

The INAF Radio Data Archive: recent developments and future perspectives

A. Zanichelli, V. Galluzzi, F. Bedosti, L. Bruno, M. Burgay, G. Coran, A. Fara, C. Knapic, M. Molinaro, M. Nanni, A. Orlati, D. Perrodin, S. Poppi, A. Possenti, S. Righini, M. Sponza, M. Stagni



INAF Radio Telescopes

Observing modes:

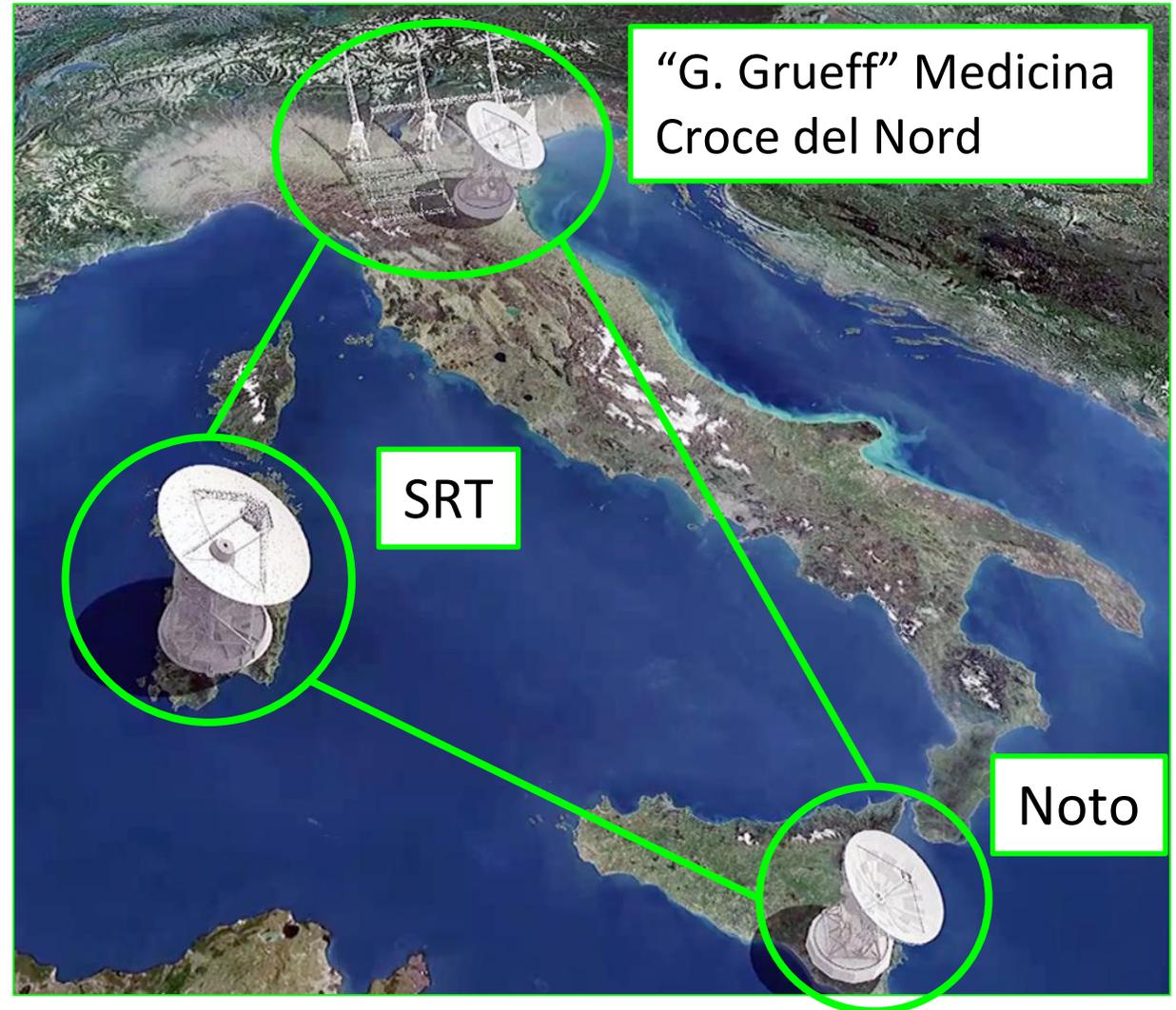
- Single dish
- VLBI (EVN, IVS, EAVN)
- VITA - VLBI ITalian Array (+software correlator)

(Next Generation) Croce del Nord

300 MHz – 116 GHz

Total intensity

Spectropolarimetry



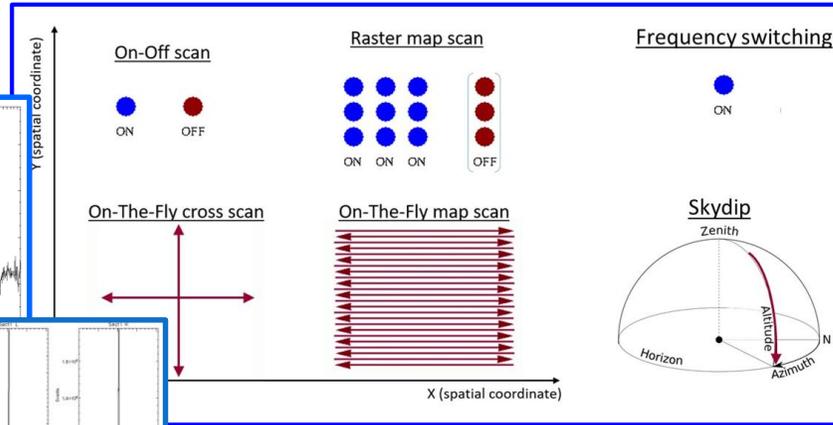
Observing with the INAF radio telescopes

Twice-a-year INAF Call for Proposals. Offered instrumentation, information and access to the Data Archive at <https://www.radiotelesopes.inaf.it/>



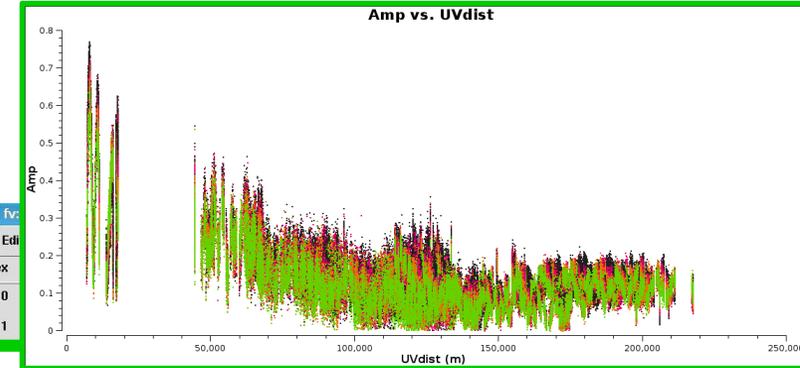
Plus, three EVN call for proposals whose observational data are available through the EVN archive

Observational data products

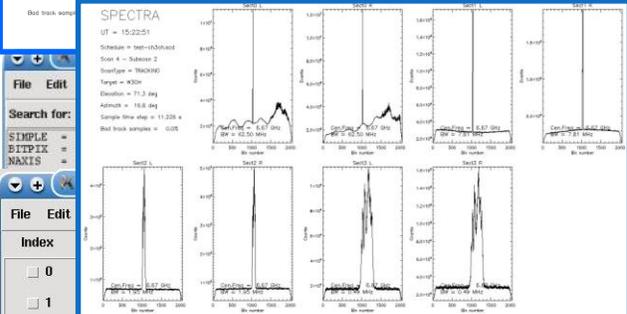
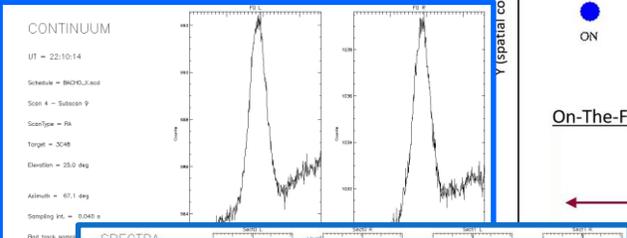


Single-dish

VLBI



Index	Table Name	Format	Dimensions	Header	Hist	Plot	All	Select
0	CONTINUUM	Binary	13 cols X 18 rows	Header	Hist	Plot	All	Select
1	SPECTRA	Binary	6 cols X 1 rows	Header	Hist	Plot	All	Select
5	INTERFEROMETER_MODEL	Binary	20 cols X 210 rows	Header	Hist	Plot	All	Select
6	CALC	Binary	11 cols X 5 rows	Header	Hist	Plot	All	Select
7	MODEL_COMPS	Binary	21 cols X 210 rows	Header	Hist	Plot	All	Select
8	UV_DATA	Binary	13 cols X 8410 rows	Header	Hist	Plot	All	Select
9	SYSTEM_TEMPERATURE	Binary	10 cols X 0 rows	Header	Hist	Plot	All	Select
10	PHASE-CAL	Binary	17 cols X 378 rows	Header	Hist	Plot	All	Select



Index	Table Name	Format	Dimensions	Header	Hist	Plot	All	Select
2	RF INPUTS	Binary	9 cols X 2 rows	Header	Hist	Plot	All	Select
3	FEED TABLE	Binary	4 cols X 1 rows	Header	Hist	Plot	All	Select
4	DATA TABLE	Binary	12 cols X 364 rows	Header	Hist	Plot	All	Select
5	ANTENNA TEMP TABLE	Binary	2 cols X 364 rows	Header	Hist	Plot	All	Select
6	SERVO TABLE	Binary	8 cols X 364 rows	Header	Hist	Plot	All	Select

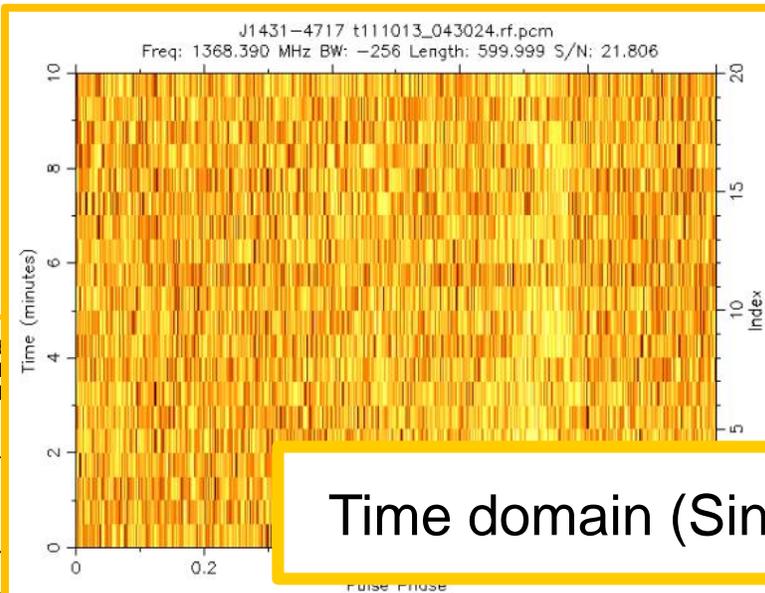
```

VLSR = 0 / Source radial velocity
HIERARCH Azimuth Offset = 0. / Longitude offset in horizontal frame
HIERARCH Elevation Offset = 0. / Latitude offset in horizontal frame
HIERARCH RightAscension Offset = 0. / Longitude offset in equatorial frame
HIERARCH Declination Offset = 0. / Latitude offset in equatorial frame
HIERARCH GalacticLon Offset = 0. / Longitude offset in galactic frame
HIERARCH GalacticLat Offset = 0. / Latitude offset in galactic frame
SCANID = 1 / Scan Identifier
HIERARCH SubScanID = 2 / Subscan Identifier
HIERARCH ScheduleName = '0207060_20140308-105028'
HIERARCH LogFileName = '0207060_20140308-105930 Log'
HIERARCH SubScanType = 'RA' / describes the scan type based on telescope
    
```

```

SIMPLE = T / file d
BITPIX = 8 / num
NAXIS = 0 / num
EXTEND =

COMMENT FITS (Flexible In
[MORE COMMENT LINES]
HDRVER = '4.0
FITSTYPE = 'PSRFITS
DATE = '2018-
UT)
OBSERVER = 'Marta Burgay
    
```



```

= '03:58:54.717' / Right ascension (hh:mm:ss.ssss)
= '+54:13:13.727' / Declination (-dd:mm:ss.sss)
= 0.0547856912665163 / [deg] Beam major axis length
= 0.0547856912665163 / [deg] Beam minor axis length
    
```

Time domain (Single Dish / VLBI)

single
 sss or ddd.ddd)
 .sss or -dd.ddd)
 (ANGC, SCANLAT)
 (mmmmmm.ssss or ddd.ddd)

The INAF Radio Archive Working Group

Alessandra Zanichelli

Francesco Bedosti

Luca Bruno

Marta Burgay

Giacomo Coran

Antonietta Fara

Vincenzo Galluzzi

Cristina Knapic

Marco Molinaro

Mauro Nanni

Andrea Orlati

Delphine Perrodin

Sergio Poppi

Andrea Possenti

Simona Righini

Massimo Sponza

Matteo Stagni



IA2 *Italian Center for Astronomical Archives*
Centro Italiano Archivi Astronomici



INAF
ISTITUTO NAZIONALE
DI ASTROFISICA



Osservatorio
Astronomico
di Cagliari

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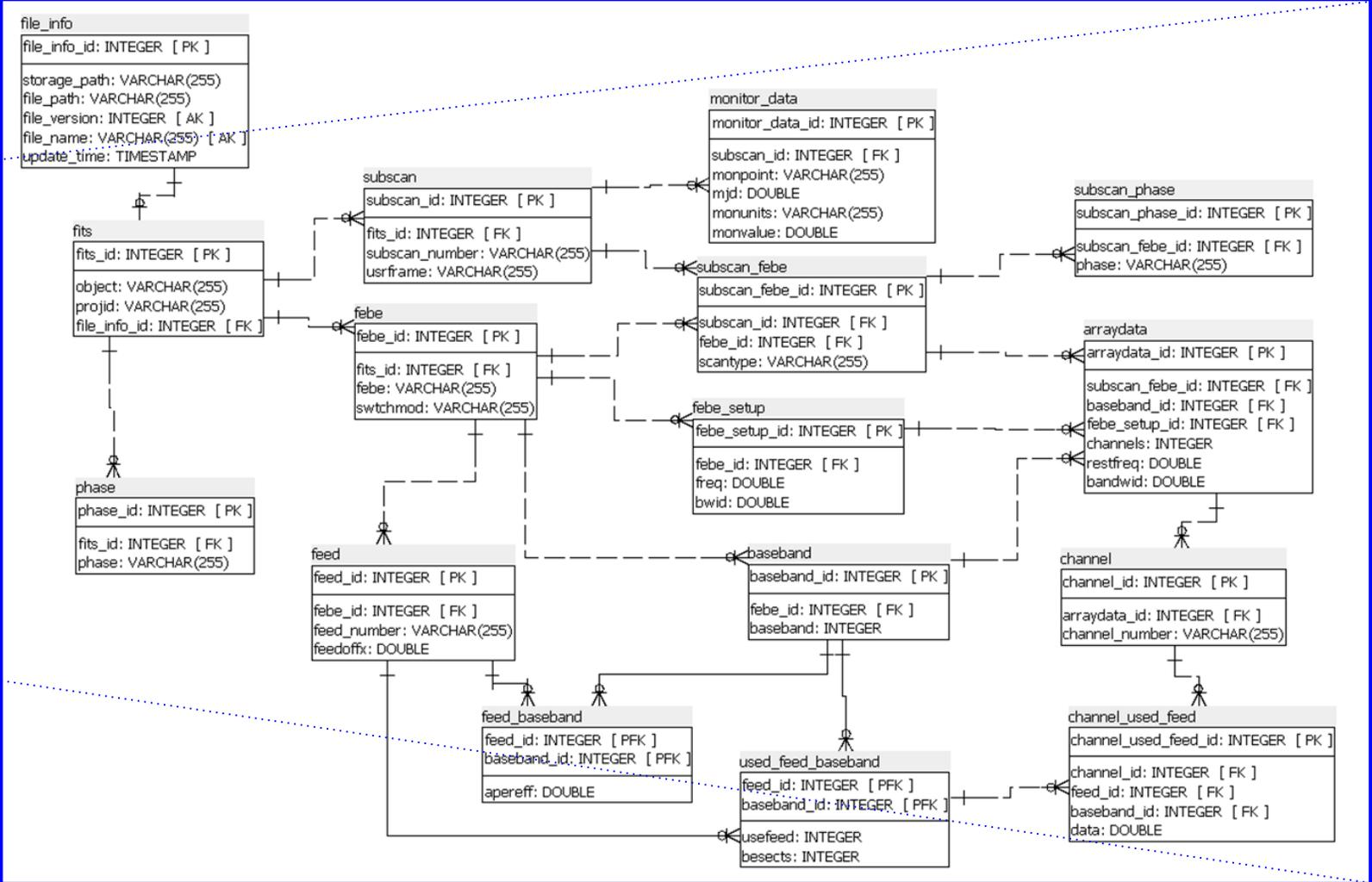
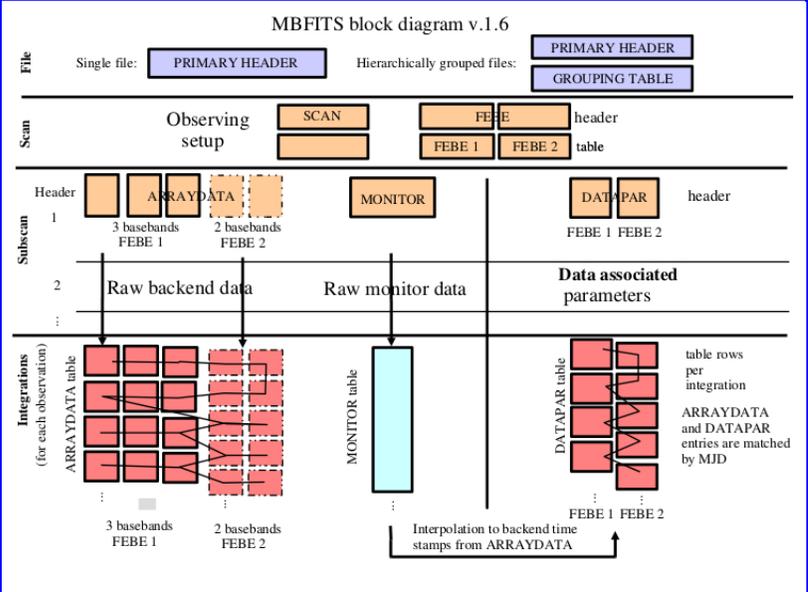
Massimo Sponza

Matteo Stagni



- progettazione, realizzazione e gestione delle componenti dell'archivio
- archiviazione dei dati e loro pubblicazione/distribuzione su web;
- long term preservation;
- compatibilità dell'archivio con gli standard promossi dall'International Virtual Observatory Alliance;
- sfruttamento scientifico dei dati
- realizzazione di un Science Gateway
- data citation

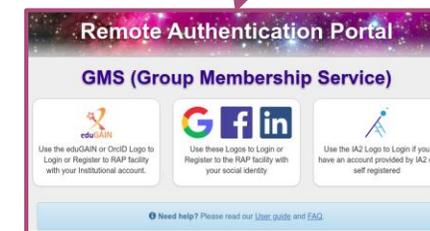
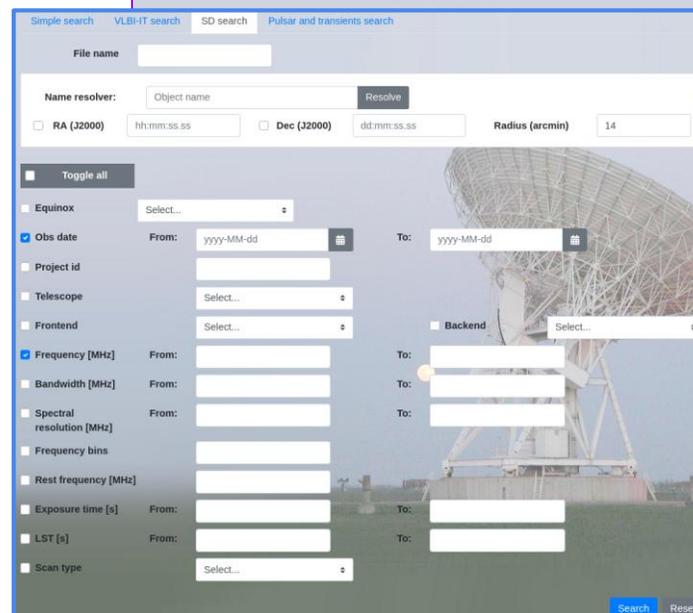
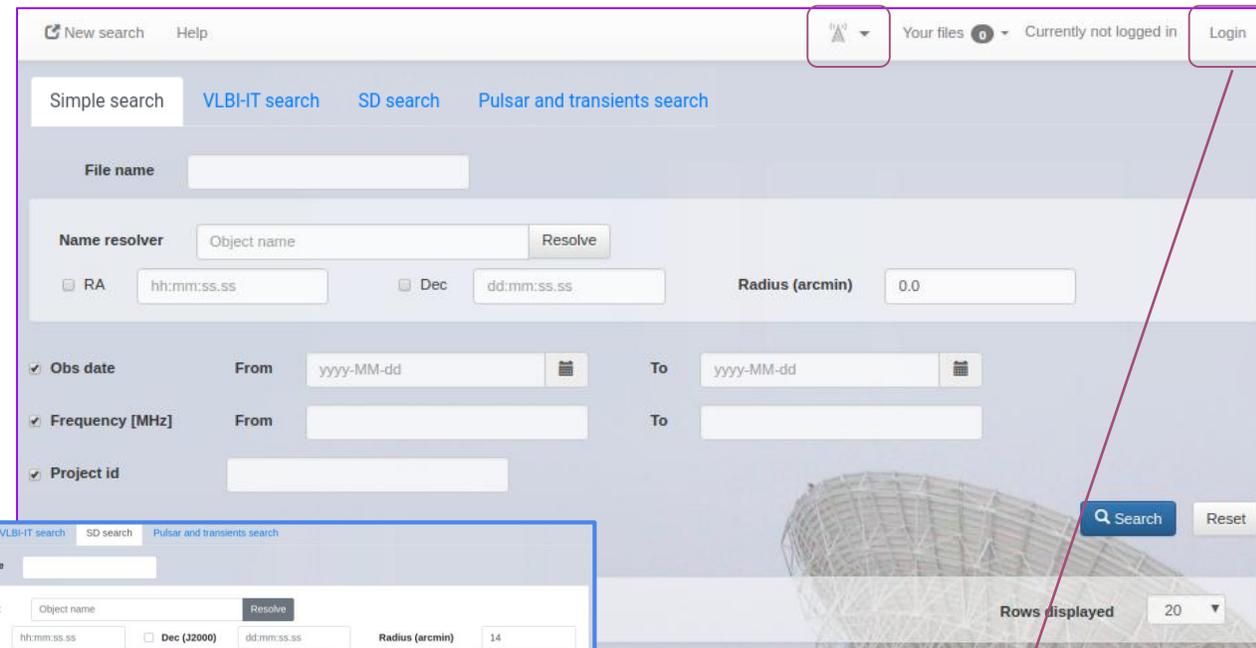
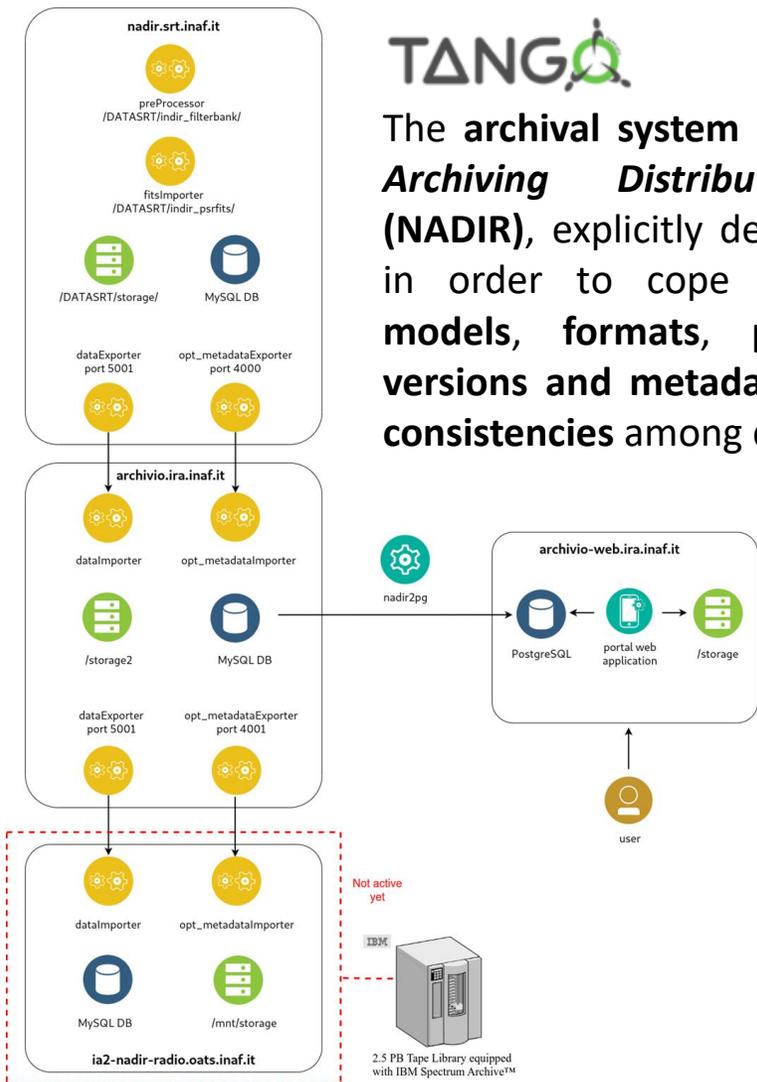
Internal data model example: SD (no-time domain) and VLBI



The archival system

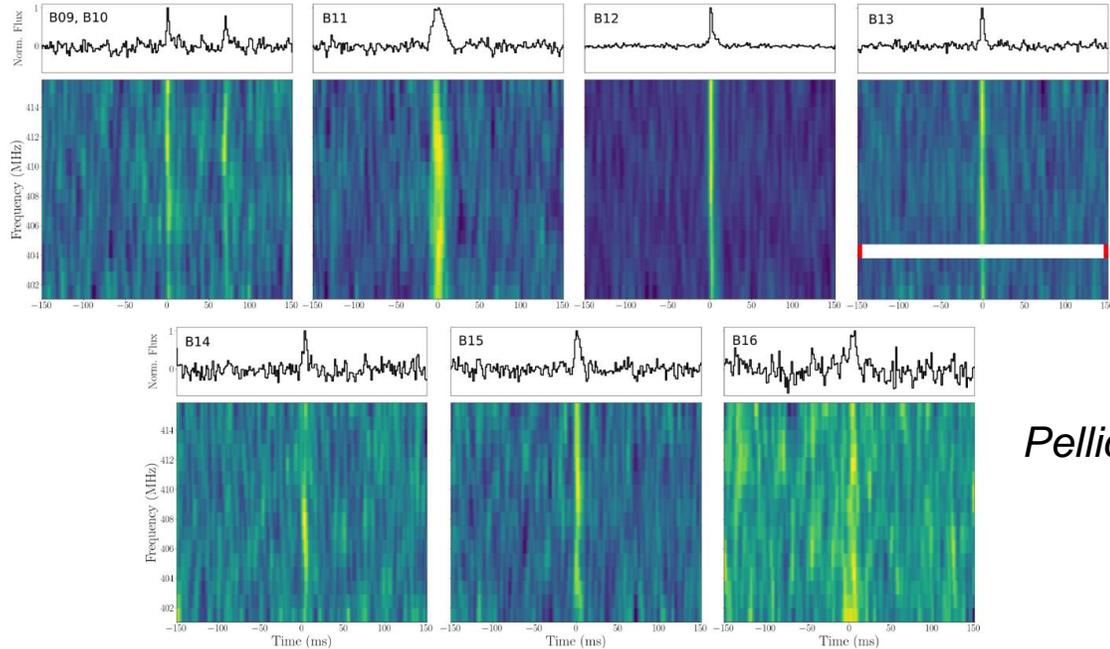


The archival system is based on the **New Archiving Distributed Infrastructure (NADIR)**, explicitly designed to be **flexible** in order to cope with **evolving data models, formats, publication policies, versions and metadata contents, keeping consistencies among different sites.**



New!

Time domain data - Next Generation Croce del Nord



Pellicciari et al. 2024

Fast Radio Burst data observed with the Northern Cross interferometer

Archived products: science-ready cutout (few seconds) datasets around FRB time of arrival + metadata



Data curation: preprocessing data before ingestion

Time consuming process, tailored for the various data types/projects. It (slowly) improves with time - more recent observations

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Correct for discrepancies in metadata: strong dependence on epoch of observation, software version, «degrees of freedom» of the observers, etc...

Inconsistent telescope name

Frontend='Our frontend'

Target name mismatch/missing

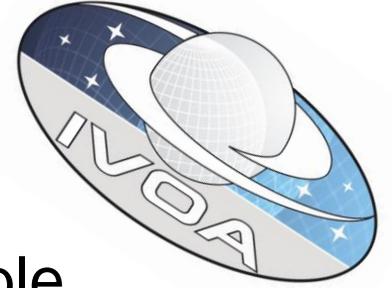
Project ID mismatch/missing

Missing observing date

Handling truncated observations

Incomplete spectroscopic information

FAIRness of data and the Virtual Observatory



- INAF radio data \leftrightarrow **F**indable, **A**ccessible, **I**nteroperable and **R**eusable
- IVOA ObsCore DM is not sufficient to describe radio data

FAIRness of data and the Virtual Observatory



- INAF radio data ↔ **F**indable, **A**ccessible, **I**nteroperable and **R**eusable
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*“Enhancing interoperable data access to radio data has become a science priority within the International Virtual Observatory Alliance (IVOA). This led to the foundation of the **IVOA Radio astronomy Interest Group** ... Together they are paving the way to a better integration of their services in the virtual observatory (VO) infrastructure and propose extension of IVOA standards to help achieving this goal.” (Louys et al 2020)*



**IVOA Obscore Extension for Radio data
Version 1.0**

IVOA Proposed Recommendation 2024-06-14

Working Group

Data Model Working Group

This version

<https://www.ivoa.net/documents/ObsCoreExtensionForRadioData/20240614>

Latest version

<https://www.ivoa.net/documents/ObsCoreExtensionForRadioData>

Previous versions

Author(s)

François Bonnarel, Mireille Louys, Baptiste Cecconi, Vincenzo Galluzzi, Yan Grange, Mark Kettenis, Mark Lacy, Alan Loh, Mattia Mancini, Peter Teuben, Alessandra Zanichelli

Editor(s)

François Bonnarel, Mark Kettenis, Mireille Louys

Future developments

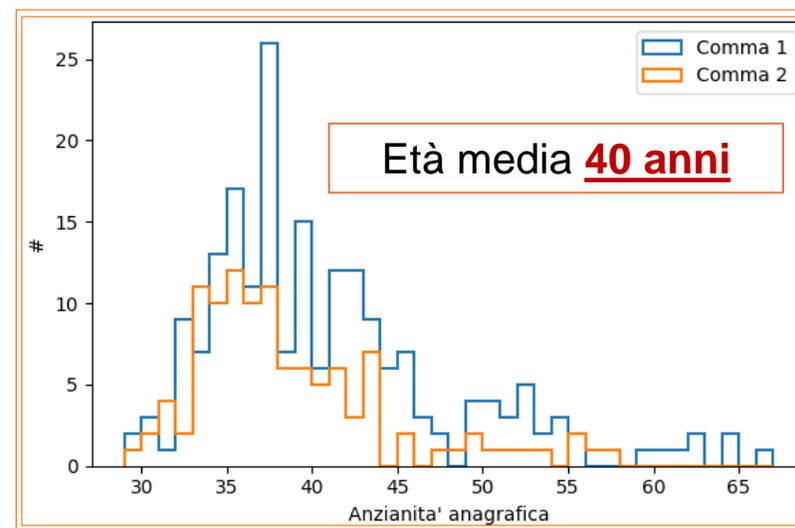
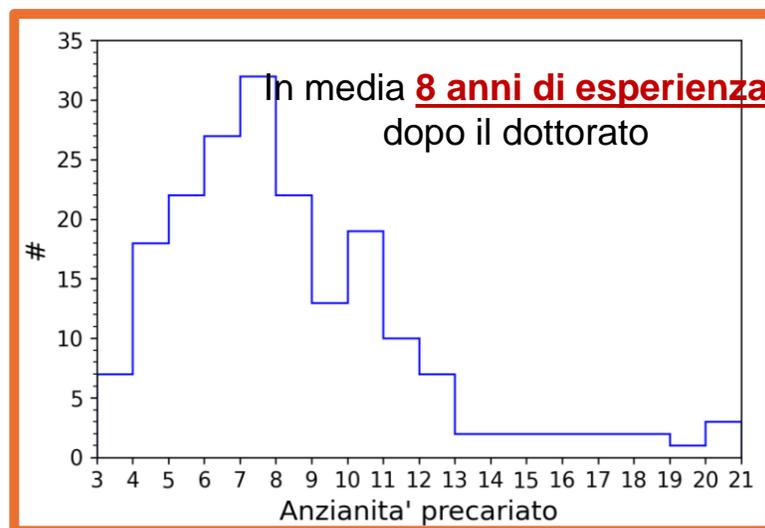
- Complete the collection with Medicina, SRT and VITA data
- Next Generation Croce del Nord
- Publish the INAF Radio Data Archive as a VO resource
- Re-engineering of the archive infrastructure
- Big data from Skarab backends/UWB receivers
- Triband receiver & the GMVA collaboration
- Building a Science Gateway





La situazione del personale precario in INAF è **CRITICA**

1.200 Tempo Indeterminato Vs **650** precari: più di 1 precario ogni 2 persone di ruolo. Tra questi, 300 potrebbero essere assunti a tempo indeterminato con la legge Madia (che scade a fine 2026)



Più 100 precari altamente qualificati e con esperienza decennale rischiano l'esodo da INAF

L'impatto su progetti nazionali e internazionali in cui INAF è coinvolto sarebbe **dirompente**
La raccolta firme a sostegno della Rete Stabilizzandi è ancora aperta

Thank you