

# UCLA

## Presentations

### Title

The Durability and Fragility of Knowledge Infrastructures: Lessons Learned from Astronomy

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<https://escholarship.org/uc/item/01r7h46q>

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### Publication Date

2016-10-16

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# The Durability and Fragility of Knowledge Infrastructures: Lessons Learned from Astronomy

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ASIST Paper Presentation

Copenhagen, Denmark

October 16, 2016



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Peter Darch



Ashley Sands



Irene Pasquetto



Bernie Randles



Milena Golshan



<https://knowledgeinfrastructures.gseis.ucla.edu>

# Jack Meadows, 1934-2016

The founder of the University of Leicester's astronomy department, who had a minor planet named in his honour, has died

August 18, 2016



By [Jack Grove](#)

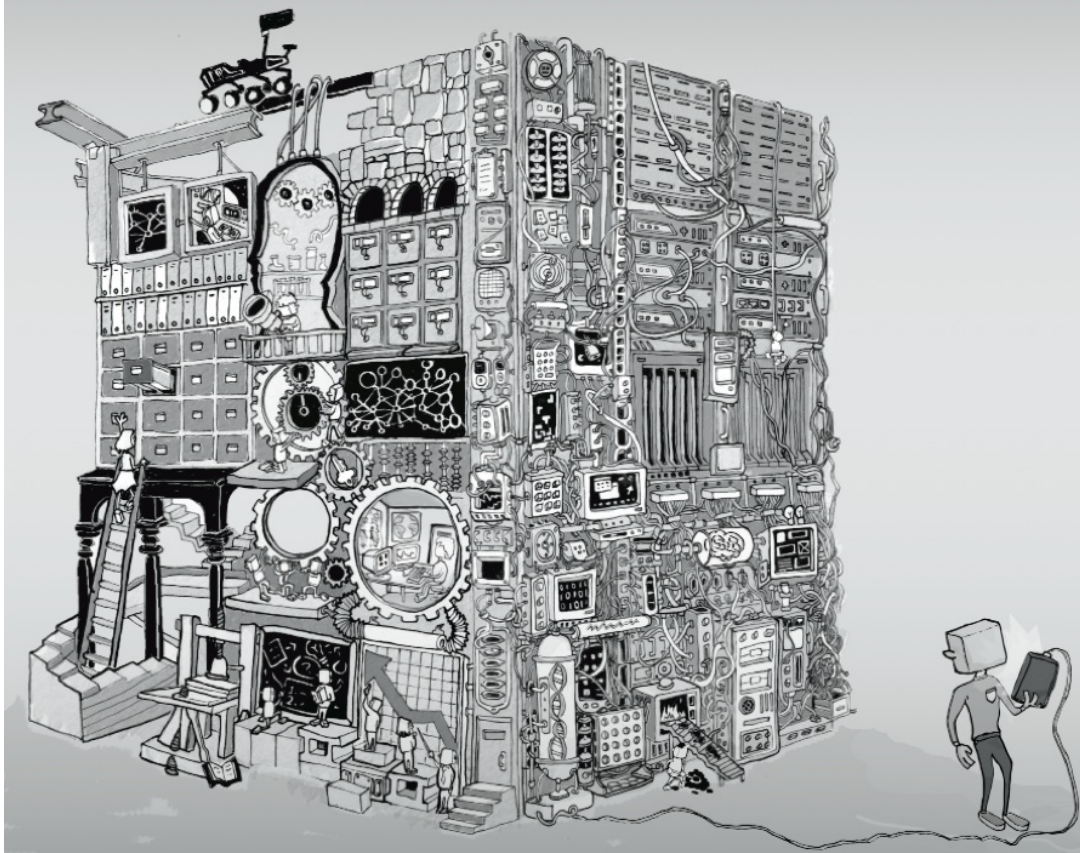
Twitter: [@jgro\\_the](#)

Meadows, A. J.  
(1974).  
*Communication in  
Science*. London:  
Butterworths.



# Knowledge Infrastructures

- What new infrastructures, divisions of labor, knowledge, and expertise are required for data-intensive science?
- How are multi-disciplinary, data-intensive scientific infrastructures established – and dismantled?
- How do data management, curation, sharing, and reuse practices vary among research areas?



Knowledge Infrastructures:  
Intellectual Frameworks and Research Challenges

*Report of a workshop sponsored by the National Science Foundation and the Sloan Foundation  
University of Michigan School of Information, 25-28 May 2012*

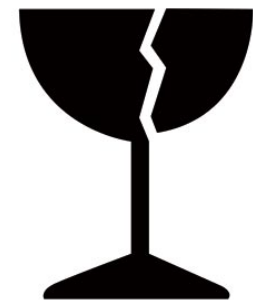
<http://knowledgeinfrastructures.org>

# Research Questions

- How has astronomy developed, deployed, and managed knowledge infrastructures for their data?
- What factors contribute to the durability and fragility of knowledge infrastructures in astronomy?



**DURABLE**



**FRAGILE**

# Durability and Fragility

- Durability
  - Persistence over time
  - Serves intended purposes
  - Resources invested in care and maintenance
- Fragility
  - Subject to failure or degradation
  - Uncertain investments in sustainability



**DURABLE**



**FRAGILE**

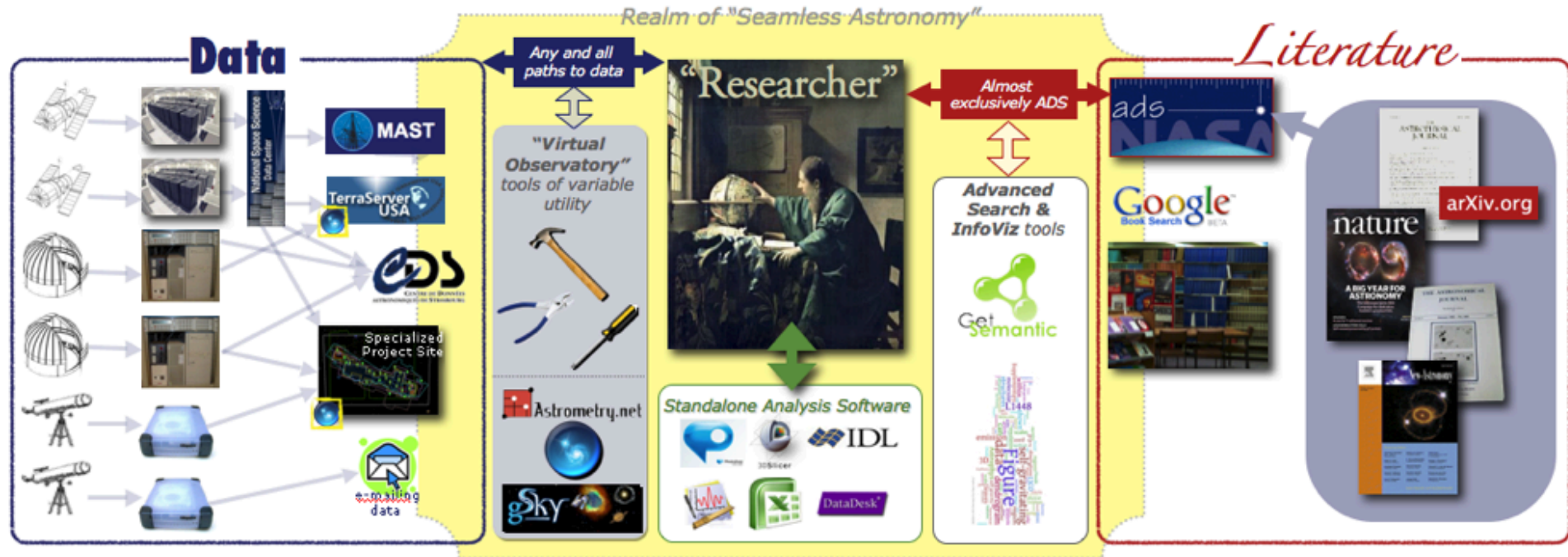
# Research Methods

- Document analysis
  - Public and private documents and artifacts
  - Official and unofficial versions of scientific practice
- Ethnography
  - Observing activities on site
  - Embedded for days or months at a time
- Interviews
  - Questions based on our research themes
  - Compare multiple sites over time





# Seamless Astronomy



[projects.iq.harvard.edu/seamlessastronomy](http://projects.iq.harvard.edu/seamlessastronomy)

Alberto Accomazzi, Christopher Beaumont, Douglas Burke, Raffaele D'Abrusco, Rahul Davé, Christopher Erdmann, Pepi Fabbiano, Alyssa Goodman, Edwin Henneken, Jay Luker, Gus Muench, Michael Kurtz, Max Lu, Victoria Mittelbach, Alberto Pepe, Arnold Rots, Patricia Udomprasert (Harvard-Smithsonian CfA); Mercé Crosas (Harvard Institute for Quantitative Social Science); Christine Borgman (UCLA); Jonathan Fay & Curtis Wong (Microsoft Research); Alberto Conti (Space Telescope Science Institute)

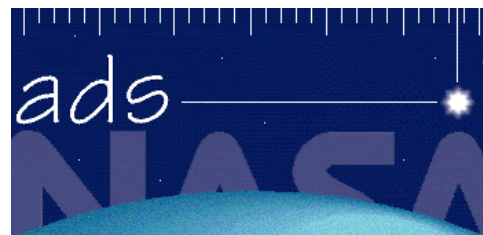


Microsoft  
**Research**



# Astronomy Knowledge Infrastructures

- Observations: continuity over millennia
- Astronomy became digital: 1970s-
- Array of stakeholders: international
- Private and public funding: renewal
- Consensus mechanisms: Decadal survey



# Infrastructure: General chronology

<b>Astronomy Infra-structure</b>	<b>1960-1985</b>	<b>1986-1990</b>	<b>1991-1995</b>	<b>1996-2000</b>	<b>2001-2005</b>	<b>2006-2010</b>	<b>2011-</b>
<i>NASA funded infrastructure</i> observatories missions centers archives & data tools	GSFC IPAC IRAS STScI	Hubble (HST) NED	ADS IRSA SATC	Chandra HEASARC 2MASS MAST NExScI Spitzer WIRE	SOFIA Spitzer Suzaku Swift	Fermi (FGST) Herschel Kepler Palomar (PTF) Planck WISE	NuSTAR
<i>Other infrastructure</i> observatories centers surveys data tools standards	SAO CfA CDS/ SIMBAD FITS		arXiv VizieR	Aladin NVO IVOA SDSS Gemini Subaru	Keck	Dataverse GitHub LSST Pan- STARRS VAO WWT	ADSASS DDT Jupyter Note- book Zenodo DES TMT

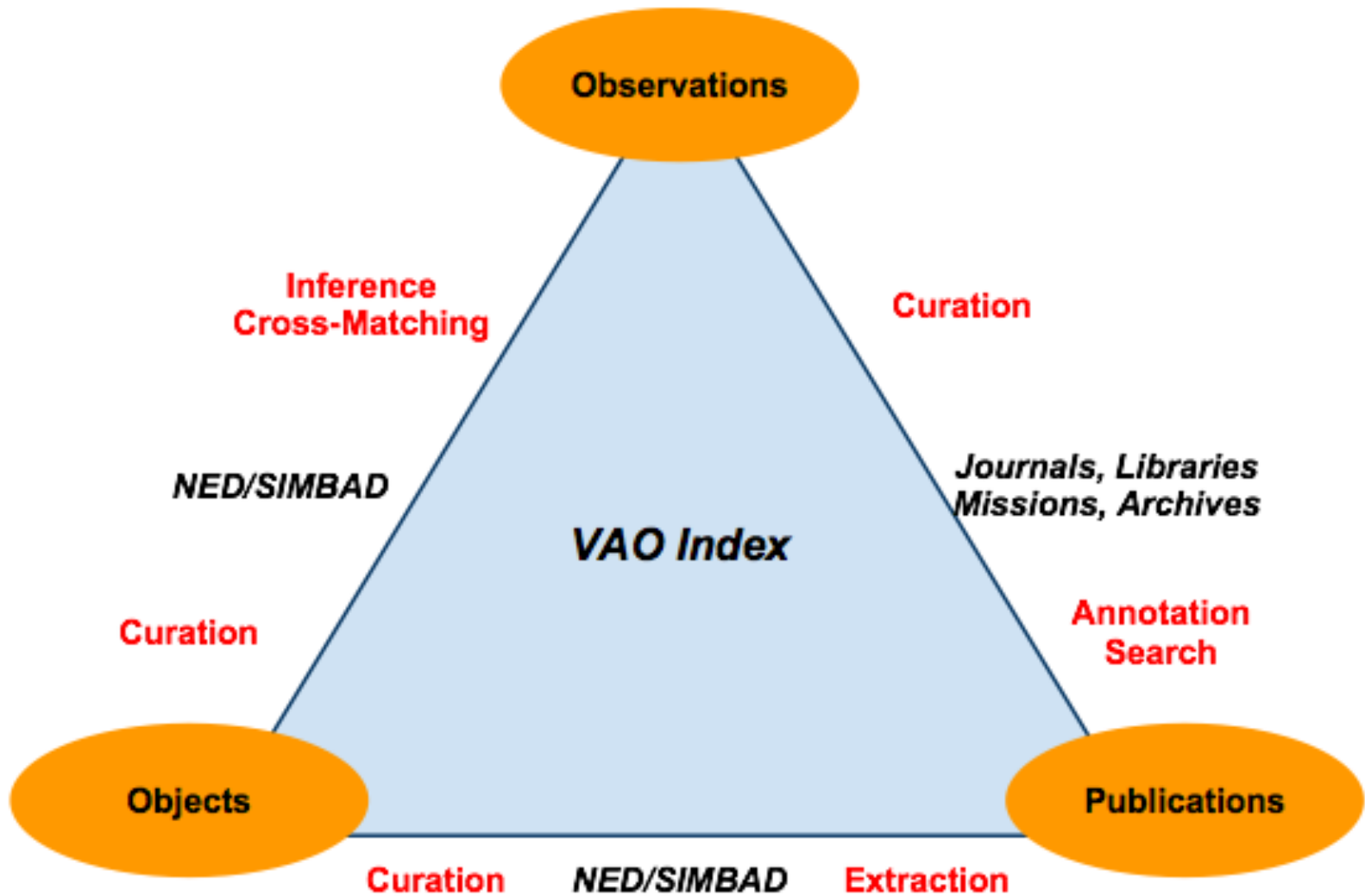


Figure 1. Relationships between Publications, Objects, Observations and the corresponding major actors in the curating process and their activities (in red).

# Data Standards and Infrastructure Fabric



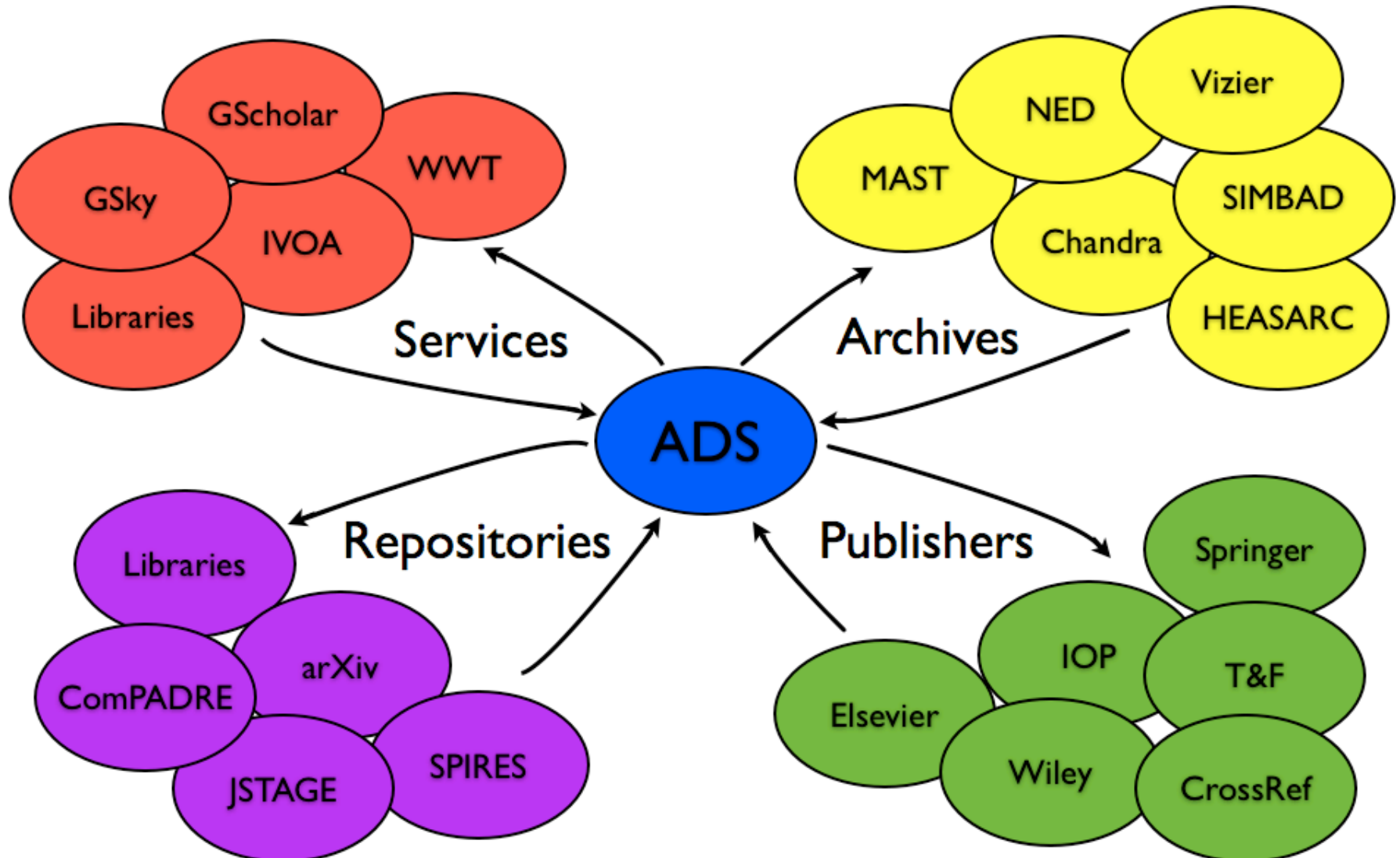
## VO Standards

- Standard Format: VOTable
- Access Protocols: ADQL, TAP, SIAP, SSAP

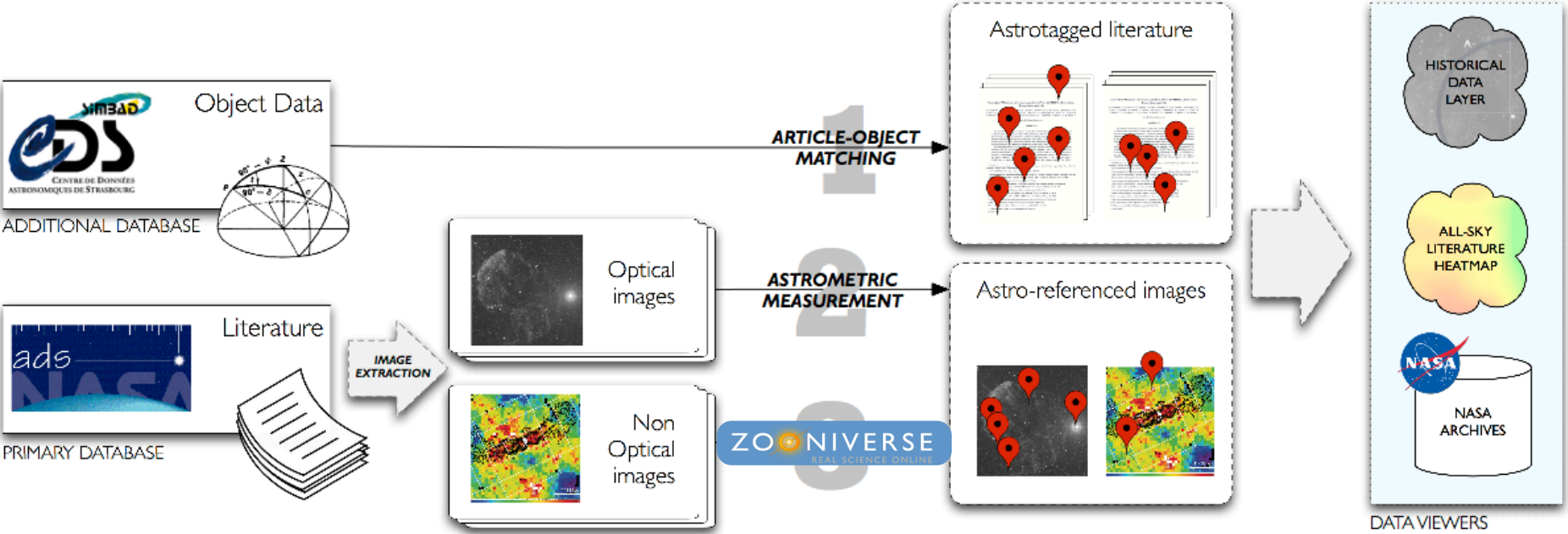


and others

# ADS Collaborators



# Seamless Astronomy: ADS All Sky Survey





# Some Durability Features

- Data Standards
  - Flexible Image Transport System (FITS)
  - Coordinate systems
- Metadata and Discovery Systems
  - Centre de Données Astronomiques de Strasbourg (CDS)
  - NASA Extragalactic Database (NED)
  - Astrophysics Data System (ADS)
- *Infrastructure Fabric*
  - *Virtual Astronomy Observatory*
  - *International Virtual Observatory of Astronomy*

FITSNAME	FILENAME	DIMENS	BITPI	BSCALE	BZERO	0
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TABLE	u2717z01p.tr1	1Fx58R	1Fx58			
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6	u271iy01t_cvt.q0h	800x800x4	16S	1.	0.	U
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[https://ned.ipac.caltech.edu/level5/Golombek/Golombek2\\_2.html](https://ned.ipac.caltech.edu/level5/Golombek/Golombek2_2.html)



Observatoire astronomique de Strasbourg



# Some Fragility Features

- Ground vs. Space-Based Missions

- Ground: SDSS, LSST, Keck
- Space: Hubble, Chandra

- Empirical vs. Theoretical Inquiry

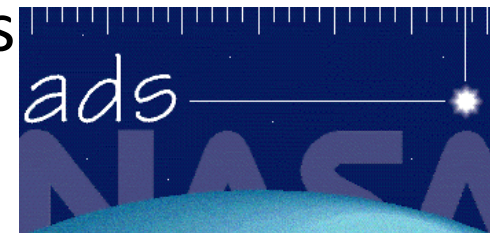
- Empirical: acquire and analyze observations
- Theoretical: models, simulated data

- Sky Surveys vs. Investigator-Led Inquiry

- Surveys: Systematic documentation of night sky
- Investigators: Question-driven studies

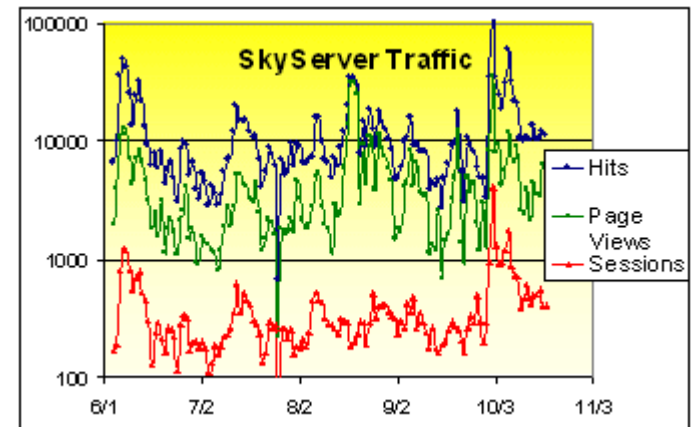
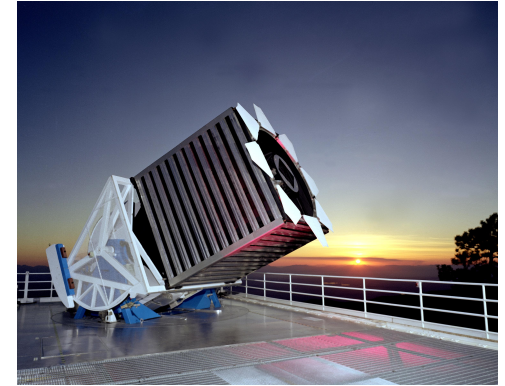
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5	u271iy01t_cvt.d0h	800x800x4	16S	1.	0.	U
TABLE	u271iy01t_cvt.d0h.tab	49Fx4R	49Fx4			
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7	u271iy01t_cvt.q1h	14x800x4	16S	1.	0.	U
TABLE	u271iy01t_cvt.q1h.tab	3Fx4R	3Fx4R			
8	u271iy01t_cvt.shh	965	16U	1.	0.	U
TABLE	u271iy01t_cvt.shh.tab	3Fx1R	3Fx1R			
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[https://ned.ipac.caltech.edu/level5/Golombek/Golombek2\\_2.html](https://ned.ipac.caltech.edu/level5/Golombek/Golombek2_2.html)



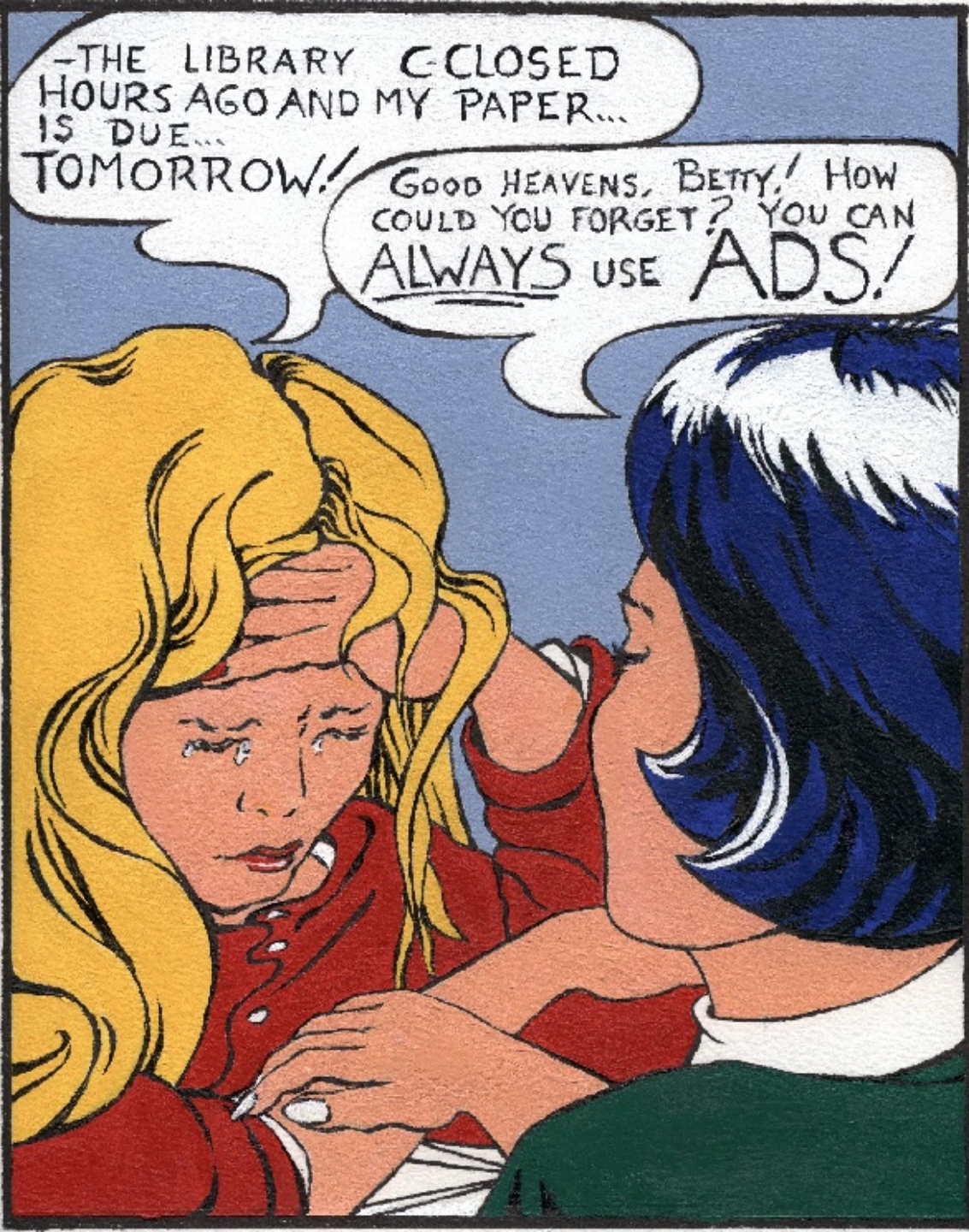
# Conclusions

- Infrastructures are fragile
- Durability is an accomplishment
- Visible infrastructure
  - Instruments
  - Institutions
- Invisible infrastructure
  - Data, metadata, provenance...
  - Information work



Telescope for the Sloan Digital Sky Survey, Apache Point, New Mexico

LSST All Hands Meeting, August 2014, Arizona State University. Arrow to Peter Darch



-THE LIBRARY CLOSED HOURS AGO AND MY PAPER... IS DUE... TOMORROW!

GOOD HEAVENS, BETTY, HOW COULD YOU FORGET? YOU CAN ALWAYS USE ADS!

Slide: Michael Kurtz, Harvard-Smithsonian Center for Astrophysics

# Acknowledgements



Christine Borgman



Peter Darch



Ashley Sands



Irene Pasquetto



Bernie Randles

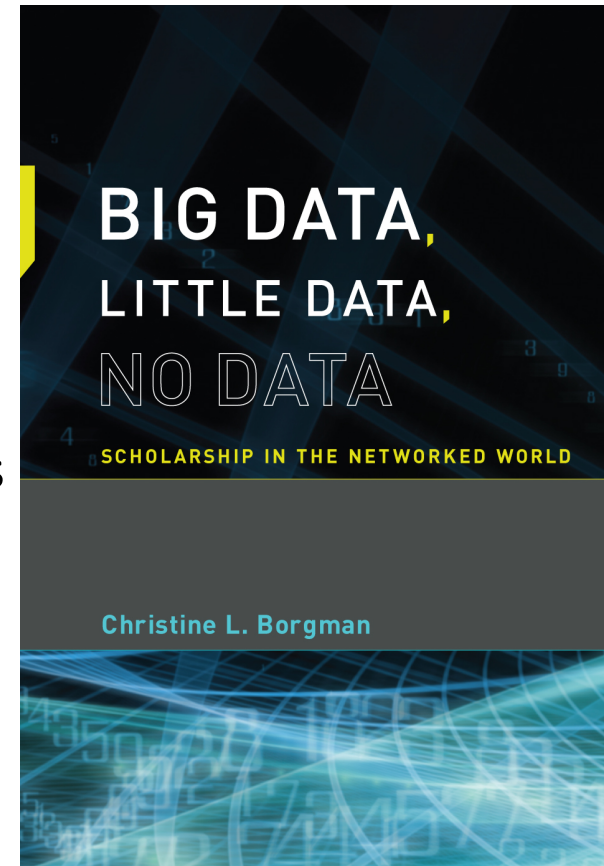


Milena Golshan



# Big Data, Little Data, No Data: Scholarship in the Networked World

- Part I: Data and Scholarship
  - Ch 1: Provocations
  - Ch 2: What Are Data?
  - Ch 3: Data Scholarship
  - Ch 4: Data Diversity
- Part II: Case Studies in Data Scholarship
  - Ch 5: Data Scholarship in the Sciences
  - Ch 6: Data Scholarship in the Social Sciences
  - Ch 7: Data Scholarship in the Humanities
- Part III: Data Policy and Practice
  - Ch 8: Releasing, Sharing, and Reusing Data
  - Ch 9: Credit, Attribution, and Discovery
  - Ch 10: What to Keep and Why



MIT Press, 2015