Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

INAF
ISTITUTO NAZIONALE DI ASTROFISICA

Enabling FRBs through the upgraded Croce del Nord and the synergies with CHORD

Training Meeting
NG-Croce

Lunedì 12 Maggio - Giovedì 15 Maggio

Radiotelescopi di Medicina
IRA - Bologna

PNRR NG-CROCE

Maura Pilia

The idea behind the project

UPGRADE OF THE N-S ARM

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REFURBISHMENT OF THE E-W ARM

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P-BAND RECEIVER IN NOTO

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FAST RADIO BURSTS

The idea behind the project

UPGRADE OF THE N-S ARM

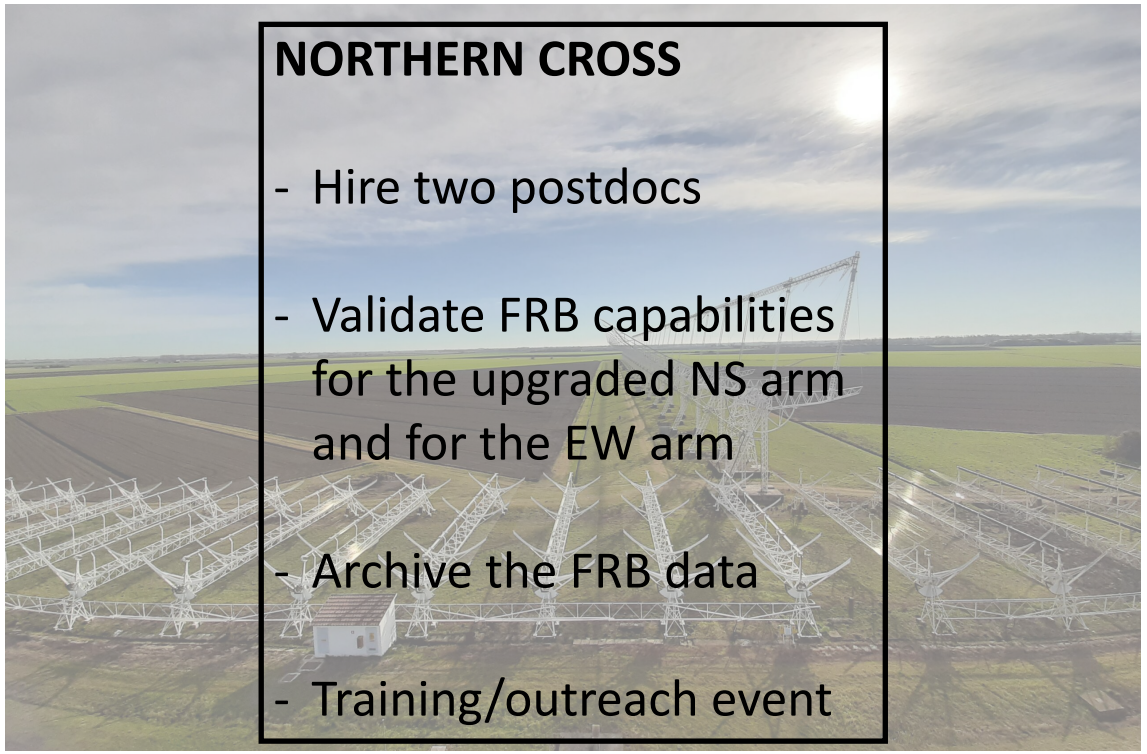
REFURBISHMENT OF THE E-W ARM

P-BAND RECEIVER IN NOTO

FRB BACKEND IN CHORD

FAST RADIO BURSTS

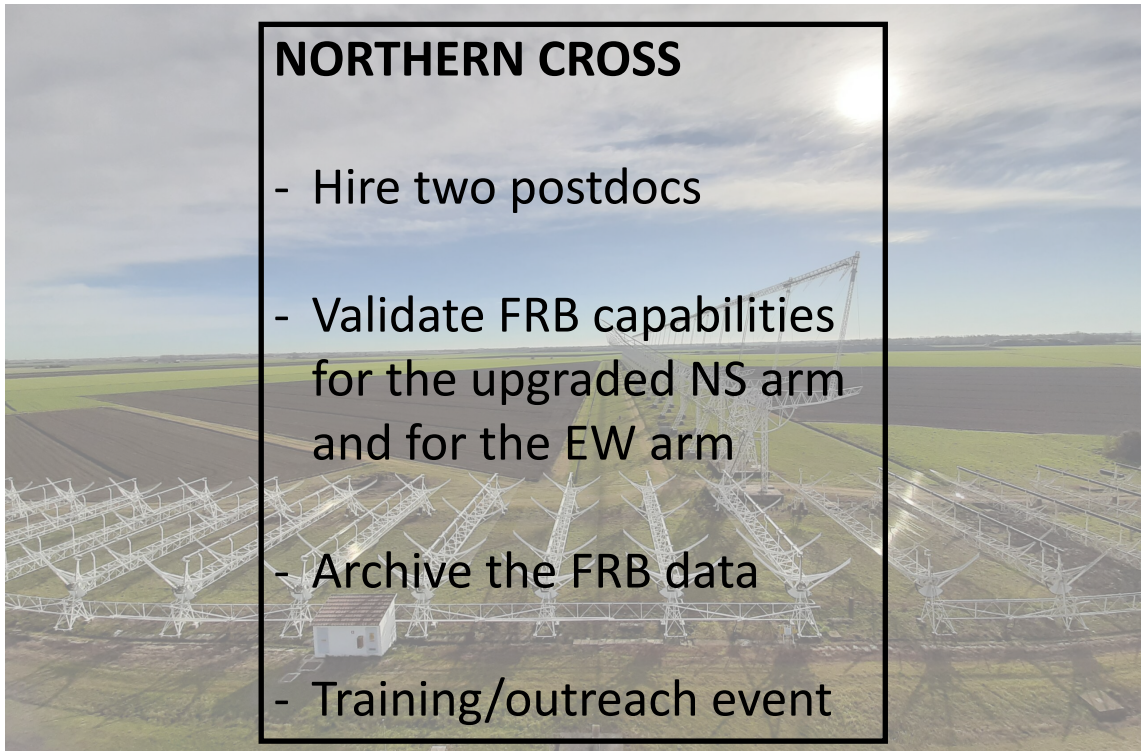
The plan



NORTHERN CROSS

- Hire two postdocs
- Validate FRB capabilities for the upgraded NS arm and for the EW arm
- Archive the FRB data
- Training/outreach event

The plan



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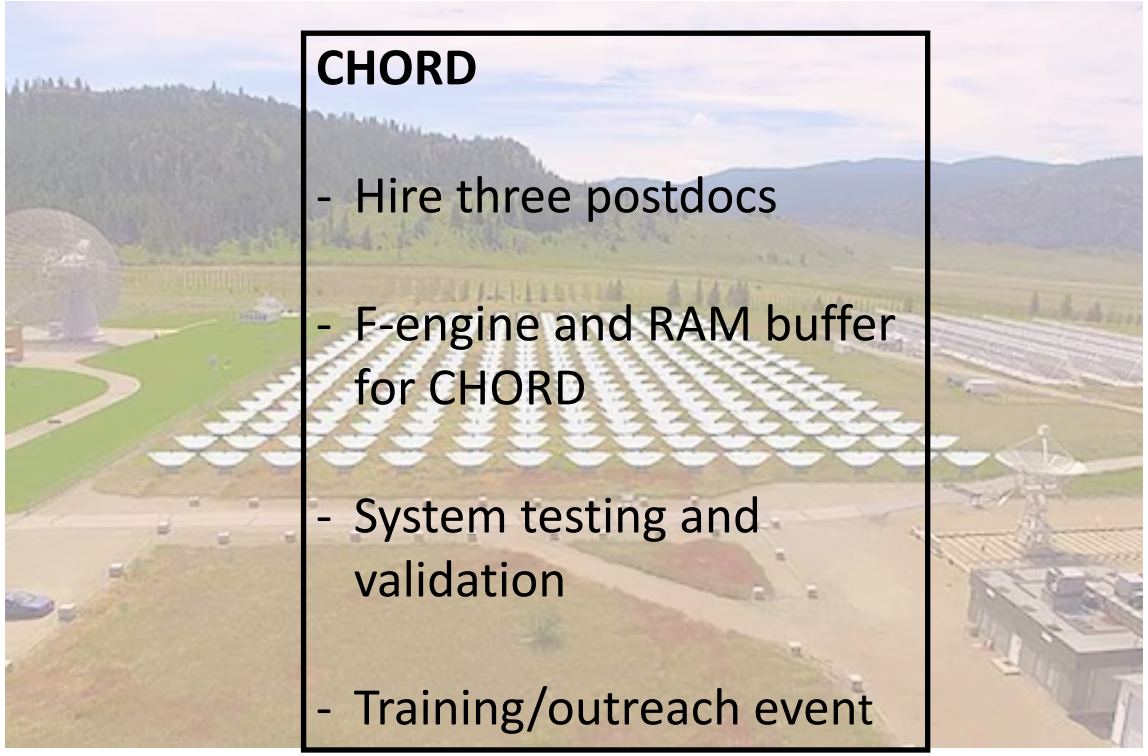


CHORD

- Hire three postdocs
- F-engine and RAM buffer for CHORD
- System testing and validation
- Training/outreach event

Fast Radio Bursts

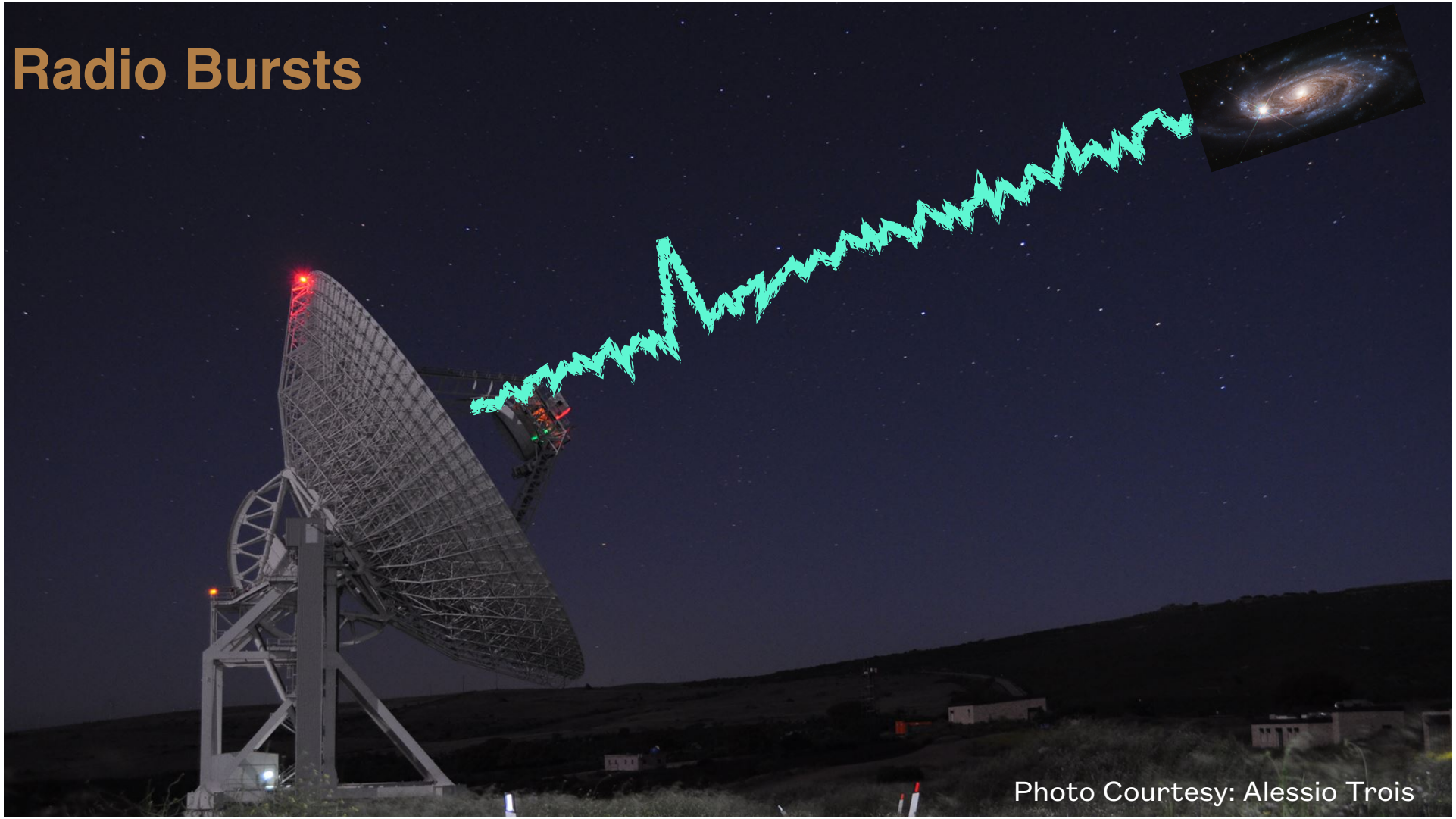
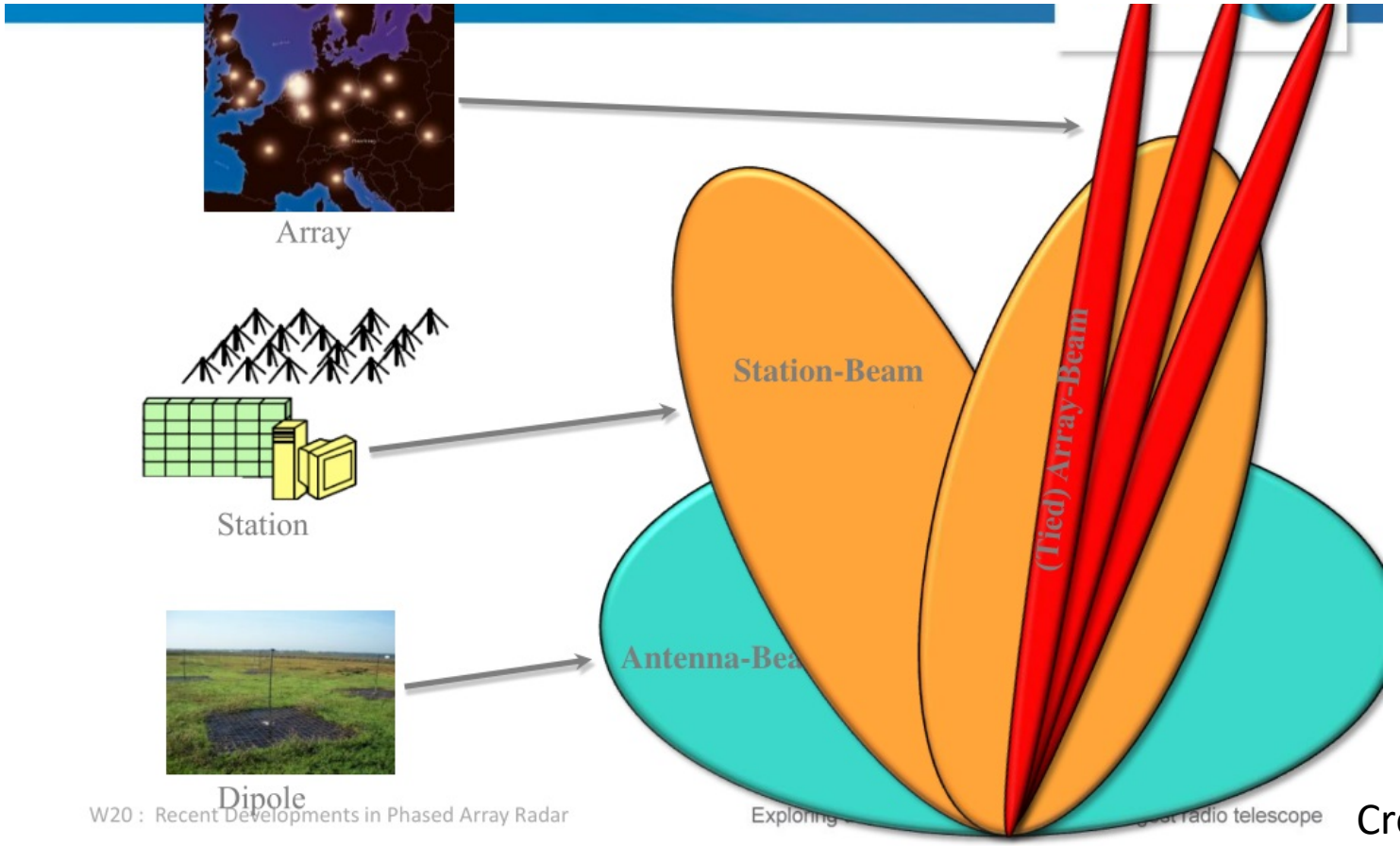


Photo Courtesy: Alessio Trois

How do we detect them?



Credits: Bij de Vaate

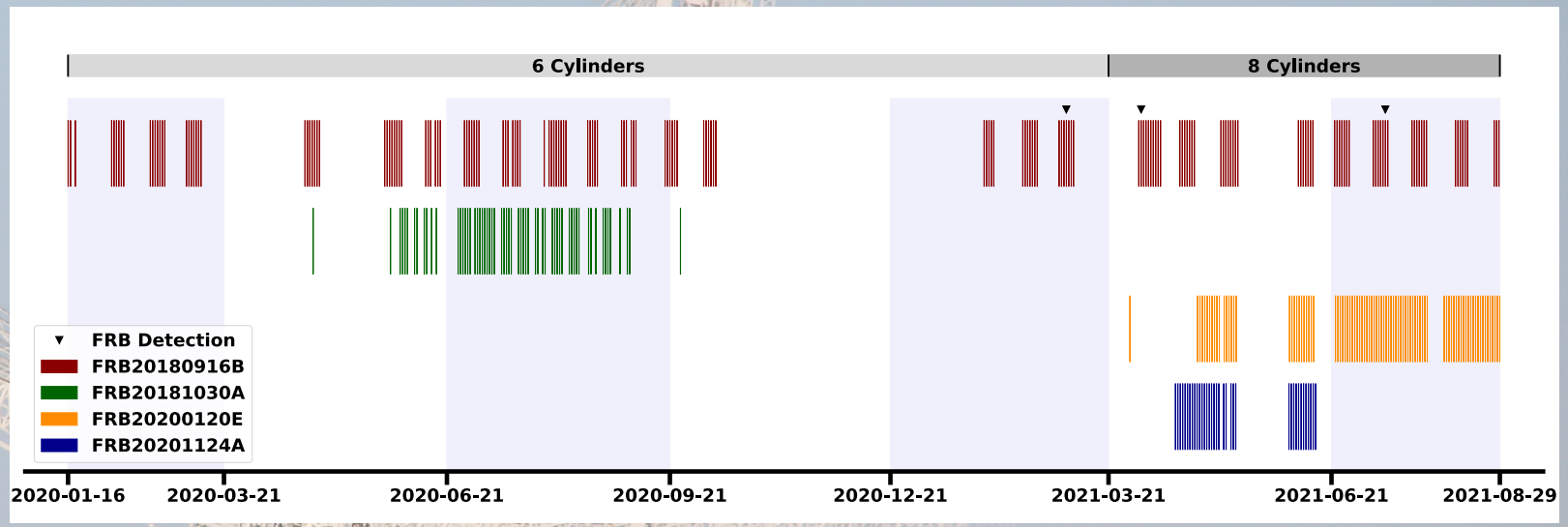
The Northern Cross as an FRB facility

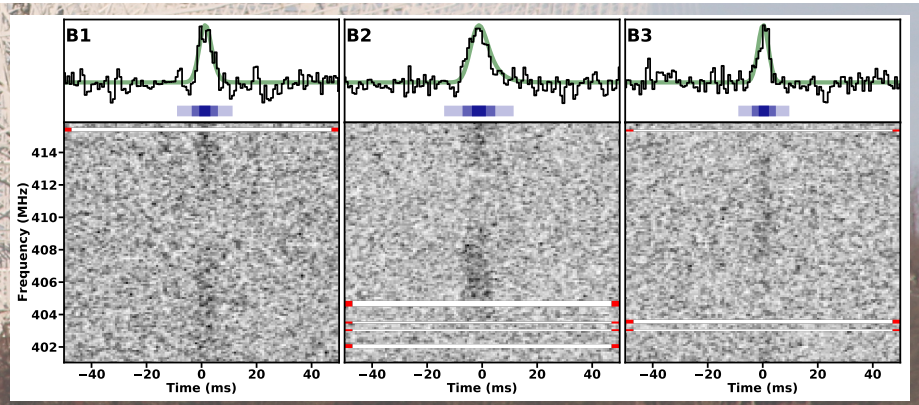
Locatelli et al. 2022, MNRAS

See G. Bernardi's talk

Northern Cross - FRB: Monitoring

- Regular monitoring of 4 active repeaters
- First light: detection of 3 bursts from R3
- Limit on rates of the other repeaters



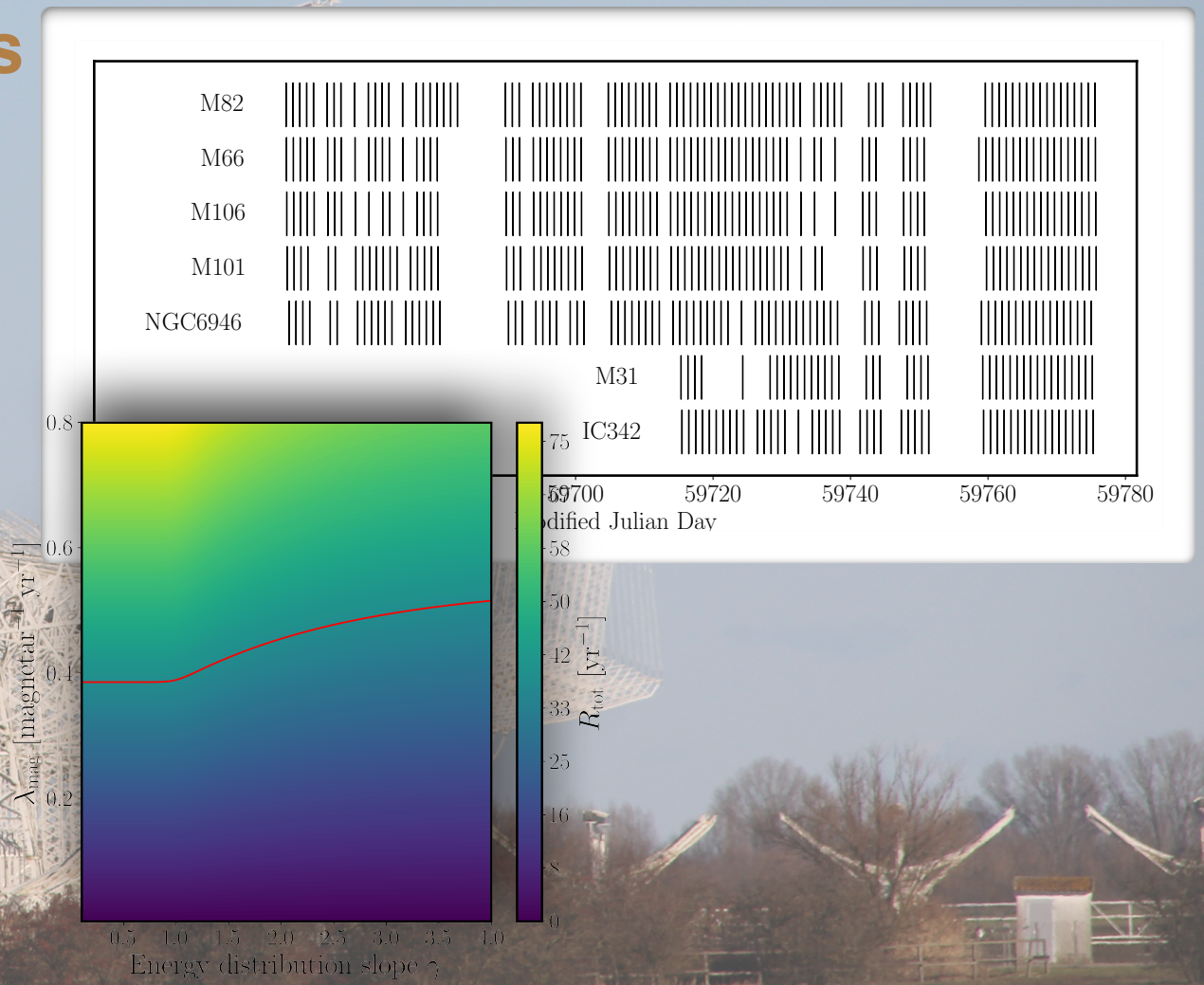


Trudu et al. 2022, MNRAS

Northern Cross - FRB: Surveys

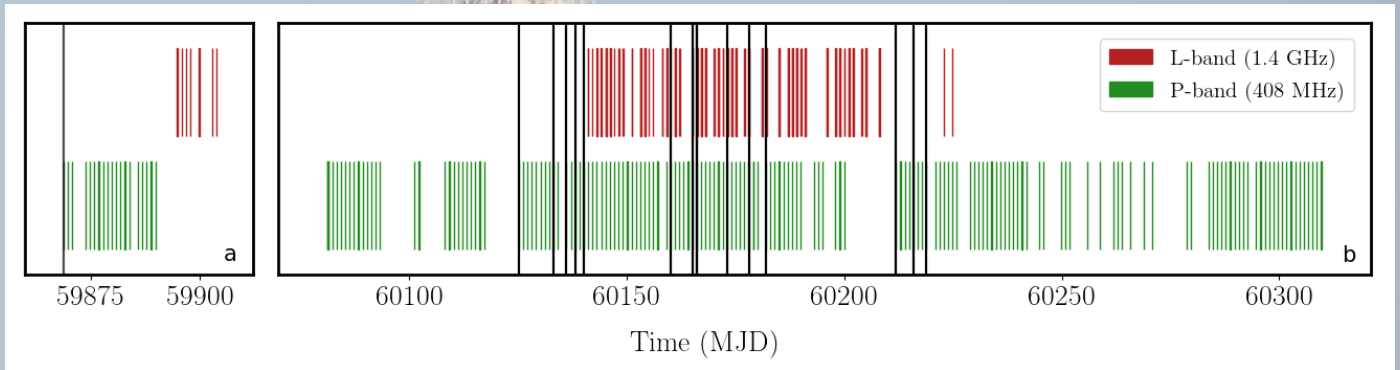
- 7 nearby galaxies with high star formation rate
- Search for magnetars like SGR 1935
- No FRBs discovered in more than 700 hours
- Magnetars like SGR less common than expected

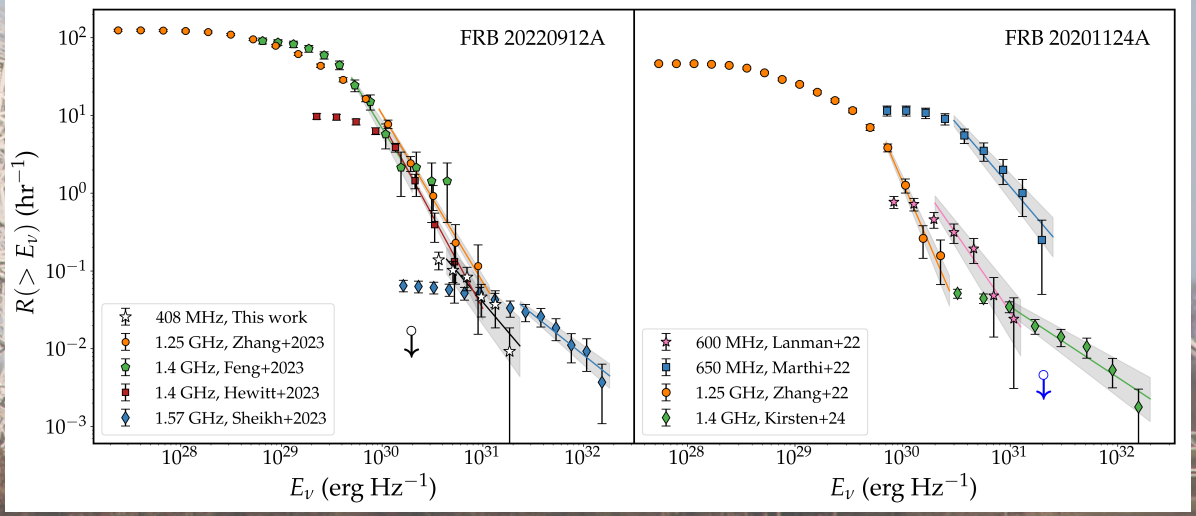
Pelliciari et al. 2023, A&A



Northern Cross - FRB: Monitoring

- FRB 20220912A
- 16 new bursts with fluence up to 147 Jy ms
- None detected at L-band
- Cumulative spectral energy rates



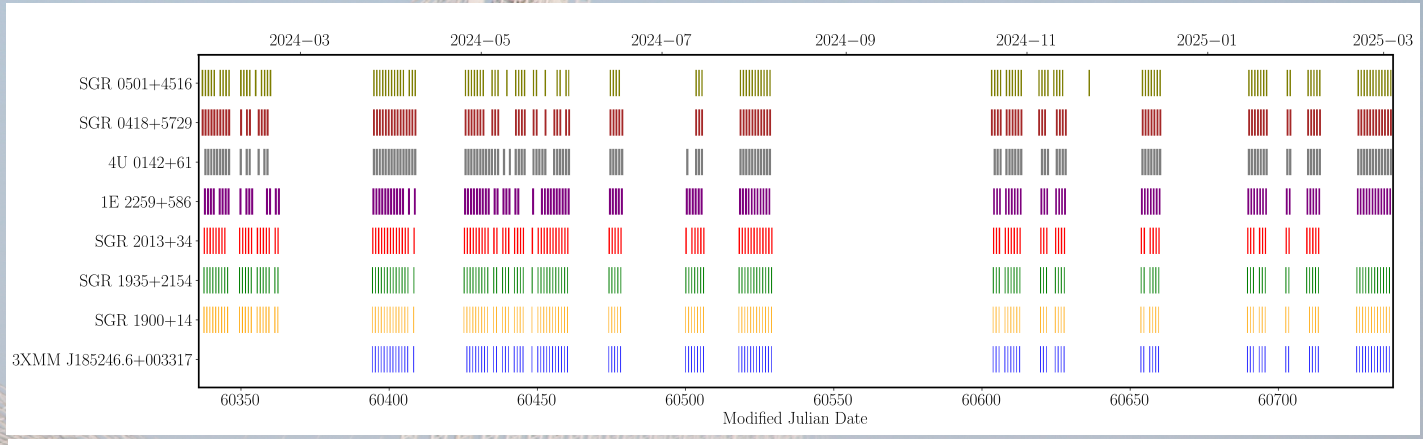


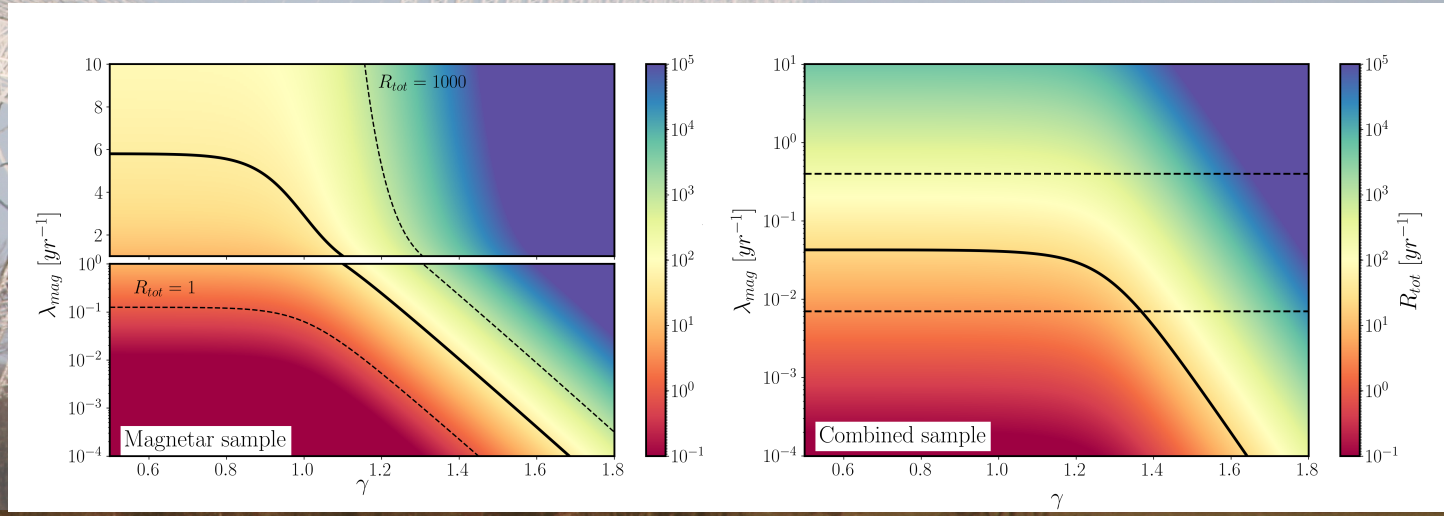
Pelliciari et al. 2024, A&A

Northern Cross - FRB: Surveys

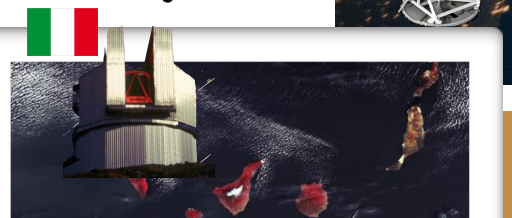
- Galactic magnetars
- No FRBs or radio pulses discovered in more than 500 hours
- Events like the galactic FRB200428 seem subdominant in the global budget of FRB events

Geminardi et al. 2025, A&A





The Northern Cross as a trigger



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The Northern Cross as an FRB facility

See D. Pelliciari's talk

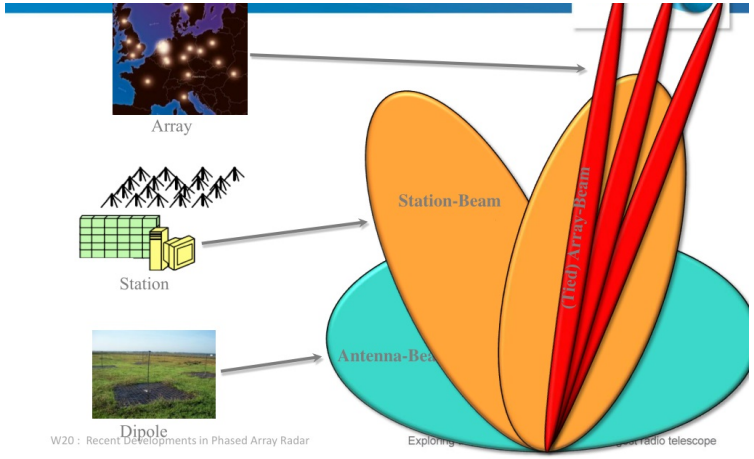
The archive

See L. Bruno's talk

The synergy with the Noto radiotelescope

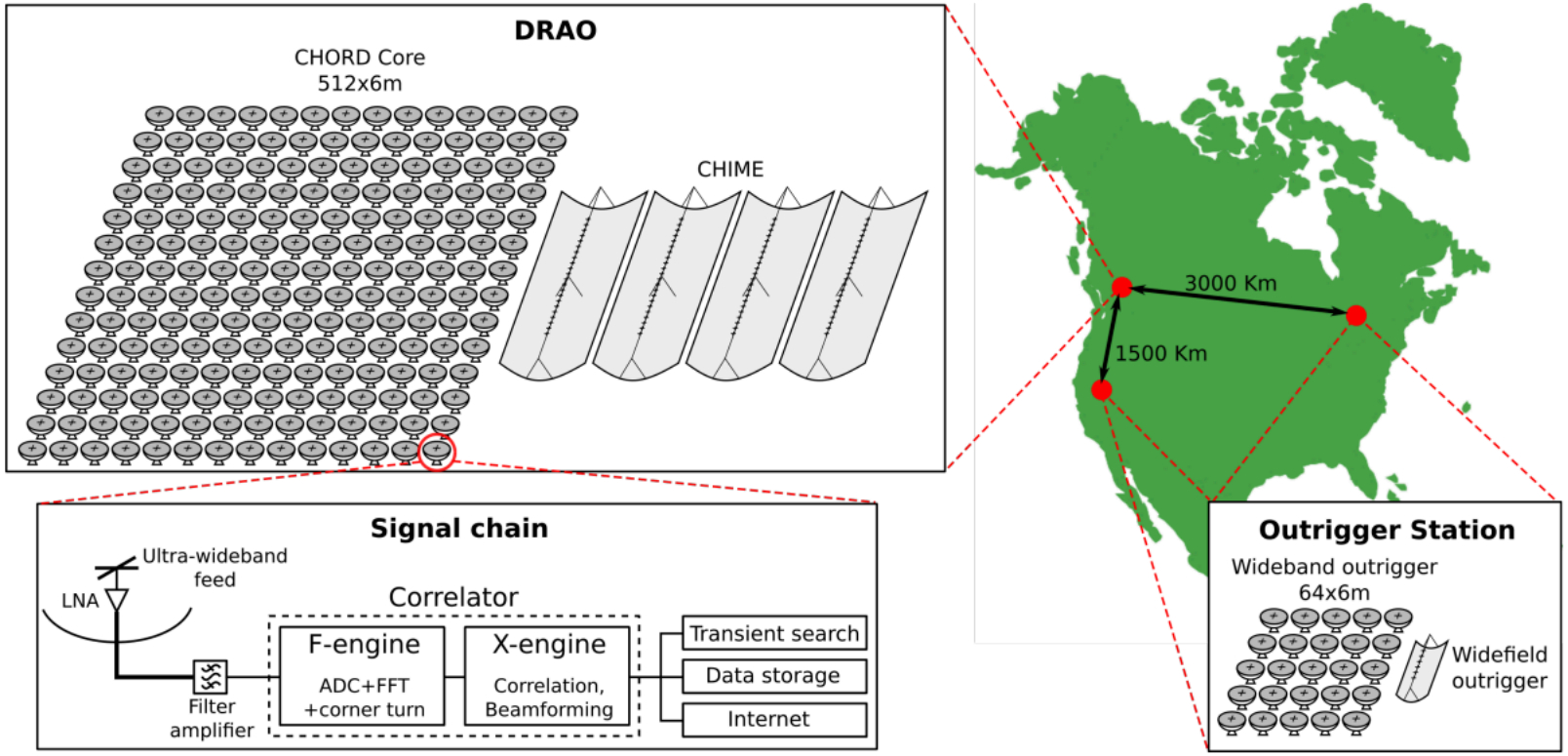
The Canadian Hydrogen Observatory and Radio transient Detector

The importance of interferometry

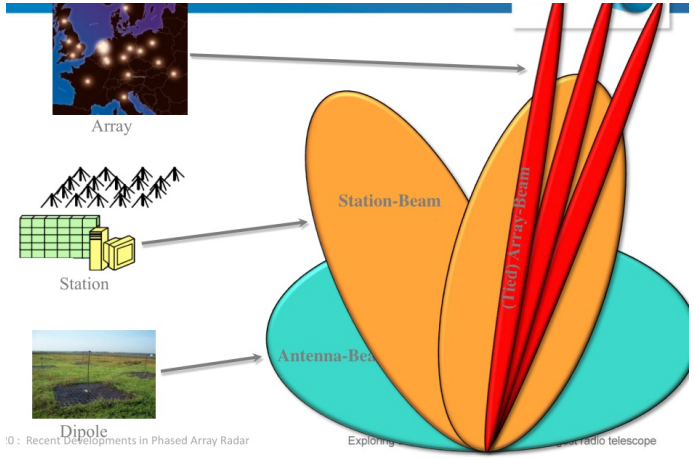


Credits: Bij de Vaate

The importance of interferometry



Vanderlinde et al. 2020, CASCA



Credits: Bij de Vaate

The importance of FRB localisation

See M. Cinus' talk

Our contributions in CHORD

Contribution to the software development

Work Package	System	Assignee	Complexity	Status	Timeline required
Pre-search RFI mitigation???	Search		??		Survey B
Examples from CHIME RFI, play with data					now?
Tools for looking into Incoherent beam during Survey A, D3A					Survey A
Long beam data sets (CHIME, D3A, early pathfinder), invesitgate					now?
Long baseband acquisition from D3A, e.g. during B0329					
Pirate???	Search	Kendrick	??		Survey B
Example RFI metadata from CHIME					
Example RFI intensity data from CHIME					
RFI/astro classifier for each beam: GPU implementation	Search	Martin		Prototyping	Survey B
Grouping in DM, time for each beam: GPU implementation	Search	Matteo T		Prototyping	Survey B
Sifting pipeline framework	Sifting	Dustin		Prototype Done	Survey B
Buffer of events from search pipeline	Sifting	Matteo T			Survey B
Grouping in beam,DM,time	Sifting	Matteo T		Not Yet Started	Survey B
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Localization	Sifting	Paul		Prototyping	Survey B
Galactic-Extragalactic decision (DM checker)	Sifting			Not Yet Started	Survey B
Known Source Sifter	Sifting			Not Yet Started	Survey B
Action Picker	Sifting	Matteo C		Designing	
Action Exectution	Sifting	Matteo C		Designing	
Simplified design for events database	Databases	Dustin		Prototyping	Survey B
Baseband Beamformer	Analysis	Amanda/Mawson/Zarif			Survey A

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See M. Trudu's talk

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See M. Topinka's talk

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See M. Cinus' talk

Summary

THANK YOU

Next Generation – Croce del Nord

IR0000026
Intervento finanziato nell'ambito del PNRR - Piano Nazionale di Ripresa e Resilienza

M4C2
Missione 4 - *Istruzione e Ricerca* **Componente 2 - *Dalla Ricerca alla Impresa***
Linea di Investimento 3.1 - *Rafforzamento e creazione di Infrastrutture di Ricerca*

CUP C53C22000880006