SAMP: Application Messaging for Desktop and Web Applications

ADASS XXI, Paris, 10 November 2011

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$Id: websamp.tex,v 1.25 2011/11/07 20:56:10 mbt Exp $

Background and History

SAMP = Simple Applications Messaging Protocol

allows astronomy software tools to exchange control and data

History:

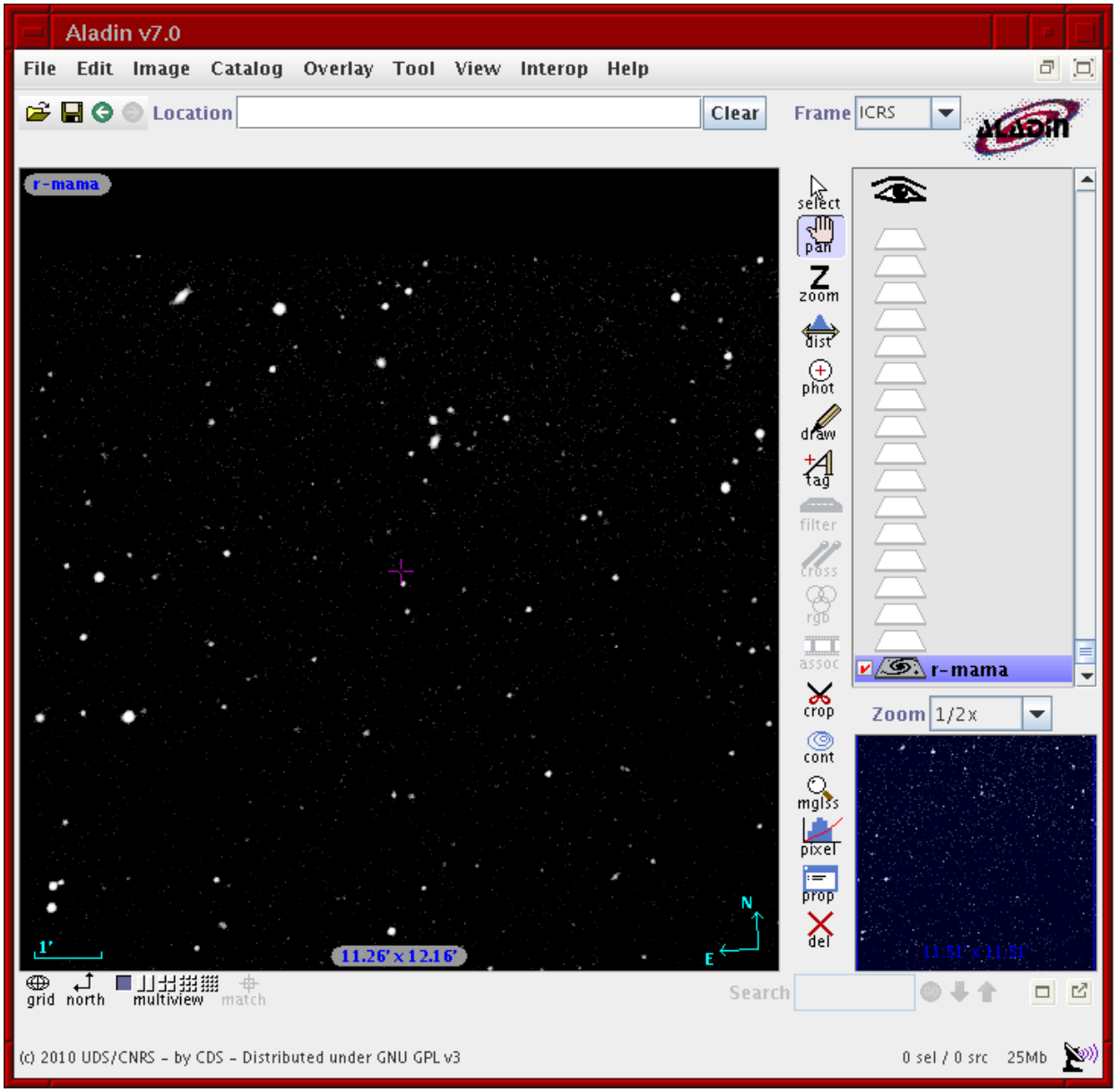
- PLASTIC v1 (Platform for Astronomical InterConnection), Euro-VO protocol 2006
- SAMP v1.11, IVOA Recommendation 2009
- Useful client-side technology for VO work patterns
- . . . but not specific to VO applications

Status:

- Quite widely used in desktop tools
  - ▷ SAOImage ds9, Aladin, TOPCAT, SPLAT, WWT, VOSpec, IRAF, HIPE, Astro-WISE, Aspro2, JSky, SkyCat/Gaia, VirGO, . . .
  - ▷ Java, Python, Perl, C, C#, Tcl, IDL, . . .
- Visible at ADASS

  ADASS XIX: 5 subject index entries for "SAMP"

  ADASS XX: 16 subject index entries for "SAMP" *(5^{th} after Java, Python, VO & XML)*


Aladin v7.0
File Edit Image Catalog Overlay Tool View Interop Help
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(c) 2010 UDS/CNRS - by CDS - Distributed under GNU GPL v3
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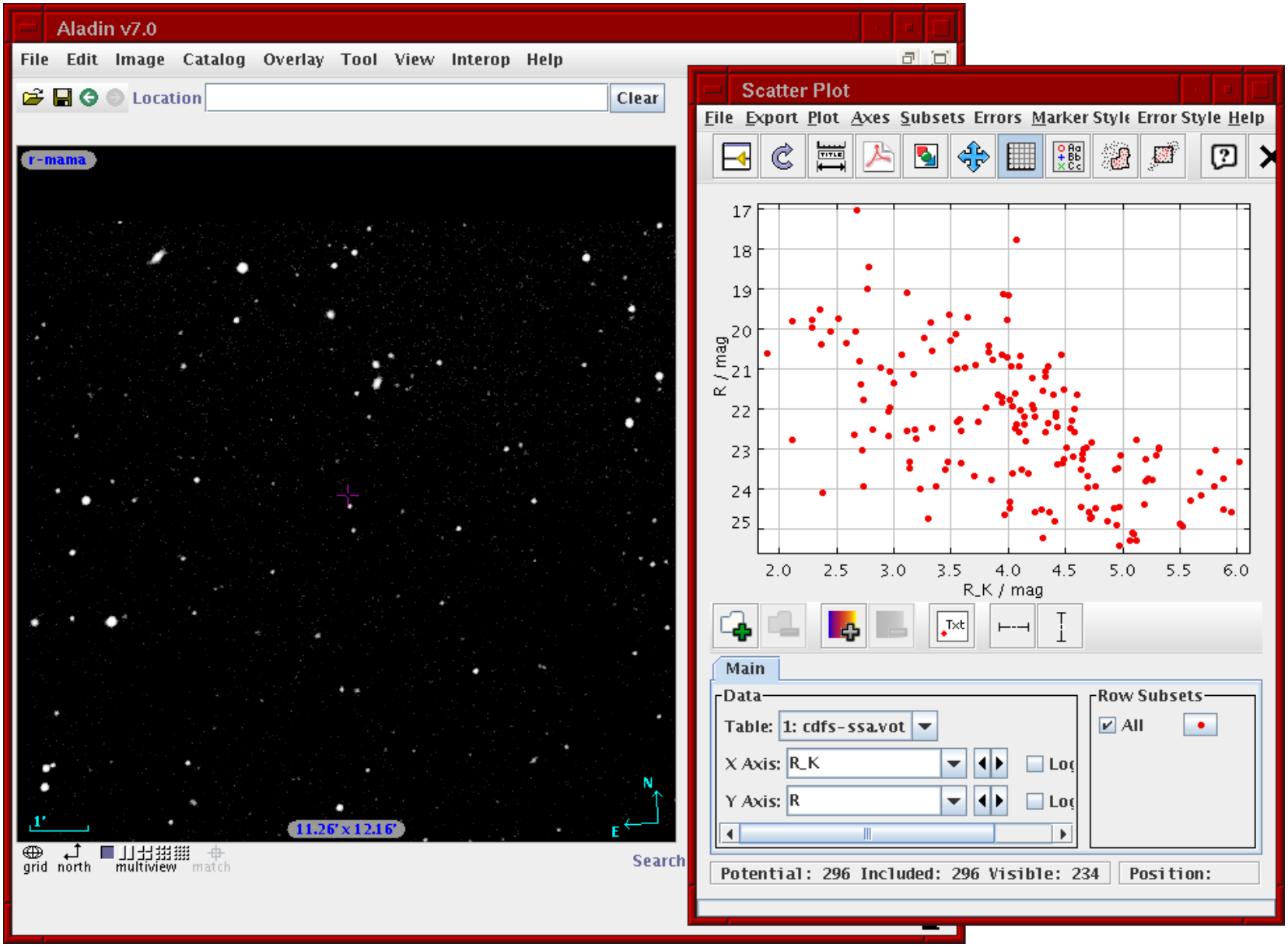
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Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
R / mag
R_K / mag
Main
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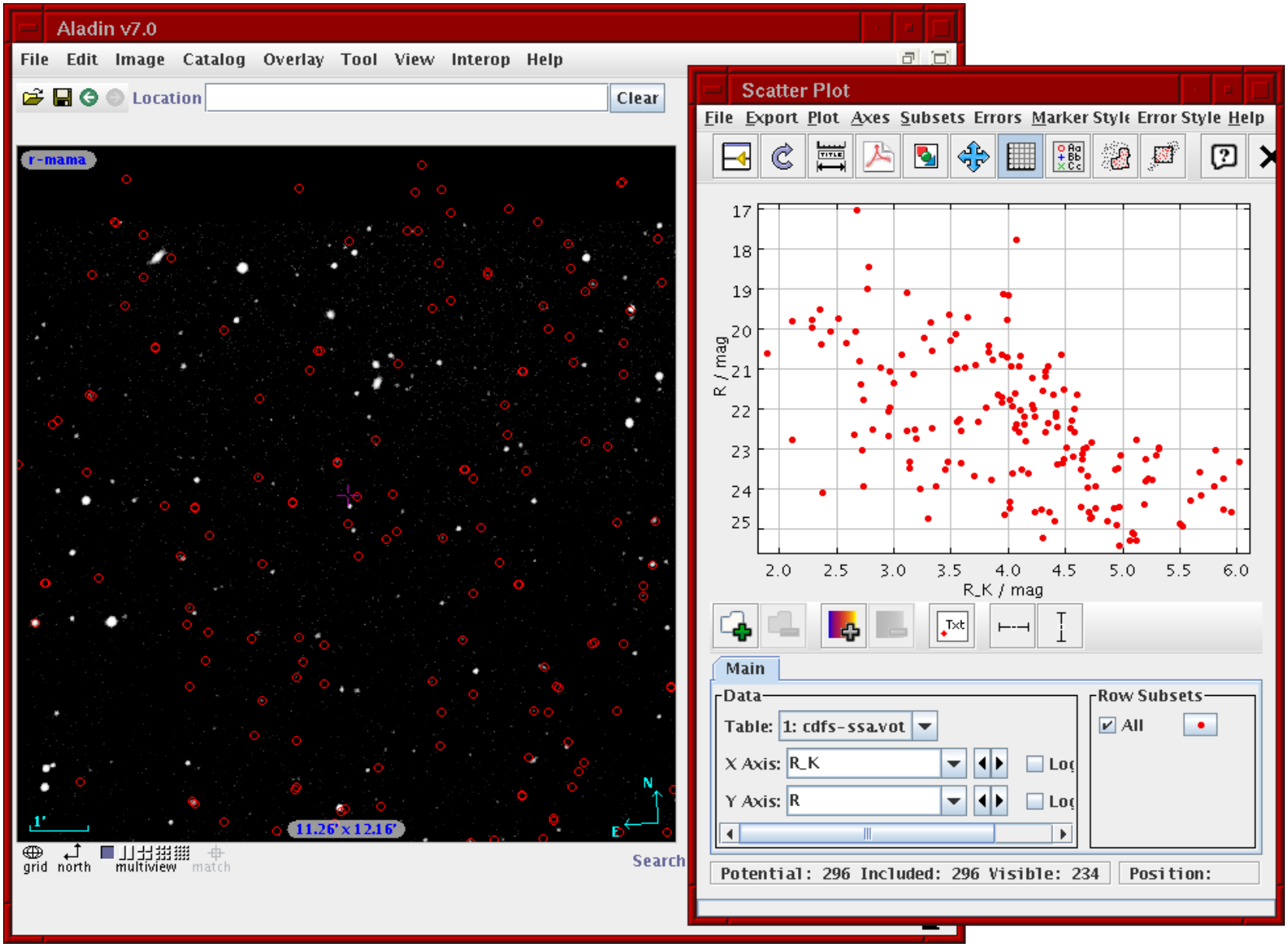
Table: 1: cdfs-ssa.vot
X Axis: R_K
Y Axis: R
Row Subsets
All
Potential: 296 Included: 296 Visible: 234
Position: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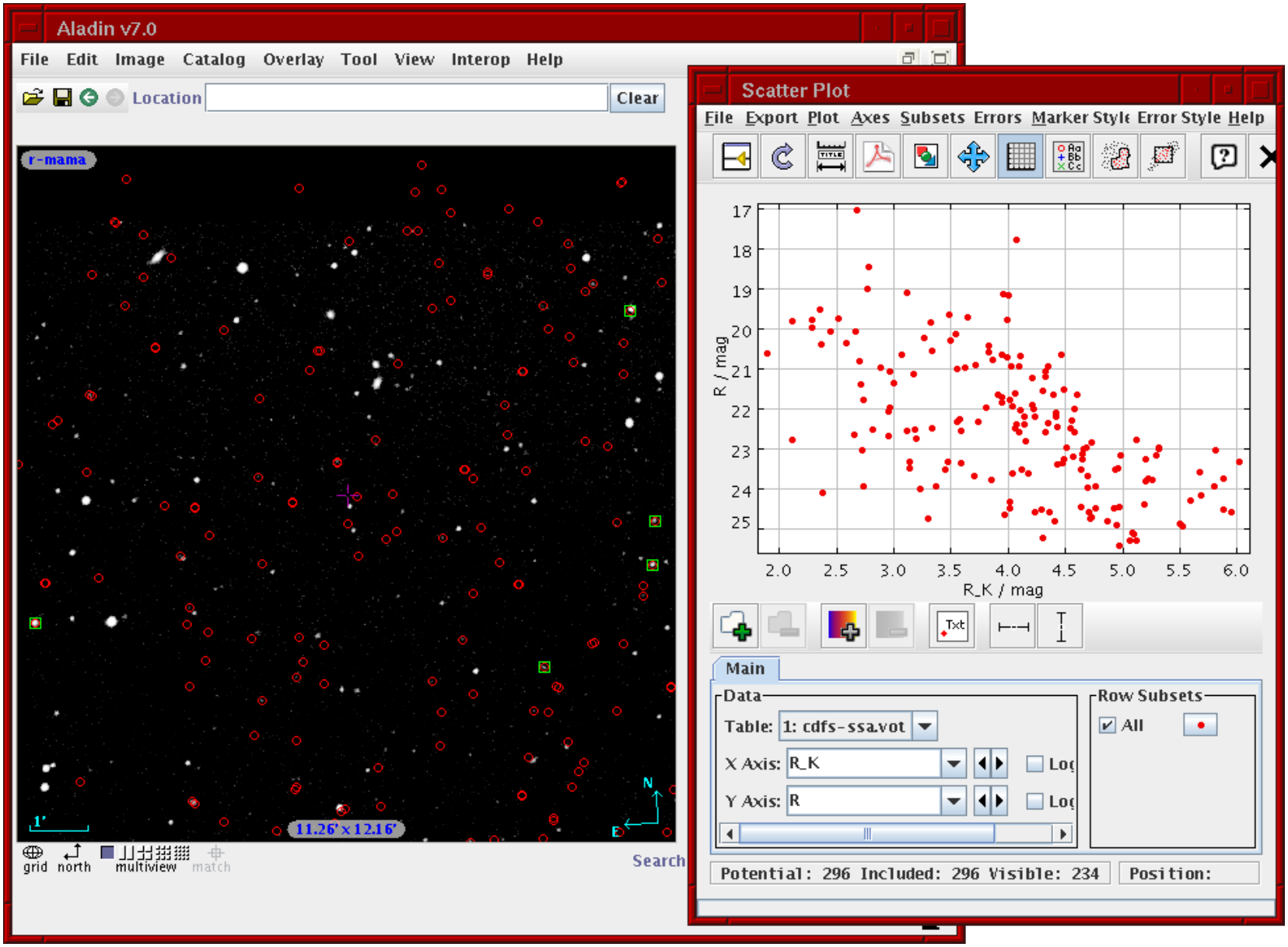
Position:


ALADIN

Table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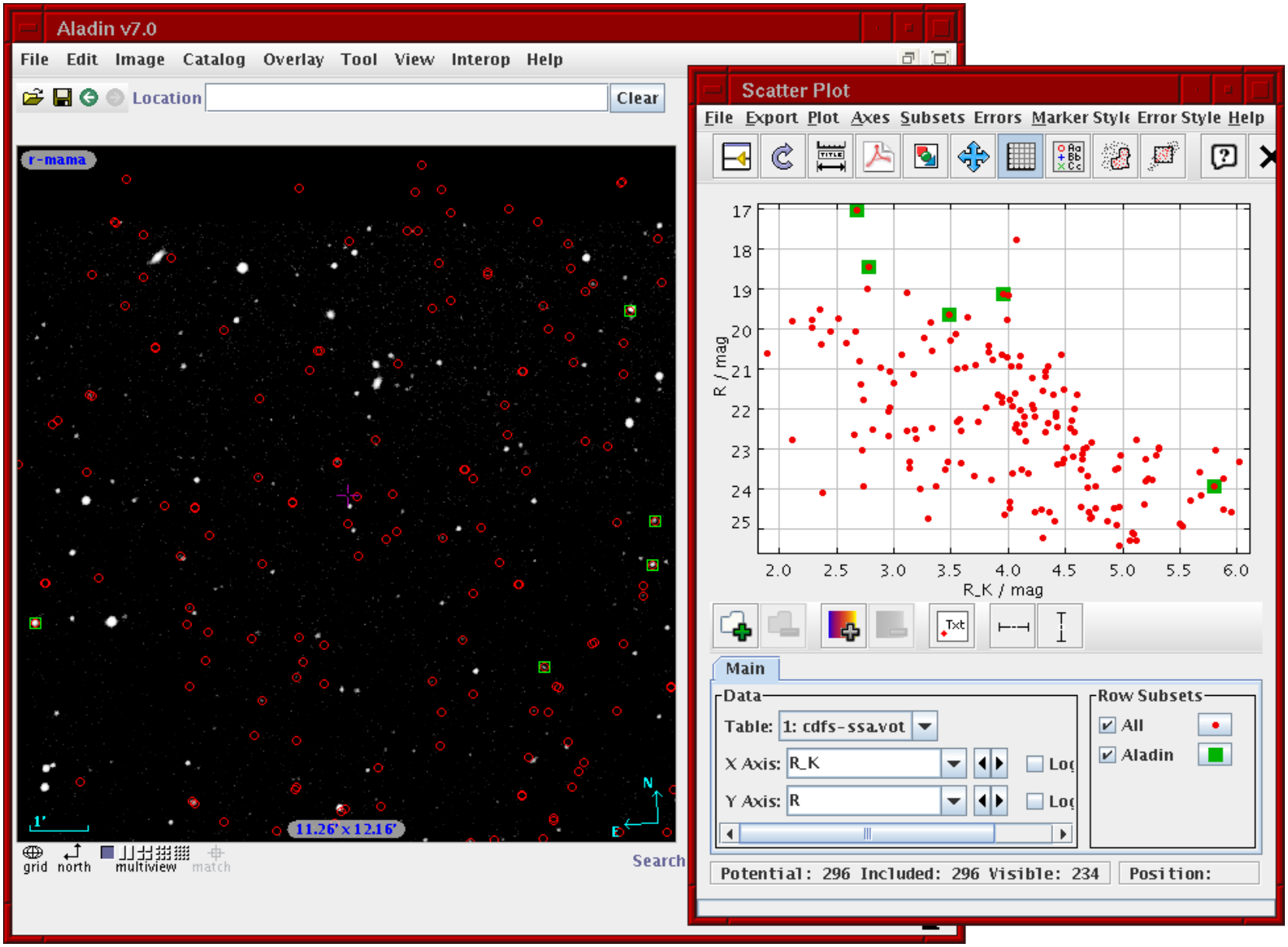
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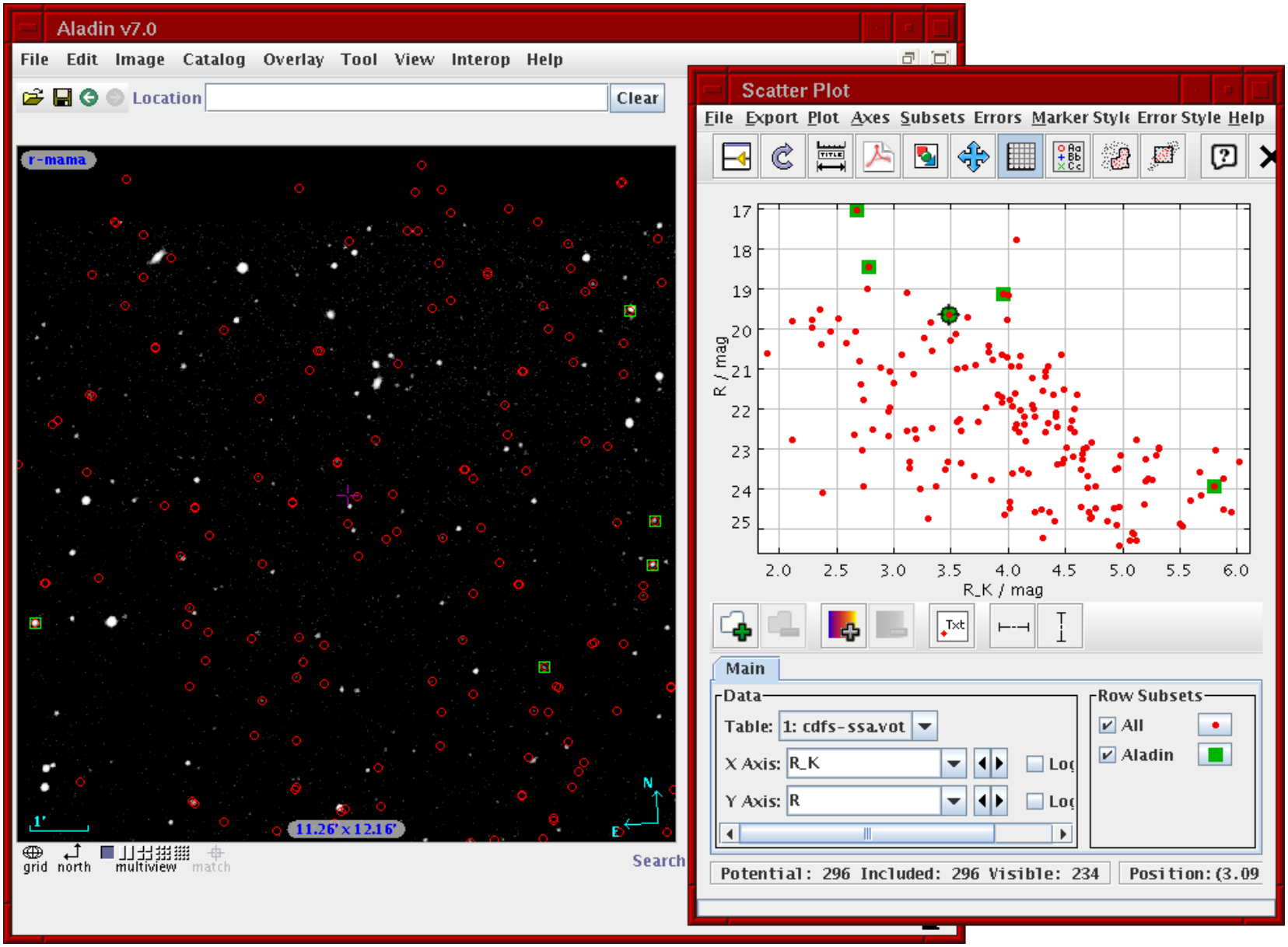
ALADIN

Row List ⟹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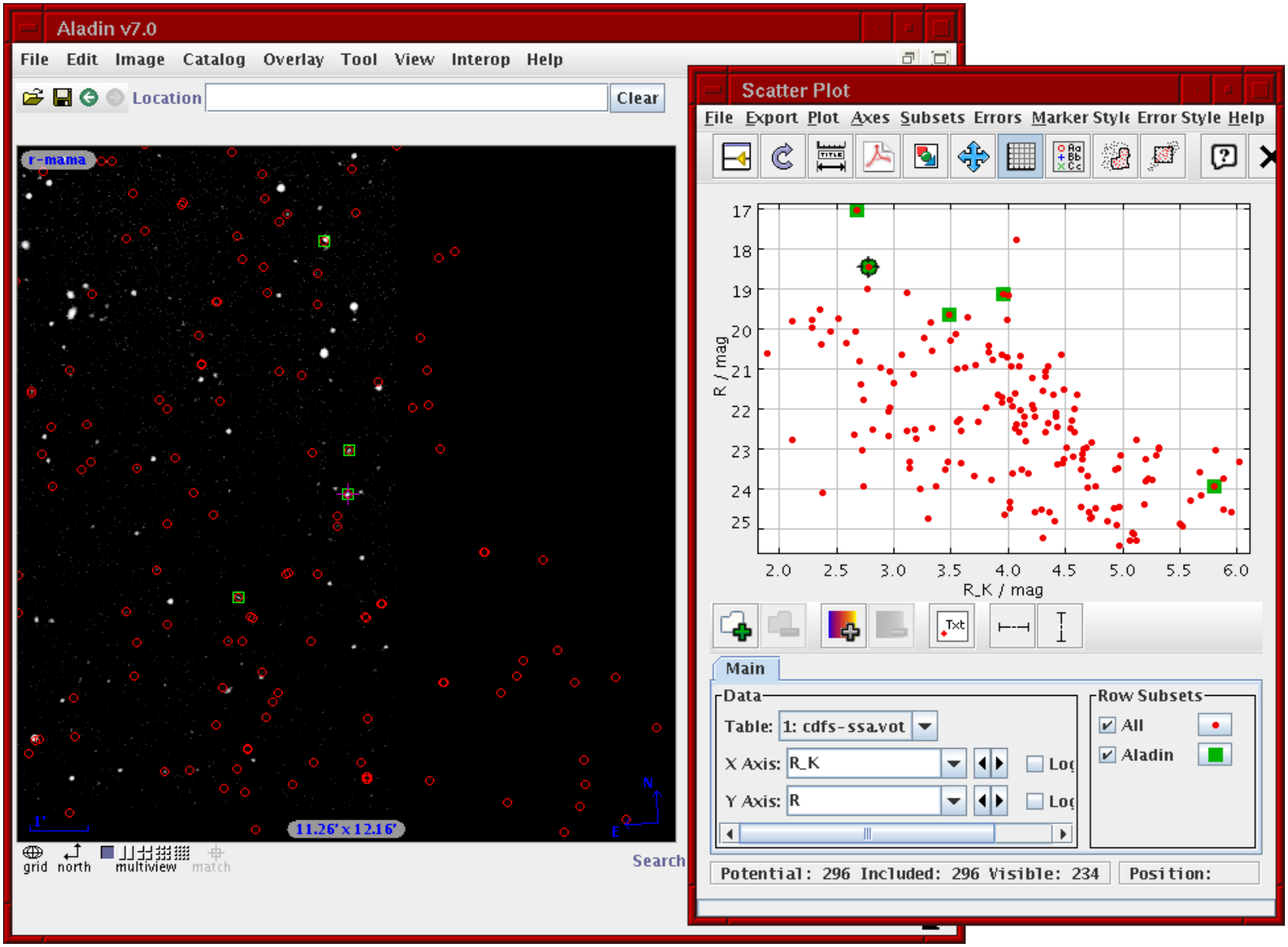
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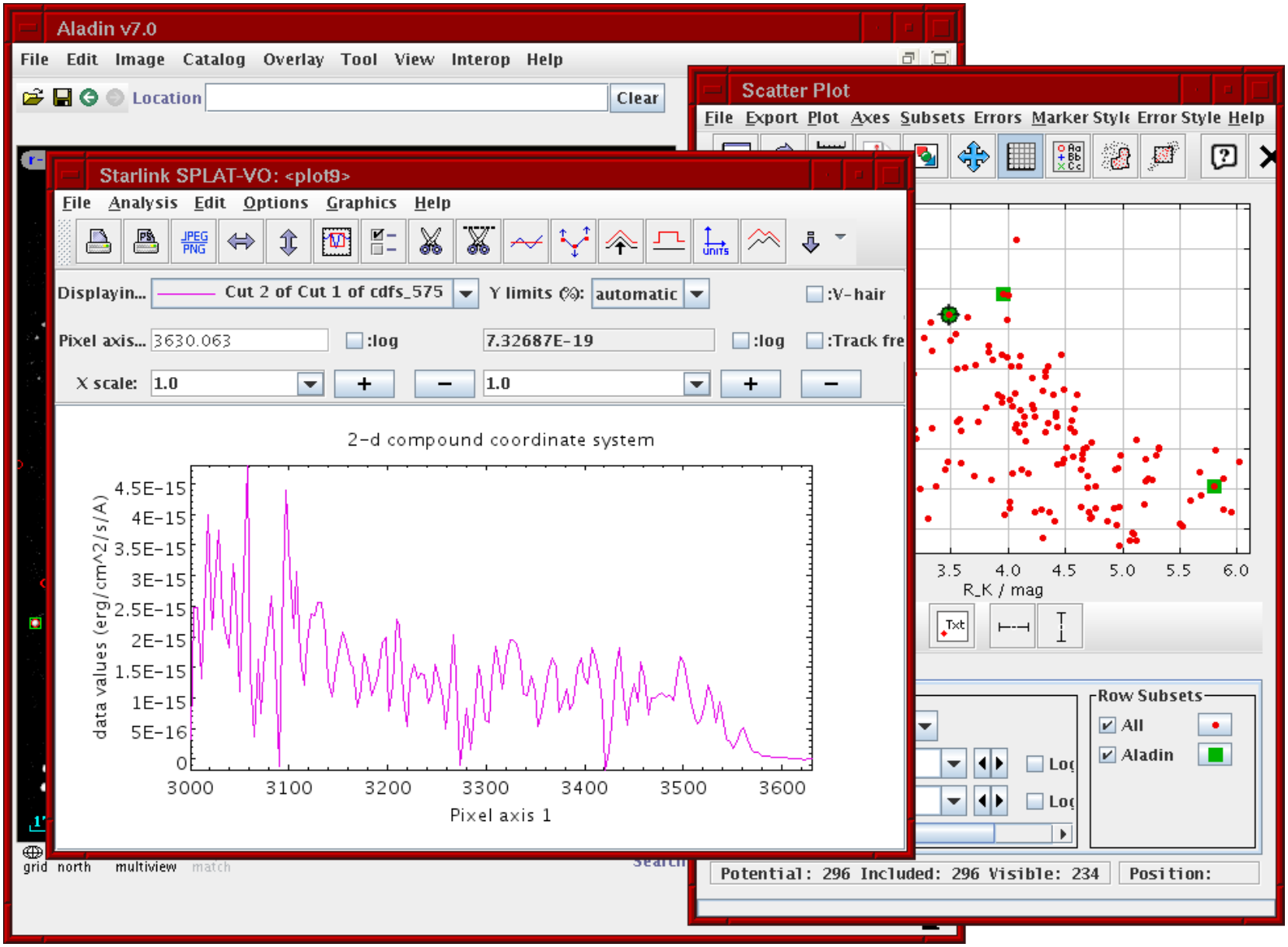
Position:

Single Row


Aladin v7.0
File Edit Image Catalog Overlay Tool View Interop Help
Location
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File Analysis Edit Options Graphics Help
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Y limits (%):
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Pixel axis...
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:log
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4E-15
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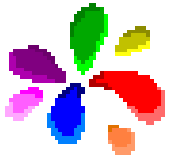


Spectrum ⟸

Design for Interoperability

Principles to maximise interoperability:

- Simple to use and learn for client developers and users
  - Platform independent
  - Lightweight to implement
- Message semantics are typically vague
  - *"Here's a table!"* not *"Plot entries from this catalogue over the current image"*
  - but also extensible
  - Arise from usage, not decreed by committee

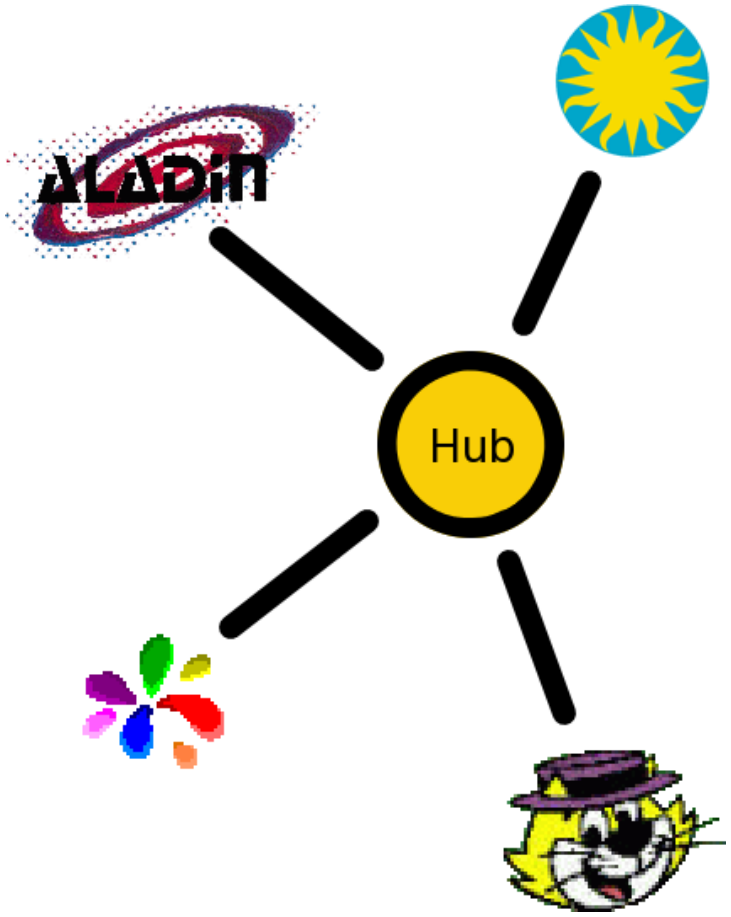
Consequences:

- Loosely coupled suites of interoperating tools
  - ... selected by the user
    - ... without conscious effort
  - ... from a pool of tools contributed by developers
    - ... who do not need close collaboration
- It works!

Hub

Hub-based operation

- Hub is daemon process, freestanding or within one client
- Clients *register* with Hub to send/receive (publish/subscribe to) messages
- Hub brokers messages and provides directory services
- All communication is Client ↔ Hub
  (but messaging conceptually Client↔Client)



3-Layer Architecture

Abstract API

- Data types
- Message structure
- Control functions

Profile

- Transport protocol
- Data encoding
- Hub discovery

Standard Profile

- XML-RPC (= HTTP + XML)
- Hub URL in ∼/.samp file

MTypes

- Message semantics
- Arguments
- Return values

- image.load.fits
- table.highlight.row
- coords.sky.pointAt
- . . .

Web Applications

SAMP works well for *desktop clients*

Would like it to work for *web clients* (code running in a browser)

- In-browser platforms:
  - JavaScript (a.k.a. JScript, ECMAScript)
  - Adobe Flash
  - MS Silverlight
  - Java applet *(when signed, works already)*
- Example scenarios:
  - Button to send a table/image/spectrum from web to a suitable desktop viewer
  - Web page receives information from desktop clients, e.g. highlight catalogue rows
  - Web page communicates with other pages loaded in the same browser
  - Rich application that happens to live in a browser
- Many persuasive use cases!

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Web SAMP Technical Barriers

Browsers impose security restrictions ("sandbox") on web clients:

- ✗ can't read local files
- ✗ can't access URLs on localhost or external hosts *(cross-domain restrictions)*
- ✗ can't run an HTTP server to receive callbacks

⇒ Untrusted web clients can't exercise user privileges

- ☺ to damage the user's system
- ☹ to send/receive SAMP messages using the Standard Profile

Options to circumvent sandbox?

- Signed Java applet — requires Java (WebSampConnector, VO Paris Data Centre)
- Browser plugin — browser-specific
- Alternative Profile

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Web Profile
- XML-RPC
- Hub URL on well-known port
- Web-friendly HTTP server

- image.load.fits
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- . . .

Web Profile

Like Standard Profile (uses XML-RPC) but:

- Hub server resides on well-known port
- Hub HTTP server configured so browser allows cross-domain access
  - W3C Cross Origin Resource Sharing — JavaScript, newer browsers
  - `/crossdomain.xml` — Flash, Java, Silverlight, nearly all browsers
  - `/clientaccesspolicy.xml` — Silverlight, IE
- Callbacks use reverse HTTP / "Long Poll"
- Hub provides proxy service for external URLs

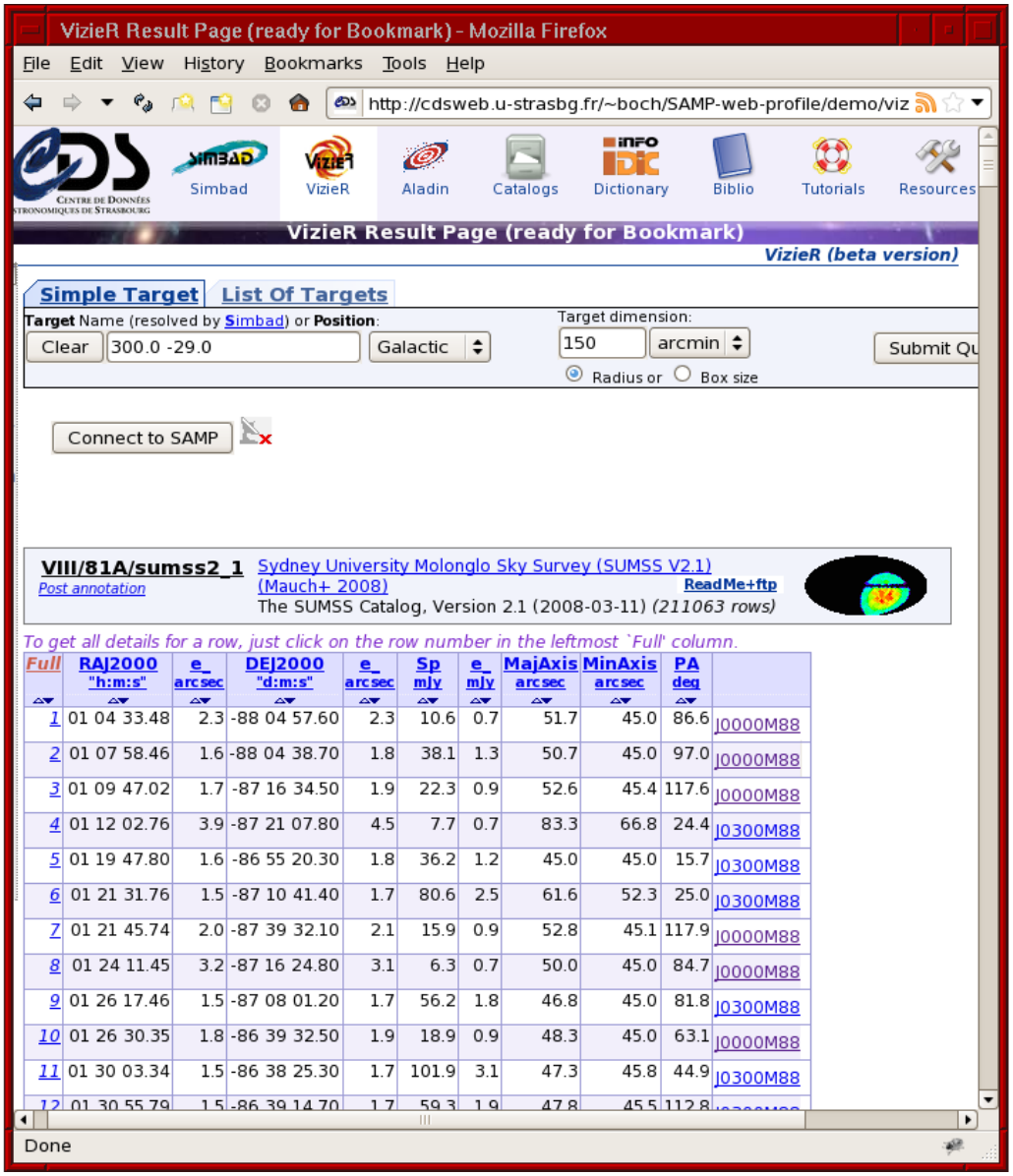
$\Rightarrow$ Browser-based clients can talk to desktop Hub

Security!

Cross-domain restrictions lifted for Hub HTTP server

- Untrusted web applications can access the Hub. What can they do?
  - ▷ Request to register with Hub
  - ▷ *If refused:*
    - nothing
  - ▷ *If granted:*
    - send/receive SAMP messages
    - read cross-domain URLs
- Address security concerns:
  1. Require explicit user approval for registration
     - Popup dialogue at registration time
  2. Ensure actions when registered are fairly harmless
     - Restrict message types to list with known harmless semantics
     - Restrict local URLs to ones referenced in previous SAMP messages

$\Rightarrow$ Hostile web apps can only take action if the user is explicitly careless. Even in this case, the worst attacks are fairly harmless.


VizieR Result Page (ready for Bookmark) - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://cdsweb.u-strasbg.fr/~boch/SAMP-web-profile/demo/viz
Simbad VizieR Aladin Catalogs Dictionary Biblio Tutorials Resources
VizieR Result Page (ready for Bookmark)
VizieR (beta version)
Simple Target List Of Targets
Target Name (resolved by Simbad) or Position:
Clear 300.0 -29.0 Galactic
Target dimension:
150 arcmin
Radius or Box size
Submit Qu
Connect to SAMP
VIII/81A/sumss2_1
Post annotation
Sydney University Molonglo Sky Survey (SUMSS V2.1)
(Mauch+ 2008)
ReadMe+ftp
The SUMSS Catalog, Version 2.1 (2008-03-11) (211063 rows)
To get all details for a row, just click on the row number in the leftmost `Full' column.
Full RAJ2000 "h:m:s" e_ arcsec DEJ2000 "d:m:s" e_ arcsec Sp mJy e_ mJy MajAxis arcsec MinAxis arcsec PA deg
1 01 04 33.48 2.3 -88 04 57.60 2.3 10.6 0.7 51.7 45.0 86.6 J0000M88
2 01 07 58.46 1.6 -88 04 38.70 1.8 38.1 1.3 50.7 45.0 97.0 J0000M88
3 01 09 47.02 1.7 -87 16 34.50 1.9 22.3 0.9 52.6 45.4 117.6 J0000M88
4 01 12 02.76 3.9 -87 21 07.80 4.5 7.7 0.7 83.3 66.8 24.4 J0300M88
5 01 19 47.80 1.6 -86 55 20.30 1.8 36.2 1.2 45.0 45.0 15.7 J0300M88
6 01 21 31.76 1.5 -87 10 41.40 1.7 80.6 2.5 61.6 52.3 25.0 J0300M88
7 01 21 45.74 2.0 -87 39 32.10 2.1 15.9 0.9 52.8 45.1 117.9 J0000M88
8 01 24 11.45 3.2 -87 16 24.80 3.1 6.3 0.7 50.0 45.0 84.7 J0000M88
9 01 26 17.46 1.5 -87 08 01.20 1.7 56.2 1.8 46.8 45.0 81.8 J0300M88
10 01 26 30.35 1.8 -86 39 32.50 1.9 18.9 0.9 48.3 45.0 63.1 J0000M88
11 01 30 03.34 1.5 -86 38 25.30 1.7 101.9 3.1 47.3 45.8 44.9 J0300M88
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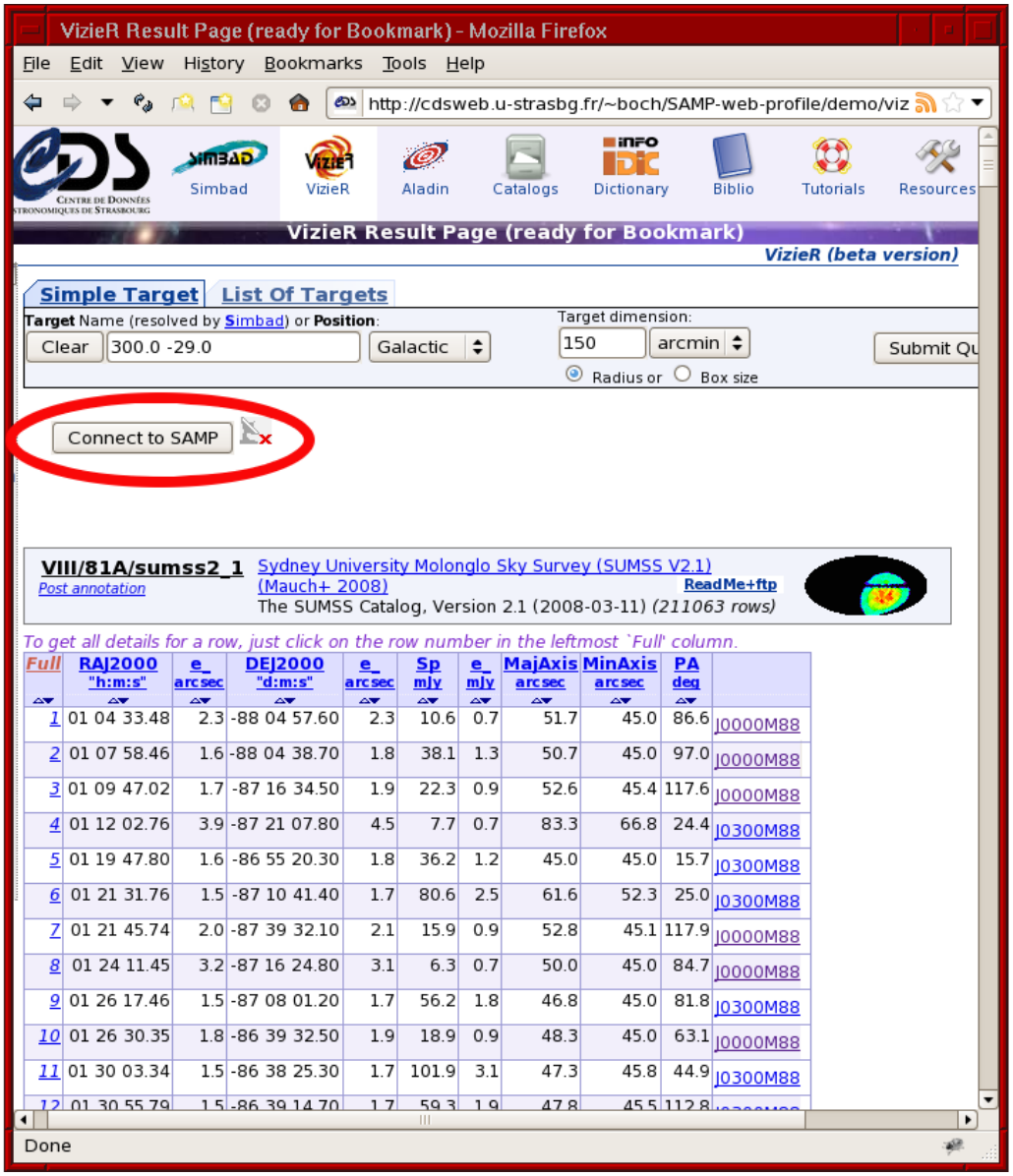
VizieR Result Page (ready for Bookmark) - Mozilla Firefox
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Simbad
VizieR
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Biblio
Tutorials
Resources
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VizieR (beta version)
Simple Target
List Of Targets
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Clear
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Full
RAJ2000 "h:m:s"
e_ arcsec
DEJ2000 "d:m:s"
e_ arcsec
Sp mJy
e_ mJy
MajAxis arcsec
MinAxis arcsec
PA deg
1 01 04 33.48 2.3 -88 04 57.60 2.3 10.6 0.7 51.7 45.0 86.6 J0000M88
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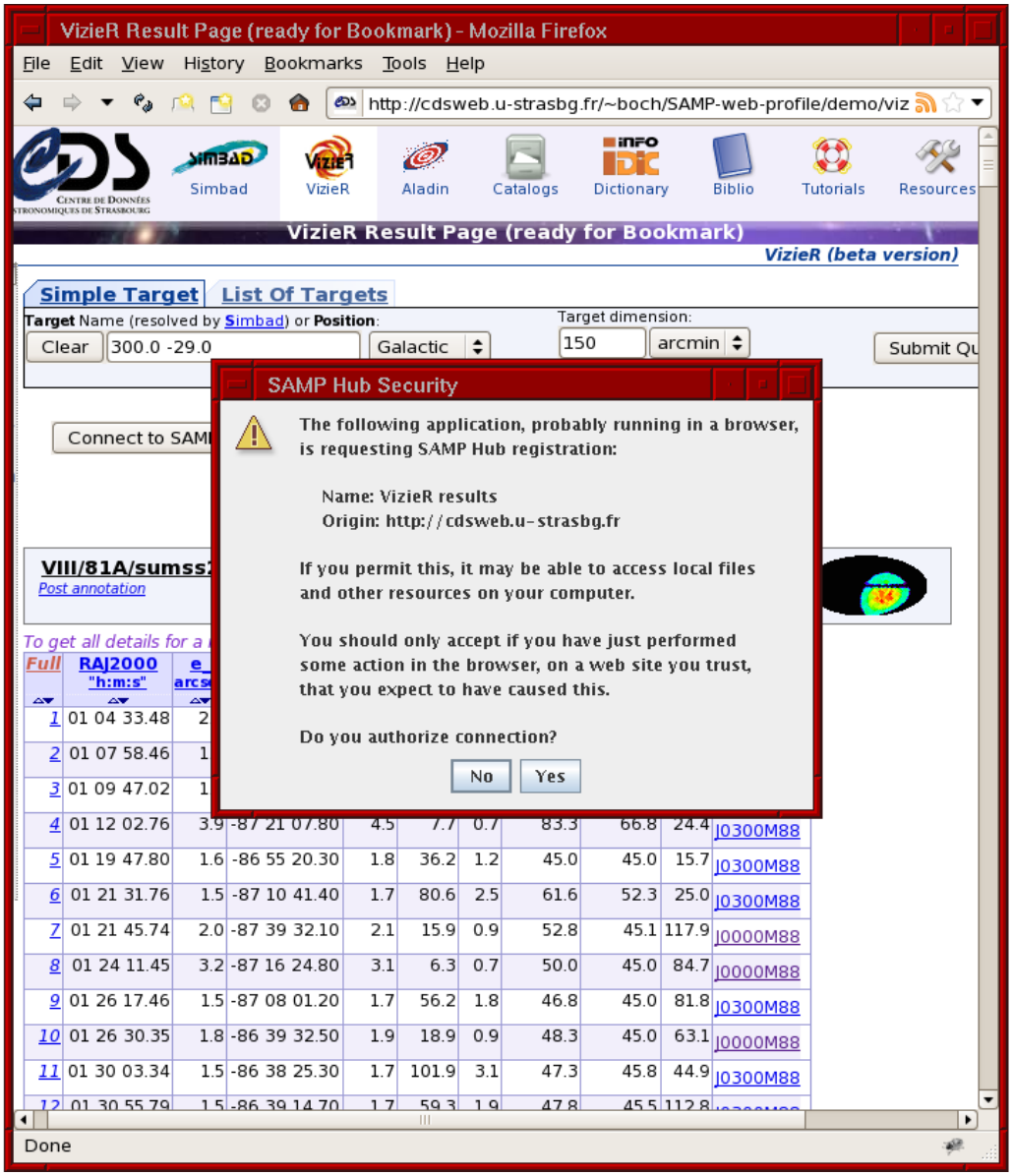
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VizieR (beta version)
Simple Target List Of Targets
Target Name (resolved by Simbad) or Position:
Clear 300.0 -29.0 Galactic
Target dimension:
150 arcmin
Submit Qu
Connect to SAM
SAMP Hub Security
The following application, probably running in a browser, is requesting SAMP Hub registration:
Name: VizieR results
Origin: http://cdsweb.u-strasbg.fr
If you permit this, it may be able to access local files and other resources on your computer.
You should only accept if you have just performed some action in the browser, on a web site you trust, that you expect to have caused this.
Do you authorize connection?
No Yes
VIII/81A/sumss2
Post annotation
To get all details for a
Full RAJ2000 "h:m:s"
1 01 04 33.48
2 01 07 58.46
3 01 09 47.02
4 01 12 02.76 -87 21 07.80
5 01 19 47.80 -86 55 20.30
6 01 21 31.76 -87 10 41.40
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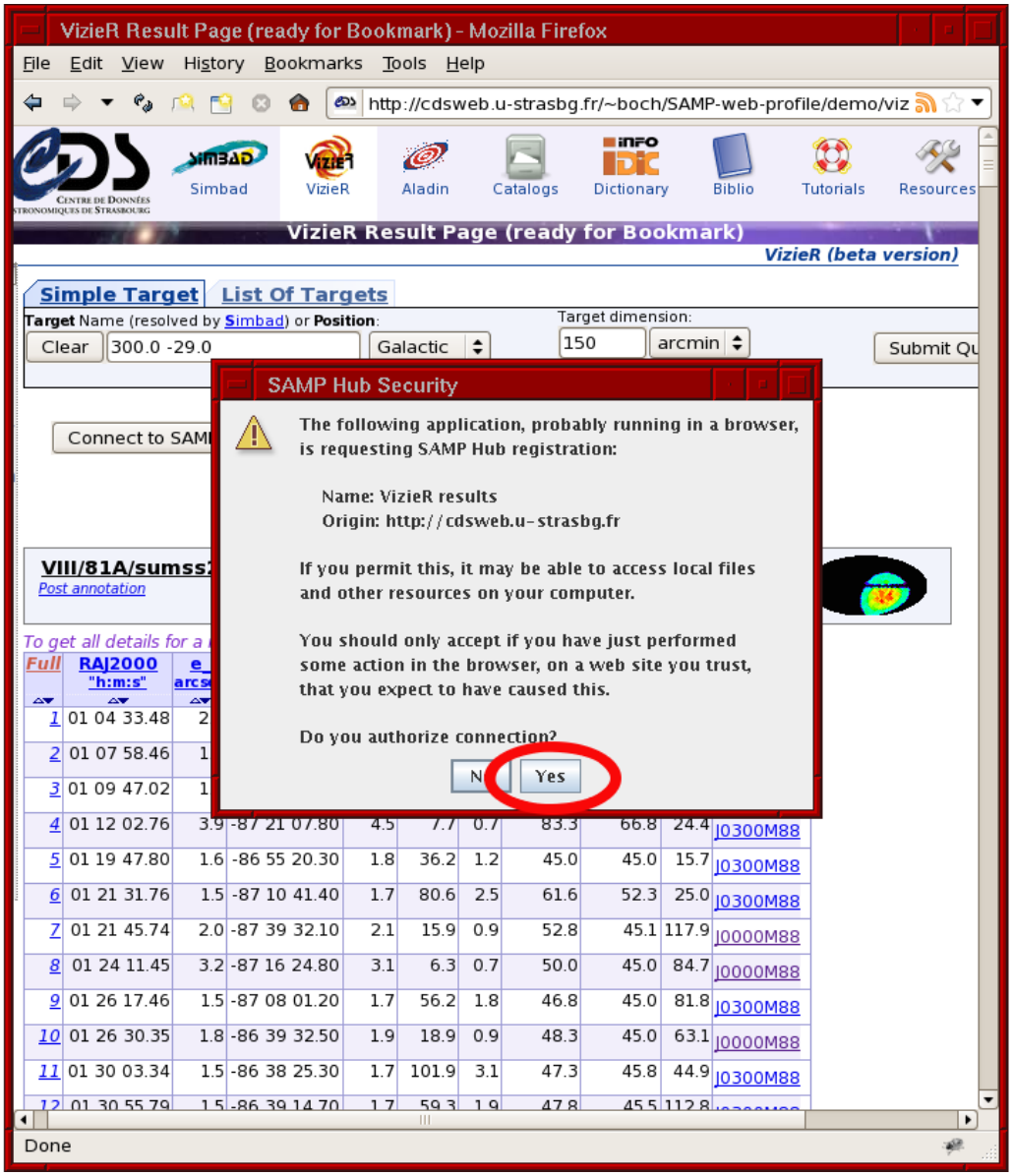
9 01 26 17.46 -87 08 01.20
10 01 26 30.35 -86 39 32.50
11 01 30 03.34 -86 38 25.30
J0300M88
J0000M88
Done

Register. . .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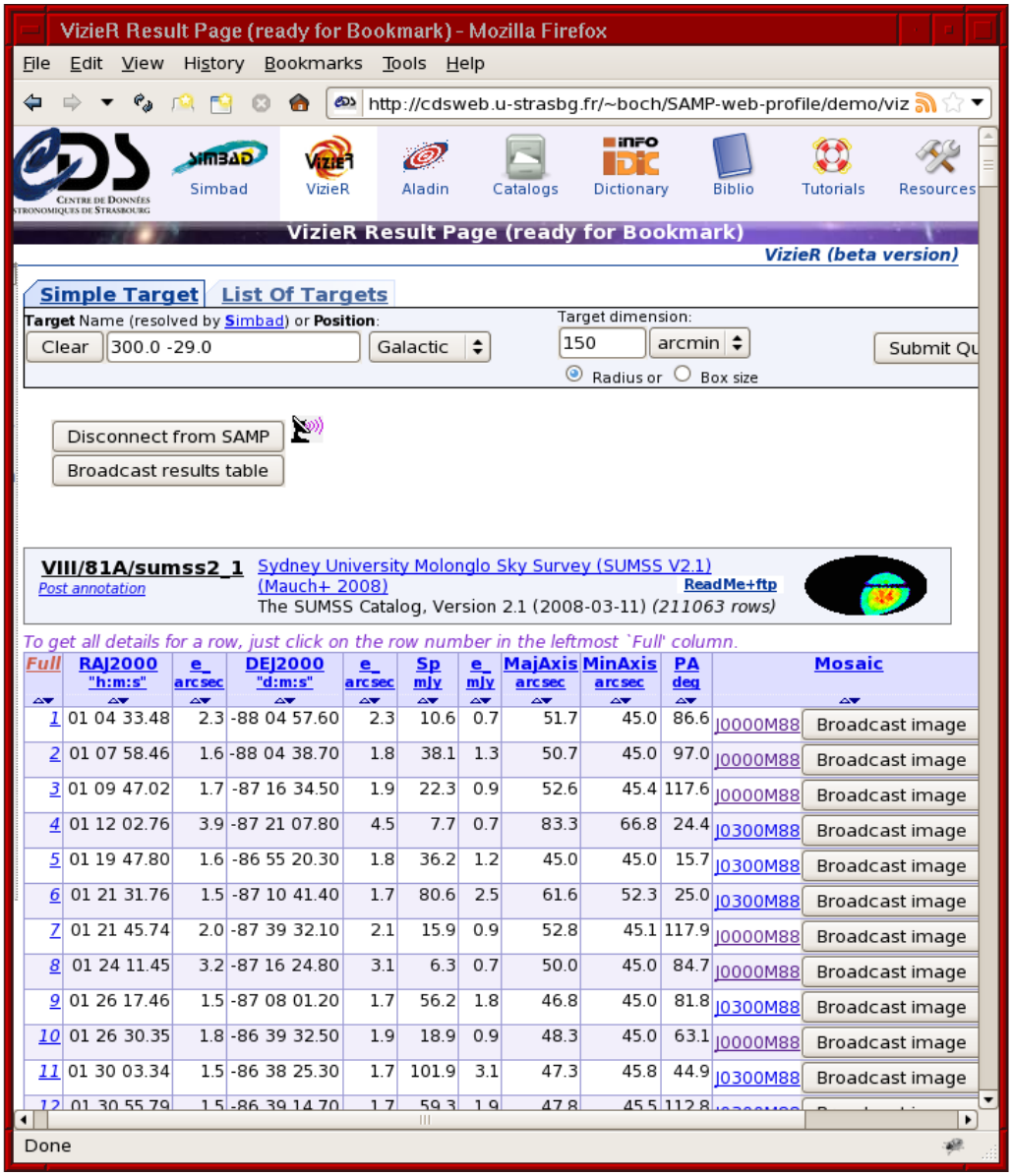
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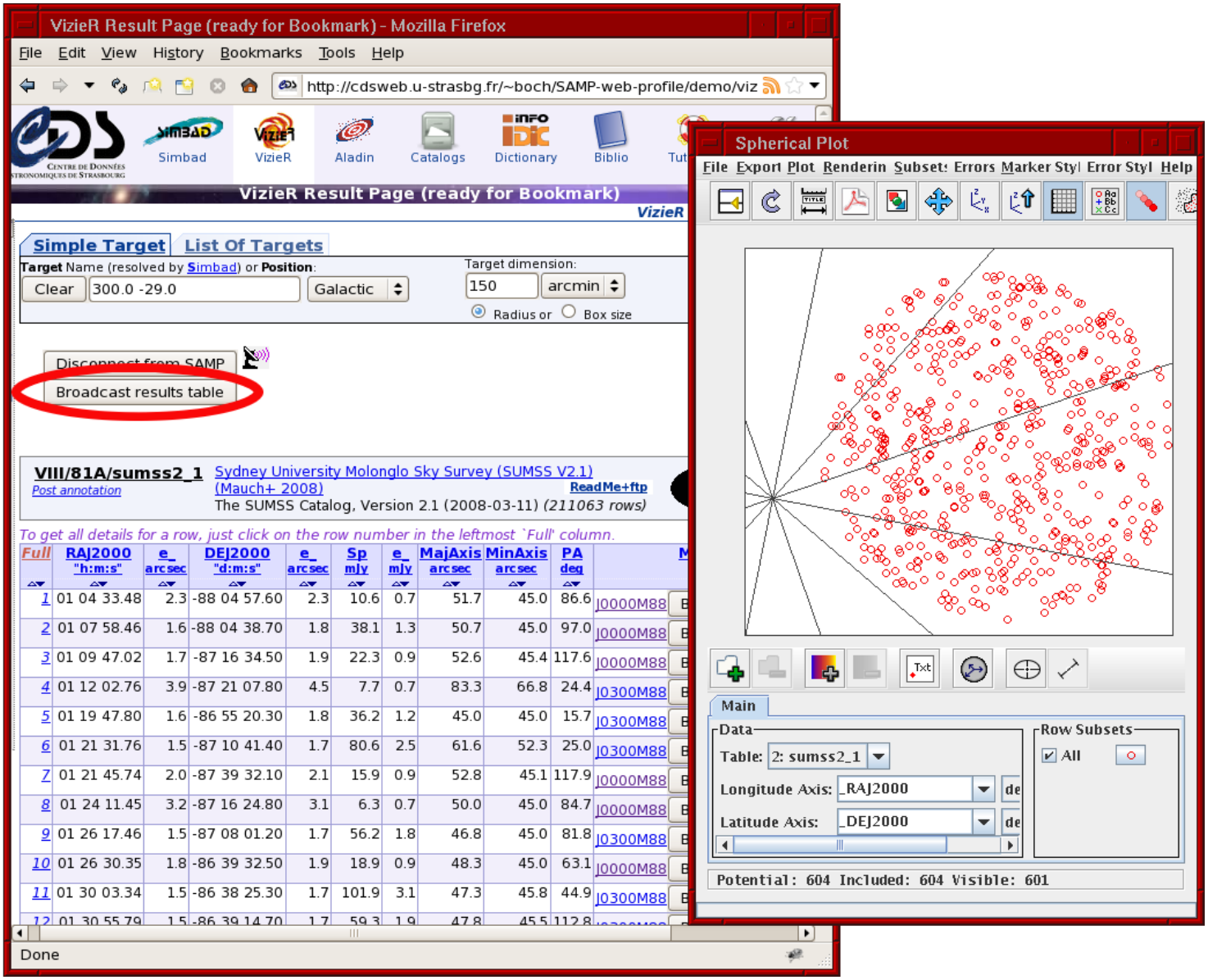
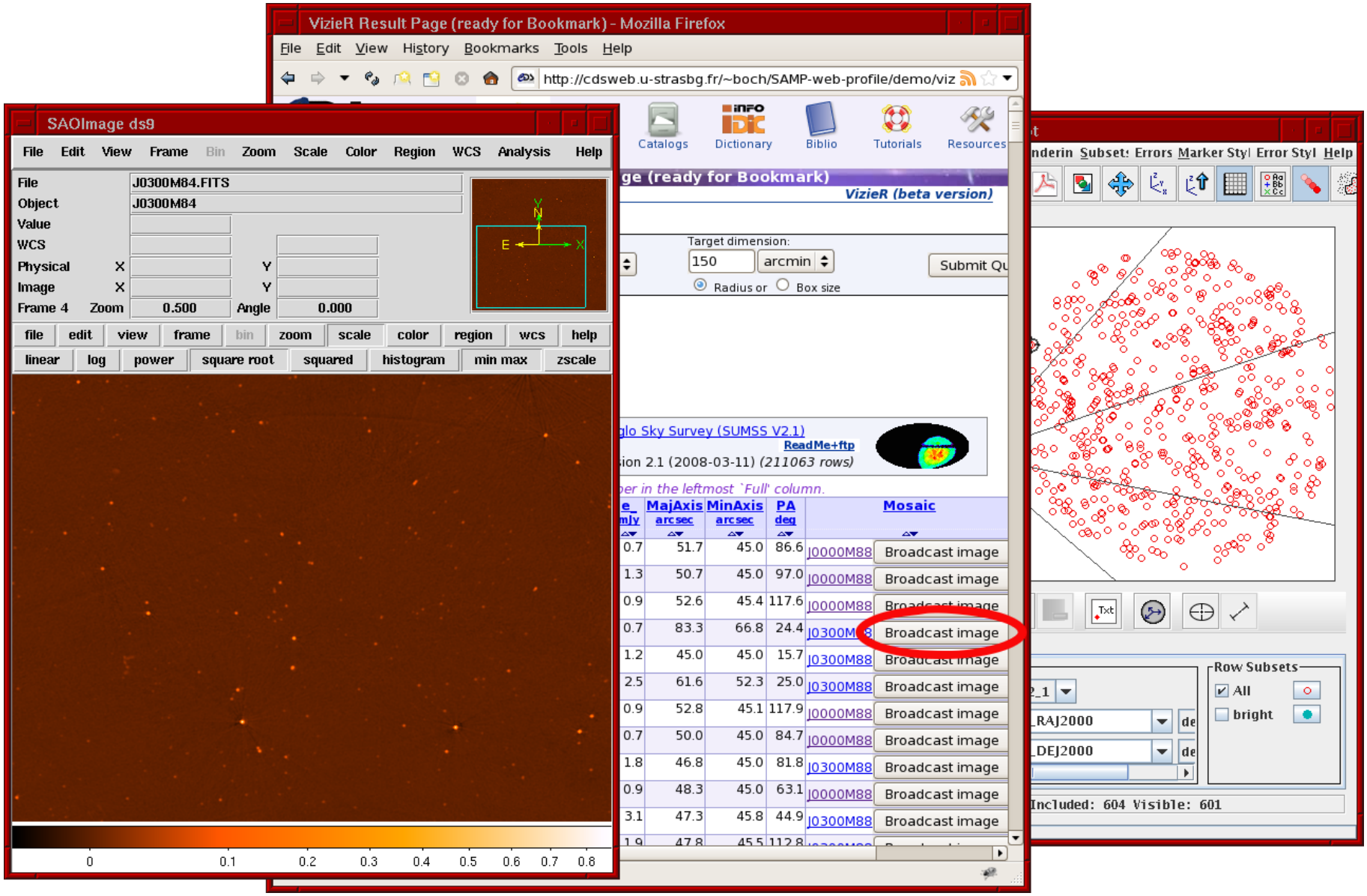
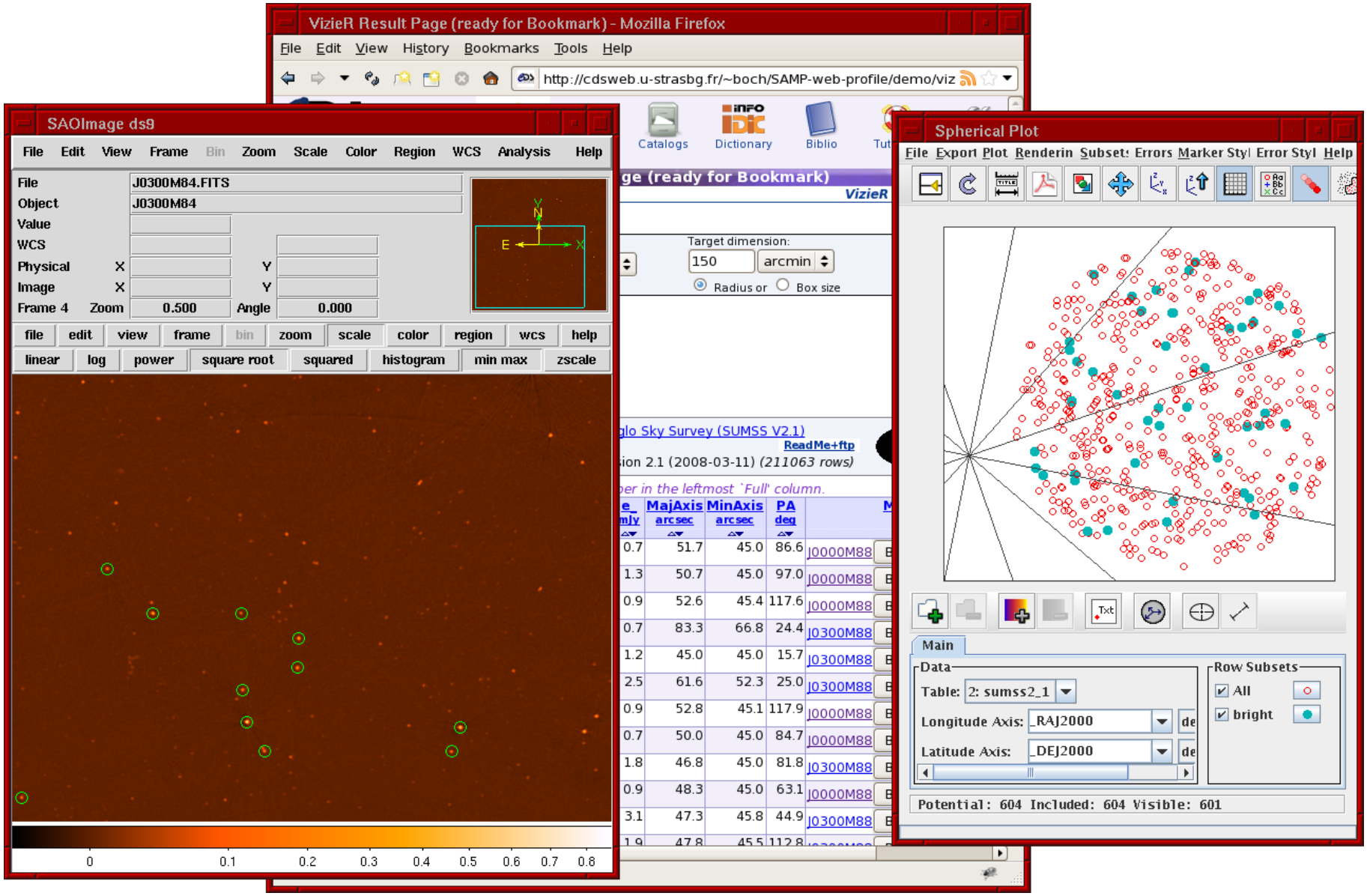
Full RAJ2000 "h:m:s" e_ arcsec DEJ2000 "d:m:s" e_ arcsec Sp mJy e_ mJy MajAxis arcsec MinAxis arcsec PA deg Mosaic
1 01 04 33.48 2.3 -88 04 57.60 2.3 10.6 0.7 51.7 45.0 86.6 J0000M88 Broadcast image
2 01 07 58.46 1.6 -88 04 38.70 1.8 38.1 1.3 50.7 45.0 97.0 J0000M88 Broadcast image
3 01 09 47.02 1.7 -87 16 34.50 1.9 22.3 0.9 52.6 45.4 117.6 J0000M88 Broadcast image
4 01 12 02.76 3.9 -87 21 07.80 4.5 7.7 0.7 83.3 66.8 24.4 J0300M88 Broadcast image
5 01 19 47.80 1.6 -86 55 20.30 1.8 36.2 1.2 45.0 45.0 15.7 J0300M88 Broadcast image
6 01 21 31.76 1.5 -87 10 41.40 1.7 80.6 2.5 61.6 52.3 25.0 J0300M88 Broadcast image
7 01 21 45.74 2.0 -87 39 32.10 2.1 15.9 0.9 52.8 45.1 117.9 J0000M88 Broadcast image
8 01 24 11.45 3.2 -87 16 24.80 3.1 6.3 0.7 50.0 45.0 84.7 J0000M88 Broadcast image
9 01 26 17.46 1.5 -87 08 01.20 1.7 56.2 1.8 46.8 45.0 81.8 J0300M88 Broadcast image
10 01 26 30.35 1.8 -86 39 32.50 1.9 18.9 0.9 48.3 45.0 63.1 J0000M88 Broadcast image
11 01 30 03.34 1.5 -86 38 25.30 1.7 101.9 3.1 47.3 45.8 44.9 J0300M88 Broadcast image
Done


VizieR Result Page (ready for Bookmark) - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://cdsweb.u-strasbg.fr/~boch/SAMP-web-profile/demo/viz
Simbad
VizieR
Aladin
Catalogs
Dictionary
Biblio
VizieR Result Page (ready for Bookmark)
Simple Target
List Of Targets
Target Name (resolved by Simbad) or Position:
Clear
300.0 -29.0
Galactic
Target dimension:
150
arcmin
Radius or Box size
Disconnect from SAMP
Broadcast results table
VIII/81A/sumss2_1
Sydney University Molonglo Sky Survey (SUMSS V2.1)
(Mauch+ 2008)
ReadMe+ftp
The SUMSS Catalog, Version 2.1 (2008-03-11) (211063 rows)
Post annotation
To get all details for a row, just click on the row number in the leftmost `Full' column.
Full
RAJ2000
DEJ2000
e_
Sp
MajAxis
MinAxis
PA
Done
Spherical Plot
File Export Plot Renderin Subset: Errors Marker Styl Error Styl Help
Main
Data
Table: 2: sumss2_1
Longitude Axis: _RAJ2000
Latitude Axis: _DEJ2000
Row Subsets
All
Potential: 604 Included: 604 Visible: 601

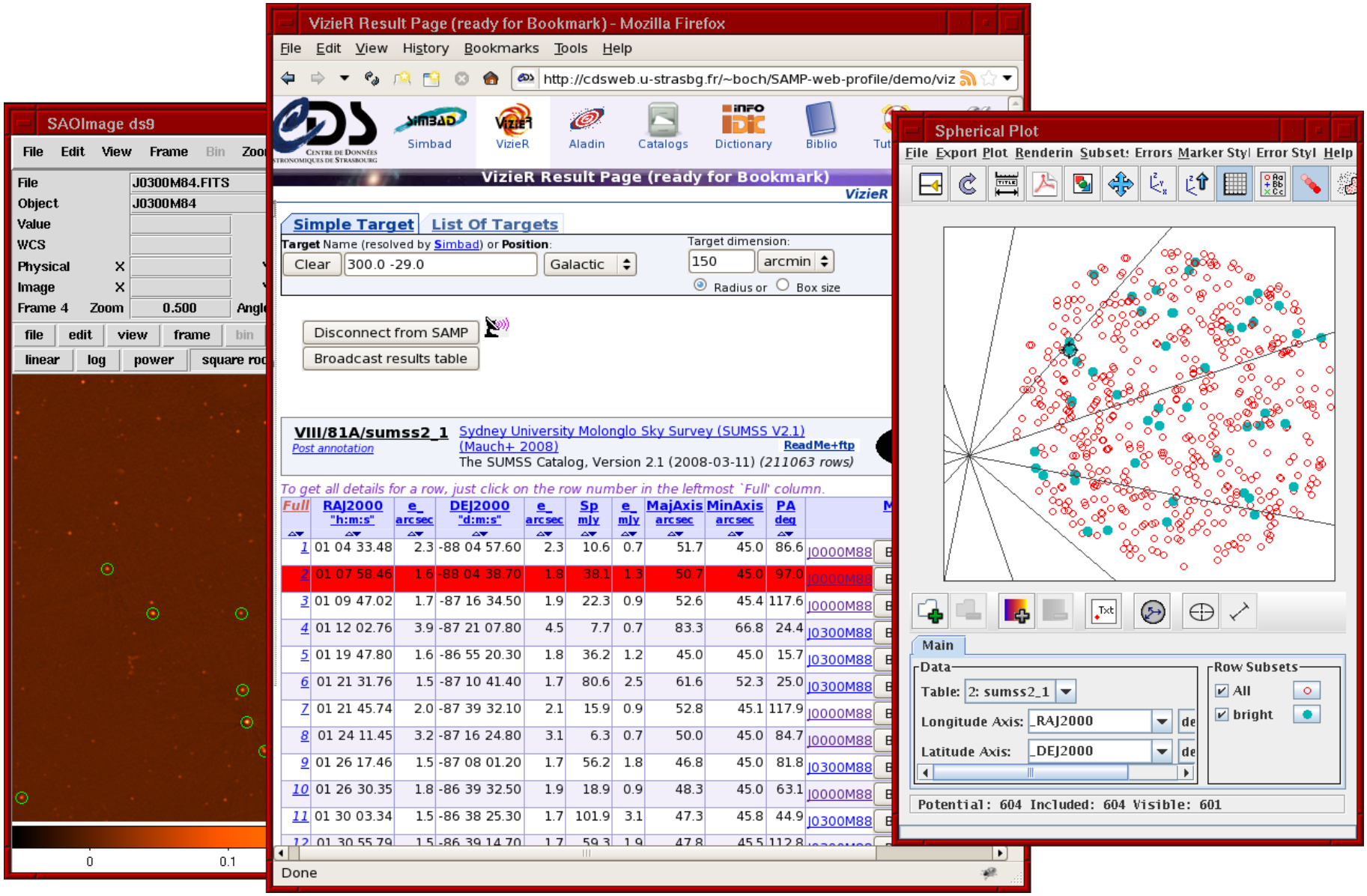
Table


VizieR Result Page (ready for Bookmark) - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://cdsweb.u-strasbg.fr/~boch/SAMP-web-profile/demo/viz
Catalogs
Dictionary
Biblio
Tutorials
Resources
VizieR (beta version)
Target dimension:
150
arcmin
Radius or
Box size
Submit Qu
ReadMe+ftp
Mosaic
Broadcast image
SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File J0300M84.FITS
Object J0300M84
Value
WCS
Physical X Y
Image X Y
Frame 4 Zoom 0.500 Angle 0.000
file edit view frame bin zoom scale color region wcs help
linear log power square root squared histogram min max zscale
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
Row Subsets
All
bright
Included: 604 Visible: 601

FITS Image ⟸


VizieR Result Page (ready for Bookmark) - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://cdsweb.u-strasbg.fr/~boch/SAMP-web-profile/demo/viz
Catalogs
Dictionary
Biblio
SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
J0300M84.FITS
J0300M84
Spherical Plot
File Export Plot Renderin Subset: Errors Marker Styl Error Styl Help
Target dimension:
150
arcmin
Radius or Box size
Main
Data
Table: 2: sumss2_1
Longitude Axis: _RAJ2000
Latitude Axis: _DEJ2000
Row Subsets
All
bright
Potential: 604 Included: 604 Visible: 601
MajAxis arcsec
MinAxis arcsec
PA deg

Row List



VizieR Single Row

Web Profile Status

SAMP Web Profile Standard:

- IVOA Proposed Recommendation — Recommendation expected early 2012

SAMP Web Profile clients:

- Experiments (JavaScript) at CDS, HEASARC, MAST, ESAC, ESO, . . .

SAMP Web Profile Hub now (last few weeks) deployed by default in:

- TOPCAT v3.8 *(embedded hub)*
- Aladin Beta 7.068 *(embedded hub)*
- JSAMP 1.3-1 *(standalone hub)*
- . . . more soon?

$\Rightarrow$ Science users will be able to make use of SAMP web applications now or soon

Summary

- SAMP is successful on the desktop
- It's set to move into the browser

http://www.ivoa.net/samp/