

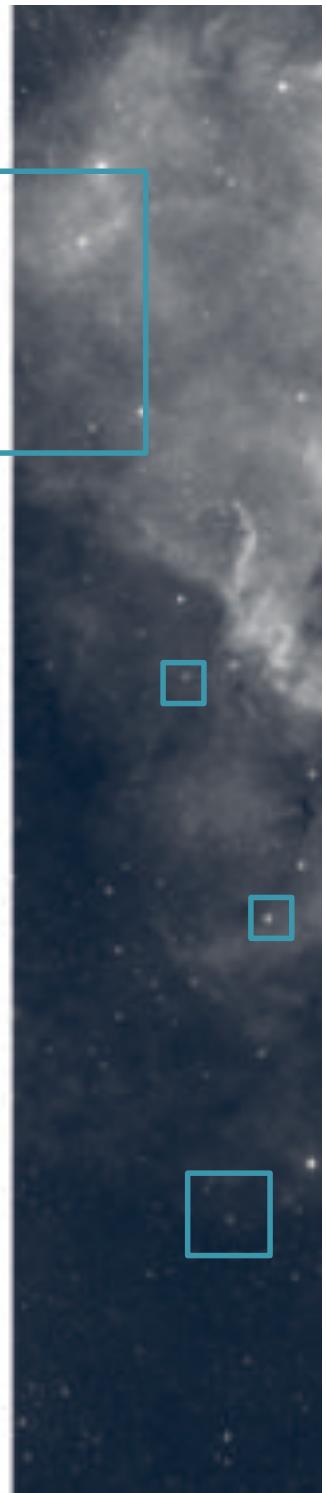
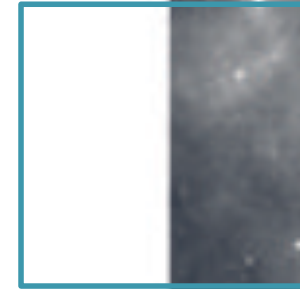
# Centre de Données astronomiques de Strasbourg

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Mark Allen and CDS Team



CDS Scientific Council, 7-8 November 2016



# Since 1972...

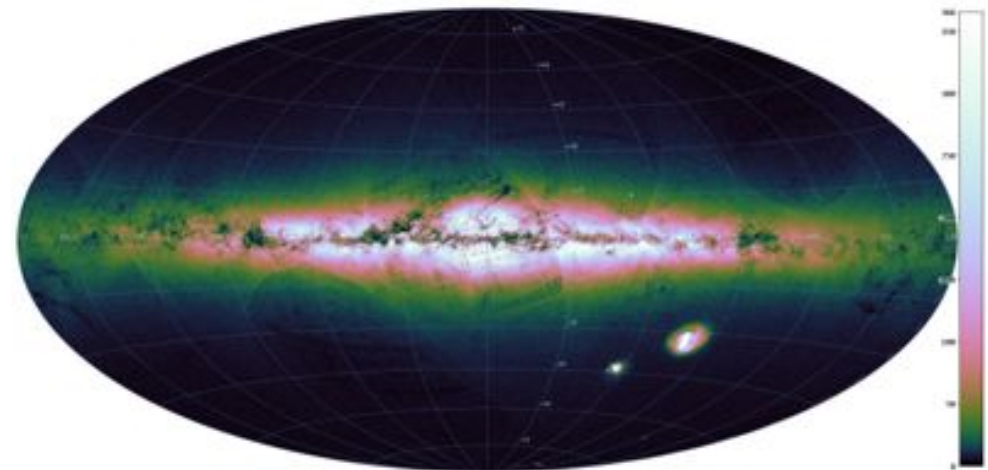
- Collect useful data on objects in electronic form
- Improve them by critical evaluation and combination
- Distribute the results to the international community
- Conduct research using the data

## **Science Driven:**

- *Necessary evolutions to meet the scientific reference service needs of the astronomy community*
- *Innovations to meet challenges and ensure sustainability*
  - *Science is changing, technology is changing*

# Astrophysics today

- **Science questions drive the need for:**
  - multi-wavelength, multi-messenger observations
  - an All-Sky approach using ‘Big Data’ surveys
  - combination of archival data and information in publications
- **Reference Services**  
are essential for:
  - Qualified information
  - Interoperability
  - Enabling science



*Gaia mission data – released Sept 14, 2016 by CDS*

# CDS Reference Services



Astronomical Objects :

*IDs, bibliography, measurements*



Catalogue Service :

*Catalogues, published tables, observation logs, surveys, associated data: images, time series, spectra etc.*



Visualisation and integration :

*images, catalogues, archives, VO portal, All-sky capabilities*



X-Match : *Catalogue cross-match*

VO compatible



Certified



Collaborative:

ESO  
ESA  
CNES  
NASA  
ADS  
NED



# CDS Reference Service Content



Astronomical Objects :

*~8.5 million objects, ~24 million ID, 14 million citation links*



Catalogue Service :

*15366 Catalogues, 32991 published tables, 19.2 billion rows, millions of associated data: **spectra, time series, images***



Visualisation and integration :

*325+ HiPS surveys: images (105 TB), catalogues, archives, VO portal, All-sky capabilities*



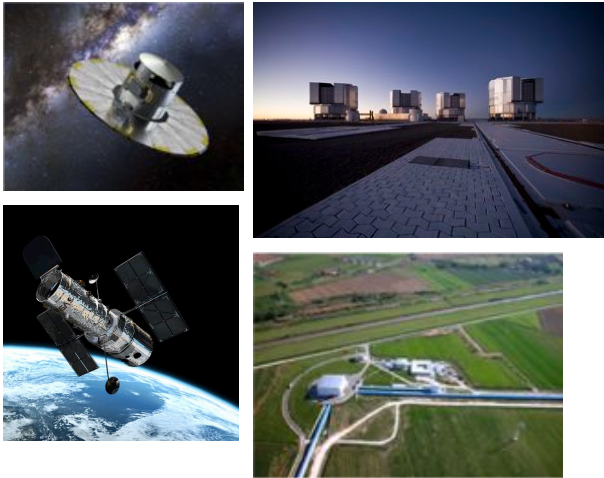
X-Match: All CDS catalogues



# Services for the global astronomy infrastructure

- Leadership and participation in global standardization 
  - Framework for global astronomy interoperability
- Provision of services and software components (tools) that are used by many archives and data centres (astronomical object name resolving, visualisation, data access)
- Contribution to the wider data sharing and Open Data initiatives

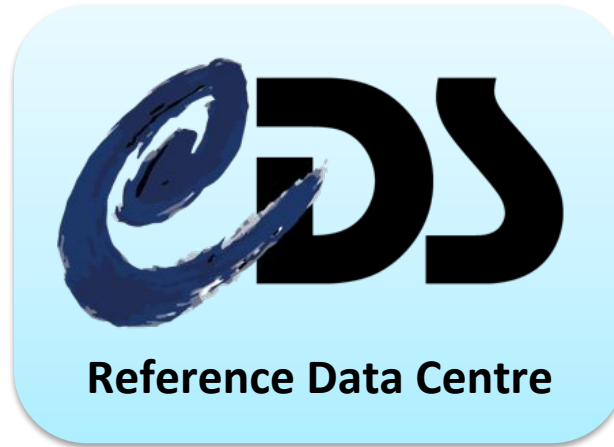
# CDS – a vital part of the global astronomy infrastructure



Ground and Space  
Observatories,  
Instruments and missions



*Archives, Services*

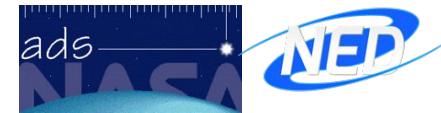


Journals



+ ...

Astronomy Data Centres



CADC, MAST, HEASARC, IPAC, + ...

Virtual Observatory



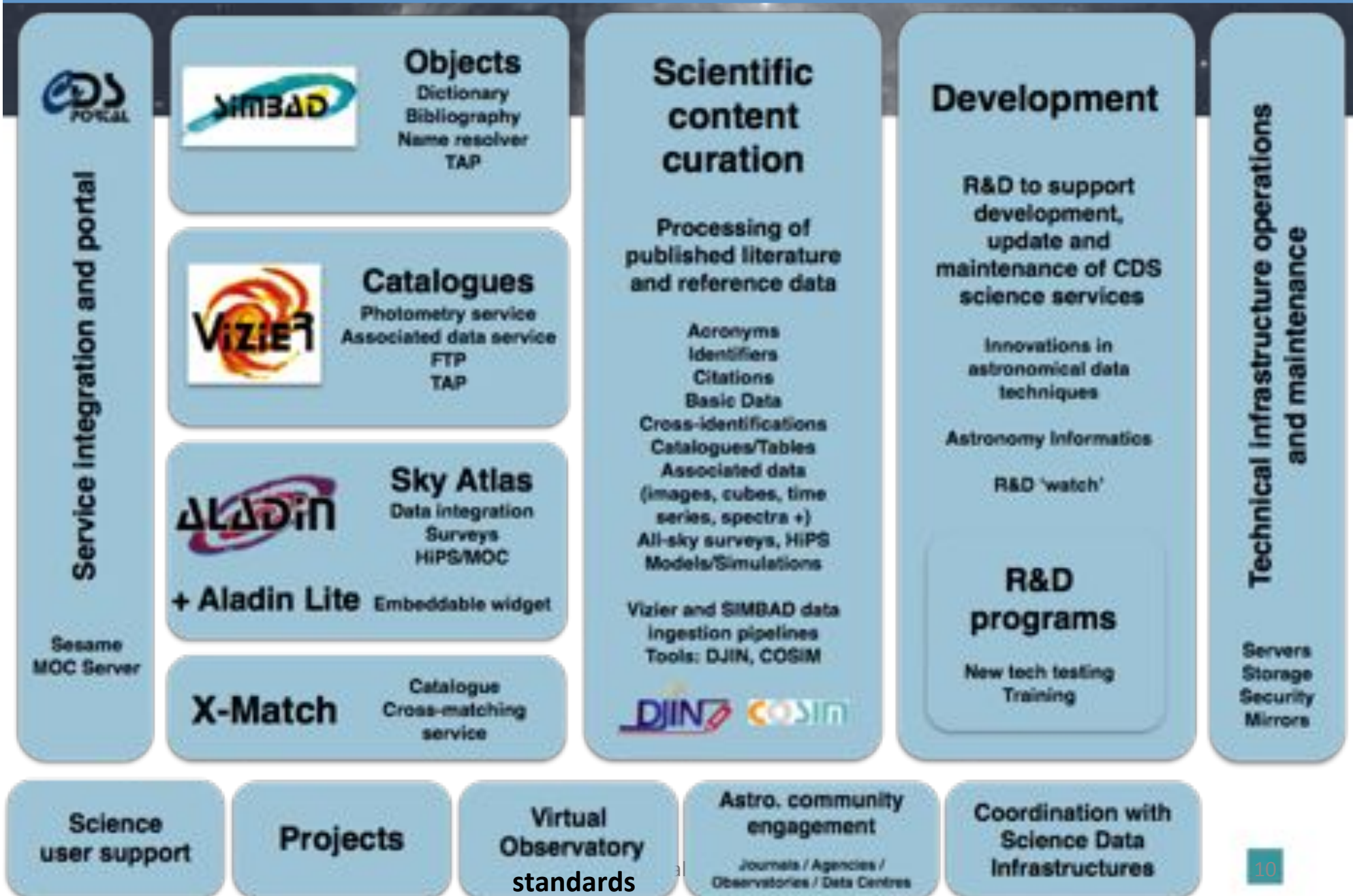
20 members



Data e-Infrastructures



# CDS activities





# Expertise of integrated team

- **Scientists** (3 CNRS, 7 CNAP )
  - Necessary expertise of active scientists covering wide range of astrophysics research areas, requirements, guidance, tests, dissemination, inspiration
- **Software Engineers** (8)
  - Development for astronomical applications with high level of Science ↔ IT interaction. Important R&D to evolve the services
- **Documentalistes** (10)
  - Special profiles for data ingestion from literature with high level of quality and scientific guidance
- **Interns** (~10), **Students** (2), **Post-docs** (2), **Contractors** (5)
- **Admin Staff** (2), **Admin & IT Support shared with OAS** (4)

# Governance

- **Infrastructure de Recherche on MENESR National Roadmap**
- **Authorities: CNRS-INSU & Université de Strasbourg**
  - these authorities nominate the CDS Director
- **International Scientific Council**
  - 3 year term (2016-2018)
  - Representatives from ESO, ESA, NASA, CNES
  - *Currently South Africa, India, Czech-Republic*
  - *French astronomy community representatives*
  - *Invited: Director OAS, CNRS-INSU, UdS VP-Research*
  - Annual meeting and written report

# CDS an integral part of the Observatoire astronomique de Strasbourg

- A host institution of the *'right size'*
- Synergies: *Scientific, Technical, Organisational*
- CDS gains access to scientific expertise
- Strong coordination with OAS Director

# CDS within the Université de Strasbourg

- CDS provides pioneering expertise for Science Data Sharing
- Supportive University environment
  - Education, research, training
  - Excellent regional relations with engineering schools and other universities

# French Astronomy (+)

- Prospective Astronomie et Astrophysique de l'INSU 2014:
  - “... CDS, infrastructure de recherche, pilier incontournable des bases de données françaises”
- Complementarity with other ANO5 labeled activities.
  - CDS plays supporting role
- Coordinator of INSU Action Specifique Observatoire Virtuel (ASOV)
- Partnership with CNES – space mission data & tools
- CDS supports French strengths in data driven science

# European Astronomy

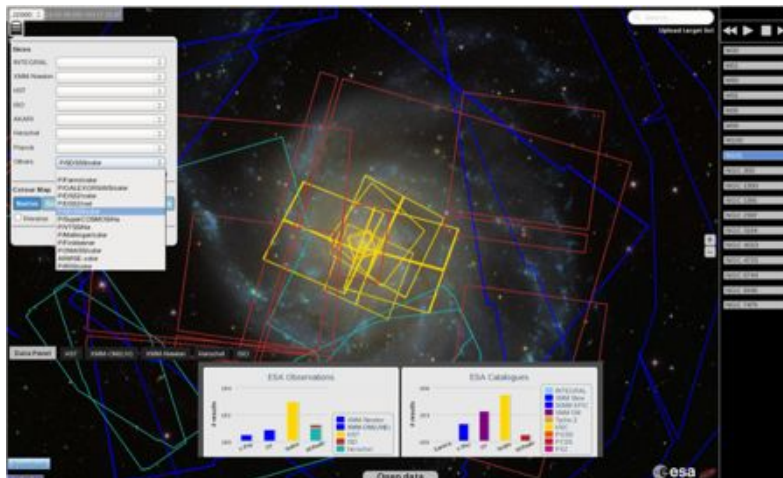
- Partnerships:

- Astronomy & Astrophysics Journal

addressing the European community needs



- ESA and ESO – major Astronomy Infrastructures. Recently adopted CDS HiPS and Aladin Lite into their archives and systems



Collaborative approach – mutual benefits for shared and interoperable systems

# European Projects

- Leadership of Euro-VO 
  - Series of 6 European projects 2001-2015
  - 4 led by CDS 2006-2015 (Development projects → Sustainability study)
  - Contributions to Astronet
- ASTERICS H2020 cluster project 
  - 2015-2019, ~20 partners, 15 M€
  - CDS leads Data Access, Discovery, Interoperability Work Package (WP4)
- RDA Europe project 1,2 & 3
- FP7 Science Projects: ASTRODEEP, VIALACTEA
- AENEAS H2020 – SKA data Centre Design study
  - starting Jan 2017 (CDS is a minor partner)

# International Astronomy

- CDS services used as essential components of major Astronomy Data Centres and observatories
- Partner with Harvard Smithsonian/NASA/ ADS
  - Astrophysical Data System – prime astronomy literature database (*CDS-ADS roles well defined*)
- Arrangements with major journals
- Founding member and leadership roles in the International Virtual Observatory Alliance (IVOA)



# IVOA

- Framework for interoperable and efficient access to astronomical data and services
- e-Science for Astronomy
- Based on Global standards

CDS – a major contributor and leader

21 standards (2011-2016), 12 with  
CDS author

CDS services VO compatible and  
leading the way



# Data Sharing

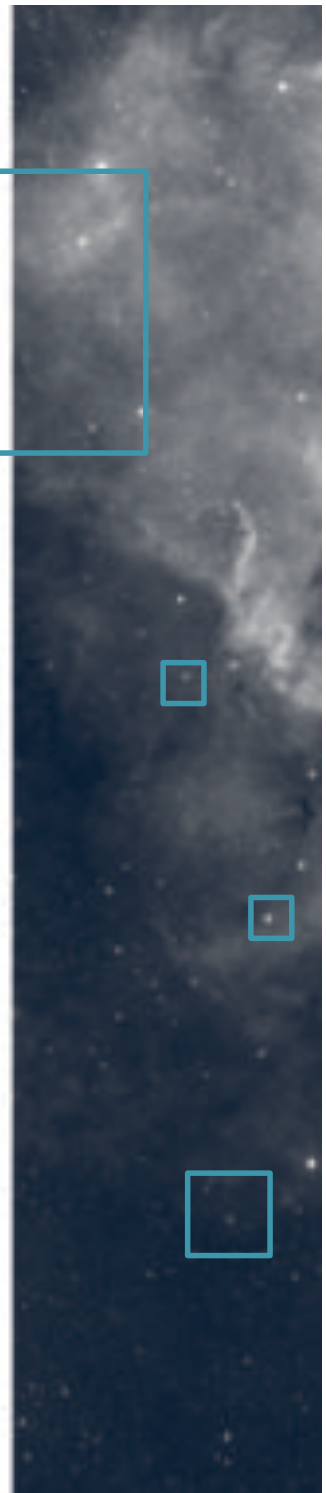
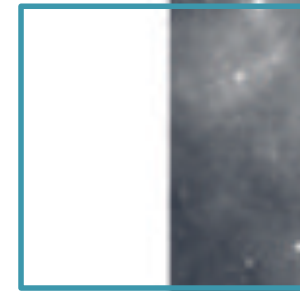
- CDS participates in the Research Data Alliance (RDA)
  - ‘building the social and technical bridges that enable sharing of open data’
  - Builds on experience of Astronomy being at forefront of data sharing
  - Common framework for data infrastructures is in line with CDS strategies

# CDS 2015 – 2016

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CDS Scientific Council, 7-8 November 2016



# 2015 - 2016

- First year under new director
- **Core work of building CDS content and operating services**
- High level strategy and plans
  - Preparing for evaluations
- Re-organisations of some CDS processes/teams
- Connections and Collaborations
- Interactions with users – schools and training events
- **Projects** – ASTERICS, ASTRODEEP, VIALACTEA, ARCHES, RDA, Europlanet

- CDS renewed as “IR” on the French national Research Infrastructure roadmap



- CDS among other infrastructures:
  - Intl. (ESO)
    - CFHT, IRAM
  - IR
    - HESS, ESO-INSTRUM, LOFAR-FR

**CDS**  
Centre de Données astronomiques de Strasbourg

**Type de l'infrastructure :** Unité exécutive de recherche

**Statut de l'infrastructure :** Unité exécutive de recherche

**Localisation de l'infrastructure :** Strasbourg

**Localisation des autres sites :** Infrastructure virtuelle

**Responsable de l'infrastructure :** Mark ALLEN

**Exploitation :** 1372

**Totaux / Partenaires :** CNRS, Univ. Strasbourg

**Contact en France :** mark.allen@cds.u-strasbg.fr

[cds.u-strasbg.fr](http://cds.u-strasbg.fr)

**La Mission du CDS est de collecter, homogénéiser, distribuer l'information astronomique pour le bénéfice de l'ensemble de la communauté internationale. L'objectif est de faciliter l'accès des astronomes enregistreurs de l'information dans ses services, avec des liens avec les archives d'observatoires, les journaux académiques et les autres bases de données, en particulier ACS et VOED. Le CDS est l'un des acteurs majeurs du développement de l'Observatoire Virtuel IAO astronomique, qui vise à donner un accès transparent et immédiat des ressources en ligne de l'astronomie.**

**Le CDS développe des services largement utilisés par la communauté: SIMBAD la base de données de référence pour les identifications et la bibliographie des objets hors système solaire; VizieR, base de données de référence pour les grands relevés du ciel; les catalogues et les tables publiques dans les journaux académiques, et de plus en plus pour d'autres types de données structurées aux publications; l'Atlas interactif du ciel Ailer, portail qui permet d'accéder à la collection d'images de référence du CDS et aux images digitales dans les archives des observations act et quibus; il y a aussi depuis 2007 le meilleur service d'identification automatisée de très grands catalogues.**

**En 2014, les services ont généré plus de 400 000 requêtes par jour et 5,75 années de données à lecture ont été le fruit de SBAC, ESO Mirror et 18 Ailer sources ACS.**

**IMPLICATIONS SOCIO-ÉCONOMIQUES**

Collaboration avec les 4 Missions scientifiques et les publications des journaux de astronomie de la discipline pour servir les publications de données dans les données. Dès 1995, le CDS a mis en ligne sur Internet les tables publiques dans le journal Astronomy & Astrophysics.

**DONNÉES**

**Estimation du flux de données :** Le CDS fournit des services permettant d'accéder à des données et de les exploiter. Ces données incluent celles qui sont sur demande à disposition, mais aussi celles des archives des observations via des liens d'interopérabilité de l'Observatoire Virtuel.

**Stockage :** Externe (Pb)

**Accessibilité :** Les données et les services sont en libre accès.

**Présence dans des réseaux de données :** Les services sont disponibles via l'Observatoire Virtuel. Le CDS est membre du World Data System (WDS) du IAO, de l'ICSD et a rejoint la certification Data Seal of Approval ([www.data-seal.org](http://www.data-seal.org/)).

**Coût de fonctionnement :** 6,7 M€

**Coût RH :** 38 ETP

**Dimension Internationale**

Le CDS participe depuis 2006 à l'association de l'Observatoire Virtuel européen Euro-VO. Celui-ci est membre de l'IAO.

**Coordonnées :** IAO - Observatoire Virtuel International

**Partenaires :** Euro-VO, FR, DE, ES, IT, UK

**USA :** CA, DC, IL, IN, LA, MI, NY, OH, OR, PA, RI, TN, VA, WI, WV, US

**Site internet :** [www.cds.u-strasbg.fr](http://www.cds.u-strasbg.fr)



## LIST OF RESEARCH INFRASTRUCTURES ASTRONOMY AND ASTROPHYSICS

| TYPE    | NAME             | FULL NAME  |
|---------|------------------|--|
| IO      | ESO              | European Southern Observatory                                |
|         | ESO ALMA         | Atacama Large Millimeter/Submillimeter Array                 |
|         | ESO EELT         | European Extremely Large Telescope                           |
|         | ESO LSP          | La Silla & Paranal Observatory                               |
| VLRI    | CFHT             | Canada-France-Hawaii Telescope                               |
| VLRI    | IRAM             | Institute for Radio Astronomy at Millimeter wavelength       |
| RI      | CDS              | Strasbourg Astronomical Data Centre                          |
| RI      | ESO-INSTRUM      | Instrumentation for ESO large telescopes                     |
| RI      | HESS             | High Energy Stereoscopic System                              |
| RI      | ILT-LOFAR FR     | International Low Frequency Radio Array Telescope - LOFAR FR |
| Project | CTA <sup>1</sup> | Cherenkov Telescope Array                                    |

# CNRS Committee for TGIR

- Official visit requested by CNRS
- Visit took place September 15, 2016
- We CDS presented as an astronomy reference data centre that is ***unique, essential, and works well***

## Positive response:

- *Nous avons tous été impressionnés par la qualité de cette structure, de remarquable visibilité internationale, et qui servira à l'évidence de référence dans la construction des politiques de données de nombreuses infrastructures de recherche.*
- *Vous pouvez être assuré de notre soutien renouvelé dans le financement du CDS, dont nous espérons pouvoir accompagner au meilleur niveau les activités et les investissements futurs.*



# HCERES evaluation – in progress

- *Haut conseil de l'évaluation de la recherche et de l'enseignement supérieur*
- 5 year evaluation of OAS
- CDS reports for
  - 2011 – 2016 activities and future perspectives
  - CDS as a national observing service
  - CDS Science team as part of the OAS
- Prospective and Strategy – provided to Council
- Visiting committee expected early 2017

# Highlight: CDS Content 2015-2016



Astronomical Objects :

*~8.5 million objects, ~24 million ID, 14 million cites*  
*+0.5 million objects, +1.2 million IDs, 2.2 million c.*



Catalogue Service :

*15366 Catalogues +1270 Catalogues, +64*  
*Catalogues + associated data (18k images, 2M*  
*spectra), + 2 surveys LAMOST, CoRoT*



Visualisation and integration :


*325+ HiPS surveys: images (105 TB), catalogues,*  
*archives +40% HiPS, +100% by volume*



X-Match: All CDS catalogues

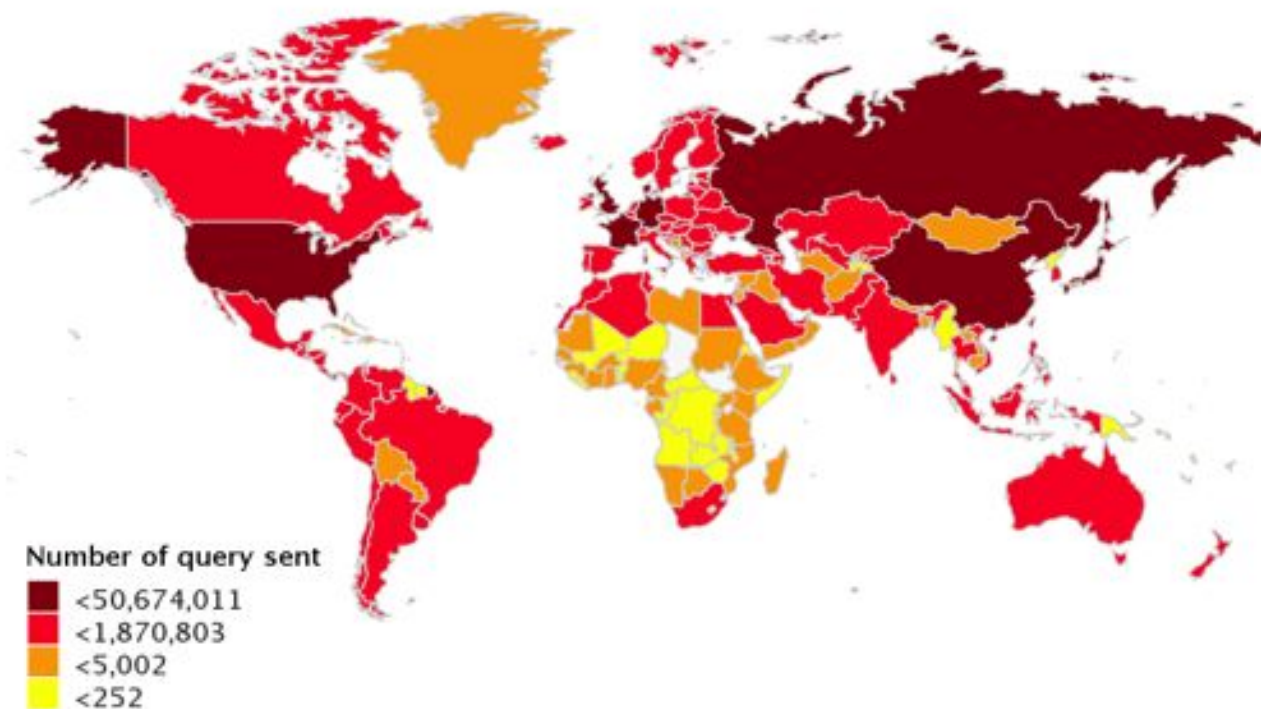


# Highlights: citations and usage

- **Textual citations identified by ADS** 
- In 2015, **695** refereed papers cited the word **SIMBAD**, **384** the word **VizieR**, and **81** the word **Aladin**
- Usage Statistics – in detailed presentations
  - **SIMBAD** ~510 000\* queries/day
  - **VizieR** ~380 000 queries/day
  - Cross-match ~600 jobs/day
  - **Aladin** + 11% actions/day, hosts +10%

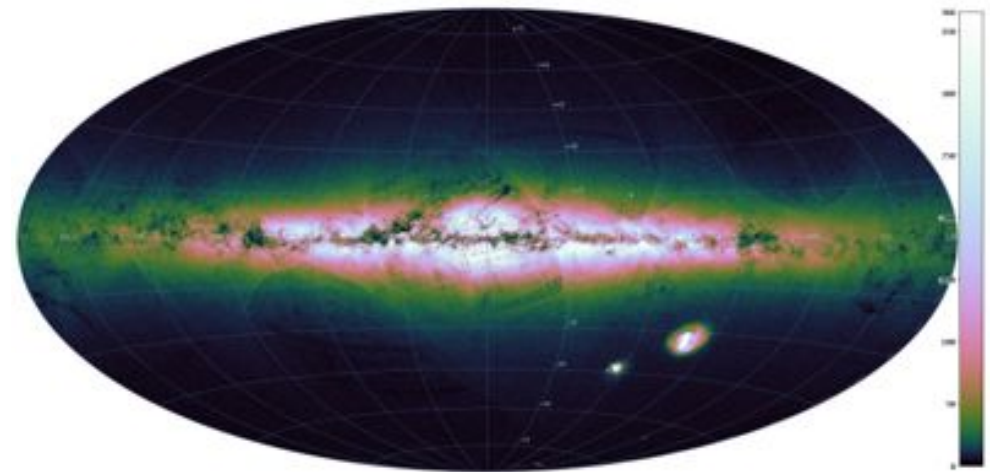
# Highlights: CDS services are widely and heavily used

- *~800 000/day in 2015 to ~890 000/day in 2016*
  - *(but working to reduce by making queries 'smarter'/'efficient')*



# Highlights: Gaia DR1 in CDS Services

- CDS a member of Gaia Coordination Unit 9
- Partner data centre for DR1
  - Planning, rehearsals, strict non-disclosure before release, Release 14 Sept 2016
- Gaia DR1 at CDS:
  - VizieR
  - TAPVizieR
  - Cross-Match Service
  - Aladin
  - HiPS catalogue



*Density map of ~1 billion Gaia sources generated by CDS*

# Highlight: VizieR Associated Data Service

- Data associated with publications: spectra, time series, images

Search associated data among the VizieR catalogues

This web page is an access to the VizieR Associated data (images, spectra, timeseries, SED) which comes from publications. This tool is the result of the documentation assigned by the authors of the catalogues (in particular by A&A authors) and supervised by the CDS documentalists team (see the VizieR ingestion tool).

**VO compatibility**  
The meta-data and the search engine are built according to the VO framework (SIA, SSA, ObsTAP) and can so be queried by VO softwares. The data are gathered with the Sggsda engines, and the VO data model ObsCore has been chosen for the documentation.

Simple search ↔ ObsTAP Query

Search by position: 40 6698792 -0 0132689 radius 1 deg

Search by spectral band: min max μm

Search by time data: start stop (MJD)

Search by catalog/identifier:

Spectrum / Time series  Image

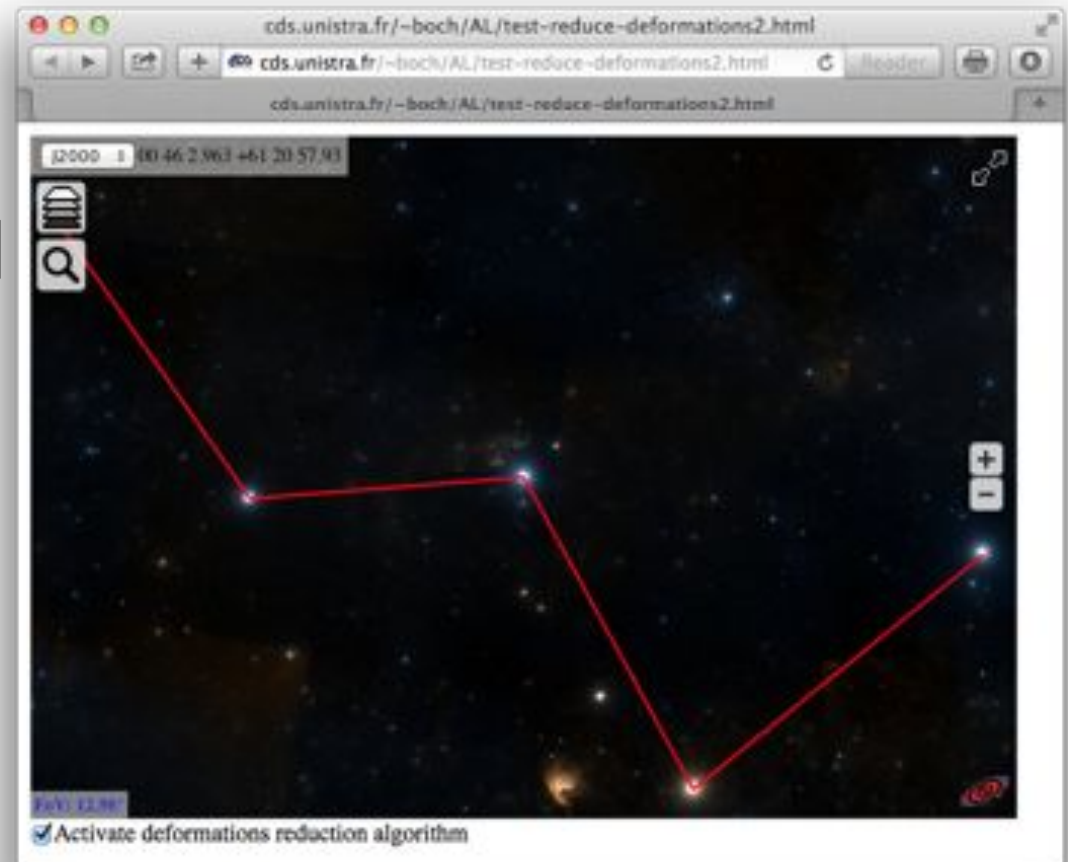
500 entries max

Show 10 entries Filter

| Preview | Target  | Data collection | Ra     | Dec    | Band min (nm) | Band max (nm) | Begin time (MJD) | End time (MJD) | Facility |
|---------|---------|-----------------|--------|--------|---------------|---------------|------------------|----------------|----------|
|         | NGC1055 | J/A+A/568/A91   | 40.437 | 0.443  | 315.000       | 390.000       |                  |                | SCSS     |
|         | NGC1088 | J/A+A/568/A91   | 40.670 | -0.013 | 315.000       | 390.000       |                  |                | SCSS     |

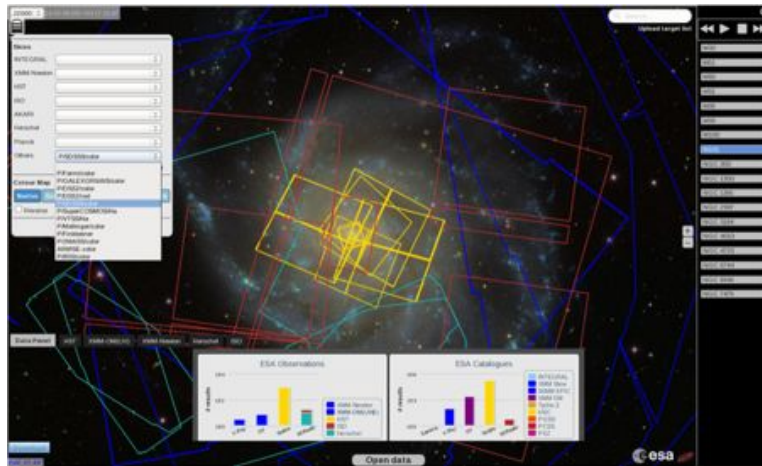
# Highlight: Aladin Lite

- Implementations
- Critical improvements enable CDS Portal and ESASky
- Collaborations improve data quality and software

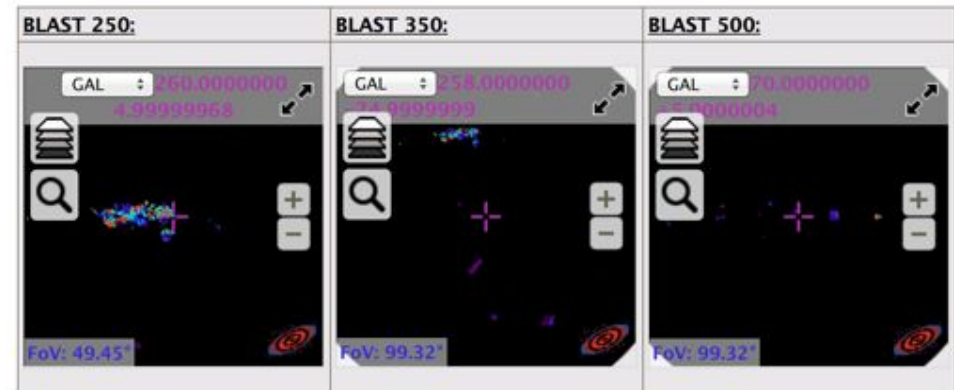


# Aladin Lite / HiPS implementations

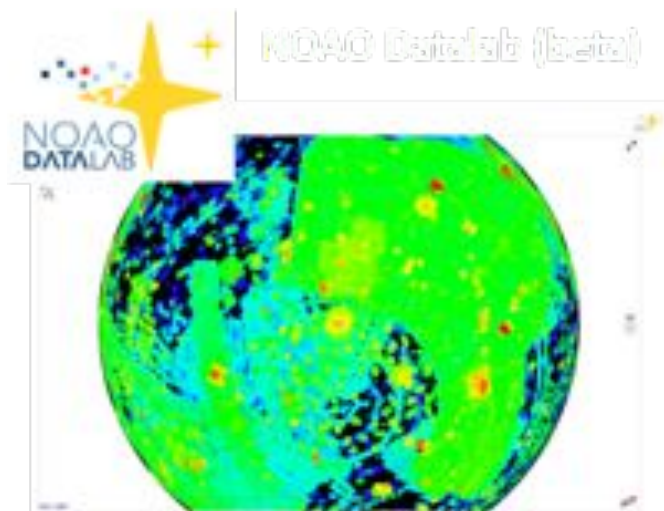
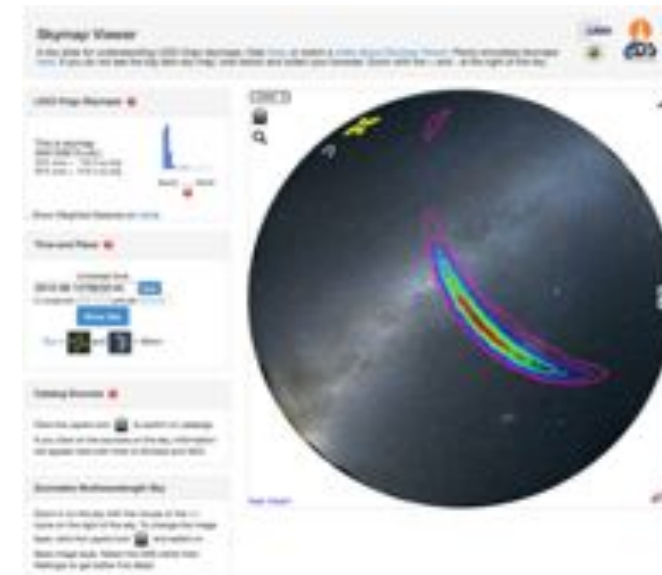
ESASky



IRAP/CADE



LIGO



+ many more



# CDS Impact - dissemination

- Papers
  - Refereed papers provided (28 in 2015, 15 in 2016)
  - ADASS 2015 – 13 poster papers, 1 oral
  - *ADASS 2016 – 6 posters, 5 oral presentations*
- Invited talks include:
  - **LSST@Europe2** Meeting (Allen)
  - **ASKAP 2016** Meeting (Vollmer)
  - **SCIOPS** (ESA, ESO) (Allen, Genova)
  - High level Data Sharing presentations (Genova)



# ADASS



# Highlight: Specific Training Events

- The CDS Student Workshop on “Accessing and Analyzing Multiwavelength Astronomical Data”
  - SAAO, May 2016
- CDS tutorials at the Science Writing for Young Astronomers (SWYA) school
  - Puerto Varas, Chile in April 2016
- CDS tutorials at the ASTERICS DADI VO School in Madrid, December 2015 *(and preparations for the upcoming ASTERICS DADI School in Strasbourg to be held in November 2016.)*
- VO tutorials in various Doctoral Schools in Paris in march and May of 2016

# Hands-on with CDS tools



# Highlights

- Françoise Genova – Étoile de l'Europe prize
  - Prize of the *French Ministry of National education, Higher Education and Research*, for the CoSADIE project
- AENEAS Horizon 2020 Project approved
  - Advanced European Network of E-Infrastructures for Astronomy with the SKA

# CDS Staff

- Mihaela Buga was successful in CNRS competition for a documentalist position (November 2015)
- François Ochsenbein departed after being at CDS from the very beginning (1971/72)
  - Instrumental in the creation and operations of many aspects of the CDS, in particular the catalogue services

# Students, Postdocs, Contractors

- **Maxime Beuret** successfully defended his PhD thesis Sept 2016 (*supv. Cambrésy*)
- **Quentin Agobert** started PhD Sept 2016 (*supv. Siebert*)
- **Heddy Arab** started as Postdoc on VIALACTEA (Jan 2016)
- **Jenny Sorce** started as Postdoc on the ASTERICS project (Oct 2016)
- **Chaitra** started as Engineer for ASTERICS
- **Thomas Delacour** – Engineer (SIMBAD/bibliography)
- **Pascal Wassong** – Engineer (Astrodeep)
- **Vincent Kaestle** – Engineer (DJIN bibliography)

# Changes to meet challenges

- CDS service integration and portal
  - New portal in development
- Process for large catalogues integrated more strongly in VizieR
- Re-organisation of Acronyms and Dictionary to enable shared workload. More mobility between SIMBAD and VizieR roles
- Updating/renewing tools used by documentalists
  - DJIN, bibliographic processing



# CDS and VO

- Continuation of high level participation in, and leadership of VO
- VO implementations in CDS services
- HiPS standardisation in progress
- VO work in frame of ASTERICS project
- VO ADASS paper – *re-motivating VO, in particular for engagement with big projects*

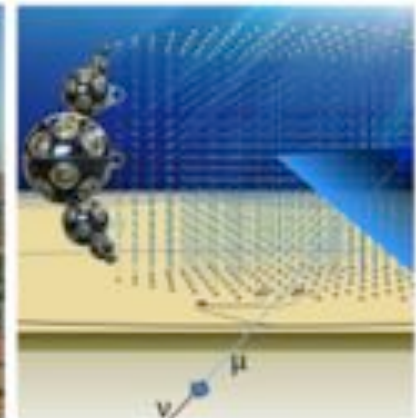
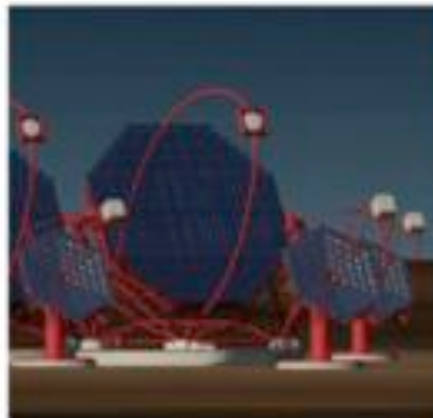
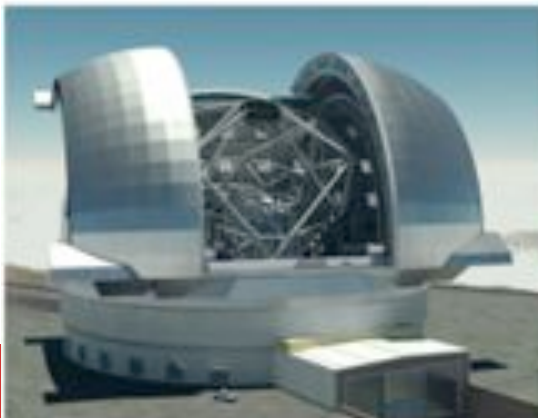
# ASTERICS

- A €15 million Research Infrastructure funded by EC Horizon 2020 framework (2015-2019)
  - To help solve the **Big Data** challenges of European astronomy and astroparticle physics
  - To provide direct interactive access to the best European astronomy data in an international framework
  - *Cross-cutting synergies and common challenges*

# concept and approach

- Supporting the European Strategy Forum on Research Infrastructures (ESFRI)
- Aspiring ESFRI projects + pathfinders
- Other world-class research infrastructures
  - e.g. LOFAR, Euclid, LSST, Virgo

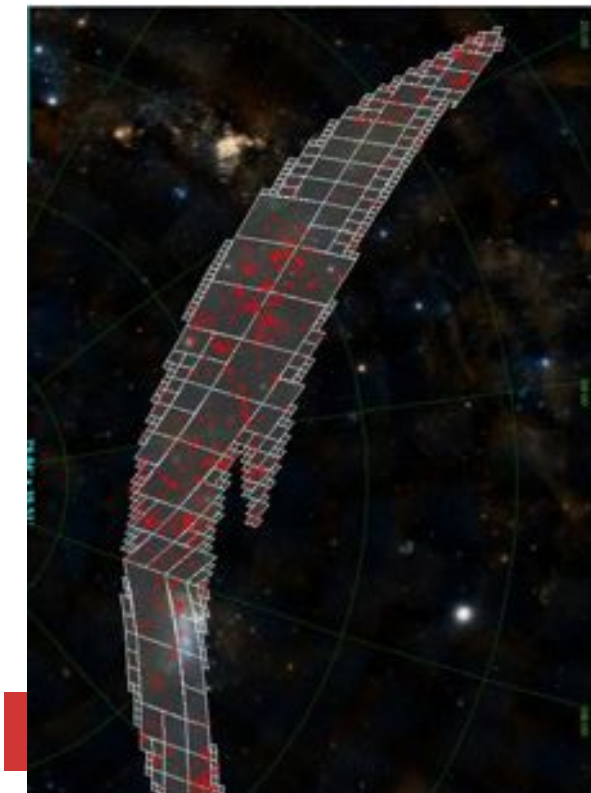
European Strategy Forum  
on Research Infrastructures







# ASTERICS connections: *gravitational waves*

ASTERICS fostered  
use of VO for grav  
wave EM follow-up




### Skymap Viewer

A sky atlas for understanding LIGO-Virgo skymaps. Help [here](#), or watch a video [about Skymap Viewer](#). Plenty simulated skymaps [here](#). If you do not see the big dark sky map, look below and widen your browser. Zoom with the + and - at the right of the sky.

LIGO  

#### LIGO-Virgo Skymaps

This is skymap  
GW150914:LAL1.  
50% area = 148.0 sq deg  
90% area = 816.4 sq deg





South North

Show Weighted Galaxies (or [table](#)).


#### Time and Place

Universal time  
2015-09-14T09:50:45

E Longitude  Latitude

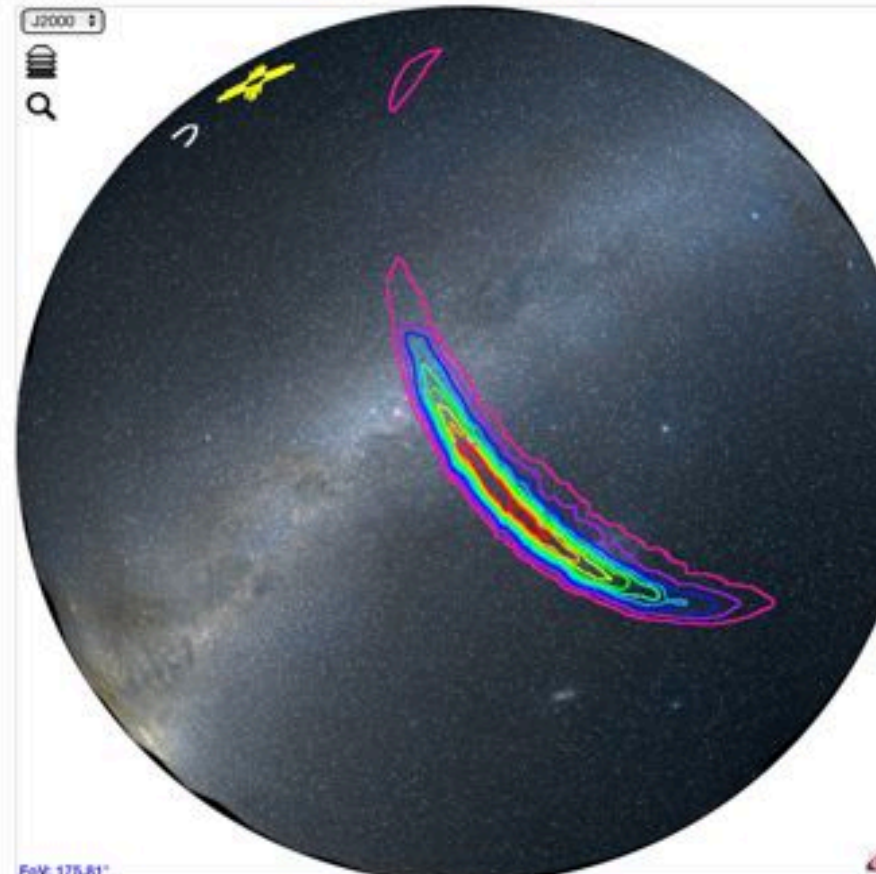
Sun =  and  = Moon

#### Catalog Sources

Click the Layers icon  to switch on catalogs.  
If you click on the sources on the sky, information will appear here with links to Simbad and NED.

#### Zoomable Multiwavelength Sky

Zoom in on the sky with the mouse or the +/- icons on the right of the sky. To change the image



FeV: 175.81'

# LISA VIII

[Home](#)

[Program](#)

[Venue and  
Travel](#)

[Participants](#)

[Social  
Events](#)

[Abstract  
Submission](#)

[Register](#)

[Contact](#)

## **Library and Information Services in Astronomy**

*"Astronomy Librarianship in the era of Big Data and Open Science"*

*Strasbourg, European Doctoral College, France, June 6-9, 2017*

Library and Information Services in Astronomy (LISA) is a series of scientific meetings for librarians and scientists that aims to provide a platform to discuss the state of the art of information maintenance, retrieval, delivery, and preservation and to learn from invited experts the directions in which our profession is moving.

LISA conferences cover such diverse topics as organization and management of books, journals, and specialized materials; electronic publishing (note that astronomy is a leader in the field); bibliographic and full text databases of astronomical literature; reports on collaborative projects.



# Summary

- A busy year with many transitions
- Very good data ingestion rates and service usage statistics
- Connections made with partners, CDS visible in the community
- Interactions/feedback from users
- Projects finishing and new ones to begin
- VO – ASTERICS in full operation
- High level strategy prepared for TGIR visit and HCERES evaluation