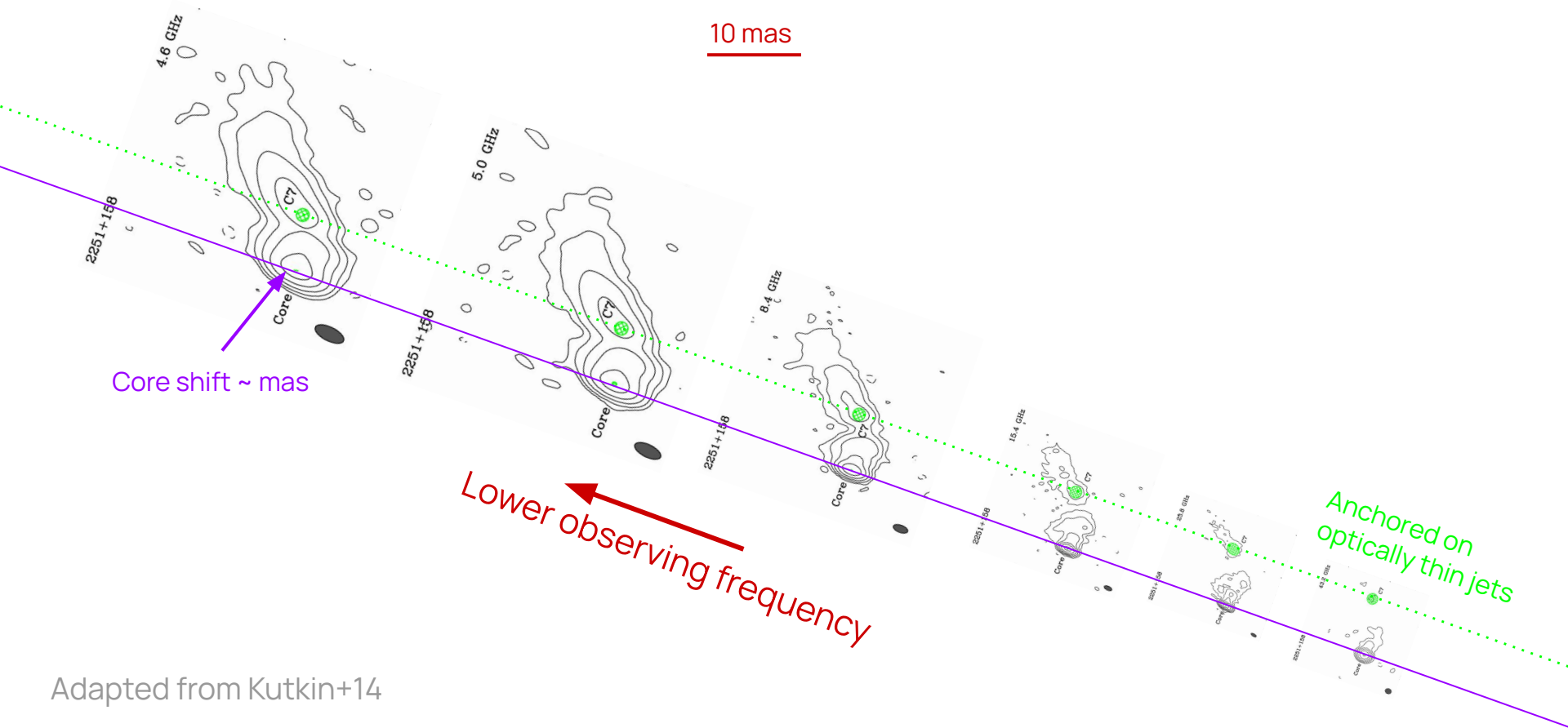
10 mas

Adapted from Kutkin+14



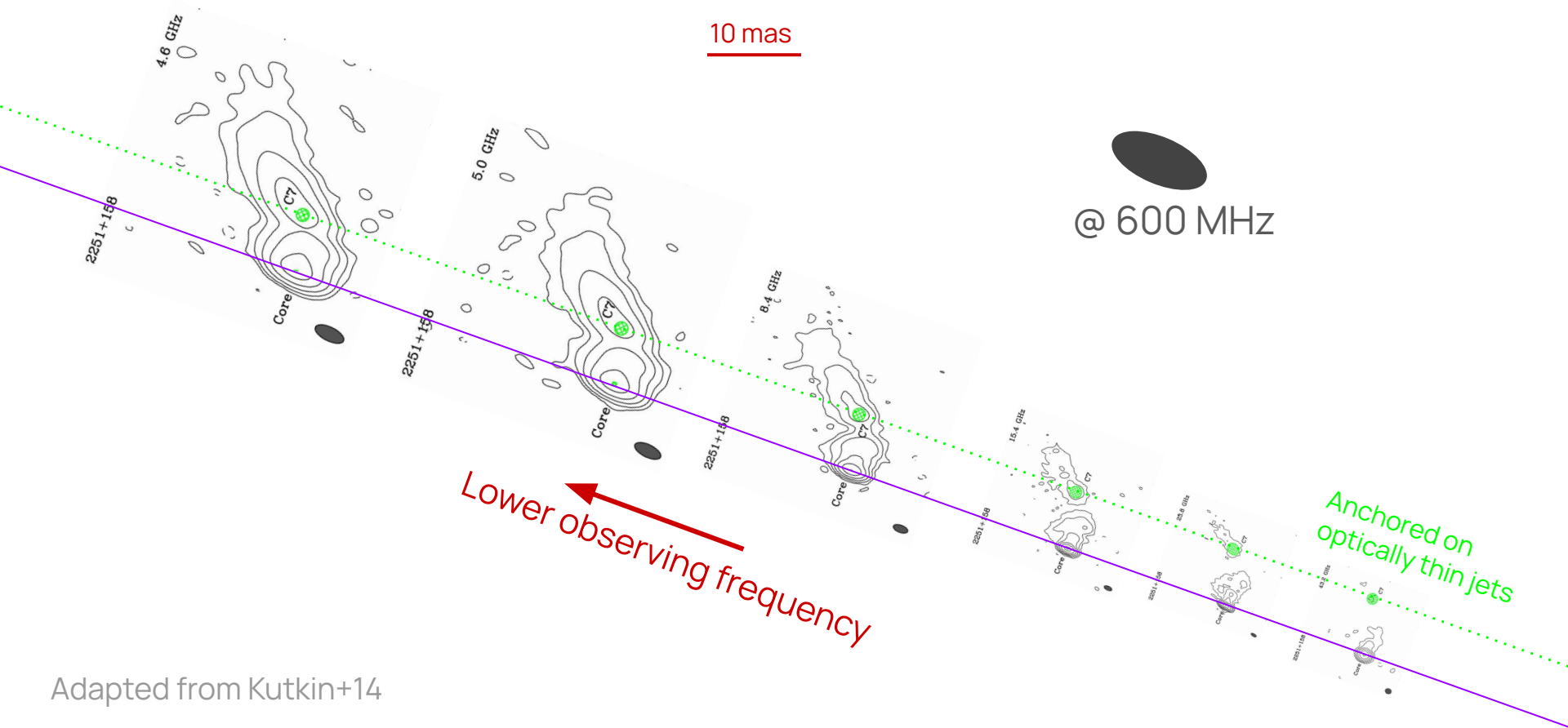


# AGN Core-shift



Adapted from Kutkin+14

# AGN Core-shift



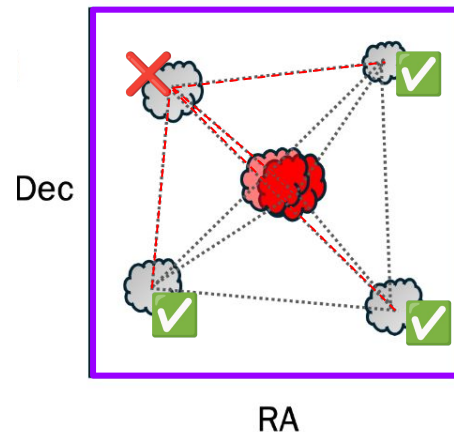
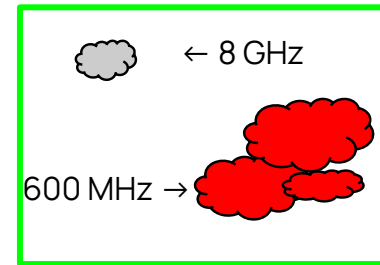
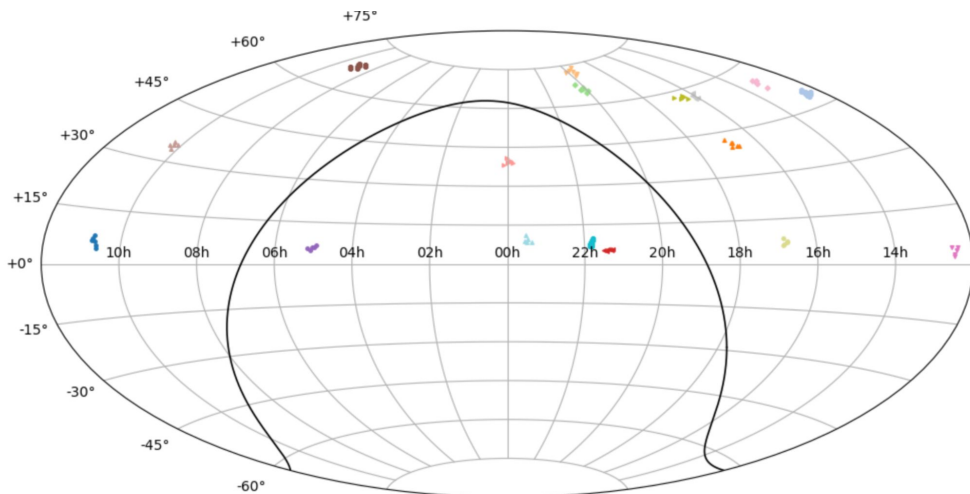
Adapted from Kutkin+14

# A VLBA Pilot Study on Calibrator Integrity at Low Frequencies

To evaluate  
source structure

+

frequency dependent position offsets  
at sub-GHz frequencies.



VLBI calibrators can look very different at lower radio frequencies

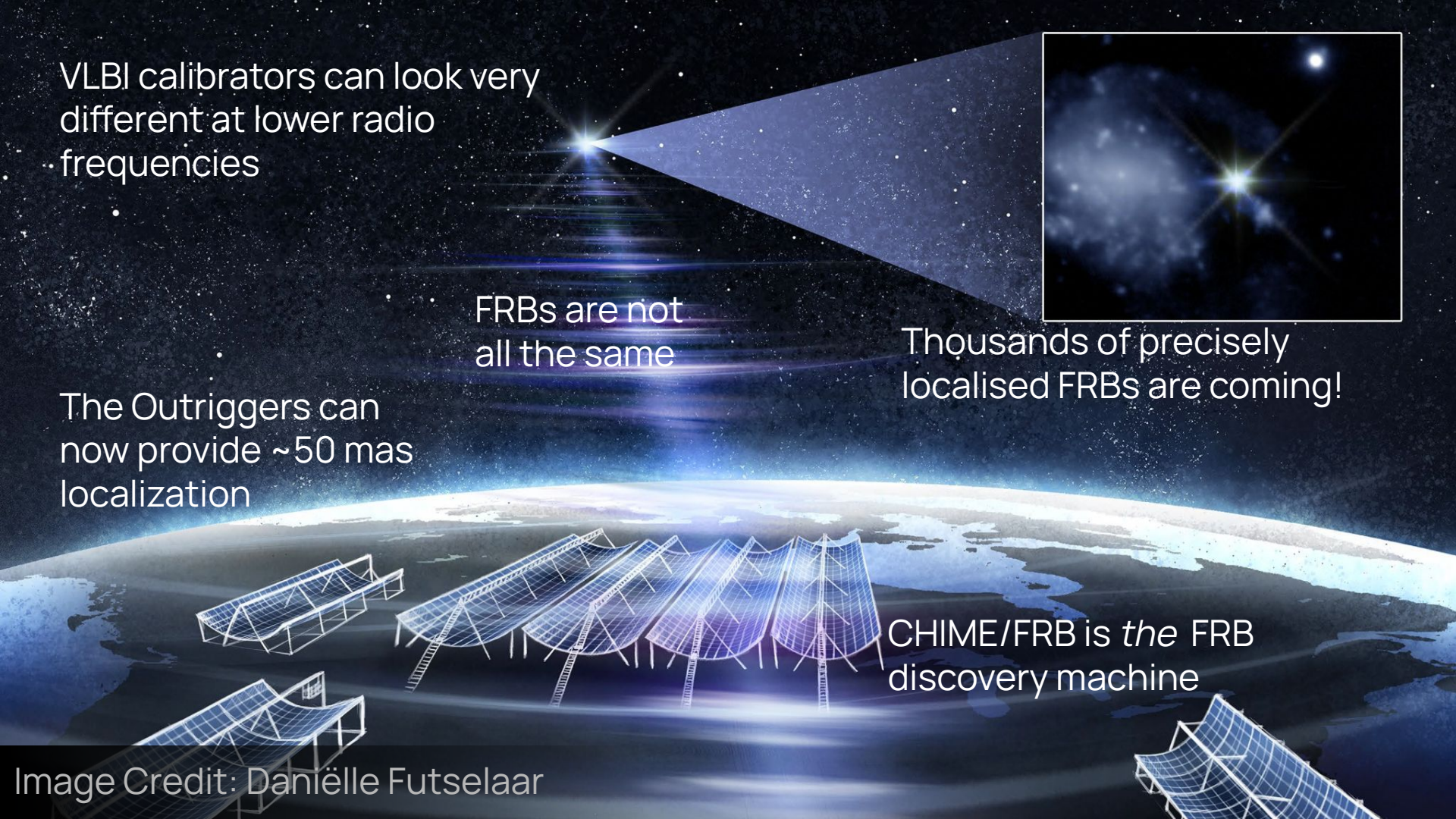
FRBs are not all the same

Thousands of precisely localised FRBs are coming!

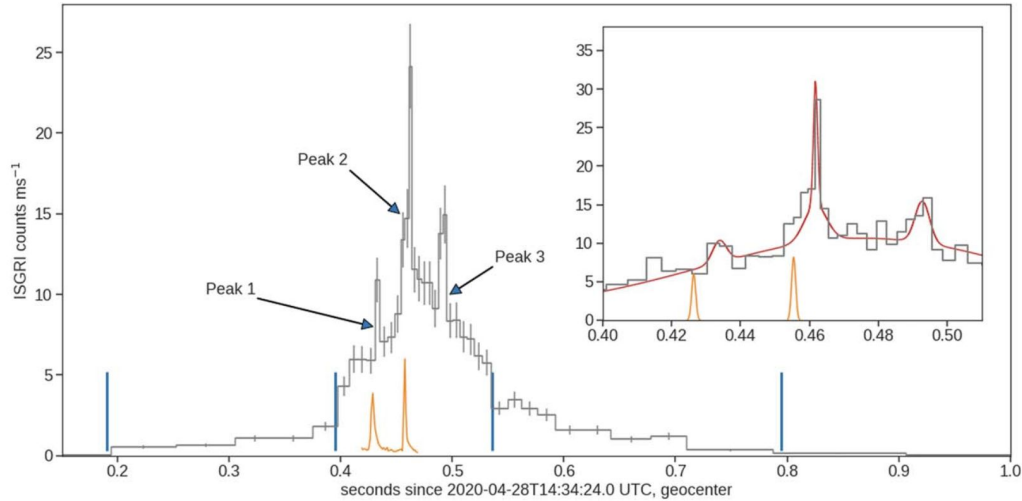
The Outriggers can now provide ~50 mas localization

CHIME/FRB is *the* FRB discovery machine

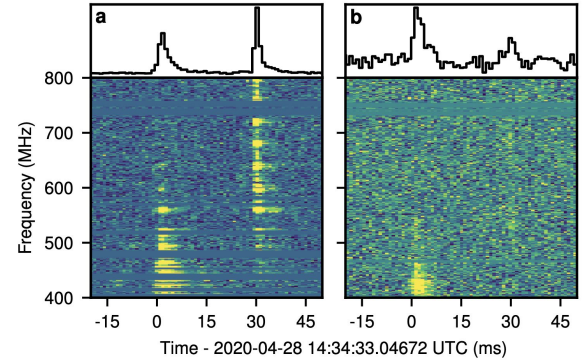
Image Credit: Daniëlle Futselaar



# BACKUP: SGR 1935+2154

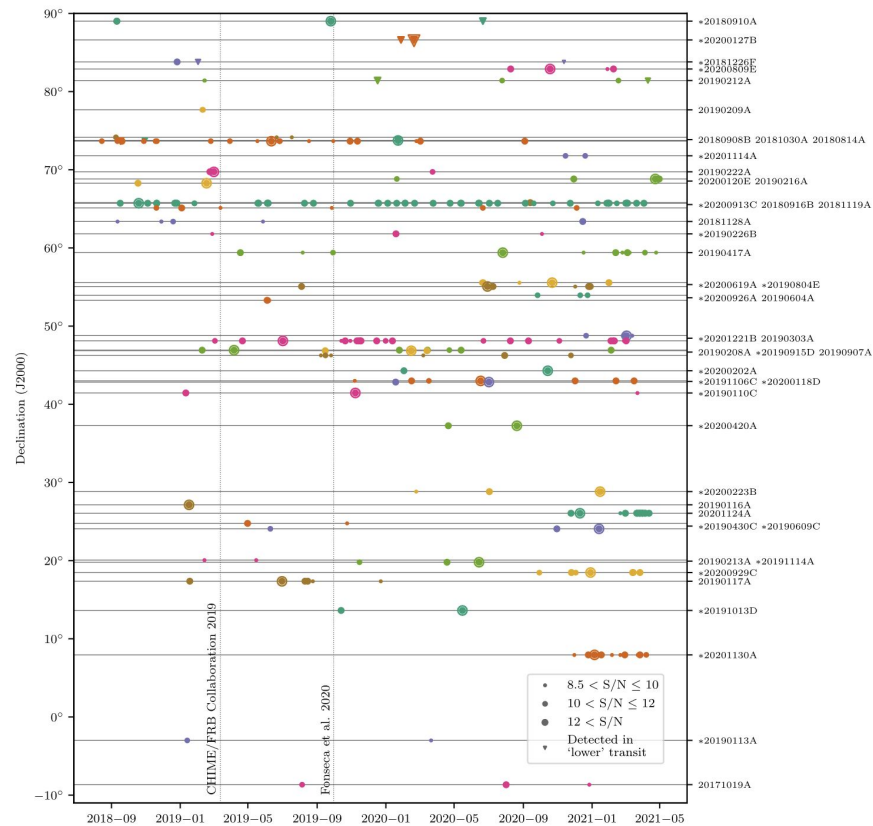
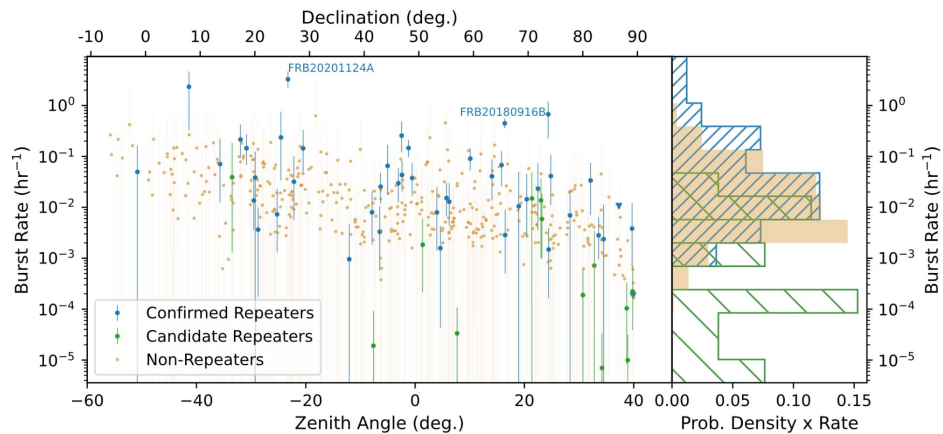


$$F_x/F_r \sim 50\,000$$



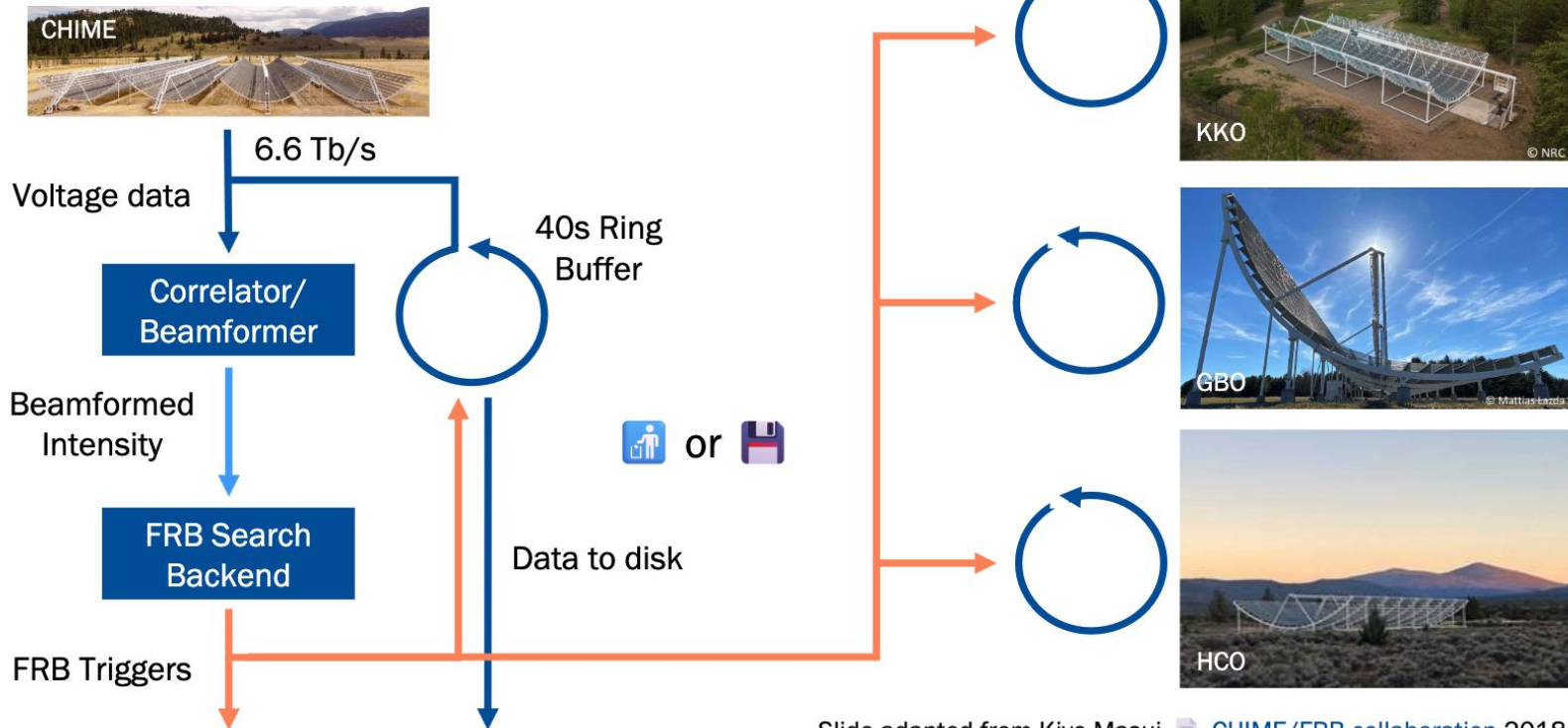
Mereghetti+ 2021  
CHIME/FRB Collaboration+ 2021  
Bochenek+ 2021

# BACKUP: Repeater population



# BACKUP: CHIME Triggering

## FRB detection



# BACKUP: FRB 20250316A JWST

