

# Virtual Observatory: what the heck is this about?

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by Paula Coelho, IAG/USP

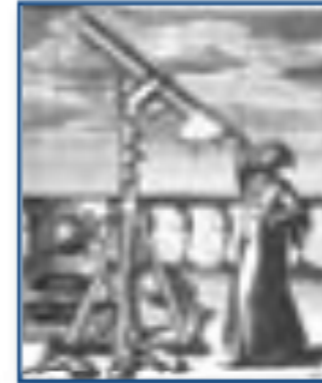
on behalf of



# Jim Gray's view of Science Development

## Science Paradigms

- Thousand years ago:  
science was **empirical**  
*describing natural phenomena*
- Last few hundred years:  
**theoretical** branch  
*using models, generalizations*
- Last few decades:  
a **computational** branch  
*simulating complex phenomena*
- Today: **data exploration** (eScience)  
*unify theory, experiment, and simulation*
  - Data captured by instruments  
or generated by simulator
  - Processed by software
  - Information/knowledge stored in computer
  - Scientist analyzes database/files  
using data management and statistics



$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{4\pi G\rho}{3} - K\frac{c^2}{a^2}$$



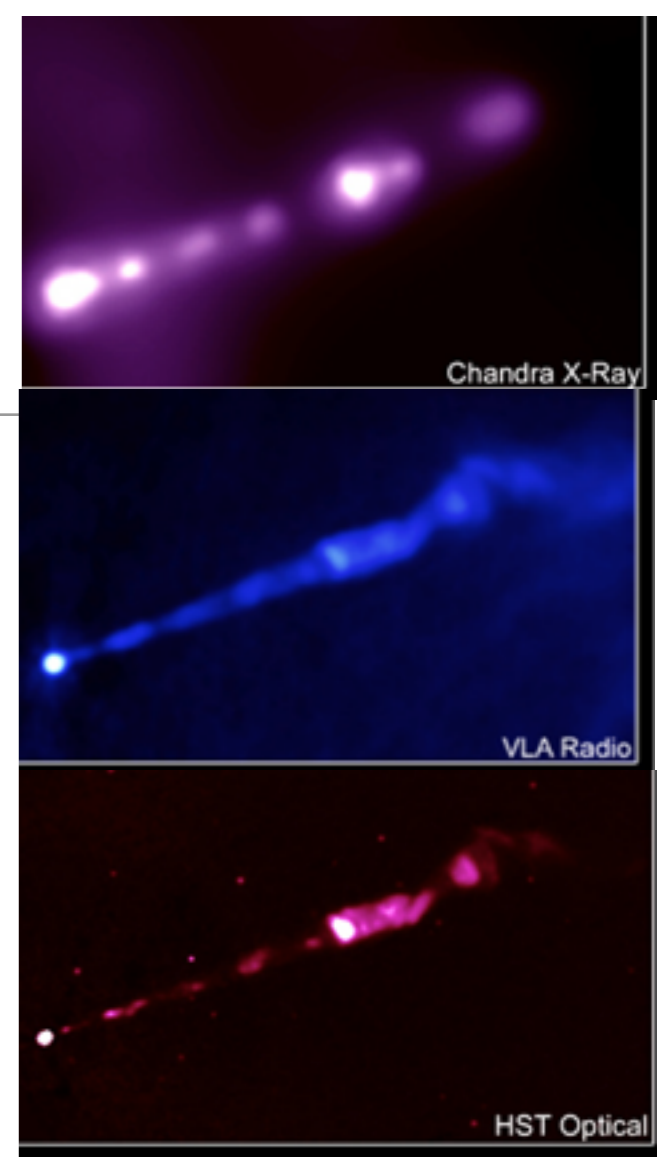
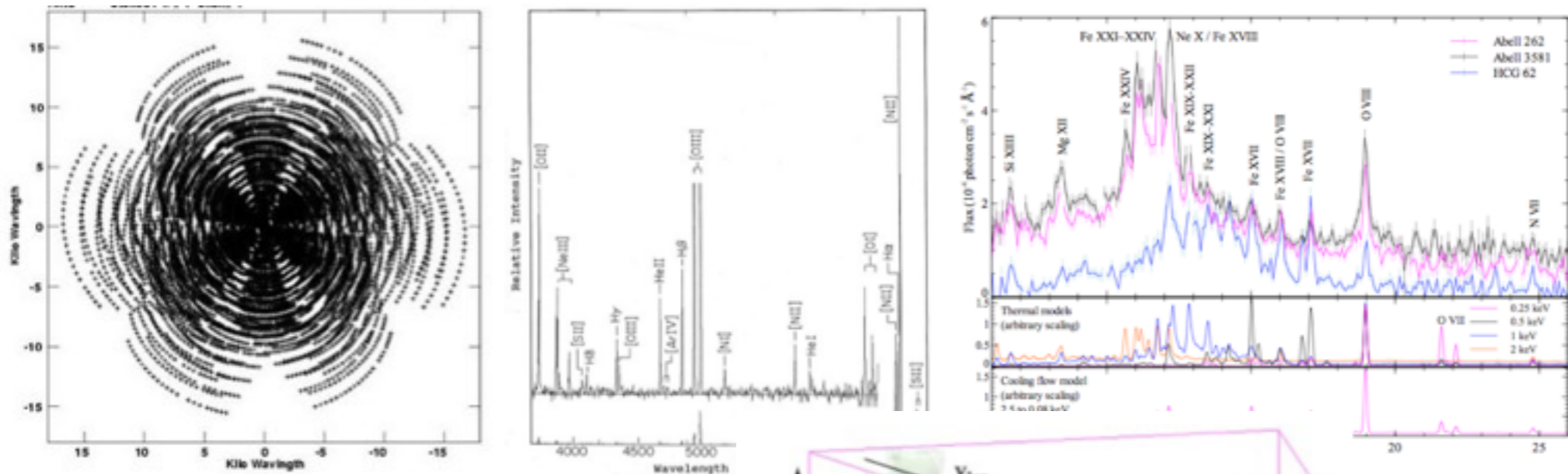
### The **F O U R T H** **P A R A D I G M**

DATA-INTENSIVE SCIENTIFIC DISCOVERY

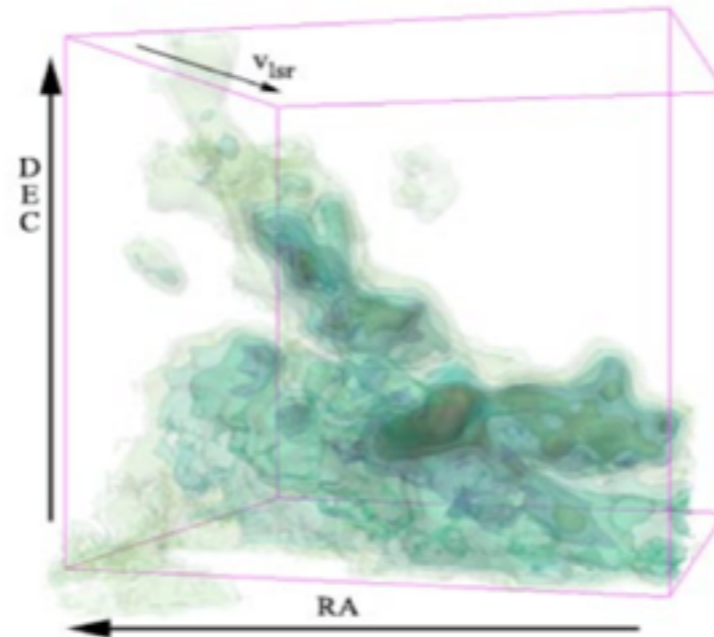
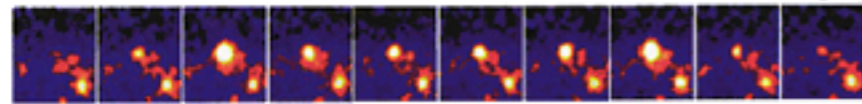
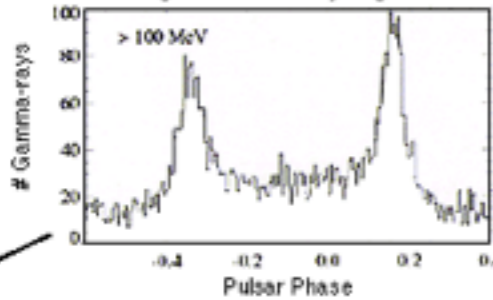
EDITED BY TONY HEY, STEWART TANSLEY, AND KRISTIN TOLLE



# Data in Astronomy



Geminga Gamma-Ray Light Curve



jdate	designation	ra	dec	sup_ra	sup_dec	glon	glat	density	r_k20fe
2451305.6569	12552517+2134339	12 55 25.2	21 34 33.9	193.854874	21.576124	312.417428	84.374259	2.51	5.4
2451700.6751	12564924+2123581	12 55 49.2	21 23 58.2	193.955109	21.399385	313.052422	84.184820	2.66	5.0
2451261.8020	12571719+2120180	12 57 17.2	21 20 18.1	194.321625	21.338383	316.206288	84.058687	2.24	5.9
2451261.8020	12572936+2132520	12 57 29.4	21 32 52.1	194.372269	21.547800	317.124578	84.251945	2.24	5.0
2451261.8020	12572893+2137370	12 57 28.9	21 37 37.1	194.370453	21.627054	317.296215	84.329266	2.35	5.0
2451261.7924	12562741+2131175	12 56 27.4	21 31 17.6	194.114243	21.521484	314.721401	84.277947	2.54	8.1
2451261.8020	12573991+2146420	12 57 39.9	21 46 42.1	194.416367	21.778374	318.097097	84.465693	2.35	5.0
2451261.7972	12564252+2148223	12 56 42.5	21 48 22.4	194.177277	21.806303	315.909778	84.544554	2.51	5.0
null	12564369+2140575	12 56 43.7	21 40 57.6	194.182068	21.682659	315.683000	84.423000	null	214.8
2451261.7924	12561052+2148274	12 56 10.5	21 48 27.5	194.043808	21.807701	314.635368	84.571294	2.78	7.4
2451261.7972	12571196+2148234	12 57 12.0	21 48 23.5	194.299911	21.773294	316.993658	84.488836	2.51	5.5
2451261.8020	12572147+2140450	12 57 21.5	21 40 45.1	194.309417	21.679213	317.130181	84.368833	2.35	5.3
2451700.6751	12554548+2153222	12 55 45.5	21 53 22.2	193.939529	21.889559	313.784434	84.668874	2.66	9.0

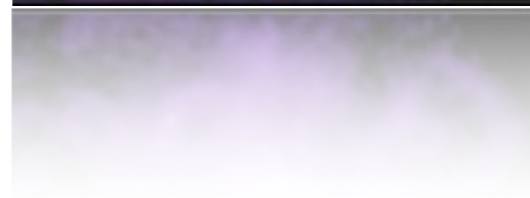
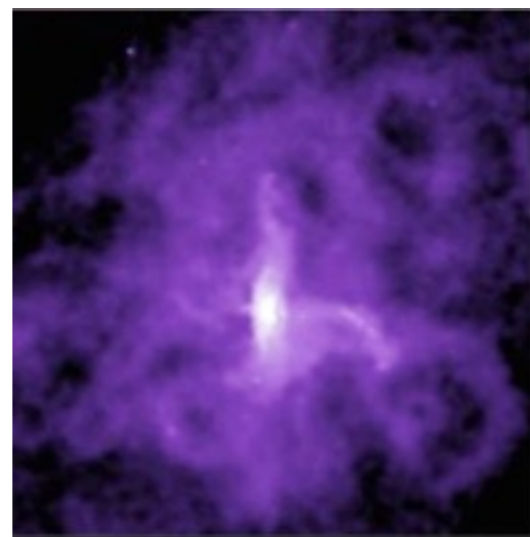
1D, 2D, 3D; intensity/polarization vs. energy, time, position, velocity.  
 tables, DBs, catalogs, x-ray event lists, radio visibility measurements...  
 various data processing levels, from raw to “science-ready”



# A new era in astronomy

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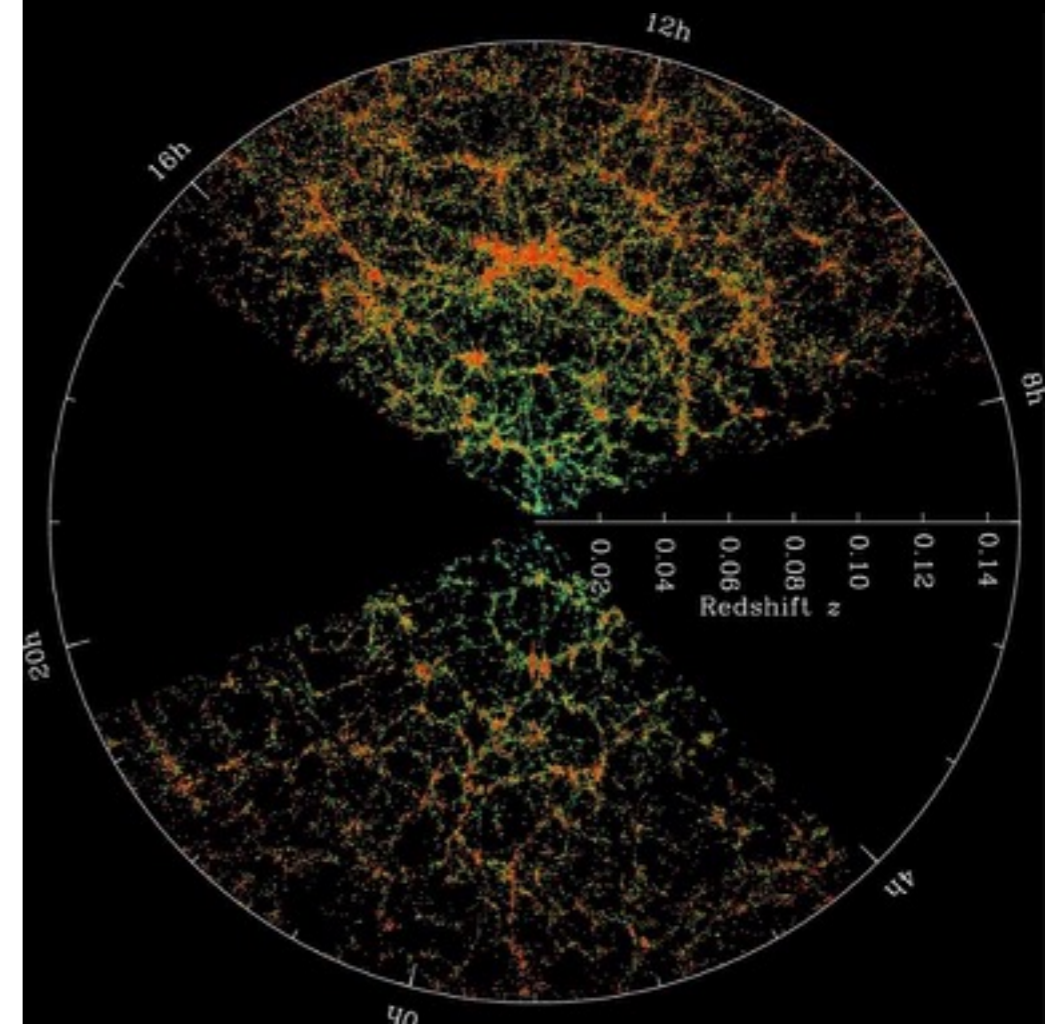
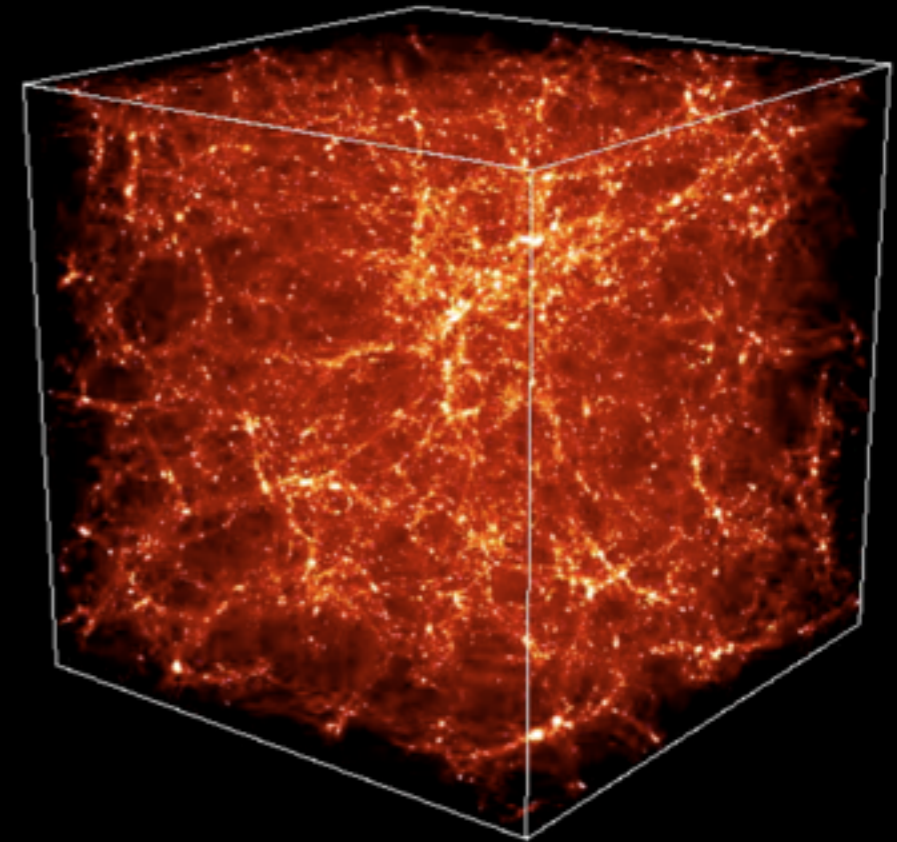
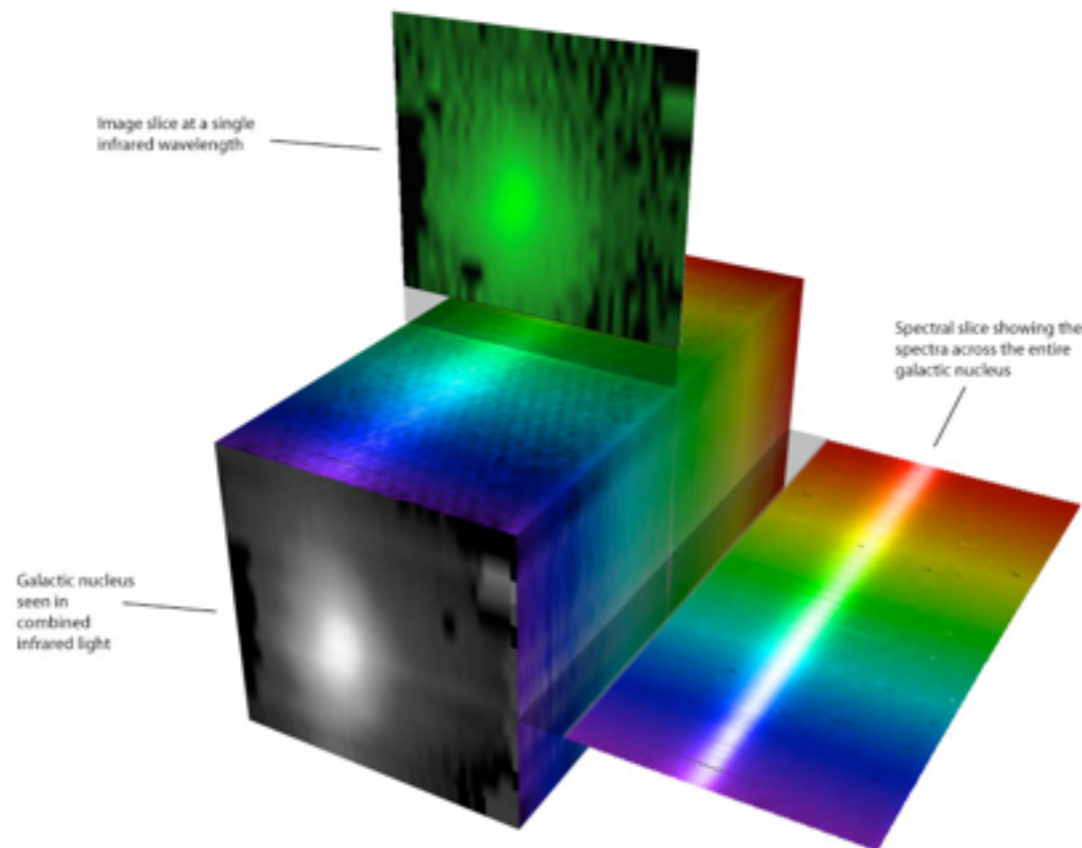
- Past: observations of small, carefully selected samples (often with a priori prejudices) of objects in one or a few wavelength bands





# A new era in Astronomy

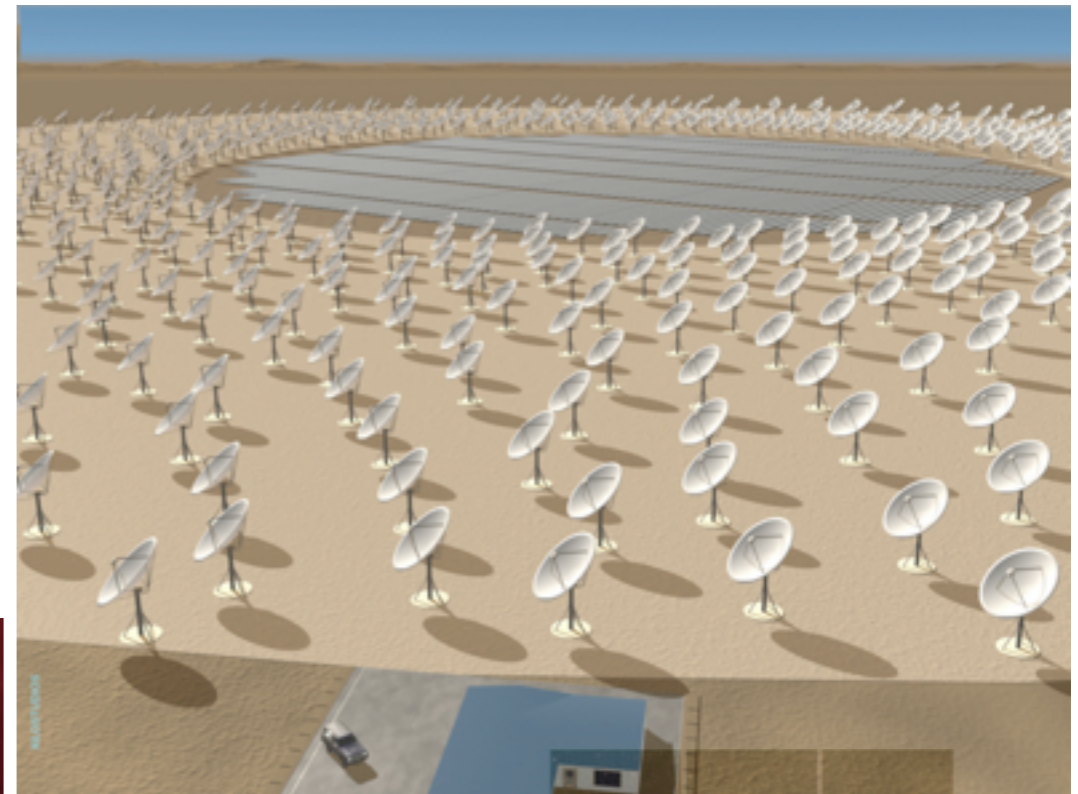
- Now: multi-wavelength data for millions of objects, allowing us to:
  - **discover** significant patterns from the analysis of statistically rich and unbiased databases
  - **understand** complex astrophysical systems via confrontation between data and sophisticated numerical simulation





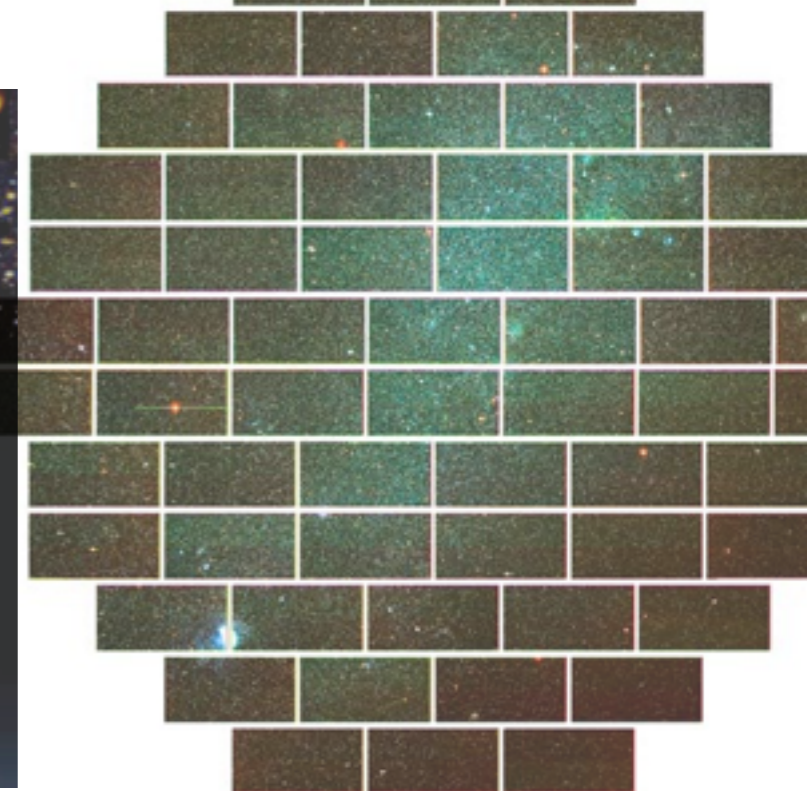
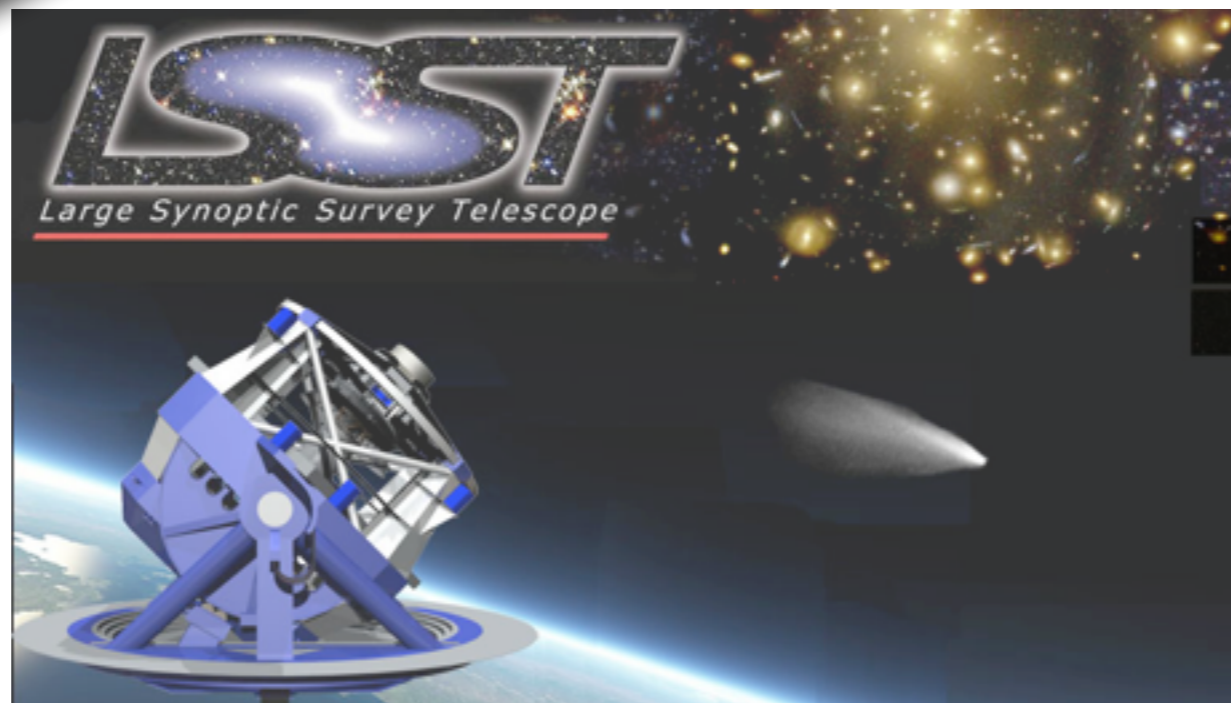
# Survey Science: Big Data in Astronomy

SDSS, DES, J-PAS,  
LSST, Gaia, SKA...



gaia

**Exploding Data Rates**



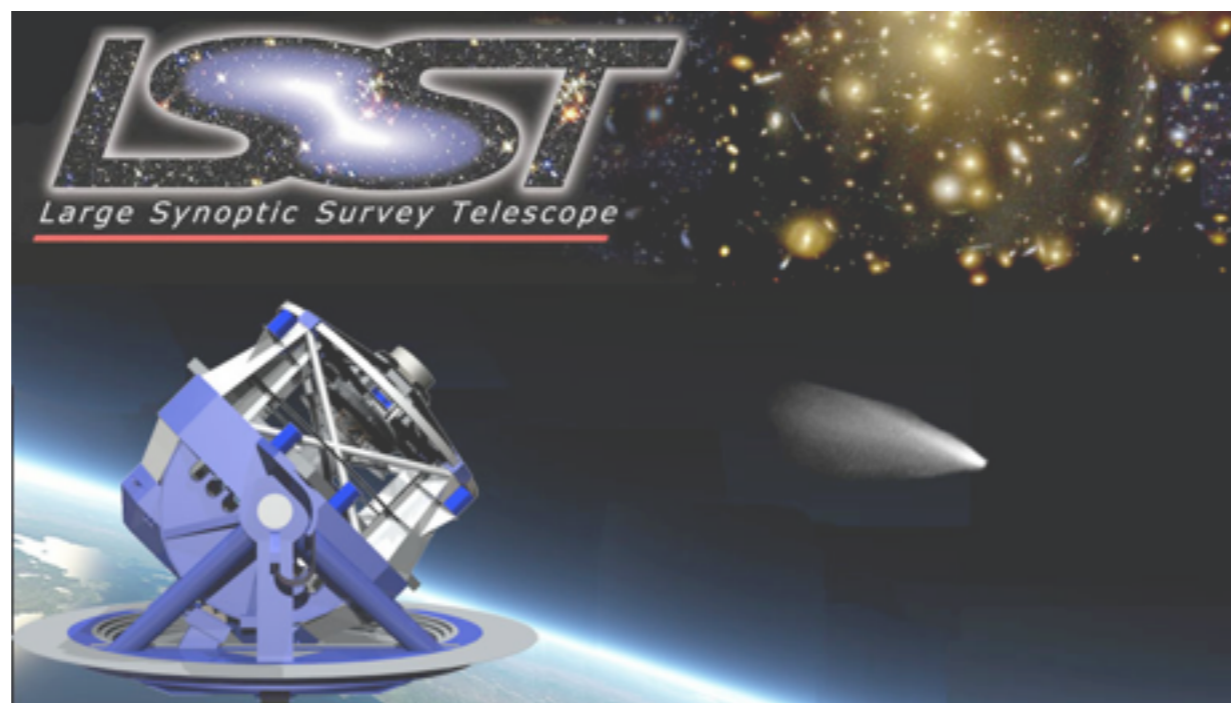
# Survey science: Big Data in Astronomy

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The Large Synoptic Survey Telescope (LSST) is a planned wide-field survey that will observe the entire available sky every few nights.

15 TB/night, 7 PB/year, 200 PB total, ~1M transient events/night

(in comparison, SDSS 170 GB/night)





# And the scary future... SKA

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The Square Kilometre Array is a project to build a radio telescope tens of times more sensitive and hundreds of times faster at mapping the sky than today's best radio astronomy facilities.

**1 exabyte of raw data in a single day; more than the entire daily Internet traffic!!**

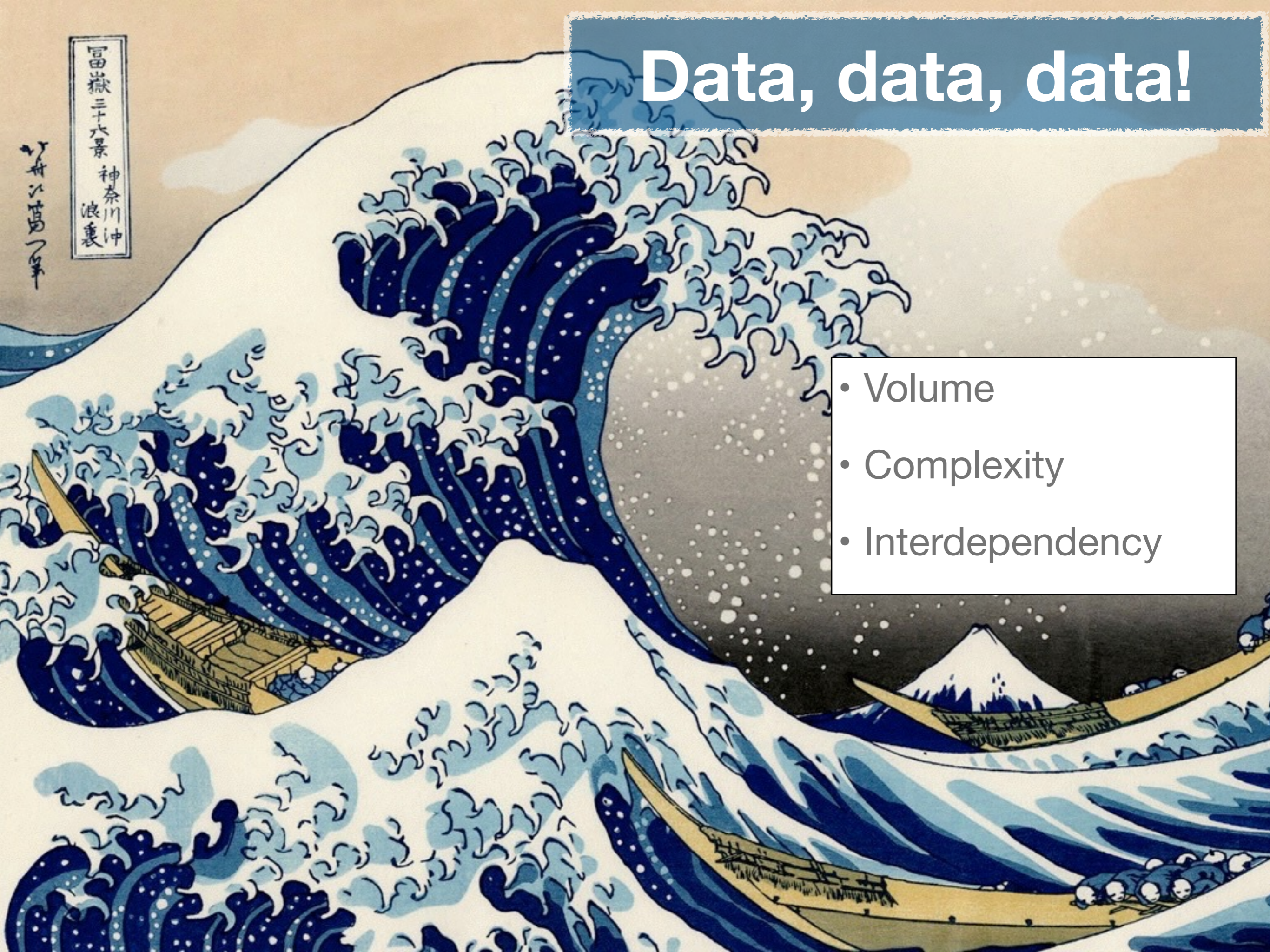


What do these projects have in common?



# Data, data, data!

- Volume
- Complexity
- Interdependency



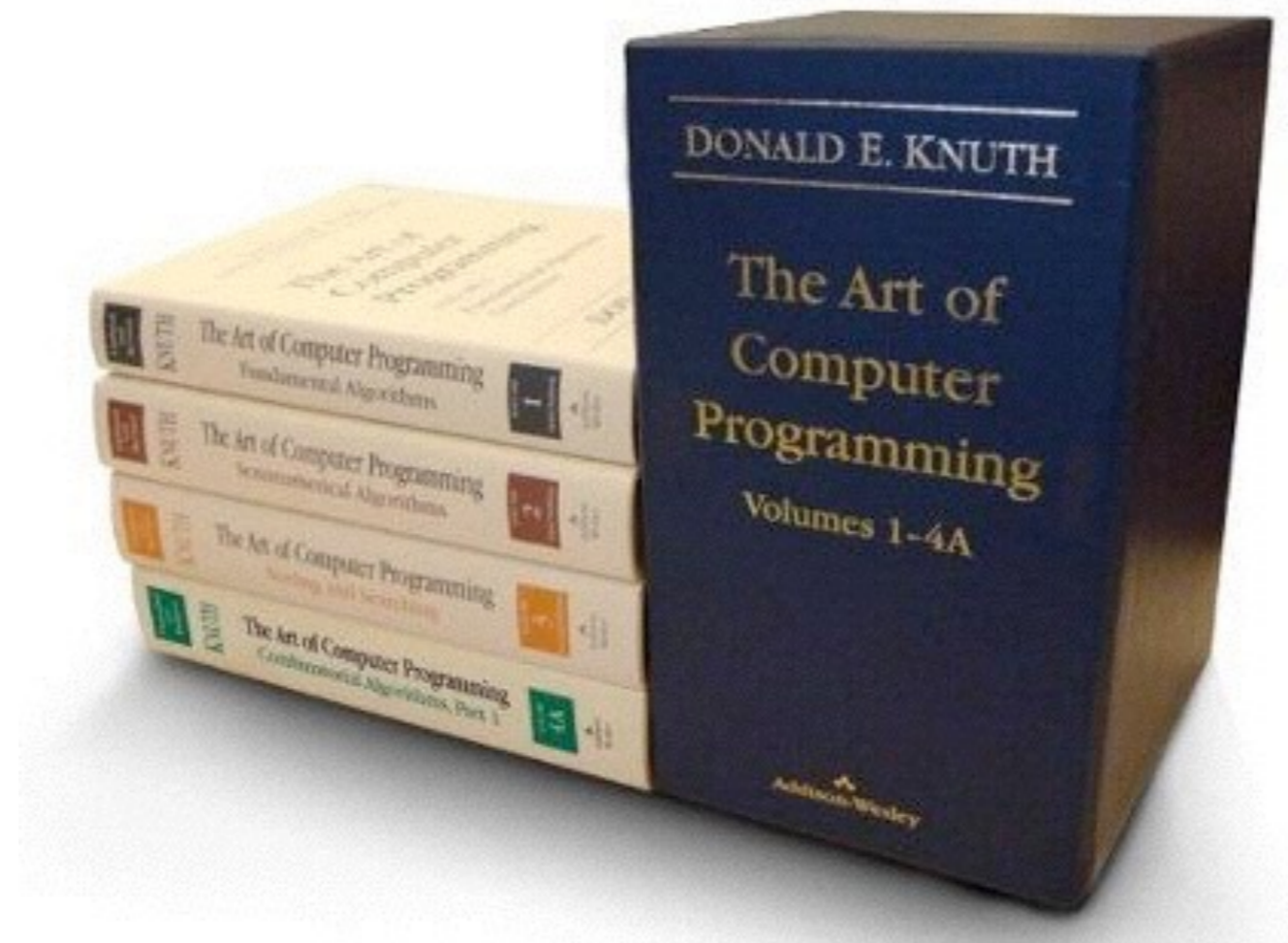
富嶽三十六景 神奈川沖  
浪裏

舟の駕り

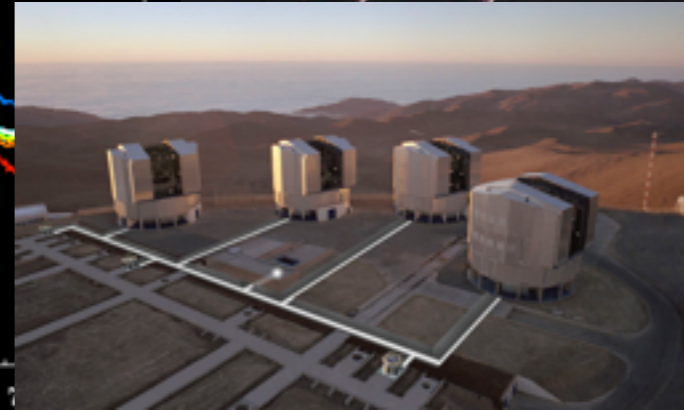
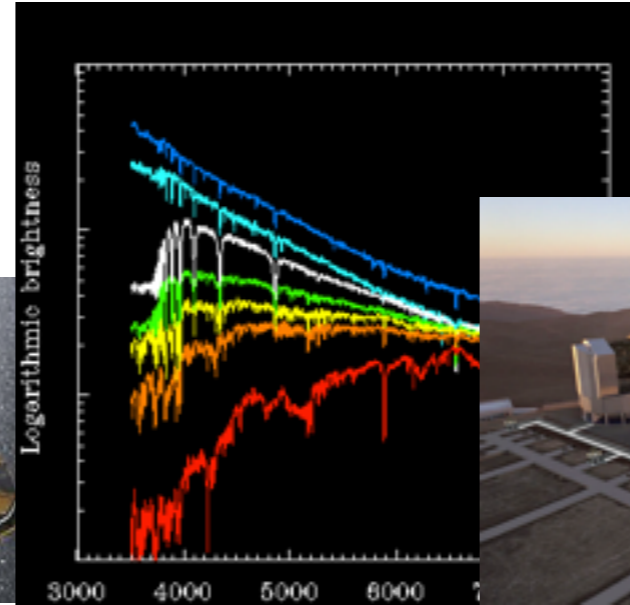
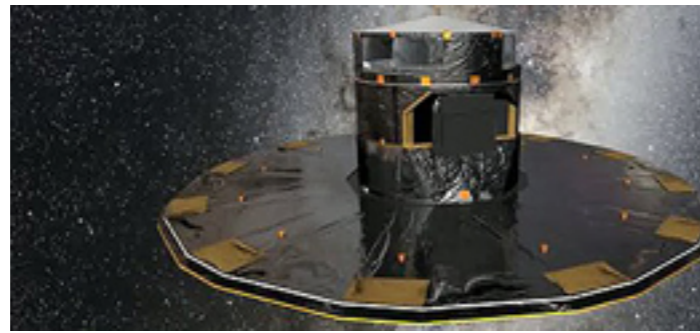
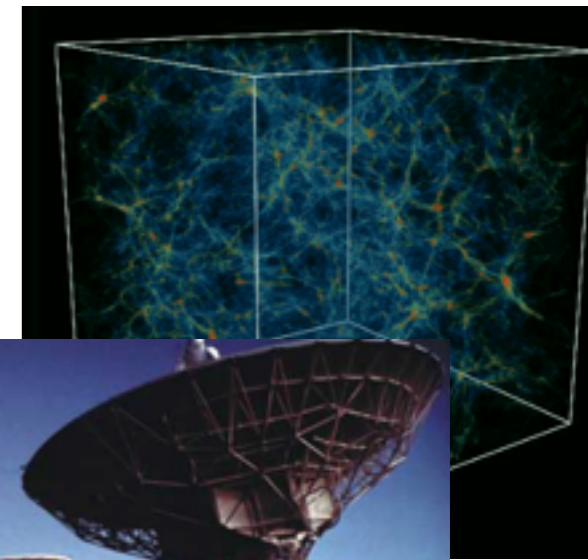
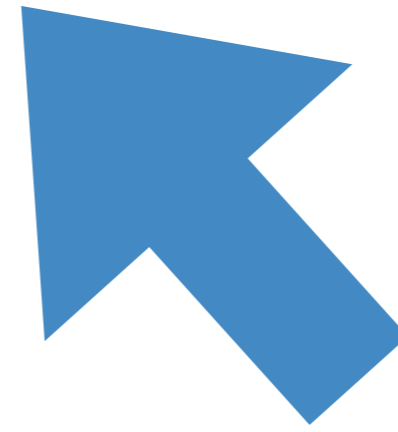
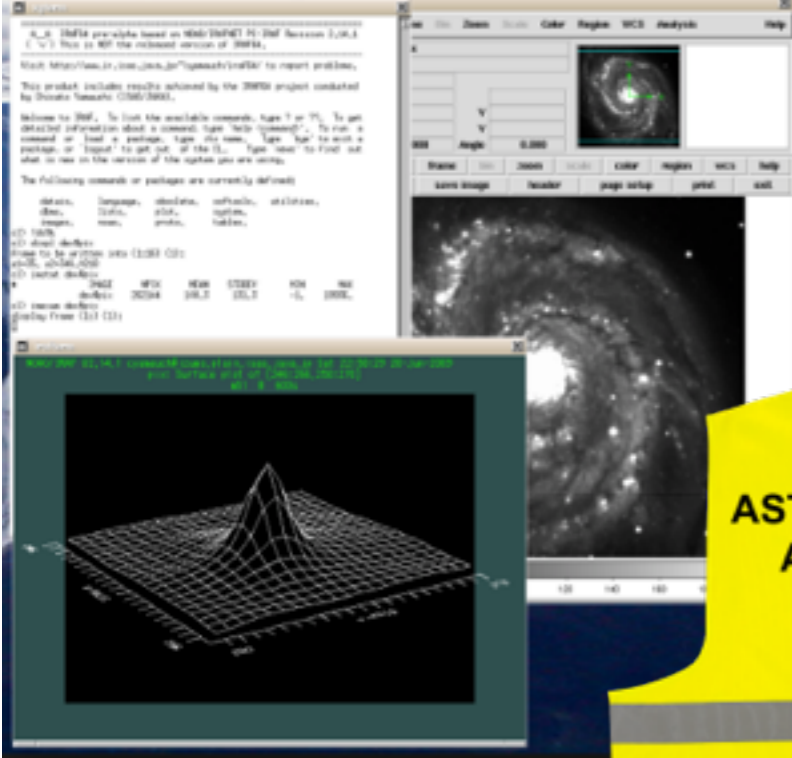


But with data...

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should come the software !





# Data – Software

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## **DATA**

**The language in which  
we register Nature  
(even if simulated!)**

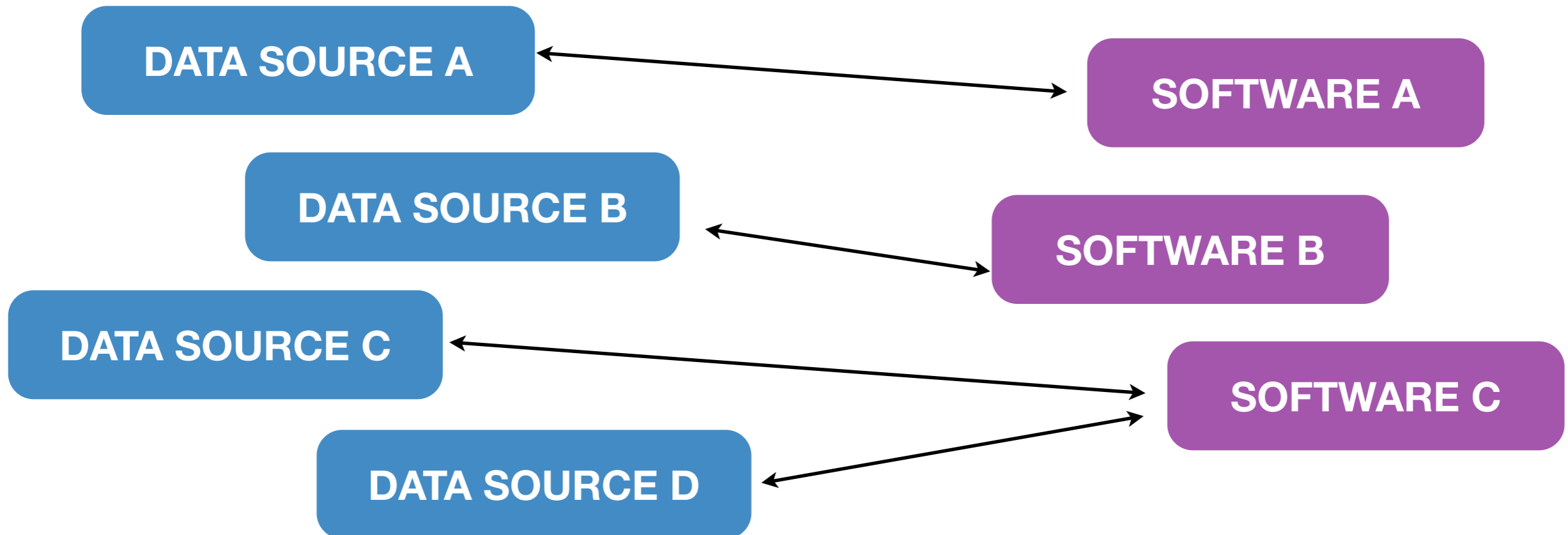
## **SOFTWARE**

**The language in which  
we interpret Nature  
(even if simulated!)**

# Data – Software

**DATA**  
The language in which  
we register Nature  
(even if simulated!)

**SOFTWARE**  
The language in which  
we interpret Nature  
(even if simulated!)

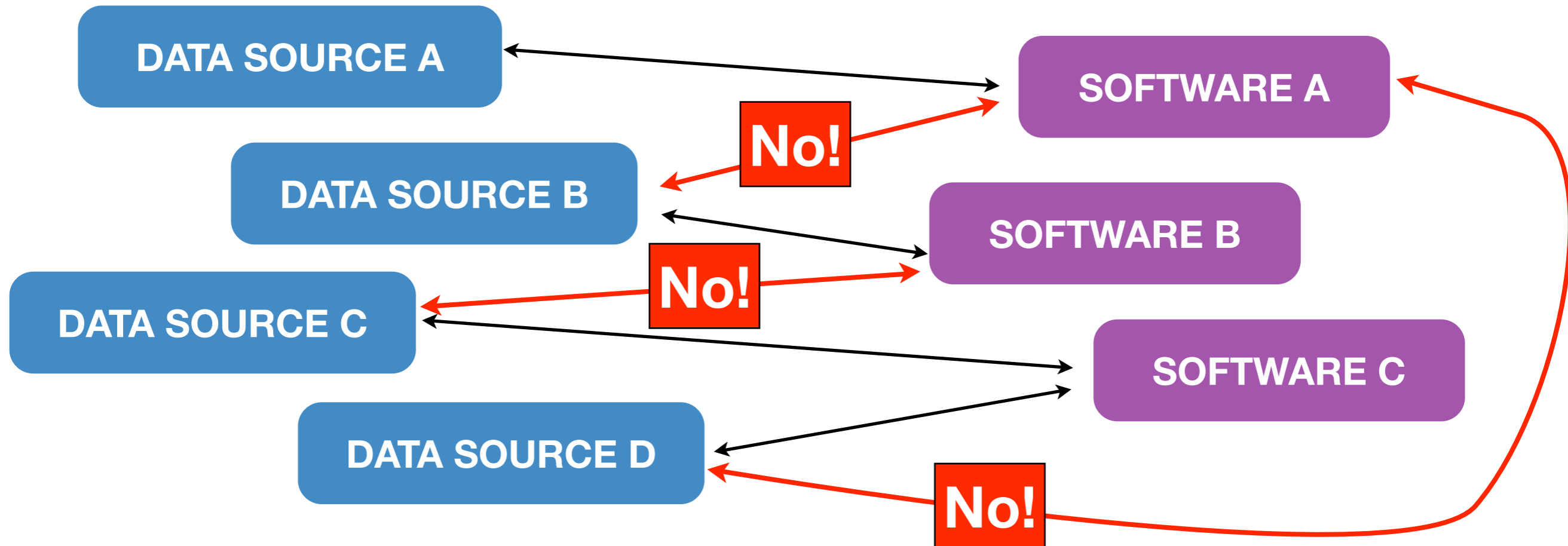




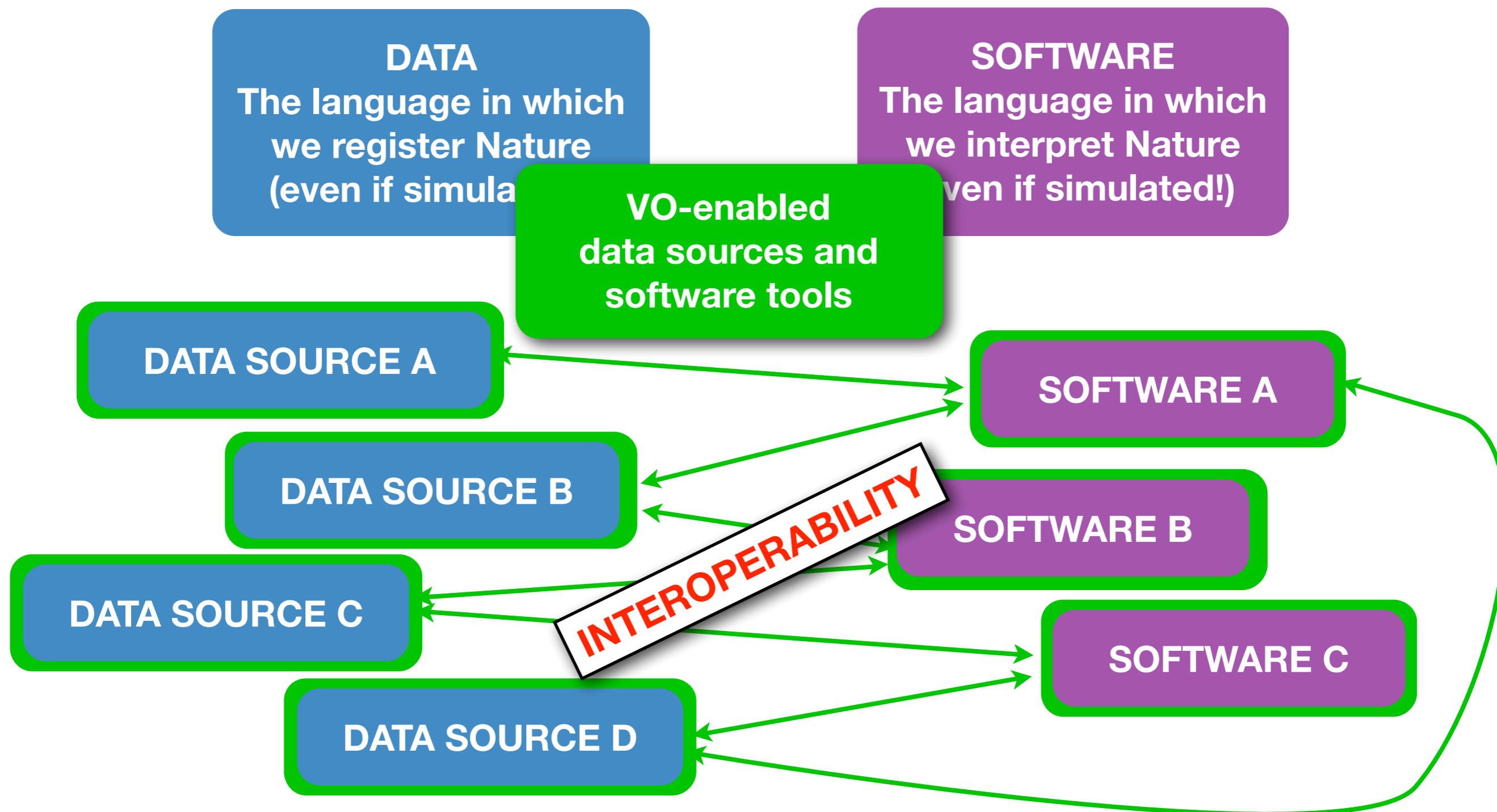
# Data – Software

**DATA**  
The language in which we register Nature (even if simulated!)

**SOFTWARE**  
The language in which we interpret Nature (even if simulated!)



# Data – Software





# The Virtual Observatory (VO) is ...

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- **the vision** that astronomical datasets and other resources should work as a seamless whole (IVOA)
- **a collection of interoperating data archives and software tools** which utilize the internet to form an environment in which astronomical research projects can be conducted (Wiki)
- a data discovery, access, and integration **facility** (B. Hanisch)

# The Virtual Observatory (VO)

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It provides a **common language** (standards, protocols, data models etc.) for communicating and exchanging data within Astronomy, and indicate where the data is stored!

**Goal:** To enable science! **Transparent and distributed access to data available worldwide**, allowing scientists to discover, access, analyze, and combine nature and lab data from **heterogeneous data collections** in a **user-friendly** manner.

*An ambitious goal and no pre-existing model to follow...*



# IVOA



*Global interoperability means world-wide agreement*

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Many projects and data centres worldwide are working towards this goal since 2002.

The **I**VOA is a standards body created by the VO projects to develop and agree the vital interoperability standards upon which the VO implementations are constructed.



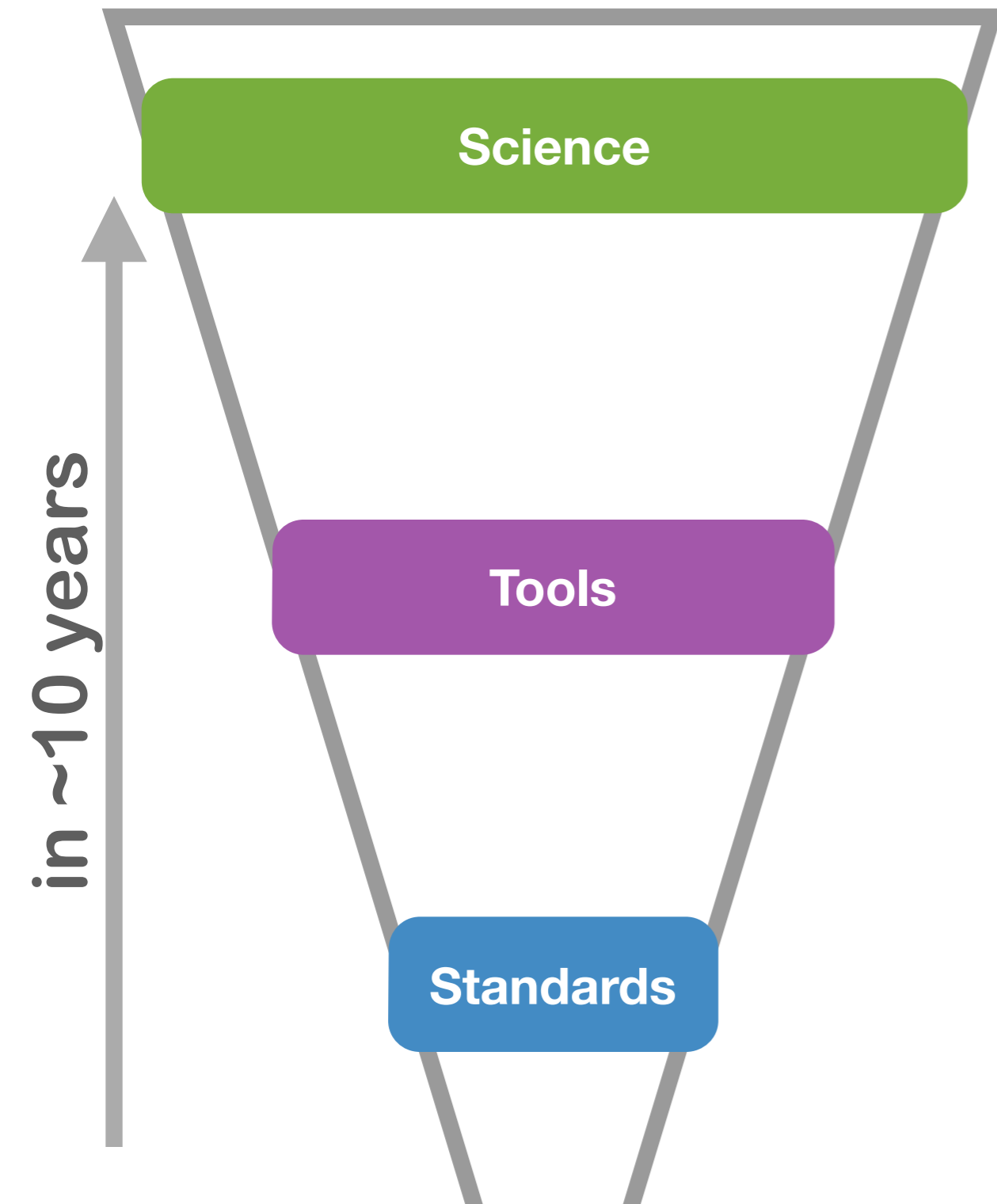
<http://www.ivoa.net>

17 country members + 2 institutions

International **V**irtual **O**bservatory **A**lliance

# VO: bottom-up approach

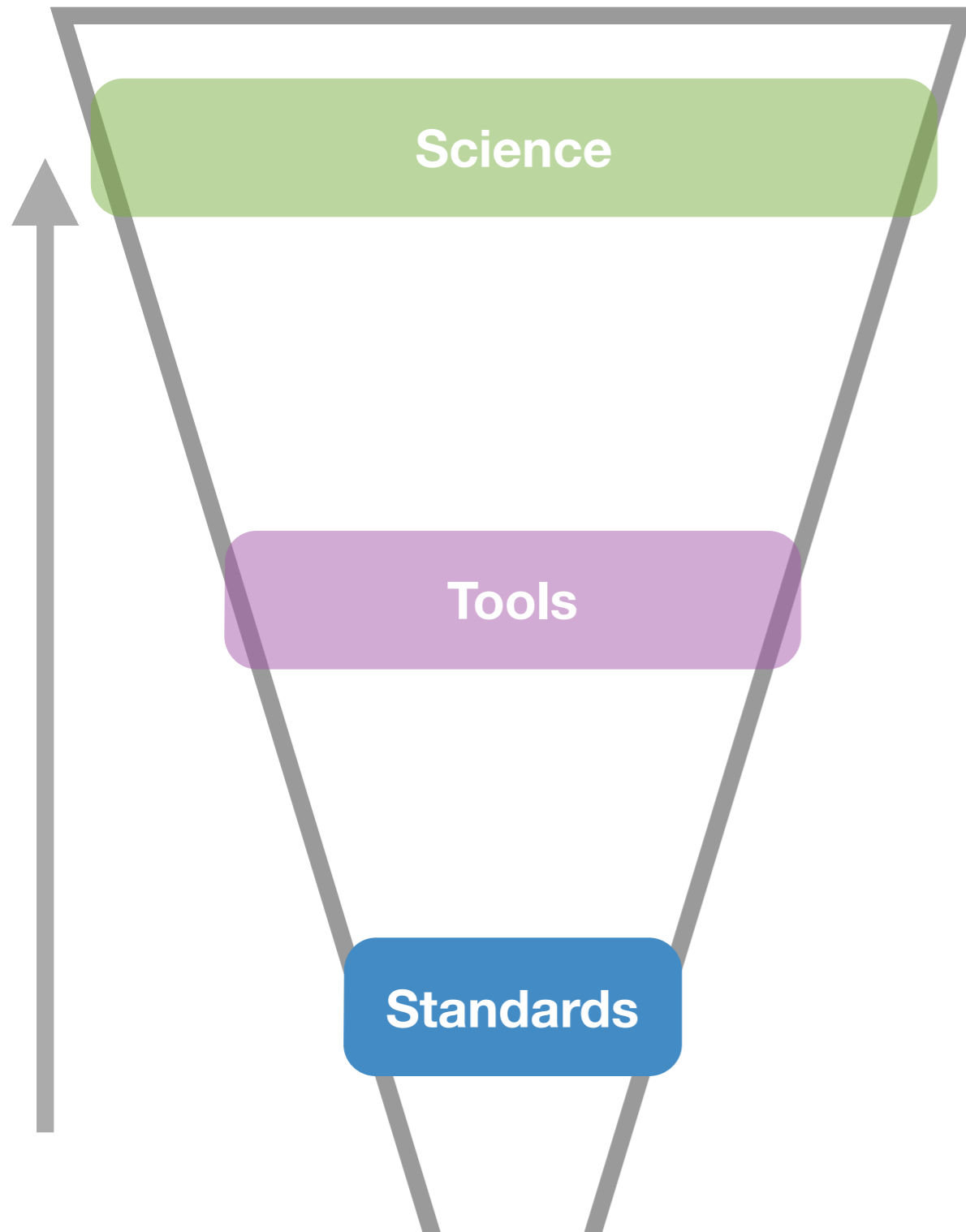
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# VO: bottom-up approach

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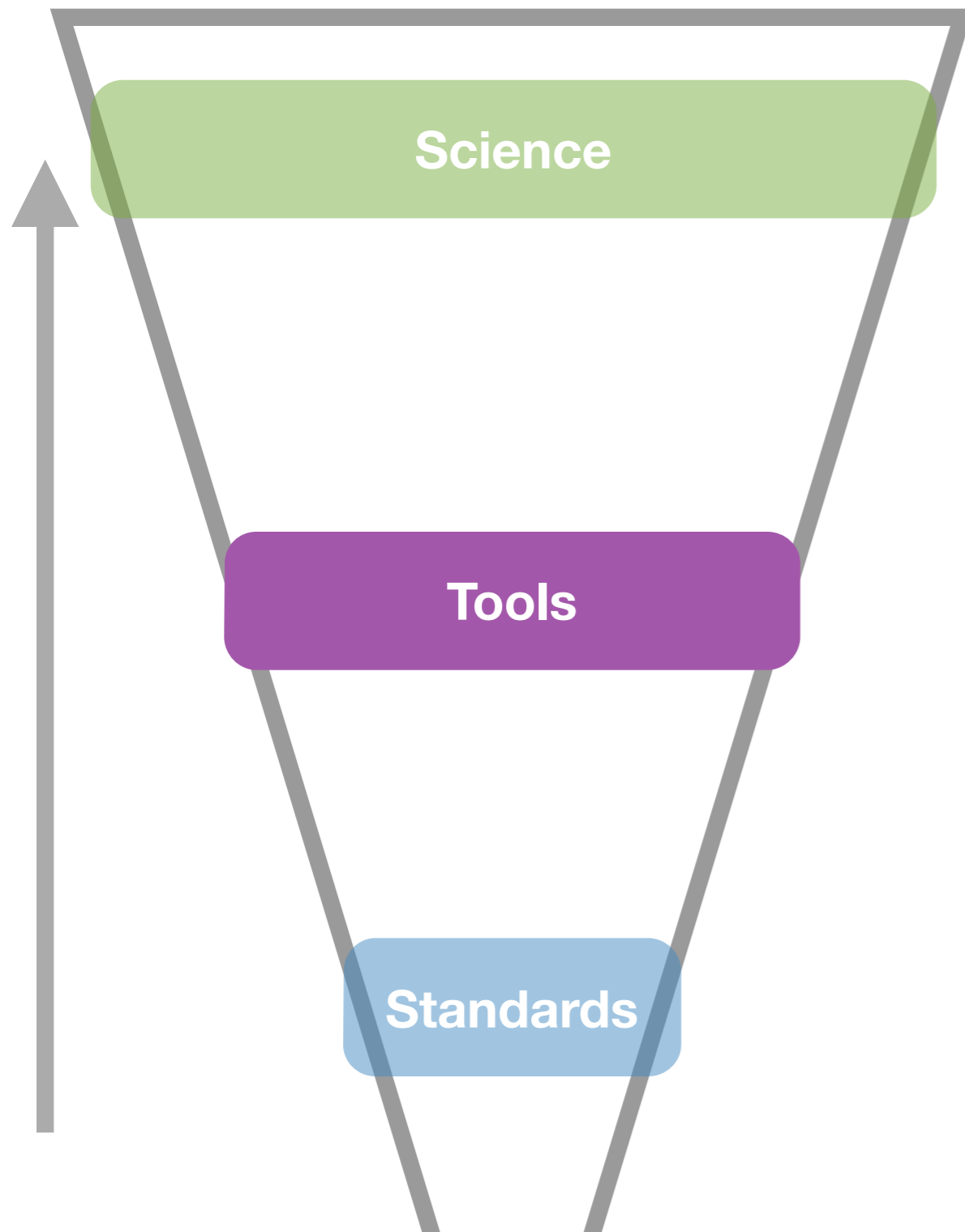


**Registry, Protocols  
and Data Models**

**Core standards  
established**

**Priorities now on  
multi-dimensional data  
and time domain  
astronomy**

# VO: bottom-up approach



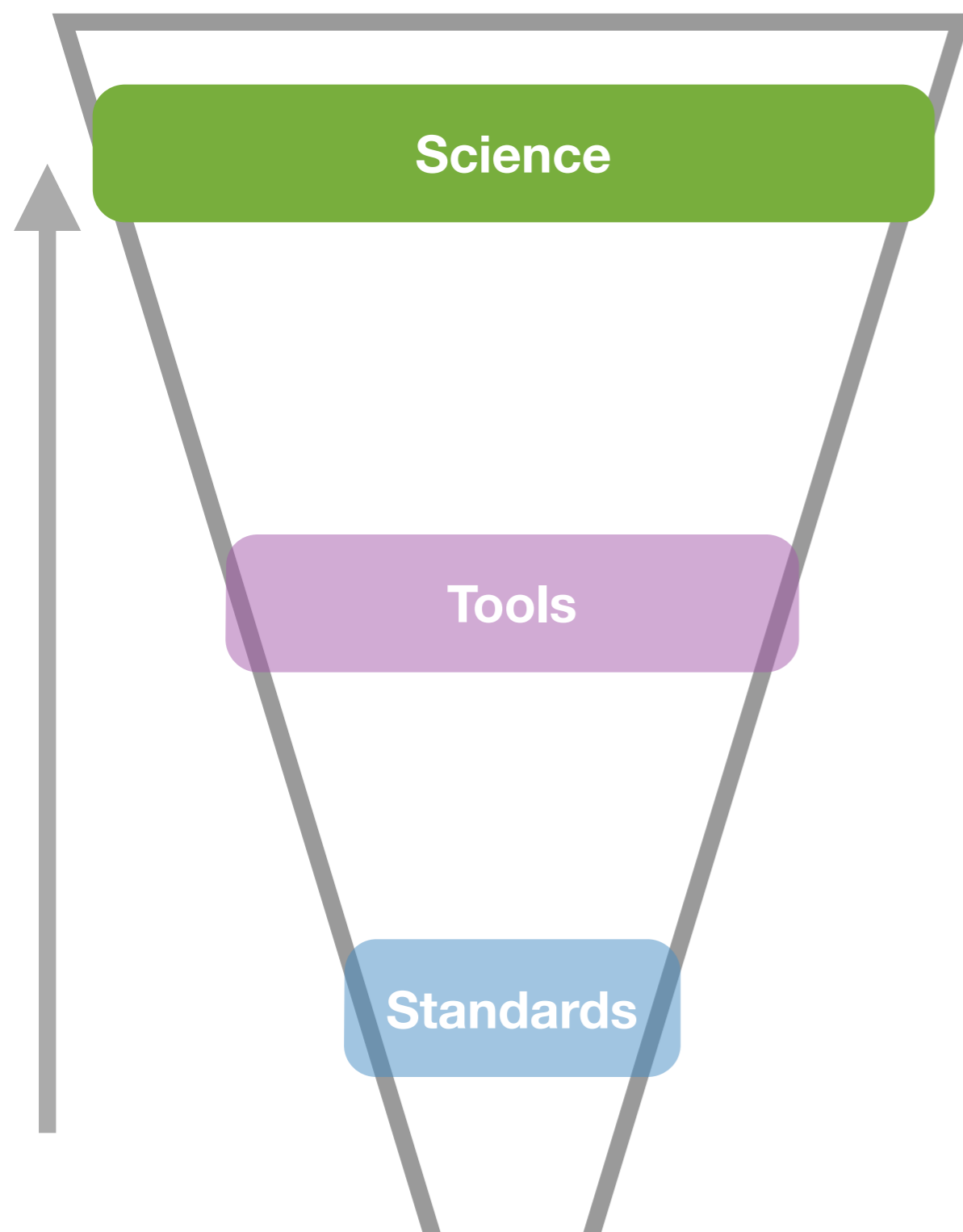
**30+ VO-enabled applications, from 10+ VO projects, many with hundreds of downloads**

**Web apps used frequently**

**Many users are unaware that data requests are being handled by VO services**



# VO: bottom-up approach



**About 300 refereed papers, several of them introducing innovative ways**

**Part of Astronomer's everyday tool kit**

**'VO' not well cited, but tools are!**

**This is just the beginning...**

scolps.esa.int

Research & Science Home | ESA Public Web Site | Sci-Tech Portal

**Research Science Portal**

Astrophysics Missions | Planetary Exploration Missions | Solar Terrestrial Science Missions | Fundamental Physics Missions

Science Archives Team

ESA Science Archives

People

9-April-2015 23:35:04

odsweb.u-strasbg.fr

Portal | Simbad | VizieR | Aladin | X-Match | Other | Help

**Centre de Données astronomiques de Strasbourg**  
*Strasbourg astronomical Data Center*

Entry point to all services | Object database | Catalogue database | Interactive sky atlas

Object/position | Obj/position/bibcode | Keywords, target, ... | Object/position

**Other services**

X-match | Dictionary | Sesame | SimPlay

Home | About CDS | People | Support | myCDS | Virtual Observatory projects | Authorities | Strasbourg

**Science Archives at ESAC**

ESA Hubble Science Archive | EXOSAT Science Archive | Herschel Science Archive | ISO Data Archive | Planck Legacy Archive | Planetary Science Archive | SOHO Science Archive | Ulysses Science Archive

Click on a satellite to visit the mission archive homepage.

European Space Astronomy Centre (ESAC) hosts most of ESA astronomy and planetary missions' archives. This currently includes:

- Cluster Science Archive → Cluster Mission
- ESA Hubble Science Archive → HST Mission
- EXOSAT Science Archive → EXOSAT Mission
- Herschel Science Archive → Herschel Mission
- ISO Data Archive → ISO Mission
- Planck Legacy Archive → Planck Mission
- ESA's Planetary Science Archive → (regrouping data from Rosetta, Mars Express, Venus Express, Huygens, Smart-1 and Giotto for the time being)

www3.cadc-coda.hia-ihh.nrc-cnrc.gc.ca

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**Canadian Astronomy Data Centre**

Telescope Data Products | Advanced Data Products | Services | Advanced Search | Login

CADC Home

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**Telescope Data Products**

- Gemini
- CFHT
- JCMT
- HST
- BLAST
- MOST

**Advanced Data Products**

- MegaPipe
- HLA
- IRIS
- CGPS

**Services**

- Meetings
- Community
- SSOIS
- CANFAR

**And future surveys, such as J-PAS and Gaia**

## **Identification of blue high proper motion objects in the Tycho-2 and 2MASS catalogues using Virtual Observatory tools**

F. M. Jiménez-Esteban<sup>1,2,3</sup>, J. A. Caballero<sup>4</sup>, and E. Solano<sup>1,2</sup>

## **New ultracool subdwarfs identified in large-scale surveys using Virtual Observatory tools ★ ★★**

### **Part I: UKIDSS LAS DR5 vs SDSS DR7**

N. Lodieu<sup>1,2</sup>, M. Espinoza Contreras<sup>1</sup>, M. R. Zapatero Osorio<sup>3</sup>, E. Solano<sup>4,5</sup>, M. Aberasturi<sup>4,5</sup>, and E. L. Martín<sup>3</sup>

## **A search for new hot subdwarf stars by means of Virtual Observatory tools**

R. Oreiro<sup>1</sup>, C. Rodríguez-López<sup>2,3</sup>, E. Solano<sup>4</sup>, A. Ulla<sup>3</sup>, R. Østensen<sup>5</sup>, and M. García-Torres<sup>6</sup>



# The VO concept elsewhere

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- Space Science
  - Virtual Heliophysics Observatory (HELIO)
  - Virtual Radiation Belt Observatory (ViRBO)
  - Virtual Space Physics Observatory (VSPO)
  - Virtual Magnetospheric Observatory (VMO)
  - Virtual Ionosphere Thermosphere Mesosphere Observatory (VITMO)
  - Virtual Solar-Terrestrial Observatory (VSTO)
  - Virtual Sun/Earth Observatory (VSEO)
- Virtual Solar Observatory
- Planetary Science Virtual Observatory
- Deep Carbon Virtual Observatory

**And currently this model is being exported to the National Institute of Standards and Technology (NIST) and to Neurosciences**

# How to learn about VO technology?

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- as an **astronomer** wanting to make the most out of the existing tools
- as a **deployer** who wants to learn how to publish data in the VO
- as a **developer** who wants to get involved in the standards and develop new tools

# How to learn about VO technology?

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- are you an **astronomer** wanting to use the VO tools?
  - take a look at the Scientific Tutorials at
  - <http://www.euro-vo.org/?q=science/scientific-tutorials>
  - check out <http://www.ivoa.net/astronomers/applications.html>



# How to learn about VO technology?

**Aladin**

**Iraf**

**VOStat**

**VOSA**

**VO Applications for Astronomers**

In this section, scientists can find available VO-compatible applications for their immediate use to do science. The level of maturity of the applications depends on a high degree on the level of maturity of the corresponding IVOA protocols and standards.. As a consequence of the flexibility of the standards, several of the applications might overlap in functionality. **The IVOA does not manage or guarantee these services/tools.**

**Applications (In alphabetical order)**  
 Aladin  
 AppLauncher  
 CASSIS  
 Cross Comparison Tool  
 CDS Xmatch Service  
 Data Discovery Tool  
 Filter Profile Service  
 Iris  
 Montage  
 Octet  
 SkyView  
 Specview  
 SPLAT  
 TAPHandle  
 TAPsh  
 TESELA  
 Time Series Search Tool  
 TOPCAT/STILTS  
 VIVO  
 VOConvert  
 VODesktop  
 VOPlot  
 VOStat  
 VOSA  
 VOSED  
 VOServices (Footprint, Spectrum, Filters, ...)  
 VOSpec  
 WCSFixer

**Functionality**  
**Search for Images:**  
 Aladin, Datascope, SkyView, VODesktop, Data Discovery Tool  
**Search for Spectra:**  
 Aladin, CASSIS, Datascope, SPLAT, Specview, VOServices, VOSpec, Data Discovery Tool  
**Search for Catalogues:**  
 Aladin, Datascope, TOPCAT, VODesktop, Data Discovery Tool  
**Search for Time Series Data:**  
 Time Series Search Tool

**Image visualisation:**  
 Aladin, SkyView  
**Spectra visualisation:**  
 CASSIS, SPLAT, Specview, VOServices, VOSpec  
**Catalogues visualisation:**  
 Aladin, TOPCAT, VOPlot  
**Cross-correlation:**  
 Aladin, STILTS, TOPCAT, CDS Xmatch Service, Cross Comparison Tool  
**Scatter, 3D plots and histograms:**  
 TOPCAT, VOPlot  
**Statistics:**  
 VOStat  
**Footprint Service:**  
 Aladin, VOServices  
**Table format conversion:**  
 TOPCAT, VOConvert, STILTS  
**Filter curves:**  
 VOServices, Filter Profile Service

**VO-compliant Tools & Services**  
 DS9: Image visualisation  
 GOSSIP: SED fitting  
 VirGO: Search for Images and Spectra  
 IRAF: Image Reduction & Analysis  
 World Wide Telescope  
 Gaia - Graphical Astronomy and Image Analysis  
 SIMBAD  
 TESELA  
 VizieR

**Browse the Registries**  
 WIRR - Web Interface to the Relational Registry  
 RSS Feed of New & Updated Services in the VO  
 AppLauncher  
 EURO-VO Registry  
 NVO Registry  
 or use VODesktop

**Manuals, Tutorials, How-tos**  
 ADQL & TAP Tutorial  
 Aladin User manual  
 CDS Xmatch service  
 Cross Correlation Tool tutorial (video)  
 Datascope how to  
 Data Discovery Tool Tutorial PDF (video)  
 Iris How-to (video)  
 Montage help  
 SkyView documentation  
 Specview examples  
 SPLAT documentation  
 STILTS documentation

**Data Discovery Tool**

**DS9**

**Topcat**

**CDS Xmatch service**

**and more...**

# How to learn about VO technology?

---

- are you a **deployer** and wants to learn how to publish data in the VO?
- there are several toolkits for VO publishing already available, see *Guide to Publishing in the VO*
- <http://wiki.ivoa.net/twiki/bin/view/IVOA/PublishingInTheVONew>

# How to learn about VO technology?

---

- are you a **developer** and want to get involved in the standards and develop new tools?
  - check out the technical pages from IVOA
  - <http://www.ivoa.net/documents/index.html>
  - libs available for Java, C++, Perl, PHP and Python
  - go to a Interop meeting to see how the guys work!



ERAND

# BRAVO

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- BRazilian Astrophysical Virtual Observatory
- 2006: BRAVO is born as a collaboration between **Divisão de Astrofísica** and **Laboratório de Computação @ INPE**
- 2009: BRAVO becomes IVOA partner and associate with INCT-A
- 2015: team 6 integrants and 5 collaborators <http://bravo.iag.usp.br>

**Would you like to join us?  
Let me know!**

# Mission

---

- To **stimulate** and to **encourage** the **projects** of the different local groups, facilitating the necessary coordination and collaboration for the **development and deployment** of the tools, systems, and organizational structures;
- To **organize workshops and schools** aiming at the dissemination of the VO concepts and the qualification of people capable to use and to work on the development of new VO services and tools;
- To **act as a partner of the IVOA** and as an intermediate between the IVOA and the Brazilian groups working with VO.



# To organize workshops and schools aiming at the dissemination of the VO concepts

2011

**I Workshop de Computação Científica em Astronomia**

2 A 5 DE JUNHO DE 2011  
 NÚCLEO DE ASTROFISICA TEORICA  
 UNIVERIDADE CRUZEIRO DO SUL  
 (SAO PAULO - SP)

**PROGRAMA**

**MINICURSOS**

- SIMULAÇÕES NUMERICAS PARA ASTRONOMIA (Diego Falcoza-Goncalves (EACH))
- INTRODUÇÃO A COMPUTAÇÃO ESTATISTICA EM ASTRONOMIA (Hektor Monteiro (UNFIC))
- PROGRAMAÇÃO PARA GPU (Ricardo Farias (COPPE UFRJ))
- INTRODUÇÃO A VETORIZAÇÃO, MPI E OPENMP (Paulo Penteado (IAS))

**PALESTRAS CONVIDADAS**

- VISUALIZAÇÃO AVANÇADA DE DADOS (Gregorz Kowal (IAS))
- TÓPICOS E DESAFIOS EM COSMOLOGIA COMPUTACIONAL (Reinaldo Rosa (LAC - INPE))
- PROCESSAMENTO DE IMAGENS (Daniel Nicolato (IN))
- RESTAURAÇÃO DE IMAGENS SOB BAIXA CONTAGEM DE FOTONS (Nelson Mascarenhas (UFSCar))
- PCA EM ASTRONOMIA (João Steiner (IAS))
- INTRODUÇÃO A GRID / CLOUD COMPUTING (Alberto Krone-Martins (IAS))
- BANCOS DE DADOS EM ASTRONOMIA (William Schoenel (UFSC))
- OBSERVATORIO VIRTUAL: UMA VISÃO GERAL (Hugo Capelato (INPE))
- PYTHON PARA ASTRONOMOS (Daniel Moser (IAS))

**COMITE ORGANIZADOR:**  
 LUCIMARA MARTINS (NAT)  
 PAULA COELHO (NAT)  
 ALEX CARCIOLI (IAS)  
 REINALDO ROSA (LAC)

**APÓIO E FINANCIAMENTO:** INAT, Universidade Cruzeiro do Sul, BRAVO, LAC, inct, CNPq, FAPESP

2014

**II Workshop de Computação Científica em Astronomia**

**IIWCCA**

3 - 6 de junho de 2014  
 Núcleo de Astrofísica Teórica  
 Universidade Cruzeiro do Sul  
 (São Paulo - SP)  
 Campus Liberdade

O principal objetivo do II WCCA é a informação: apresentar aos astrônomos, de uma forma eficiente, os principais métodos computacionais de uso corrente em ciência, em particular em Astronomia e apresentar aos profissionais da computação quais os principais problemas computacionais da Astronomia. Outro objetivo do evento é a integração: colocar em contato os astrônomos brasileiros ligados à área de computação e métodos numéricos, conhecer suas expertises e necessidades, além de identificar os recursos de hardware disponíveis e aprender como melhor utilizá-los. Finalmente, incentivar o contato entre astrônomos e profissionais da área de computação, tanto cientistas da computação quanto engenheiros, se torna cada vez mais necessário no panorama da ciência moderna; cada vez mais o software se torna a principal linguagem utilizada para descrição e estudo da natureza.

**Comitê Científico**

Alex Cavaliéri Carcioli (IAG e BRAVO) - Co-chair  
 Alberto Krone-Martins (Universidade de Lisboa) - Co-chair  
 Claudia Bauzer Medeiros (IC/UNICAMP)  
 Lucimara Pires Martins (NAT/UCS) - Chair  
 Paula Rodrigues Teixeira Coelho (IAG e BRAVO) - Co-chair  
 Paulo Penteado (Northern Arizona University)  
 Reinaldo Roberto Rosa (LAC/INPE)  
 Fábio Porto (LNCC)

[Translate](#)

• NAT/LAC/BRAVO initiative



# To organize workshops and schools aiming at the dissemination of the VO concepts

2012



## DESAFIO BRAVO

**O QUE É?**  
O BRAVO, a Microsoft Research e a AMD te desafiam a desenvolver um sistema para disponibilizar imagens do telescópio SOAR no Wide World Telescope, por meio de protocolos do Observatório Virtual.

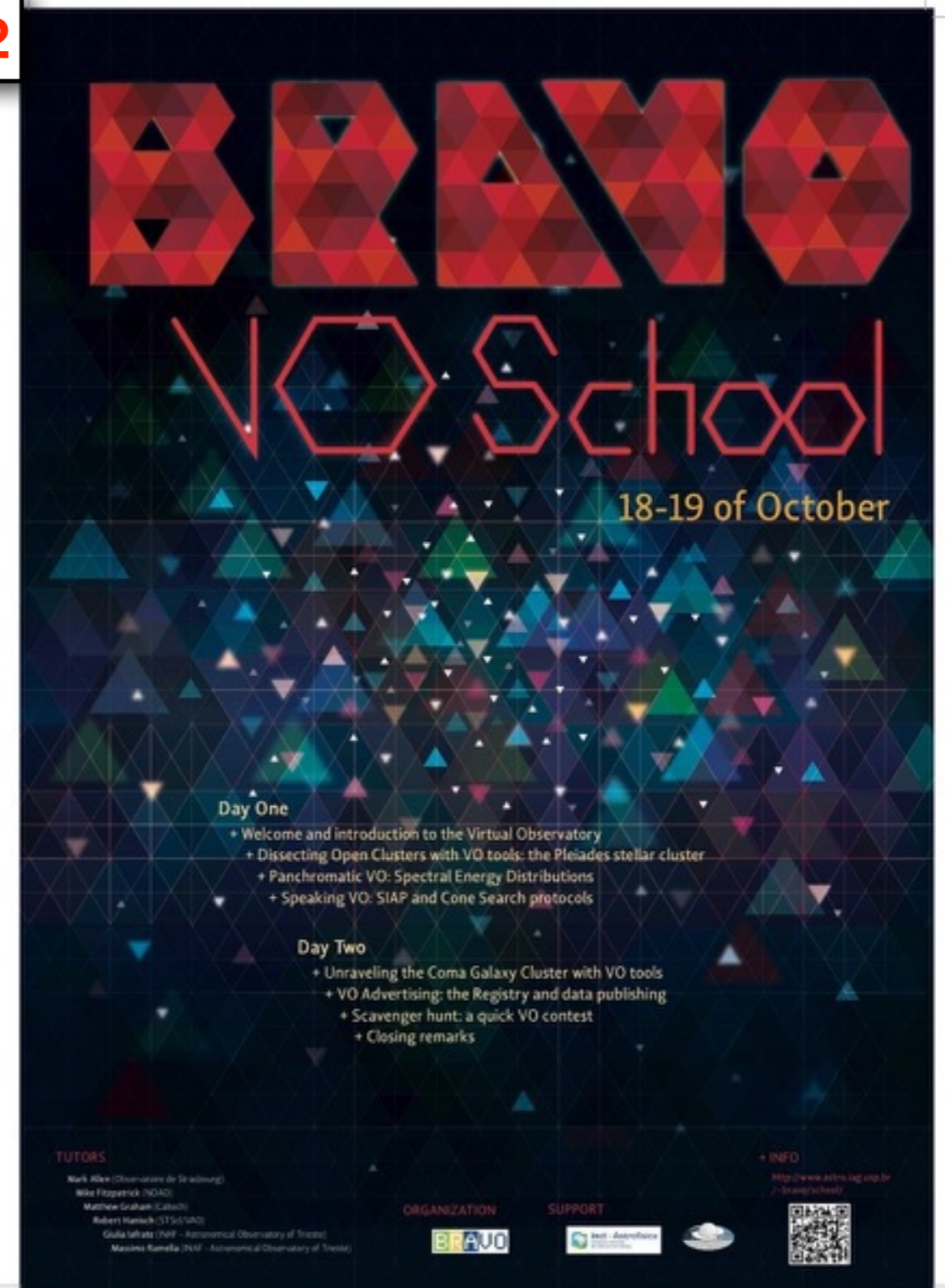
**QUEM?**  
Podem participar graduandos, mestrandos e doutorandos da área de exatas. Pós-doutorandos se estiverem com muita vontade. Preferencialmente em pares!

**QUANDO?**  
As inscrições estarão abertas de 11 de junho até 12 de agosto e os trabalhos devem ser entregues até 17 de agosto de 2012. A premiação será feita em Outubro durante o encontro IVOA Interop e os estágios da equipe vencedora serão realizados em 2013.

**PRÊMIO?**  
Um mês de estágio na Microsoft Research (Redmond, Estados Unidos) e/ou um mês no Instituto CALTECH (Califórnia, Estados Unidos), além de dois notebooks.

**MAIS INFORMAÇÕES**  
[www.astro.iag.usp.br/~bravo/desafio/](http://www.astro.iag.usp.br/~bravo/desafio/)

ORGANIZAÇÃO: BRAVO  
PATROCÍNIOS: Microsoft Research, Inct - Astrofísica, AMD  
APOIOS: SOAR, sgi, Laboratório Nacional de Computação Científica



## BRAVO VO School

18-19 of October

**Day One**

- + Welcome and introduction to the Virtual Observatory
- + Dissecting Open Clusters with VO tools: the Pleiades stellar cluster
- + Panchromatic VO: Spectral Energy Distributions
- + Speaking VO: SIAP and Cone Search protocols

**Day Two**

- + Unraveling the Coma Galaxy Cluster with VO tools
- + VO Advertising: the Registry and data publishing
- + Scavenger hunt: a quick VO contest
- + Closing remarks

**TUTORS**  
Mark Allen (Observatoire de Strasbourg)  
Mike Fitzpatrick (NOAO)  
Matthew Graham (Caltech)  
Robert Hainack (STScI/VOA)  
Giulia Iaffaità (INAF - Astronomical Observatory of Trieste)  
Massimo Ramella (INAF - Astronomical Observatory of Trieste)

**ORGANIZATION**  
BRAVO

**SUPPORT**  
Inct - Astrofísica

**INFO**  
<http://www.astro.iag.usp.br/~bravo/school/>



To act as a partner of the IVOA and as an intermediate between the IVOA and the Brazilian groups working with VO

S A B

**XXXVII**

Reunião Anual da  
Sociedade Astronômica  
Brasileira

14 a 18 de outubro de 2012  
Águas de Lindóia - SP  
Hotel Majestic

2012

**IVOA** Interop

21 26 | 10 | 2012

São Paulo

**BRÁVO**



To stimulate and to encourage the projects, facilitating the development and deployment of the tools, systems, and organizational structures



We negotiated community access to the IAG/NAT's Alphacrucis cluster, together with the emergent groups

**GINA**

O uso de GPUs (Graphical Processing Units) tem aberto novas possibilidades para computação astronômica, provendo paralelização em grande escala.

GINA (GPUs para o Instituto Nacional de Ciência e Tecnologia de Astrofísica) é um cluster experimental, com o objetivo de ser um ambiente de desenvolvimento e testes de aplicativos que fazem uso de GPUs na área de Astronomia.

Está aberto para o uso de toda a comunidade astronômica brasileira

**GPUs para o INCT-A**

**BRAVO**  
BRAZILIAN RADIO ASTRONOMICAL OBSERVATORY

O computador GINA possui atualmente 2 nós, cada um com:

- 2 GPUs NVIDIA Tesla C2050 (448 núcleos cada)
- 2 CPUs Intel Xeon X5650 (6 núcleos cada)
- 48 GB de RAM

Os softwares já disponíveis incluem:

- CUDA C
- CUDA Fortran
- IDL (com GPULib)
- R (com R+GPU)
- Python (com PyCUDA)
- MPI, OpenMP, TORQUE

Veja mais em:

<http://www.astro.iag.usp.br/~gina>



# To stimulate and to encourage the projects, facilitating the development and deployment of the tools, systems, and organizational structures

2011 - 2015?

Quanto tempo de sua pesquisa precisa ser dedicado para tarefas de Tecnologia da Informação para as quais, como astrônomo, você não possui conhecimento ou vocação?

Caso você tenha respondido "muito", e caso seu projeto faça uso de Observatório Virtual, o BRAVO pode ajudá-lo por meio de um novo mecanismo chamado:

## CASO DE USUÁRIO



Um Caso de Usuário é um projeto simples, curto e facilmente testável, voltado à implementação ou uso de serviços de Observatório Virtual.

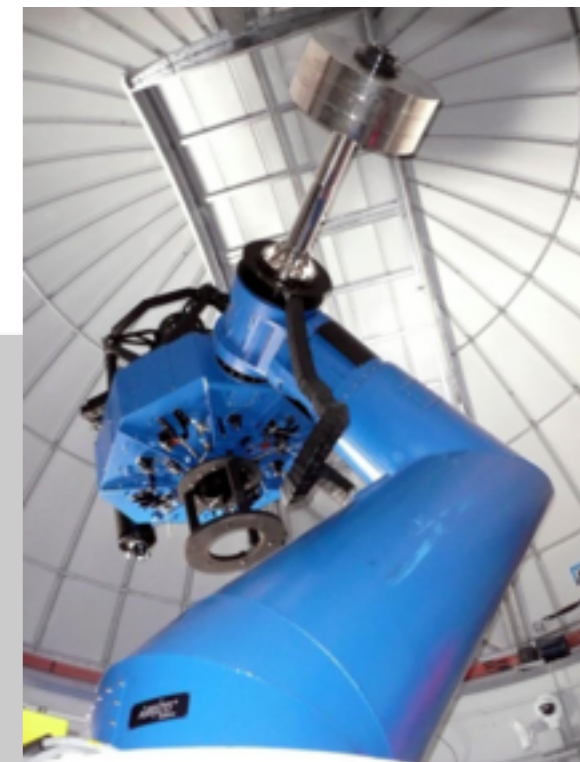
Aliás, mesmo que você tenha uma idéia para um projeto de Observatório Virtual nas condições acima, mas não possua o *know-how* para elaborar um Caso de Usuário completo, o BRAVO poderá auxiliá-lo.

Veja mais em:

<http://www.astro.iag.usp.br/~bravo/cdu>

- A Database for the SOUTH POL survey
- Photometric Redshifts Portal
- Grid of Synthetic Spectra (3x)

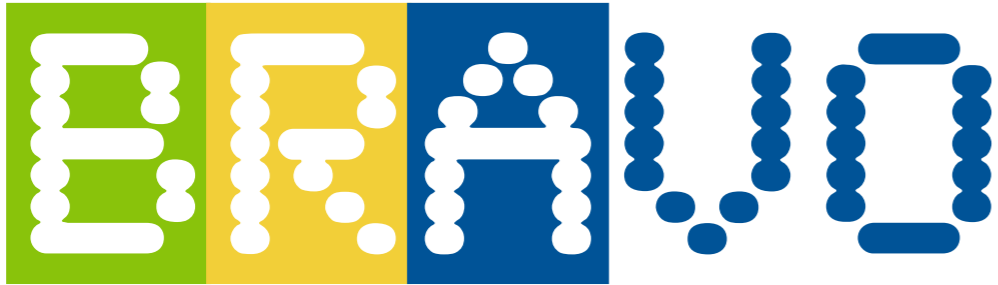
- A-Plus (S-Plus + J-Plus), ~50TB/year



# BRAVO nowadays

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- **Setting up a small team for deployment of VO services**
  - in our recently acquired server @ LAi
- **Synergy with J-PAS and A-Plus surveys**
  - 3 telescopes, 2 surveys, 17000 square degrees. A consortium of Spanish and Brazilian institutions. The team of scientists and engineers includes more than 100 people from Brazil, Spain, the U.S.A. and other countries.
- **Archiving and publishing of T80S data (S-Plus), and negotiating mirror of T80N data (J-Plus)**
- **Strong support from VO communities abroad.**



**We are an alliance of people in Brazil who believes in worldwide, interoperable and distributed access to astronomical data and software.**

**Would you like to join us? Let us know!**

Obrigada!

[bravo@iag.usp.br](mailto:bravo@iag.usp.br)