The SKADS sky databases

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and the Oxford SKADS team [*]

Outline

- S-cubed databases
- Online access
- Use of S3 Tools
- Polarization
- Global Sky Model
- S-cubed by AstroGrid
- Perspectives

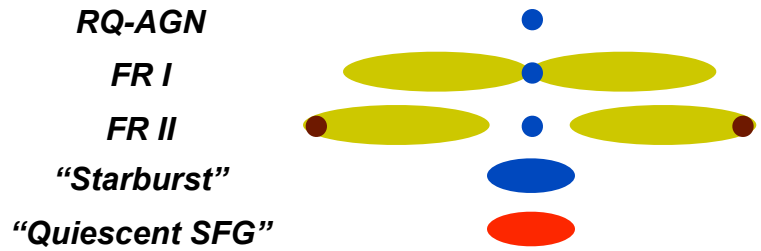
SKADS Simulated Skies

SEX : Semi-Empirical eXtragalactic

'Continuum simulation'

- Observed / extrapolated luminosity functions
- Population of underlying DM density field
- Clusters identified via Press-Schechter filter
- 5 different source types

$$A = 20^\circ \times 20^\circ$$
$$0 \leqslant z \leqslant 20$$
$$S \geqslant 10 \text{ nJy}$$
$$N_{\text{sources}} \sim 275,000,000$$



Wilman et al., 2008, MNRAS, 388, 1335

SAX : Semi-Analytical eXtragalactic

'Line simulation'

- Post-processing of Millenium Simulation cubes
- SFR / AGN continua from luminosity functions
- Line properties from cold gas mass functions
- Currently contains HI and CO (J=1-0)
- Redshift cutoff determines sky area, e.g. :

$$0 \leqslant z \leqslant 4$$
$$A = 5.39^\circ \times 5.39^\circ$$
$$N_{\text{sources}} \sim 500,000,000$$

Obreschkow et al., 2008 (in prep.)

Online access to S-cubed

http://s-cubed.physics.ox.ac.uk

- Hosted by OeRC
- PostgreSQL databases

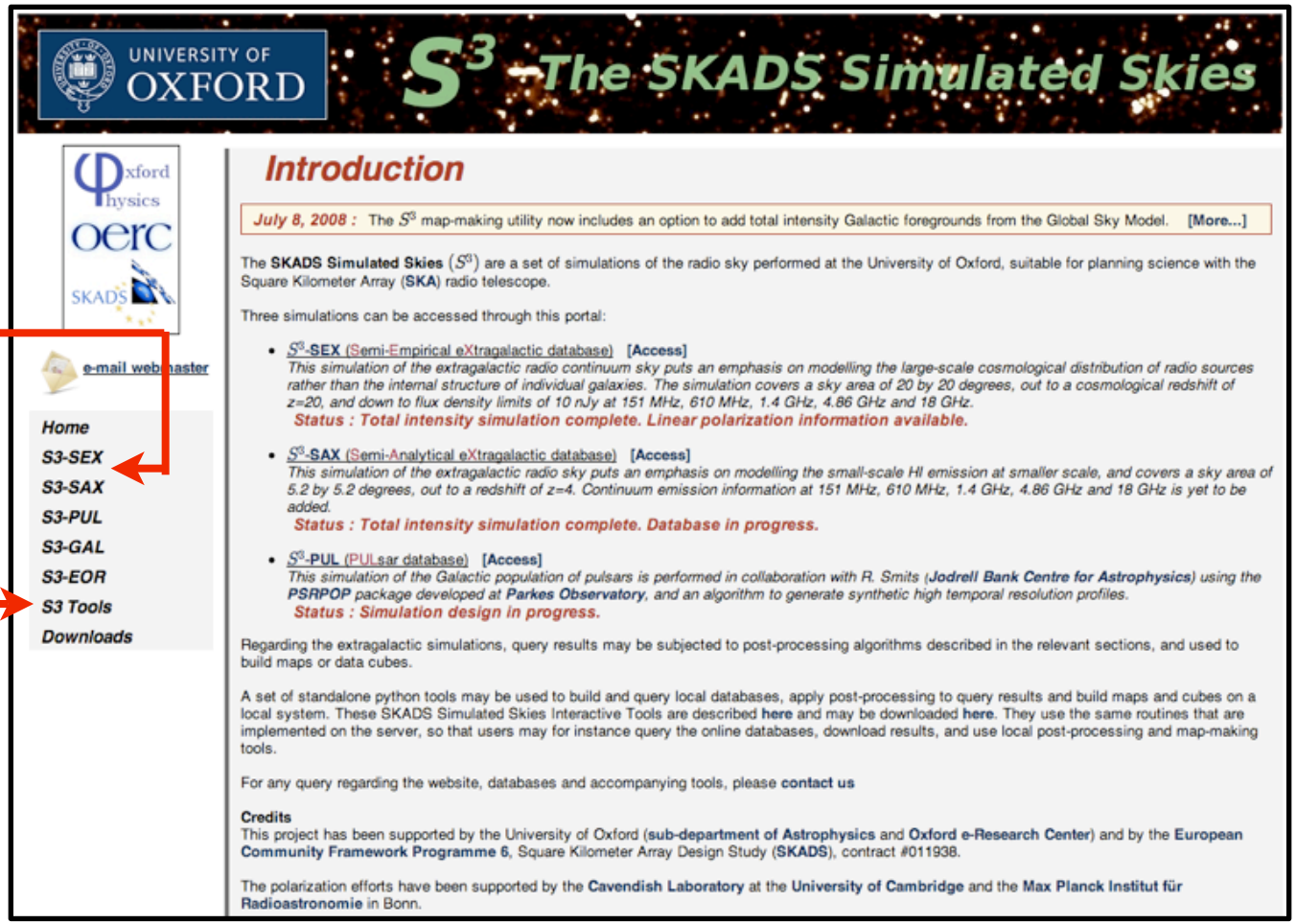
Current procedure

- Online query (SEX/SAX)
- Local install of S3 Tools
- Local post-processing
- Local map-making

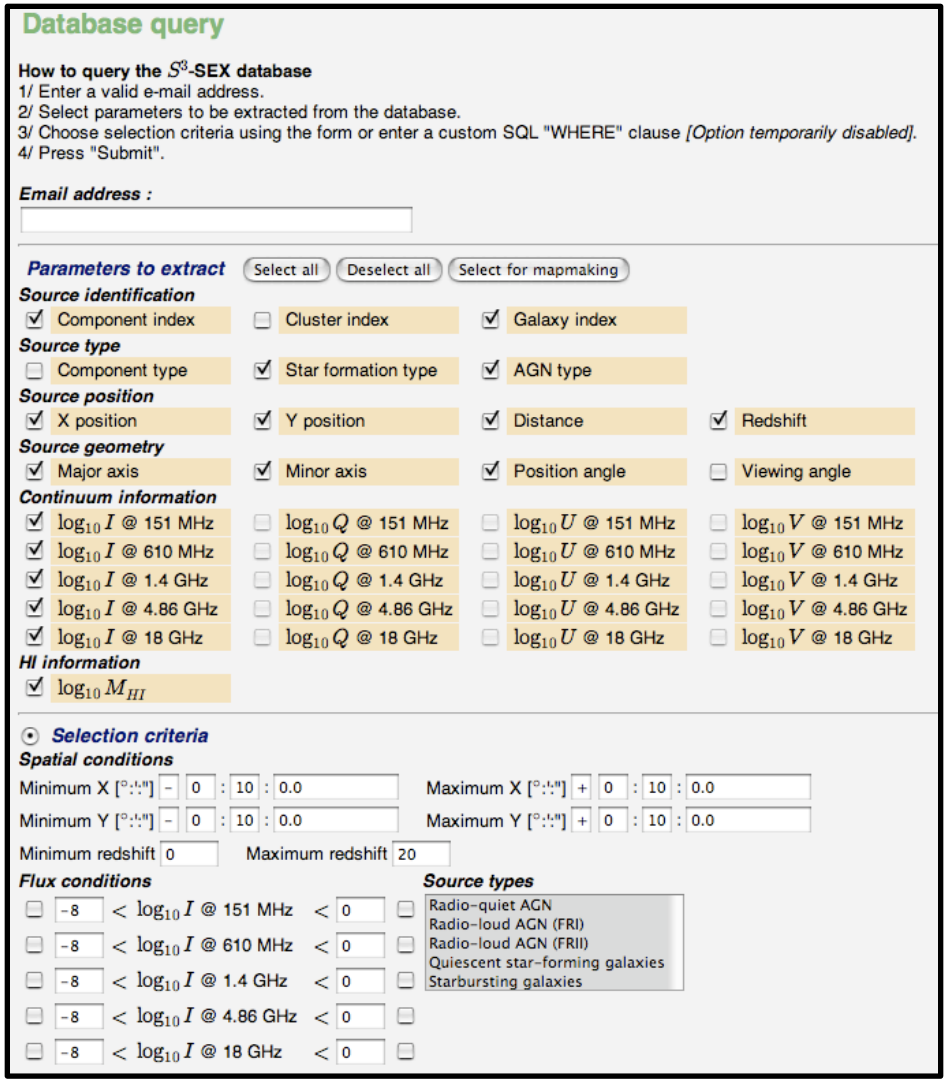
Upcoming

- Online post-processing
- Online map-making

Common routines



Querying S-cubed



Database query

How to query the S^3-SEX database
1/ Enter a valid e-mail address.
2/ Select parameters to be extracted from the database.
3/ Choose selection criteria using the form or enter a custom SQL "WHERE" clause *[Option temporarily disabled]*.
4/ Press "Submit".

Email address :

Parameters to extract — Select all | Deselect all | Select for mapmaking

Source identification
☑ Component index ☐ Cluster index ☑ Galaxy index

Source type
☐ Component type ☑ Star formation type ☑ AGN type

Source position
☑ X position ☑ Y position ☑ Distance ☑ Redshift

Source geometry
☑ Major axis ☑ Minor axis ☑ Position angle ☐ Viewing angle

Continuum information

☑ $\log_{10} I$ @ 151 MHz	☐ $\log_{10} Q$ @ 151 MHz	☐ $\log_{10} U$ @ 151 MHz	☐ $\log_{10} V$ @ 151 MHz
☑ $\log_{10} I$ @ 610 MHz	☐ $\log_{10} Q$ @ 610 MHz	☐ $\log_{10} U$ @ 610 MHz	☐ $\log_{10} V$ @ 610 MHz
☑ $\log_{10} I$ @ 1.4 GHz	☐ $\log_{10} Q$ @ 1.4 GHz	☐ $\log_{10} U$ @ 1.4 GHz	☐ $\log_{10} V$ @ 1.4 GHz
☑ $\log_{10} I$ @ 4.86 GHz	☐ $\log_{10} Q$ @ 4.86 GHz	☐ $\log_{10} U$ @ 4.86 GHz	☐ $\log_{10} V$ @ 4.86 GHz
☑ $\log_{10} I$ @ 18 GHz	☐ $\log_{10} Q$ @ 18 GHz	☐ $\log_{10} U$ @ 18 GHz	☐ $\log_{10} V$ @ 18 GHz

HI information
☑ $\log_{10} M_{HI}$

Selection criteria

Spatial conditions
Minimum X [°:':"] − 0 : 10 : 0.0 Maximum X [°:':"] + 0 : 10 : 0.0
Minimum Y [°:':"] − 0 : 10 : 0.0 Maximum Y [°:':"] + 0 : 10 : 0.0
Minimum redshift 0 Maximum redshift 20

Flux conditions
☐ −8 < $\log_{10} I$ @ 151 MHz < 0 ☐
☐ −8 < $\log_{10} I$ @ 610 MHz < 0 ☐
☐ −8 < $\log_{10} I$ @ 1.4 GHz < 0 ☐
☐ −8 < $\log_{10} I$ @ 4.86 GHz < 0 ☐
☐ −8 < $\log_{10} I$ @ 18 GHz < 0 ☐

Source types
Radio-quiet AGN
Radio-loud AGN (FRI)
Radio-loud AGN (FRII)
Quiescent star-forming galaxies
Starbursting galaxies

Specify your query

- Select parameters to extract from simulation
- Select spatial and redshift windows
- Select flux and source type

↓

Submit query

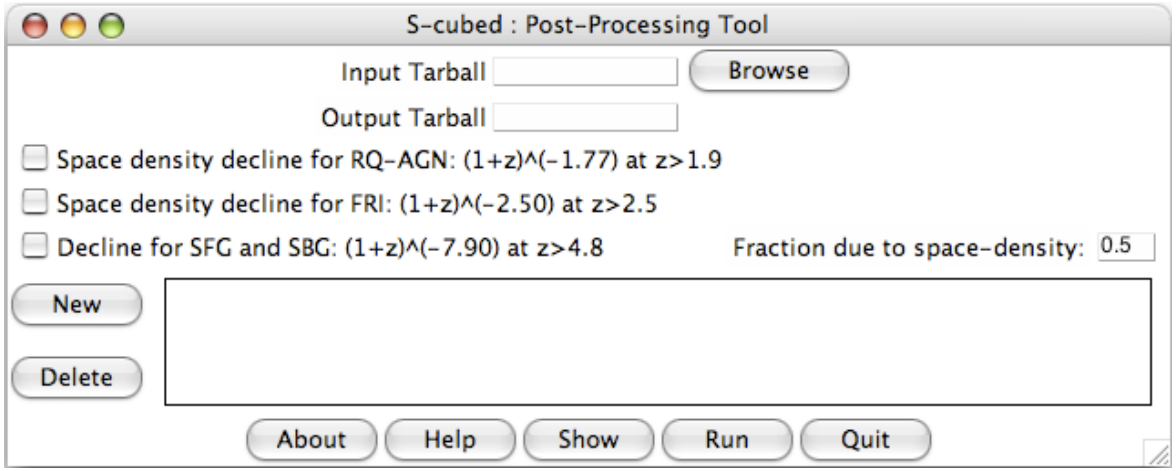
- Query entered in queue
- User redirected to query result page
- E-mail sent as query completes

↓

Retrieve query results

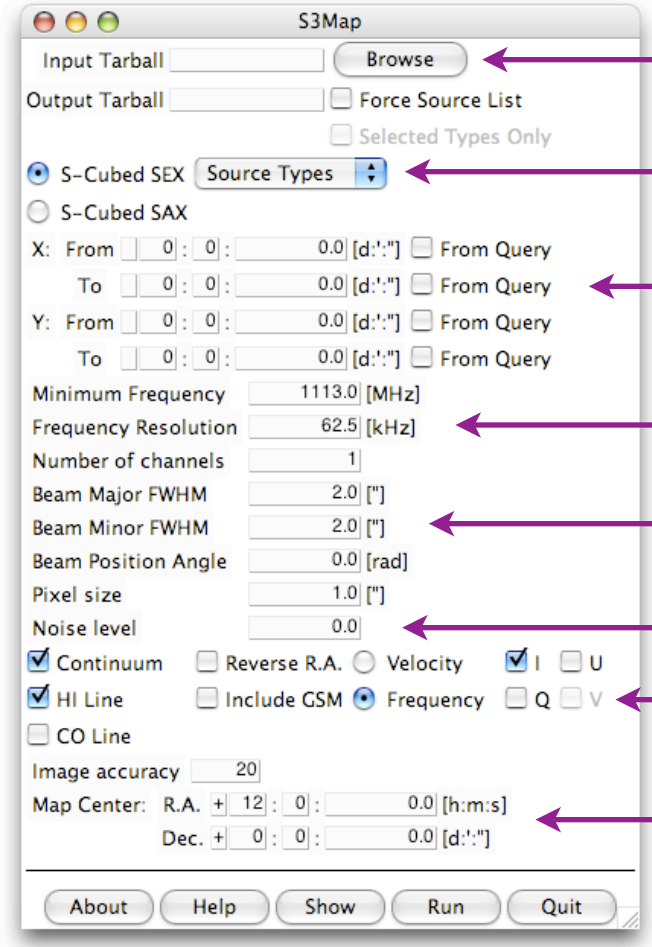
- Download tarball to local drive
- Contains query results + description file[s]

Post-processing



- Space density and luminosity declines
- Source type specific
- Power-law and exponential functional forms
- Default options + Possibility to define your own
- Modular scripting : New post-processing options “easy” to implement

Making maps and cubes



Input query results

Source types

Spatial region

Frequency range

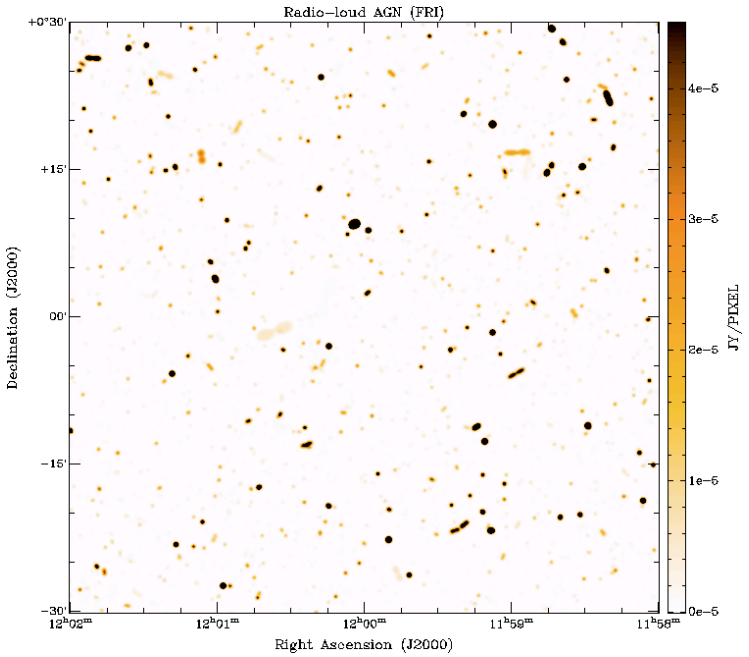
Resolution

Noise

Contents and axes

Position of output map

Central square degree of S-cubed SEX [only FR I radio-loud AGN] @ 1.4 GHz



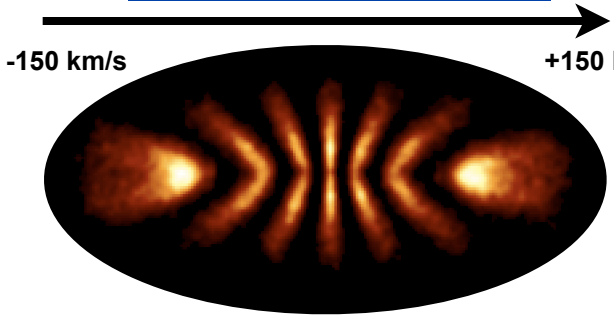
High-resolution HI in SAX

1150 Template HI cubes from
Rense Boomsma (Kapteyn)

5 Hubble types × 5 velocity scales × 46 inclinations

(Downloadable from the S-cubed website)

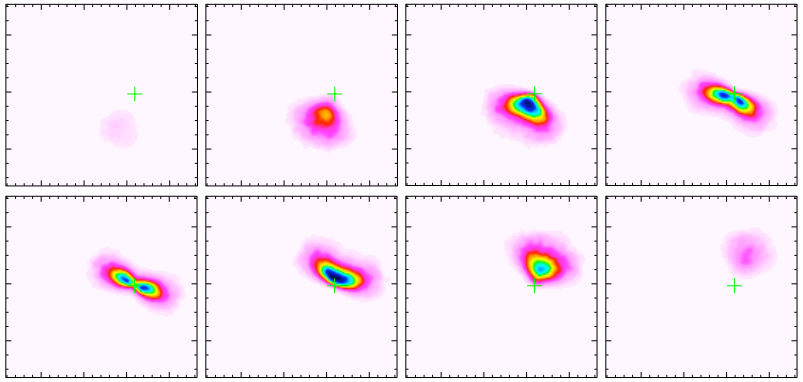
Example template cube



Sb-Sbc type galaxy, 50 degrees inclination

From template cubes to SAX cubes

SAX information	*Action*
• Numerical Hubble type • Inclination angle • HI line width	*Pick template*
• HI line width • Angular size • HI flux	*Get scaling factors*
• Position angle	*Rotate*
• Sky position • Redshift	*Paste on master cube*



Channel maps from sample SAX cube [1.2419 to 1.24225 GHz]

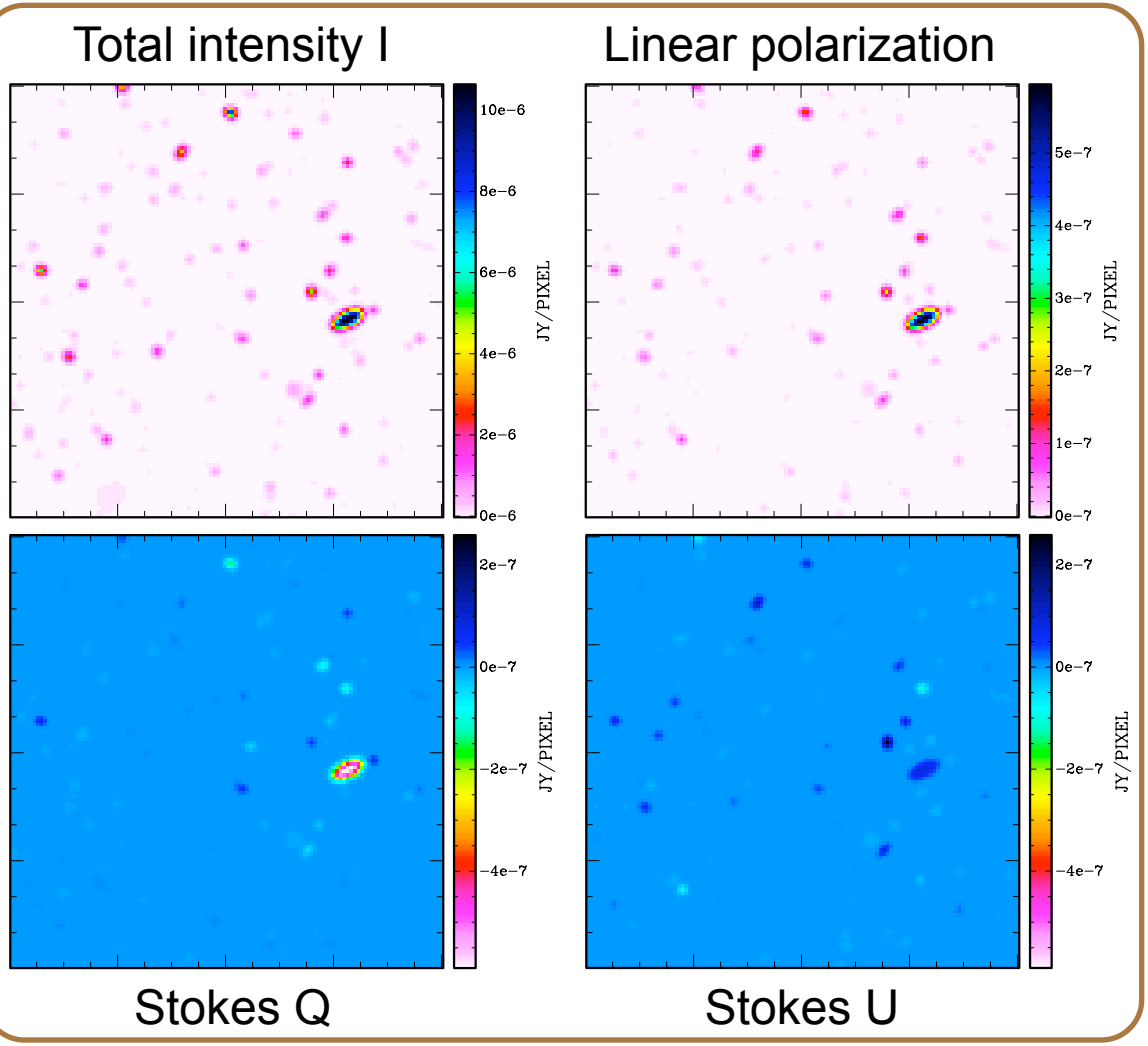
Polarized emission

S3Map

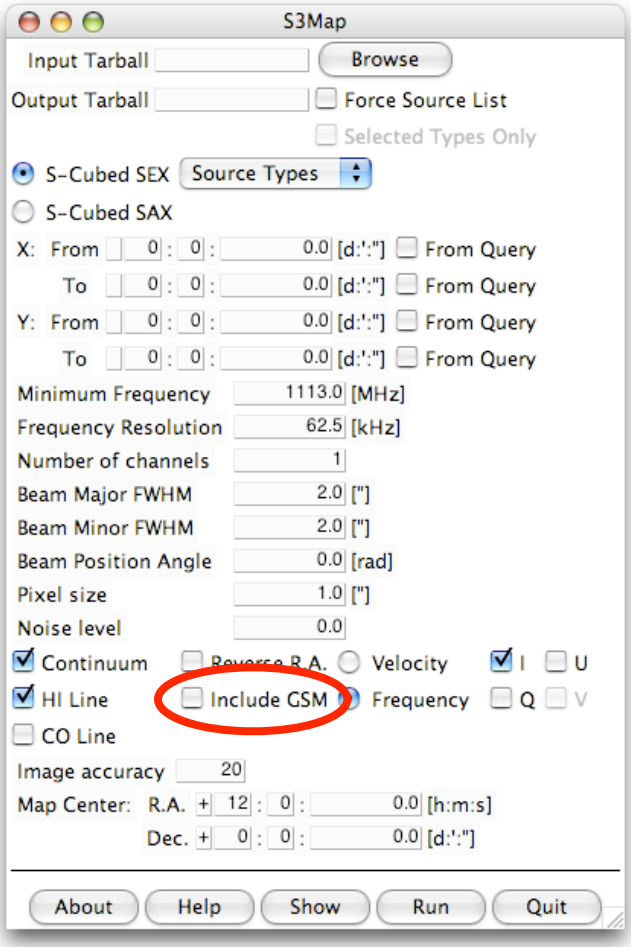
Input Tarball [Browse]
Output Tarball [ ] Force Source List
[ ] Selected Types Only
(•) S-Cubed SEX [Source Types]
( ) S-Cubed SAX
X: From 0 : 0 : 0.0 [d:':"] [ ] From Query
To 0 : 0 : 0.0 [d:':"] [ ] From Query
Y: From 0 : 0 : 0.0 [d:':"] [ ] From Query
To 0 : 0 : 0.0 [d:':"] [ ] From Query
Minimum Frequency 1113.0 [MHz]
Frequency Resolution 62.5 [kHz]
Number of channels 1
Beam Major FWHM 2.0 ["]
Beam Minor FWHM 2.0 ["]
Beam Position Angle 0.0 [rad]
Pixel size 1.0 ["]
Noise level 0.0
[x] Continuum [ ] Reverse R.A. ( ) Velocity [x] I [ ] U
[x] HI Line [ ] Include GSM (•) Frequency [ ] Q [ ] V
[ ] CO Line
Image accuracy 20
Map Center: R.A. + 12 : 0 : 0.0 [h:m:s]
Dec. + 0 : 0 : 0.0 [d:':"]
[About] [Help] [Show] [Run] [Quit]

Example :
Central 2' by 2' of S-cubed SEX
Maximum polarisation : 15%

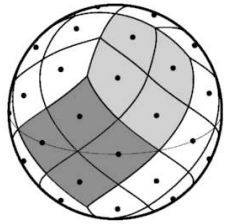
Python routines by Joern Geisbuesch, Paul Alexander [MRAO]

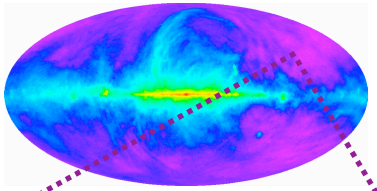


Global Sky Model

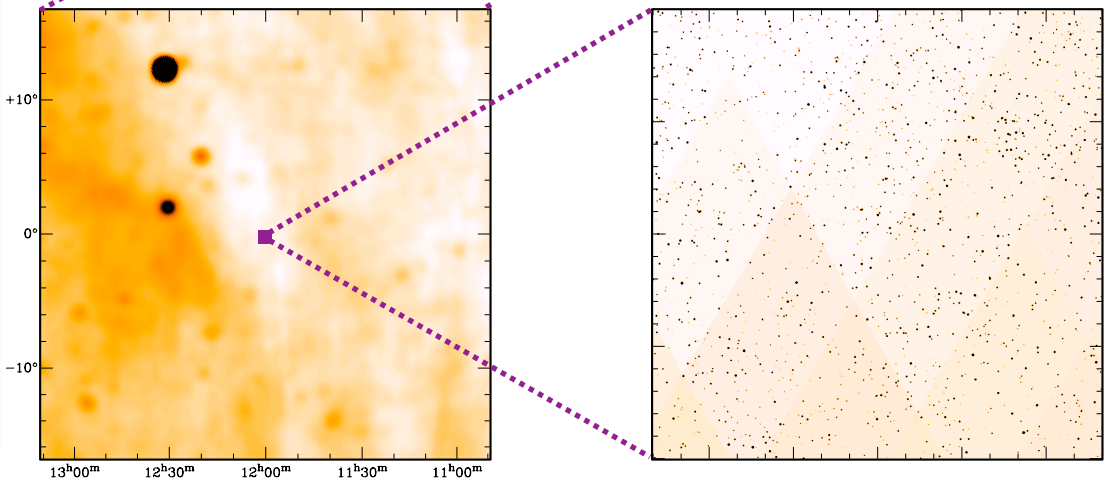


- Courtesy of Angelica de Oliveira-Costa (MIT)
- Compiles publicly available radio surveys
- Covers 10 MHz to 100 GHz
- HEALPIX format
- S3Tools adapted from available IDL routines





[Haslam et al. @ 408 MHz]

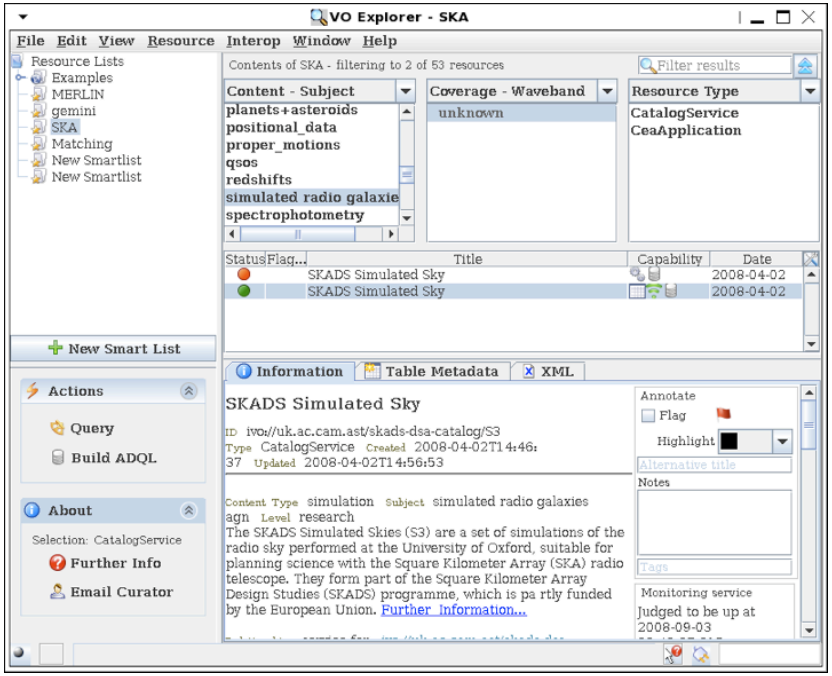


http://space.mit.edu/home/angelica/gsm/
http://healpix.jpl.nasa.gov/

Central 20' by 20' of S-cubed SEX [only starburst galaxies] overlaid with GSM @ 1.113 GHz [x 1e15]

S-cubed by AstroGrid

Credit goes to Eduardo Gonzalez-Solares, Nick Walton [IoA] and Anita Richards [Manchester]



VO harvests data providers' standard descriptions

- Publishing registries at Cambrige, CDS, HEASARC, ...
- VOExplorer searches Registry of resources
- Look for content description containing 'SKA' and 'simulated'

Choose SKADS Simulated Sky

- Catalogues stored on MySQL at Cambridge
- Browse / sort details of columns etc...
- User types in SQL-like ADQL or uses tree GUI

Query sent to database

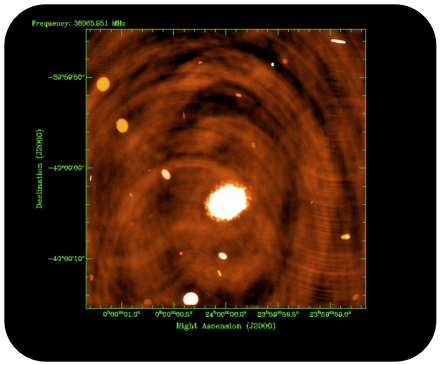
- Results returned as standard xml-like VOTable
- Examine, process, convert to ascii e.g. in TopCat

Pipes to plug on the way to VO-S3 and VO-S3Tools

- Post-processing and map-making (already scripted)
- Update of S-cubed SEX
- Registration of S-cubed SAX

Perspectives

- Improve modularity : VO compliance, maintenance issues
- Compatibility with MeqTrees (Smirnov, Salvini)
- HI spectra banks (AGES/HIPASS) to be used in S-cubed SEX
- Epoch of Reionization signals (Combes, Santos)
- Polarized emission from the Galaxy (Reich)
- Cluster depolarization
- S-cubed PUL (Smits, Karastergiou)
- S-cubed SEX-HEMIS (Wilman)
- S-cubed beyond SKADS : high z CO observations for ALMA (Heywood)



30” x 30” x 64 channel AIPS simulation of an ALMA observation

CO source at z~2 from SAX + Background continuum from SEX