### Visibility data discovery and access prototype based on ObsTAP + DataLink

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#### Our GOAL

- Demonstrate how we can use existing Standards to expose visibility data in the VO and highlight what is missing by :
- Try to expose a small collection of visibility data observations (masurement sets) in an ObsTAP service
- Solve the Observation / dataset issue
  - Visibilty data observations are genetrally gathering several datasets
- Provide additional information useful for data selection by adding
   « ad hoc » columns in ObsCore table and various information via
   DataLink
- Initiate a discussion on how we can standardize this additional information

### Small MS collection

- Various measurement sets provided by Katharina Lutz and Yelena Stein (post docs at CDS) and Alan Loh (Nançay)
  - 7 ATCA MS
    - Single and multi-fields: 1-2 Ghz, 4-5 Hhz, 6-7Ghz, 40-50 Ghz bands
  - 2 EVLA MS
    - Single and multi fields 1-2 Ghz band
  - 1 LOFAR MS
    - 50-60 Mhz band
  - 1 NENUFAR MS
    - 50-60 Mhz band

# Processed Metadata: listobs output

- For each measurement set we extract metadata using the casa listobs command
- Algorithm to split measurement sets into several datasets and extract ObsCore metadata for them developped by one of us (A.Egner) as an internship.

```
MeasurementSet Name: /home/klutz/Interns/Anais Radio-Data-Archive/Measurement Sets/HI data narrow channels.ms
                                                                                                                            MS Version 2
  Observer: TB.KL
                      Project: C2705
Observation: ATCA
Data records: 18900
                        Total elapsed time = 3229.86 seconds
  Observed from 10-Sep-2015/02:13:20.0 to 10-Sep-2015/03:07:09.9 (UTC)
  ObservationID = 0
             Timerange (UTC)
                                     Scan FldId FieldName
                                                                                 SpwIds
                                                                                        Average Interval(s)
 10-Sep-2015/02:13:20.0 - 02:53:29.9
                                               0 eso208-q026
                                                                          14460 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
             02:54:10.0 - 02:59:09.9
                                               1 0823-500
                                                                          1800 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
             02:59:50.0 - 03:07:09.9
                                               0 eso208-q026
                                                                          2640 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
          (nRows = Total number of rows per scan)
Fields: 2
                               07:35:21.099994 -50.02.34.99996 J2000
                                                                                 17100
           eso208-q026
           0823-500
                               08:25:26.868994 -50.10.38.49003 J2000
Spectral Windows: (4 unique spectral windows and 1 unique polarization setups)
               #Chans
                       Frame
                               ChO(MHz) ChanWid(kHz) TotBW(kHz) CtrFreq(MHz) Corrs
                              3124.000
                                            -1000.000
                2049
                                                       2049000.0
                                                                   2100.0000
                               1410.500
                20/10
                               3124,000
                                            -1000.000
                                                       2049000.0
                                                                   2100.0000
                                                                              XX XY YX YY
                              1410.500
                                                                   1406.2500
Sources: 2
                          SpwId RestFreq(MHz) SysVel(km/s)
     Name
      eso208-q026
                               1420.40575
      0823-500
Antennas: 6:
                                                                Offset from array center (m)
                                                                                                           ITRF Geocentric coordinates (m)
                                                                   East
                                                                                North
                                                                                          Elevation
      CAO1 ANT1
                              +149.33.56.6 -30.08.43.7
                                                              1499.9977
                                                                               0.7721
                                                                                           -1.6135 -4751674.967380 2791612.460760 -3200482.268996
                      22.0 m
                              +149.33.50.3 -30.08.43.7
                                                              1331.6239
                                                                                            -1.7741 -4751589.523380 2791757.543760 -3200482.252996
      CA03 ANT3
                              +149.33.48.0 -30.08.43.7
                                                              1270.4069
                                                                                            -1.8330 -4751558.449380 2791810.287760 -3200482.260996
      CA04 ANT4
                                                                               0.4463
                                                                                            -2.2224 -4751348.704380 2792166.364760 -3200482.244996
                      22.0 m
                              +149.33.32.6 -30.08.43.7
                                                               857.1470
      CA05
                      22.0 m
                              +149.33.28.0
                                            -30.08.43.7
                                                               734.6957
                                                                               0.3678
                                                                                            -2.3296 -4751286.549380 2792271.868760 -3200482.258996
      CA06 ANT6
                      22.0 m
                             +149.31.08.2 -30.08.43.8
                                                              -2999.9964
                                                                              -0.8846
                                                                                            -4.6136 -4749390.961380 2795489.734760 -3200482.194996
```

## A few hints on the choice we made

- A dataset is defined as a subset of contiguous or overlapping SpectralWindows of same Channel Width for a given Field
- obs\_id, facility\_name, instrument\_name built or extracted from generic measurement set information (Observer, project, Observation name, etc..)

\_\_\_\_\_

Observer: TB,KL Project: C2705

Observation: ATCA

Data records: 18900 Total elapsed time = 3229.86 seconds

Observed from 10-Sep-2015/02:13:20.0 to 10-Sep-2015/03:07:09.9 (UTC)

## A few hints on the choice we made

 target\_name , s\_ra, s\_dec, obs\_publisher\_did extracted from the field table for each datasets we create :

```
Fields: 2

ID Code Name RA Decl Epoch SrcId nRows
0 eso208-g026 07:35:21.099994 -50.02.34.99996 J2000 0 17100
1 0823-500 08:25:26.868994 -50.10.38.49003 J2000 1 1800
```

 f\_min, f\_max, em\_min, em\_max, em\_res\_power, em\_xel, pol\_states, pol\_xel, s\_fov, s\_region extracted from the SpectralW indow table

```
Spectral Windows: (4 unique spectral windows and 1 unique polarization setups)
                #Chans
                         Frame
                                Ch0(MHz) ChanWid(kHz)
                                                        TotBW(kHz) CtrFreq(MHz)
                 2049
                        T0P0
                                3124.000
                                             -1000.000
                                                         2049000.0
                                                                     2100.0000
                17409
                       T0P0
                                1410.500
                                                -0.488
                                                            8500.5
                                                                     1406.2500
                        T0P0
                                             -1000.000
                 2049
                                3124.000
                                                         2049000.0
                                                                    2100.0000
                17409
                       T0P0
                                1410.500
                                                -0.488
                                                            8500.5
                                                                    1406.2500
```

s\_fov is estimated as 1.02 \* (central lambda / Antenna Diameter)\* (180/ pi) (f\_min, f\_max non ObsCore columns)

# A few hints on the choice we made

t\_min, t\_max, t\_exptime extracted from « scan table »

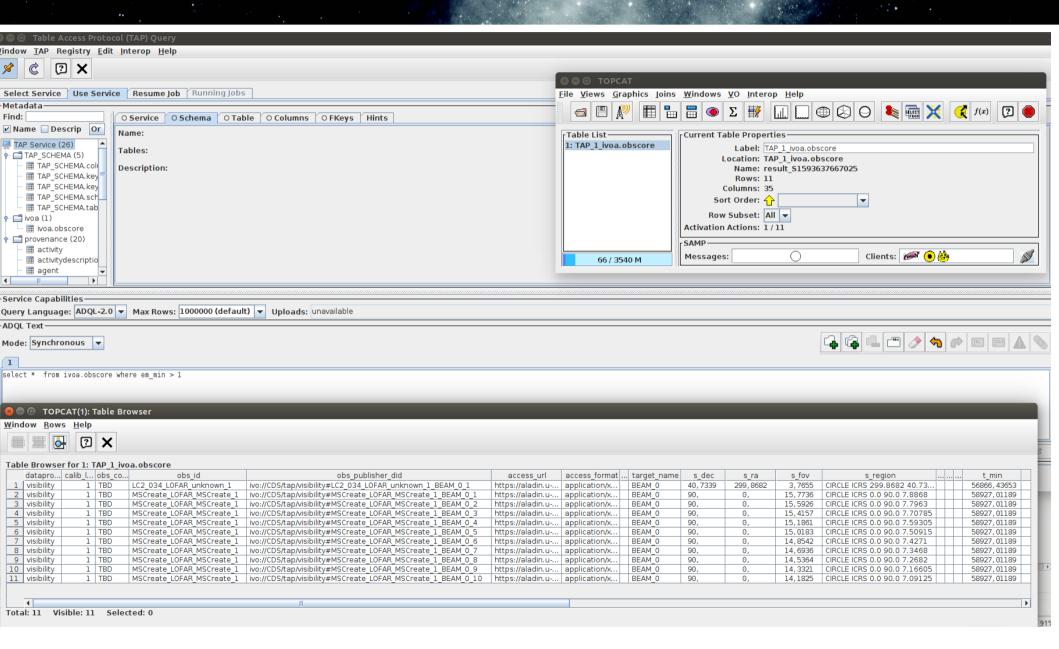
```
Date Timerange (UTC) Scan FldId FieldName nRows SpwIds Average Interval(s) ScanIntent
10-Sep-2015/02:13:20.0 - 02:53:29.9 0 0 eso208-g026 14460 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
02:54:10.0 - 02:59:09.9 1 1 0823-500 1800 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
02:59:50.0 - 03:07:09.9 2 0 eso208-g026 2640 [0,1,2,3] [9.86, 9.86, 9.86, 9.86]
(nRows = Total number of rows per scan)
```

- Antenna diameter from Antenna table (common value)
- Still unsolved :
  - s\_resolution, s\_xel1,s\_xel2
  - t\_resolution, t\_xel
  - obs\_collection

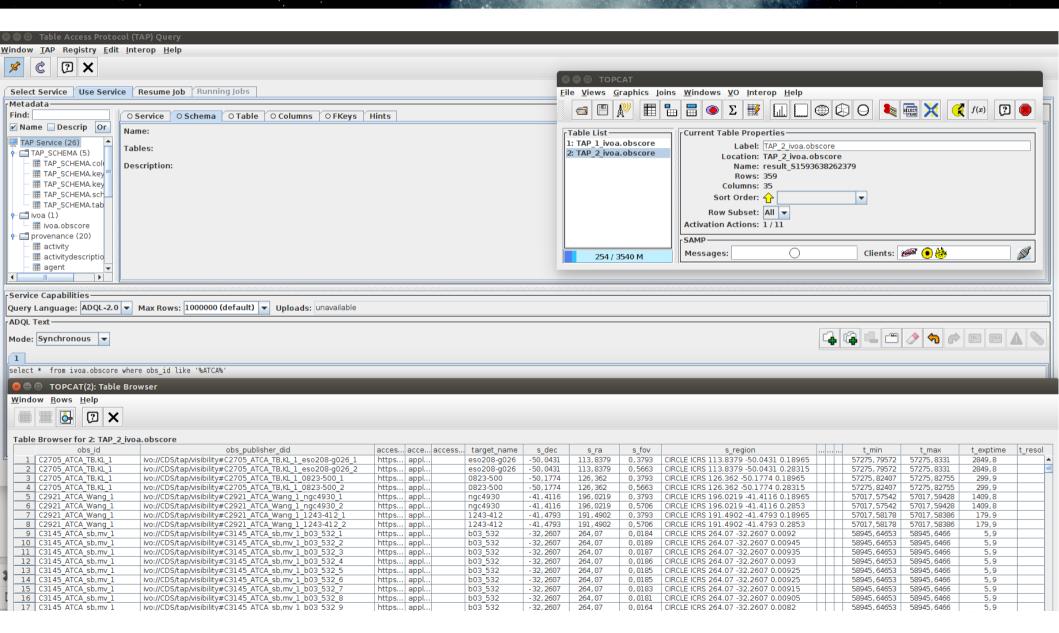
# Visibility data ObsTAP CDS prototype

- A service with 374 different datasets from 11 observations
- access\_url gives a DataLink response
   VOTable providing links to
  - Full listobs result file
  - MS zip file
  - Various plots (uv coverage, antennae, etc...)

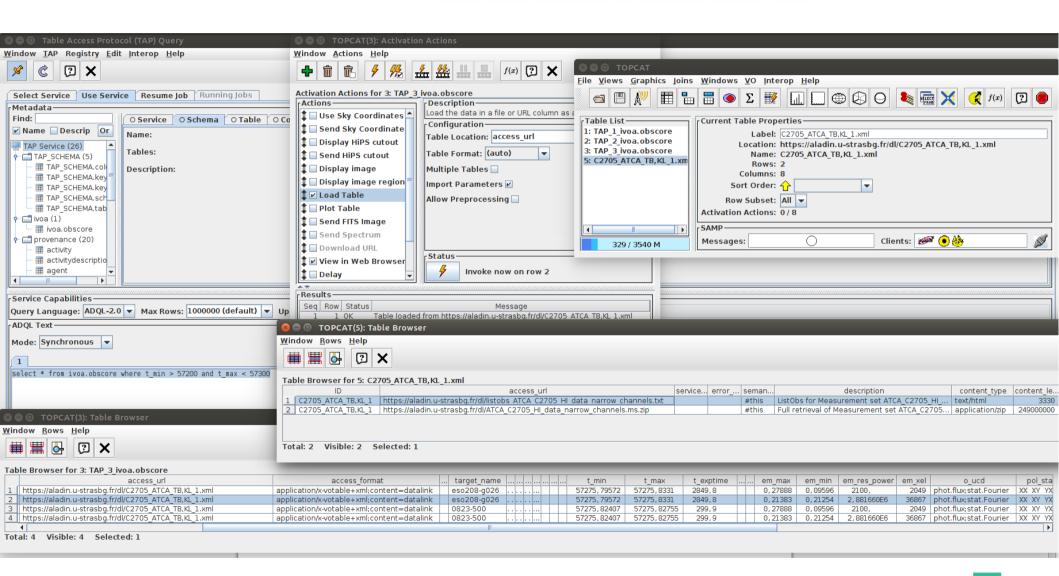
« select \* from ivoa.obscore where em min > 1 »



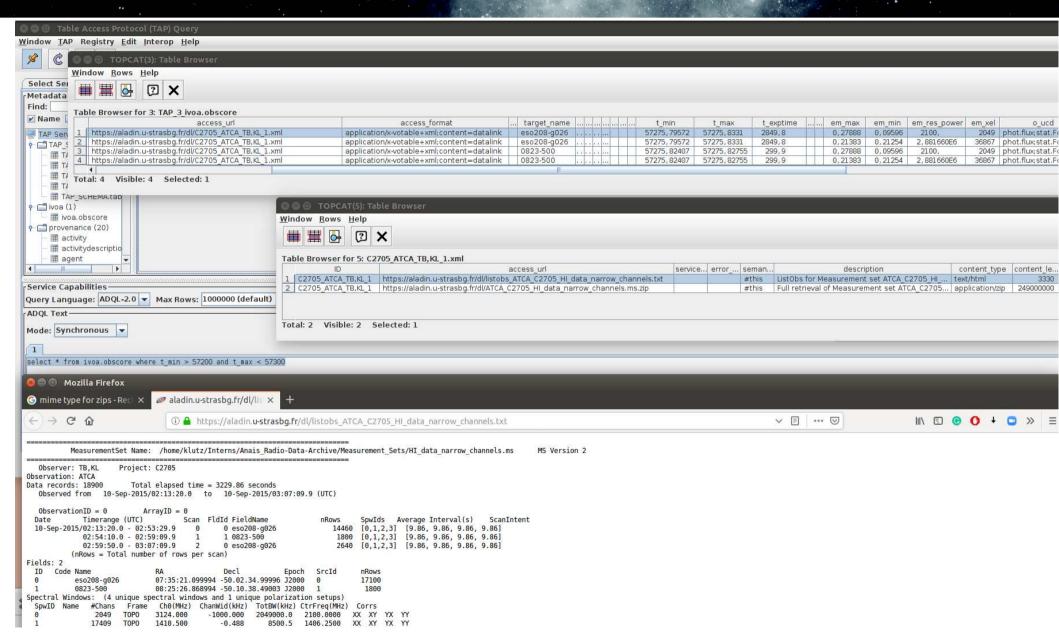
« select \* from ivoa.obscore where obs id like '%ATCA%'»



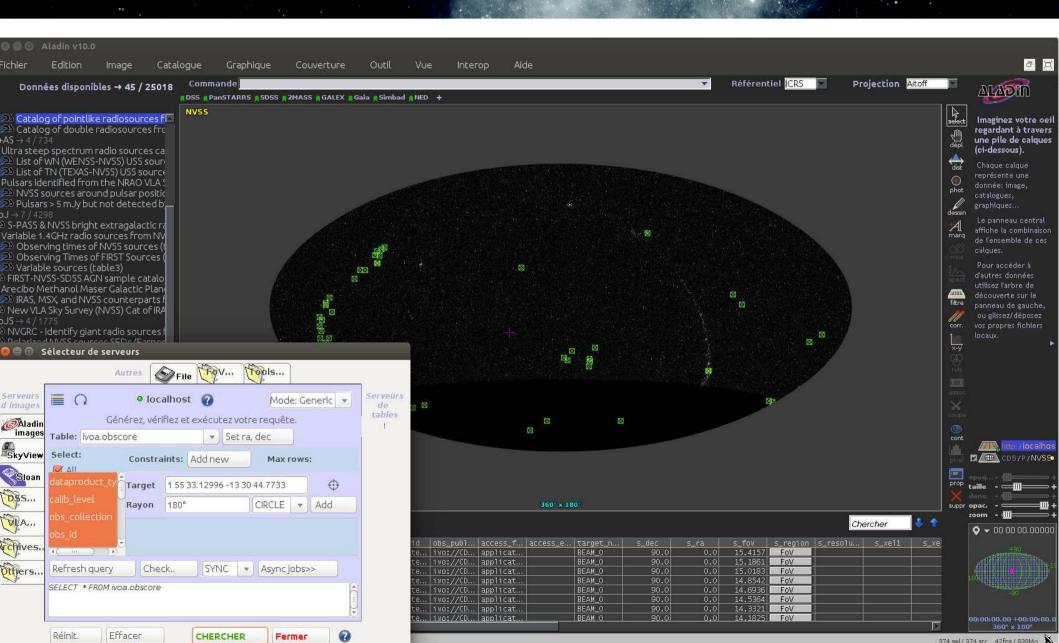
« select \* from ivoa.obscore where t\_min > 57200 and t\_max < 57300»
+ DataLink acces to listobs result - 1</pre>



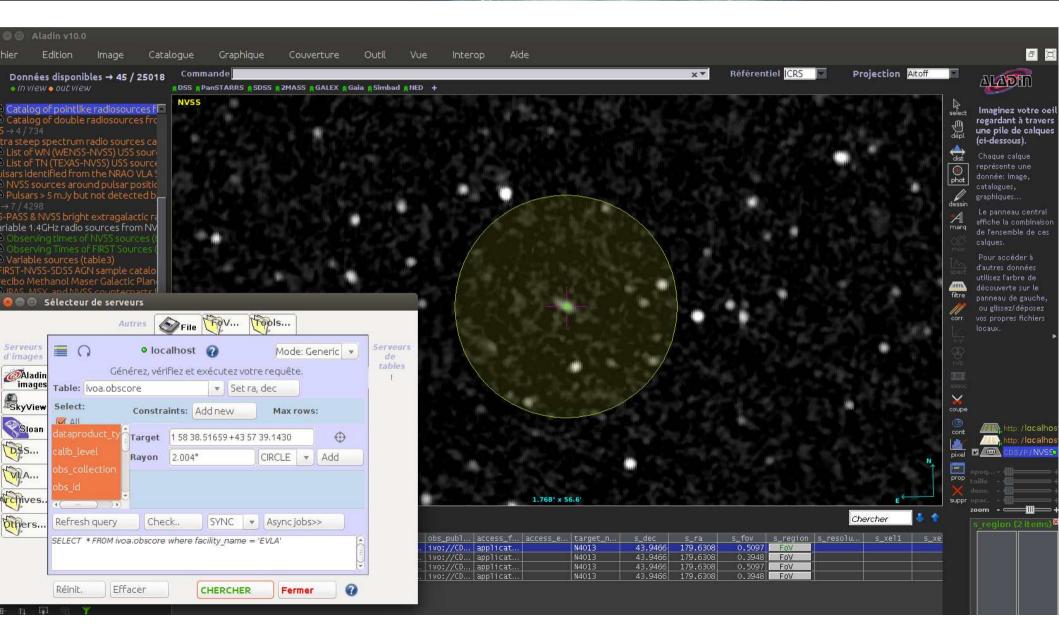
« select \* from ivoa.obscore where t\_min > 57200 and t\_max < 57300»
+ DataLink acces to listobs result - 2</pre>



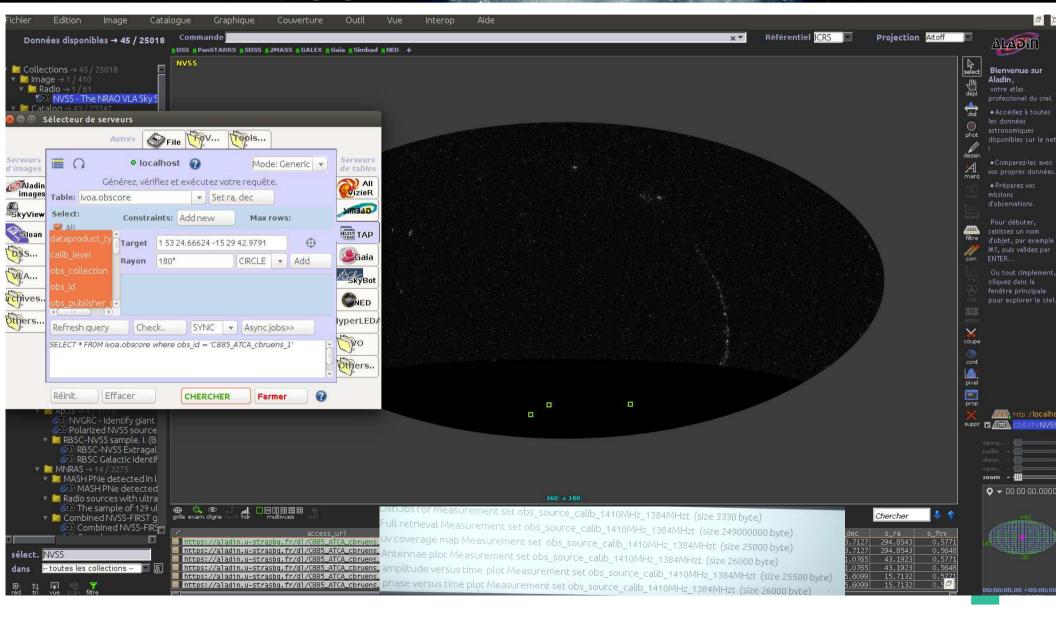
#### Prototype queried via Aladin Overal distribution of datasets



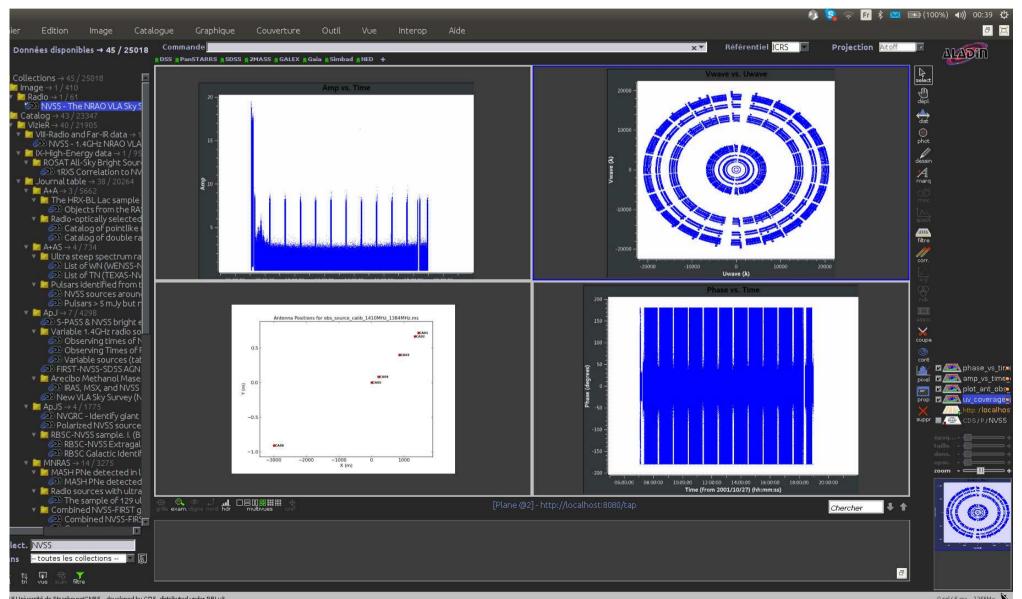
### Prototype queried via Aladin EVLA MS field of view on top of NVSS



### Prototype queried via Aladin ASCA MS with DataLinks



### Prototype queried via Aladin ASCA MS linked plots



### Work coming next

- Add other MS (JIVE, LOFAR, ALMA???)
- Add other free metadata columns in ObsCore
  - uv characterisation, number of antennae,
- Add new descriptive metadata in DataLink
- Make an attempt of standardizing metadata
  - = Characterisation and Provenance extension
- Collaborations ?