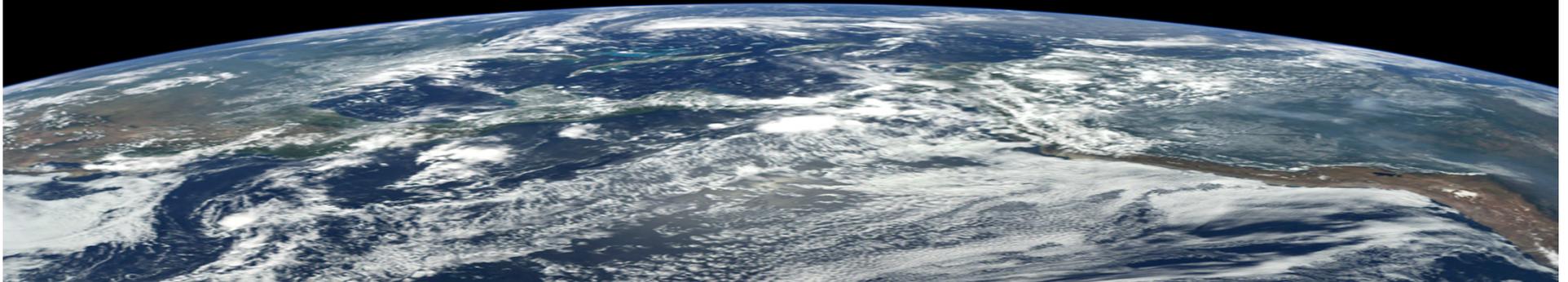


The Information Visualization MOOC Plug-and-Play Microscopes Mapping Science Exhibit

Katy Börner, Indiana University, USA
Frontiers of Visualization Meeting
Networking and Information Technology R&D (NITRD) Program
May 2, 2014



Overview

This course provides an overview about the state of the art in information visualization. It teaches the process of producing effective visualizations that take the needs of users into account.

Among other topics, the course covers:

- Data analysis algorithms that enable extraction of relationships in data
- Major visualization and interaction techniques
- Discussions of systems that drive research and development.

A certificate will be issued upon successful completion. Please watch the introduction video to get better acquainted with the course.

Katy Börner, Ph.D.
Indiana University

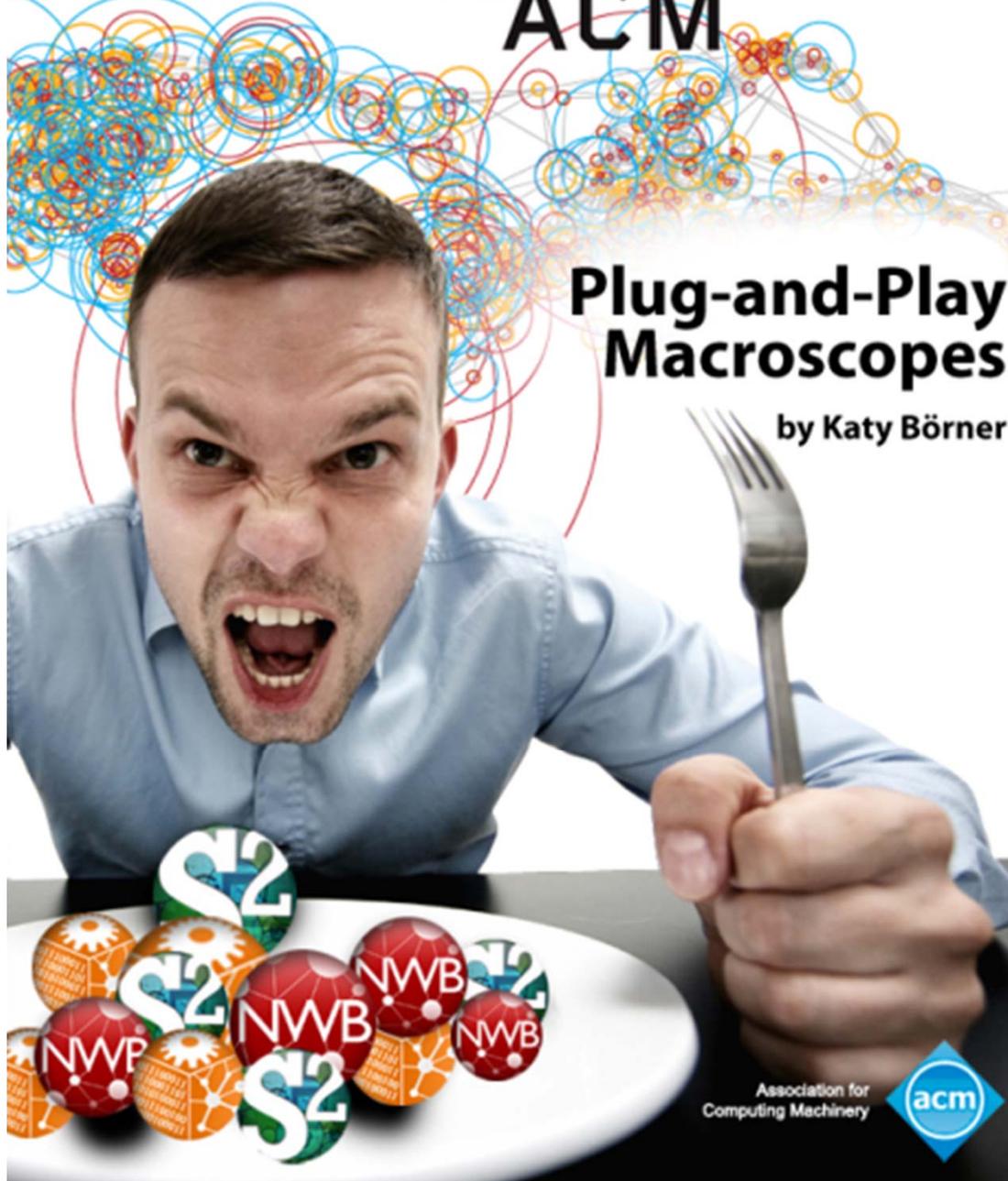


[Sign Up For The Course](#)

Register for free at <http://ivmooc.cns.iu.edu>. Class restarted on Jan 28, 2014.

COMMUNICATIONS OF THE ACM

CACM.ACM.ORG



Plug-and-Play Macroscopes

by Katy Börner

Börner, Katy. (March 2011).
Plug-and-Play Macroscopes.
Communications of the ACM,
54(3), 60-69.

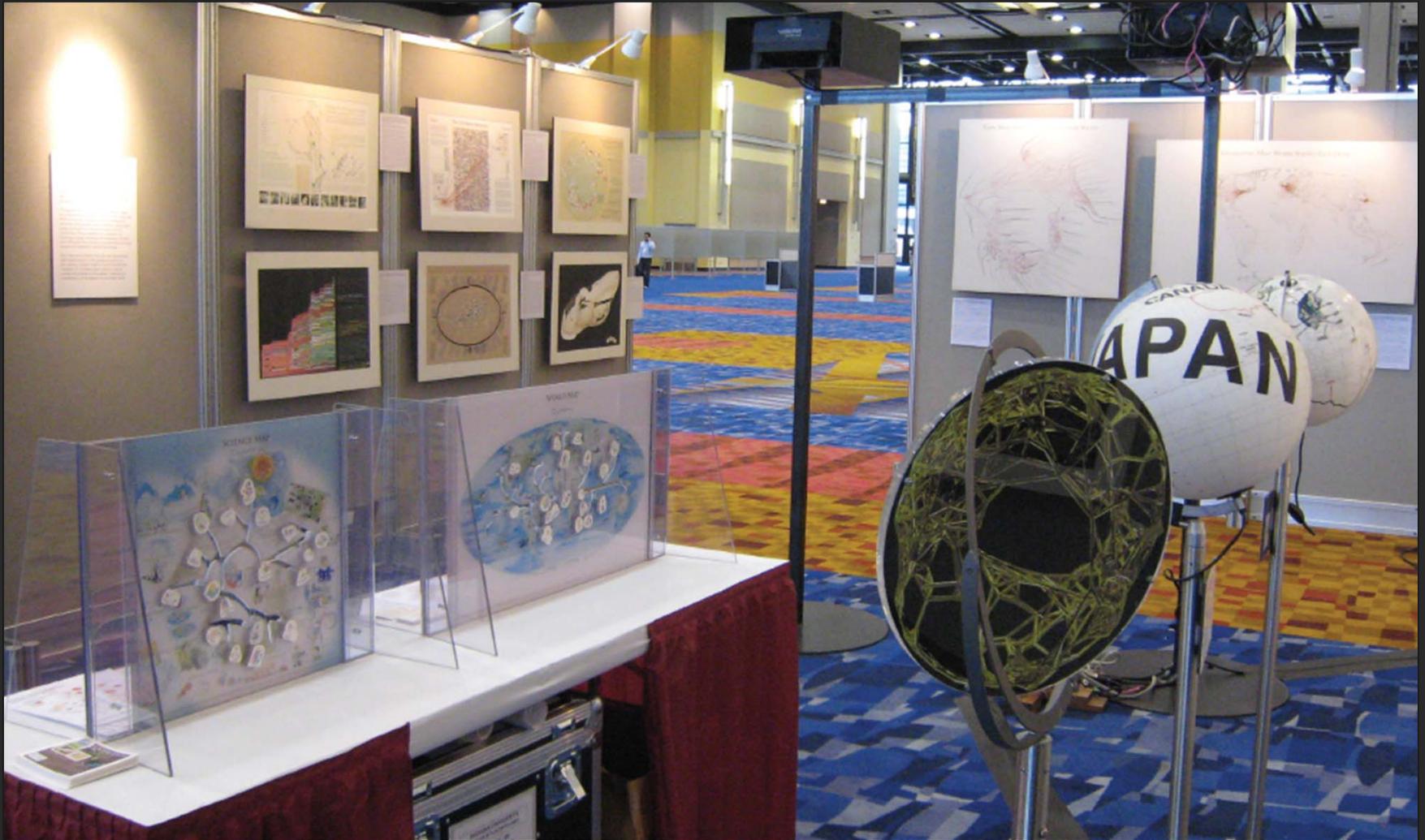
Video and paper are at
<http://www.scivee.tv/node/27704>

Association for
Computing Machinery

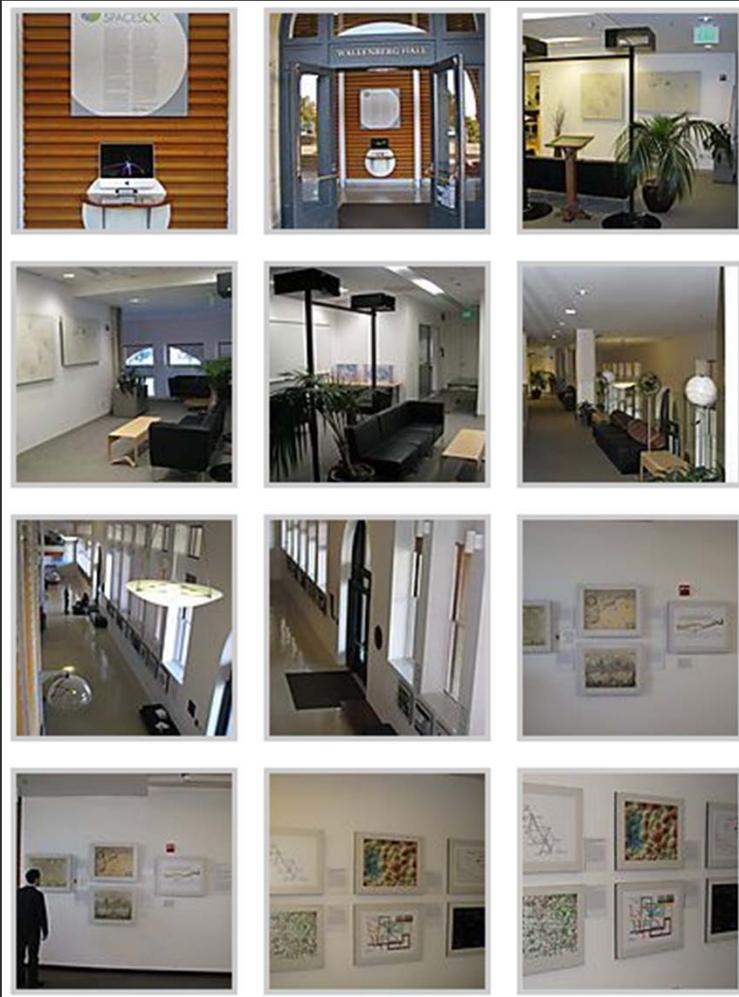


Places & Spaces: Mapping Science Exhibit

<http://scimaps.org>



After nine years, there now exist 90 out of 100 maps.



Mapping Science Exhibit at MEDIA X in the Wallenberg Hall, Stanford University
<http://mediax.stanford.edu>

113 Years of Physical Review

This visualization aggregates 389,899 articles published in 720 volumes of 11 journals between 1893 and 2005. The 91,362 articles published from 1893 to 1976 take up the left third on the map. In 1977, the Physical Review introduced the Physics and Astronomy Classification Scheme (PACS) codes, and the visualization subdivides into the top-level PACS codes. The 217,503 articles from 1977 to 2000, for which good citation data is not available, occupy the middle third on the map. The 80,634 articles from 2001 to 2005, for which good citation data is available, fill the last third of the map.

Each vertical bar is subdivided vertically into the journals that appear in it with height proportional to the number of papers, and each journal is subdivided horizontally into the volumes of the journal appearing in the column.

On top of this base map, all citations from the papers in every top-level PACS code in 2005 are overlaid and then drawn from the source area to the individual volumes containing papers cited.

The small Nobel Prize medals indicate the 24 volumes containing the 26 papers appearing in Physical Review for 11 Nobel prizes between 1990 and 2005. Each year, Thomson ISI predicts three Nobel Prize awardees in physics based on citation counts, high impact papers, and discoveries or theories worthy of special recognition. Correct predictions by Thomson ISI are highlighted.

Nobel Prizes in Physical Review

Year of Nobel Prize Winners Publication Year(s) (indicated by Nobel Prize medals on the right)

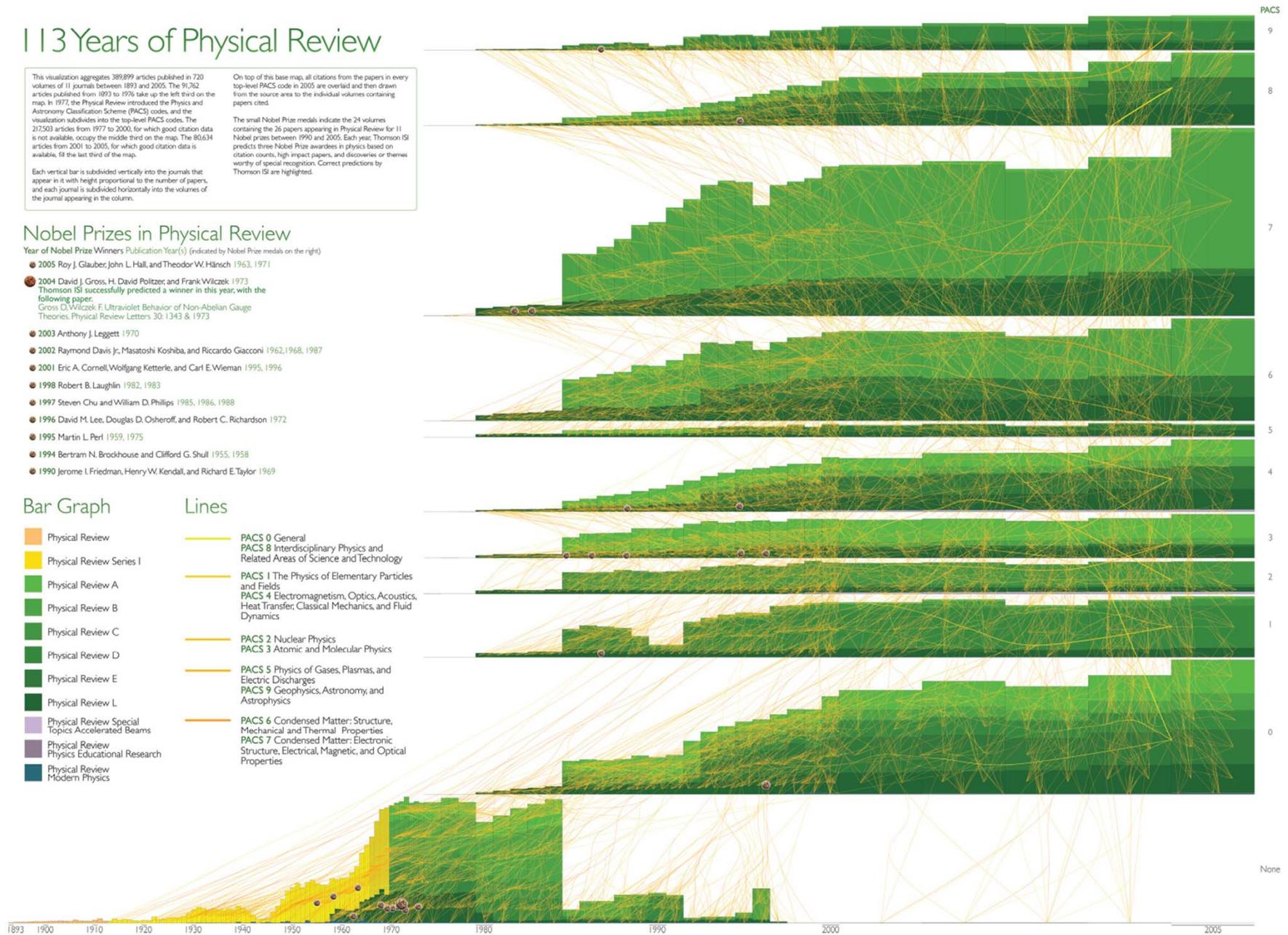
- 2005 Roy J. Glauber, John L. Hall, and Theodor W. Hänsch 1963, 1971
- 2004 David J. Gross, H. David Politzer, and Frank Wilczek 1973
Thomson ISI successfully predicted a winner in this year, with the following paper:
Gross D, Wilczek F. Ultraviolet Behavior of Non-Abelian Gauge Theories. *Physical Review Letters* 30: 1343 & 1973
- 2003 Anthony J. Leggett 1970
- 2002 Raymond Davis Jr., Masatoshi Koshiba, and Riccardo Giacconi 1962, 1968, 1987
- 2001 Eric A. Cornell, Wolfgang Ketterle, and Carl E. Wieman 1995, 1996
- 1998 Robert B. Laughlin 1982, 1983
- 1997 Steven Chu and William D. Phillips 1985, 1986, 1988
- 1996 David M. Lee, Douglas D. Osheroff, and Robert C. Richardson 1972
- 1995 Martin L. Perl 1959, 1975
- 1994 Bertram N. Brockhouse and Clifford G. Shull 1955, 1958
- 1990 Jerome I. Friedman, Henry W. Kendall, and Richard E. Taylor 1969

Bar Graph

- Physical Review
- Physical Review Series I
- Physical Review A
- Physical Review B
- Physical Review C
- Physical Review D
- Physical Review E
- Physical Review L
- Physical Review Special Topics Accelerated Beams
- Physical Review Physics Educational Research
- Physical Review Modern Physics

Lines

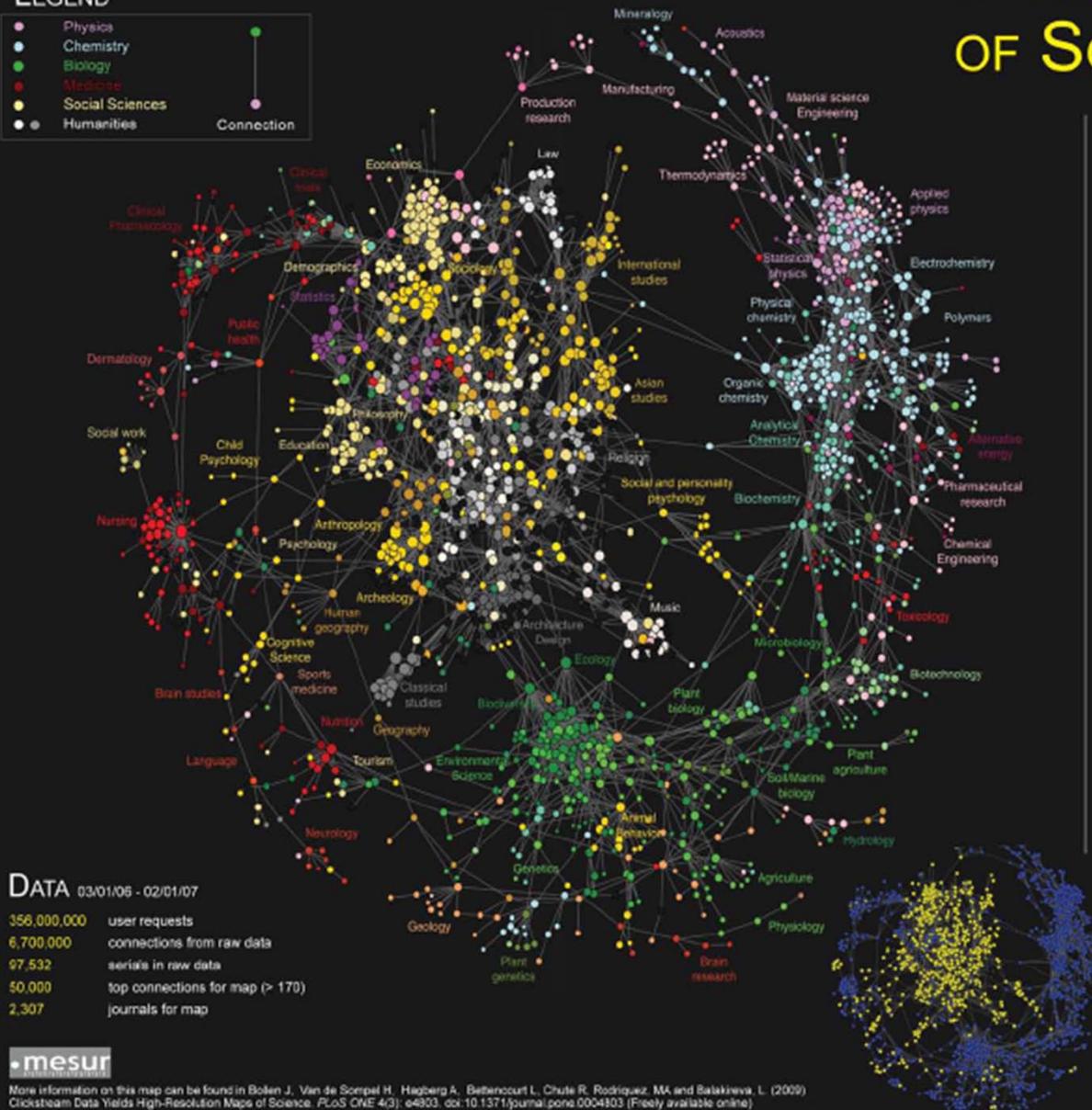
- PACS 0 General
- PACS 8 Interdisciplinary Physics and Related Areas of Science and Technology
- PACS 1 The Physics of Elementary Particles and Fields
- PACS 4 Electromagnetism, Optics, Acoustics, Heat Transfer, Classical Mechanics, and Fluid Dynamics
- PACS 2 Nuclear Physics
- PACS 3 Atomic and Molecular Physics
- PACS 5 Physics of Gases, Plasmas, and Electric Discharges
- PACS 9 Geophysics, Astronomy, and Astrophysics
- PACS 6 Condensed Matter: Structure, Mechanical and Thermal Properties
- PACS 7 Condensed Matter: Electronic Structure, Electrical, Magnetic, and Optical Properties



114 Years of Physical Review - Bruce W. Herr II, Russell Duhon, Katy Borner, Elisha Hardy, Shashikant Penumarthy - 2007

CLICKSTREAM MAP OF SCIENCE

LEGEND



This is the first map created from large-scale, world-wide, scholarly usage data. It visualizes the collective flow of scientists' movements from one journal to another other in their online navigation behavior.

The MESUR project (www.mesur.org) collected a database of nearly 1 billion user requests recorded by the web portals of some of the world's most significant publishers, aggregators and large university consortia, among them Thomson Scientific (Web of Science), Elsevier (Scopus), JSTOR, Ingenta, University of Texas (9 campuses), 6 health institutions, and California State University (23 campuses). All usage logs acquired by the MESUR project contain session identifiers that identify the individual clickstreams of individual scientists navigating from one article to the next.

Pairs of journals are connected when they have a high probability of being followed by each other in users' clickstreams. The circles represent individual journals. A line between two circles indicates that they are strongly connected in either direction. The colors indicate the scientific domain a journal belongs to according to their Dewey Decimal and JCR classification codes that were mapped into the Getty Research Center's Arts and Architecture Taxonomy (AAT) to allow classifications at various levels of detail. The size of circles corresponds to the strength (degree centrality) of a journal's connections in the map. The map is arranged by the Fruchterman-Reingold algorithm that treats connections like springs: connected journals are drawn together, but they are not allowed to get too close.

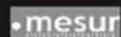
This map is derived from usage data and therefore also reflects the actions of those who read the literature but rarely publish themselves, e.g. practitioners and laypersons. As a result, practitioner-driven domains such as nursing, social work, and tourism studies are prominently featured. The natural sciences vs. the social sciences and humanities emerge as two distinct clusters that are connected via various specific interdisciplinary spokes. Most domains are highly interdisciplinary, but this is more so the case for the social sciences and humanities. Surprisingly, mathematics and computer science are not represented as one specific cluster, but spread-out through the map.

Like citation maps, this map is based upon a particular sample of the scientific community, albeit one that includes non-publishing scientists and practitioners and a much greater sample of publications. From MESUR's database of 1 billion user events, we created a matrix of 6 million connections between approximately 100,000 serials. From that matrix, we selected only 50,000 connections with the highest number of observations, ranging from approximately 40,000 to 170 observations. This subset of connections pertained to the 2,307 most used journals. This procedure may introduce specific biases which require investigation. This map should therefore not be construed as a final map of scientific activity, but as a showcase for the feasibility of tracking scientific activity from usage data. We hope this methodology will provide unique insights into the real-time structure of scientific activity as it can be observed from scholarly clickstream data.

When we cut the AAT taxonomy at the top level, only two directions remain: natural science (blue nodes) vs. the social sciences and humanities (yellow nodes). Some journals along the spokes of the wheel have classifications (colors) that do not correspond to their location in the map. This indicates either that journal in question is highly interdisciplinary, and/or has been assigned a classification that does not correspond to how scientists actually use the particular journal.

DATA 03/01/05 - 02/01/07

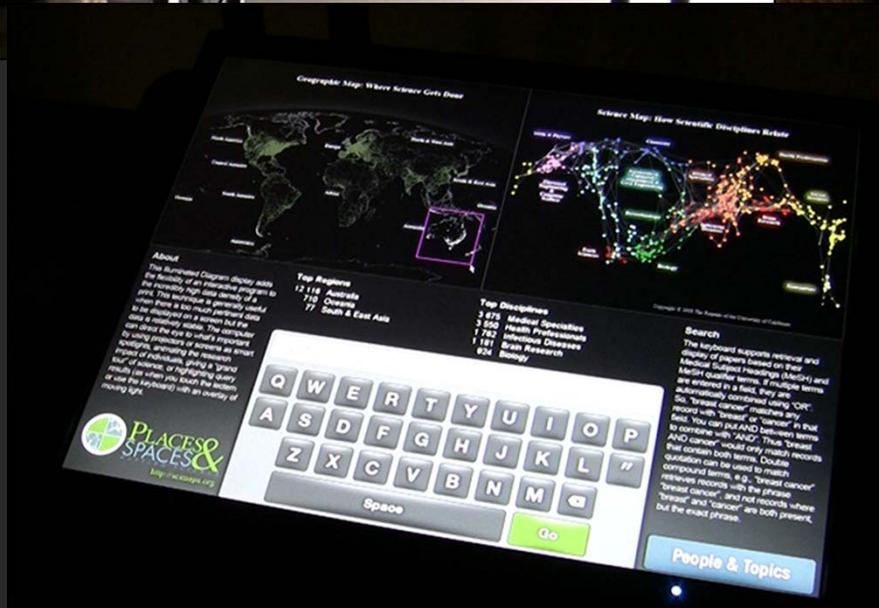
356,000,000	user requests
6,700,000	connections from raw data
97,532	serials in raw data
50,000	top connections for map (> 170)
2,307	journals for map



More information on this map can be found in Bollen J., Van de Sompel H., Hagberg A., Bettencourt L., Chute R., Rodriguez, M.A. and Balakireva, L. (2009) Clickstream Data Yields High-Resolution Maps of Science. *PLoS ONE* 4(3): e4803. doi:10.1371/journal.pone.0004803 (Freely available online)

Design layout by: Jeremy D. Chacon

Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriguez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.



Illuminated Diagram
Display on display at the
Smithsonian in DC.

http://scimaps.org/exhibit_info/#ID

Geographic Map: Where Science Gets Done



Science Map: How Scientific Disciplines Relate



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About

This Illuminated Diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.

Top Five Continents

North America - 4,000 records
South & East Asia - 3,589
Australia - 2,431
Africa - 2,206
South America - 1,562

Top Five Scientific Disciplines

Math & Physics - 4,000 records
Health Professionals - 3,589
Social Sciences - 2,431
Aeronautical, Chemical, Mechanical & Civil Engineering - 2,206
Humanities - 1,562

Search

The keyboard supports retrieval and display of papers based on their Medical Subject Headings (MeSH) and MeSH qualifier terms. If multiple terms are entered in a field, they are automatically combined using "OR". So, "breast cancer" matches any record with "breast" or "cancer" in that field. You can put AND between terms to combine with "AND". Thus "breast AND cancer" would only match records that contain both terms. Double quotation can be used to match compound terms, e.g., "breast cancer" retrieves records with the phrase "breast cancer", and not records where "breast" and "cancer" are both present, but the exact phrase.

Input your search query here.



People & Topics



Science Maps in “Expedition Zukunft” science train visiting 62 cities in 7 months
12 coaches, 300 m long Opening was on April 23rd, 2009 by German Chancellor
Merkel <http://www.expedition-zukunft.de>

References

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains**. In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Volume 37, Chapter 5, pp. 179-255. <http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf>

Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1/

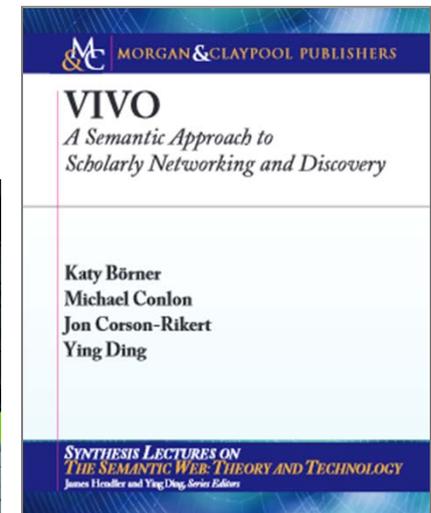
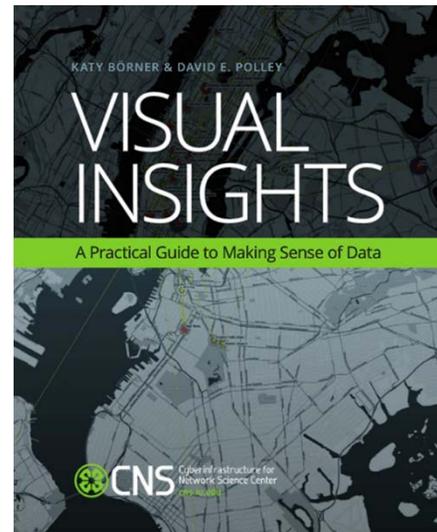
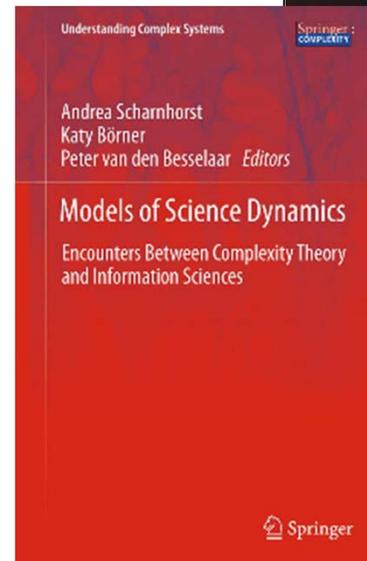
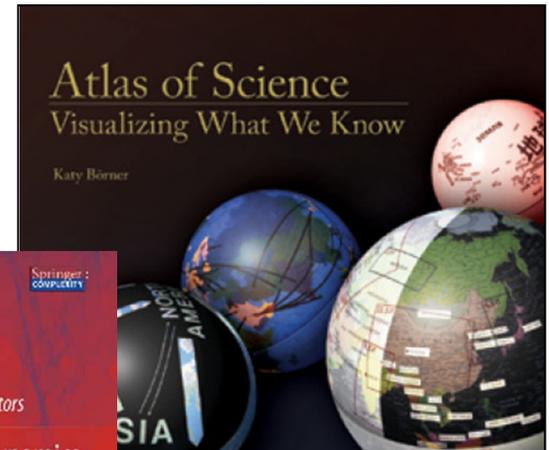
Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science**. In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc., Volume 41, Chapter 12, pp. 537-607. <http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>

Börner, Katy (2010) **Atlas of Science**. MIT Press. <http://scimaps.org/atlas>

Scharnhorst, Andrea, Börner, Katy, van den Besselaar, Peter (2012) **Models of Science Dynamics**. Springer Verlag.

Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. MIT Press.



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We work closely with clients to provide custom-made data, visualization, and software solutions

Research
Open Data and Open Code for Big Science of Science Studies

Latest News
Put your money where your citations are: a proposal for a new funding system (website accessed 9/05/13)

Upcoming Events
OCT 1 Katy Börner attends PIUG 2013 Northeast Conference
10.13 Katy Börner presents Mapping Science Exhibit at WSSF
10.15 Ted Polley & Google Team present IVMOOC at EDUCAUSE
10.22 Katy Börner presents at the SciELO 15 Years Conference

Development
Behind the scenes of the design and development of *AcademyScope*

Outreach
See some of the most fascinating data visualizations in the world.

Videos
Watch Katy Börner's full presentation from TEDxBloomington

Teaching
Successful IVMOOC will be offered again in January of 2014

Our Products
We work closely with clients to provide custom-made data, visualization, and software solutions

All papers, maps, tools, talks, press are linked from <http://cns.iu.edu>

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