



VIRTUAL ASTRONOMICAL OBSERVATORY

# The Virtual Observatory and The Virtual Astronomical Observatory

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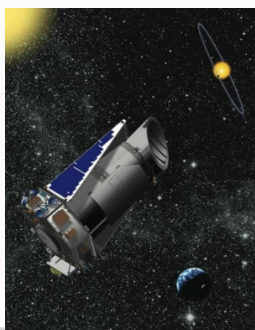
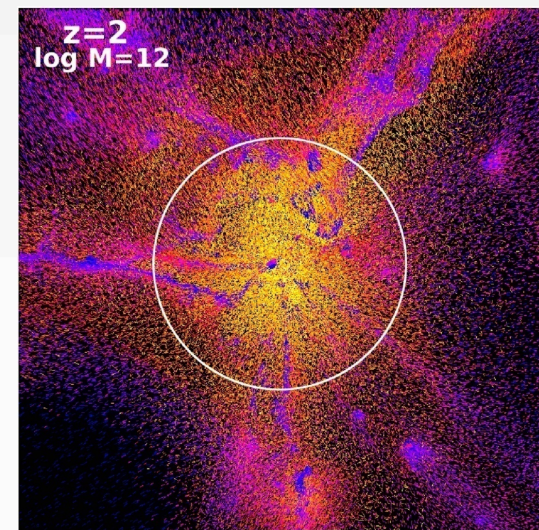
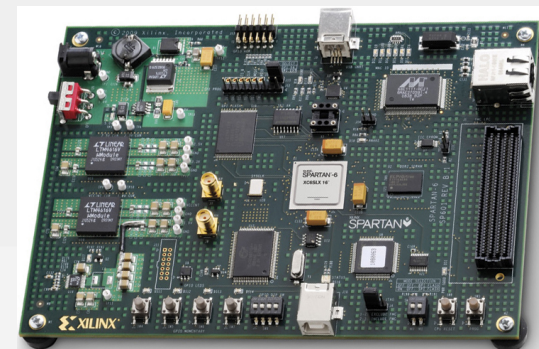
The VAO is operated by the VAO, LLC,  
a not-for-profit 501(c)(3) organization.



# The Virtual Observatory

Astronomy being transformed by Information Technology

- Generate large data sets
  - High speed digital signal processing
  - Large format CCDs
  - HPC-based simulations
- **How to deal with the data?**
  - Access, analyze, archive
  - New telescopes only going to exacerbate challenge





# The Virtual Observatory

## The VO is a data discovery, access, and integration facility

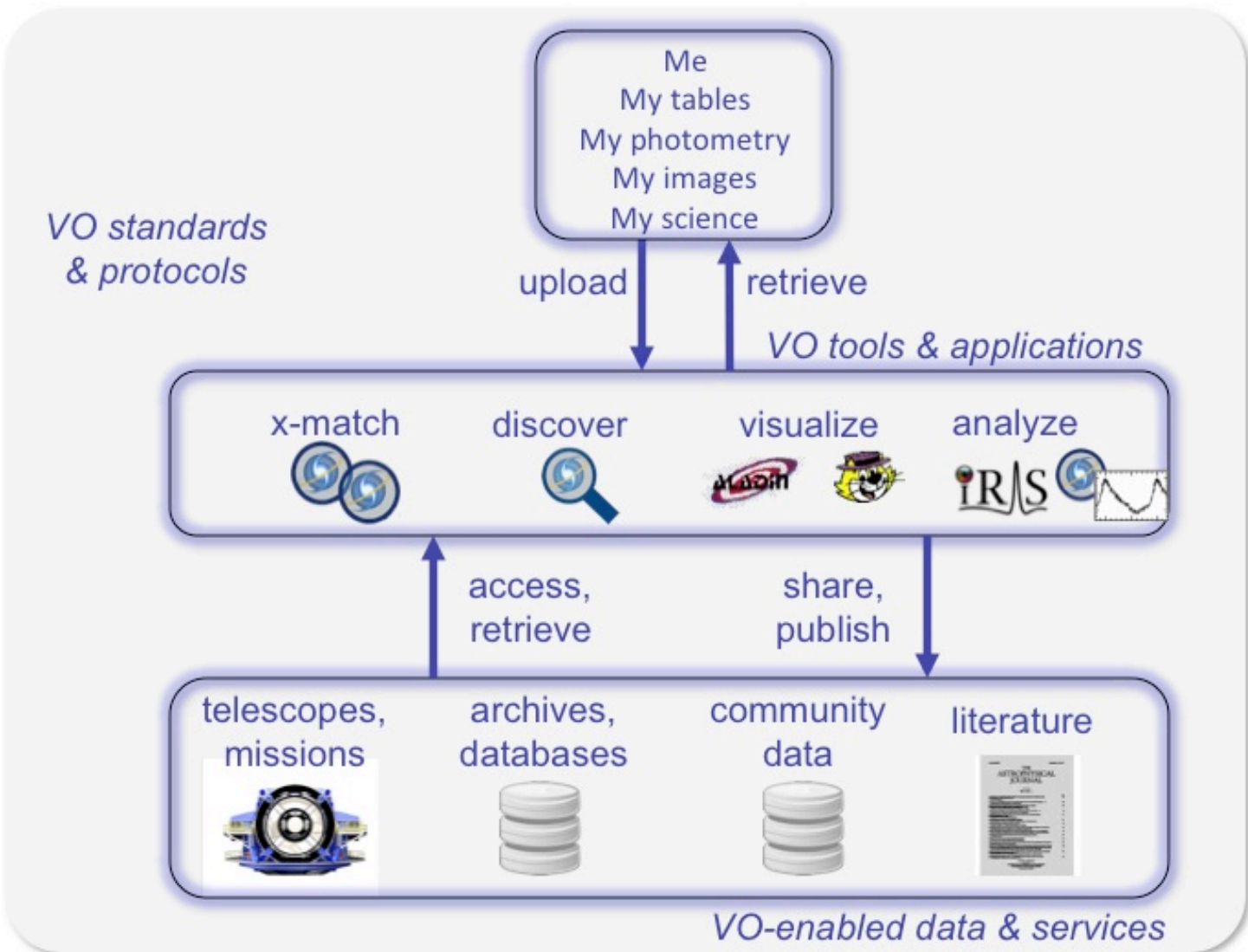
- Image, spectral, time series data
- Catalogs, databases
- Transient event notices
- Software and services
- Distributed computing authentication, authorization, process management
- Application inter-communication



*International coordination and collaboration*



# The Virtual Observatory





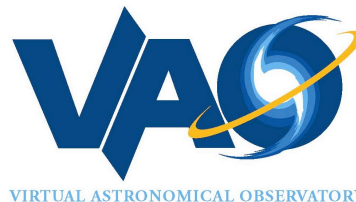
# VO impact and penetration

Astronomers use VO every day without realizing it

- A few examples
  - Major archives and data centers are VO compliant
  - Hubble Legacy Archive is built with “VO Inside”
  - Dark Energy Survey pipeline and archive
  - WIYN One-Degree Imager pipeline and archive
  - Pan-STARRS
  - LSST development
- ~1M VO-compliant service requests every 2 weeks from several sites



# 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  
 Managed by VAO, LLC, co-owned by AUI and AURA
  - VAO Board of Directors (J. Gallagher, chair)
  - Science Council, G. Fabbiano (CfA, acting)
  - Users Committee, C. Miller (U. Mich.)

<http://www.usvao.org/>

**US Virtual Astronomical Observatory**

Home Science Tools & Services About the VAO VO News Support & Community Contact & Connect Search

**VAO Tools & Services**

- **Data Discovery Tool** – Retrieve astronomical data about a given position or object in the sky.
- **Iria: SED Analysis Tool** – Find, plot, and fit spectral energy distributions (SEDs) with this desktop application.
- **Time Series Search Tool** – Discover time-series data from three major archives & analyze them with the NASA Exoplanet Archive periodogram application.
- **Cross-Comparison Tool** – Perform fast positional cross-matches between an input table of up to 1 million sources and common astronomical source catalogs.

**About the VAO**  
 The Virtual Astronomical Observatory (VAO) is part of a worldwide effort called the Virtual Observatory (VO) that aims to link astronomy data and services.



# Research Collaborations

- Call for Proposals issued in January  
VAO to provide in-kind resources to further a well-defined research project and/or expose valuable data to the community
- **Think about next year!**



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## Call for Proposals

### Science Collaborations with the Virtual Astronomical Observatory

8 January 2012

Proposals due: 1 March 2012

The US Virtual Astronomical Observatory (VAO) seeks proposals from the astronomical research community for science collaborations that utilize virtual observatory capabilities or develop novel virtual observatory tools to produce new research results. Proposals may be in any area of astronomy, but projects that benefit from the integration of data in multiple wavelength regions, that involve analysis of time-domain data sets, and/or utilize large databases or data sets are the most germane to the VAO. The VAO Science Council has suggested, for example, that multi-wavelength studies of M31 would be a good candidate for such a collaboration, but proposals in any area of astronomy are welcome and will be considered.

The VAO cannot directly fund these collaborations, but will provide in-kind support in using and adapting VO technologies in the selected projects. Such support may include VAO technical staff visiting a research team or covering travel costs for members of a research team to visit a VAO organization. Ongoing support will be in the form of telecons, e-meetings (e.g., using WebEx), a Wiki site, or other on-line collaborative tools.

## Accepted

- Serving data and models of the Magellanic Clouds from *Spitzer* and *Herschel* legacy programs (PI: Meixner)
- Serving light curves from the American Association of Variable Star Observers (PI: Templeton)
- VO image interfaces to the NASA Extragalactic Database (PI: Schombert)
- VO-compliant databases for the Evolutionary Map of the Universe and Variable and Slow Transient Survey Science Projects (PI: Murphy)



# VAO Science Tools

<http://www.usvao.org/>

US Virtual Astronomical Observatory

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## Science Tools & Services

- **Data Discovery Tool**  
Retrieve astronomical data about a given position or object in the sky.
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Find, plot, and fit spectral energy distributions (SEDs) with this desktop application.
- **Cross-Comparison Tool**  
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- **Time Series Search Tool**  
Discover time-series data from three major archives & analyze them with the NASA Exoplanet Archive periodogram application.

View a welcome and introduction to the VAO Science Tools from director Robert Hanisch:

Welcome to the VAO
Share
More info

Robert Hanisch
Director - Virtual Astronomical Observatory

0:08 / 2:15

### VAO Tools & Services

- ▶ [Data Discovery Tool](#) – Retrieve astronomical data about a given position or object in the sky.
- ▶ [Iris: SED Analysis Tool](#) - Find, plot, and fit spectral energy distributions (SEDs) with this desktop application.
- ▶ [Time Series Search Tool](#) – Discover time-series data from three major archives & analyze them with the NASA Exoplanet Archive periodogram application
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## More VO Tools & Applications

Below is just a selective sample of the VO tools and services that have been developed by various Virtual Observatory projects around the world. For a more complete listing, see this evolving list at the IVOA Applications Working Group page. Prototypes produced by the predecessor to the VAO are still available at <http://www.us-vo.org>

- Monitor real-time alerts of transient events: [Skylalert](#)
- Manipulate tabular data graphically: [TOPCAT](#)
- Find and overlay images at different wavelengths: [Aladin](#)
- Make mosaics from 2MASS, DPOSS, or SDSS: [Montage](#)
- Plot results from VO queries: [VOPlot](#)

### More News from the VO

- ▶ Aladin update from CDS
- ▶ VAO Working with LSST, SDSC
- ▶ The VAO at the SPIE Telescopes & Instrumentation Conferences
- ▶ VAO Software Release: Data Discovery Tool (version 1.3)
- ▶ VO Inside: NASA HEASARC Xamin Catalog & Archive Interface
- ▶ How To Use Cloud Computing To Do Astronomy
- ▶ Welcome to the (new) VAO Website!
- ▶ Astronomy Computing Today: New Astronomy Projects Take Up The Virtual Observatory

Member of the  
International Virtual Observatory Alliance





# Time Series Tool

## VAO Time Series Tool

### Introduction

Discover time series data sets at the [Harvard Time Series Center \(TSC\)](#), the [NASA Exoplanet Archive](#) at IPAC/Caltech, and the [Catalina Real-Time Transient Survey](#) at CACR/Caltech, and analyze them with the NASA Exoplanet Archive's periodogram application.

This service is a pathfinder for developing a utility that interconnects repositories of time series data. Please give us your feedback - it is important in driving future VO capabilities.

This service is recommended for use with the most recent versions of Firefox, Chrome or Safari. Internet Explorer 9, old versions of Firefox (prior to version 8) and Opera are not supported.

### VAO Time Series Search

Use the fields below to enter a search location and radius.

Location:

Radius:  arcsec

Archive	Dataset Description	Total Holdings	Number Found	Display
NSIED	Kepler	381655	6	<a href="#">display</a>
NSIED	Kepler planetary candidates	1235	1	<a href="#">display</a>
NSIED	TRÉS (Trans-atlantic Exoplanet Survey) observations of the Kepler field	25947	1	<a href="#">display</a>
CACR	Catalina Real-Time Transit Survey	197961949	1	<a href="#">display</a>

#### Example Locations:

NGC 3016  
Kepler-11  
88.31522 +32.61827  
05h53m15.65s +32d37m05.8s  
177.68200 +3.29886 ga

- Discover time series data
  - Harvard Time Series Center (TSC)
  - NASA Exoplanet Archive at IPAC/Caltech
  - Catalina Real-Time Transient Survey at CACR/Caltech
- Analyze with the NASA Exoplanet Archive's periodogram application
- Pathfinder for developing utility that interconnects time series data repositories



# Time Series Tool II

Kepler planetary candidates

star_id	9941662
koi	13.01
field	The Kepler Field
ra	286.971159
dec	46.868401
pm_ra	0.000000
pm_dec	0.000000
pm_total	0.000000
gal_lat	16.806619
gal_lon	77.505951
umag	null
gmag	9.697000
rmag	10.045000
imag	10.548000
zmag	10.020000
gredmag	null
d51mag	9.669000
jmag	9.465000
hmag	9.455000
kmag	9.425000
kepmag	9.958000
filter	Kepler Magnitude
transit_duration	3.202900

Kepler

TrES (Trans-atlantic Exoplanet Survey) observations of the Kepler field

star_id	TrES_Lyr1_00173
region	TrES_Lyr1
ra	286.971250
dec	46.868330
bmag	10.704000
vmag	10.476000
rmag	11.504000
rerr	0.039100
starthjd	2453541.787548
endhjd	2453616.734163
lcfil	R
npts	11398
lcdisp	0.140000
lcchisq	13356.299805
n5sig	0
f5sig	0.000000
public	Y
reference_ids	8
etss_id	173
download	<a href="#">download</a>
plot	<a href="#">plot</a>
periodogram	<a href="#">periodogram</a>

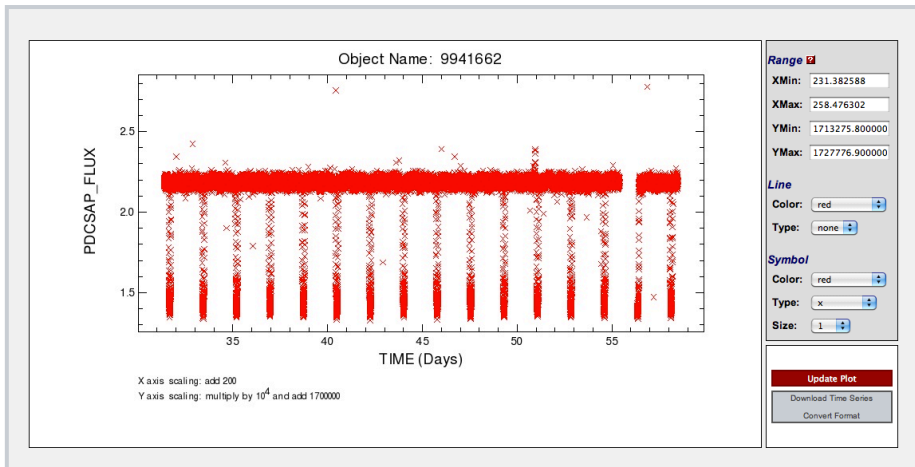
TrES

After searching on an object,  
examine its entries in a time  
series data set ...



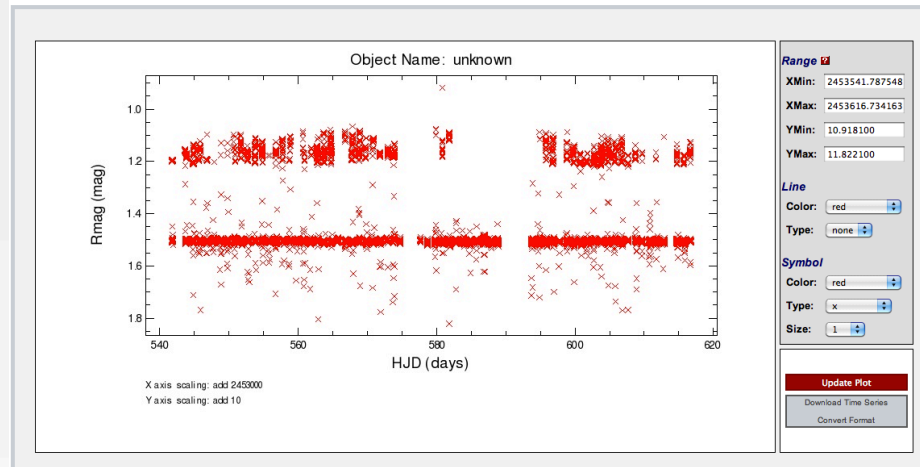
# Time Series Tool III

NASA Exoplanet Archive Light Curve Viewer



Kepler

NASA Exoplanet Archive Light Curve Viewer



TrES

Plot the time series as a “quick look” ...



# Tool Series IV

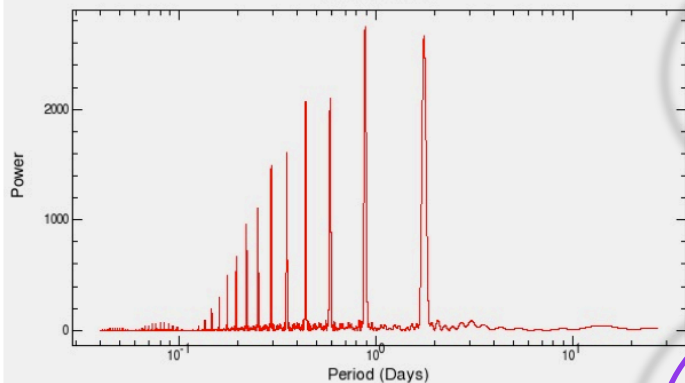
## NASA Exoplanet Archive Periodogram Service

[About](#)
[Usage](#)
[Performance](#)
[Troubleshooting](#)
[Algorithms](#)
[Parameters](#)

### Periodogram [Download](#)

Linear  Log

Star ID: 9941662



### Most Significant Periods [Download](#)

Rank	Period	Power	P-value	Link
1	0.881834	2755.170455	0	<a href="#">Phased curve</a>
2	1.762381	2664.109661	0	<a href="#">Phased curve</a>
3	0.587816	2100.440015	0	<a href="#">Phased curve</a>
4	0.440943	2075.150904	0	<a href="#">Phased curve</a>
5	0.352784	1613.287483	0	<a href="#">Phased curve</a>

The P-values above are computed for 359080 periods sampled, and an exponential power distribution is assumed. **A note of caution when interpreting the results from the periodogram:** The calculated statistical significance (p-value) of ranked periods may not be reliable. Several factors may invalidate the assumptions applied in estimating the statistical significance. To learn more, please review our algorithms page.

Input		Current Values
<a href="#">Create Periodogram</a>		
Periodogram type	<input checked="" type="radio"/> Lomb-Scargle <input type="radio"/> BLS <input type="radio"/> Plavchan	Lomb-Scargle
Input file	kplr009941662-2...2_sic_lc.tbl Number of points: 37057	<a href="#">View Time Series</a>
Time column	TIME Min: 231.3826, Max: 258.4763	TIME
Data column	PDCSAP_FLUX Min: 4713275.8000, Max: 1727599.0000	PDCSAP_FLUX

Constraints Range		
<a href="#">Show / Hide</a>		
Time Constraint column	Min <input type="text"/> Max <input type="text"/>	<input type="text"/>
Data Constraint column	Min <input type="text"/> Max <input type="text"/>	<input type="text"/>
Constraint range	Column: SAP_QUALITY Min: 0.000000 Max: 0.000000	<input type="text"/> 0.000000 <input type="text"/> 0.000000

Adjustable Periodogram Parameters		
The estimated time for processing is 55s		
<b>Period Sampling</b>		
<input type="checkbox"/> Compute Optimal Period		
Period range	Min: 0.040000 Max: 27.093714	<input type="text"/> 0.040000 <input type="text"/> 27.093714
Period step method	Fixed df	FixedDf
Fixed step size	0.00006950	0.00006950

### Algorithm Settings

Analyze!



# Data Discovery Tool

Cornell University  
Library

arXiv.org > astro-ph > arXiv:1207.1715 Search or Article-id

Astrophysics > Earth and Planetary Astrophysics

## SOPHIE velocimetry of Kepler transit candidates VII. An additional companion in the KOI-13 system

A. Santerne, C. Moutou, S. C. C. Barros, C. Damiani, R. F. Díaz, J.-M. Almenara, A. S. Bonomo, F. Bouchy, M. Deleuil, G. Hébrard

*(Submitted on 6 Jul 2012)*

We report the discovery of a new stellar companion in the KOI-13 system. KOI-13 is composed by two fast-rotating A-type stars of similar magnitude. One of these two stars hosts a transiting planet discovered by Kepler. We obtained new radial velocity measurements using the SOPHIE spectrograph at the Observatoire de Haute-Provence that revealed an additional companion in this system. This companion has a mass between 0.4 and 1 Msun and orbits one of the two main stars with a period of  $65.831 \pm 0.029$  days and an eccentricity of  $0.52 \pm 0.02$ . The radial velocities of the two stars were derived using a model of two fast-rotating line profiles. From the residuals, we found a hint of the stellar variations seen in the Kepler light curve with an amplitude of about 1.41 km/s and a period close to the rotational period. This signal appears to be about three order of magnitude larger than expected for stellar activity. From the analysis of the residuals, we also put a 3-sigma upper-limit on the mass of the transiting planet KOI-13.01 of 14.8 Mjup and 9.4 Mjup, depending on which star hosts the transit. We found that this new companion has no significant impact on the photometric determination of the mass of KOI-13.01 but is expected to affect precise infrared photometry. Finally, using dynamical simulations, we infer that the new companion is orbiting around KOI-13B while the transiting planet candidate is expected to orbit KOI-13A. Thus, the transiting planet candidate KOI-13.01 is orbiting the main component of a hierarchical triple system.

Comments: Accepted in A&A. 4 pages including 4 figures and the RV table  
Subjects: **Earth and Planetary Astrophysics (astro-ph.EP)**; Solar and Stellar Astrophysics (astro-ph.SR)  
Cite as: [arXiv:1207.1715v1](https://arxiv.org/abs/1207.1715v1) [astro-ph.EP]

Question:

1. Can I combine my data with existing data to understand an object better?

E.g., KOI-13 system

2. Do I need to acquire additional data or do they exist already?

a.k.a. observational or proposal planning



# Data Discovery Tool

Data Discovery Tool searches VO-aware collections for data

- Catalog, images, spectra
- Waveband
- ...

➤ Do your data need to be in a VO-aware service?

The screenshot displays the VAO Data Discovery Tool interface. At the top, the VAO logo is on the left, and the search criteria are: "Search All Virtual Observatory Collections: KOI-13" with a search radius of 10 Arcsec. Below this, the interface shows a table of 34 total rows with 14 new rows received. The table lists various collections with their short names and titles. On the right, the "AstroView" window shows a star field with coordinates [RA] 19:08:28.469 and [DEC] +46:46:57.971.

**Search Criteria:** Search All Virtual Observatory Collections: KOI-13  
 Examples: M101, 14.03 12.6 +54 20 56.7, more...  
 Radius: 10 Arcsec

**Table Headers:** Short Name, Title

Short Name	Title
1 KTC	Kepler Data Search
2 SkyView	SkyView Virtual Observatory
3 DSS ESO	Digitized Sky Survey
4 2MASS QL	2MASS All-Sky Quicklook Image Service
5 2MASS ASKY AT	2MASS All-Sky Atlas Image Service
6 IRTS	The Infrared Telescope in Space Data Atlas
7 ROSAT SIA	SIA Service for ROSAT Archive
8 ADS	Astrophysics Data System
9 HEAVENS @ ISDC	Mining the HEAVENS with the Virtual Observatory
10 ISSA	The IRAS Sky Survey Atlas
11 HEAVENS @ ISDC	Mining the HEAVENS with the Virtual Observatory
12 Simbad	The SIMBAD astronomical database
13 Enhanced KIC_CT	Enhanced Kepler Target Search
14 DSS1R	First Digitized Sky Survey: Red Plates
15 USNO-B1	USNO-B1 Catalogue
16 Tycho-2	Tycho-2 Catalog of the 2.5 Million Brightest Stars
17 DFBS	Digitized First Byurakan Survey
18 twomass-psc	The 2MASS All-Sky Catalog
19 nomad	The Naval Observatory Merged Astrometric Datas
20 gsc2_3_2	The Guide Star Catalog II (GSC-II), version 2.3.2
21 ACRS	Astrographic Catalog of Reference Stars
22 USNO-SA2.0	USNO-SA2.0
23 2MASS-PSC	2MASS All-Sky Point Source Catalog
24 NOMAD	NOMAD Catalogue
25 USNO-A2.0	USNO-A2.0
26 SAO	Smithsonian Astrophysical Observatory Star Catal
27 USNO-A2	USNO-A2 Catalogue
28 GSC23	Guide Star Catalog 2.3
29 Kepler Planetary Can...	Planetary Candidates observed by Kepler
30 KIC_CT	Kepler Target Search
31 KIC	Kepler Input Catalog
32 StarDB's NSVS CS	StarDB: variability analysis of the Northern Sky Ve
33 ExoPlanet [2]	Extrasolar Planets Encyclopaedia
34 exoplanet-cat	extrasolar planet interactive catalog including bib

**Filters:** Clear Filters, Edit Facets..., Help...  
 Filter All Record Fields

**Categories:** Catalog (22 of 22), Custom Service (1 of 1), Images (9 of 9), Spectra (1 of 1)

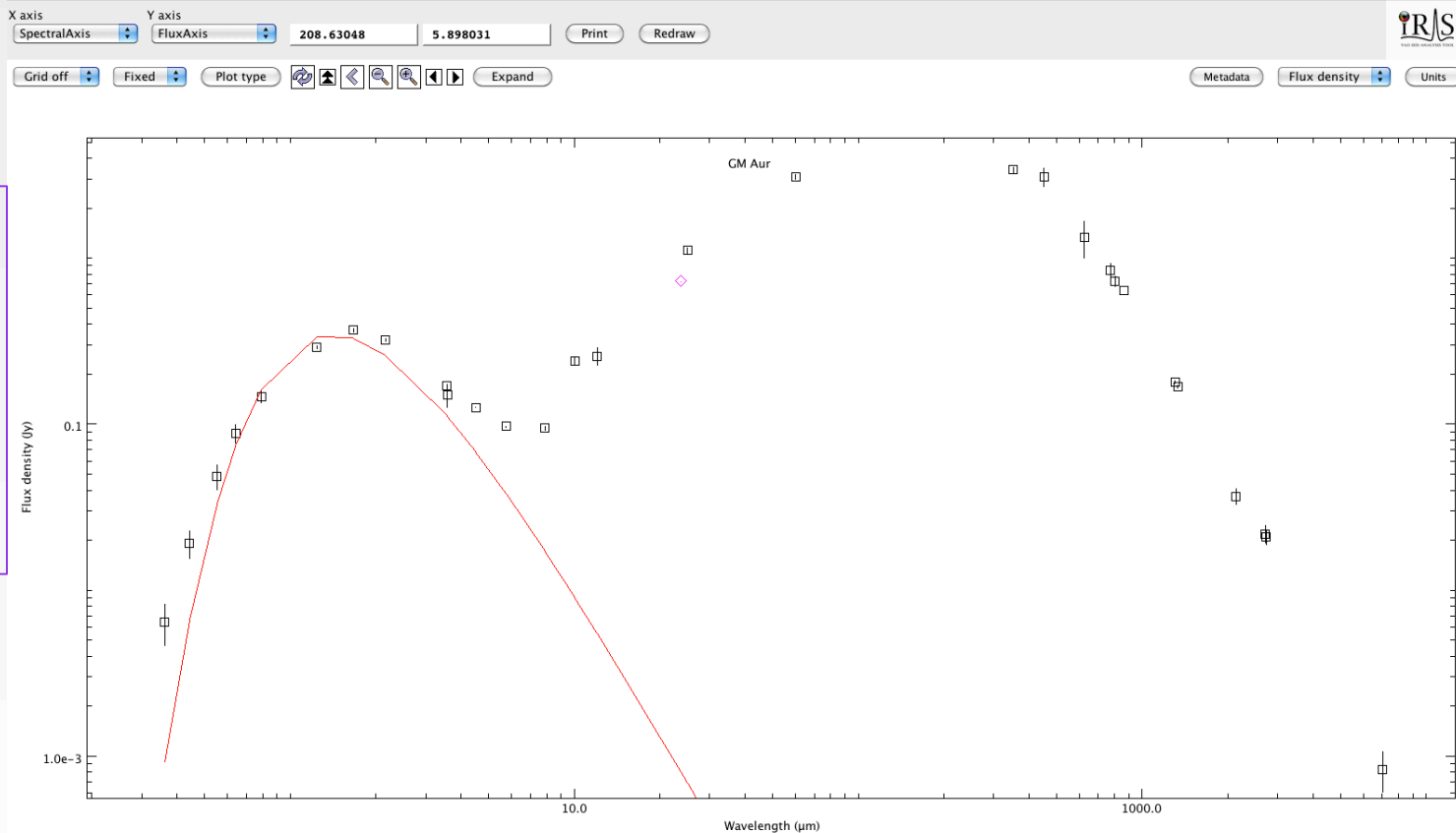
**Waveband:** EUV (1 of 1), Gamma-ray (5 of 5), Infrared (10 of 10), Millimeter (2 of 2), Optical (16 of 16), Radio (3 of 3), Ultraviolet (1 of 1), UV (3 of 3), Visible (4 of 4), X-ray (6 of 6)

**Publisher:** CDS (1 of 1), ESO (1 of 1), German Astrophysical Virtual Observatory (1 of 1), NASA Astrophysics Data System (1 of 1), NASA/GSFC HEASARC (4 of 4), NASA/HEASARC (1 of 1), NASA/IPAC Infrared Science Archive (5 of 5), National Optical Astrono (2 of 2), Observatoire de Paris (1 of 1), Space Telescope Science (1 of 1), Space Telescope Science Institute (5 of 5), StarDB team, Department of Astronomy, Yonsei University (1 of 1), Sternberg Astronomical Institute Virtual Observatory Project (3 of 3), United States Naval (3 of 3)



# SED tool: *Iris*

SEDs needed  
to understand  
emission  
physics  
e.g., star vs.  
disk



GM Aur



# Cross-Matching

## VAO Catalog Cross-Comparison Tool

[User Guide](#) | [Sample Tables](#) | [VAO Home](#) | [Contacts](#)

VAO Cross-Comparison

**Compared**    kic\_test.txt    (13161029 sources)

Upload a table

Max Match Distance:

1

Compare

arcsec

User Tables

Delete	File	# Rows	# Columns	Size
<input type="checkbox"/>	kic_test.txt	13161029	4	737 MB

On-line Catalogs

Catalog	# Rows	# Columns
IRAS_PSC	245889	81
SDSS_DR7	453846233	95
TWOMASS_PSC	470992970	127
USNO_B1	1045175762	56
WISE_prelim	257310278	277

History Restore Details

Delete	User Table	Catalog	Max Dist (arcsec)	Max Match Dist	Min Match Dist	Avg Match Dist	Input Rows Matched	#Matches	#Bad Records	#Unmatched Records	Time
<input type="checkbox"/>	kic_test.txt	WISE_prelim	1	1.0000	0.0003	0.4198	1636747	1636747	0	11524282	269.06



# Cross-Matching and Cross-Identification



Cornell University  
Library

arXiv.org > astro-ph > arXiv:1207.0521

Search or Article-ID

Astrophysics > Earth and Planetary Astrophysics

## Confusion limited surveys: using WISE to quantify the rarity of warm dust around Kepler stars

G. M. Kennedy, M. C. Wyatt

(Submitted on 2 Jul 2012)

We describe a search for infra-red excess emission from dusty circumstellar material around 180,000 stars observed by the Kepler and WISE missions. This study is motivated by i) the potential to find bright warm disks around planet host stars, ii) a need to characterise the distribution of rare warm disks, and iii) the possible identification of candidates for discovering transiting dust concentrations. We find about 8,000 stars that have excess emission, mostly at 12 $\mu$ m. The positions of these stars correlate with the 100 $\mu$ m background level so most of the flux measurements associated with these excesses are spurious. We identify 271 stars with plausible excesses by making a 5MJy/sr cut in the IRAS 100 $\mu$ m emission. The number counts of these excesses, at both 12 and 22 $\mu$ m, have the same distribution as extra-Galactic number counts. Thus, although some excesses may be circumstellar, most can be explained as chance alignments with background galaxies. The one exception is a 22 $\mu$ m excess associated with a relatively nearby A-type star that we were able to confirm because the disk occurrence rate is independent of stellar distance. Despite our low detection rate, these results place valuable upper limits on the distribution of large mid-infrared excesses; e.g. fewer than 1:1000 stars have 12 $\mu$ m excesses ( $F_{\text{obs}}/F_{\text{star}}$ ) larger than a factor of five. In contrast to previous studies, we find no evidence for disks around 1790 stars with candidate planets (we attribute one significant 12 $\mu$ m excess to a background galaxy), and no evidence that the disk distribution around planet hosts is different to the bulk population. Higher resolution imaging of stars with excesses is the best way to rule out galaxy confusion and identify more reliable disk candidates among Kepler stars. A similar survey to ours that focusses on nearby stars would be well suited to finding the distribution of rare warm disks.

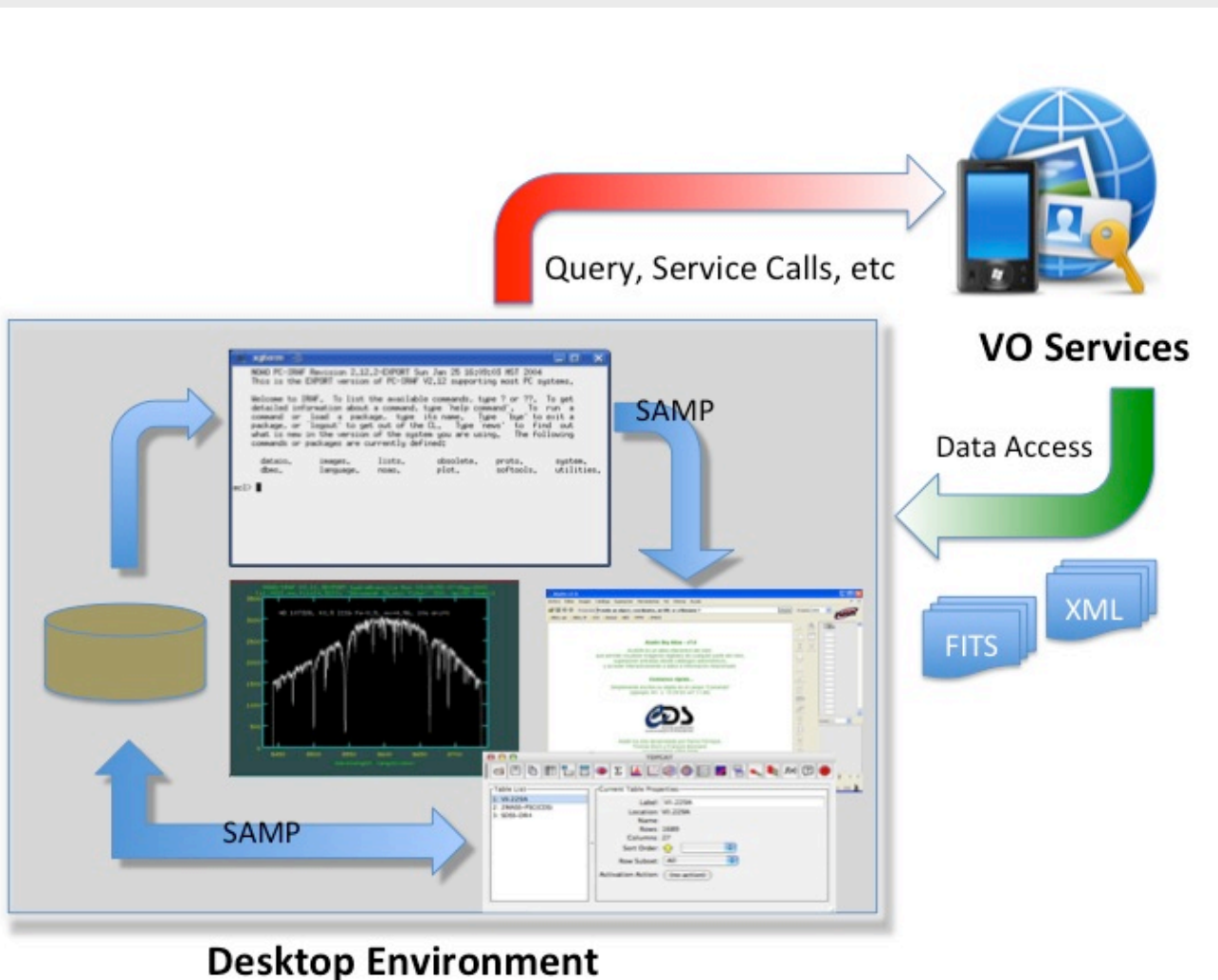
Delete	User Table	Catalog	Max Dist (arcsec)	Max Match Dist	% Match Dist	Avg Match Dist	Input Rows Matched	#Matches	#Bad Records	#Unmatched Records	Time
<input type="checkbox"/>	kic_test.txt	WISE_prelim	1	1.0000	0.0003	0.4198	1636747	1636747	0	11524282	269.06

## Distinguish *cross-matching* and *cross-identification*

- Cross-matching  $\rightarrow$  two objects are at the same position on the sky (within uncertainties)
  - Cf. brown dwarf searches
- Cross-identification  $\rightarrow$  two sources at different wavelengths represent the same object
  - On-going research into probabilistic approaches



# VAO-IRAF Integration



- 2000 registered IRAF users
- ~ 5000 total users
- > 700 IRAF tasks now VO-aware
- > 1000 downloads of IRAF v. 2.16 as of 2012 April 1



# seleste

Intuitive yet flexible and powerful access to catalogs, or any tabular data

- Discover and browse catalogs and databases
- Full access to data and metadata
- Quick look results
- Customizable for fine-tuned results
- SQL queries, with click-and-drag GUI
- Scriptable via command line interface
- Query results saved or passed to other VO tools

The screenshot shows the seleste web interface. At the top, there is a toolbar with icons for Submit, Open, Save, Clear, Services, Upload, Jobs, Form, ADQL, Guide, and Help. Below the toolbar, the main content area is titled "Two Micron All Sky Survey (2MASS)". On the left, there is a "Contents" sidebar with a tree view showing folders like "twomass\_psc", "twomass\_scn", "twomass\_xsc", and "twomass\_pscXBestDR7PhotoObjAll". Below the sidebar is a "Relationships" section. The main content area has a "Welcome to seleste!" message and a "1. Intro" tab selected. The message explains the "Guide" mode and provides instructions on how to control the query mode through the "View" menu or toolbar icons (Form, ADQL, Guide). It also mentions the "Save", "Open", and "Clear" commands. At the bottom, it instructs the user to click the "2. Service" tab to continue.



# VOStat

- **VOStat, rev 2** is a Web-service providing a suite of statistical analyses for VO datasets.
  - Developed at Penn State
  - <http://vostat.org/>
- Java-based GUI to the **R** public domain statistical software environment
  - > 60,000 functions in > 3500 packages
  - <http://r-project.org>
- Input files obtained via SAMP, URL, or user (ASCII, FITS, VOTable)
- **R** code provided to assist user in further analysis on local computer.
- VOStat provides ~ 60 statistical functions  
2D & 3D plots, smoothers (kernel, ASH), hypothesis tests (K-S, A-D), regressions (linear, robust, local), PCA, normal mixtures, hierarchical clustering, spatial (k-NN, Moran's I, Ripley's K, 2-pt correlation), directional data, non-detections (Kaplan-Meier, Lynden-Bell-Woodroffe, 2-sample tests), time series (ACF, ARMA, Fourier)



# Coming Attractions

- Renewed emphasis on Time Series Tool
- Python interfaces to VO libraries and services
- Inter-operability
  - E.g., DDT → *Iris*
  - In alpha/pre-beta stage currently
- VO-aware versions of other software packages
  - e.g., CIAO (Chandra Interactive Analysis of Observations),
  - CASA (Common Astronomical Software Applications)
- Data publishing initiative
  - How do I share my data with the community?
  - viz. NSF Data Management and NASA ROSES policies
  - Currently in pilot stage