

Pre- and post-observation tools @ the (32m) Italian radio telescopes

A. Zanichelli, S. Righini, A. Orlati, K.-H. Mack, C. Knapic, M. Bartolini
et al. from Bologna, Cagliari and Trieste



WHERE DID WE STAND?

Single-dish with the Medicina and Noto 32 m dishes:

- Field System: not suited for single-dish observations
- Backends: custom data formats, custom tools for data reduction
- No systematic feedback
- No systematic data archival

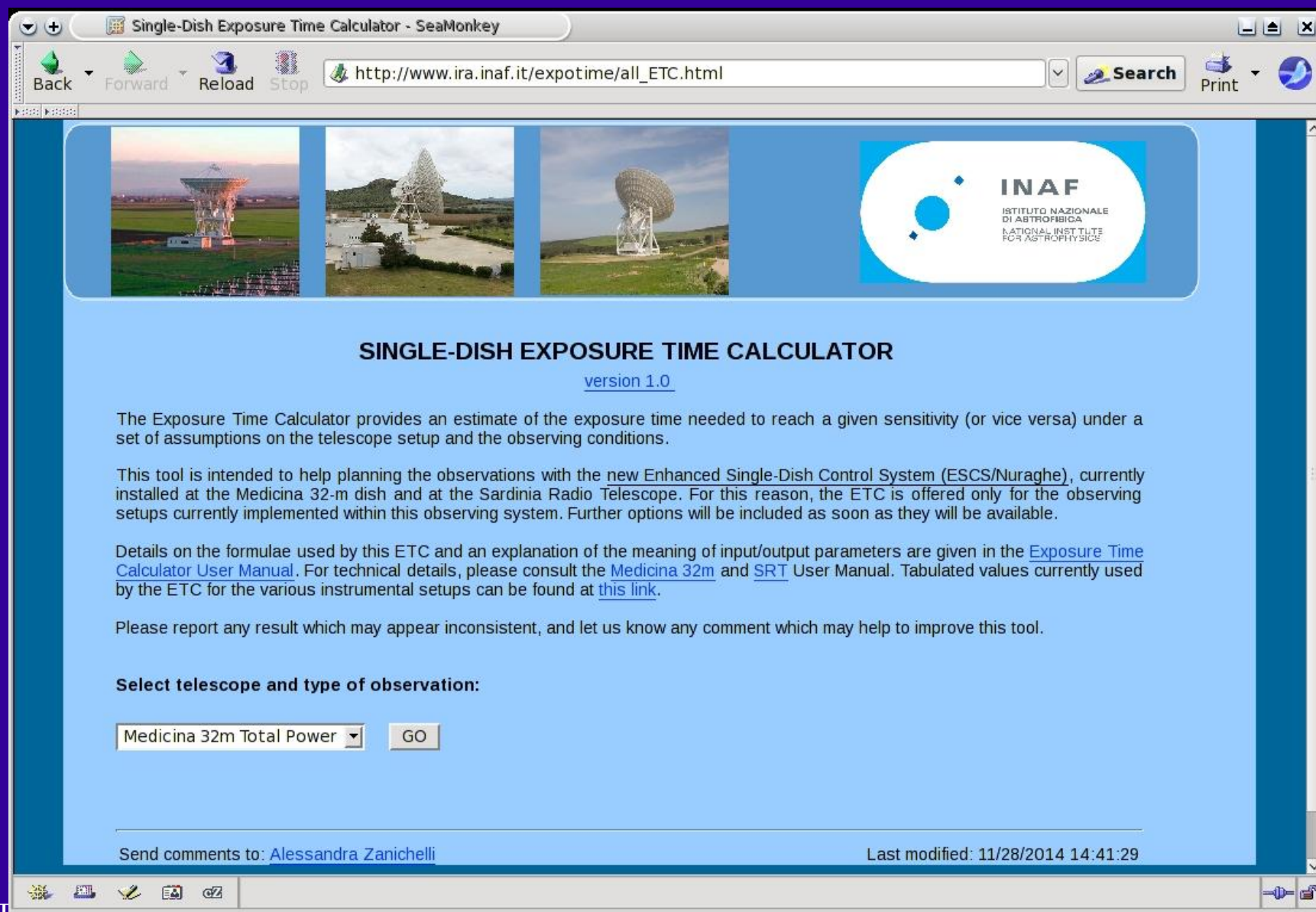
A MODERN RADIO OBSERVATORY

- Enhanced Single Dish Control System / Nuraghe: an common system for the Italian radio telescopes.
- ...But also:
 - Observation Preparation and Feedback
 - Data analysis (formats and tools)
 - Public Archive for radio data

Observation Preparation & Feedback

- **The proposal**
 - **Evaluate exposure time**
 - **Observability**

Observation Preparation & Feedback



The screenshot shows a web browser window titled "Single-Dish Exposure Time Calculator - SeaMonkey". The address bar displays the URL "http://www.ira.inaf.it/expotime/all_ETC.html". The page features a header with three images of radio telescopes and the INAF logo (Istituto Nazionale di Astrofisica). The main content area is titled "SINGLE-DISH EXPOSURE TIME CALCULATOR" and includes a "version 1.0" link. The text explains that the calculator provides an estimate of exposure time based on telescope setup and observing conditions. It notes that the tool is intended for the new Enhanced Single-Dish Control System (ESCS/Nuraghe) at the Medicina 32-m dish and the Sardinia Radio Telescope. Details on the formulae and input/output parameters are provided in the "Exposure Time Calculator User Manual". A "GO" button is visible next to the "Medicina 32m Total Power" dropdown menu. The footer includes a link to "Send comments to: Alessandra Zanichelli" and a timestamp "Last modified: 11/28/2014 14:41:29".

Single-Dish Exposure Time Calculator - SeaMonkey

http://www.ira.inaf.it/expotime/all_ETC.html

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA
NATIONAL INSTITUTE
FOR ASTROPHYSICS

SINGLE-DISH EXPOSURE TIME CALCULATOR

[version 1.0](#)

The Exposure Time Calculator provides an estimate of the exposure time needed to reach a given sensitivity (or vice versa) under a set of assumptions on the telescope setup and the observing conditions.

This tool is intended to help planning the observations with the new Enhanced Single-Dish Control System (ESCS/Nuraghe), currently installed at the Medicina 32-m dish and at the Sardinia Radio Telescope. For this reason, the ETC is offered only for the observing setups currently implemented within this observing system. Further options will be included as soon as they will be available.

Details on the formulae used by this ETC and an explanation of the meaning of input/output parameters are given in the [Exposure Time Calculator User Manual](#). For technical details, please consult the [Medicina 32m](#) and [SRT](#) User Manual. Tabulated values currently used by the ETC for the various instrumental setups can be found at [this link](#).

Please report any result which may appear inconsistent, and let us know any comment which may help to improve this tool.

Select telescope and type of observation:

Medicina 32m Total Power

Send comments to: [Alessandra Zanichelli](#) Last modified: 11/28/2014 14:41:29

**SRT**

Sardinia Radio Telescope

SRT Total Power Observations

[version 1.0](#)

Receiver and backend parameters

Receiver **Total Power backend:** Bandwidth per IF (MHz) Number of output IFs

Observational parameters

Source elevation (degrees) Season [Radiometer Formula computations](#)

(An example of computation for Position Switching observations will be given in the output page.)

 [On-The-Fly Cross Scan](#)Scan Speed (arcmin/sec) Scan length (integer n. of HPBW) Sampling interval (sec) [On-The-Fly Map](#)Scan Speed (arcmin/sec) Map edge (integer n. of HPBW) Sampling interval (sec) Scans/HPBW Pointlike: Flux (mJy/beam) Extended: Flux (mJy) x size (arcmin) y size (arcmin)

If sensitivity is given the corresponding time is computed, and vice versa.

 Sensitivity (mJy/beam) Total time (sec)

SRT ETC for Total Power Results

www.ira.inaf.it/cgi-bin/expotime/radioEtc Cerca

Summary of Input Parameters

Backend: Continuum
Receiver: K (22 GHz)
HPBW: 0.80 arcmin
N. of output IF: 2
Bandwidth per IF: 2000.000 MHz
Source elevation: 30.00 deg
Season: Autumn
Requested computations: OTF Map
Scan Speed: 3.00 arcmin/sec
Map edge in HPBW: 5
Sampling interval: 0.040 sec
Source geometry: extended
Scans per HPBW: 3.00
Source flux: 15.00 mJy
Source X size: 0.5 arcmin
Source Y size: 0.5 arcmin
Requested Total Sensitivity: 1.000 mJy/beam

Results

Receiver gain: 0.66 K/Jy
Actual elevation used for computations: 30.00 deg
Receiver Temperature: 25.00 K
Atmospheric Opacity: 0.13
System Temperature: 87.05 K
Confusion Noise: 0.03 mJy at frequency 20.000 GHz and for a spectral index $\alpha=0.5$
Total N. of Maps: 5
Total OTF Map Time: 1178.23 sec
Effective Total OTF Map sensitivity: 1.039 mJy/beam
Map size: 8.85 arcmin

Compute Reset Form

Observation Preparation & Feedback

CASTIA - Source Visibility

CASTIA is a software package able to check radio source visibility at a given date from a collection of international facilities. The tool outputs plots containing the visibility and the elevation of radio sources versus time. A special mark is used for the transit time and visual warnings are present when the azimuth rate is beyond the recommended limit or superposition with the sun/moon occurs. The query can be done by source name, sent to the SIMBAD name resolver for finding the corresponding right ascension and declination, or by giving coordinates for a single source or for a group of targets.

Parameters:

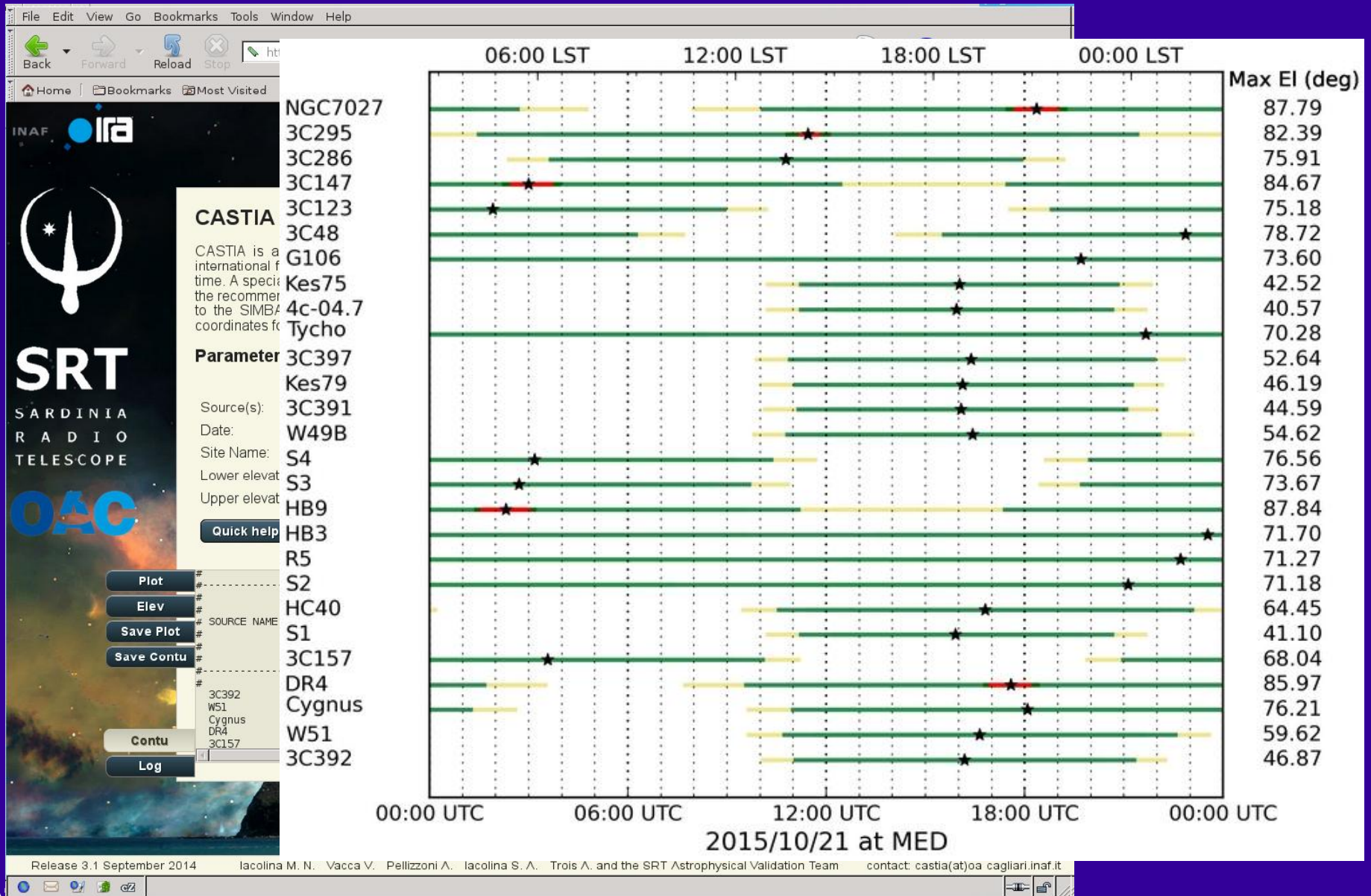
Source(s):
 Date:
 Site Name:
 Lower elevation:
 Upper elevation:

ELEVATION LSTs (hh:mm:ss.ss) IN DATE 2015/10/21 at MED

SOURCE NAME	SH-RISE	LE-RISE	UE-RISE	TRANSIT	UE-SET	LE-SET	SH-SET
	20.0	10.0	80.0		80.0	10.0	20.0
	deg	deg	deg		deg	deg	deg
3C392	14:49:16.01	13:49:06.15	NONE	18:56:47.63	NONE	0:10:22.94	23:10:13.06
WS1	14:24:11.90	13:29:05.88	NONE	19:24:33.36	NONE	1:25:32.25	0:30:26.22
Cygnus	14:49:16.01	13:44:06.34	NONE	20:51:39.84	NONE	4:03:12.17	2:50:40.19
DR4	13:34:05.70	12:19:04.40	19:34:48.79	20:21:24.21	21:15:02.21	4:28:12.26	2:50:40.19
3C157	0:45:28.68	23:45:18.83	NONE	6:17:57.89	NONE	12:54:05.14	11:54:00.30

Release 3.1 September 2014 Iacolina M. N., Vacca V., Pellizzoni A., Iacolina S. A., Trois A., and the SRT Astrophysical Validation Team contact: castia(at)oa.cagliari.inaf.it

Observation Preparation & Feedback



Observation Preparation & Feedback

- The proposal
 - Evaluate exposure time
 - Observability

- **The observations**
 - Schedule creation and online observing tools
 - **End of Mission Report: a feedback to the Observatory**

Observer

Feedback

- The pr
- Evalu
- Obser

- The o
- Sche
- End

IRTF INSTITUTO NAZIONALE DI ASTROFISICA
ISTITUTO DI RADIOASTRONOMIA

Back Home About us People Research Radiotelescopes Computing Outreach Site map

Observer Feedback Report

Observer

Email

Project Number

Observing Dates

Telescope Medicina 32m Noto 32m Combined Medicina+Noto

Please rate your observing run and comment below on aspects of the service which you feel need a detailed description.

Overall satisfaction with the service provided:

Excellent Good Sufficient Poor

Did you achieve the objectives of your proposal?

Yes Partly No

Time loss (how much and for what reasons).

< 10% 10 - 30 % 30 - 50 % 50 - 70 % 70 - 90 % > 90 %

Telescope Receiver/Backend Weather Other

Radio Interference

Yes No

If yes, at which level?

Strong Medium Barely detected

Please describe when and type (repetitive pulses, broad band..):

Overall Performances

Telescope	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor
Receiver/Backend	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor
Software	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor
Astronomical support	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor <input type="radio"/> n/a
Technical support	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor <input type="radio"/> n/a
Documentation	<input type="radio"/> Excellent <input checked="" type="radio"/> Good <input type="radio"/> Sufficient <input type="radio"/> Poor <input type="radio"/> n/a

DATA ANALYSIS

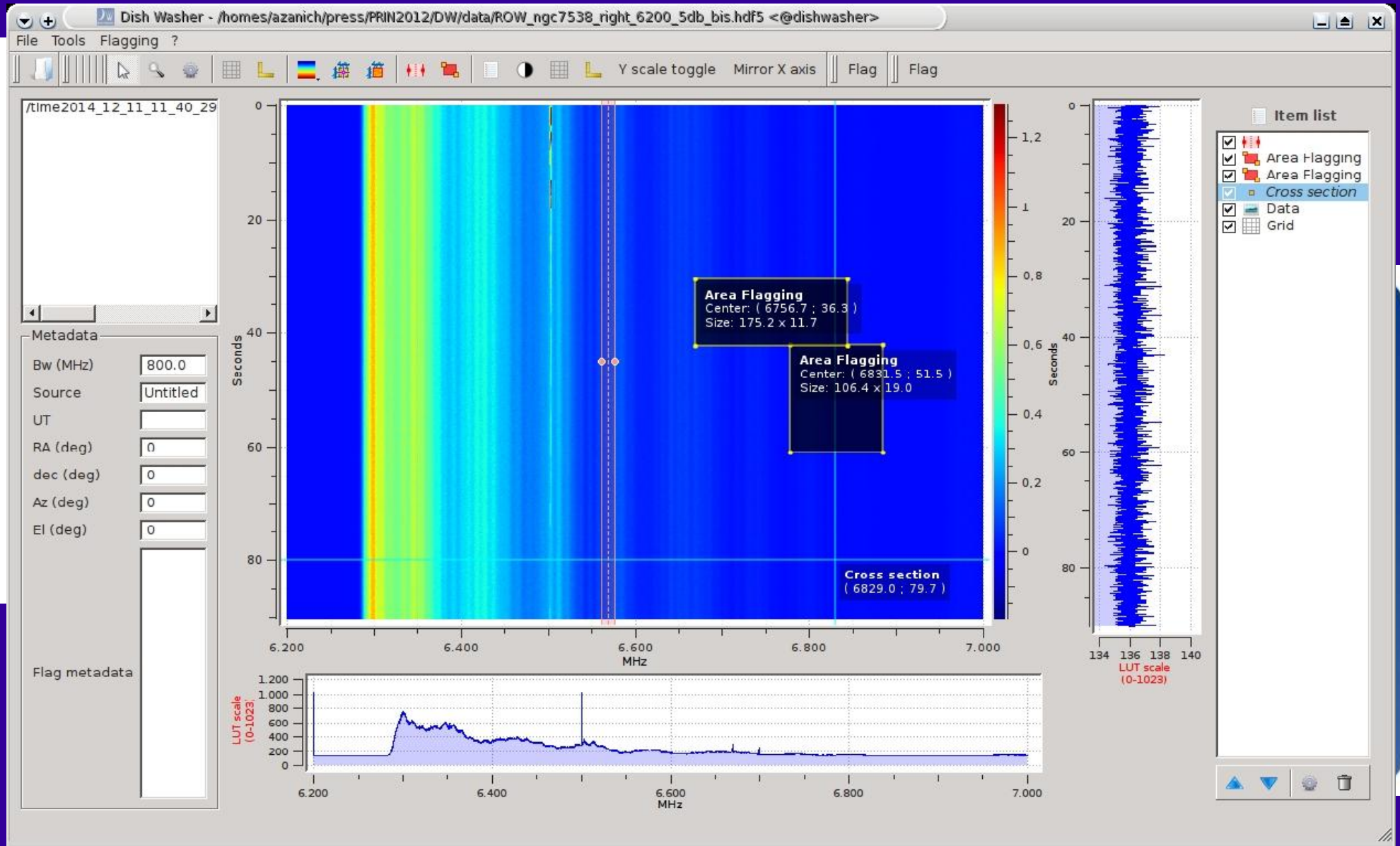
- **Data Reduction Tools**
 - RFI flagging
 - OTF Cross Scans
 - OTF Maps

DATA ANALYSIS

- RFI is a most serious problem for the Italian radio telescopes.
- Medicina 32m: a *pathfinder* for the evolution of the RFI situation in other European regions?
- **Dish Washer**: a software tool to ease the identification and mitigation of RFI in single-dish data.
- Supported formats: FITS (and HDF5)
- *Tecno Project* financed by INAF in 2012 (PI K.-H. Mack)



DATA ANALYSIS



DATA ANALYSIS

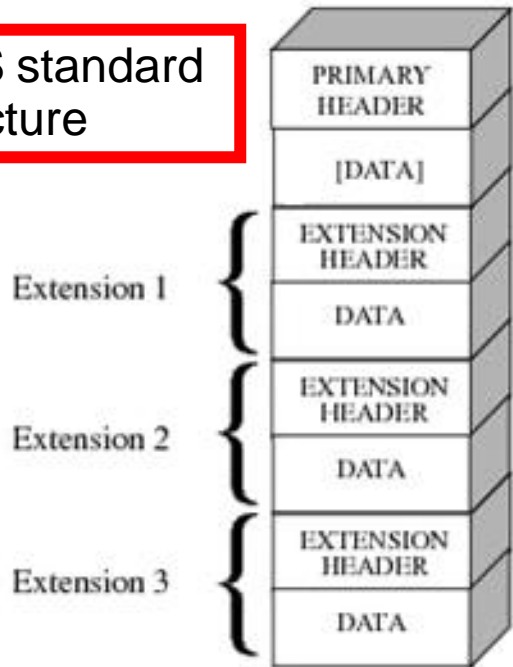
- **Data Reduction Tools**
 - RFI flagging
 - **OTF Cross Scans**
 - **OTF Maps**

DATA ANALYSIS

- **Data Reduction Tools**
 - RFI flagging
 - OTF Cross Scans
 - OTF Maps

- **Data Formats**
 - **Standard FITS for single-dish observations**
 - Standard MBFITS (ongoing)
 - **VLBI-IT data**

FITS standard structure



```

fv: Header of 20140308-105032-Maintenance-Empty_001_002.fits[0]
File Edit Tools Help
Search for: [ ] Find Case sensitive? No
SIMPLE = T / file does conform to FITS standard
BITPIX = 8 / number of bits per data pixel
NAXIS = 0 / number of data axes
EXTEND = T / FITS dataset may contain extensions
COMMENT FITS (Flexible Image Transport System) format is defined in 'Astronomy
COMMENT and Astrophysics', volume 376, page 359; bibcode: 2001A&A...376..359H
COMMENT V.1.0 Created by S. Righini, M. Bartolini & A. Orlati
HISTORY V.0.8 First output standard for Italian radiotelescopes
HISTORY V.0.82 The tsys column in data table replaced with the Tant table, it re
HISTORY ports the tsys measurement for each input of each section
HISTORY V.0.9 The section table has been splitted into two tables: sections and
HISTORY rf inputs table
HISTORY V.0.91 Added the flux column in section table
HISTORY V.0.92 SubScanType added as primary header keyword
HISTORY V.1.0 Added new table to store position of subreflector e primary focus
HISTORY receivers: SERVO TABLE
DATE = '2014-03-08T10:50:33' / file creation date (YYYY-MM-DDThh:mm:ss UT)
HIERARCH Project_Name = 'GZT06C' / Name of the project
OBSERVER= / Name of the observer
ANTENNA = 'SRT' / Name of the station
HIERARCH SiteLongitude = 0.161358481873679 / Longitude of the site (radians)
HIERARCH SiteLatitude = 0.689283579621821 / Latitude of the site (radians)
HIERARCH SiteHeight = 650. / Height of the site (meters)
BEAMS = 1 / Number of beams
SECTIONS= 2 / Total number of sections
  
```

fv: Summary of 20140308-105032-Maintenance-Empty_001_002.fits in /home/alex/escs/archivioD

Index	Extension	Type	Dimension	View				
<input type="checkbox"/> 0	Primary	Image	0	Header	Image	Table		
<input type="checkbox"/> 1	SECTION TABLE	Binary	5 cols X 2 rows	Header	Hist	Plot	All	Select
<input type="checkbox"/> 2	RF INPUTS	Binary	9 cols X 2 rows	Header	Hist	Plot	All	Select
<input type="checkbox"/> 3	FEED TABLE	Binary	4 cols X 1 rows	Header	Hist	Plot	All	Select
<input type="checkbox"/> 4	DATA TABLE	Binary	12 cols X 364 rows	Header	Hist	Plot	All	Select
<input type="checkbox"/> 5	ANTENNA TEMP TABLE	Binary	2 cols X 364 rows	Header	Hist	Plot	All	Select
<input type="checkbox"/> 6	SERVO TABLE	Binary	8 cols X 364 rows	Header	Hist	Plot	All	Select

ta
ifies the receiver
ht ascension at J2000 (r
ation at J2000 (radians)
orizontal frame
zonal frame
n equatorial frame
uatorial frame
galactic frame
lactic frame
ype based on telescope m

FITS standard structure

Extension 1

Extension 2

Extension 3

```

fv: Header of Sum-20150917-125302-maintenance-w3oh.fits[0] in /hor
File Edit Tools Help
Search for: Find Case sensitive? No
SIMPLE = T / file does conform to FITS standard
BITPIX = 8 / number of bits per data pixel
NAXIS = 0 / number of data axes
EXTEND = T / FITS dataset may contain extensions
COMMENT FITS (Flexible Image Transport System) format is defined in 'Astronomy
COMMENT and Astrophysics', volume 376, page 359; bibcode: 2001A&A...376..359H
HIERARCH Observation Date = '2015-09-17T13:11:15' / file creation date (YYYY-
COMMENT V. 1.1 Created by S. Righini, M. Bartolini & A. Orlati
HISTORY V. 0.8 First output standard for Italian radiotelescopes
HISTORY V. 0.82 The tsys column in data table replaced with the Tant table, it re
HISTORY ports the tsys measurement for each input of each section
HISTORY V. 0.9 The section table has been splitted into two tables: sections and
HISTORY rf inputs table
HISTORY V. 0.91 Added the flux column in section table
HISTORY V. 0.92 SubScanType added as primary header keyword
HISTORY V. 1.0 Added new table to store position of subreflector e primary focus
HISTORY receivers: SERVO TABLE
HISTORY V. 1.01 New keywords in FEED TABLE header to describe derotator configura
HISTORY tion
HISTORY V. 1.1 Summary.fits file included in order to describe the scan configura
HISTORY tion
HIERARCH BackendName = 'XARCOS ' / Backend name
CREATOR = 'ESCS v0.5 ' / Software (incl. version)
HIERARCH Declination = 1.07990841507474 / Target declination (radians)
EQUINOX = 2000 / Equinox of RA, Dec
EXPTIME = 120. / Total integration time (seconds)
FITSVER = 'V. 1.1 ' / FITS version
LST = '14:15:16.7' / Local sidereal time
HIERARCH LogFileName = 'Xarcos-Test-w3oh 20150917_131115.log' / Name of the log
HIERARCH NUSEBANDS = 3 / Number of sections
OBJECT = 'w3oh ' / Target source name
OBSID = 'Moscadelli' / Observer or operator initials
PROJID = '15-01' / ProjectID
CHAN3 = 2048
CHAN2 = 1024
CHAN1 = 256
BWID2 = 450.0
BWID3 = 300.0
BWID1 = 600.0
FREQ3 = 22150.0
FREQ2 = 22100.0
FREQRES3= 146484.0
FREQRES2= 439453.0
FREQRES1= 2343750.0
FREQ1 = 22000.0
HIERARCH RESTFREQ1 = 22235.07985 / Rest frequency (MHz)
HIERARCH RESTFREQ2 = 22235.07985 / Rest frequency (MHz)
HIERARCH RESTFREQ3 = 22235.07985 / Rest frequency (MHz)
HIERARCH ReceiverCode = 'KKC ' / Receiver name
HIERARCH RightAscension = 0.641706660521798 / Target right ascension (radians)
HIERARCH SCANSTART = 0 0 / Scan starting position (deg)
  
```

Index	Extension
<input type="checkbox"/> 0	Primary
<input type="checkbox"/> 1	SECTION TABLE
<input type="checkbox"/> 2	RF INPUTS
<input type="checkbox"/> 3	FEED TABLE
<input type="checkbox"/> 4	DATA TABLE
<input type="checkbox"/> 5	ANTENNA TEMP TA
<input type="checkbox"/> 6	SERVO TABLE

DATA ANALYSIS

- Data

- Data

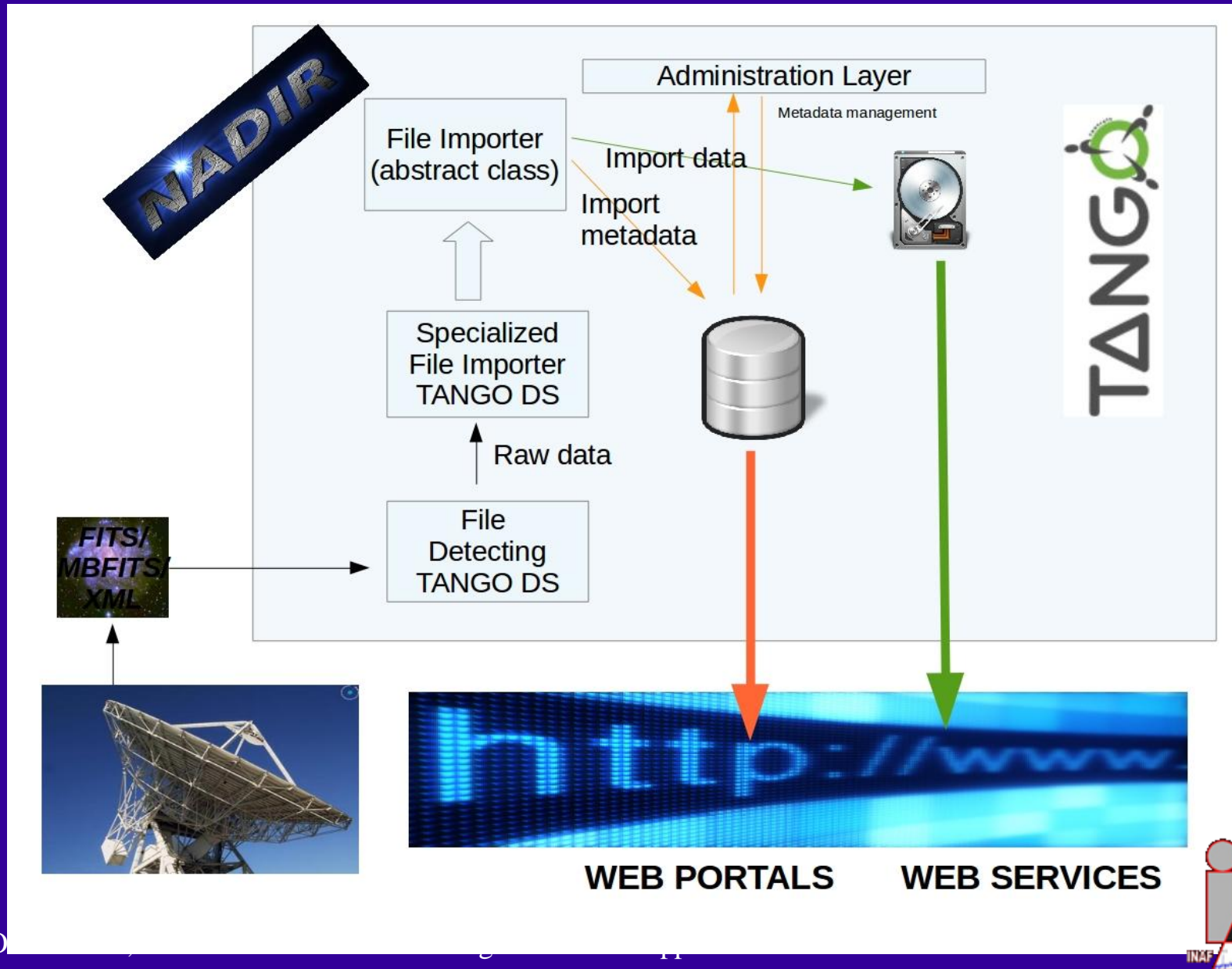
```
1313f.xml + (~/escs/vlbi/vlbiFits_gju2015/L313f) - GVIM
File Edit Tools Syntax Buffers Window Help
[Icons]
<?xml version='1.0' encoding='UTF-8'?>
<database>
  <table>
    <PROJID>1313f</PROJID>
    <TELESCOP>VLBIT</TELESCOP>
    <PINAME>Marcello Giroletti</PINAME>
    <OBJECT>0212+735</OBJECT>
    <RA>30.2918926036</RA>
    <DEC>73.8257282611</DEC>
    <START>2014-03-28 14:19:43</START>
    <ANTENNAS>Nt-Md-Mc</ANTENNAS>
    <FREQ>4966.49</FREQ>
    <OBS_MODE>16x8MHz</OBS_MODE>
    <RATE>512.0</RATE>
    <ONTIME>4430</ONTIME>
  </table>
  <table>
    <PROJID>1313f</PROJID>
    <TELESCOP>VLBIT</TELESCOP>
    <PINAME>Marcello Giroletti</PINAME>
    <OBJECT>0340+362</OBJECT>
    <RA>45.7247090019</RA>
    <DEC>36.370119325</DEC>
    <START>2014-03-28 14:19:43</START>
    <ANTENNAS>Nt-Md-Mc</ANTENNAS>
    <FREQ>4966.49</FREQ>
    <OBS_MODE>16x8MHz</OBS_MODE>
    <RATE>512.0</RATE>
    <ONTIME>4430</ONTIME>
  </table>
  <table>
    <PROJID>1313f</PROJID>
  </table>
-- INSERT --
1,1 Top
```

VLBI-IT
Summary file

THE DATA ARCHIVE

- Collaboration with IA2: INAF Astronomical Archives Service
 - Web based interface, query on selected parameters
 - Data policy: private and/or public access (SSO)
 - VO compliant data and catalogs publication, pipeline management
- Radio Archive contents
 - Single-Dish data from the 32m antennas (and SRT), FITS/MBFITS
 - VLBI-IT data

THE DATA ARCHIVE



NADIR

- Based on TANGO Distributed Control System
- Development of services in the major OO Languages (C++, Java, Python)
- Handling of different data format (FITS/ MBFITS/ HDF5/ XML)
- Flexible revision of policy and versions
- Strong logging and error handling
- Open source
- Maintained at IA2

NADIR is a configurable and flexible software that **answer the challenging problem of archiving software reuse and scalability**. It can also handle calibrated data.

NADIR Mandatory Requirements:

- **INSTRUMENT;**
- **OBS DATE;**

NADIR functional requirements:

- **ProjID;**
- **PINAME;**

Data delivery depends on ingestion date and policy. Policy depends on OWNERSHIP.


THE DATA ARCHIVE

Radio Search - SeaMonkey

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop <http://nadir.ira.inaf.it:8080/radioWeb/> Search Print

Home Bookmarks



[Home](#) [Decimal degrees](#) [Login](#)

Radio Archive

File name

RA Dec Radius

Observation Date From: To:

Frequency MIN: MAX:

Project ID

Frontend

Backend

Bandwidth

THE DATA ARCHIVE

Radio Search - SeaMonkey

File Edit View Go Bookmarks Tools Window Help

Home Decimal degrees Login

Radio Archive

File name

RA Dec Radius

Observation Date From: To:

Frequency MIN: MAX:

Project ID

VLBI-IT SD

Telescope

PI Name

Exposure Time

Antennas

Data Rate

Search

THE DATA ARCHIVE

Radio Search - SeaMonkey

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop Search Print

Home Bookmarks

[Home](#) [Decimal degrees](#) [Login](#)

Radio Archive

File	Date	Ra (hh:mm:ss.ss)	Dec (dd:mm:ss.ss)	Project Id	Frequency
<input type="checkbox"/> FITS.tar	2014-03-08T10:50:33	00:27:00.000	31:35:00.00	13-10	5000.0 - 5330.0
	2014-03-08T10:50:33	00:27:00.000	31:35:00.00	13-10	5200.0 - 5530.0
	2014-03-08T10:50:33	00:27:00.000	31:35:00.00	13-10	4800.0 - 4950.0
<input type="checkbox"/> 20120728-030455-test.tar.gz	2012-07-28T03:04:55	00:27:00.000	31:35:00.00	13-10	5200.0 - 5530.0
	2012-07-28T03:04:55	00:27:00.000	31:35:00.00	13-10	4800.0 - 4950.0
	2012-07-28T03:04:55	00:27:00.000	31:35:00.00	13-10	5000.0 - 5330.0

Grazie !