VO講習会2014睦月
2014/1/27
国立天文台　三鷹

VOツール使用法（1）

TOPCAT

国立天文台　天文データセンター
小宮　悠

TOPCAT

(Tool for OPerations on Catalogues And Tables)

- カタログ・テーブルデータの処理
- VOからのカタログの取得・検索
- グラフの作成
- ファイル形式 : FITS, VOTable, ASCII, CSV …

- ホームページ
  http://www.star.bristol.ac.uk/~mbt/topcat/

インストール

- http://www.star.bristol.ac.uk/~mbt/topcat/#install
- （Virtual Machine にはインストール済）

- ダウンロードして使用する場合
  - Windows
    - topcat-full.jar をダウンロード。ダブルクリックで実行。
  - Mac
    - topcat-full.dmg をダウンロードしてインストール。
  - UNIX
    - topcat-full.jar と、起動スクリプトをダウンロード
    - スクリプトに実行権限を付与(chmod +x topcat)
    - コマンドラインから起動
- Web start も可能
  - OSに依らず。ホームページのWebStartにある topcat-full をクリックすると、起動。

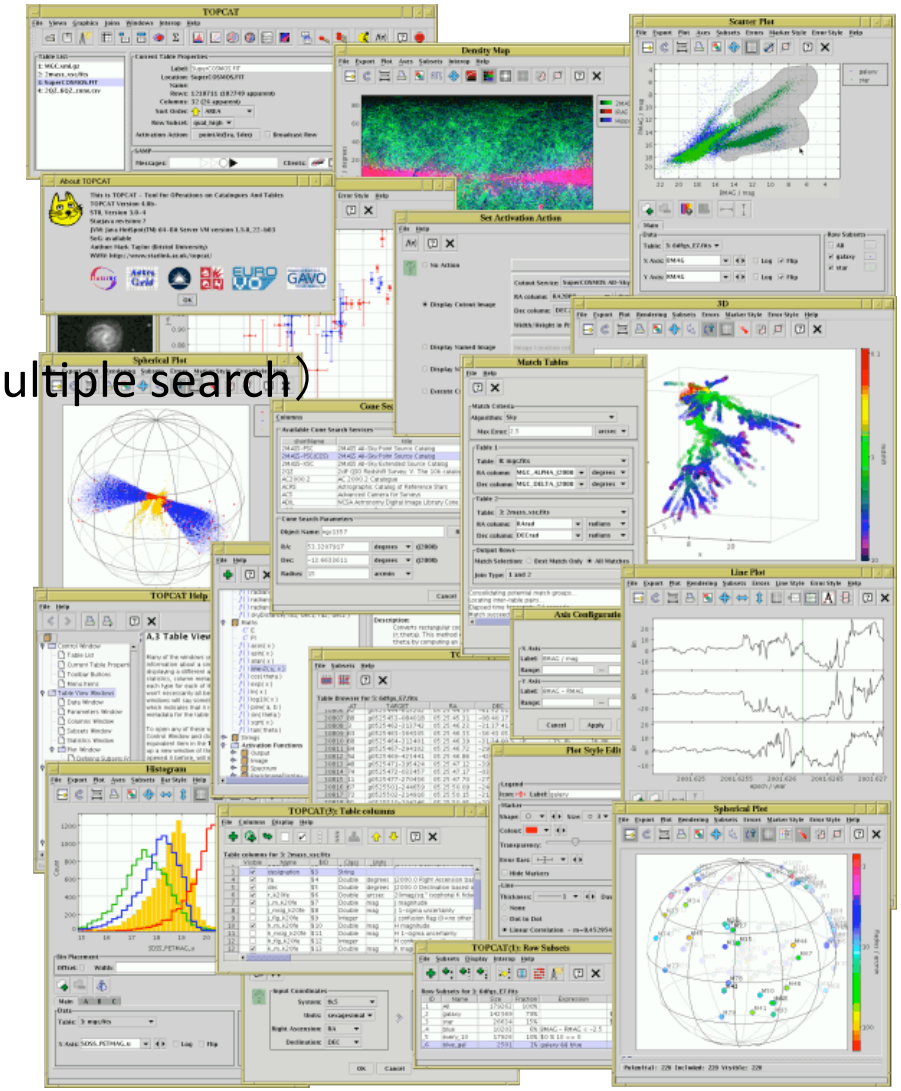
- 大きなデータを読む場合は、JAVAの最大メモリ量を大きく設定して開く。
  - Windows: java –Xmx512m –jar topcat-full.jar
  - Mac: /Applications/TOPCAT.app/bin/topcat –Xmx512m (パスはdmgからインストールした場所)

マニュアル類

- 講習会用資料
  - http://jvo.nao.ac.jp/vos2014a/
- 本家マニュアル
  - http://www.star.bristol.ac.uk/~mbt/topcat/#docs
  - FAQ, スクリーンショット集などもある
- Euro VOによるVO使用例　(他のVOツールも含む)
  - http://www.euro-vo.org/?q=science/scientific-tutorials
- Help 
  - その画面に関するHelpページを表示

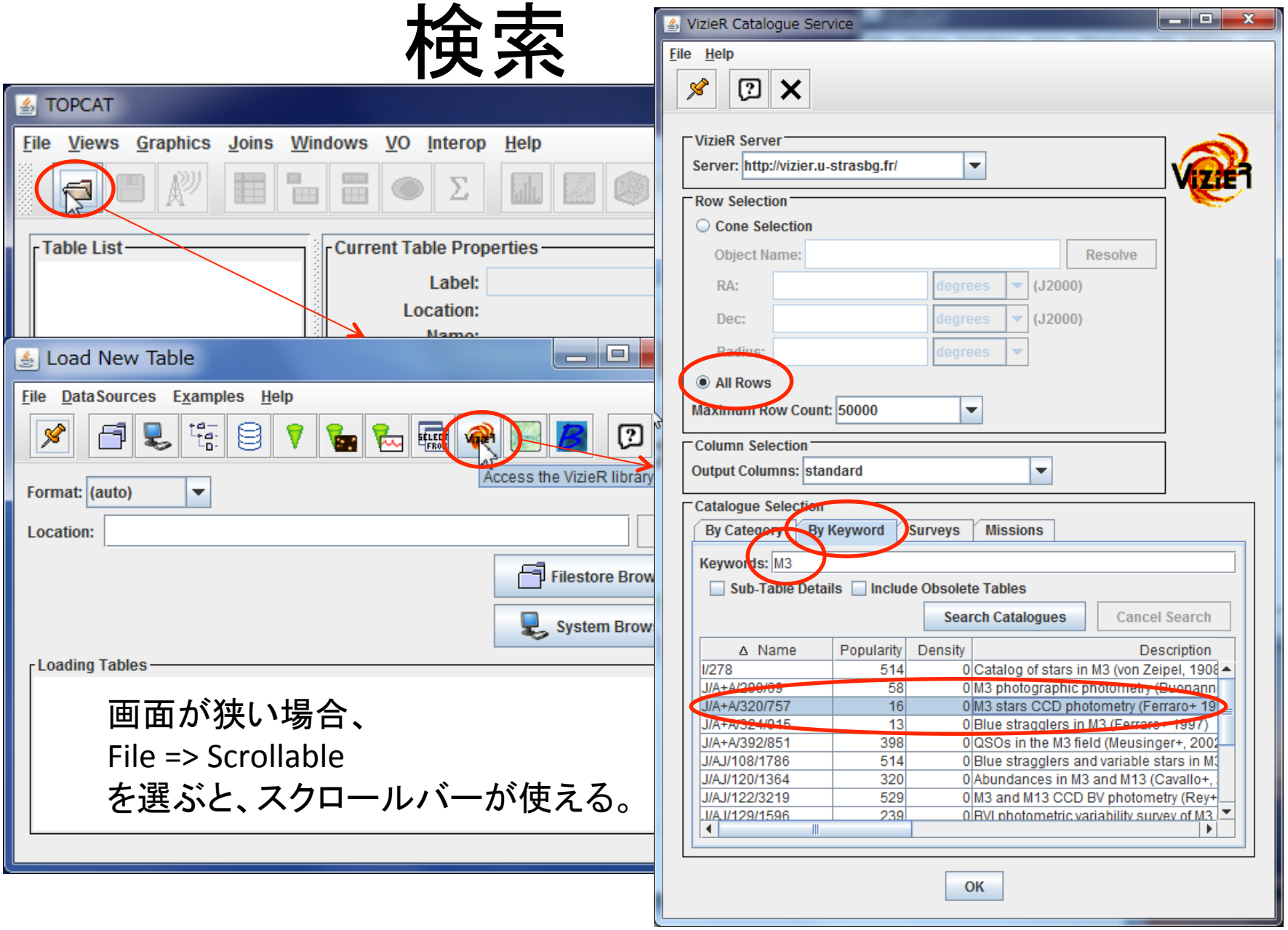
機能

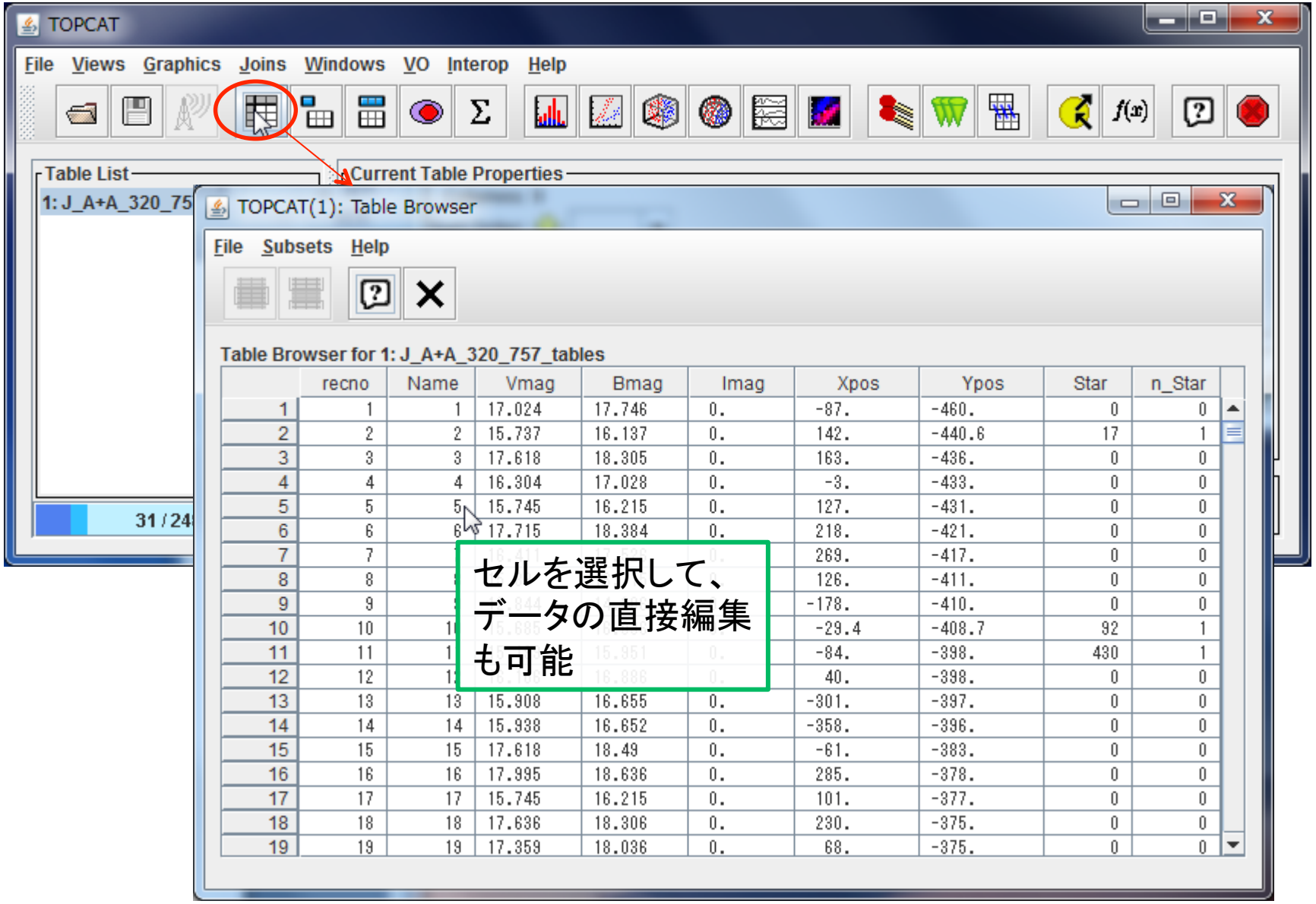
- VO検索
- 部分集合(filter)
- カラム間の計算
- クロスマッチ
- VO上のカタログとのクロスマッチ（Multiple search）
- グラフ作成
  - ヒストグラム
  - Linear fit
  - Subgroup
- 統計
- 画像のクイックルック
- 他ツールとの連携（SAMP）
- 保存（FITS, VOTable, csv, ...）
- などなど

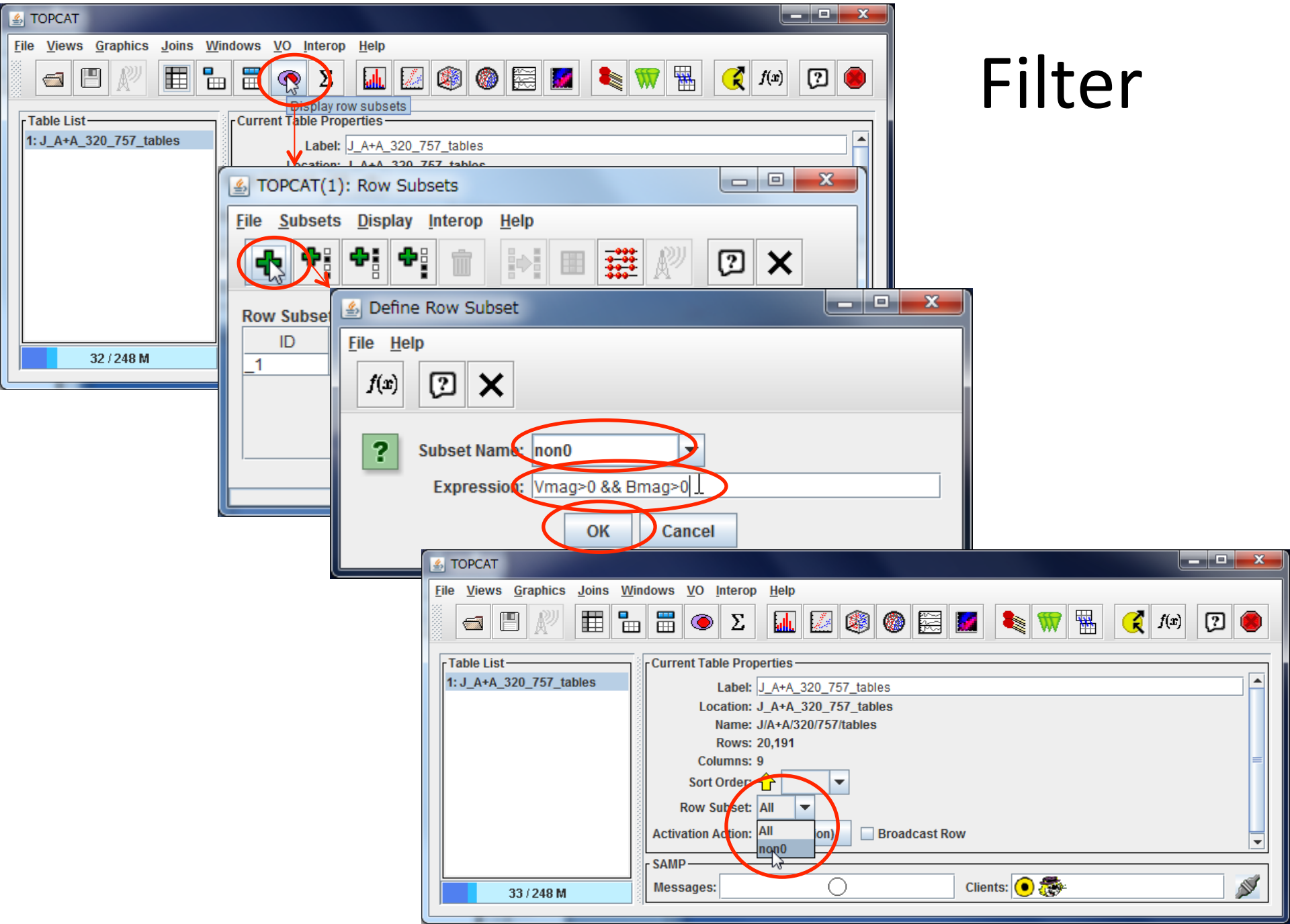


- テキスト　P.１１８　使用例
  球状星団M３のHR図作成

検索

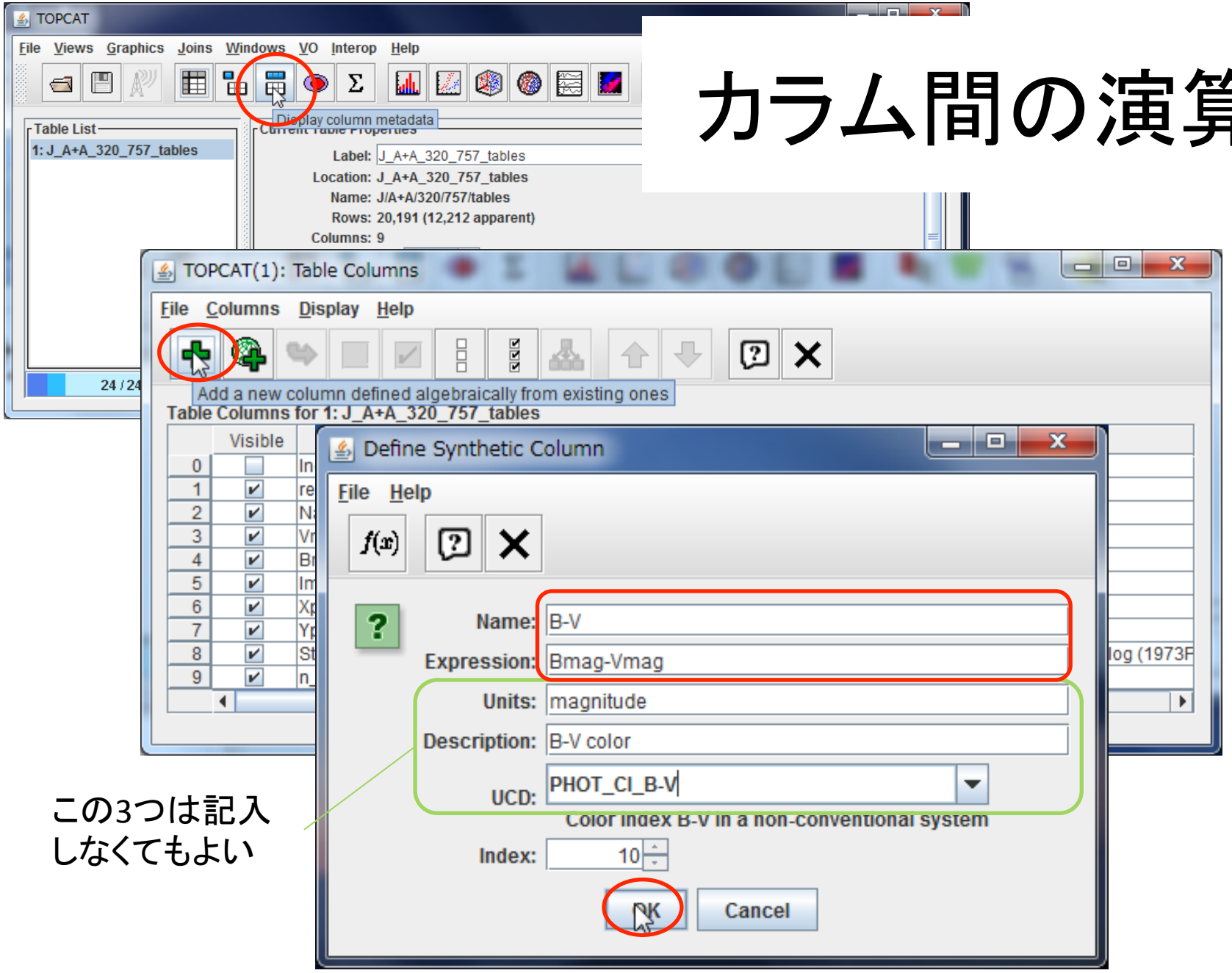

TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
Current Table Properties
Label:
Location:
Load New Table
File DataSources Examples Help
Access the VizieR library
Format: (auto)
Location:
Filestore Brow
System Brow
Loading Tables
画面が狭い場合、
File => Scrollable
を選ぶと、スクロールバーが使える。
VizieR Catalogue Service
File Help
VizieR Server
Server: http://vizier.u-strasbg.fr/
Row Selection
Cone Selection
Object Name:
Resolve
RA:
degrees
(J2000)
Dec:
degrees
(J2000)
Radius:
degrees
All Rows
Maximum Row Count: 50000
Column Selection
Output Columns: standard
Catalogue Selection
By Category
By Keyword
Surveys
Missions
Keywords: M3
Sub-Table Details
Include Obsolete Tables
Search Catalogues
Cancel Search
Name
Popularity
Density
Description
I/278 514 0 Catalog of stars in M3 (von Zeipel, 1908
J/A+A/320/757 16 0 M3 stars CCD photometry (Ferraro+ 19
J/A+A/324/915 13 0 Blue stragglers in M3 (Ferraro+ 1997)
J/A+A/392/851 398 0 QSOs in the M3 field (Meusinger+, 200
J/AJ/108/1786 514 0 Blue stragglers and variable stars in M3
J/AJ/120/1364 320 0 Abundances in M3 and M13 (Cavallo+,
J/AJ/122/3219 529 0 M3 and M13 CCD BV photometry (Rey+
OK


TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
1: J_A+A_320_75
Current Table Properties
TOPCAT(1): Table Browser
File Subsets Help
Table Browser for 1: J_A+A_320_757_tables
recno Name Vmag Bmag Imag Xpos Ypos Star n_Star
1 1 1 17.024 17.746 0. -87. -460. 0 0
2 2 2 15.737 16.137 0. 142. -440.6 17 1
3 3 3 17.618 18.305 0. 163. -436. 0 0
4 4 4 16.304 17.028 0. -3. -433. 0 0
5 5 5 15.745 16.215 0. 127. -431. 0 0
6 6 6 17.715 18.384 0. 218. -421. 0 0
7 7 269. -417. 0 0
8 8 126. -411. 0 0
9 9 -178. -410. 0 0
10 10 -29.4 -408.7 92 1
11 11 -84. -398. 430 1
12 12 40. -398. 0 0
13 13 13 15.908 16.655 0. -301. -397. 0 0
14 14 14 15.938 16.652 0. -358. -396. 0 0
15 15 15 17.618 18.49 0. -61. -383. 0 0
16 16 16 17.995 18.636 0. 285. -378. 0 0
17 17 17 15.745 16.215 0. 101. -377. 0 0
18 18 18 17.636 18.306 0. 230. -375. 0 0
19 19 19 17.359 18.036 0. 68. -375. 0 0
セルを選択して、
データの直接編集
も可能

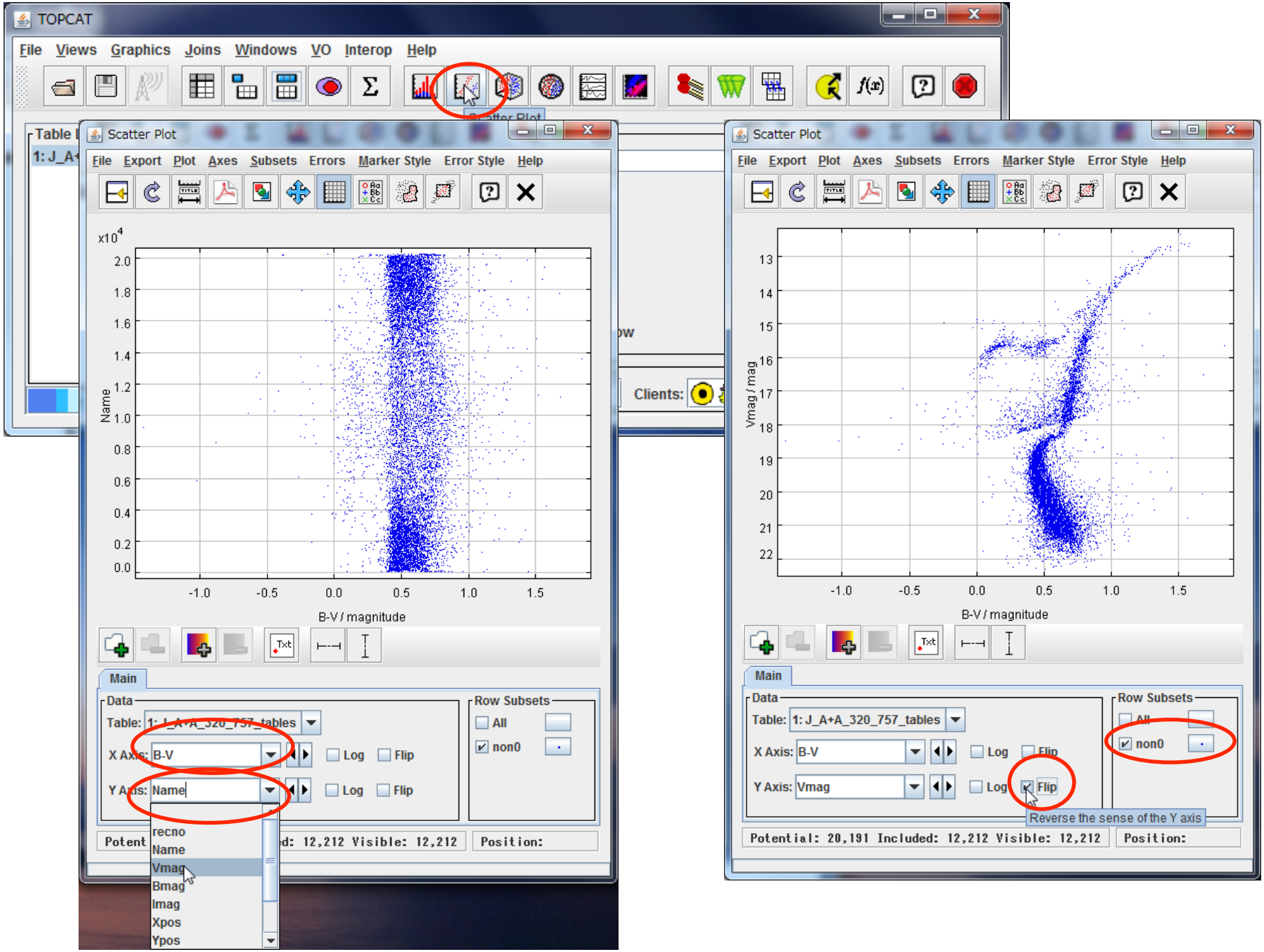

TOPCAT
File Views Graphics Joins Windows VO Interop Help
Display row subsets
Table List
1: J_A+A_320_757_tables
Current Table Properties
Label: J_A+A_320_757_tables
32 / 248 M
TOPCAT(1): Row Subsets
File Subsets Display Interop Help
Row Subset
ID
1
Define Row Subset
File Help
Subset Name: non0
Expression: Vmag>0 && Bmag>0
OK
Cancel
TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
1: J_A+A_320_757_tables
Current Table Properties
Label: J_A+A_320_757_tables
Location: J_A+A_320_757_tables
Name: J/A+A/320/757/tables
Rows: 20,191
Columns: 9
Sort Order:
Row Subset: All
Activation Action: All non0
Broadcast Row
SAMP
Messages:
Clients:
33 / 248 M

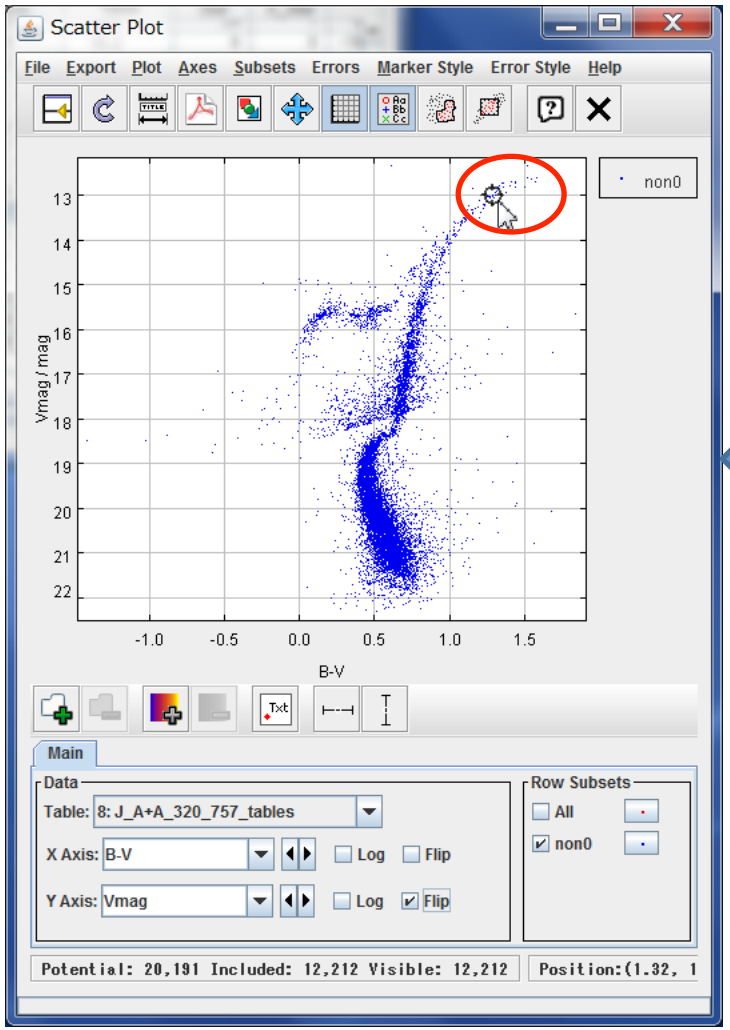
Filter

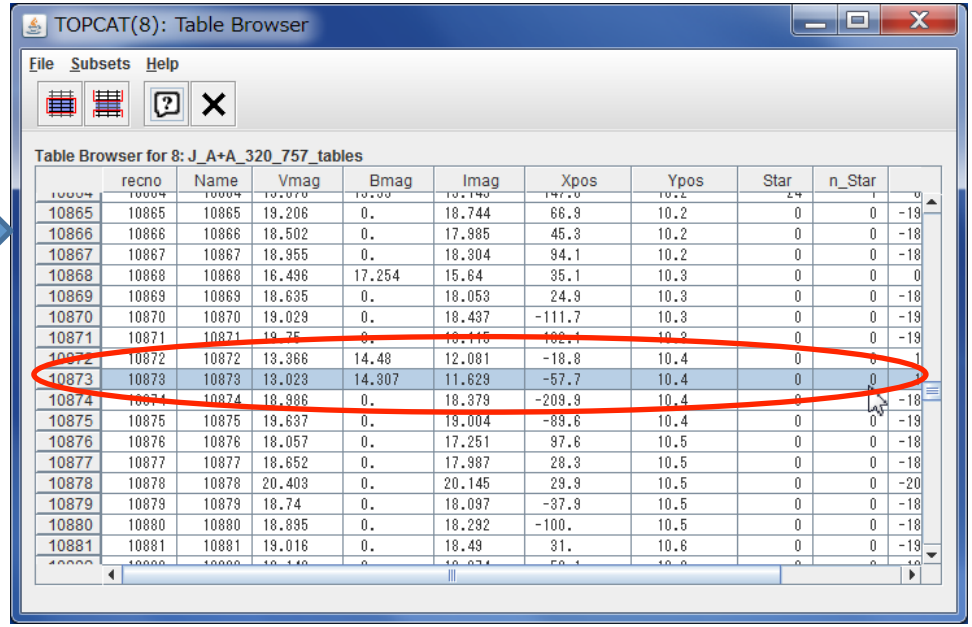
カラム間の演算



この3つは記入
しなくてもよい

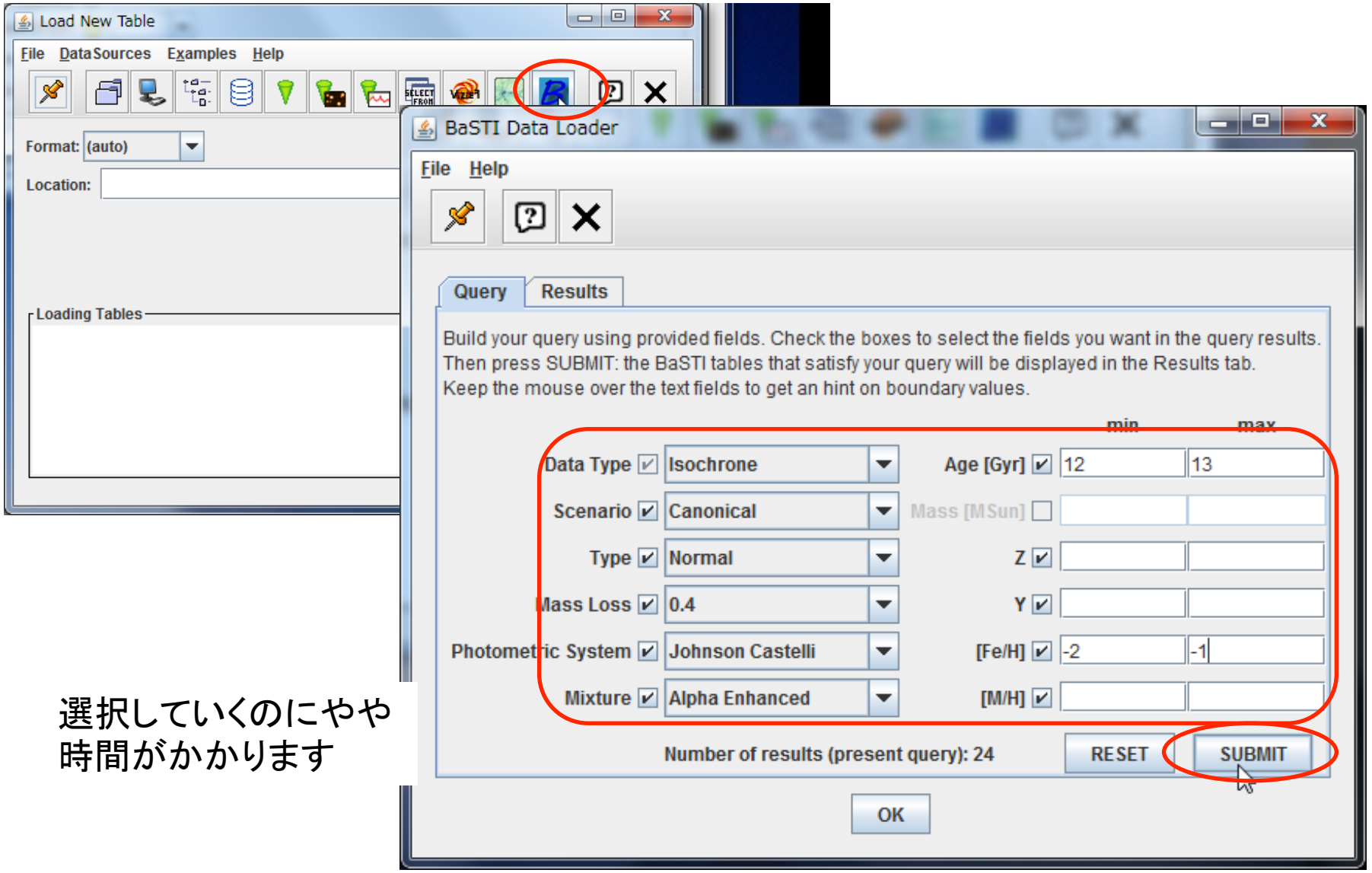

TOPCAT
File Views Graphics Joins Windows VO Interop Help
Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
x10^4
Name
B-V / magnitude
Main
Data
Table: 1: J_A+A_320_757_tables
X Axis: B-V
Y Axis: Name
Log Flip
Row Subsets
All
non0
recno
Name
Vmag
Bmag
Imag
Xpos
Ypos
Potent d: 12,212 Visible: 12,212
Position:
Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
Vmag / mag
B-V / magnitude
Main
Data
Table: 1: J_A+A_320_757_tables
X Axis: B-V
Y Axis: Vmag
Log Flip
Row Subsets
All
non0
Reverse the sense of the Y axis
Potential: 20,191 Included: 12,212 Visible: 12,212
Position:



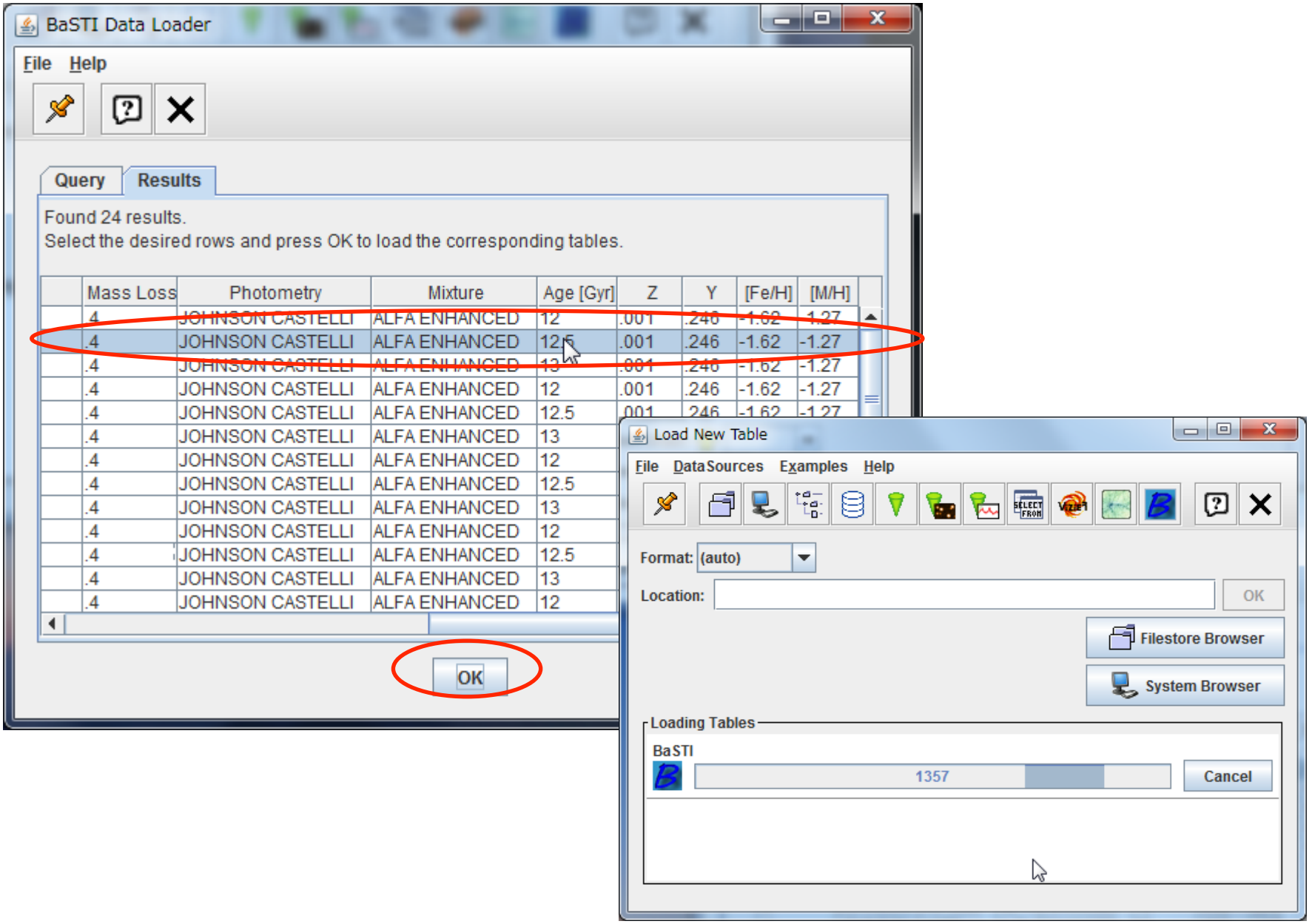


テーブルデータと、グラフ上の点の
対応関係を確認できる

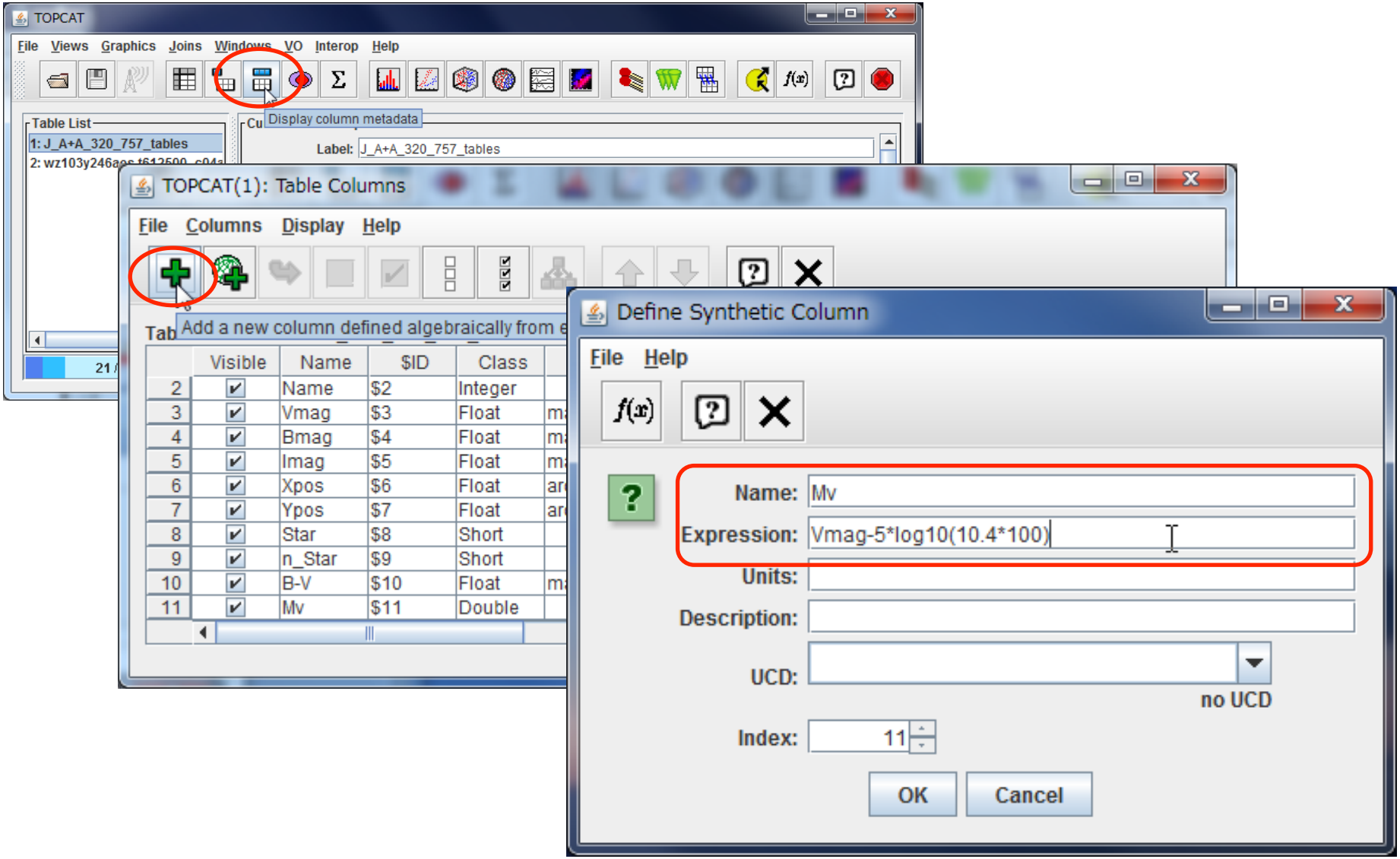
恒星理論データの検索



選択していくのにやや
時間がかかります

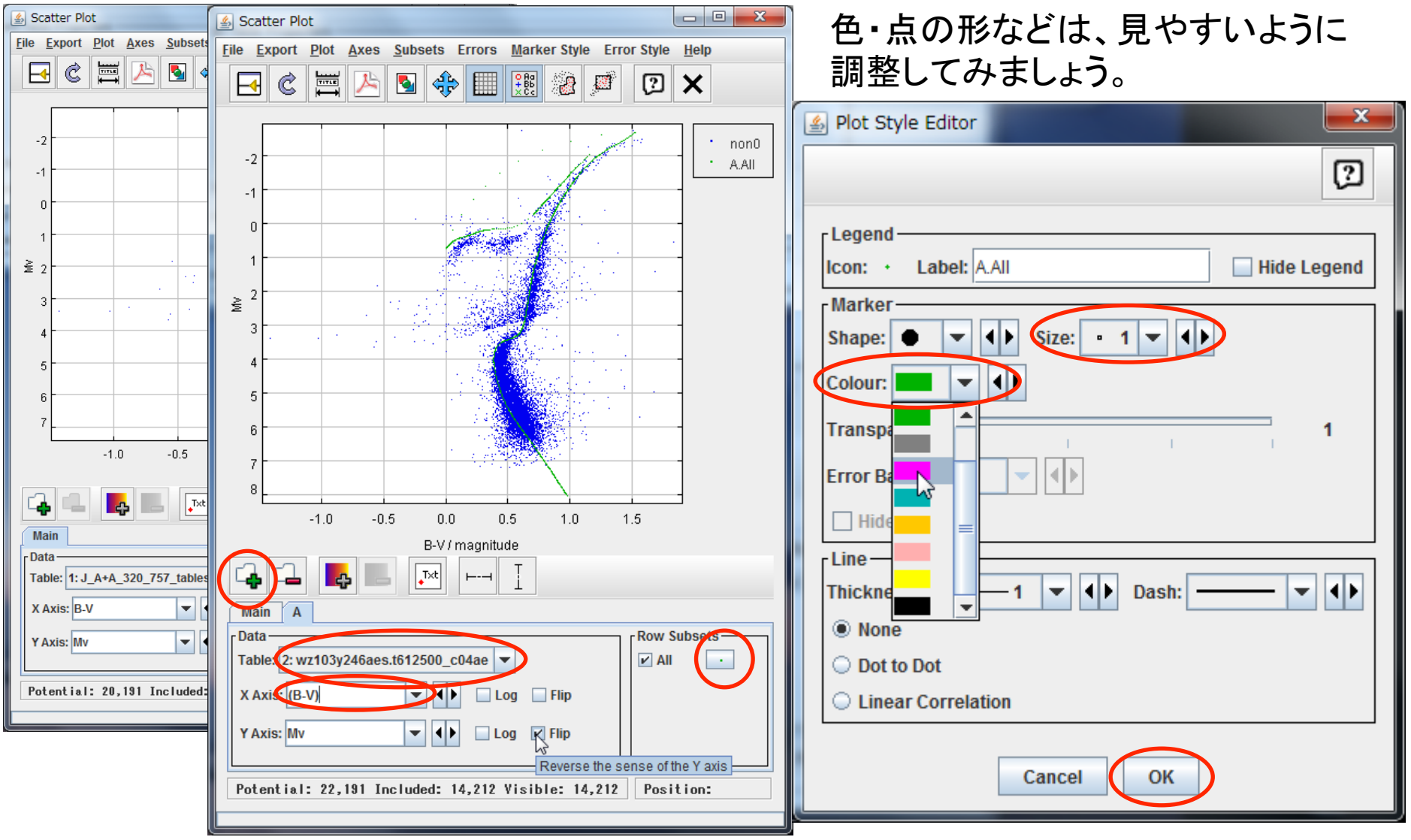

BaSTI Data Loader
File Help
Query
Results
Found 24 results.
Select the desired rows and press OK to load the corresponding tables.
Mass Loss | Photometry | Mixture | Age [Gyr] | Z | Y | [Fe/H] | [M/H]
.4 JOHNSON CASTELLI ALFA ENHANCED 12 .001 .246 -1.62 -1.27
.4 JOHNSON CASTELLI ALFA ENHANCED 12.5 .001 .246 -1.62 -1.27
.4 JOHNSON CASTELLI ALFA ENHANCED 13 .001 .246 -1.62 -1.27
.4 JOHNSON CASTELLI ALFA ENHANCED 12 .001 .246 -1.62 -1.27
.4 JOHNSON CASTELLI ALFA ENHANCED 12.5 .001 .246 -1.62 -1.27
.4 JOHNSON CASTELLI ALFA ENHANCED 13
.4 JOHNSON CASTELLI ALFA ENHANCED 12
.4 JOHNSON CASTELLI ALFA ENHANCED 12.5
.4 JOHNSON CASTELLI ALFA ENHANCED 13
.4 JOHNSON CASTELLI ALFA ENHANCED 12
.4 JOHNSON CASTELLI ALFA ENHANCED 12.5
.4 JOHNSON CASTELLI ALFA ENHANCED 13
.4 JOHNSON CASTELLI ALFA ENHANCED 12
OK
Load New Table
File DataSources Examples Help
Format: (auto)
Location:
OK
Filestore Browser
System Browser
Loading Tables
BaSTI
1357
Cancel

絶対等級の計算

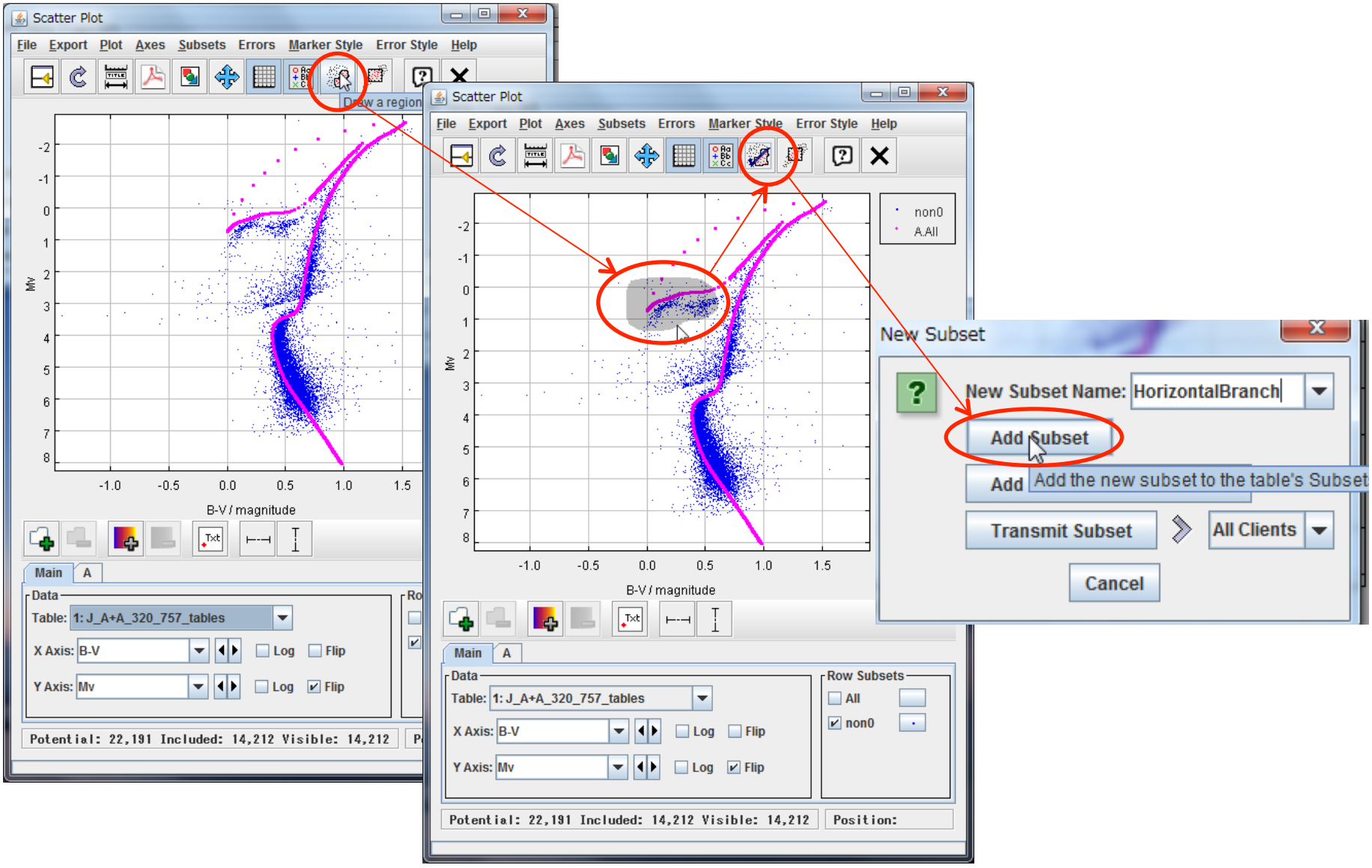

TOPCAT
File Views Graphics Joins Windows VO Interop Help
Display column metadata
Table List
1: J_A+A_320_757_tables
Label: J_A+A_320_757_tables
TOPCAT(1): Table Columns
File Columns Display Help
Add a new column defined algebraically from e
Visible Name $ID Class
2 Name $2 Integer
3 Vmag $3 Float
4 Bmag $4 Float
5 Imag $5 Float
6 Xpos $6 Float
7 Ypos $7 Float
8 Star $8 Short
9 n_Star $9 Short
10 B-V $10 Float
11 Mv $11 Double
Define Synthetic Column
File Help
Name: Mv
Expression: Vmag-5*log10(10.4*100)
Units:
Description:
UCD:
no UCD
Index: 11
OK
Cancel

重ねてplot

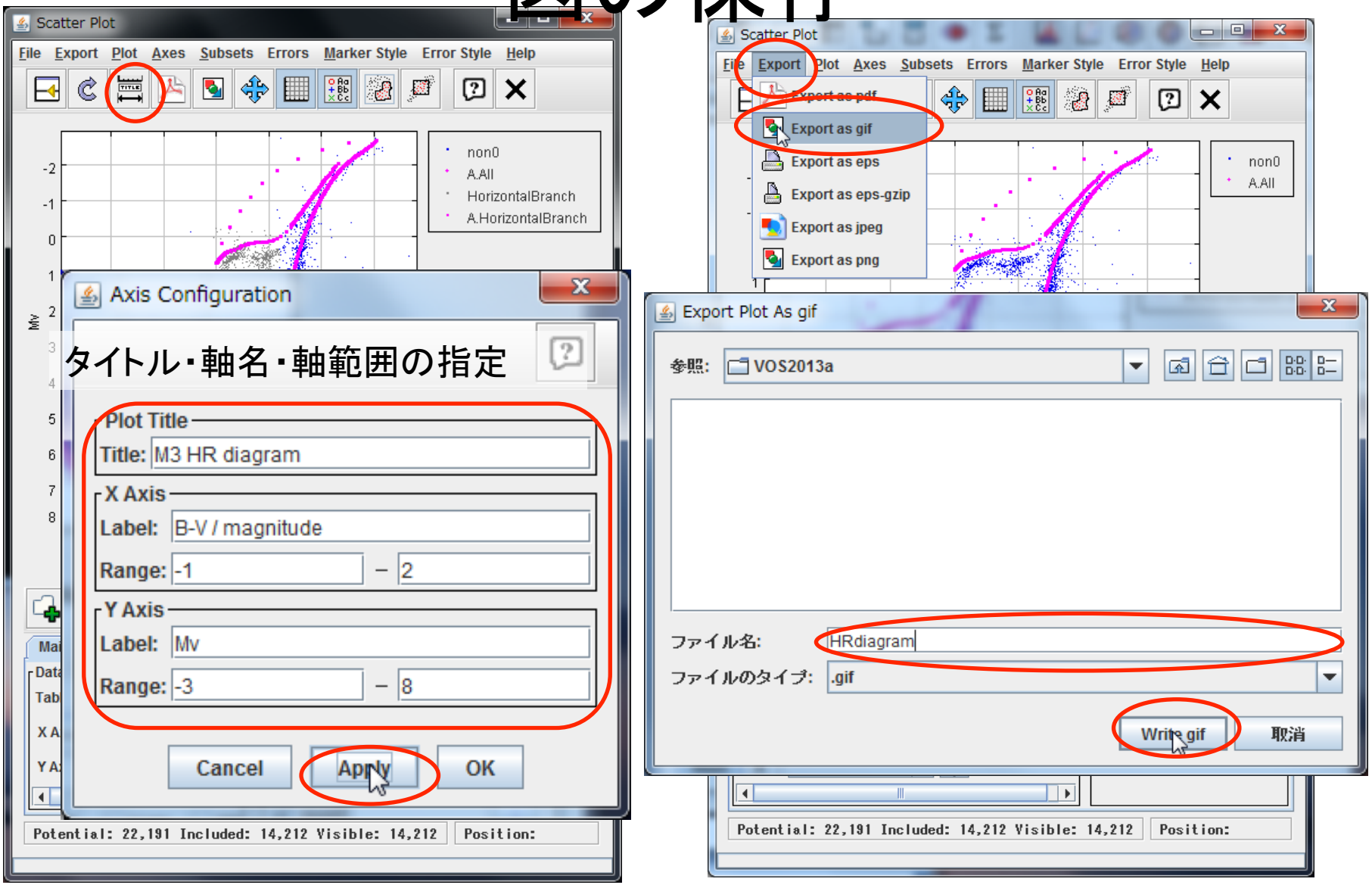
色・点の形などは、見やすいように調整してみましょう。



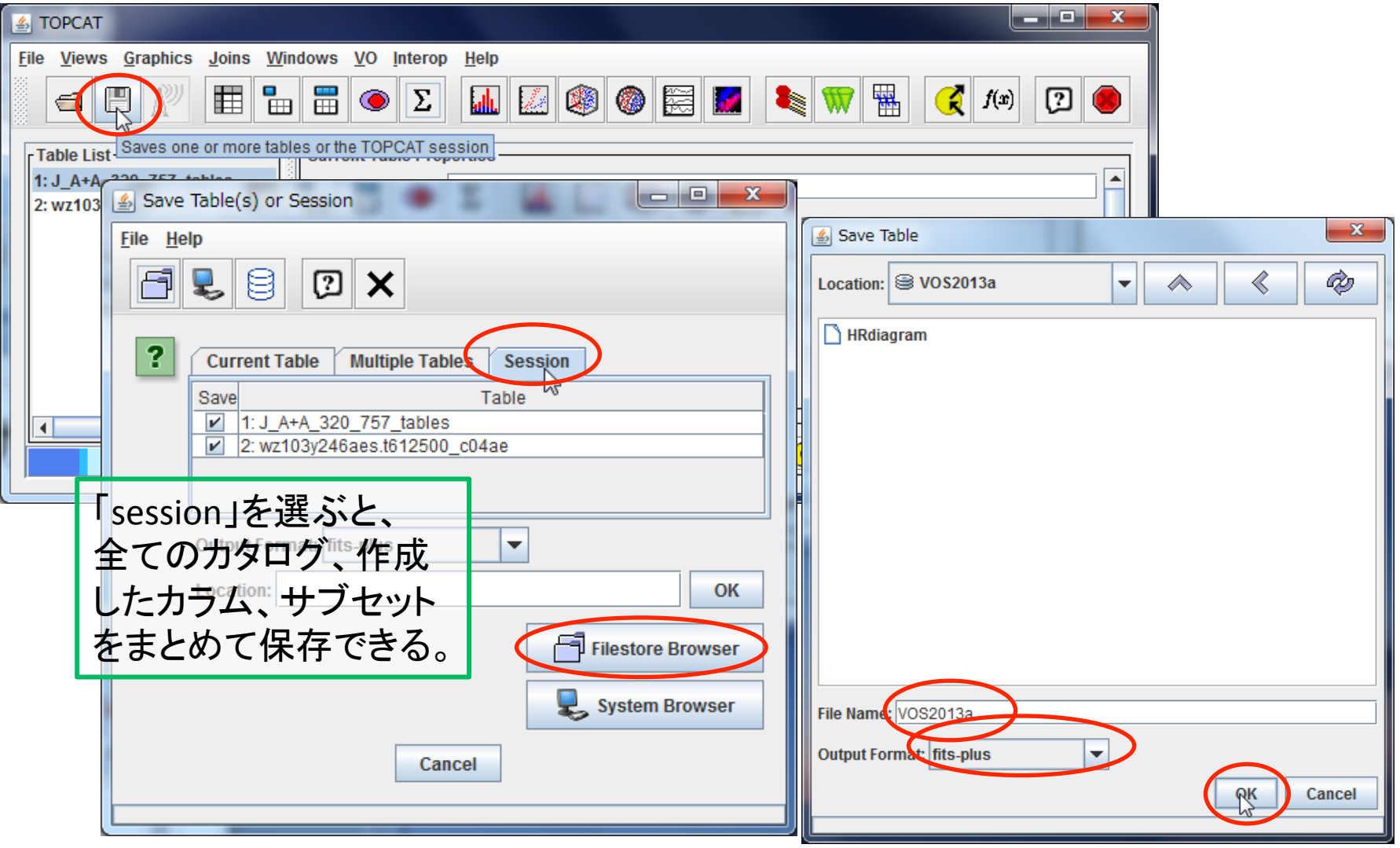
Row subset


Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
Draw a region
Mv
B-V / magnitude
Main A
Data
Table: 1: J_A+A_320_757_tables
X Axis: B-V
Y Axis: Mv
Log Flip
Potential: 22,191 Included: 14,212 Visible: 14,212
non0
A.All
Row Subsets
All
non0
Position:
New Subset
New Subset Name: HorizontalBranch
Add Subset
Add
Add the new subset to the table's Subset
Transmit Subset
All Clients
Cancel

図の保存


Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
non0
A.All
HorizontalBranch
A.HorizontalBranch
Axis Configuration
タイトル・軸名・軸範囲の指定
Plot Title
Title: M3 HR diagram
X Axis
Label: B-V / magnitude
Range: -1 – 2
Y Axis
Label: Mv
Range: -3 – 8
Cancel
Apply
OK
Potential: 22,191 Included: 14,212 Visible: 14,212
Position:
Export as pdf
Export as gif
Export as eps
Export as eps-gzip
Export as jpeg
Export as png
Export Plot As gif
参照: VOS2013a
ファイル名: HRdiagram
ファイルのタイプ: .gif
Write gif
取消

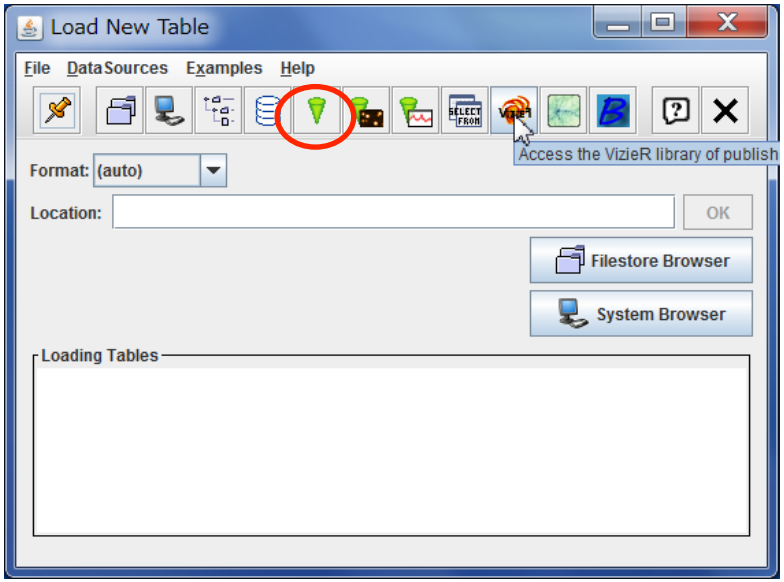
データの保存



「session」を選ぶと、
全てのカタログ、作成
したカラム、サブセット
をまとめて保存できる。

使用例(2)クロスマッチ

X線と可視光でのAGNのカタログを取得してクロスマッチする。

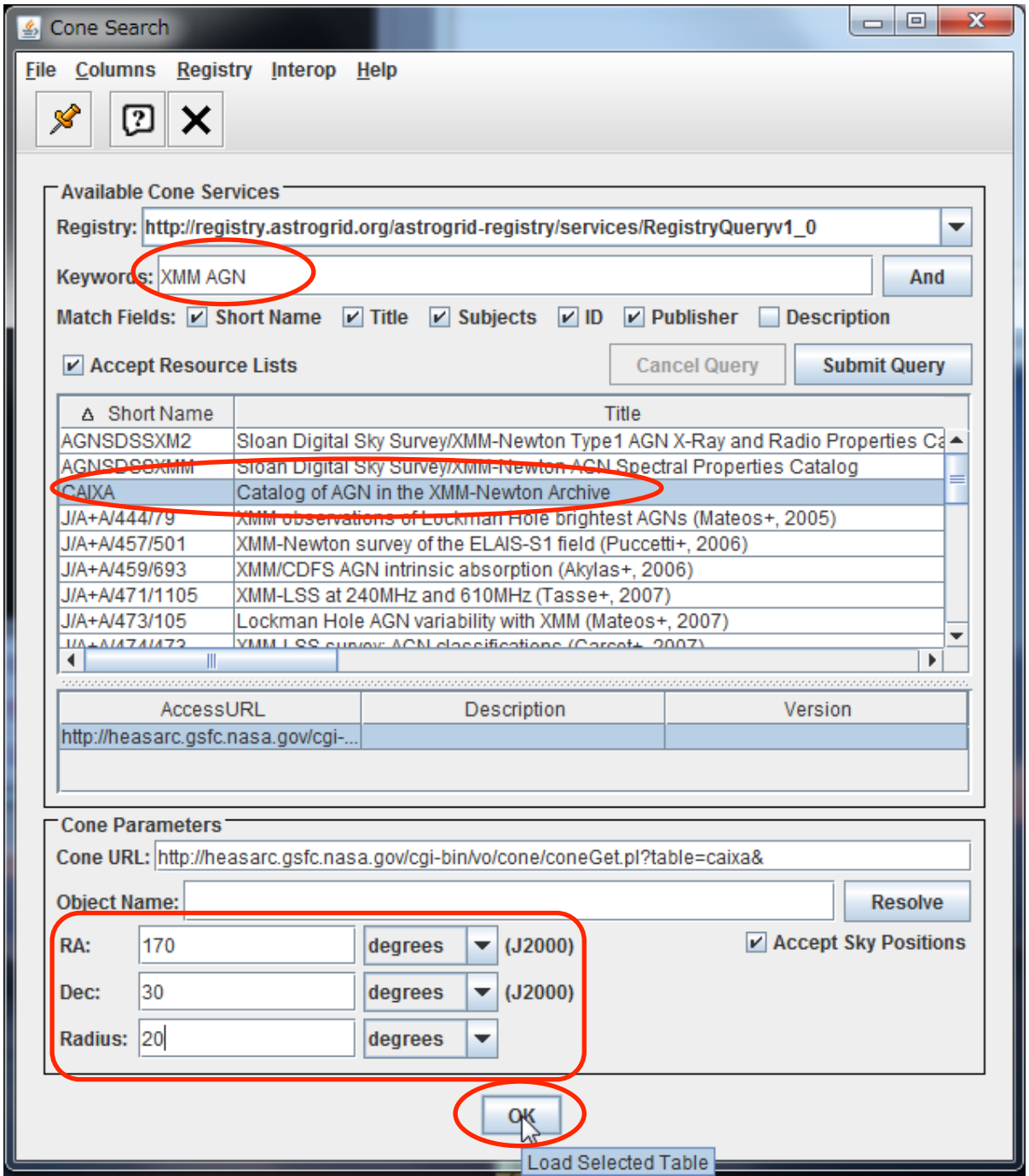


方法1

2つのデータを検索・取得した後、クロスマッチ。

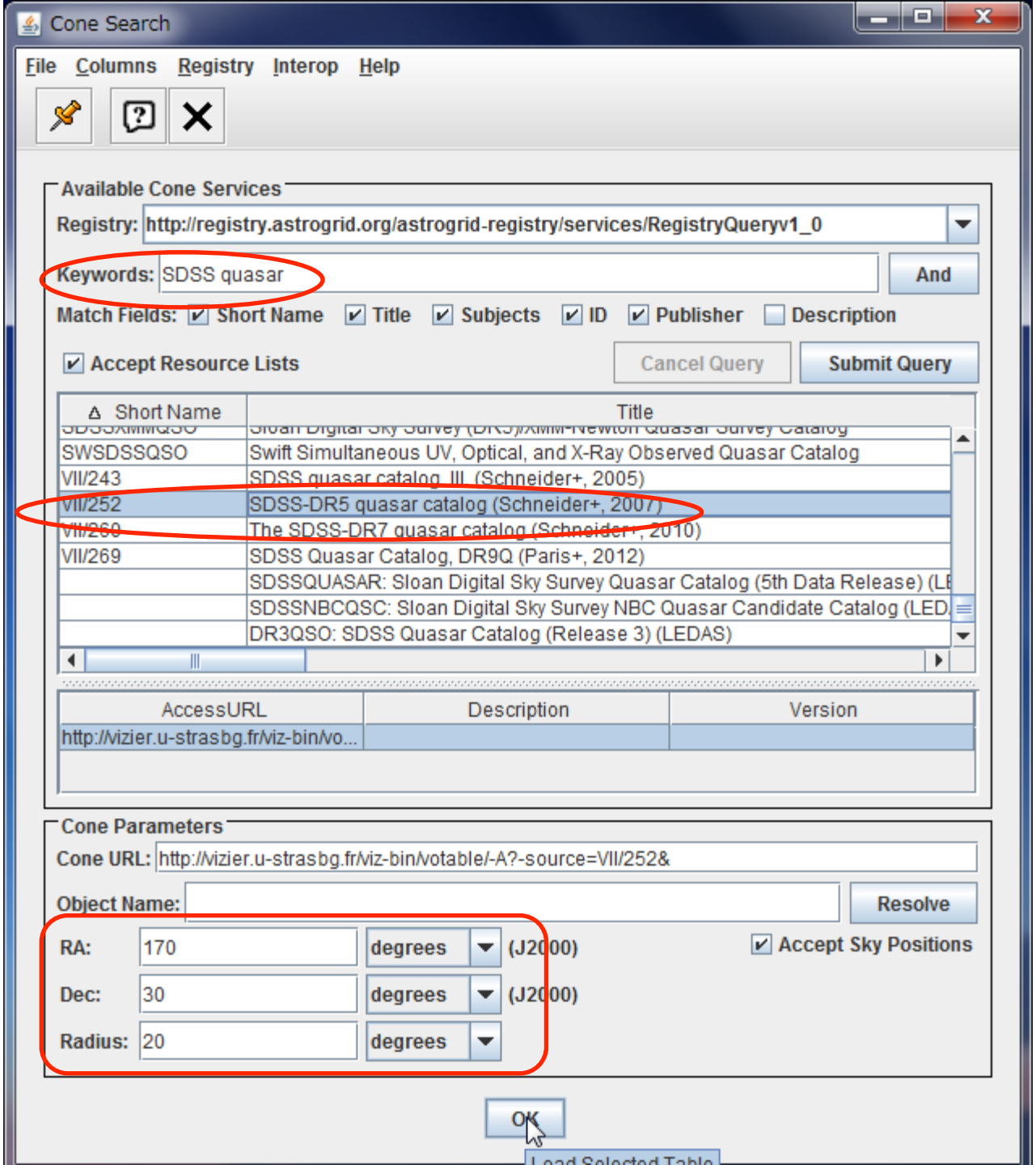
方法2

手元のカタログとVO上のデータとをクロスマッチしながら検索



Cone search から
Keyword: XMM AGN
でサービス検索。
ヒットしたサービスの
中から、CAIXAを使用。

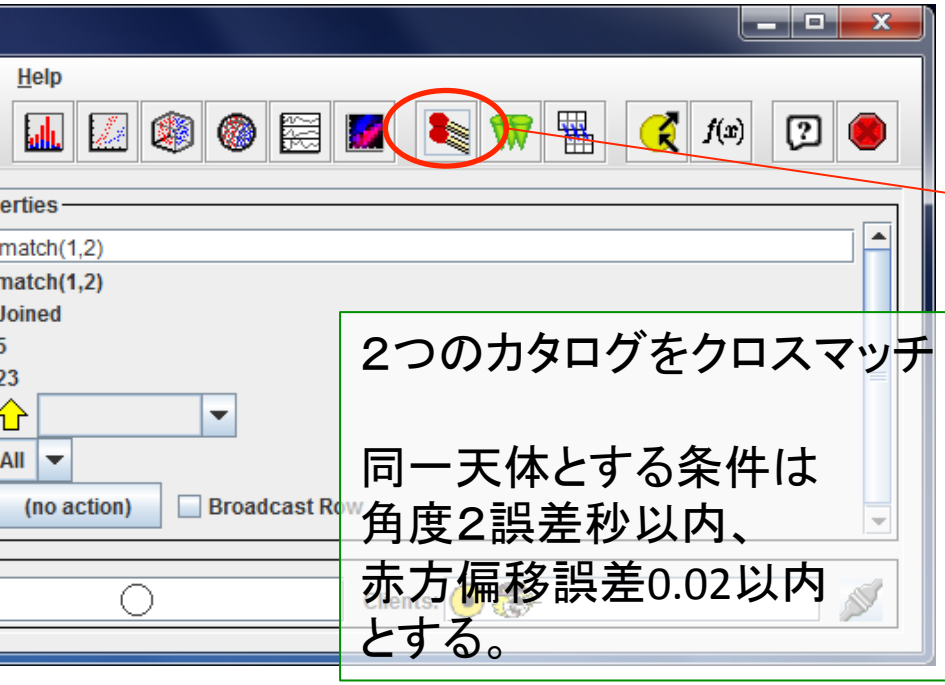
RA: 170 deg
Dec:30 deg
Radius:20 deg
で検索すると
14件ヒット



同様に、今度は
SDSS-DR5 quasar catalog (Schneider+ 2007)
にアクセス。

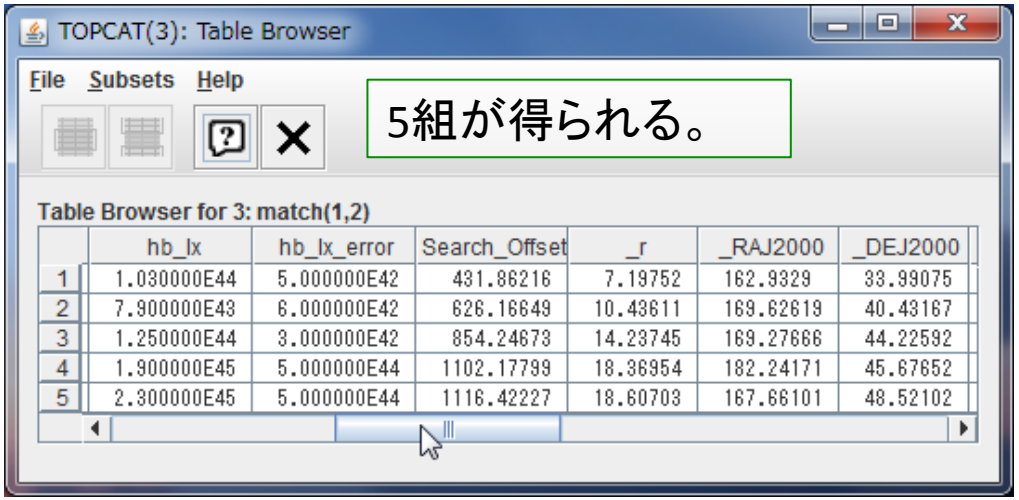
同じ領域を検索。

8335件ヒット。



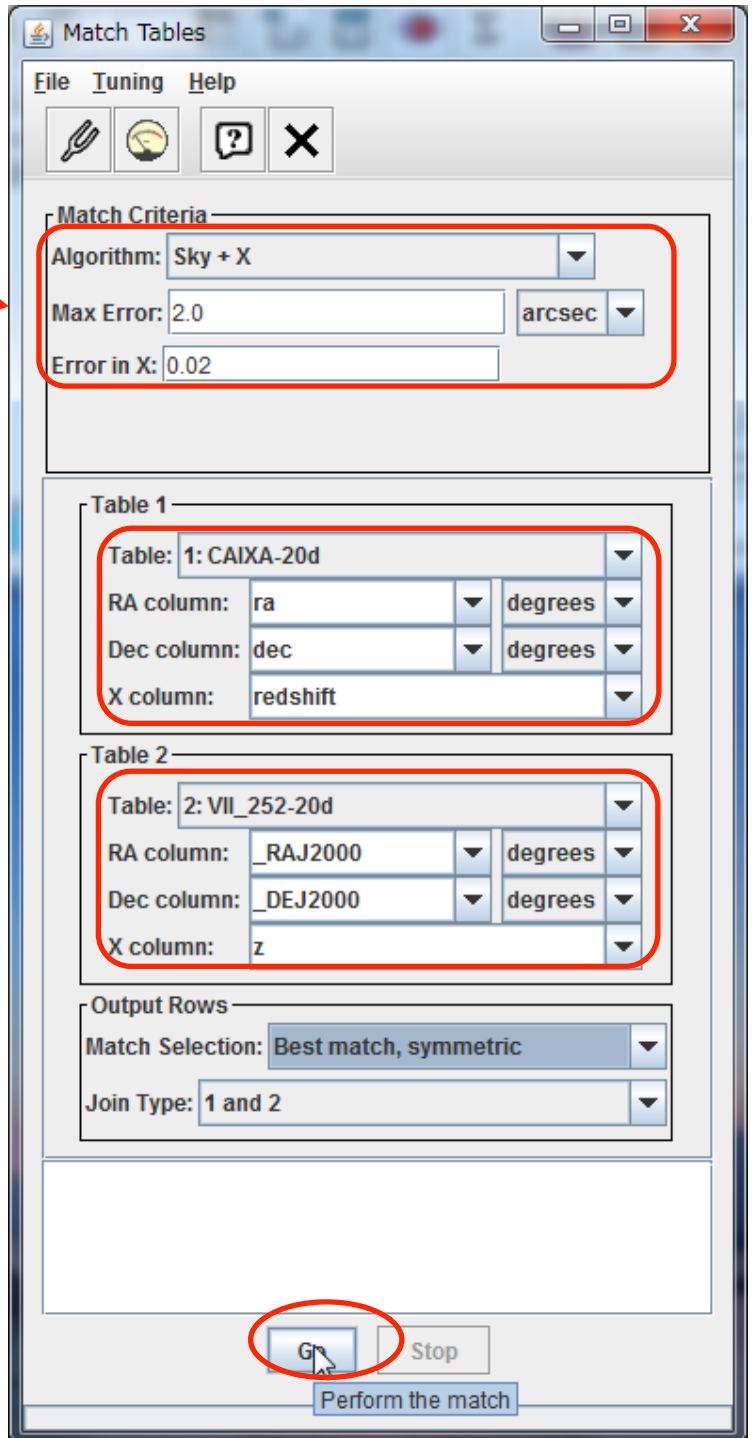
2つのカタログをクロスマッチ

同一天体とする条件は
角度2誤差秒以内、
赤方偏移誤差0.02以内
とする。

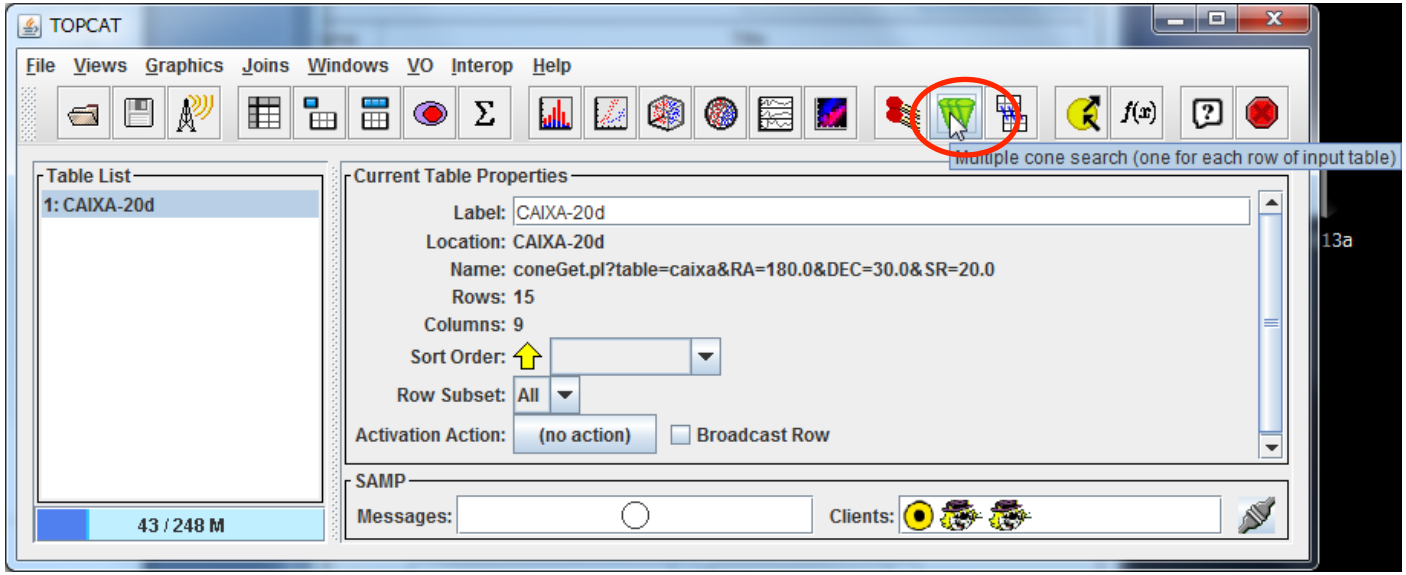


	hb_lx	hb_lx_error	Search_Offset	_r	_RAJ2000	_DEJ2000
1	1.030000E44	5.000000E42	431.86216	7.19752	162.9329	33.99075
2	7.900000E43	6.000000E42	626.16649	10.43611	169.62619	40.43167
3	1.250000E44	3.000000E42	854.24673	14.23745	169.27666	44.22592
4	1.900000E45	5.000000E44	1102.17799	18.36954	182.24171	45.67652
5	2.300000E45	5.000000E44	1116.42227	18.60703	167.66101	48.52102

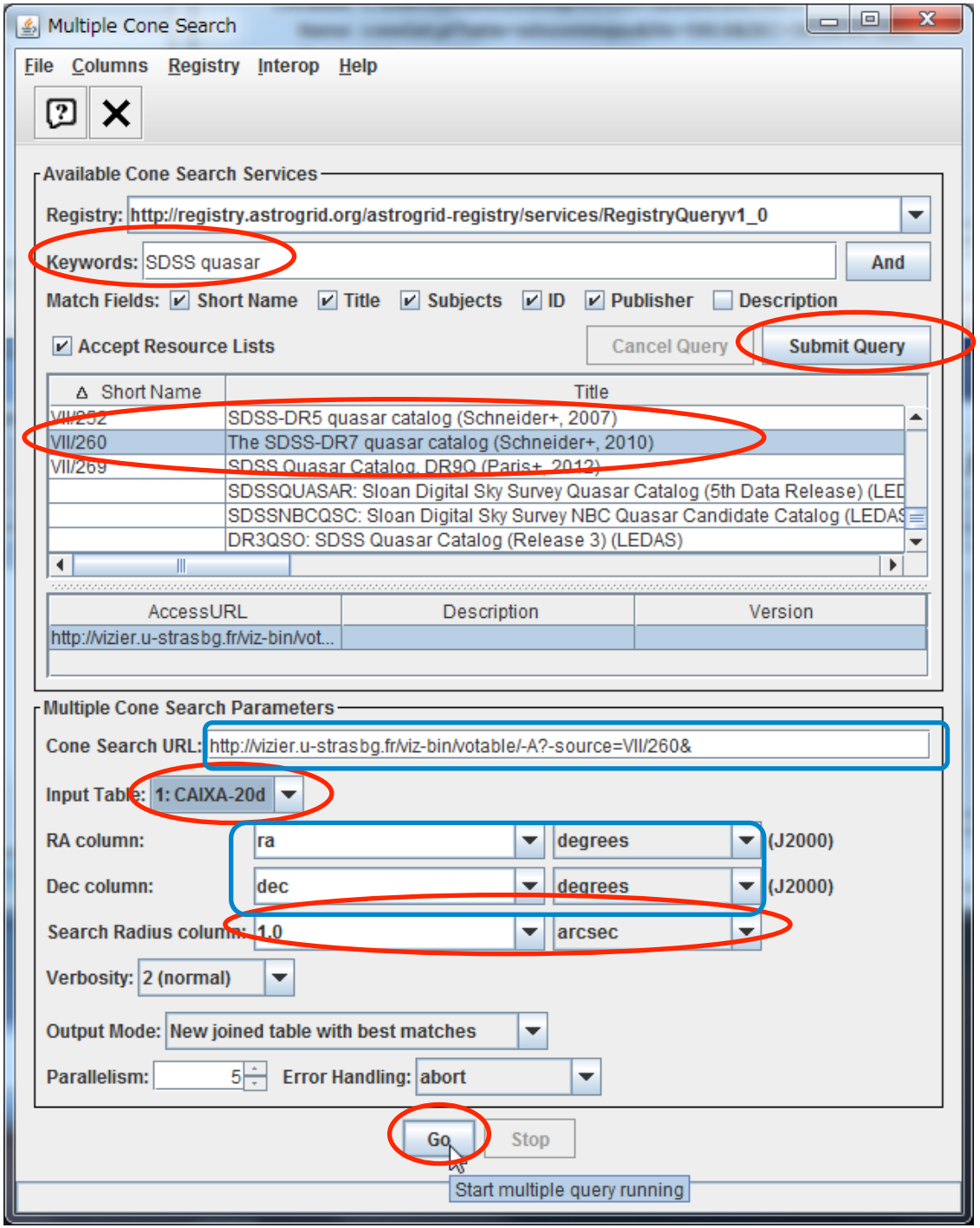
5組が得られる。



クロスマッチ検索



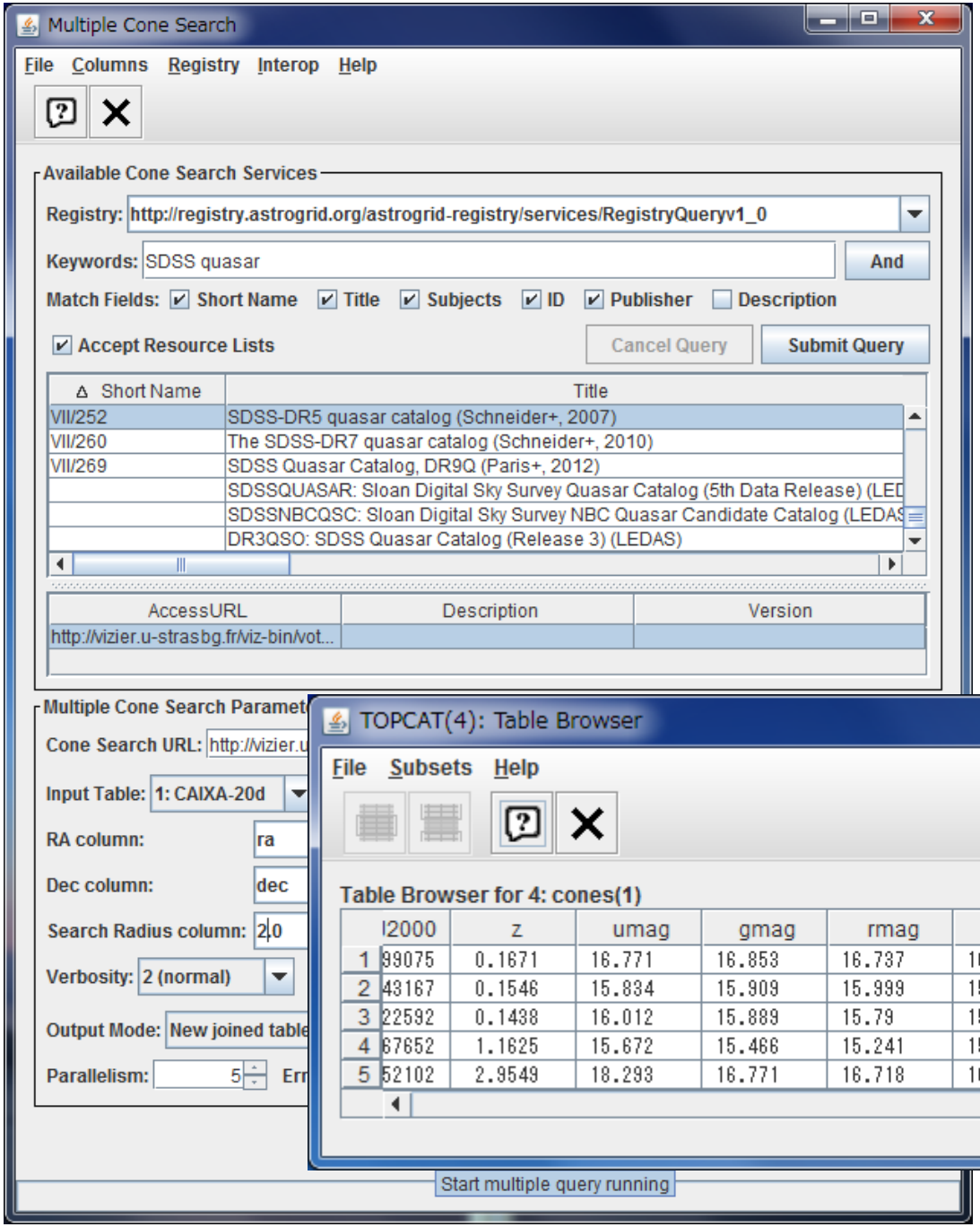
今は、検索した結果を取得してからクロスマッチしたが、
VO上にあるデータと直接クロスマッチしながら検索することも出来る。



サービスは同様に選ぶ。

Input table で、既に取得しているXMMのカタログを選択。

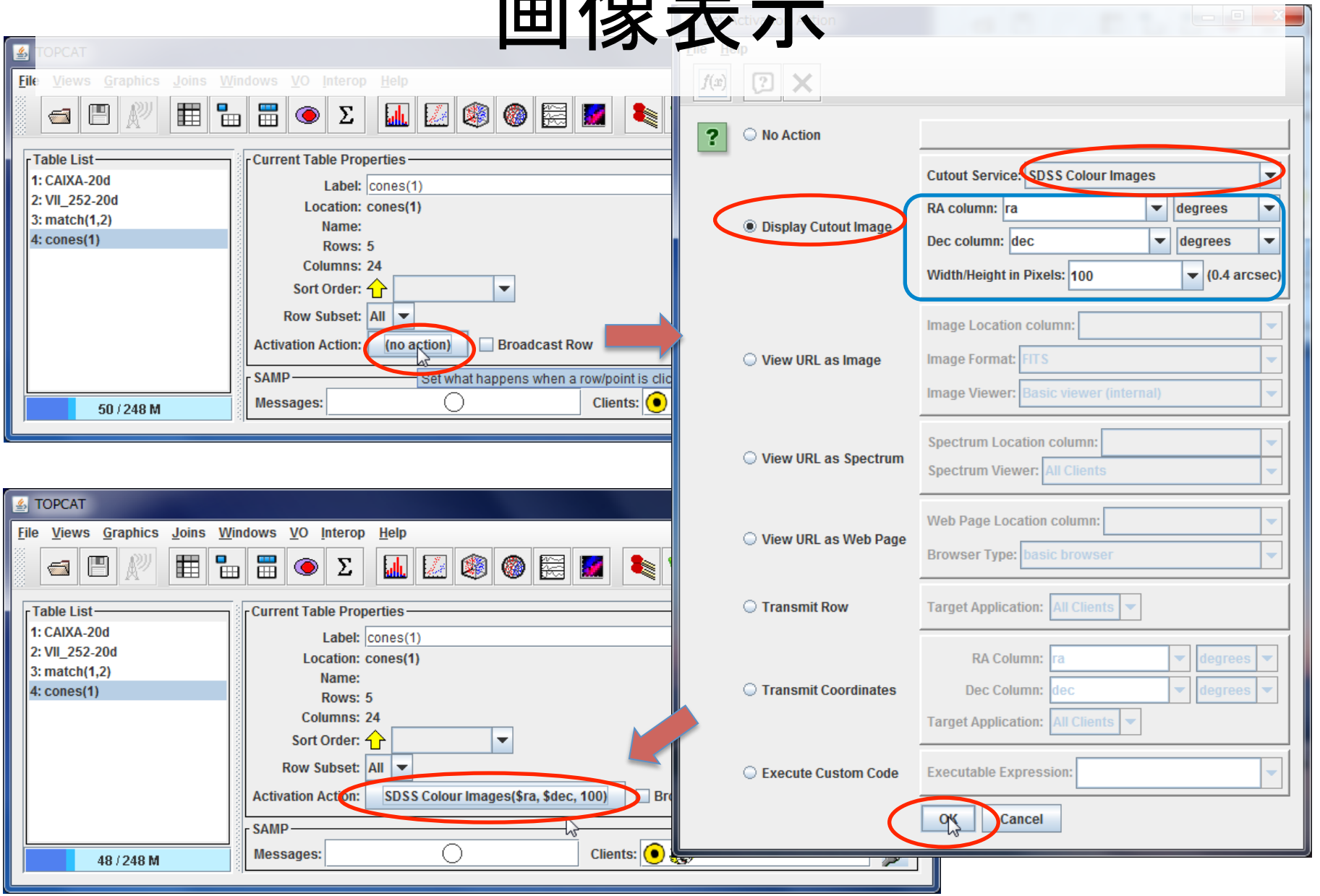
検索条件は座標誤差。



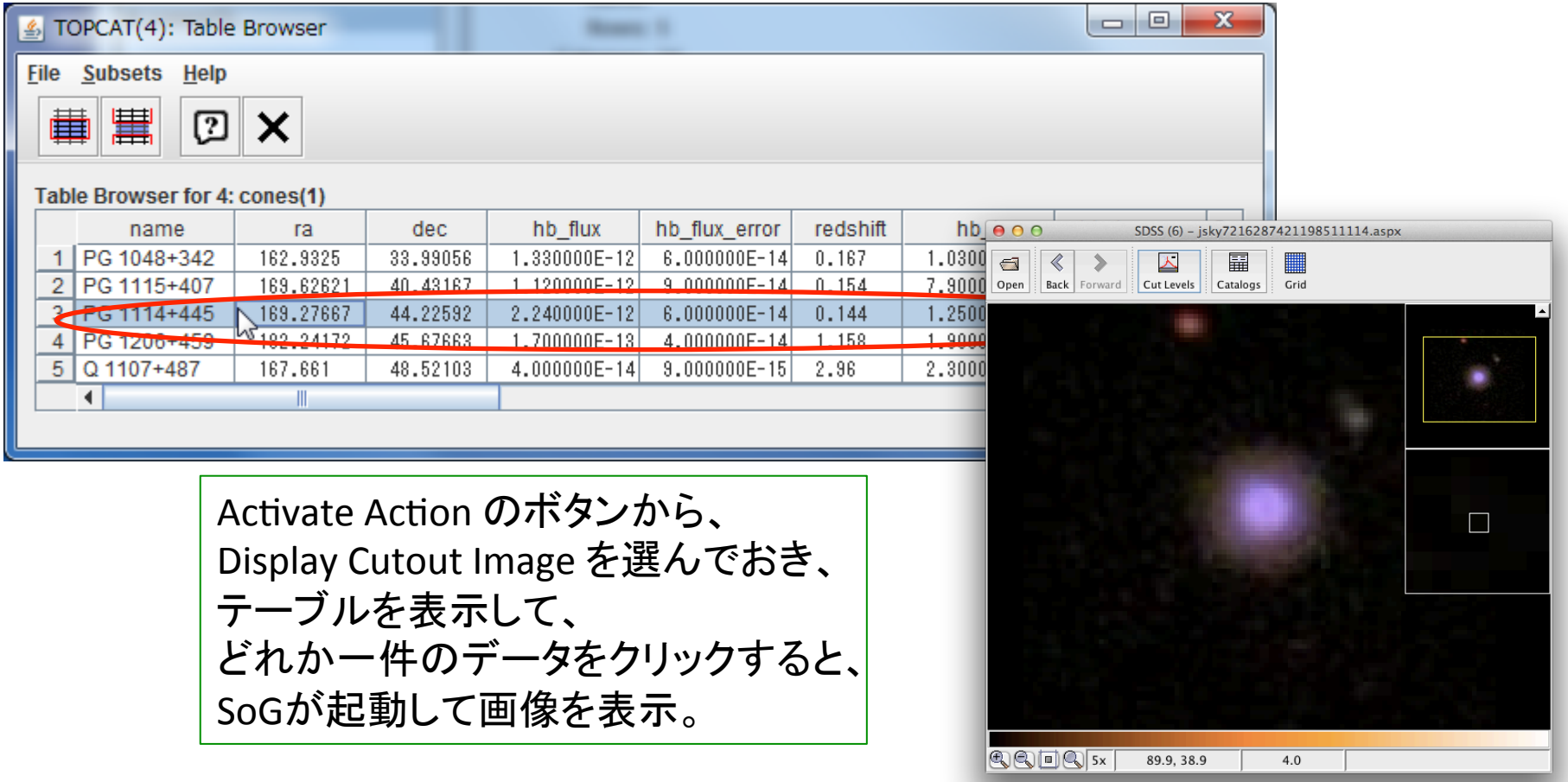
(もちろん)
先ほどと同じ結果が得られる。
(Separation のカラムが付く。)

場合によって使い分け。

画像表示

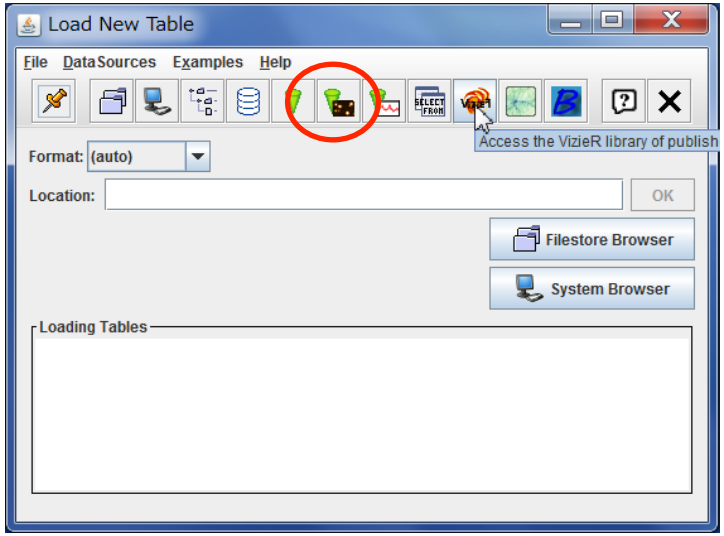

TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
1: CAIXA-20d
2: VII_252-20d
3: match(1,2)
4: cones(1)
Current Table Properties
Label: cones(1)
Location: cones(1)
Name:
Rows: 5
Columns: 24
Sort Order:
Row Subset: All
Activation Action: (no action)
Broadcast Row
SAMP
Messages:
Clients:
50 / 248 M
No Action
Display Cutout Image
Cutout Service: SDSS Colour Images
RA column: ra
Dec column: dec
degrees
Width/Height in Pixels: 100
(0.4 arcsec)
View URL as Image
Image Location column:
Image Format: FITS
Image Viewer: Basic viewer (internal)
View URL as Spectrum
Spectrum Location column:
Spectrum Viewer: All Clients
View URL as Web Page
Web Page Location column:
Browser Type: basic browser
Transmit Row
Target Application: All Clients
Transmit Coordinates
RA Column: ra
Dec Column: dec
Target Application: All Clients
Execute Custom Code
Executable Expression:
OK
Cancel
TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
1: CAIXA-20d
2: VII_252-20d
3: match(1,2)
4: cones(1)
Current Table Properties
Label: cones(1)
Location: cones(1)
Name:
Rows: 5
Columns: 24
Sort Order:
Row Subset: All
Activation Action: SDSS Colour Images($ra, $dec, 100)
SAMP
Messages:
Clients:
48 / 248 M

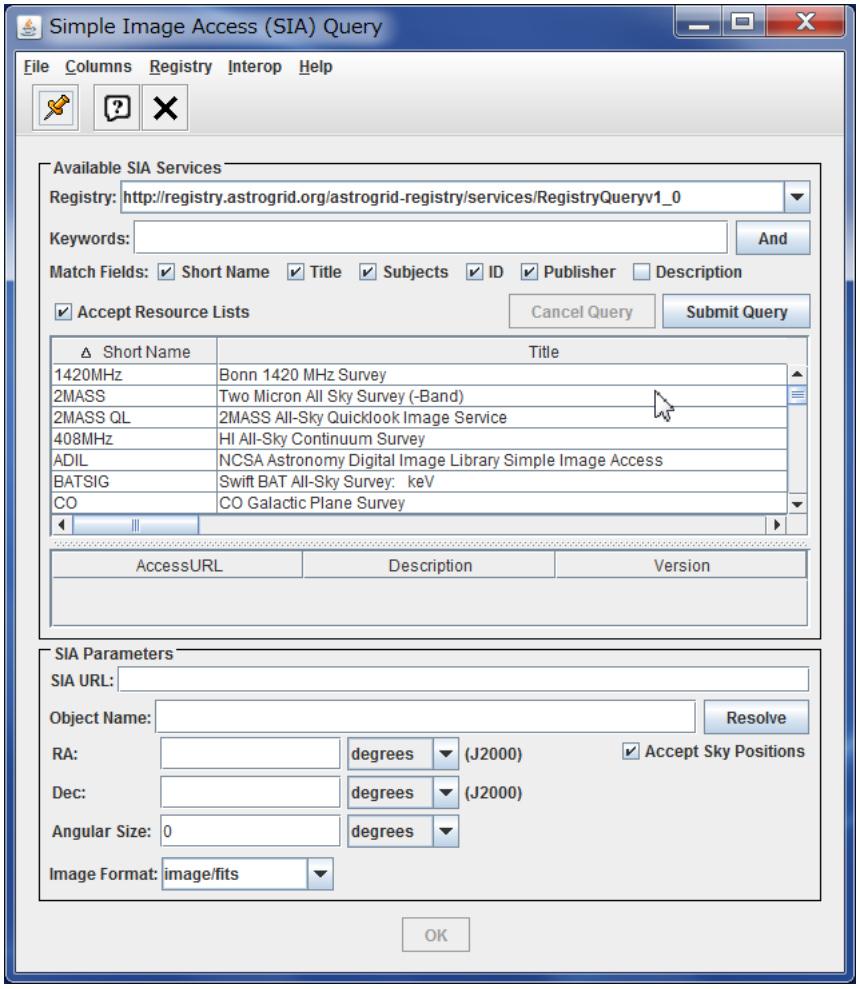
画像表示



Activate Action のボタンから、
Display Cutout Image を選んでおき、
テーブルを表示して、
どれか一件のデータをクリックすると、
SoGが起動して画像を表示。

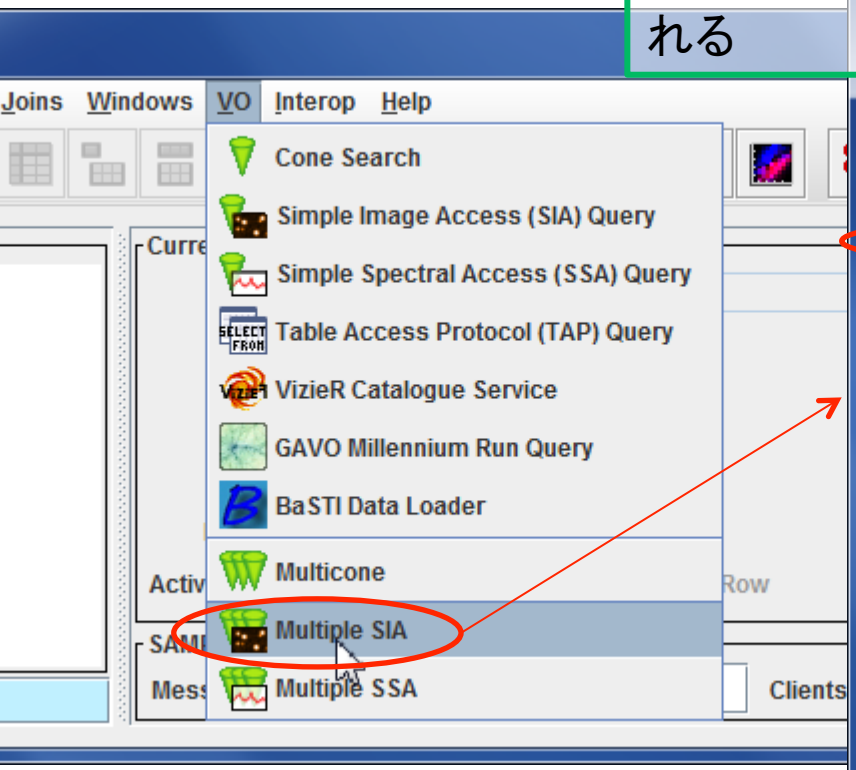
画像データの検索

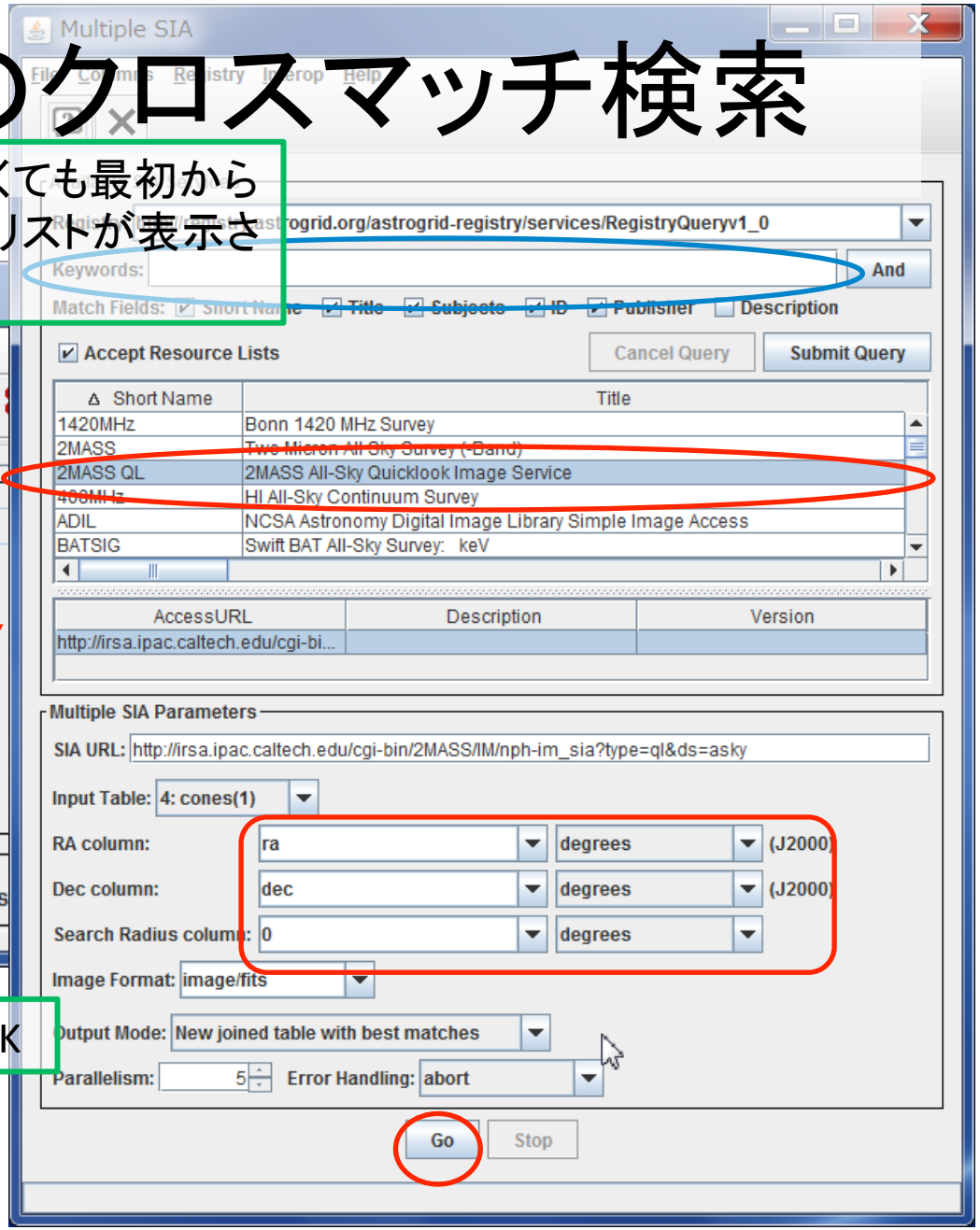

Load New Table
File DataSources Examples Help
Access the VizieR library of publish
Format: (auto)
Location:
OK
Filestore Browser
System Browser
Loading Tables


Simple Image Access (SIA) Query
File Columns Registry Interop Help
Available SIA Services
Registry: http://registry.astrogrid.org/astrogrid-registry/services/RegistryQueryv1_0
Keywords:
And
Match Fields: Short Name Title Subjects ID Publisher Description
Accept Resource Lists
Cancel Query
Submit Query
Short Name
Title
1420MHz Bonn 1420 MHz Survey
2MASS Two Micron All Sky Survey (-Band)
2MASS QL 2MASS All-Sky Quicklook Image Service
408MHz HI All-Sky Continuum Survey
ADIL NCSA Astronomy Digital Image Library Simple Image Access
BATSIG Swift BAT All-Sky Survey: keV
CO CO Galactic Plane Survey
AccessURL
Description
Version
SIA Parameters
SIA URL:
Object Name:
Resolve
RA:
degrees
(J2000)
Accept Sky Positions
Dec:
degrees
(J2000)
Angular Size: 0
degrees
Image Format: image/fits
OK

画像データのクロスマッチ検索

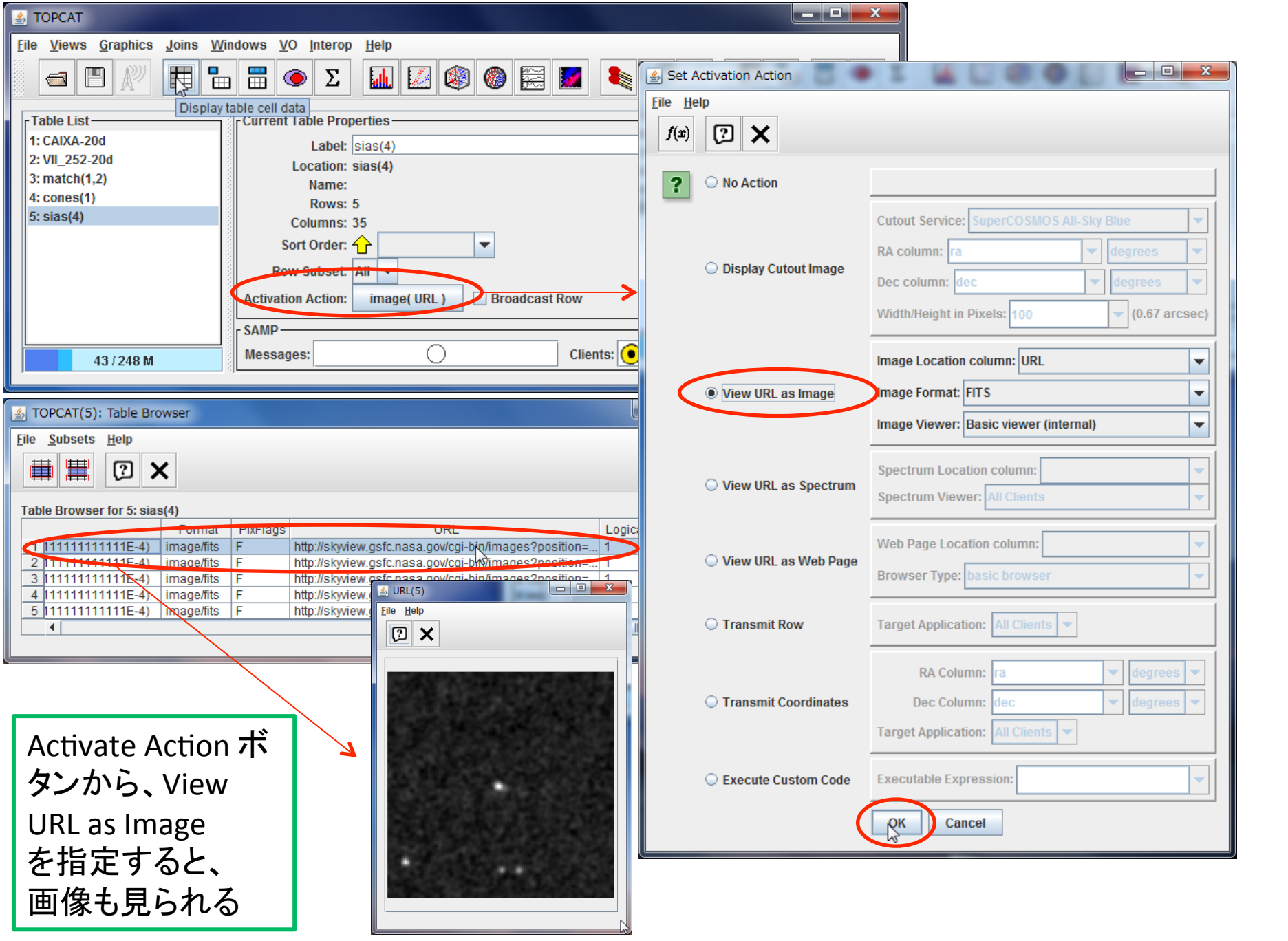
検索しなくても最初からサービスリストが表示される





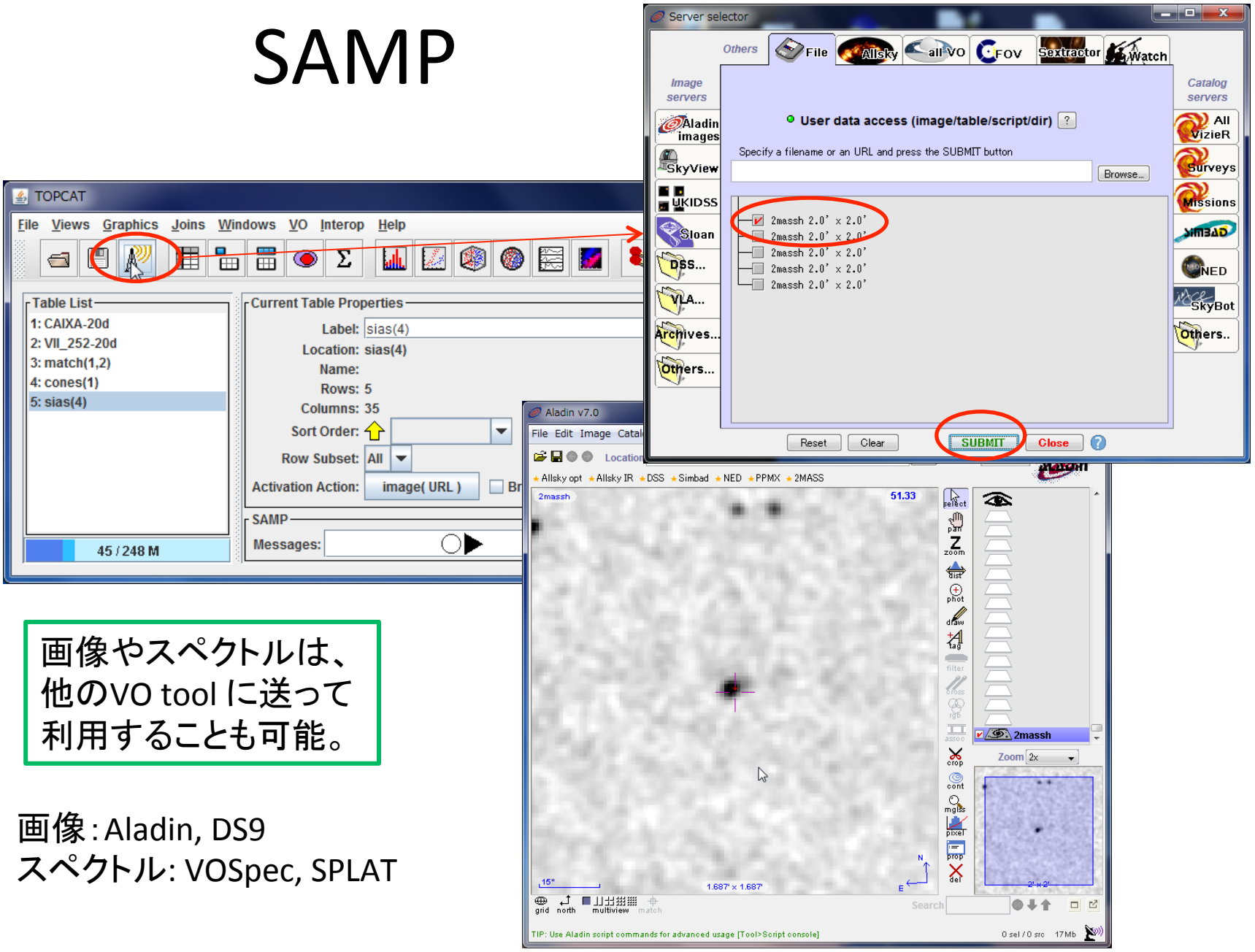
検索半径 0 でもOK


TOPCAT(5): Table Browser
File Subsets Help
Table Browser for 5: sias(4)
Format PixFlags URL Logical... Separation
1 111111111111E-4) image/fits F http://skyview.gsfc.nasa.gov/cgi-bin/images?position=... 1 0.
2 111111111111E-4) image/fits F http://skyview.gsfc.nasa.gov/cgi-bin/images?position=... 1 0.
3 111111111111E-4) image/fits F http://skyview.gsfc.nasa.gov/cgi-bin/images?position=... 1 0.
4 111111111111E-4) image/fits F http://skyview.gsfc.nasa.gov/cgi-bin/images?position=... 1 0.
5 111111111111E-4) image/fits F http://skyview.gsfc.nasa.gov/cgi-bin/images?position=... 1 0.
画像のあるURLの
リストを取得



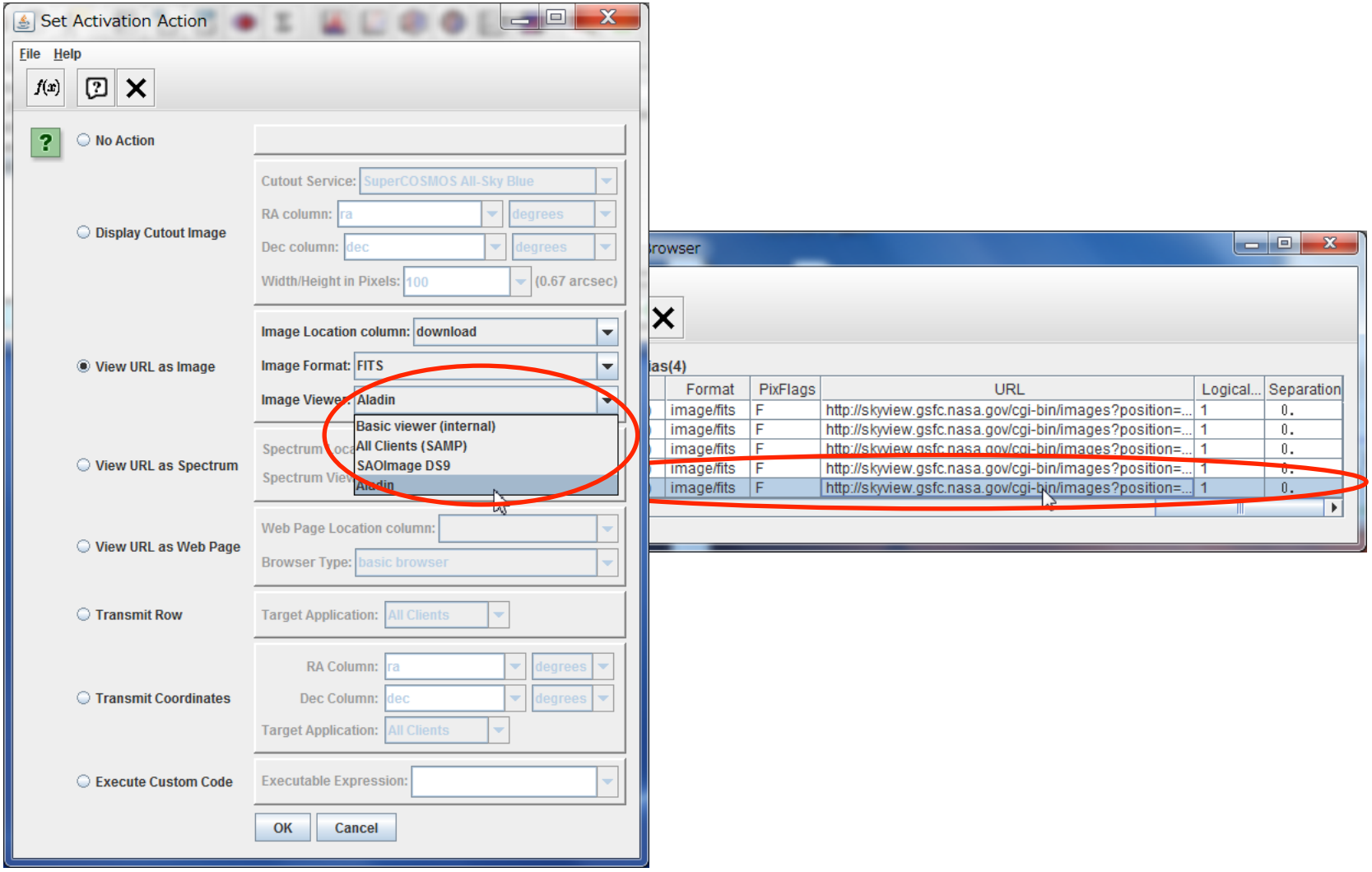
Activate Action ボタンから、View URL as Image を指定すると、画像も見られる

SAMP

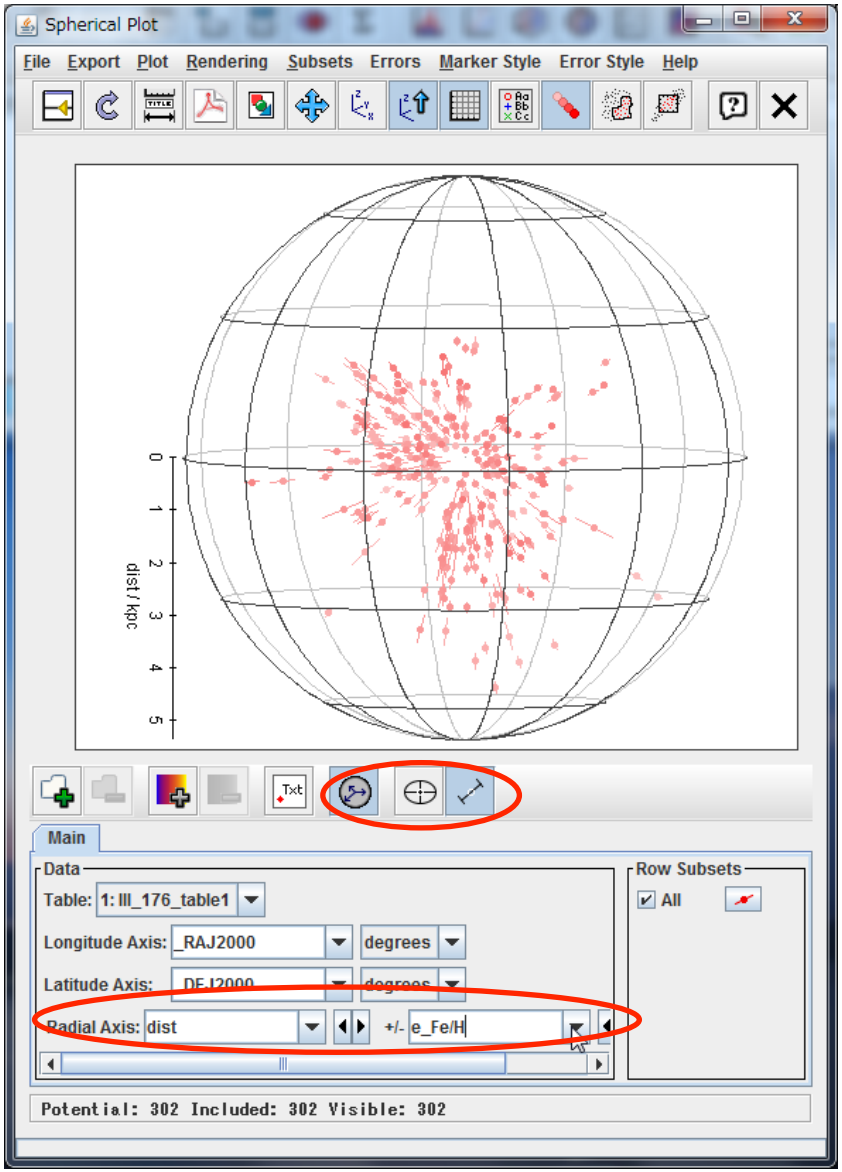


画像やスペクトルは、
他のVO tool に送って
利用することも可能。

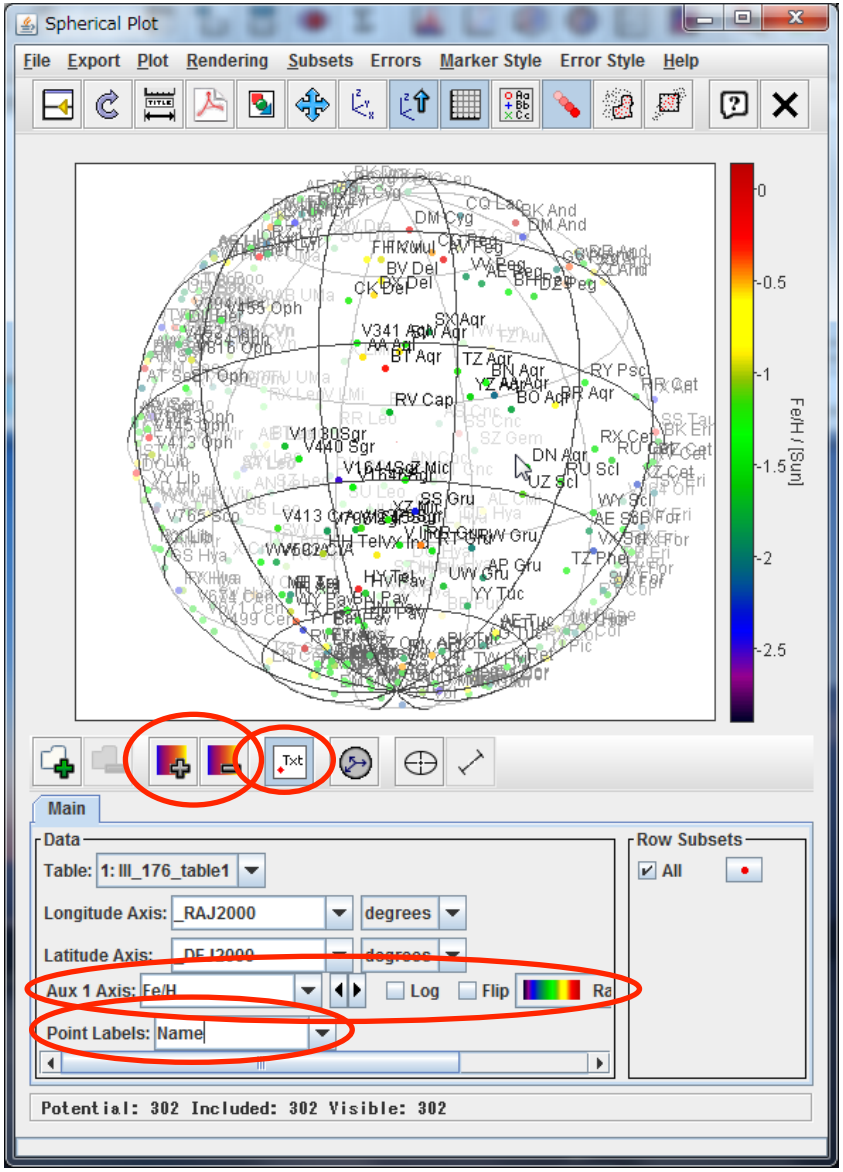
画像：Aladin, DS9
スペクトル: VOSpec, SPLAT


Set Activation Action
File Help
No Action
Display Cutout Image
Cutout Service: SuperCOSMOS All-Sky Blue
RA column: ra
degrees
Dec column: dec
degrees
Width/Height in Pixels: 100
(0.67 arcsec)
View URL as Image
Image Location column: download
Image Format: FITS
Image Viewer: Aladin
Basic viewer (internal)
All Clients (SAMP)
SAOImage DS9
Aladin
View URL as Spectrum
View URL as Web Page
Web Page Location column:
Browser Type: basic browser
Transmit Row
Target Application: All Clients
Transmit Coordinates
RA Column: ra
degrees
Dec Column: dec
degrees
Target Application: All Clients
Execute Custom Code
Executable Expression:
OK
Cancel
Format
PixFlags
URL
Logical...
Separation
image/fits
F
http://skyview.gsfc.nasa.gov/cgi-bin/images?position=...
1
0.

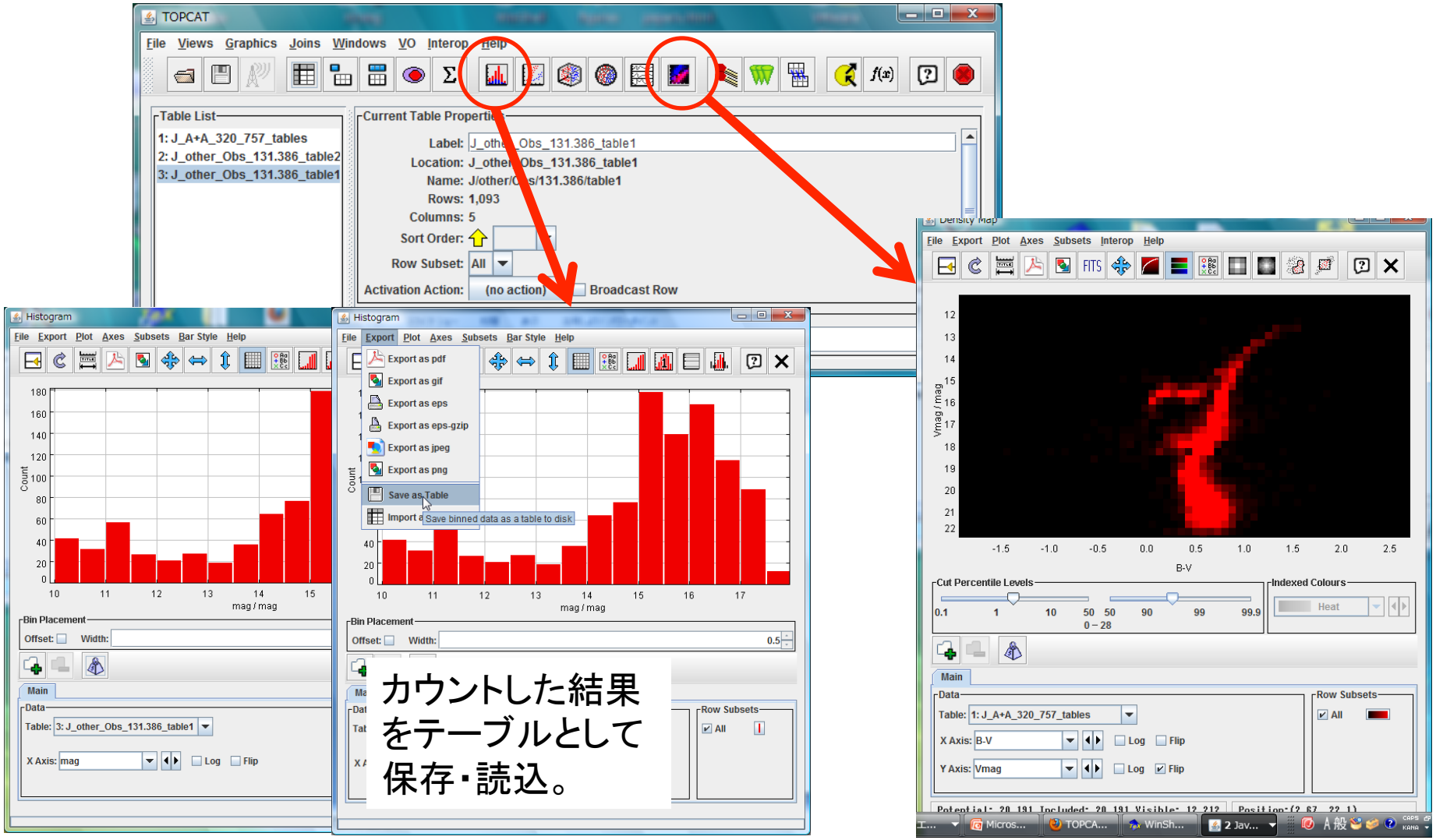
様々なplot



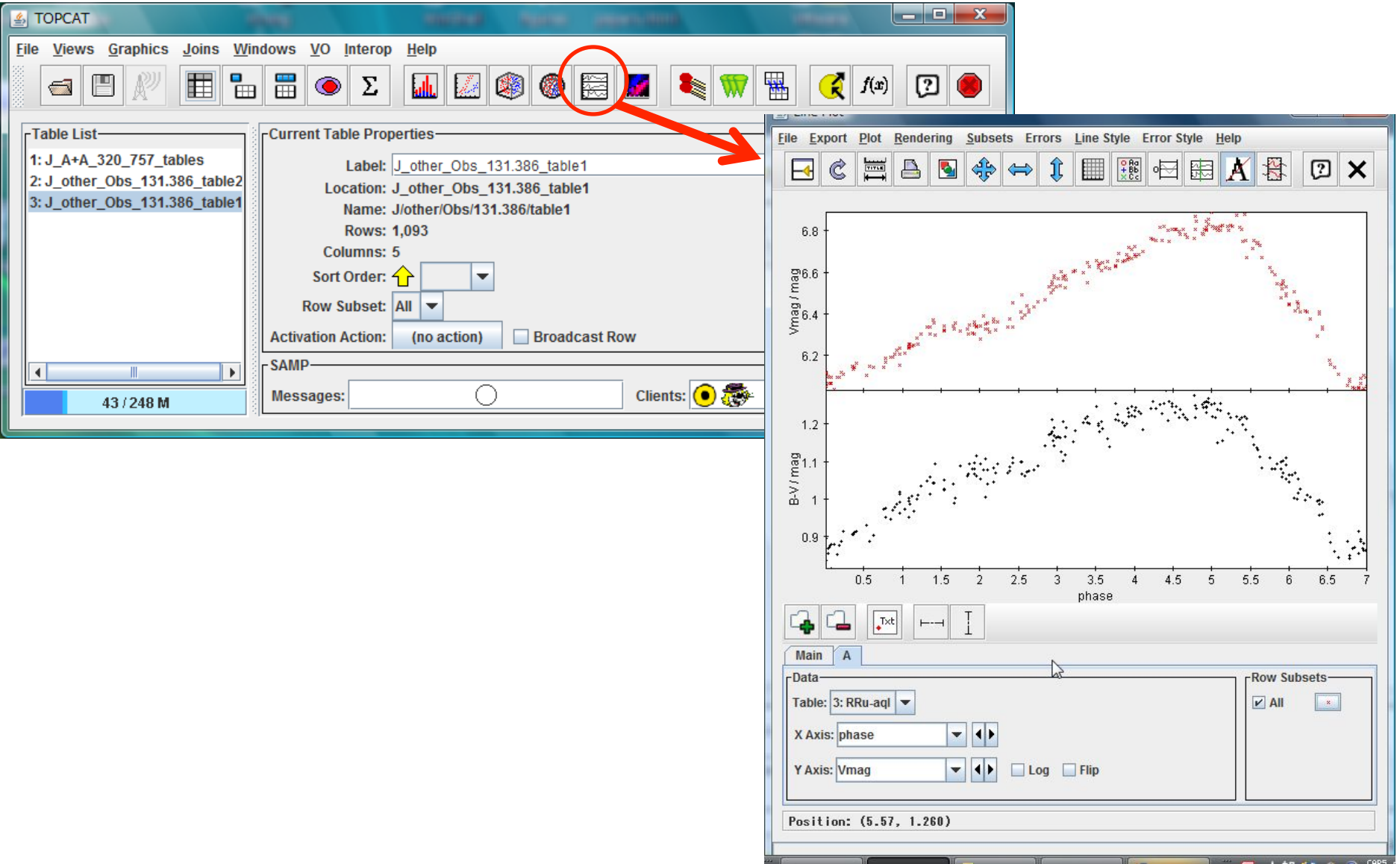
3次元極座標表示
Error bar


Spherical Plot
File Export Plot Rendering Subsets Errors Marker Style Error Style Help
0
-0.5
-1
-1.5
-2
-2.5
Fe/H / [Sun]
Txt
Main
Data
Table: 1: III_176_table1
Longitude Axis: _RAJ2000
degrees
Latitude Axis: _DEJ2000
degrees
Aux 1 Axis: Fe/H
Log
Flip
Point Labels: Name
Row Subsets
All
Potential: 302 Included: 302 Visible: 302

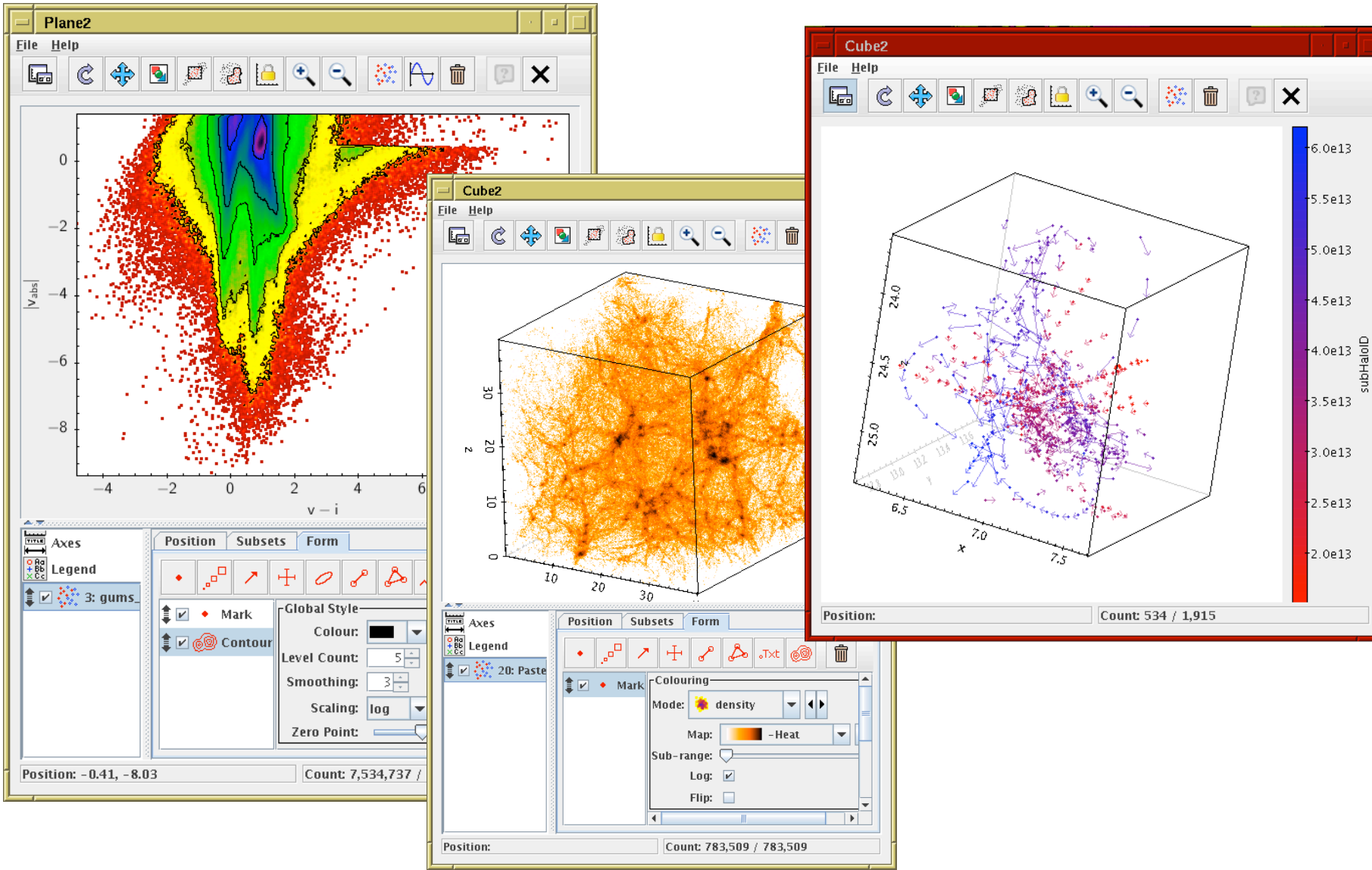
ヒストグラム、
density plot(2Dヒストグラム)



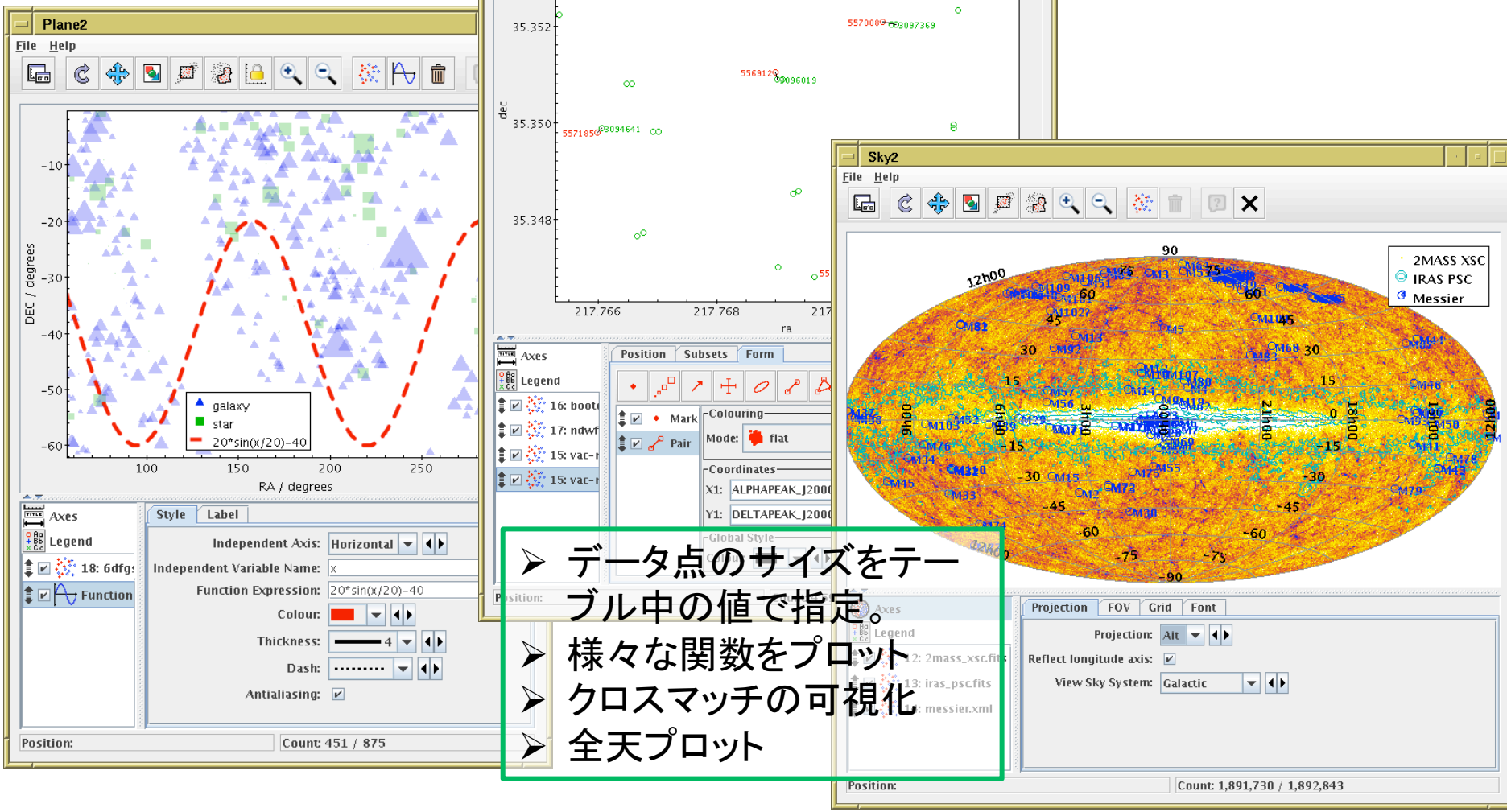
同じx軸で、複数のグラフをプロット



Version 4.0 の新機能

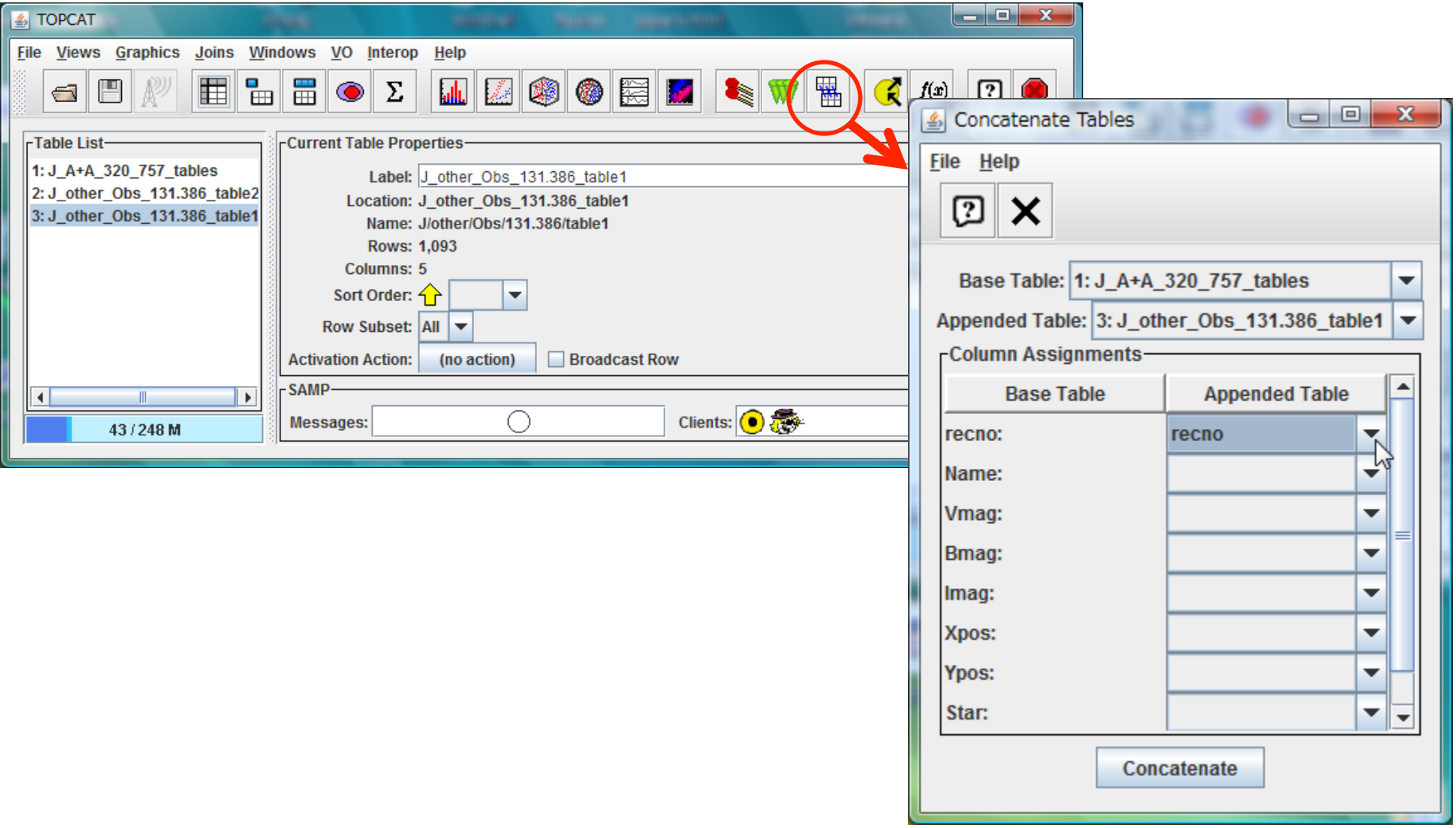


新機能



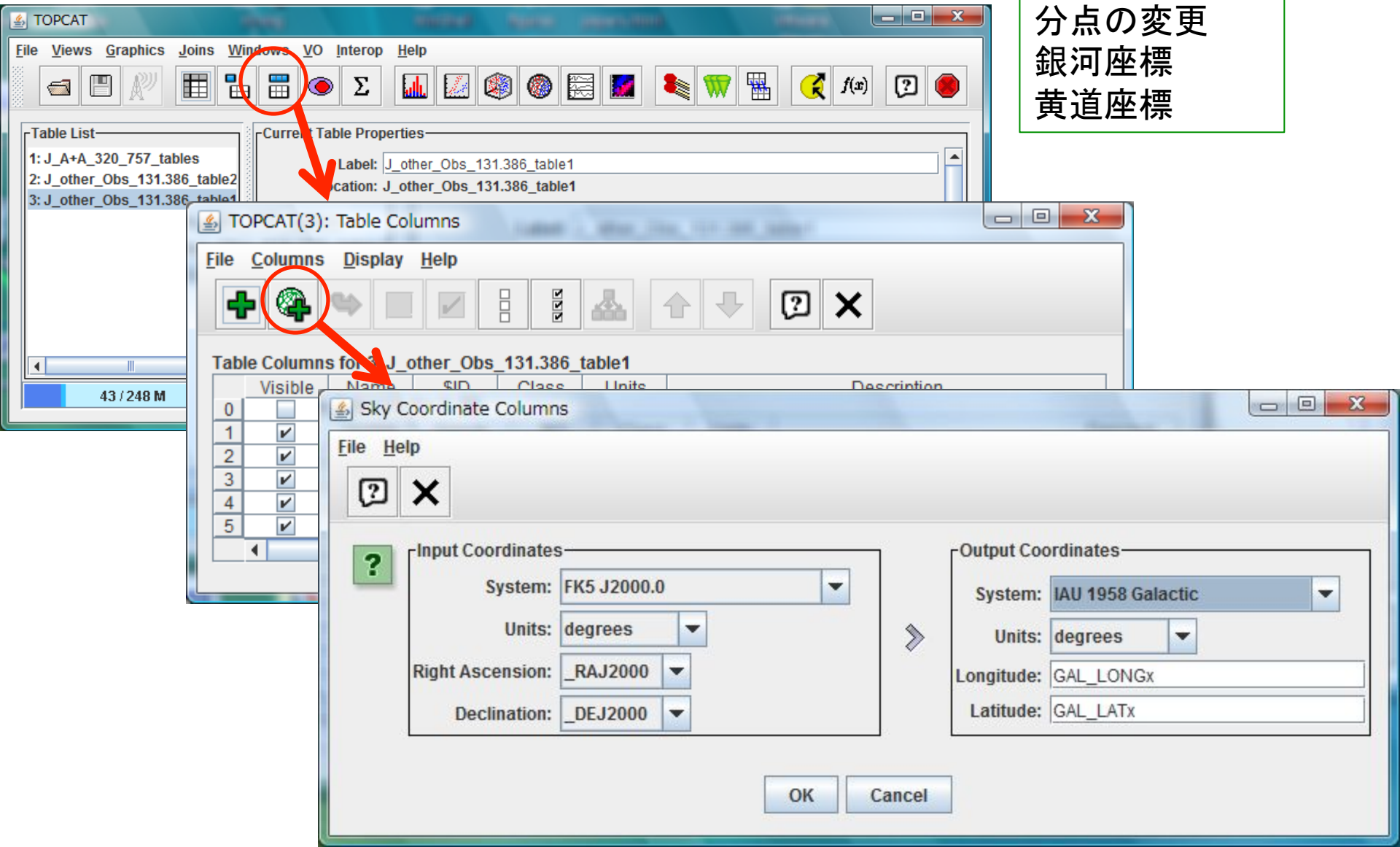
- データ点のサイズをテーブル中の値で指定。
- 様々な関数をプロット
- クロスマッチの可視化
- 全天プロット

Table Join(縦に)

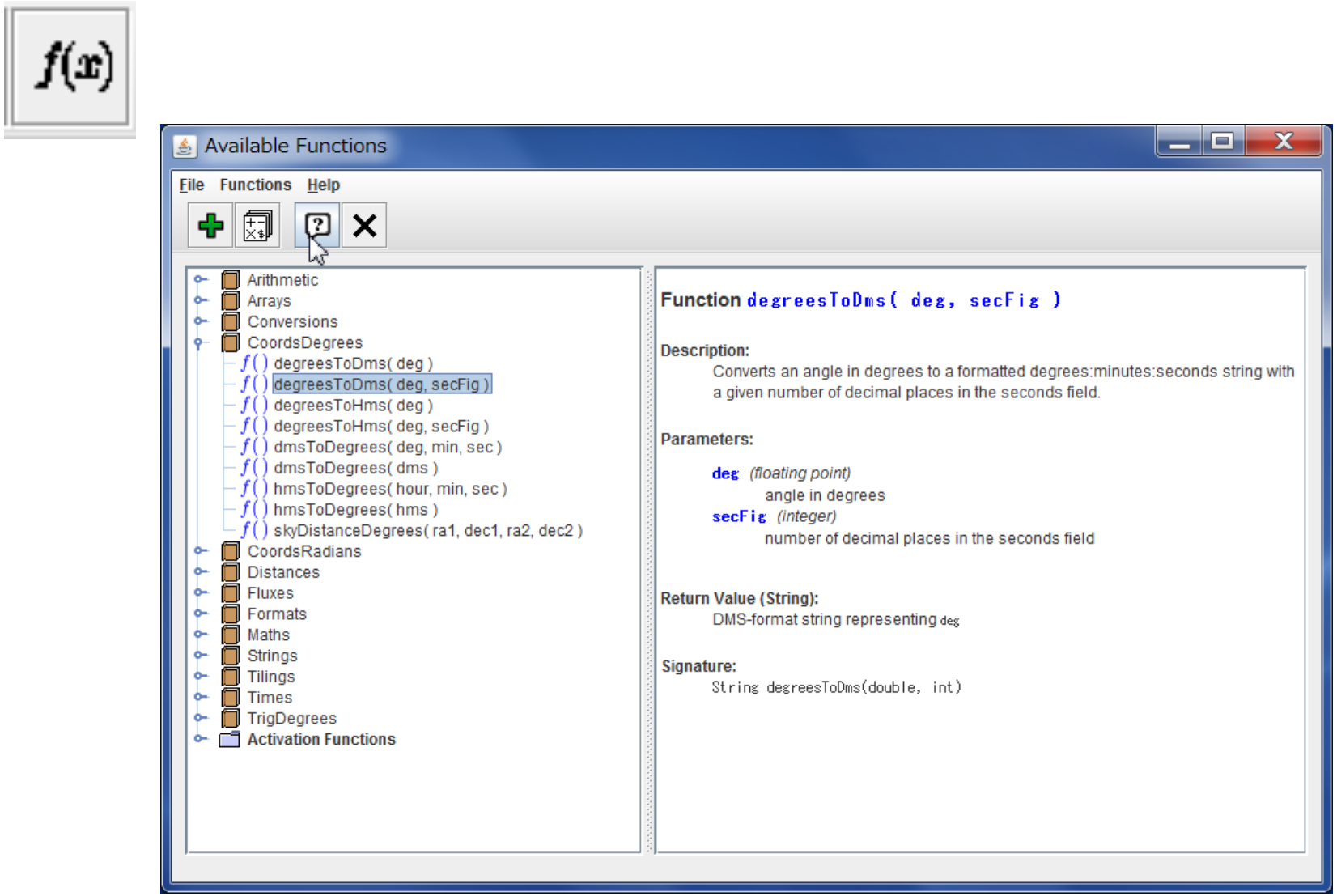


座標系の変換

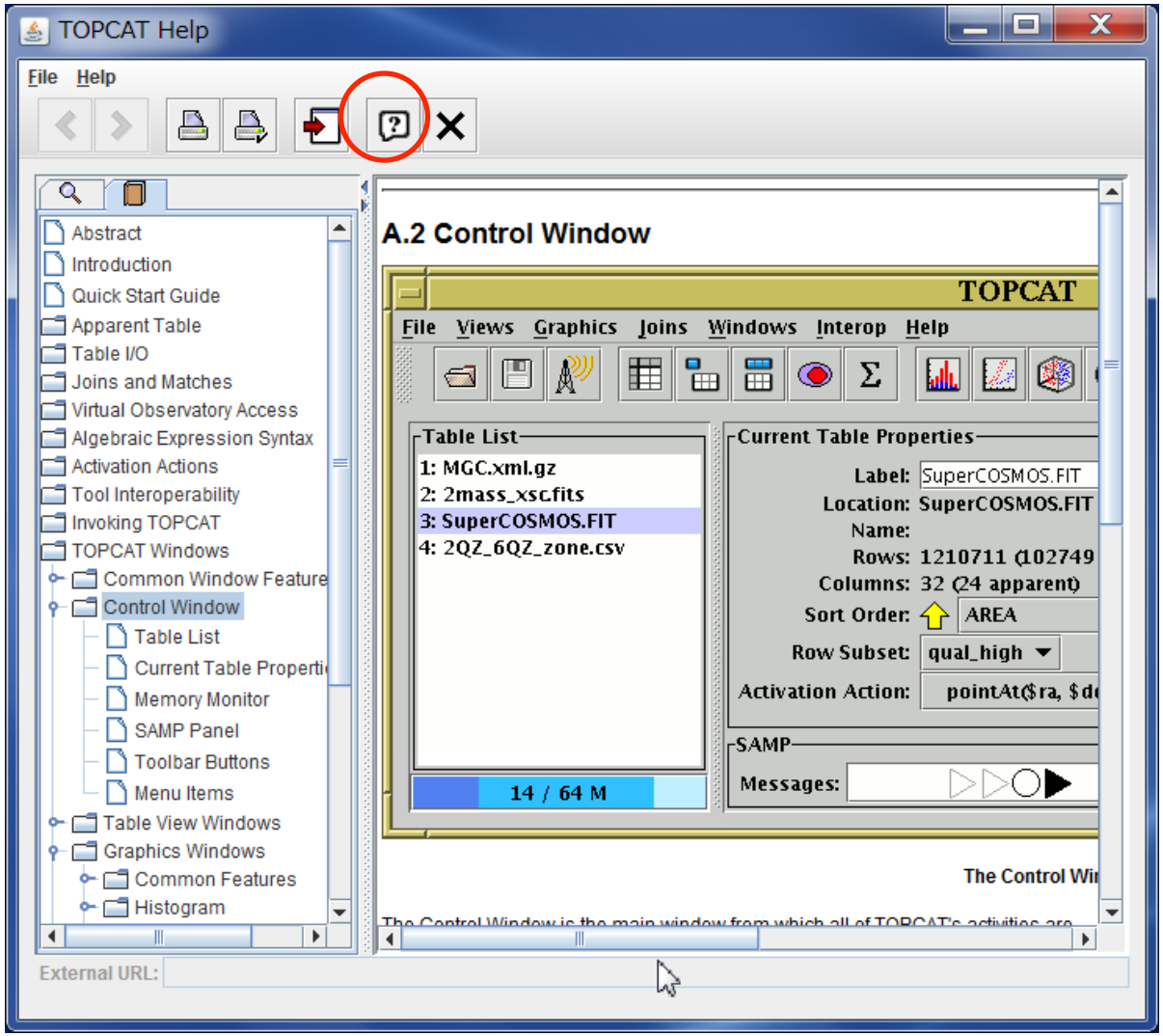
分点の変更
銀河座標
黄道座標



関数一覧


Available Functions
File Functions Help
Arithmetic
Arrays
Conversions
CoordsDegrees
degreesToDms(deg)
degreesToDms(deg, secFig)
degreesToHms(deg)
degreesToHms(deg, secFig)
dmsToDegrees(deg, min, sec)
dmsToDegrees(dms)
hmsToDegrees(hour, min, sec)
hmsToDegrees(hms)
skyDistanceDegrees(ra1, dec1, ra2, dec2)
CoordsRadians
Distances
Fluxes
Formats
Maths
Strings
Tilings
Times
TrigDegrees
Activation Functions
Function degreesToDms(deg, secFig)
Description:
Converts an angle in degrees to a formatted degrees:minutes:seconds string with a given number of decimal places in the seconds field.
Parameters:
deg (floating point)
angle in degrees
secFig (integer)
number of decimal places in the seconds field
Return Value (String):
DMS-format string representing deg
Signature:
String degreesToDms(double, int)

Help


TOPCAT Help
File Help
Abstract
Introduction
Quick Start Guide
Apparent Table
Table I/O
Joins and Matches
Virtual Observatory Access
Algebraic Expression Syntax
Activation Actions
Tool Interoperability
Invoking TOPCAT
TOPCAT Windows
Common Window Feature
Control Window
Table List
Current Table Properti
Memory Monitor
SAMP Panel
Toolbar Buttons
Menu Items
Table View Windows
Graphics Windows
Common Features
Histogram
A.2 Control Window
TOPCAT
File Views Graphics Joins Windows Interop Help
Table List
1: MGC.xml.gz
2: 2mass_xsc.fits
3: SuperCOSMOS.FIT
4: 2QZ_6QZ_zone.csv
14 / 64 M
Current Table Properties
Label: SuperCOSMOS.FIT
Location: SuperCOSMOS.FIT
Name:
Rows: 1210711 (102749
Columns: 32 (24 apparent)
Sort Order: AREA
Row Subset: qual_high
Activation Action: pointAt($ra, $d
SAMP
Messages:
The Control Wi
External URL:

STILTS

- コマンドラインでのテーブル操作ツール
- http://www.star.bristol.ac.uk/~mbt/stilts/
- クロスマッチ、検索、plot ….