VIRTUAL ASTRONOMICAL OBSERVATORY

Science Initiatives of the US Virtual Observatory

Robert Hanisch
Space Telescope Science Institute
Director, Virtual Astronomical Observatory

US VO efforts

- National Virtual Observatory (NVO) development effort, 2001-08
  - $14M, 17 organizations
  - NSF Information Technology Research program
- Virtual Astronomical Observatory (VAO) operational facility, 2010-2015
  - Funding is $5.5M/year for five years, subject to annual performance review, 9 organizations
  - $4M/year from NSF/AST
  - $1.5M/year from NASA
  - Covers ~27 FTE over the nine organizations
- VAO is managed by the VAO,LLC (limited liability company) co-owned by AUI (operates NRAO and ALMA) and AURA (operates NOAO and STScI)
  - VAO has its own Board of Directors (J. Gallagher, chair)
  - R. Hanisch, director; B. Berriman, program manager, J. Lazio, project scientist, A. Szalay, technology advisor
  - G. Fabbiano, chair of Science Council

www.usvao.org

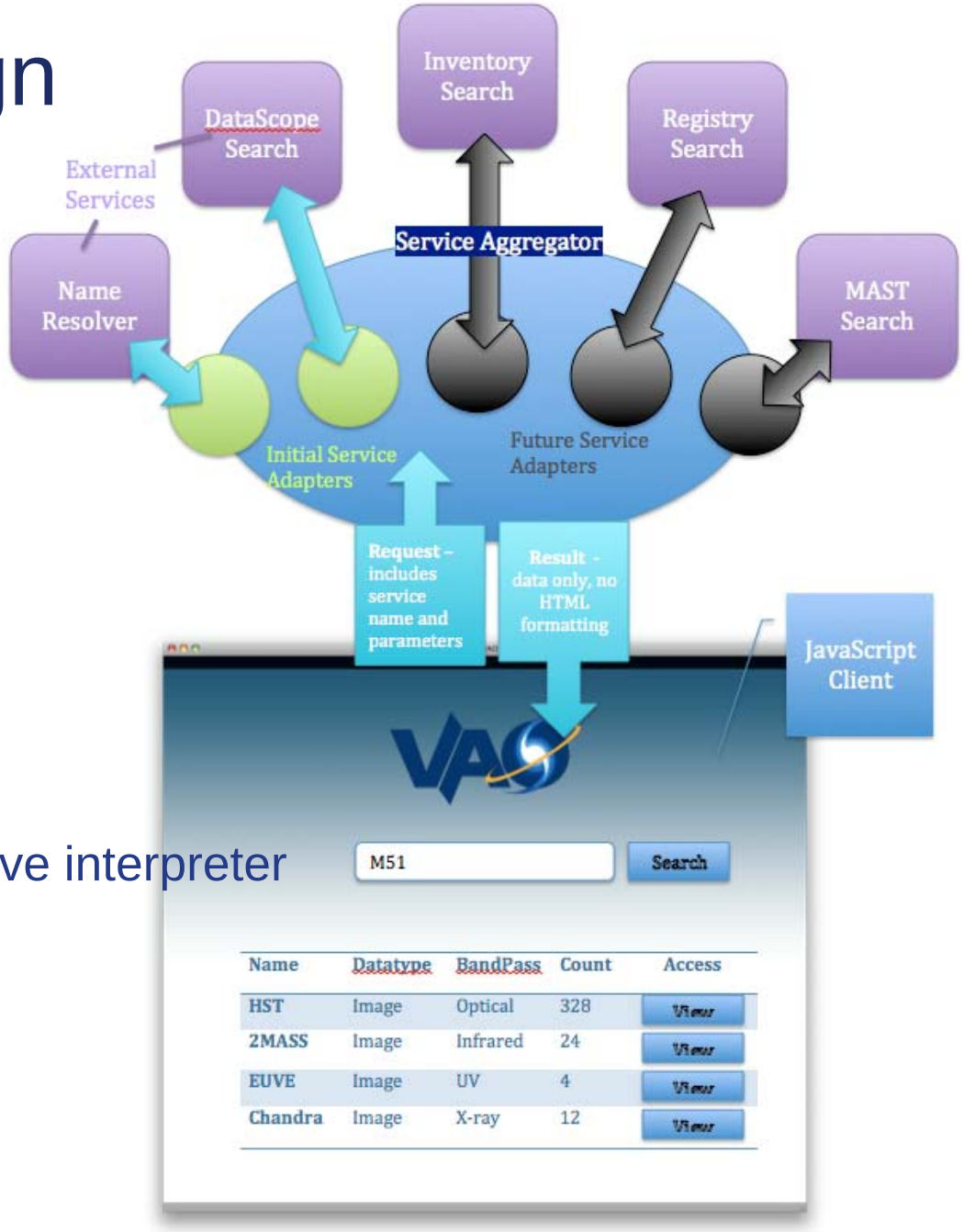
Science initiatives

The VAO has selected seven science initiatives that were endorsed by the Science Council as providing maximal scientific impact in the astronomy community:

1. Development of a dedicated VAO Portal (Data Discovery Tool)
2. Scalable cross-matching between catalogs of sources
3. Building and analyzing spectral energy distributions (SEDs)
4. Time domain astronomy: (a) Periodograms and light curve analyses; (b) Transient event services
5. Data linking and semantic astronomy
6. Desktop tool integration
7. Data mining and statistical analysis

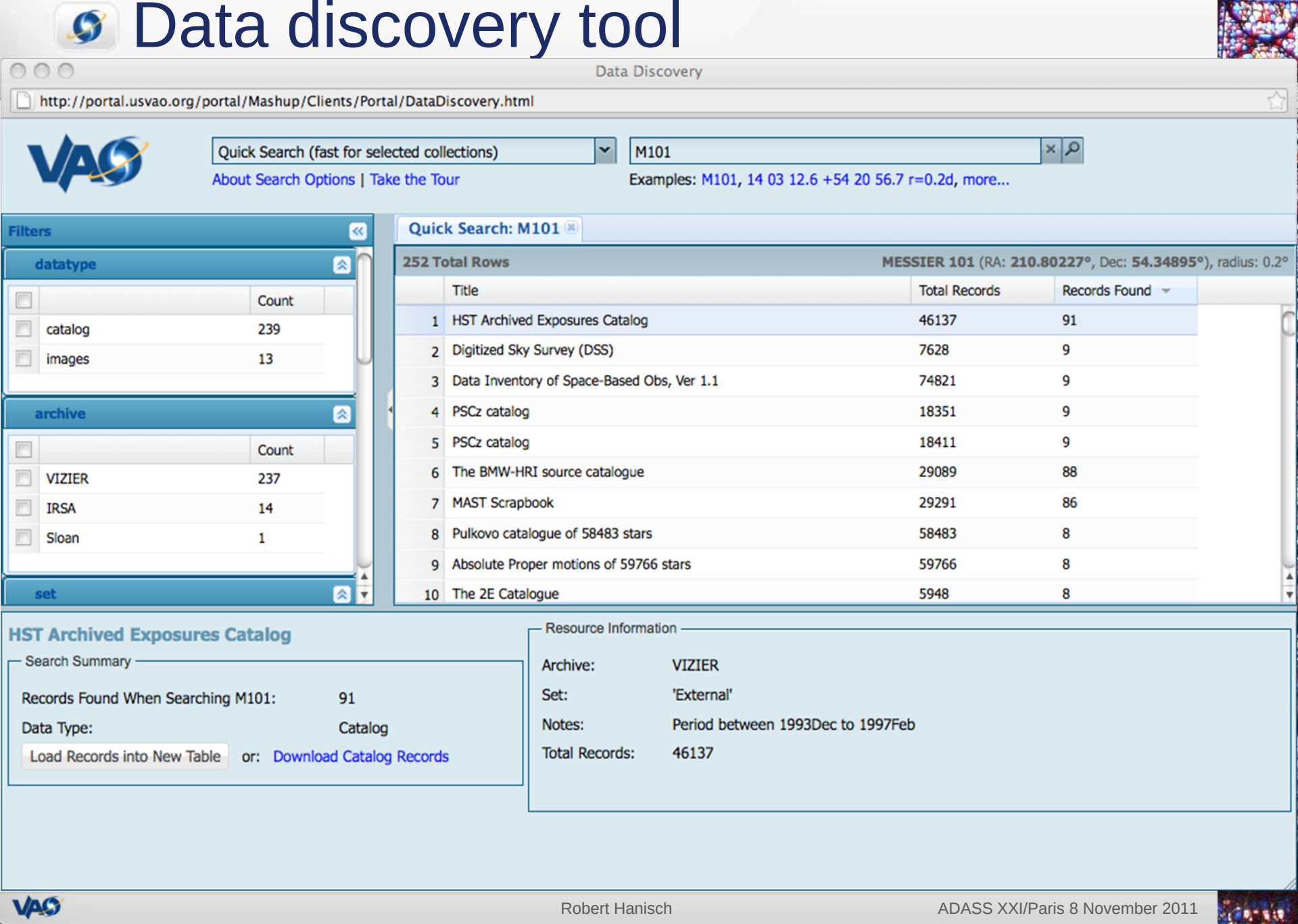
- These initiatives are complementary to VO applications and tools developed throughout the IVOA (Aladin, TOPCAT, VOStat, etc.)
- Exploit SAMP for applications interoperability

Portal design concept



context sensitive interpreter

Data discovery tool



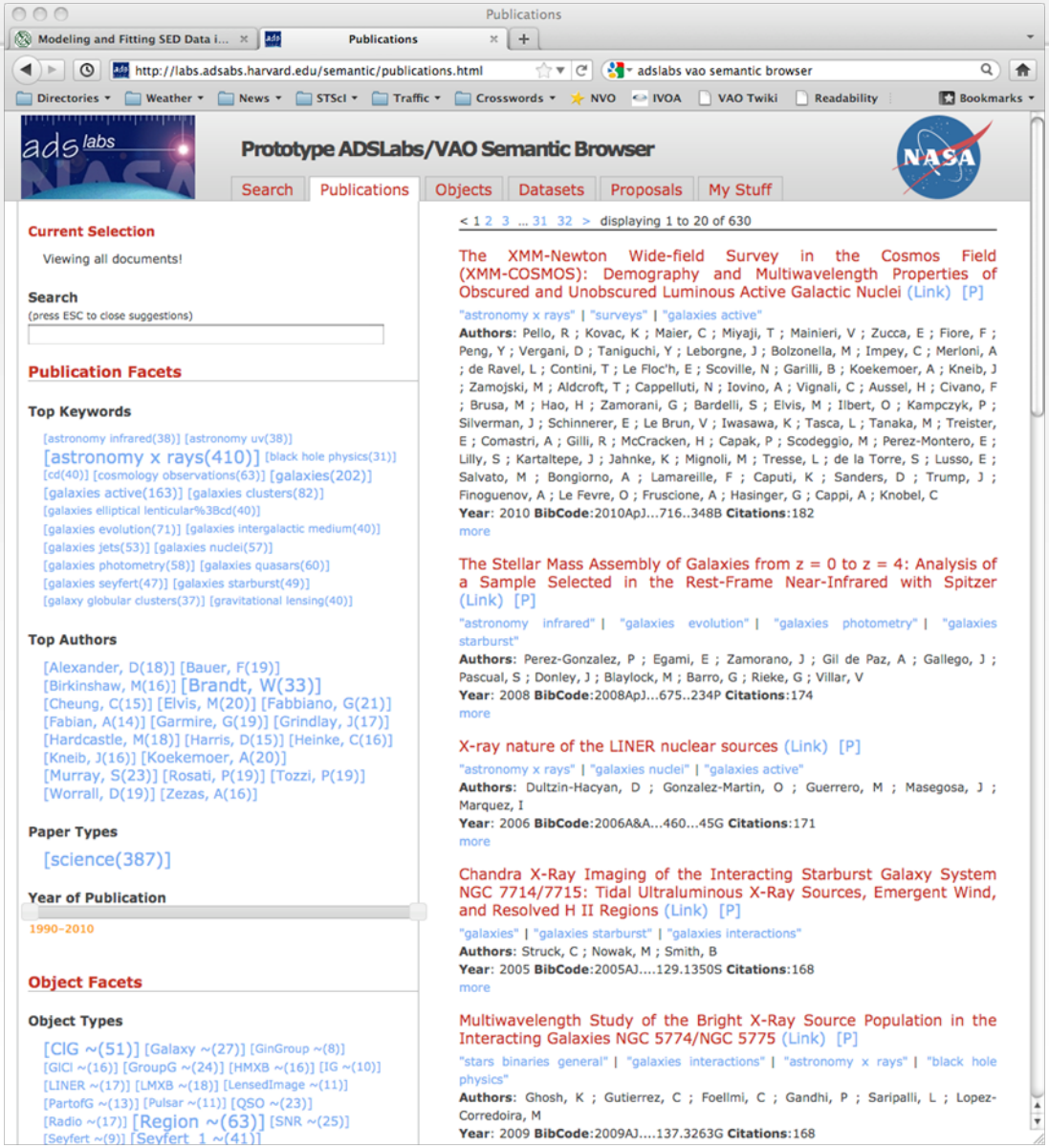
Data discovery tool

Quick Search: M101 | HST Archived Exposures Catalog: M101

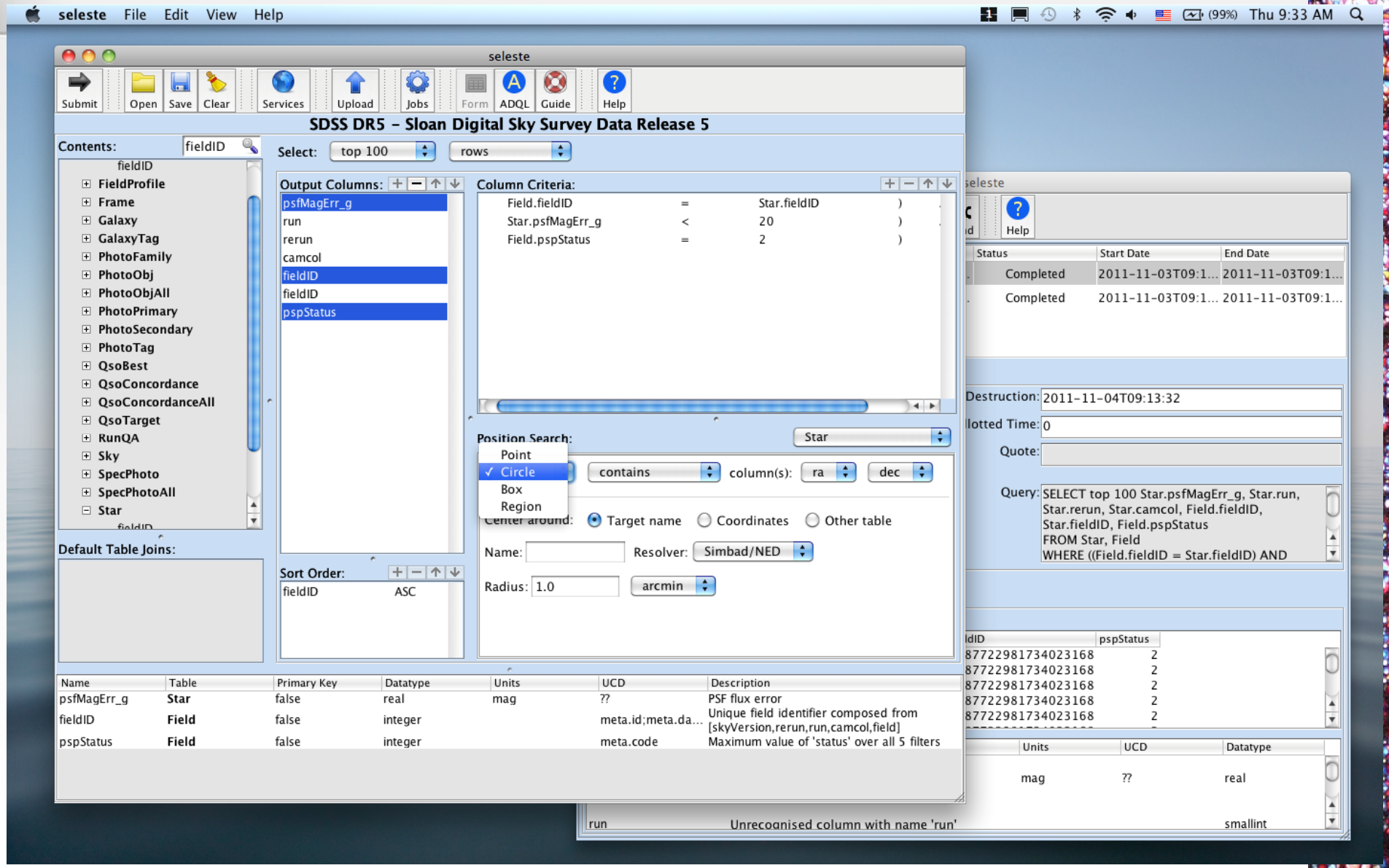
91 Total Rows — **MESSIER 101** (RA: **210.80227°**, Dec: **54.34895°**), radius: 0.2°

	ra	dec	Target	RAh	RAm	RAs	DE-	DEd	DEm	DEs	v3	fov	config
1	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
2	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
3	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
4	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
5	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
6	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
7	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
8	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2
9	210.8497	54.35992	NGC5457-FLD1	14	3	23.94	+	54	21	35.7	8.5	SM93	WFPC2

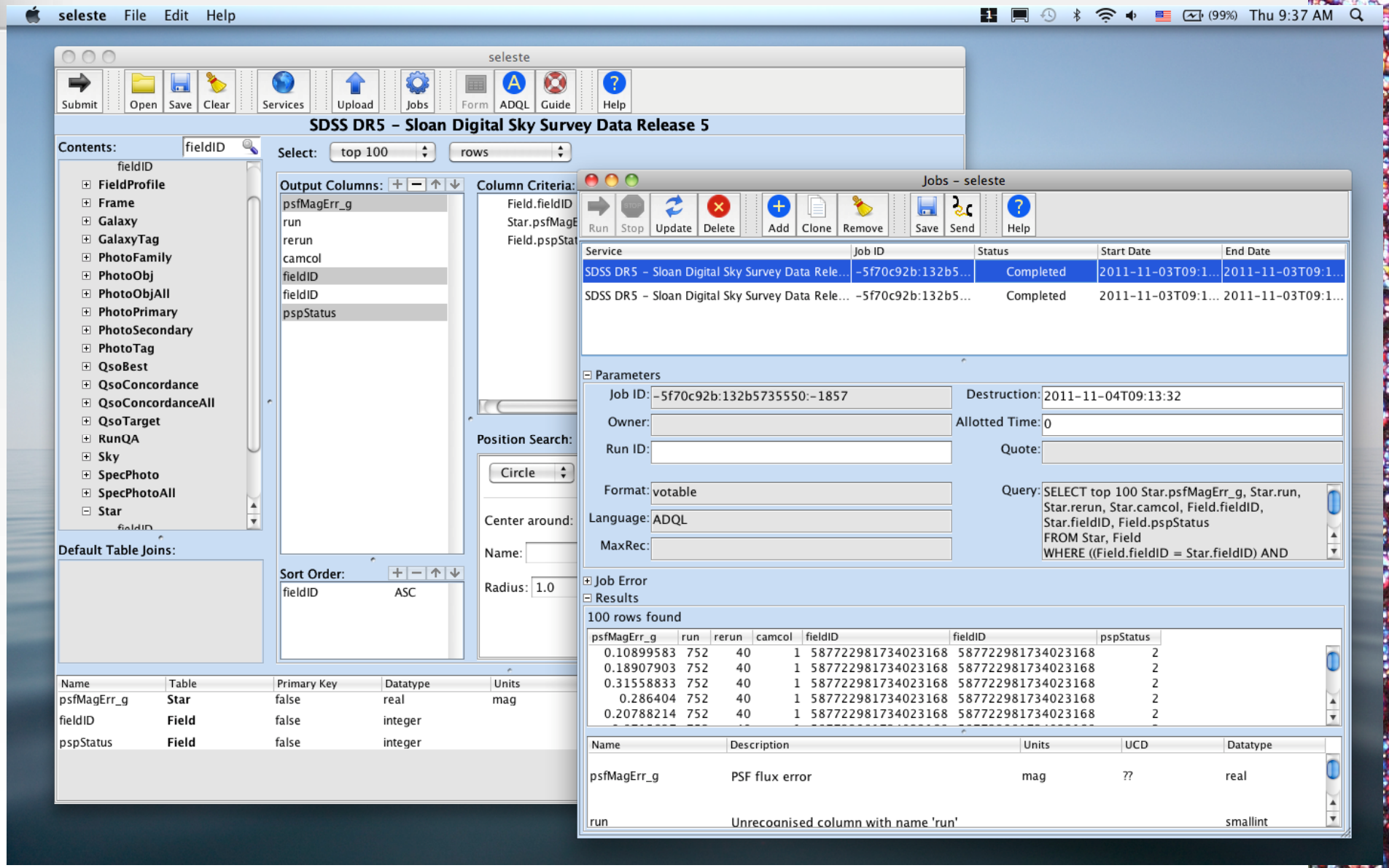
Semantic discovery tool



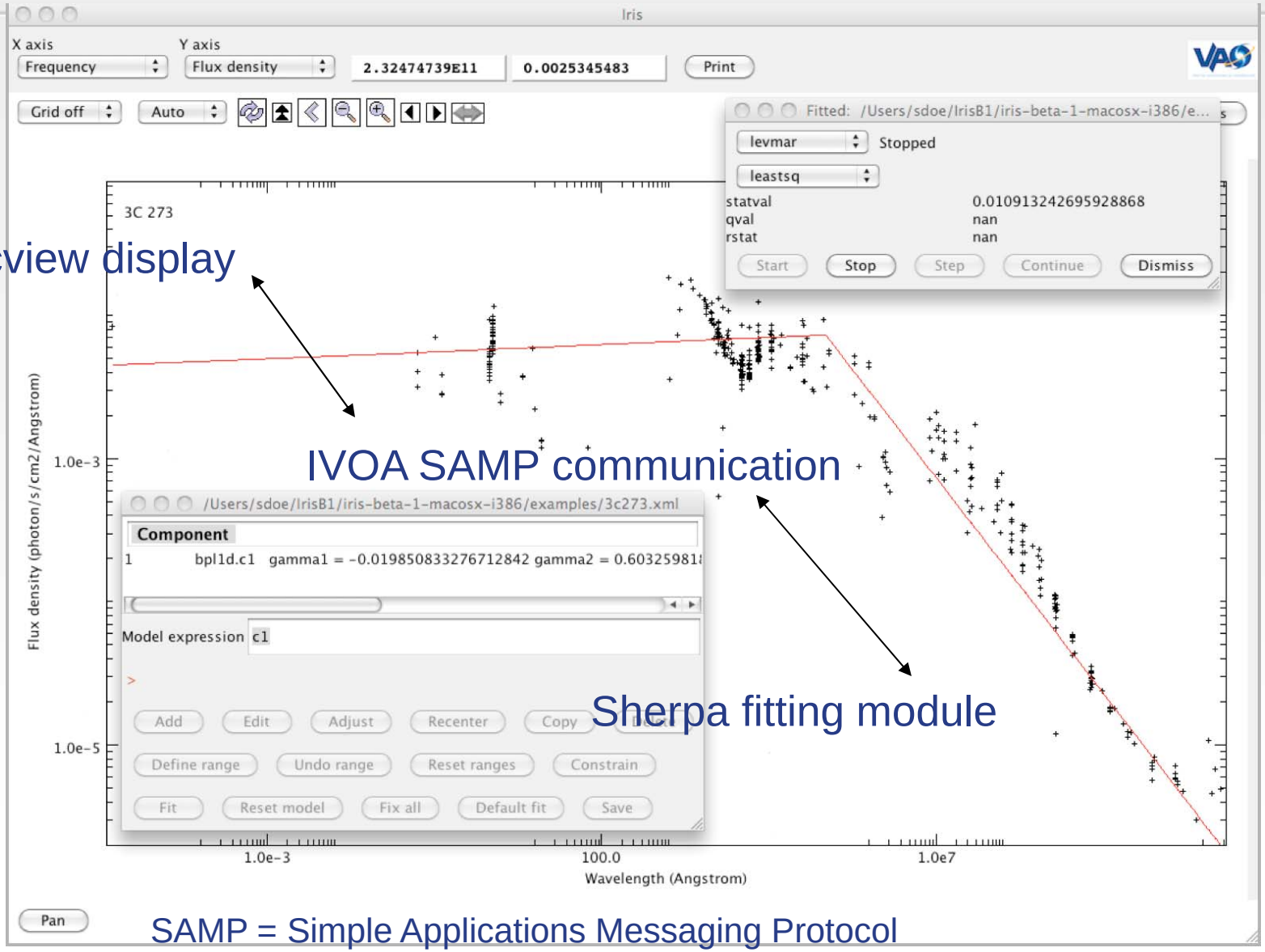
TAP client: *Seleste*



TAP client: *Seleste*



Spectral Energy Distribution tool: *Iris*



Specview display

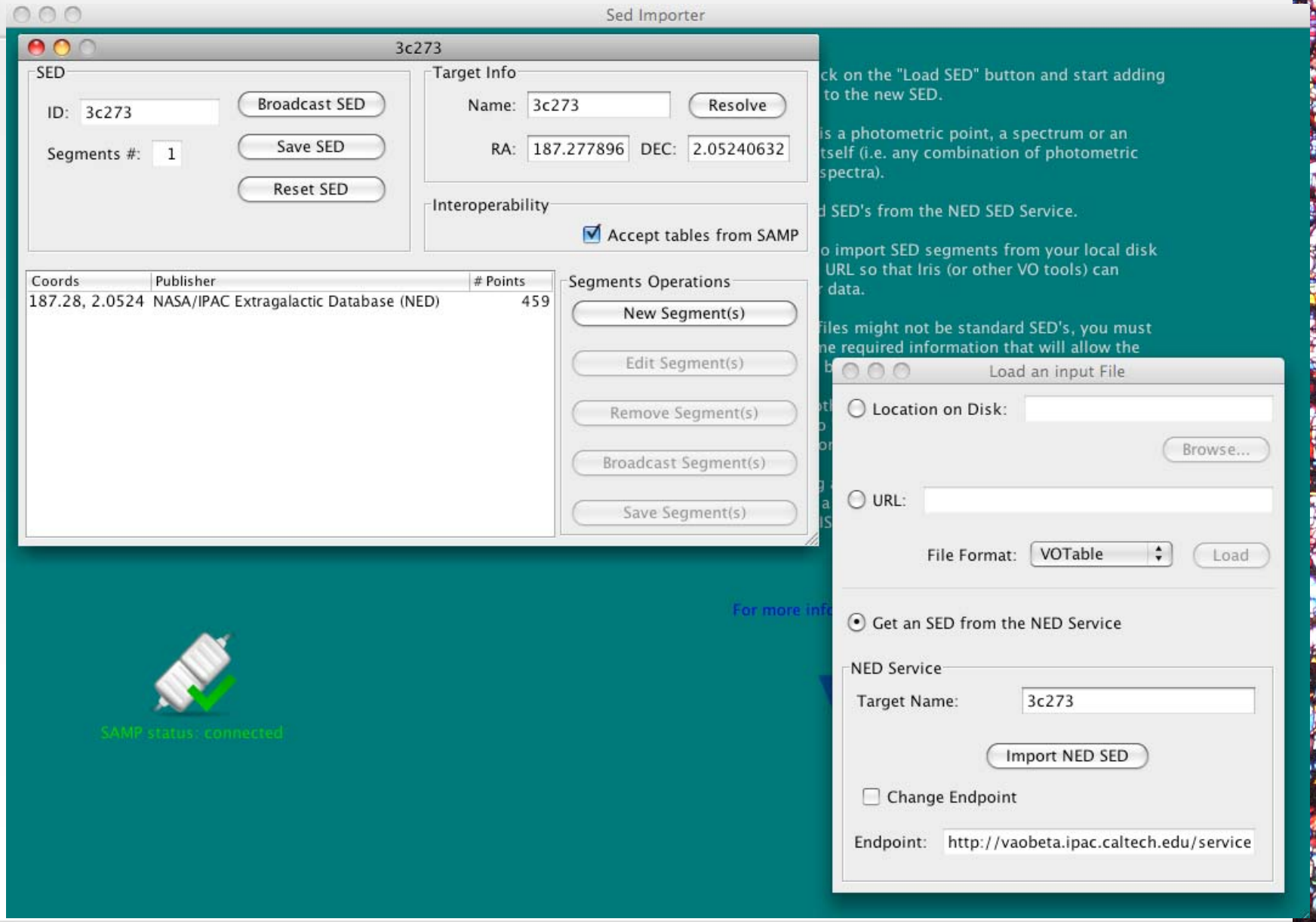
IVOA SAMP communication

Sherpa fitting module

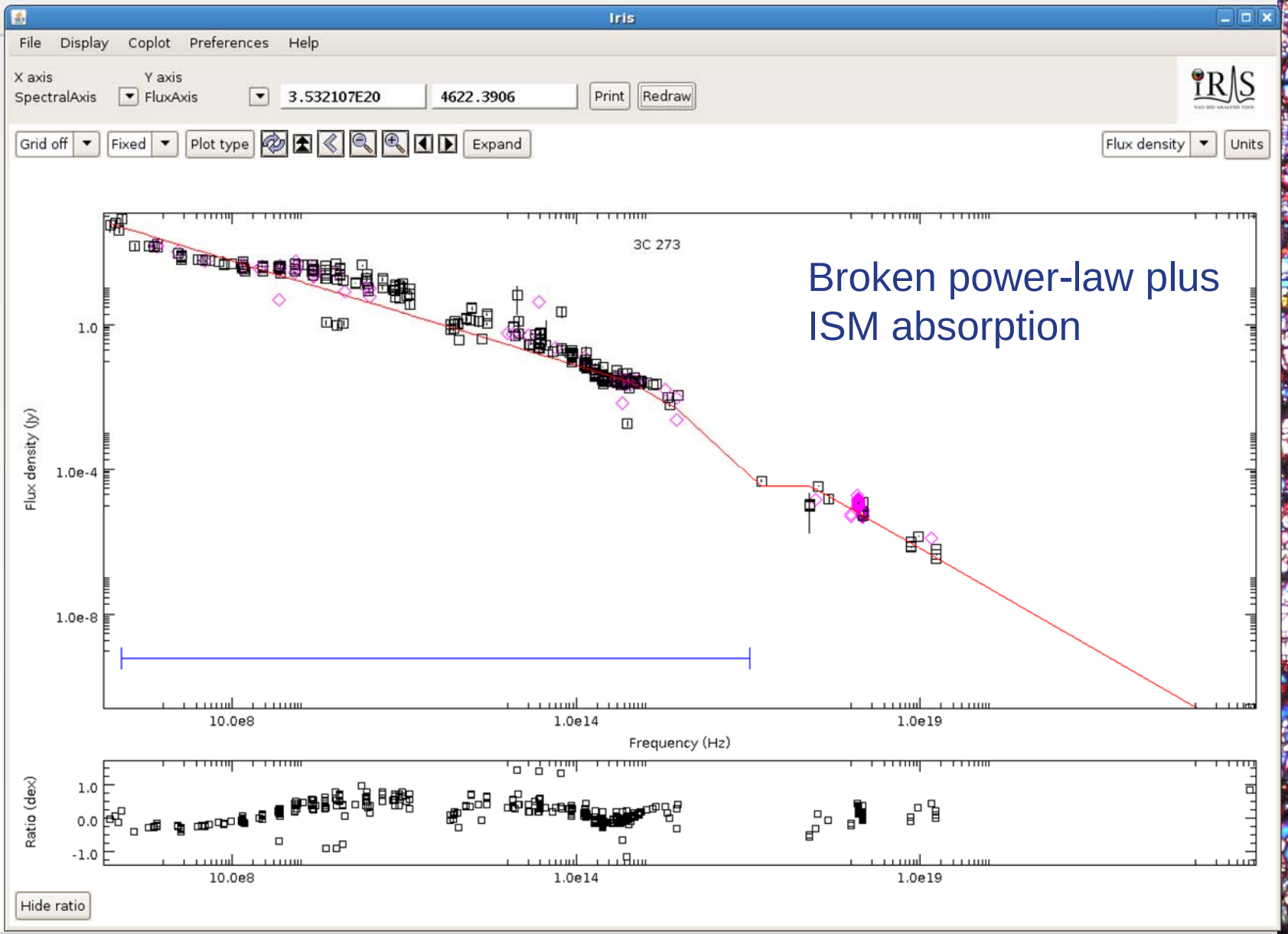
SAMP = Simple Applications Messaging Protocol

SED tool: *Iris*

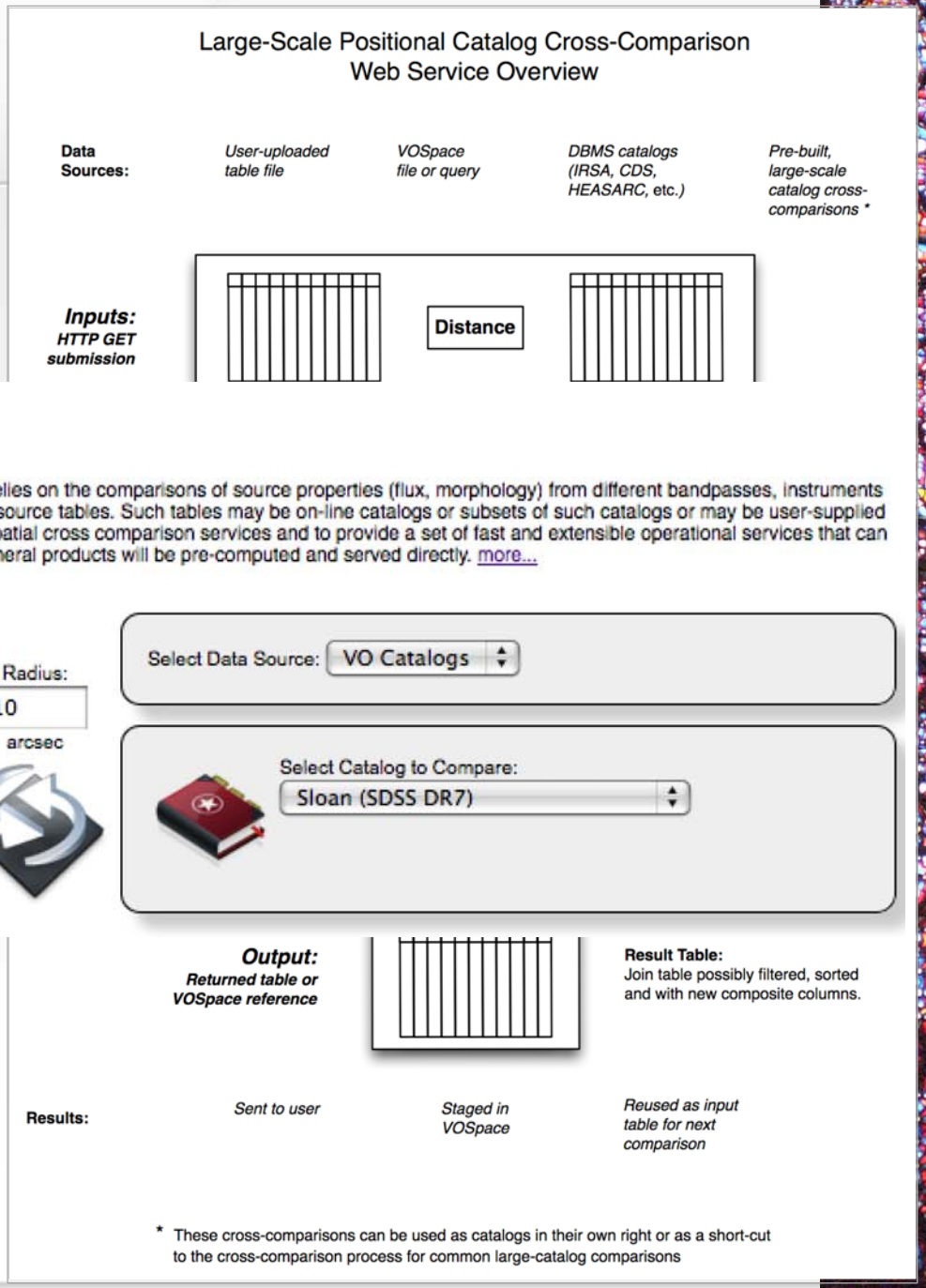
SED Importer



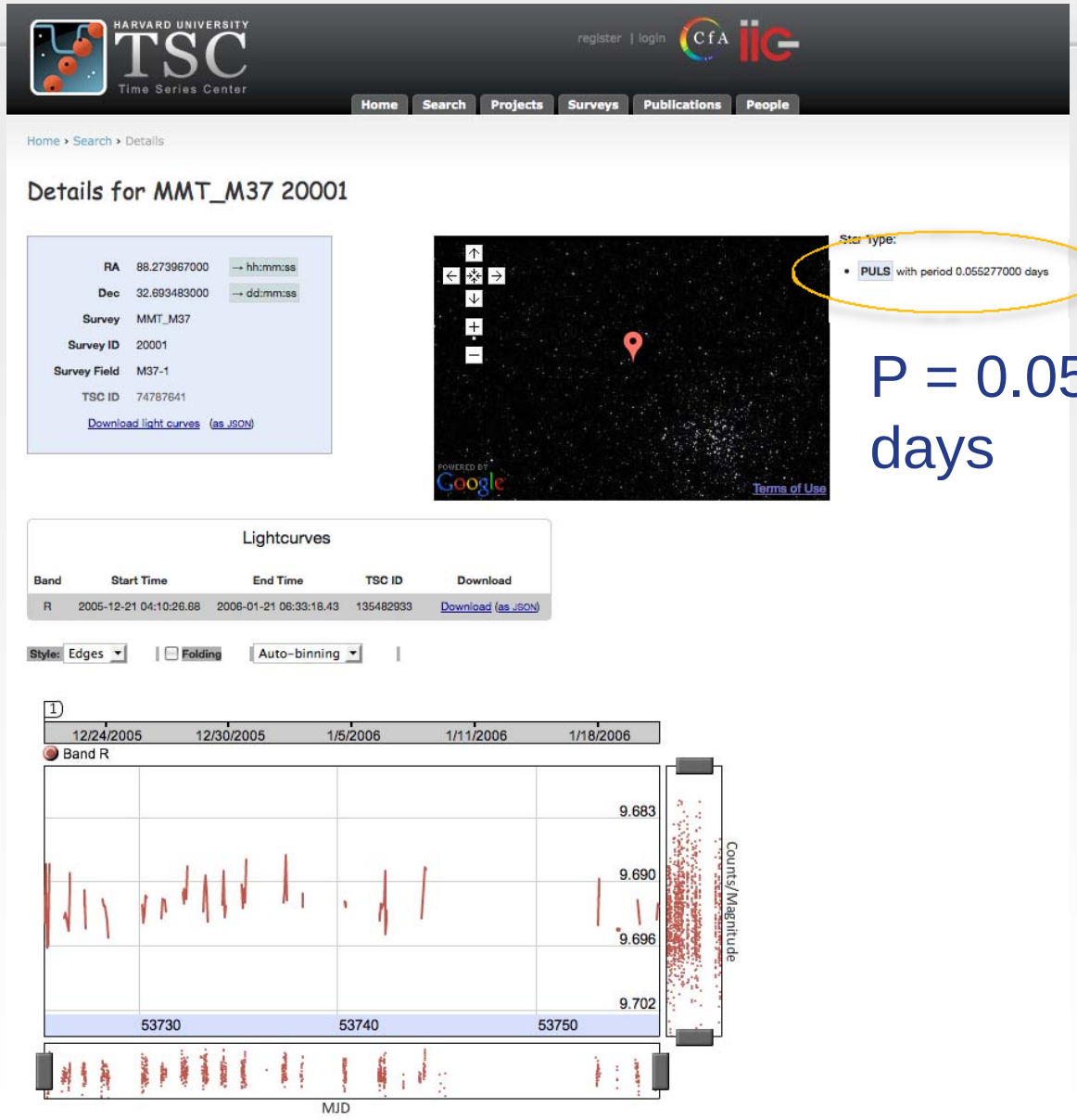
SED fitting


Iris
File Display Coplot Preferences Help
X axis SpectralAxis
Y axis FluxAxis
3.532107E20
4622.3906
Print
Redraw
Grid off
Fixed
Plot type
Expand
Flux density
Units
3C 273
Broken power-law plus
ISM absorption
Flux density (Jy)
1.0
1.0e-4
1.0e-8
10.0e8
1.0e14
1.0e19
Frequency (Hz)
Ratio (dex)
1.0
0.0
-1.0
10.0e8
1.0e14
1.0e19
Hide ratio

Cross-matching



Time series integration/tools



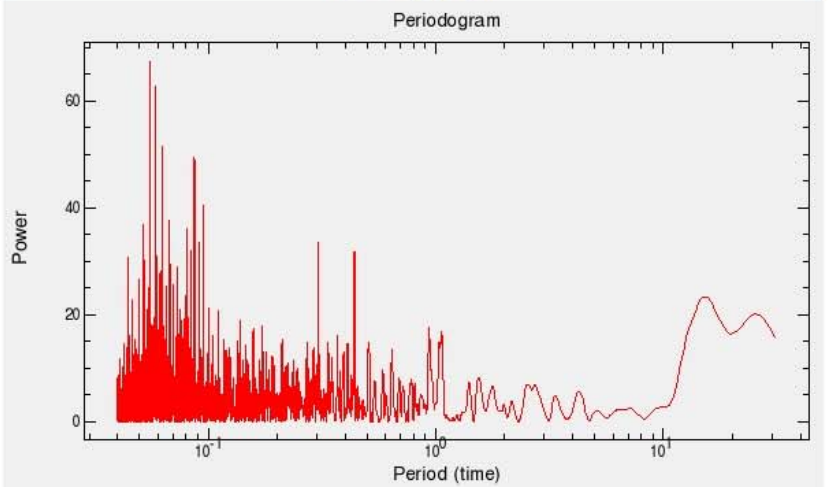
P = 0.055277 days

Time series integration/tools

- About Periodograms
- Changing Parameters
- Performance
- Troubleshooting
- Algorithms
- Parameters
- Periodogram Service News

NStED Periodogram Service

Power Spectrum



Input (Submit)		Current Values (Reset)
Periodogram type	Lomb-Scargle / BLS / Plavchan	Lomb-Scargle
Input file	ascii.tbl *Number of points: 1327*	View Time Series
Time column	col1 *Min: 53725.1739, Max: 53756.2731*	col1
Data column	col2 *Min: 9.6780, Max: 9.7028*	col2
Constraint column	None	none

Adjustable Periodogram Parameters

The estimated time for processing is 15s

Period Sampling			
Period range	Min	0.040000	0.040000
	Max	31.099210	31.099210
Period step method	Fixed df		FixedDf
Fixed step size	0.00188170		0.00188170

Algorithm Settings

Output Options		
Number of peaks to return	50	50
Peak significance threshold (P-Value)	1	1

Submit

P = 0.05528 days

Download Periodogram (ASCII)

Rank	Period	Power	P-value	Link
1	0.055278	67.457128	0	Phased curve
2	0.058528	62.782253	0	Phased curve
3	0.062082	51.537318	0	Phased curve
4	0.086992	49.345746	0	Phased curve
5	0.095256	40.519022	0	Phased curve
6	0.067228	37.643664	0	Phased curve
7	0.052097	36.853611	1.47327e-12	Phased curve

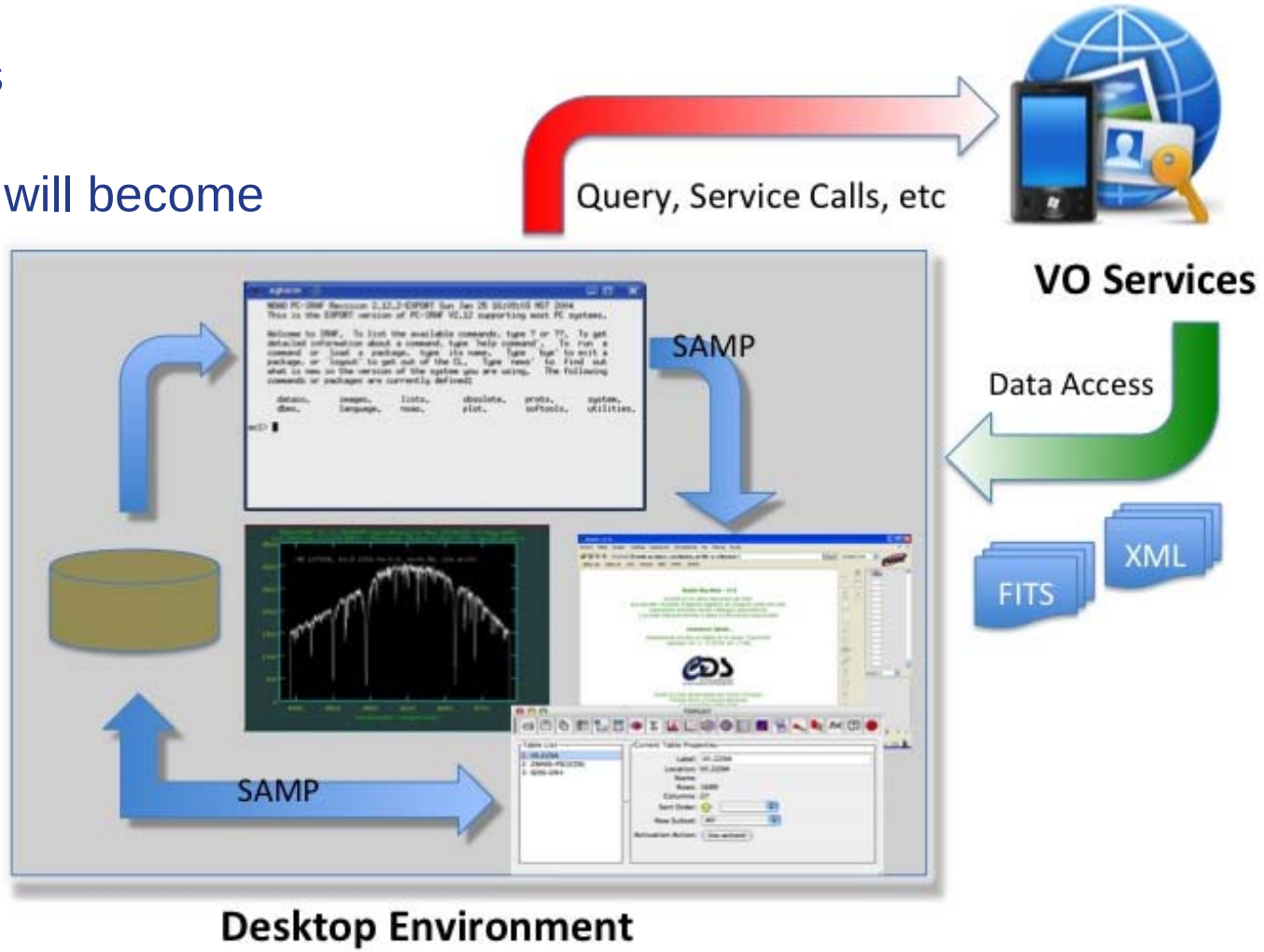
*The P-values above are computed for **13270** periods sampled, and an exponential power distribution is assumed.*

VO-IRAF integration

2000 registered IRAF users

~5000 total users

>700 IRAF tasks will become VO-aware



Data mining

http://dame.dsf.unina.it

Summary

- VAO has developed new research tools, which are now being released
- Introduction to the research community via AAS workshop and exhibit; VAO “community days”
- Goal is a “VO-web” of applications, utilizing tools from all international VO projects and from the user community
- Please visit demonstration table! Please join our e-mail list!