Science Priorities for the VO

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http://wiki.ivoa.net/twiki/bin/view/IVOA/IvoaSciencePriorities

European Space Agency

IVOA Interop, Victoria, 28/05/2018

Outline

1. Motivation
2. Scientific priorities
    1. Currently identified
    2. Upcoming
3. Final recommendations

Motivation: to enable more science !

What we do here has the goal of improving human's knowledge about the Universe

How do we do it best? By understanding in detail our users.

Timeline of a scientific paper

Make hypothesis

- Motivation
- *Visualization*
- Creativity
- Knowledge

Obtain data to test hypothesis

- *Simple / easy* access to *reliable* and *relevant* data

Analyze data to create new theory

- *Fast* computation on new data
- *Easy* comparison between data and models/ theory

Publish result

- *Reproducible* data representation

Revise existing data with new theory

- Data *completeness* and *consistency*

Fame & Glory

Science is about revising the data

re-search

Tension between data homogeneity and completeness

- The most advanced data query system should enable a dialogue, like in the movie “her” (2013)

Current scientific priorities at IVOA

- Time-domain astronomy: light-curves -> VOEvent and Data Models
- Multi-dimensional data: spectral or time cubes (sky + wavelength/frequency or sky + time)

- New priorities:

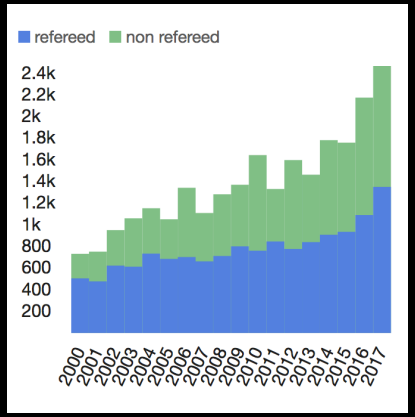
  - An IVOA portal : one single place where users will find **all** information

- More suggestions:

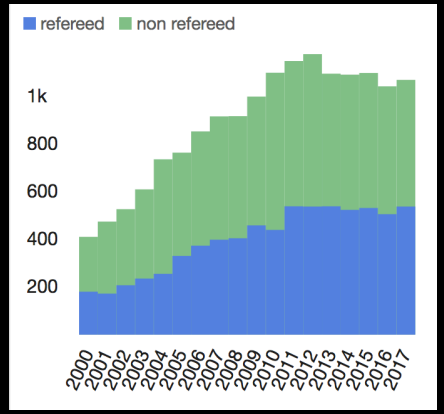
  - Standard for science platforms? (check scienceplatfoms.slack.com)
  - Virtual Reality/Advanced Reality standards?
  - Other growing areas/priorities?

Upcoming scientific priorities at IVOA

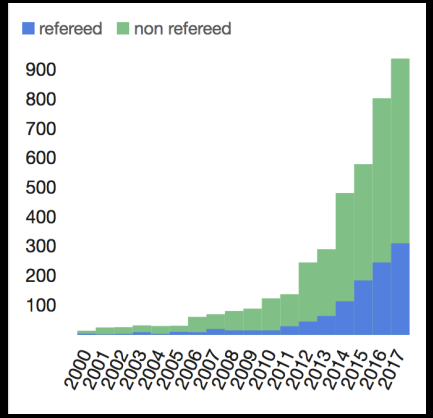
Gravitational waves



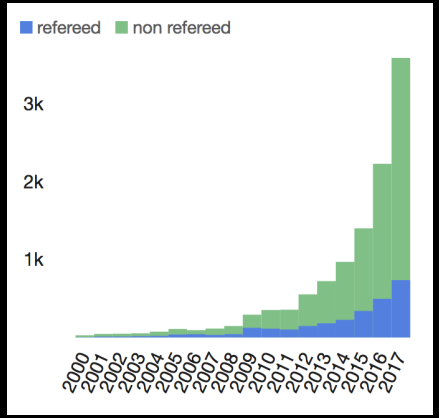
Multi-wavelength



Python



Machine learning



Python, astronomy and the IVOA

- A very large and growing fraction of astronomical research today is done with python, therefore it is essential that VO resources are visible and easy to use with that programming language.

- There are several python packages related to VO: pyvo, astroquery, ..

- Astropy has grown rapidly in the last few years. Astroquery is a module inside astropy to query data services, and it contains most of the services represented at the IVOA

The evolution of astropy in the last few years

https://youtu.be/TLuVM4j561E

Data services queriable via astropy/astroquery

Available Services

If you're new to Astroquery, a good place to start is the A Gallery of Queries:

- A Gallery of Queries

The following modules have been completed using a common API:

- ALMA Queries (`astroquery.alma`)
- Atomic Line List (`astroquery.atomic`)
- Besancon Queries (`astroquery.besancon`)
- ESASky Queries (`astroquery.esasky`)
- ESO Queries (`astroquery.eso`)
- Gaia TAP+ (`astroquery.gaia`)
- GAMA Queries (`astroquery.gama`)
- HEASARC Queries (`astroquery.heasarc`)
- IRSA Image Server program interface (IBE) Queries (`astroquery.ibe`)
- IRSA Queries (`astroquery.irsa`)
- IRSA Dust Extinction Service Queries (`astroquery.irsa_dust`)
- MAGPIS Queries (`astroquery.magpis`)
- MAST Queries (`astroquery.mast`)
- Minor Planet Center Queries (`astroquery.mpc`)
- NASA ADS Queries (`astroquery.nasa_ads`)
- NED Queries (`astroquery.ned`)
- NIST Queries (`astroquery.nist`)
- NRAO Queries (`astroquery.nrao`)
- NVAS Queries (`astroquery.nvas`)
- SIMBAD Queries (`astroquery.simbad`)
- Skyview Queries (`astroquery.skyview`)
- Splatalogue Queries (`astroquery.splatalogue`)
- UKIDSS Queries (`astroquery.ukidss`)
- Vamdc Queries (`astroquery.vamdc`)
- VizieR Queries (`astroquery.vizier`)
- VO Simple Cone Search (`astroquery.vo_conesearch`)
- VSA Queries (`astroquery.vsa`)
- xMatch Queries (`astroquery.xmatch`)

These others are functional, but do not follow a common & consistent API:

- ALFALFA Queries (`astroquery.alfalfa`)
- CosmoSim Queries (`astroquery.cosmosim`)
- Exoplanet Orbit Database (`astroquery.exoplanet_orbit_database`)
- Fermi Queries (`astroquery.fermi`)
- HITRAN Queries (`astroquery.hitran`)
- JPL Horizons Queries (`astroquery.jplhorizons`)
- LAMDA Queries (`astroquery.lamda`)
- NASA Exoplanet Archive (`astroquery.nasa_exoplanet_archive`)
- OAC API Queries (`astroquery.oac`)
- OGLE Queries (`astroquery.ogle`)
- Open Exoplanet Catalogue(`astroquery.open_exoplanet_catalogue`)
- SDSS Queries (`astroquery.sdss`)
- Spitzer Heritage Archive (`astroquery.sha`)

There are also subpackages that serve as the basis of others.

- WFAU Queries (`astroquery.wfau`)

Data services queriable via astropy/astroquery

Catalogs

The first serve catalogs, which generally return one row of information for each source (tl
catalogs that *each* have one row for each source)

- ALFALFA Queries (`astroquery.alfalfa`)
- GAMA Queries (`astroquery.gama`)
- IRSA Image Server program interface (IBE) Queries (`astroquery.ibe`)
- IRSA Queries (`astroquery.irsa`)
- IRSA Dust Extinction Service Queries (`astroquery.irsa_dust`)
- MAST Queries (`astroquery.mast`)
- NED Queries (`astroquery.ned`)
- OGLE Queries (`astroquery.ogle`)
- Open Exoplanet Catalogue(`astroquery.open_exoplanet_catalogue`)
- SDSS Queries (`astroquery.sdss`)
- Spitzer Heritage Archive (`astroquery.sha`)
- SIMBAD Queries (`astroquery.simbad`)
- UKIDSS Queries (`astroquery.ukidss`)
- VSA Queries (`astroquery.vsa`)
- VizieR Queries (`astroquery.vizier`)
- xMatch Queries (`astroquery.xmatch`)
- VO Simple Cone Search (`astroquery.vo_conesearch`)
- NASA Exoplanet Archive (`astroquery.nasa_exoplanet_archive`)
- Exoplanet Orbit Database (`astroquery.exoplanet_orbit_database`)

Archives

Archive services provide data, usually in FITS images or spectra. They will generally return a table listing the available data first.

- ALFALFA Queries (`astroquery.alfalfa`)
- ALMA Queries (`astroquery.alma`)
- ESO Queries (`astroquery.eso`)
- Fermi Queries (`astroquery.fermi`)
- Gaia TAP+ (`astroquery.gaia`)
- HEASARC Queries (`astroquery.heasarc`)
- IRSA Image Server program interface (IBE) Queries (`astroquery.ibe`)
- IRSA Queries (`astroquery.irsa`)
- MAGPIS Queries (`astroquery.magpis`)
- MAST Queries (`astroquery.mast`)
- NED Queries (`astroquery.ned`)
- NRAO Queries (`astroquery.nrao`)
- NVAS Queries (`astroquery.nvas`)
- SDSS Queries (`astroquery.sdss`)
- Spitzer Heritage Archive (`astroquery.sha`)
- UKIDSS Queries (`astroquery.ukidss`)
- VSA Queries (`astroquery.vsa`)
- Skyview Queries (`astroquery.skyview`)

Simulations

Simulation services query databases of simulated or synthetic data

- Besancon Queries (`astroquery.besancon`)
- CosmoSim Queries (`astroquery.cosmosim`)

Other

There are other astronomically significant services, e.g. line list and atomic/molecular cross section and collision rate services, that don't fit the above categories.

- Atomic Line List (`astroquery.atomic`)
- LAMDA Queries (`astroquery.lamda`)
- NIST Queries (`astroquery.nist`)
- Splatalogue Queries (`astroquery.splatalogue`)
- NASA ADS Queries (`astroquery.nasa_ads`)
- Vamdc Queries (`astroquery.vamdc`)
- HITRAN Queries (`astroquery.hitran`)
- TAP/TAP+ (`astroquery.utils.tap`)
- JPL Horizons Queries (`astroquery.jplhorizons`)

Python, astronomy and the IVOA

- The development of astropy and pyvo are based on github and follow the open source principles in which anyone can contribute to the code and there is a small group of coordinators that look after the overall evolution of the packages.

- While there are python packages to access the IVOA data infrastructure, they are often not produced nor maintained by the original data providers and therefore lack consistency or robustness

- More on Thursday at 9:00 at the CSP astropy-IVOA synergies session

The IVOA needs you

- We need active and enthusiastic scientists at the Committee of Science Priorites!!
- Talk to me if you are interested!!

Final recommendations from the CSP

- Always ask the question: how is the user going to use this?
- Always follow the user workflow to the paper and keep the big picture (is provenance clear? Can I explain/make a plot of this?)
- Connect to the future generation of users where they are: e.g. python, github, open source projects, social media, online open fora, connected to new big astronomy projects, using mobile devices and expecting quick answers


esa
Thanks!
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