

Title: 21st Century Science Maps

Date: Sep 09, 2008 02:00 PM

URL: <http://pirsa.org/08090031>

Abstract: Cartographic maps of physical places have guided mankind's explorations for centuries. They enabled the discovery of new worlds while also marking territories inhabited by unknown monsters. Domain maps of abstract semantic spaces, see scimaps.org, aim to serve today's explorers understanding and navigating the world of science. The maps are generated through scientific analysis of large-scale scholarly datasets in an effort to connect and make sense of the bits and pieces of knowledge they contain. They can be used to objectively identify major research areas, experts, institutions, collections, grants, papers, journals, and ideas in a domain of interest. Local maps provide overviews of a specific area: its homogeneity, import-export factors, and relative speed. They allow one to track the emergence, evolution, and disappearance of topics and help to identify the most promising areas of research. Global maps show the overall structure and evolution of our collective scholarly knowledge. This talk will present an overview of the techniques and cyber-technologies used to study science by scientific means together with sample science maps and their interpretations.

21st Century Science Maps

Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



Category	Count	Subcategory	Description
Books	1,000,000	Books	Books
CDs	100,000	CDs	CDs
DVDs	100,000	DVDs	DVDs
Maps	100,000	Maps	Maps
Videos	100,000	Videos	Videos
Software	100,000	Software	Software
Artifacts	100,000	Artifacts	Artifacts
Posters	100,000	Posters	Posters
Other	100,000	Other	Other
Total	1,400,000		

Science in the 21st Century
Perimeter Institute, Waterloo, Ontario, Canada
Sept 8-12, 2008



21st Century Science Maps

Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



DATA	TEST 1	TEST 2	TEST 3
DATA 1	TEST 1.1	TEST 1.2	TEST 1.3
DATA 2	TEST 2.1	TEST 2.2	TEST 2.3
DATA 3	TEST 3.1	TEST 3.2	TEST 3.3
DATA 4	TEST 4.1	TEST 4.2	TEST 4.3
DATA 5	TEST 5.1	TEST 5.2	TEST 5.3
DATA 6	TEST 6.1	TEST 6.2	TEST 6.3
DATA 7	TEST 7.1	TEST 7.2	TEST 7.3
DATA 8	TEST 8.1	TEST 8.2	TEST 8.3
DATA 9	TEST 9.1	TEST 9.2	TEST 9.3
DATA 10	TEST 10.1	TEST 10.2	TEST 10.3
DATA 11	TEST 11.1	TEST 11.2	TEST 11.3
DATA 12	TEST 12.1	TEST 12.2	TEST 12.3
DATA 13	TEST 13.1	TEST 13.2	TEST 13.3
DATA 14	TEST 14.1	TEST 14.2	TEST 14.3
DATA 15	TEST 15.1	TEST 15.2	TEST 15.3
DATA 16	TEST 16.1	TEST 16.2	TEST 16.3
DATA 17	TEST 17.1	TEST 17.2	TEST 17.3
DATA 18	TEST 18.1	TEST 18.2	TEST 18.3
DATA 19	TEST 19.1	TEST 19.2	TEST 19.3
DATA 20	TEST 20.1	TEST 20.2	TEST 20.3
DATA 21	TEST 21.1	TEST 21.2	TEST 21.3
DATA 22	TEST 22.1	TEST 22.2	TEST 22.3
DATA 23	TEST 23.1	TEST 23.2	TEST 23.3
DATA 24	TEST 24.1	TEST 24.2	TEST 24.3
DATA 25	TEST 25.1	TEST 25.2	TEST 25.3
DATA 26	TEST 26.1	TEST 26.2	TEST 26.3
DATA 27	TEST 27.1	TEST 27.2	TEST 27.3
DATA 28	TEST 28.1	TEST 28.2	TEST 28.3
DATA 29	TEST 29.1	TEST 29.2	TEST 29.3
DATA 30	TEST 30.1	TEST 30.2	TEST 30.3
DATA 31	TEST 31.1	TEST 31.2	TEST 31.3
DATA 32	TEST 32.1	TEST 32.2	TEST 32.3
DATA 33	TEST 33.1	TEST 33.2	TEST 33.3
DATA 34	TEST 34.1	TEST 34.2	TEST 34.3
DATA 35	TEST 35.1	TEST 35.2	TEST 35.3
DATA 36	TEST 36.1	TEST 36.2	TEST 36.3
DATA 37	TEST 37.1	TEST 37.2	TEST 37.3
DATA 38	TEST 38.1	TEST 38.2	TEST 38.3
DATA 39	TEST 39.1	TEST 39.2	TEST 39.3
DATA 40	TEST 40.1	TEST 40.2	TEST 40.3
DATA 41	TEST 41.1	TEST 41.2	TEST 41.3
DATA 42	TEST 42.1	TEST 42.2	TEST 42.3
DATA 43	TEST 43.1	TEST 43.2	TEST 43.3
DATA 44	TEST 44.1	TEST 44.2	TEST 44.3
DATA 45	TEST 45.1	TEST 45.2	TEST 45.3
DATA 46	TEST 46.1	TEST 46.2	TEST 46.3
DATA 47	TEST 47.1	TEST 47.2	TEST 47.3
DATA 48	TEST 48.1	TEST 48.2	TEST 48.3
DATA 49	TEST 49.1	TEST 49.2	TEST 49.3
DATA 50	TEST 50.1	TEST 50.2	TEST 50.3
DATA 51	TEST 51.1	TEST 51.2	TEST 51.3
DATA 52	TEST 52.1	TEST 52.2	TEST 52.3
DATA 53	TEST 53.1	TEST 53.2	TEST 53.3
DATA 54	TEST 54.1	TEST 54.2	TEST 54.3
DATA 55	TEST 55.1	TEST 55.2	TEST 55.3
DATA 56	TEST 56.1	TEST 56.2	TEST 56.3
DATA 57	TEST 57.1	TEST 57.2	TEST 57.3
DATA 58	TEST 58.1	TEST 58.2	TEST 58.3
DATA 59	TEST 59.1	TEST 59.2	TEST 59.3
DATA 60	TEST 60.1	TEST 60.2	TEST 60.3
DATA 61	TEST 61.1	TEST 61.2	TEST 61.3
DATA 62	TEST 62.1	TEST 62.2	TEST 62.3
DATA 63	TEST 63.1	TEST 63.2	TEST 63.3
DATA 64	TEST 64.1	TEST 64.2	TEST 64.3
DATA 65	TEST 65.1	TEST 65.2	TEST 65.3
DATA 66	TEST 66.1	TEST 66.2	TEST 66.3
DATA 67	TEST 67.1	TEST 67.2	TEST 67.3
DATA 68	TEST 68.1	TEST 68.2	TEST 68.3
DATA 69	TEST 69.1	TEST 69.2	TEST 69.3
DATA 70	TEST 70.1	TEST 70.2	TEST 70.3
DATA 71	TEST 71.1	TEST 71.2	TEST 71.3
DATA 72	TEST 72.1	TEST 72.2	TEST 72.3
DATA 73	TEST 73.1	TEST 73.2	TEST 73.3
DATA 74	TEST 74.1	TEST 74.2	TEST 74.3
DATA 75	TEST 75.1	TEST 75.2	TEST 75.3
DATA 76	TEST 76.1	TEST 76.2	TEST 76.3
DATA 77	TEST 77.1	TEST 77.2	TEST 77.3
DATA 78	TEST 78.1	TEST 78.2	TEST 78.3
DATA 79	TEST 79.1	TEST 79.2	TEST 79.3
DATA 80	TEST 80.1	TEST 80.2	TEST 80.3
DATA 81	TEST 81.1	TEST 81.2	TEST 81.3
DATA 82	TEST 82.1	TEST 82.2	TEST 82.3
DATA 83	TEST 83.1	TEST 83.2	TEST 83.3
DATA 84	TEST 84.1	TEST 84.2	TEST 84.3
DATA 85	TEST 85.1	TEST 85.2	TEST 85.3
DATA 86	TEST 86.1	TEST 86.2	TEST 86.3
DATA 87	TEST 87.1	TEST 87.2	TEST 87.3
DATA 88	TEST 88.1	TEST 88.2	TEST 88.3
DATA 89	TEST 89.1	TEST 89.2	TEST 89.3
DATA 90	TEST 90.1	TEST 90.2	TEST 90.3
DATA 91	TEST 91.1	TEST 91.2	TEST 91.3
DATA 92	TEST 92.1	TEST 92.2	TEST 92.3
DATA 93	TEST 93.1	TEST 93.2	TEST 93.3
DATA 94	TEST 94.1	TEST 94.2	TEST 94.3
DATA 95	TEST 95.1	TEST 95.2	TEST 95.3
DATA 96	TEST 96.1	TEST 96.2	TEST 96.3
DATA 97	TEST 97.1	TEST 97.2	TEST 97.3
DATA 98	TEST 98.1	TEST 98.2	TEST 98.3
DATA 99	TEST 99.1	TEST 99.2	TEST 99.3
DATA 100	TEST 100.1	TEST 100.2	TEST 100.3
DATA 101	TEST 101.1	TEST 101.2	TEST 101.3
DATA 102	TEST 102.1	TEST 102.2	TEST 102.3
DATA 103	TEST 103.1	TEST 103.2	TEST 103.3
DATA 104	TEST 104.1	TEST 104.2	TEST 104.3
DATA 105	TEST 105.1	TEST 105.2	TEST 105.3
DATA 106	TEST 106.1	TEST 106.2	TEST 106.3
DATA 107	TEST 107.1	TEST 107.2	TEST 107.3
DATA 108	TEST 108.1	TEST 108.2	TEST 108.3
DATA 109	TEST 109.1	TEST 109.2	TEST 109.3
DATA 110	TEST 110.1	TEST 110.2	TEST 110.3
DATA 111	TEST 111.1	TEST 111.2	TEST 111.3
DATA 112	TEST 112.1	TEST 112.2	TEST 112.3
DATA 113	TEST 113.1	TEST 113.2	TEST 113.3
DATA 114	TEST 114.1	TEST 114.2	TEST 114.3
DATA 115	TEST 115.1	TEST 115.2	TEST 115.3
DATA 116	TEST 116.1	TEST 116.2	TEST 116.3
DATA 117	TEST 117.1	TEST 117.2	TEST 117.3
DATA 118	TEST 118.1	TEST 118.2	TEST 118.3
DATA 119	TEST 119.1	TEST 119.2	TEST 119.3
DATA 120	TEST 120.1	TEST 120.2	TEST 120.3
DATA 121	TEST 121.1	TEST 121.2	TEST 121.3
DATA 122	TEST 122.1	TEST 122.2	TEST 122.3
DATA 123	TEST 123.1	TEST 123.2	TEST 123.3
DATA 124	TEST 124.1	TEST 124.2	TEST 124.3
DATA 125	TEST 125.1	TEST 125.2	TEST 125.3
DATA 126	TEST 126.1	TEST 126.2	TEST 126.3
DATA 127	TEST 127.1	TEST 127.2	TEST 127.3
DATA 128	TEST 128.1	TEST 128.2	TEST 128.3
DATA 129	TEST 129.1	TEST 129.2	TEST 129.3
DATA 130	TEST 130.1	TEST 130.2	TEST 130.3
DATA 131	TEST 131.1	TEST 131.2	TEST 131.3
DATA 132	TEST 132.1	TEST 132.2	TEST 132.3
DATA 133	TEST 133.1	TEST 133.2	TEST 133.3
DATA 134	TEST 134.1	TEST 134.2	TEST 134.3
DATA 135	TEST 135.1	TEST 135.2	TEST 135.3
DATA 136	TEST 136.1	TEST 136.2	TEST 136.3
DATA 137	TEST 137.1	TEST 137.2	TEST 137.3
DATA 138	TEST 138.1	TEST 138.2	TEST 138.3
DATA 139	TEST 139.1	TEST 139.2	TEST 139.3
DATA 140	TEST 140.1	TEST 140.2	TEST 140.3
DATA 141	TEST 141.1	TEST 141.2	TEST 141.3
DATA 142	TEST 142.1	TEST 142.2	TEST 142.3
DATA 143	TEST 143.1	TEST 143.2	TEST 143.3
DATA 144	TEST 144.1	TEST 144.2	TEST 144.3
DATA 145	TEST 145.1	TEST 145.2	TEST 145.3
DATA 146	TEST 146.1	TEST 146.2	TEST 146.3
DATA 147	TEST 147.1	TEST 147.2	TEST 147.3
DATA 148	TEST 148.1	TEST 148.2	TEST 148.3
DATA 149	TEST 149.1	TEST 149.2	TEST 149.3
DATA 150	TEST 150.1	TEST 150.2	TEST 150.3
DATA 151	TEST 151.1	TEST 151.2	TEST 151.3
DATA 152	TEST 152.1	TEST 152.2	TEST 152.3
DATA 153	TEST 153.1	TEST 153.2	TEST 153.3
DATA 154	TEST 154.1	TEST 154.2	TEST 154.3
DATA 155	TEST 155.1	TEST 155.2	TEST 155.3
DATA 156	TEST 156.1	TEST 156.2	TEST 156.3
DATA 157	TEST 157.1	TEST 157.2	TEST 157.3
DATA 158	TEST 158.1	TEST 158.2	TEST 158.3
DATA 159	TEST 159.1	TEST 159.2	TEST 159.3
DATA 160	TEST 160.1	TEST 160.2	TEST 160.3
DATA 161	TEST 161.1	TEST 161.2	TEST 161.3
DATA 162	TEST 162.1	TEST 162.2	TEST 162.3
DATA 163	TEST 163.1	TEST 163.2	TEST 163.3
DATA 164	TEST 164.1	TEST 164.2	TEST 164.3
DATA 165	TEST 165.1	TEST 165.2	TEST 165.3
DATA 166	TEST 166.1	TEST 166.2	TEST 166.3
DATA 167	TEST 167.1	TEST 167.2	TEST 167.3
DATA 168	TEST 168.1	TEST 168.2	TEST 168.3
DATA 169	TEST 169.1	TEST 169.2	TEST 169.3
DATA 170	TEST 170.1	TEST 170.2	TEST 170.3
DATA 171	TEST 171.1	TEST 171.2	TEST 171.3
DATA 172	TEST 172.1	TEST 172.2	TEST 172.3
DATA 173	TEST 173.1	TEST 173.2	TEST 173.3
DATA 174	TEST 174.1	TEST 174.2	TEST 174.3
DATA 175	TEST 175.1	TEST 175.2	TEST 175.3
DATA 176	TEST 176.1	TEST 176.2	TEST 176.3
DATA 177	TEST 177.1	TEST 177.2	TEST 177.3
DATA 178	TEST 178.1	TEST 178.2	TEST 178.3
DATA 179	TEST 179.1	TEST 179.2	TEST 179.3
DATA 180	TEST 180.1	TEST 180.2	TEST 180.3
DATA 181	TEST 181.1	TEST 181.2	TEST 181.3
DATA 182	TEST 182.1	TEST 182.2	TEST 182.3
DATA 183	TEST 183.1	TEST 183.2	TEST 183.3
DATA 184	TEST 184.1	TEST 184.2	TEST 184.3
DATA 185	TEST 185.1	TEST 185.2	TEST 185.3
DATA 186	TEST 186.1	TEST 186.2	TEST 186.3
DATA 187	TEST 187.1	TEST 187.2	TEST 187.3
DATA 188	TEST 188.1	TEST 188.2	TEST 188.3
DATA 189	TEST 189.1	TEST 189.2	TEST 189.3
DATA 190	TEST 190.1	TEST 190.2	TEST 190.3
DATA 191	TEST 191.1	TEST 191.2	TEST 191.3
DATA 192	TEST 192.1	TEST 192.2	TEST 192.3
DATA 193	TEST 193.1	TEST 193.2	TEST 193.3
DATA 194	TEST 194.1	TEST 194.2	TEST 194.3
DATA 195	TEST 195.1	TEST 195.2	TEST 195.3
DATA 196	TEST 196.1	TEST 196.2	TEST 196.3
DATA 197	TEST 197.1	TEST 197.2	TEST 197.3
DATA 198	TEST 198.1	TEST 198.2	TEST 198.3
DATA 199	TEST 199.1	TEST 199.2	TEST 199.3
DATA 200	TEST 200.1	TEST 200.2	TEST 200.3
DATA 201	TEST 201.1	TEST 201.2	TEST 201.3
DATA 202	TEST 202.1	TEST 202.2	TEST 202.3
DATA 203	TEST 203.1	TEST 203.2	TEST 203.3
DATA 204	TEST 204.1	TEST 204.2	TEST 204.3
DATA 205	TEST 205.1	TEST 205.2	TEST 205.3
DATA 206	TEST 206.1	TEST 206.2	TEST 206.3
DATA 207	TEST 207.1	TEST 207.2	TEST 207.3
DATA 208	TEST 208.1	TEST 208.2	TEST 208.3
DATA 209	TEST 209.1	TEST 209.2	TEST 209.3
DATA 210	TEST 210.1	TEST 210.2	TEST 210.3
DATA 211	TEST 211.1	TEST 211.2	TEST 211.3
DATA 212	TEST 212.1	TEST 212.2	TEST 212.3
DATA 213	TEST 213.1	TEST 213.2	TEST 213.3
DATA 214	TEST 214.1	TEST 214.2	TEST 214.3
DATA 215	TEST 215.1	TEST 215.2	TEST 215.3
DATA 216	TEST 216.1	TEST 216.2	TEST 216.3
DATA 217	TEST 217.1	TEST 217.2	TEST 217.3
DATA 218	TEST 218.1	TEST 218.2	TEST 218.3
DATA 219	TEST 219.1	TEST 219.2	TEST 219.3
DATA 220	TEST 220.1	TEST 220.2	TEST 220.3
DATA 221	TEST 221.1	TEST 221.2	TEST 221.3
DATA 222	TEST 222.1	TEST 222.2	TEST 222.3
DATA 223	TEST 223.1	TEST 223.2	TEST 223.3
DATA 224	TEST 224.1	TEST 224.2	TEST 224.3
DATA 2			

21st Century Science Maps

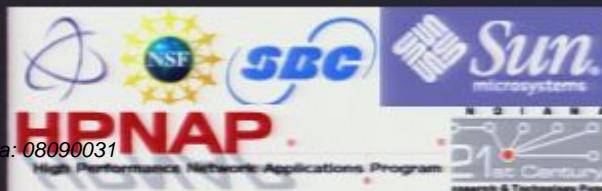
Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



Category	Count	Category	Count	Category	Count	Category	Count
Books	1,000+	CDs	1,000+	DVDs	1,000+	Software	1,000+
CDs	1,000+	CDs	1,000+	DVDs	1,000+	Software	1,000+
DVDs	1,000+	DVDs	1,000+	Software	1,000+	Software	1,000+
Software	1,000+	Software	1,000+	Software	1,000+	Software	1,000+
Books	1,000+	CDs	1,000+	DVDs	1,000+	Software	1,000+
CDs	1,000+	CDs	1,000+	DVDs	1,000+	Software	1,000+
DVDs	1,000+	DVDs	1,000+	Software	1,000+	Software	1,000+
Software	1,000+	Software	1,000+	Software	1,000+	Software	1,000+

Science in the 21st Century
Perimeter Institute, Waterloo, Ontario, Canada
Sept 8-12, 2008



Pirsa: 08090031



21st Century Science Maps

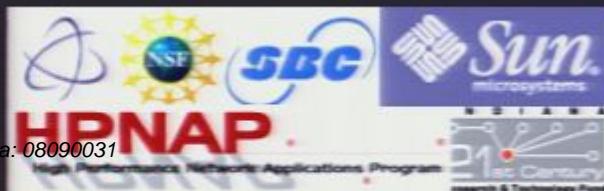
Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



Category	Count	Category	Count	Category	Count	Category	Count
Chemical	1,000	Computer	1,000	Mathematics	1,000	Physics	1,000
Earth	1,000	Engineering	1,000	Medicine	1,000	Psychology	1,000
Life	1,000	Humanities	1,000	Social	1,000	Biology	1,000
Physical	1,000	Business	1,000	Arts	1,000	Chemistry	1,000
Other	1,000	Law	1,000	Geography	1,000	Physics	1,000
Total	8,000	Total	8,000	Total	8,000	Total	8,000

Science in the 21st Century
Perimeter Institute, Waterloo, Ontario, Canada
Sept 8-12, 2008



Pirsa: 08090031



Page 5/153

21st Century Science Maps

Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



Category	Category ID	Description	Link to full description
Science	SCIENCE	Science	View details
Mathematics	MATHEMATICS	Mathematics	View details
Computer Science	COMPUTER SCIENCE	Computer Science	View details
Physics	PHYSICS	Physics	View details
Chemistry	CHEMISTRY	Chemistry	View details
Biology	BIOLOGY	Biology	View details
Astronomy	ASTRONOMY	Astronomy	View details
Geology	GEOLGY	Geology	View details
Earth Sciences	EARTH SCIENCES	Earth Sciences	View details
Environmental Sciences	ENVIRONMENTAL SCIENCES	Environmental Sciences	View details
Mathematics Education	MATH EDUCATION	Mathematics Education	View details
Computer Science Education	CS EDUCATION	Computer Science Education	View details
Physics Education	PHYS EDUCATION	Physics Education	View details
Chemistry Education	CHEM EDUCATION	Chemistry Education	View details
Biology Education	BIO EDUCATION	Biology Education	View details
Astronomy Education	ASTRO EDUCATION	Astronomy Education	View details
Geology Education	GEOL EDUCATION	Geology Education	View details
Earth Sciences Education	EARTH SCI EDUCATION	Earth Sciences Education	View details
Environmental Sciences Education	ENV SCI EDUCATION	Environmental Sciences Education	View details
Mathematics Research	MATH RESEARCH	Mathematics Research	View details
Computer Science Research	CS RESEARCH	Computer Science Research	View details
Physics Research	PHYS RESEARCH	Physics Research	View details
Chemistry Research	CHEM RESEARCH	Chemistry Research	View details
Biology Research	BIO RESEARCH	Biology Research	View details
Astronomy Research	ASTRO RESEARCH	Astronomy Research	View details
Geology Research	GEOL RESEARCH	Geology Research	View details
Earth Sciences Research	EARTH SCI RESEARCH	Earth Sciences Research	View details
Environmental Sciences Research	ENV SCI RESEARCH	Environmental Sciences Research	View details
Mathematics Pedagogy	MATH PEDAGOGY	Mathematics Pedagogy	View details
Computer Science Pedagogy	CS PEDAGOGY	Computer Science Pedagogy	View details
Physics Pedagogy	PHYS PEDAGOGY	Physics Pedagogy	View details
Chemistry Pedagogy	CHEM PEDAGOGY	Chemistry Pedagogy	View details
Biology Pedagogy	BIO PEDAGOGY	Biology Pedagogy	View details
Astronomy Pedagogy	ASTRO PEDAGOGY	Astronomy Pedagogy	View details
Geology Pedagogy	GEOL PEDAGOGY	Geology Pedagogy	View details
Earth Sciences Pedagogy	EARTH SCI PEDAGOGY	Earth Sciences Pedagogy	View details
Environmental Sciences Pedagogy	ENV SCI PEDAGOGY	Environmental Sciences Pedagogy	View details
Mathematics Curriculum	MATH CURRICULUM	Mathematics Curriculum	View details
Computer Science Curriculum	CS CURRICULUM	Computer Science Curriculum	View details
Physics Curriculum	PHYS CURRICULUM	Physics Curriculum	View details
Chemistry Curriculum	CHEM CURRICULUM	Chemistry Curriculum	View details
Biology Curriculum	BIO CURRICULUM	Biology Curriculum	View details
Astronomy Curriculum	ASTRO CURRICULUM	Astronomy Curriculum	View details
Geology Curriculum	GEOL CURRICULUM	Geology Curriculum	View details
Earth Sciences Curriculum	EARTH SCI CURRICULUM	Earth Sciences Curriculum	View details
Environmental Sciences Curriculum	ENV SCI CURRICULUM	Environmental Sciences Curriculum	View details
Mathematics Assessment	MATH ASSESSMENT	Mathematics Assessment	View details
Computer Science Assessment	CS ASSESSMENT	Computer Science Assessment	View details
Physics Assessment	PHYS ASSESSMENT	Physics Assessment	View details
Chemistry Assessment	CHEM ASSESSMENT	Chemistry Assessment	View details
Biology Assessment	BIO ASSESSMENT	Biology Assessment	View details
Astronomy Assessment	ASTRO ASSESSMENT	Astronomy Assessment	View details
Geology Assessment	GEOL ASSESSMENT	Geology Assessment	View details
Earth Sciences Assessment	EARTH SCI ASSESSMENT	Earth Sciences Assessment	View details
Environmental Sciences Assessment	ENV SCI ASSESSMENT	Environmental Sciences Assessment	View details
Mathematics Instructional Materials	MATH IM MATERIALS	Mathematics Instructional Materials	View details
Computer Science Instructional Materials	CS IM MATERIALS	Computer Science Instructional Materials	View details
Physics Instructional Materials	PHYS IM MATERIALS	Physics Instructional Materials	View details
Chemistry Instructional Materials	CHEM IM MATERIALS	Chemistry Instructional Materials	View details
Biology Instructional Materials	BIO IM MATERIALS	Biology Instructional Materials	View details
Astronomy Instructional Materials	ASTRO IM MATERIALS	Astronomy Instructional Materials	View details
Geology Instructional Materials	GEOL IM MATERIALS	Geology Instructional Materials	View details
Earth Sciences Instructional Materials	EARTH SCI IM MATERIALS	Earth Sciences Instructional Materials	View details
Environmental Sciences Instructional Materials	ENV SCI IM MATERIALS	Environmental Sciences Instructional Materials	View details
Mathematics Professional Development	MATH PD	Mathematics Professional Development	View details
Computer Science Professional Development	CS PD	Computer Science Professional Development	View details
Physics Professional Development	PHYS PD	Physics Professional Development	View details
Chemistry Professional Development	CHEM PD	Chemistry Professional Development	View details
Biology Professional Development	BIO PD	Biology Professional Development	View details
Astronomy Professional Development	ASTRO PD	Astronomy Professional Development	View details
Geology Professional Development	GEOL PD	Geology Professional Development	View details
Earth Sciences Professional Development	EARTH SCI PD	Earth Sciences Professional Development	View details
Environmental Sciences Professional Development	ENV SCI PD	Environmental Sciences Professional Development	View details
Mathematics Curriculum Development	MATH CURR DEV	Mathematics Curriculum Development	View details
Computer Science Curriculum Development	CS CURR DEV	Computer Science Curriculum Development	View details
Physics Curriculum Development	PHYS CURR DEV	Physics Curriculum Development	View details
Chemistry Curriculum Development	CHEM CURR DEV	Chemistry Curriculum Development	View details
Biology Curriculum Development	BIO CURR DEV	Biology Curriculum Development	View details
Astronomy Curriculum Development	ASTRO CURR DEV	Astronomy Curriculum Development	View details
Geology Curriculum Development	GEOL CURR DEV	Geology Curriculum Development	View details
Earth Sciences Curriculum Development	EARTH SCI CURR DEV	Earth Sciences Curriculum Development	View details
Environmental Sciences Curriculum Development	ENV SCI CURR DEV	Environmental Sciences Curriculum Development	View details
Mathematics Instructional Materials Development	MATH IM DEV	Mathematics Instructional Materials Development	View details
Computer Science Instructional Materials Development	CS IM DEV	Computer Science Instructional Materials Development	View details
Physics Instructional Materials Development	PHYS IM DEV	Physics Instructional Materials Development	View details
Chemistry Instructional Materials Development	CHEM IM DEV	Chemistry Instructional Materials Development	View details
Biology Instructional Materials Development	BIO IM DEV	Biology Instructional Materials Development	View details
Astronomy Instructional Materials Development	ASTRO IM DEV	Astronomy Instructional Materials Development	View details
Geology Instructional Materials Development	GEOL IM DEV	Geology Instructional Materials Development	View details
Earth Sciences Instructional Materials Development	EARTH SCI IM DEV	Earth Sciences Instructional Materials Development	View details
Environmental Sciences Instructional Materials Development	ENV SCI IM DEV	Environmental Sciences Instructional Materials Development	View details
Mathematics Professional Development Development	MATH PD DEV	Mathematics Professional Development Development	View details
Computer Science Professional Development Development	CS PD DEV	Computer Science Professional Development Development	View details
Physics Professional Development Development	PHYS PD DEV	Physics Professional Development Development	View details
Chemistry Professional Development Development	CHEM PD DEV	Chemistry Professional Development Development	View details
Biology Professional Development Development	BIO PD DEV	Biology Professional Development Development	View details
Astronomy Professional Development Development	ASTRO PD DEV	Astronomy Professional Development Development	View details
Geology Professional Development Development	GEOL PD DEV	Geology Professional Development Development	View details
Earth Sciences Professional Development Development	EARTH SCI PD DEV	Earth Sciences Professional Development Development	View details
Environmental Sciences Professional Development Development	ENV SCI PD DEV	Environmental Sciences Professional Development Development	View details

Science in the 21st Century

Perimeter Institute, Waterloo, Ontario, Canada

Sept 8-12, 2008



21st Century Science Maps

Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu

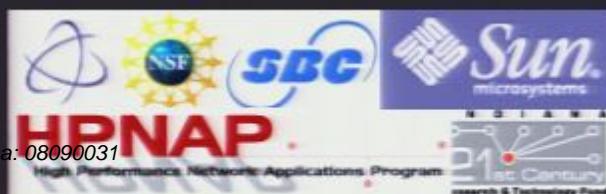


Category	Count	Label	Description	Link
21st Century	1	21st Century	21st Century Science Maps	http://www.21stcenturymaps.org
10	10	1000	1000 Books	http://www.1000books.org
1000	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org
1000 Books	1000	1000 Books	1000 Books	http://www.1000books.org

Science in the 21st Century

Perimeter Institute, Waterloo, Ontario, Canada

Sept 8-12, 2008



21st Century Science Maps

Dr. Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



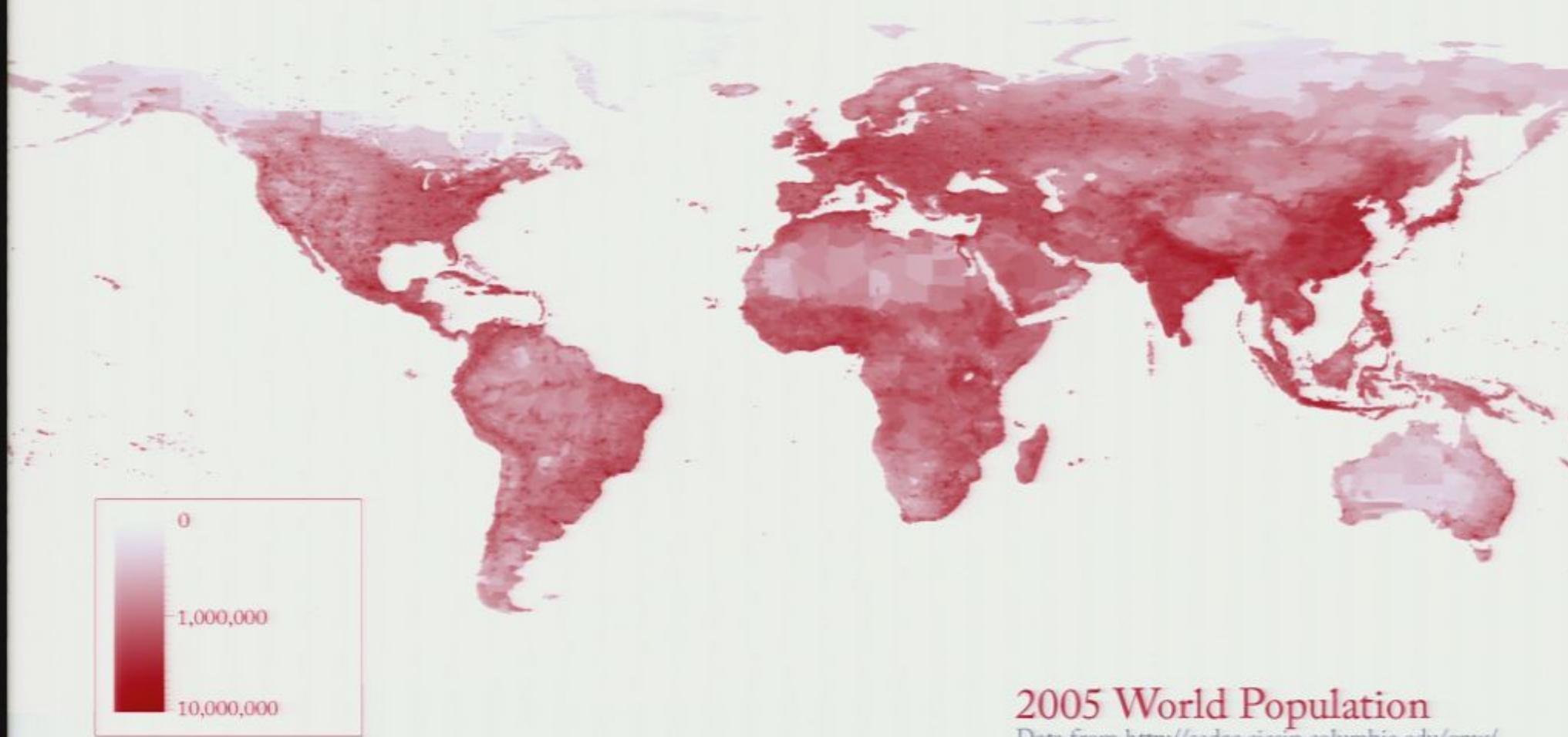
Category	Count	Subcategory	Description
Geographic	1,000+	Geographic	Geographic maps, including political, physical, and thematic maps.
Scientific	1,000+	Scientific	Scientific maps, including maps of geological, astronomical, and environmental phenomena.
Historical	1,000+	Historical	Historical maps, including maps from ancient civilizations and historical events.
Artistic	1,000+	Artistic	Artistic maps, including maps used in art and design.
Total	3,000+		

Science in the 21st Century
Perimeter Institute, Waterloo, Ontario, Canada
Sept 8-12, 2008



2005 World Population

The population map uses a quarter degree box resolution. Boxes with zero people are given in white. Darker shades of red indicate higher population counts per box using a logarithmic interpolation. The highest density boxes appear in Mumbai, with 11,687,850 people in the quarter degree block, Calcutta (10,816,010), and Shanghai (8,628,088).



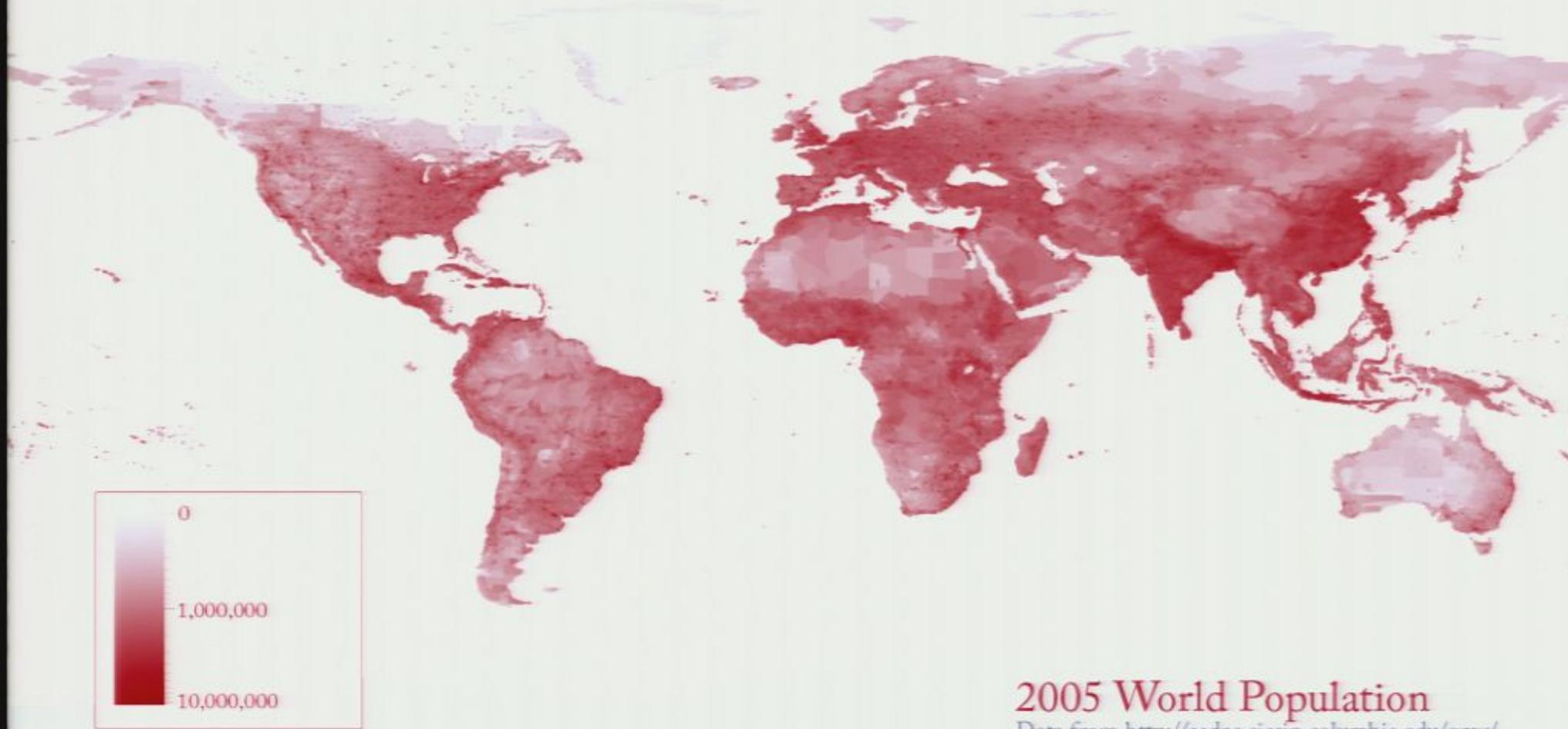
2005 World Population

Data from <http://sedac.ciesin.columbia.edu/gpw/>

Page 9/153

2005 World Population

The population map uses a quarter degree box resolution. Boxes with zero people are given in white. Darker shades of red indicate higher population counts per box using a logarithmic interpolation. The highest density boxes appear in Mumbai, with 11,687,850 people in the quarter degree block, Calcutta (10,816,010), and Shanghai (8,628,088).



2005 World Population

Data from <http://sedac.ciesin.columbia.edu/gpw/>

Page 10/153

2000 Night on Earth

This image shows city lights at night. It was composed from hundreds of pictures made by orbiting satellites. The seaboards of Europe, the eastern United States, and Japan are particularly well lit. Many cities exist near rivers or oceans so that goods can be exchanged cheaply by boat. The central parts of South America, Africa, Asia, and Australia are rather dark despite their high population density, see map to the left.

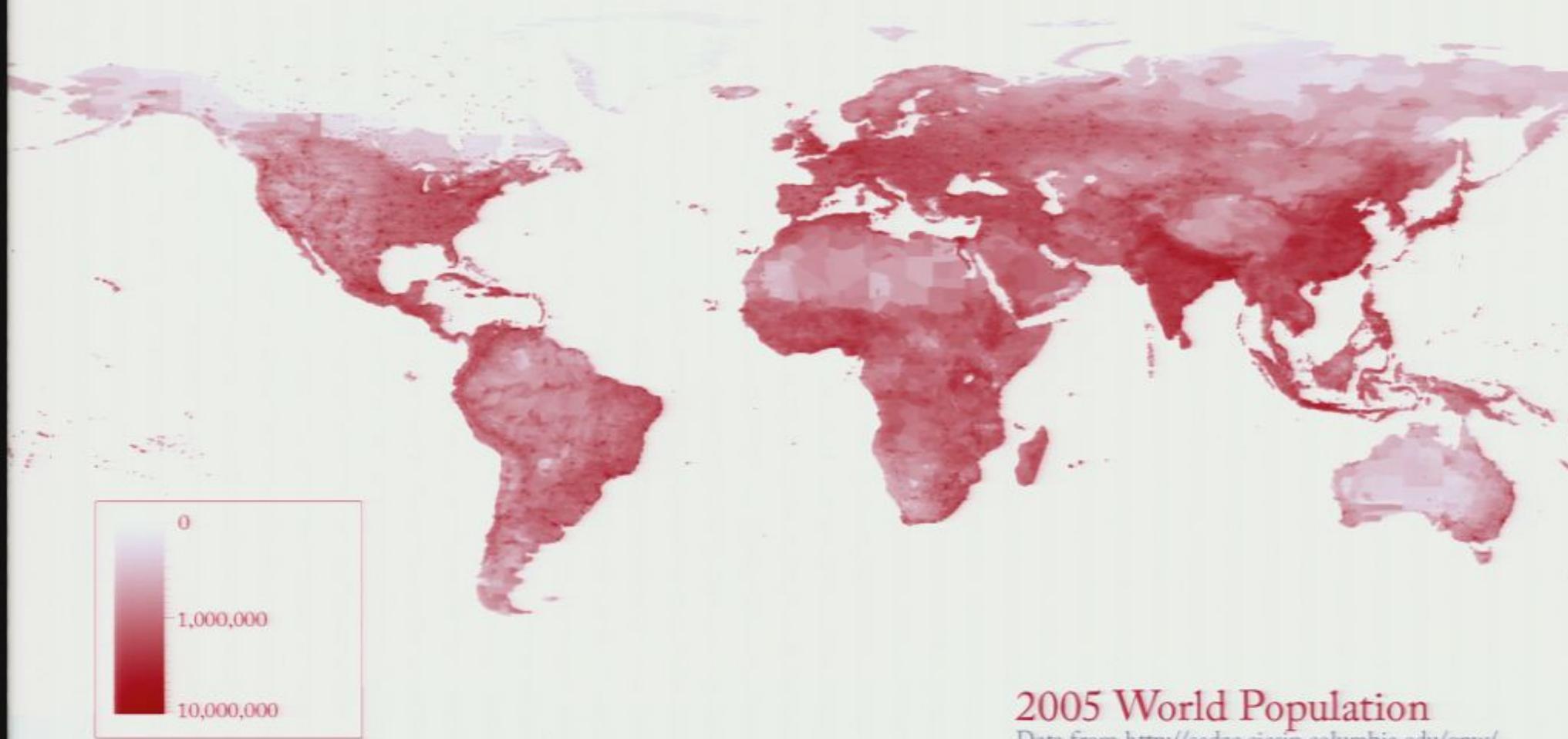


Earth at Night
More information available at:
<http://antwrp.gsfc.nasa.gov/apod/ap00127.html>

Astronomy Picture of the Day
2000 November 27
<http://antwrp.gsfc.nasa.gov/apod/astro00127.html>

2005 World Population

The population map uses a quarter degree box resolution. Boxes with zero people are given in white. Darker shades of red indicate higher population counts per box using a logarithmic interpolation. The highest density boxes appear in Mumbai, with 11,687,850 people in the quarter degree block, Calcutta (10,816,010), and Shanghai (8,628,088).



2005 World Population

Data from <http://sedac.ciesin.columbia.edu/gpw/>

Page 12/153

2000 Night on Earth

This image shows city lights at night. It was composed from hundreds of pictures made by orbiting satellites. The seaboards of Europe, the eastern United States, and Japan are particularly well lit. Many cities exist near rivers or oceans so that goods can be exchanged cheaply by boat. The central parts of South America, Africa, Asia, and Australia are rather dark despite their high population density, see map to the left.

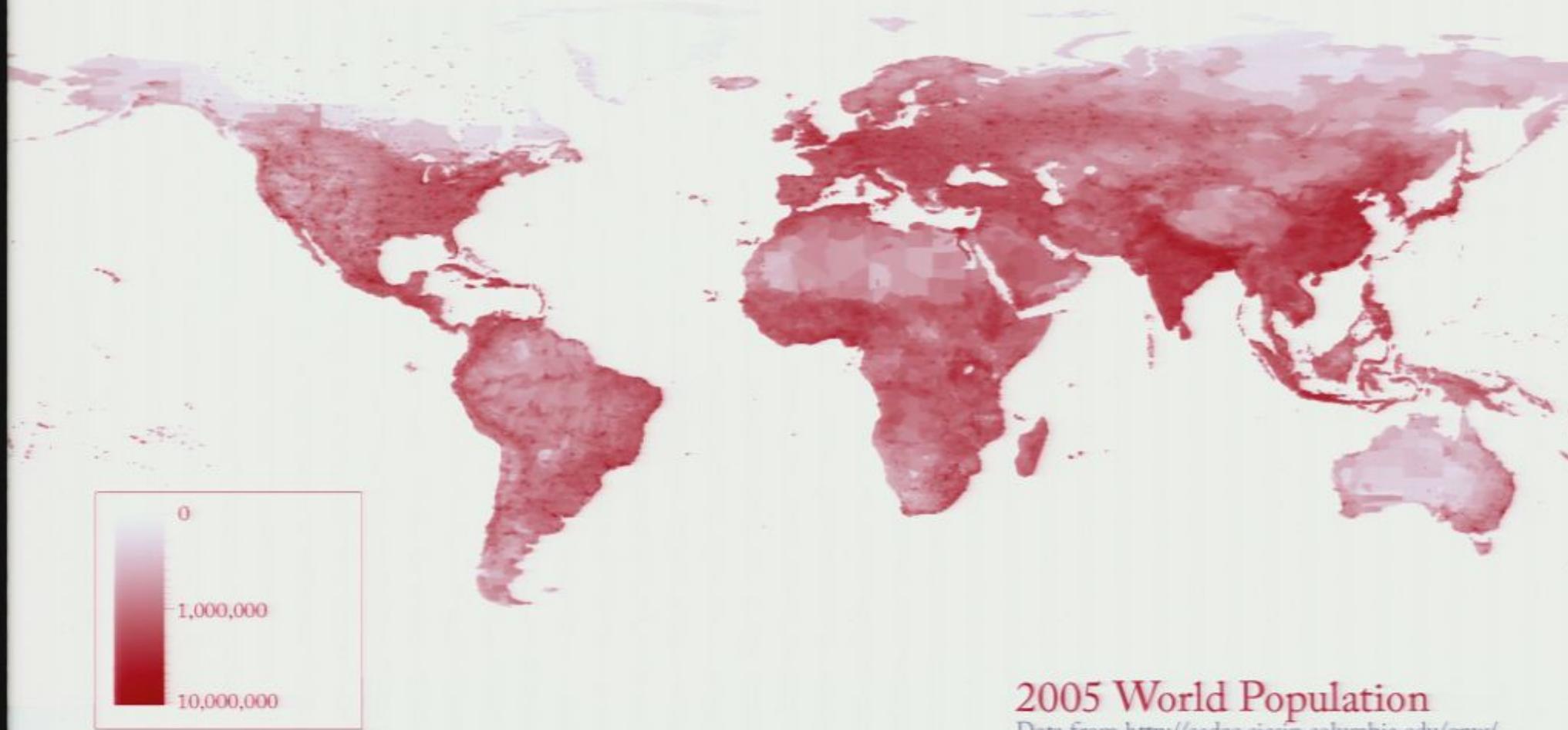


Earth at Night
More information available at:
<http://antwrp.gsfc.nasa.gov/apod/ap001127.html>

Astronomy Picture of the Day
2000 November 27
<http://antwrp.gsfc.nasa.gov/apod/astropix.html>

2005 World Population

The population map uses a quarter degree box resolution. Boxes with zero people are given in white. Darker shades of red indicate higher population counts per box using a logarithmic interpolation. The highest density boxes appear in Mumbai, with 11,687,850 people in the quarter degree block, Calcutta (10,816,010), and Shanghai (8,628,088).



2005 World Population

Data from <http://sedac.ciesin.columbia.edu/gpw/>

Page 14/153

2000 Night on Earth

This image shows city lights at night. It was composed from hundreds of pictures made by orbiting satellites. The seaboards of Europe, the eastern United States, and Japan are particularly well lit. Many cities exist near rivers or oceans so that goods can be exchanged cheaply by boat. The central parts of South America, Africa, Asia, and Australia are rather dark despite their high population density, see map to the left.

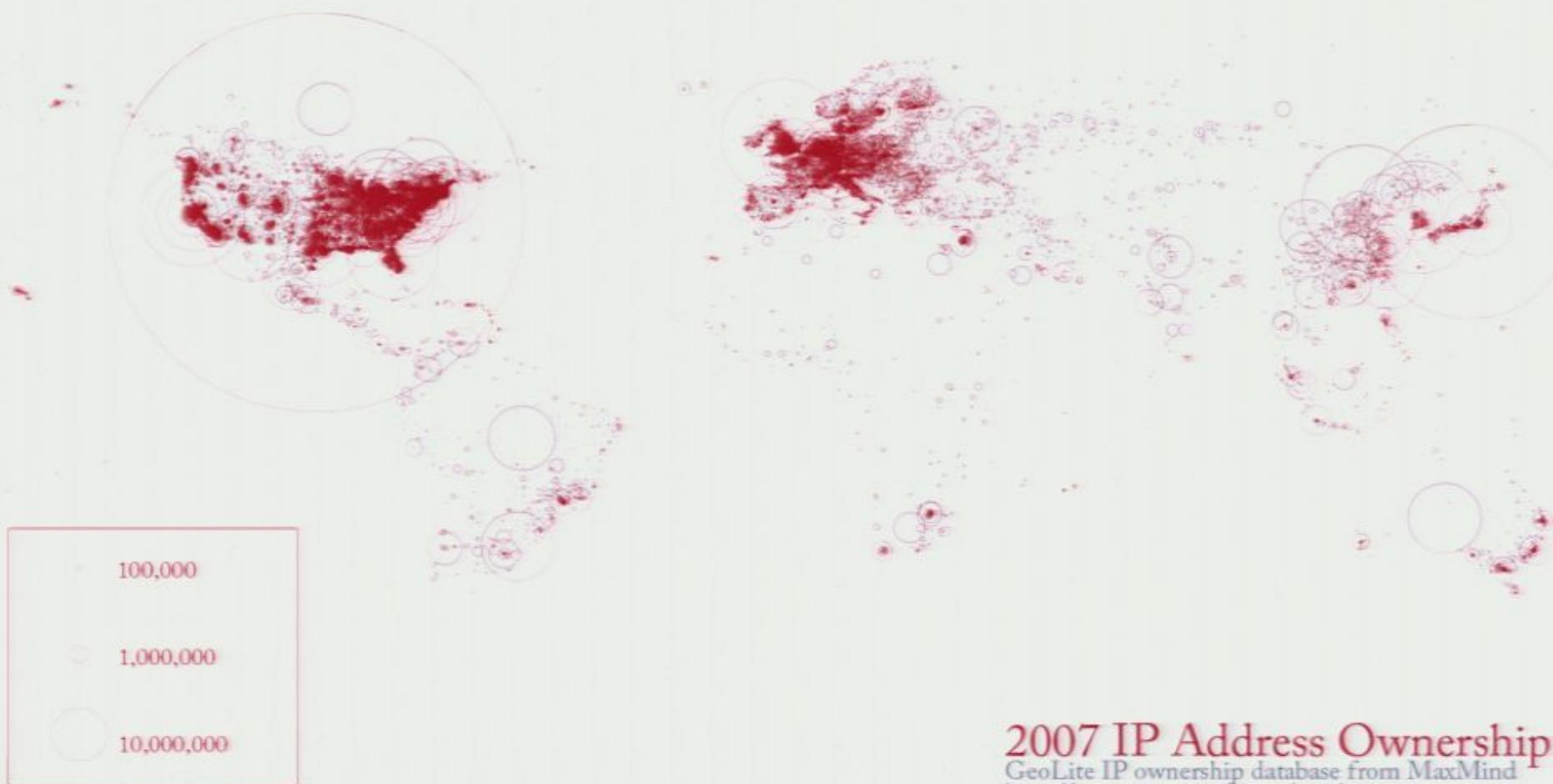


Earth at Night
More information available at:
<http://antwrp.gsfc.nasa.gov/apod/ap00127.html>

Astronomy Picture of the Day
2000 November 27
<http://antwrp.gsfc.nasa.gov/apod/ap00127.html>

2007 IP Address Ownership

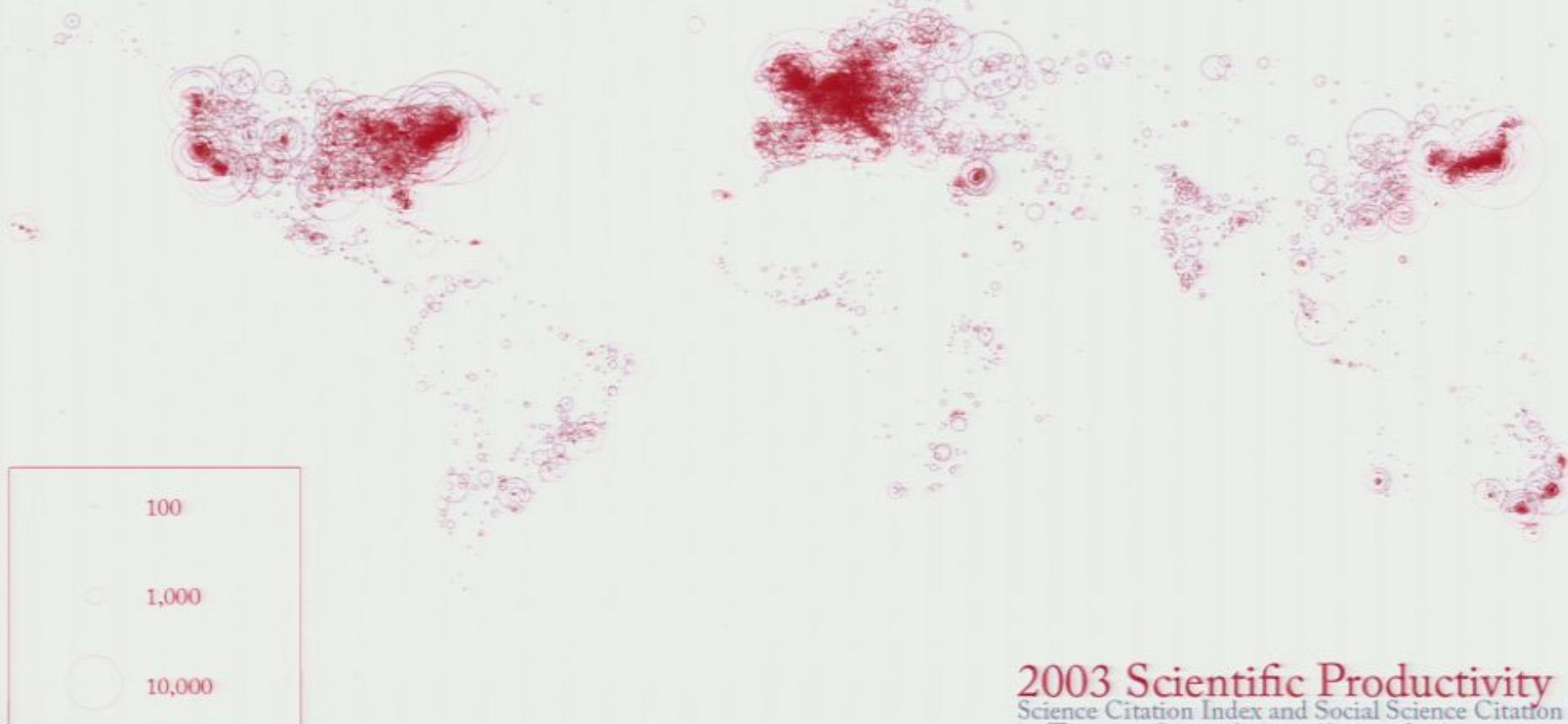
This map shows IP address ownership by location. Each owner is represented by a circle and the area size of circle corresponds to the number of IP addresses owned. The largest circle denotes MIT's holdings of an entire class A subnet, which equates to 16,581,375 IP addresses. The countries that own the most IP addresses are USA (560 million), Japan (130 million), Great Britain (47 million).



2007 IP Address Ownership
GeoLite IP ownership database from MaxMind
<http://www.maxmind.com/app/geoip-country>

2003 Scientific Productivity

Shown is where science is performed today. Each circle indicates a geographic location at which scholarly papers are published. The larger the circle the more papers are produced. Boston, MA, London, England, and New York, NY are the top three paper production areas. Note the strong resemblance with the Night on Earth and the IP Ownership maps and the striking differences to the world population map.



2003 Scientific Productivity
Science Citation Index and Social Science Citation Index
by Thomson Scientific <http://scientific.thomson.com/>
Page 17/153

2007 IP Address Ownership

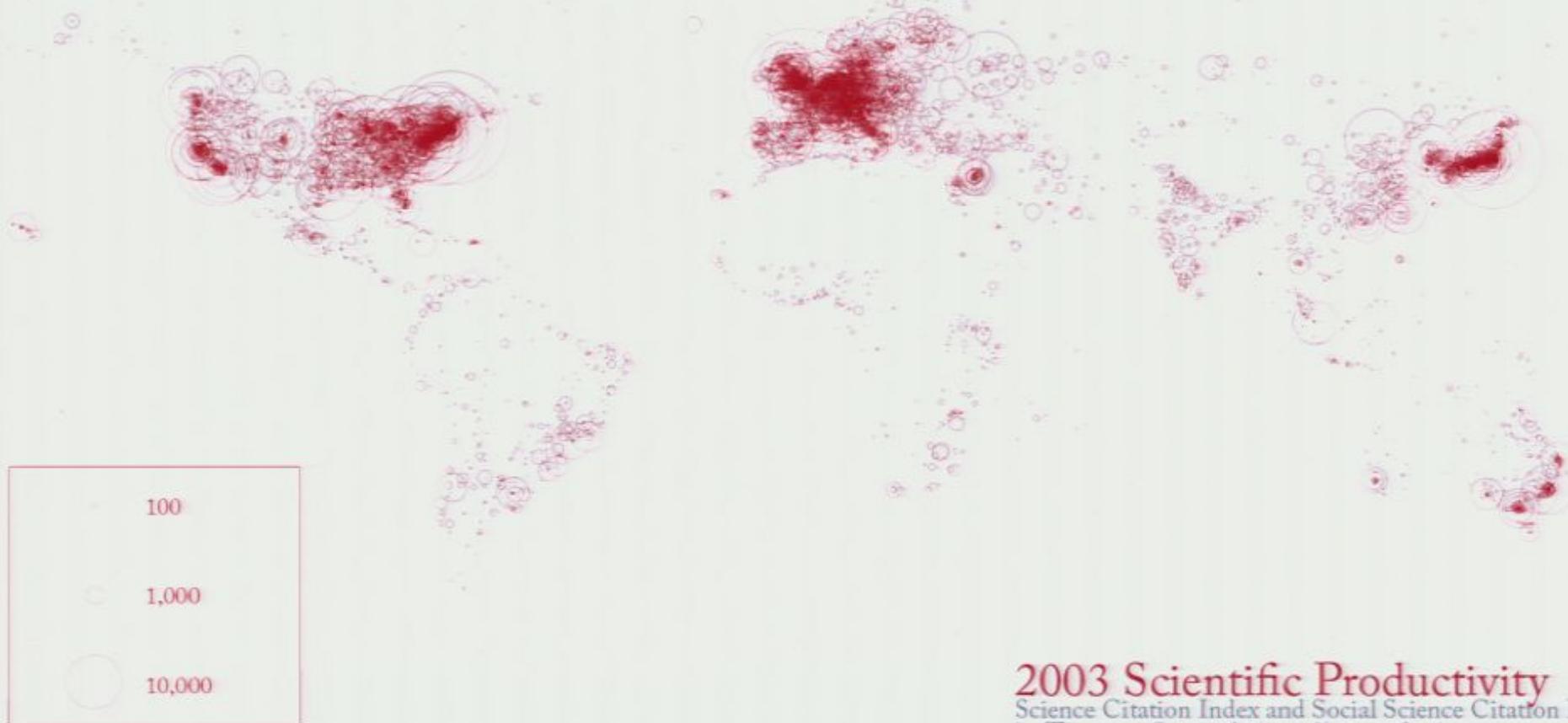
This map shows IP address ownership by location. Each owner is represented by a circle and the area size of circle corresponds to the number of IP addresses owned. The largest circle denotes MIT's holdings of an entire class A subnet, which equates to 16,581,375 IP addresses. The countries that own the most IP addresses are USA (560 million), Japan (130 million), Great Britain (47 million).



2007 IP Address Ownership
GeoLite IP ownership database from MaxMind
<http://www.maxmind.com/app/geoip-country>

2003 Scientific Productivity

Shown is where science is performed today. Each circle indicates a geographic location at which scholarly papers are published. The larger the circle the more papers are produced. Boston, MA, London, England, and New York, NY are the top three paper production areas. Note the strong resemblance with the Night on Earth and the IP Ownership maps and the striking differences to the world population map.



2003 Scientific Productivity

Science Citation Index and Social Science Citation Index
by Thomson Scientific <http://scientific.thomson.com/>

"Human history becomes more and more a race between education and catastrophe."

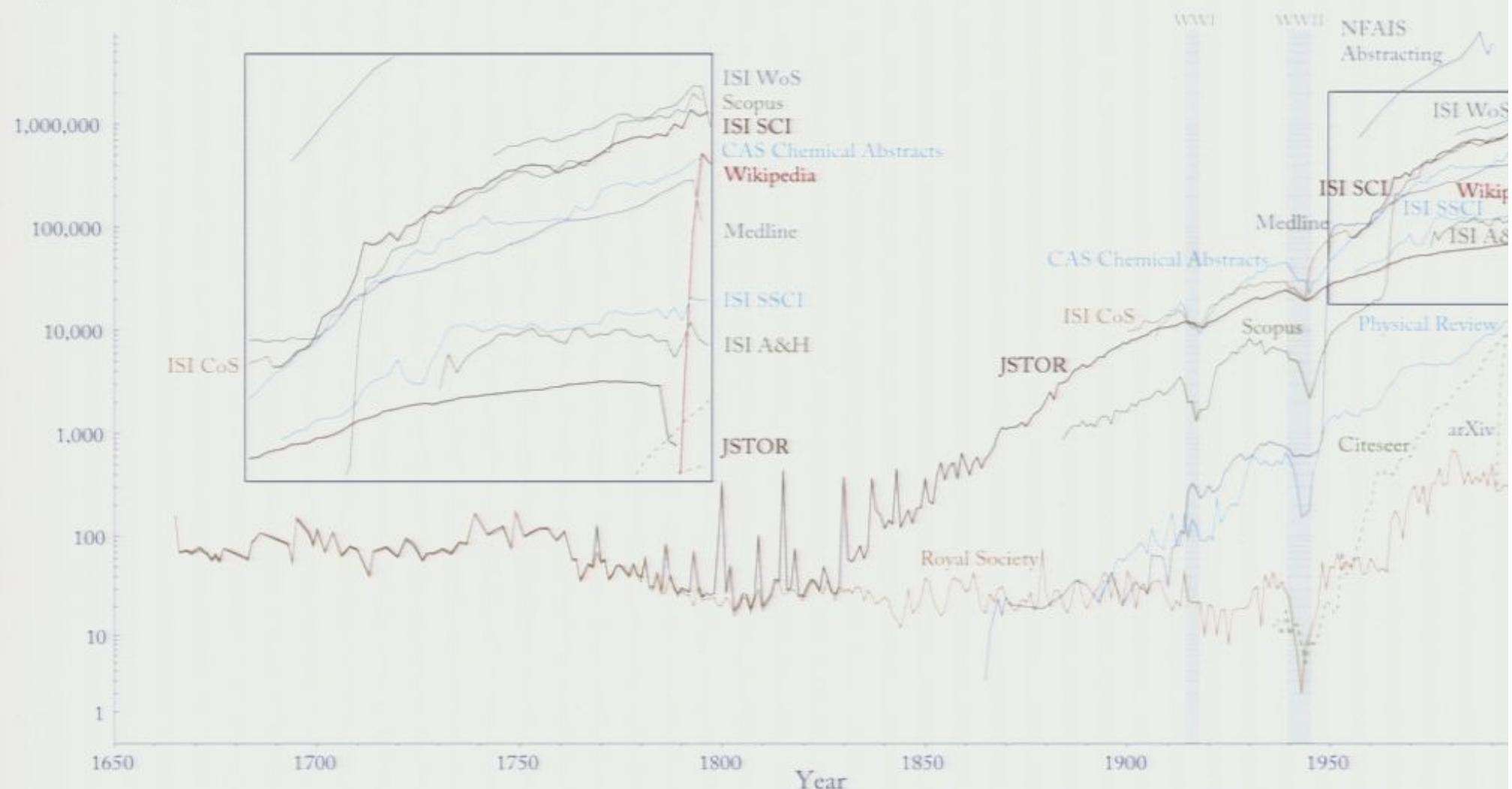
Herman G. Wells (1938) World Brain

In the 1960's, Richard Buckminster Fuller proposed the "World Peace Game" or "World Game", a comprehensive, anticipatory, design science approach to the problems of the world. The playing of World Game was intended to

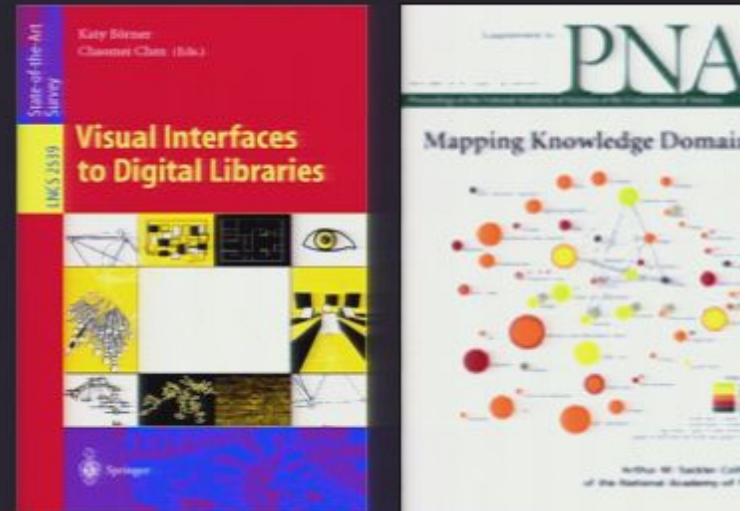
"make the world work for 100% of humanity in the shortest possible time through spontaneous cooperation without ecological damage or disadvantage to anyone."

Growth of Scientific Knowledge, 1665 to 2006

Papers & Wikipedia Entries



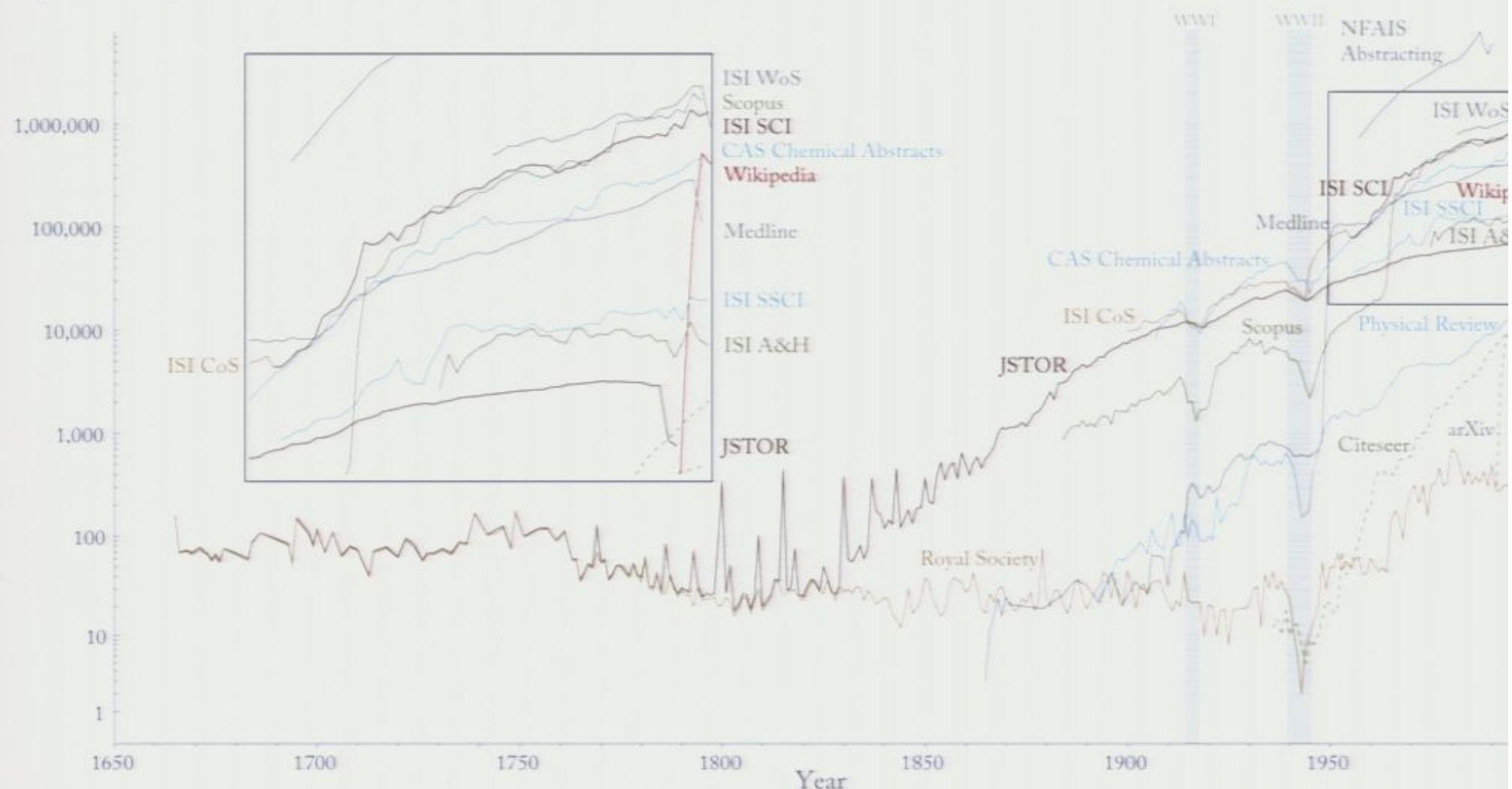
Computational Scientometrics: Studying Science by Scientific Means



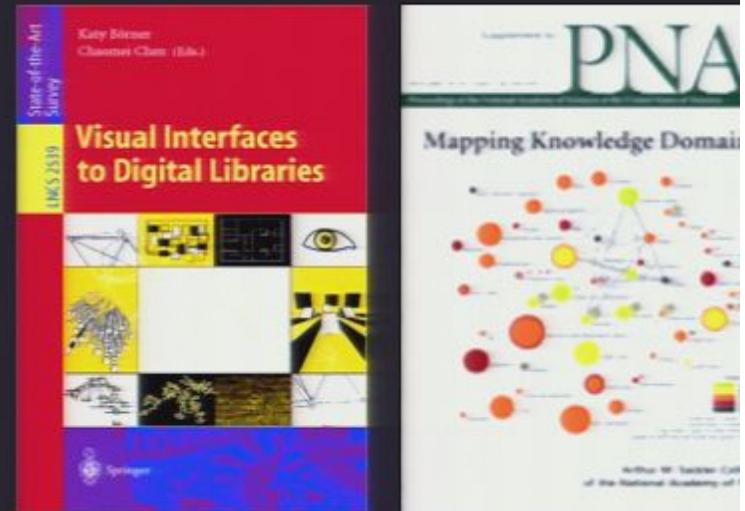
- Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, Volume 37, Chapter 5, pp. 179-255. <http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf>
- 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.), *Annual Review of Information Science & Technology*, Information Today, Inc./American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. <http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>
- **Places & Spaces: Mapping Science** exhibit, see also <http://scimaps.org>.

Growth of Scientific Knowledge, 1665 to 2006

Papers & Wikipedia Entries



Computational Scientometrics: Studying Science by Scientific Means



- Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, 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, Sanya, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Information Today, Inc./American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. <http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>
- **Places & Spaces: Mapping Science** exhibit, see also <http://scimaps.org>.

“Science of Science” Opportunities

Advantages for Funding Agencies

- Supports monitoring of (long-term) money flow and research developments, evaluation of funding strategies for different programs, decisions on project durations, funding patterns.
- Staff resources can be used for scientific program development, to identify areas for future development, and the stimulation of new research areas.

Advantages for Researchers

- Easy access to research results, relevant funding programs and their success rates, potential collaborators, competitors, related projects/publications (**research push**).
- More time for research and teaching.

Advantages for Industry

- Fast and easy access to major results, experts, etc.
- Can influence the direction of research by entering information on needed technologies (**industry-pull**).

Advantages for Publishers

- Unique interface to their data.
- Publicly funded development of databases and their interlinkage.

For Society

- Dramatically improved access to scientific knowledge and expertise.

Process of Analyzing and Mapping Knowledge Domains

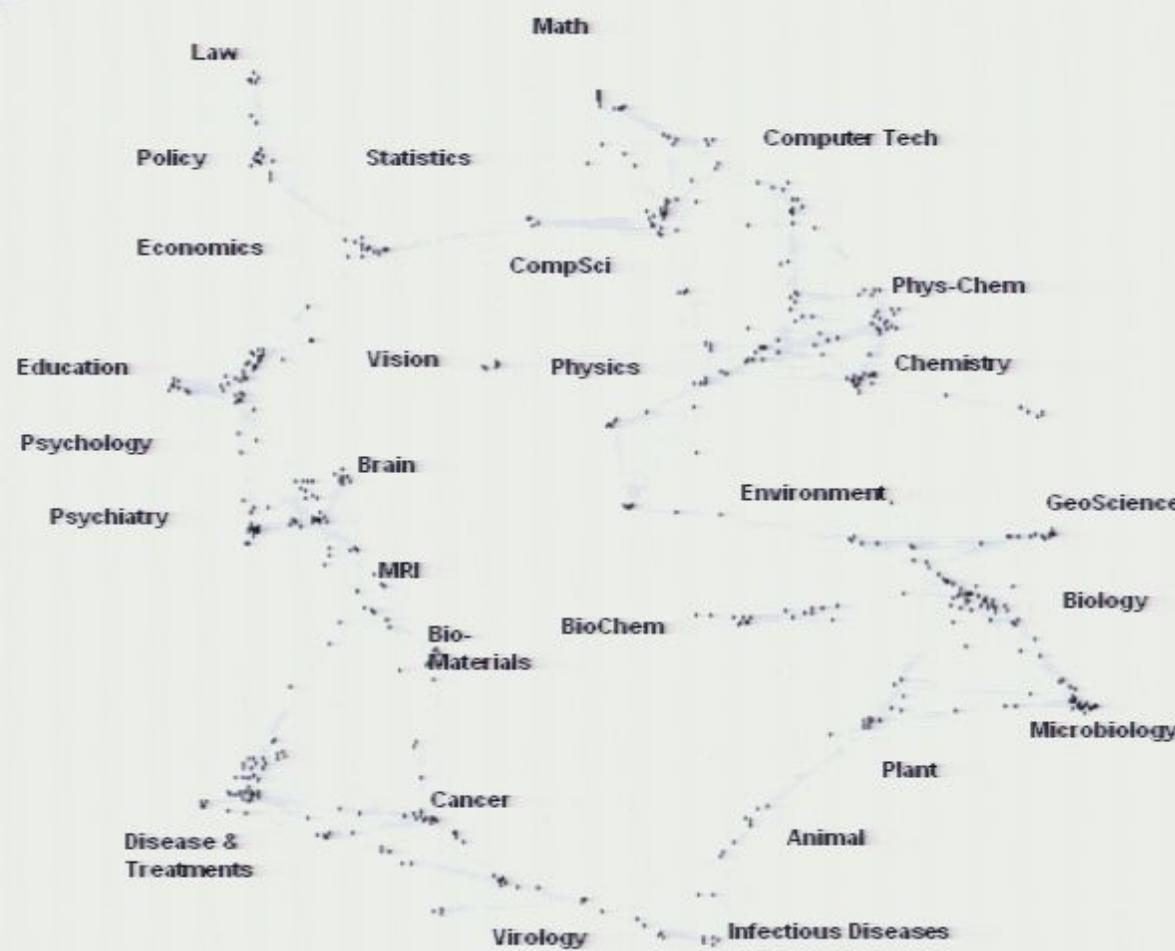
DATA EXTRACTION	UNIT OF ANALYSIS	MEASURES	LAYOUT (often one code does both similarity and ordination steps)		DISPLAY
			SIMILARITY	ORDINATION	
SEARCHES ISI INSPEC Eng Index Medline ResearchIndex Patents etc.	COMMON CHOICES Journal Document Author Term	COUNTS/FREQUENCIES Attributes (e.g. terms) Author citations Co-citations By year THRESHOLDS By counts	SCALAR (unit by unit matrix) Direct citation Co-citation Combined linkage Co-word / co-term Co-classification VECTOR (unit by attribute matrix) Vector space model (words/terms) Latent Semantic Analysis (words/terms) ind. Singular Value Decomp (SVD)	DIMENSIONALITY REDUCTION Eigenvector/ Eigenvalue solutions Factor Analysis (FA) and Principal Components Analysis (PCA) Multi-dimensional scaling (MDS) LSA , Topics Pathfinder networks (PFNet) Self-organizing maps (SOM) includes SOM, ET-maps, etc.	INTERACTION Browse Pan Zoom Filter Query Detail on de
BROADENING By citation By terms			CORRELATION (if desired) Pearson's R on any of above	CLUSTER ANALYSIS SCALAR Triangulation Force-directed placement (FDP)	ANALYSIS

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003) Visualizing Knowledge Domains. In Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Volume 37, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, chapter 5, pp. 179-255.

Latest 'Base Map' of Science

Karin W. Boyack, Katy Borner, & Richard Klarans (2007). *Mapping the Structure and Evolution of Chemistry Research*. 11th International Conference on Scientometrics and Informetrics, pp. 112-123.

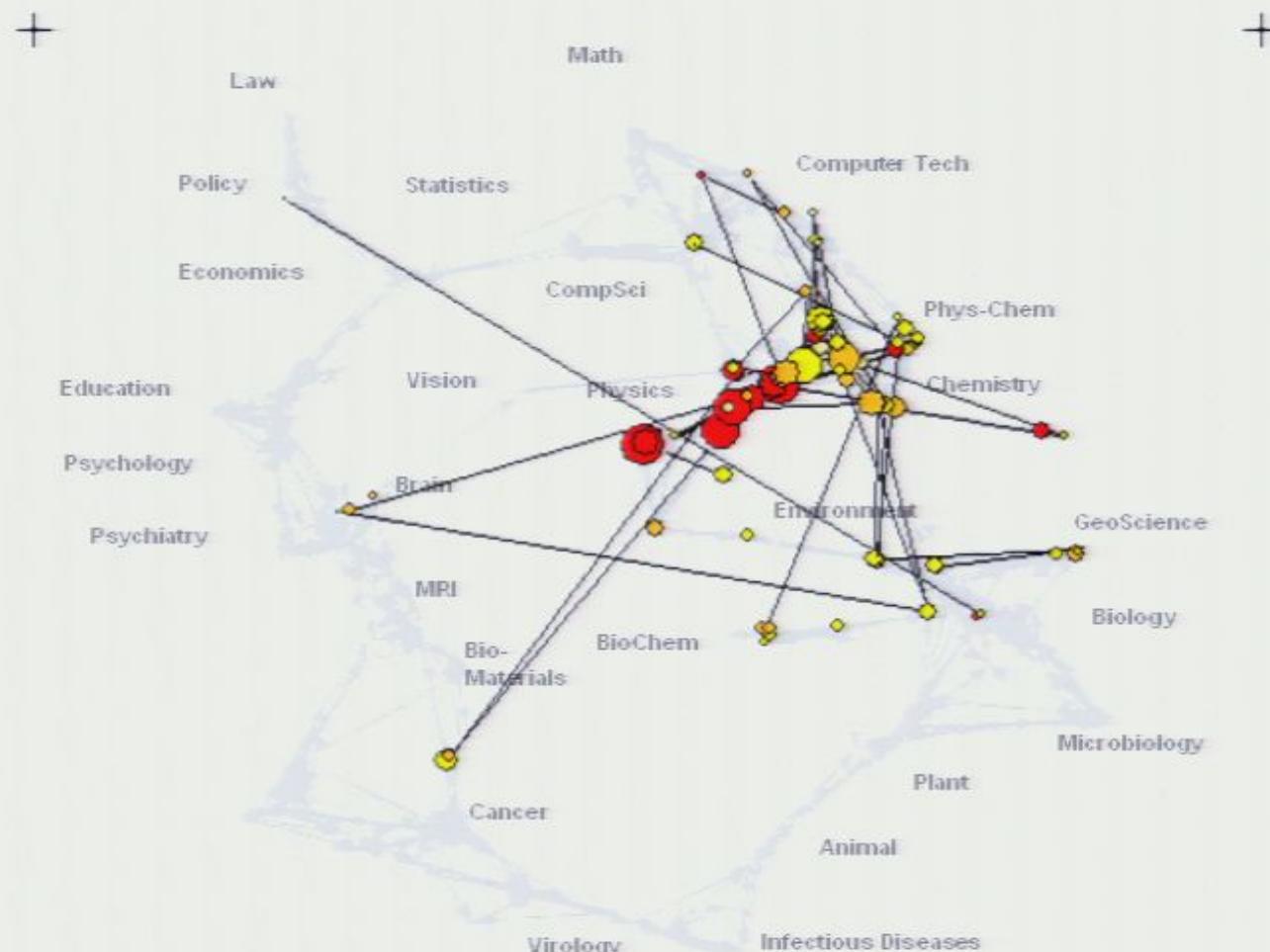
- Uses combined SCI/SSCI from 2002
 - 1.07M papers, 24.5M references, 7,300 journals
 - Bibliographic coupling of papers, aggregated to journals
- Initial ordination and clustering of journals gave 671 clusters
- Coupling counts were reaggregated at the journal cluster level to calculate the
 - (x,y) positions for each journal cluster
 - by association, (x,y) positions for each journal



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Borner, & Richard Klavans (2007).

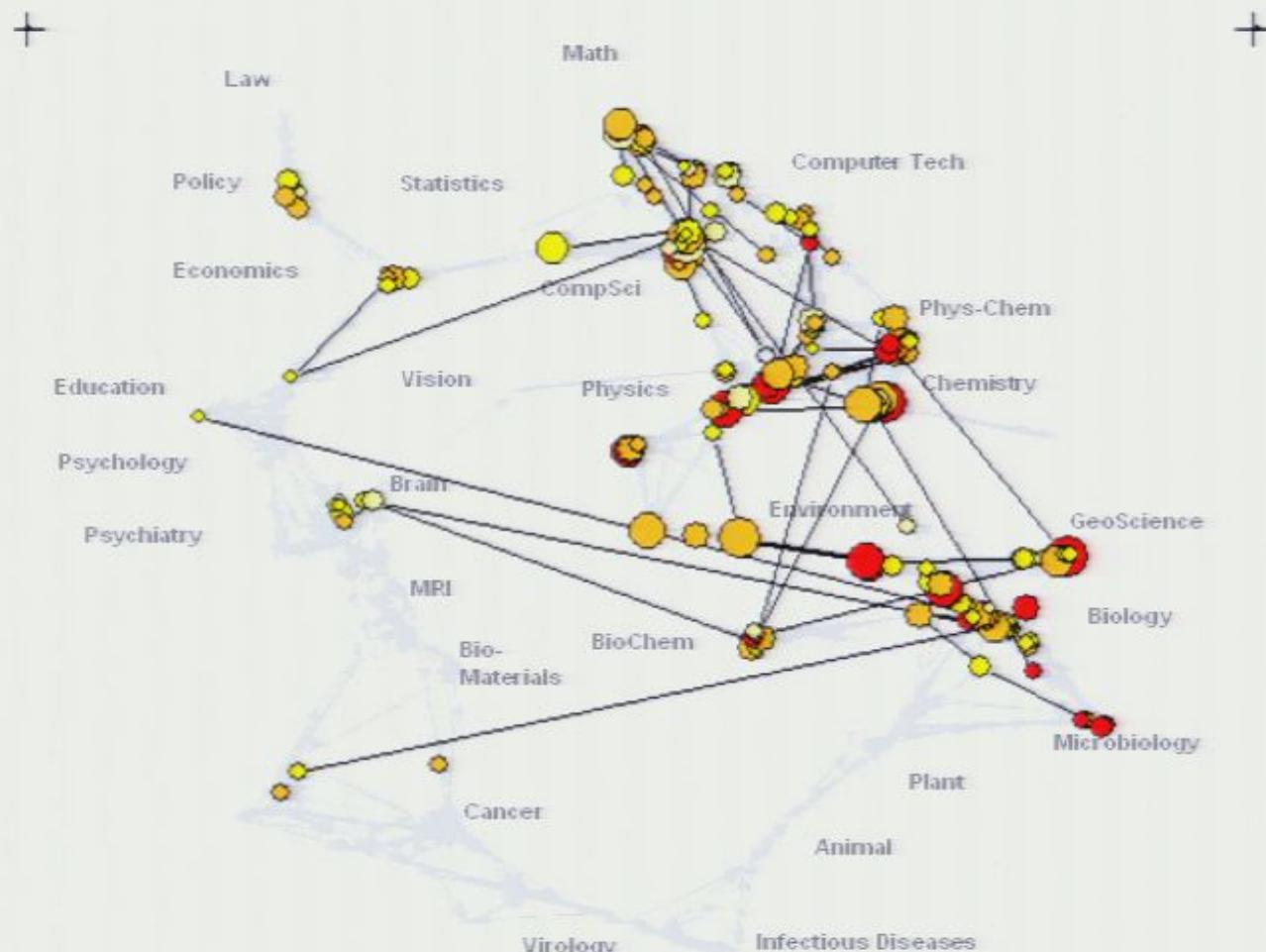
Funding patterns of the US Department of Energy (DOE)



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Borner, & Richard Klarans (2007).

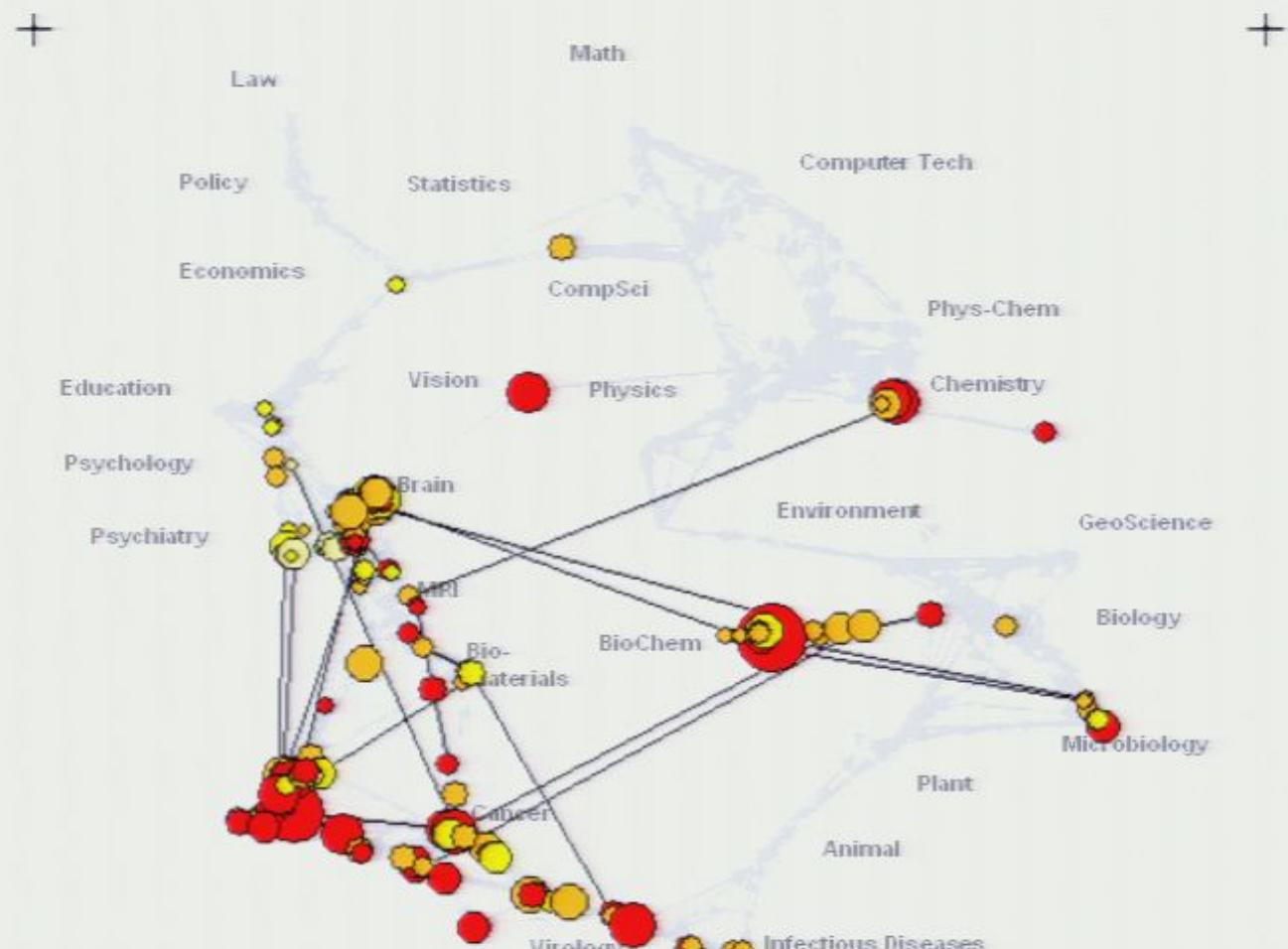
Funding Patterns of the National Science Foundation (NSF)



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Borner, & Richard Klarans (2007).

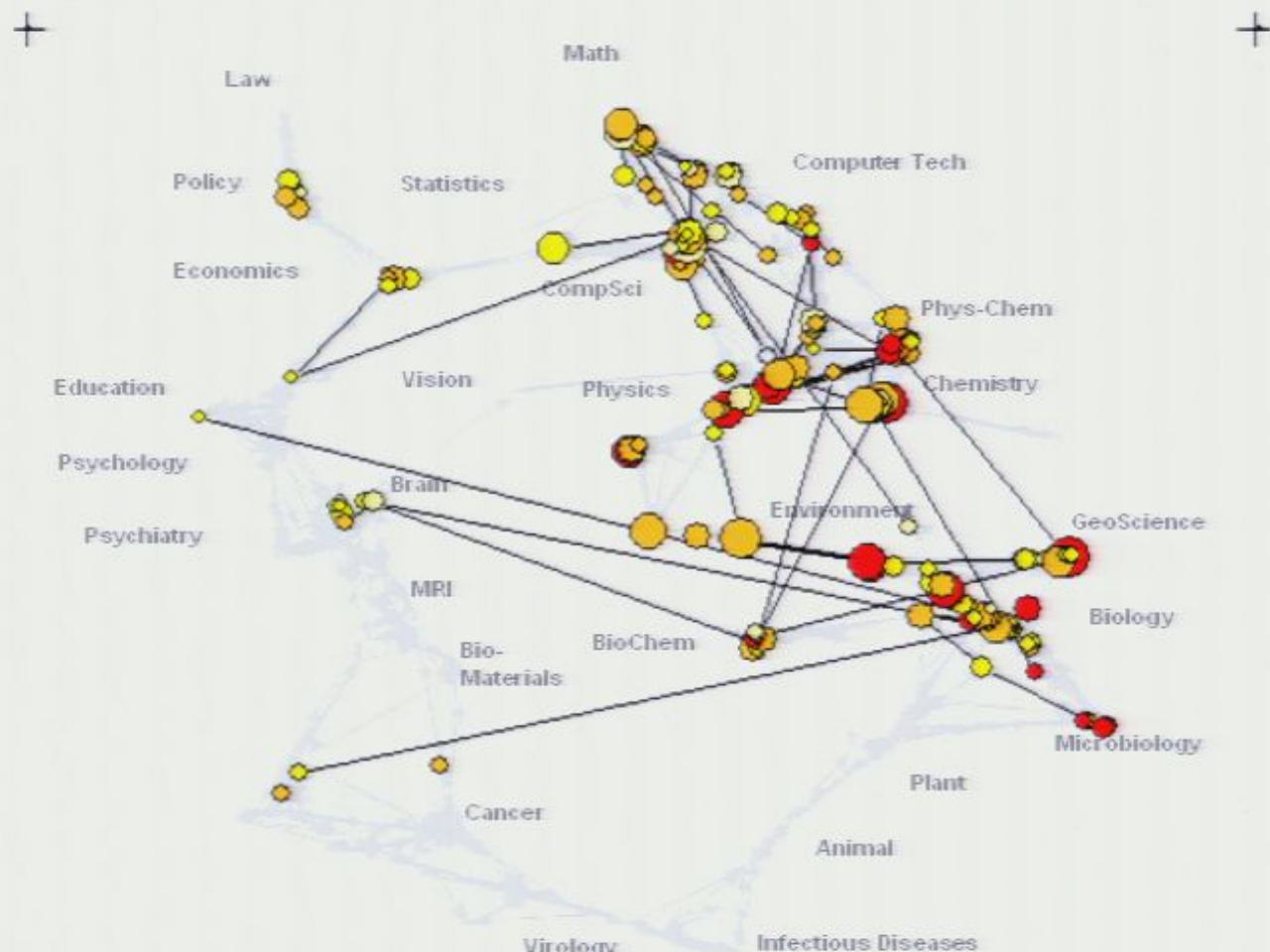
Funding Patterns of the National Institutes of Health (NIH)



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Borner, & Richard Klarans (2007).

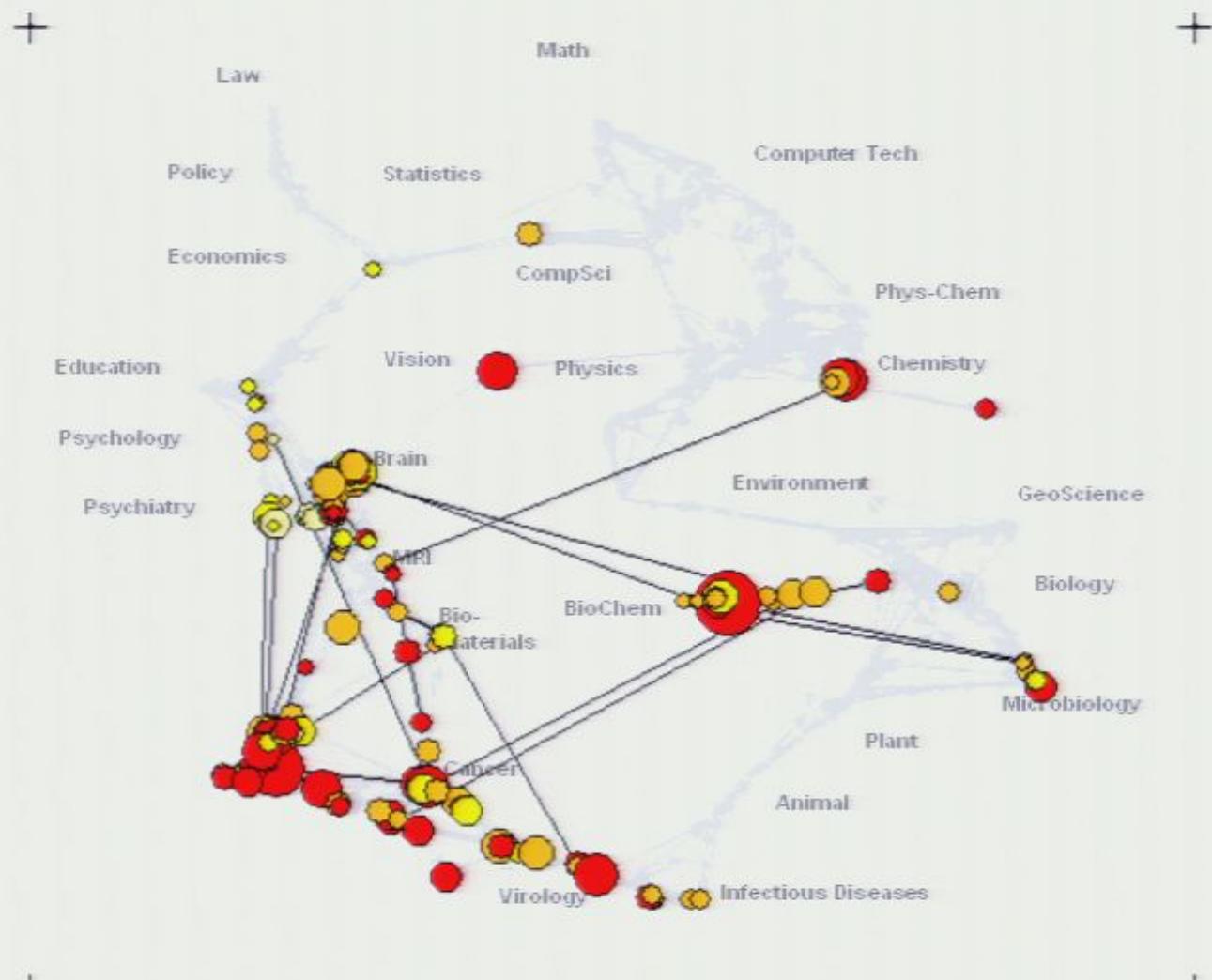
Funding Patterns of the National Science Foundation (NSF)



Science map applications: Identifying core competency

Karin W. Boyack, Katy Borner & Richard Klarans (2007).

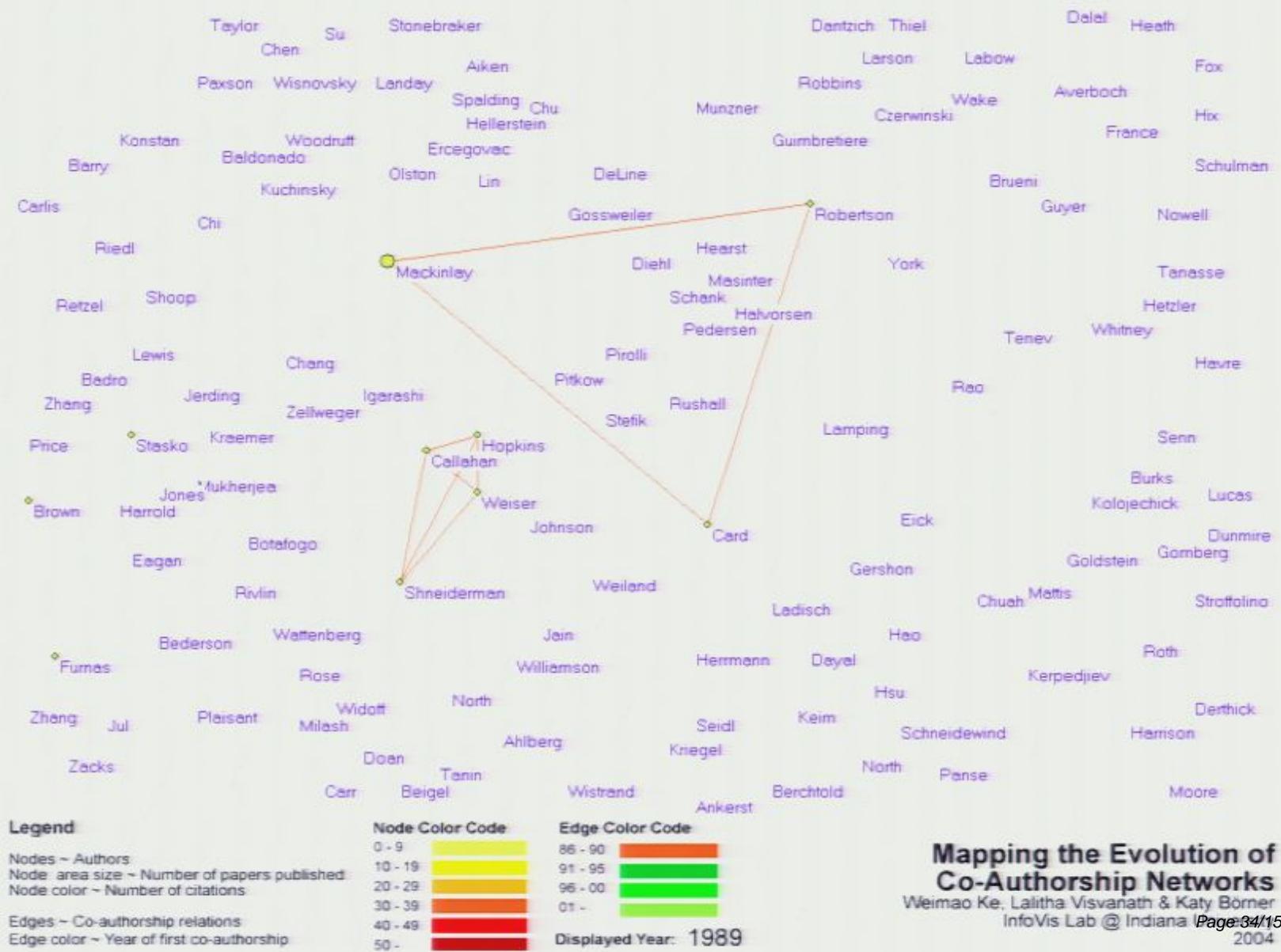
Funding Patterns of the National Institutes of Health (NIH)



Sample Science Studies

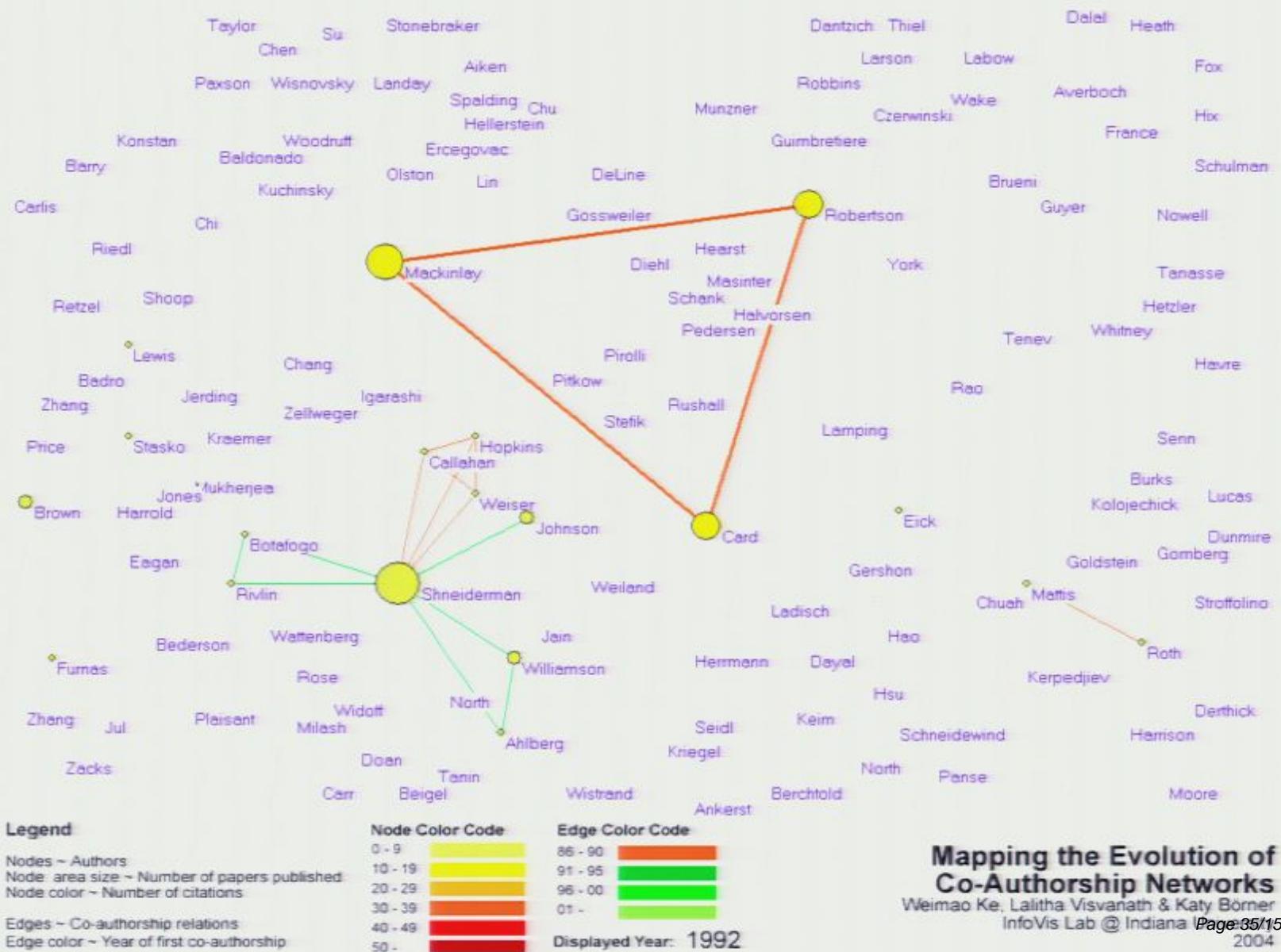
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



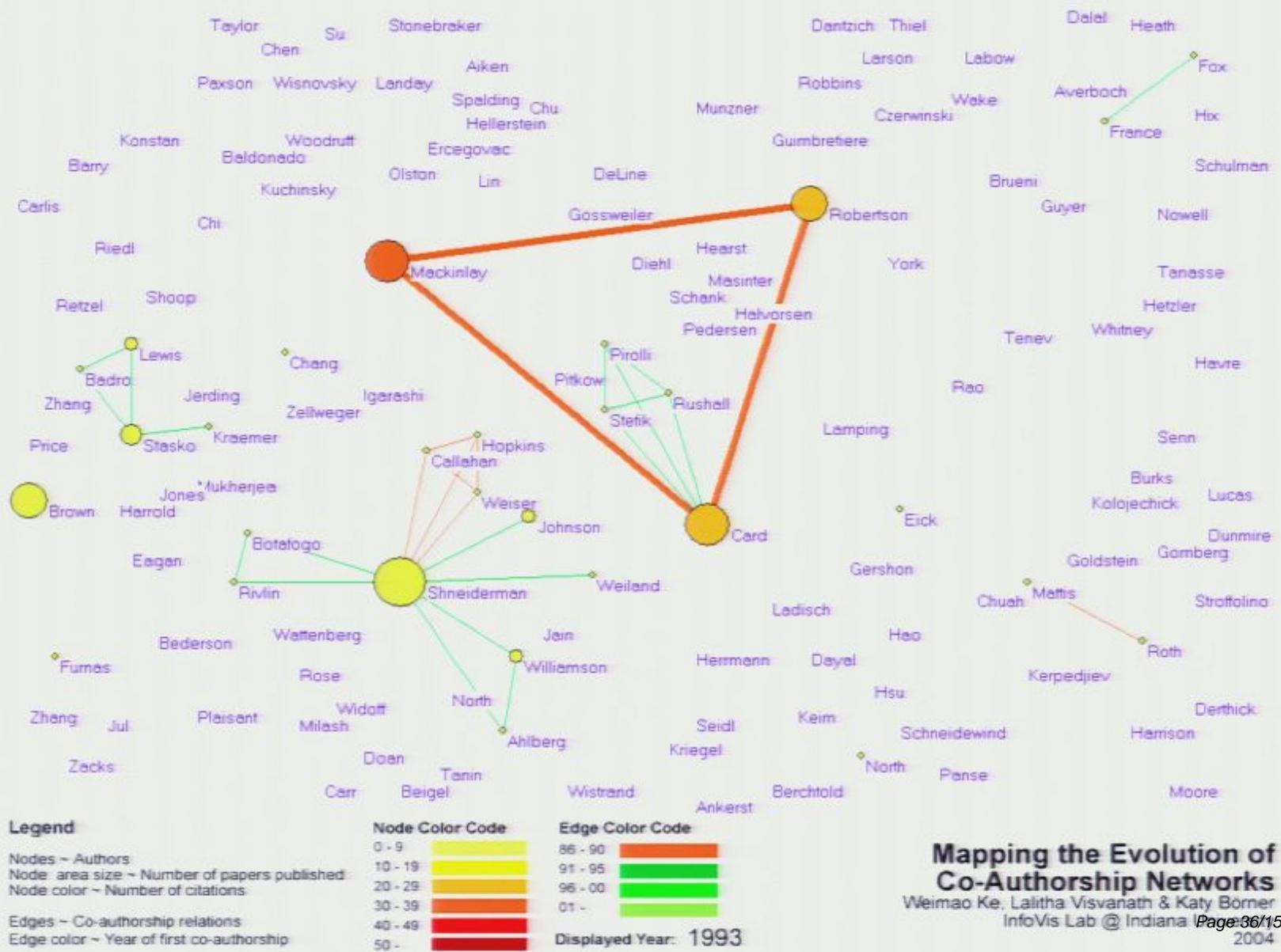
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



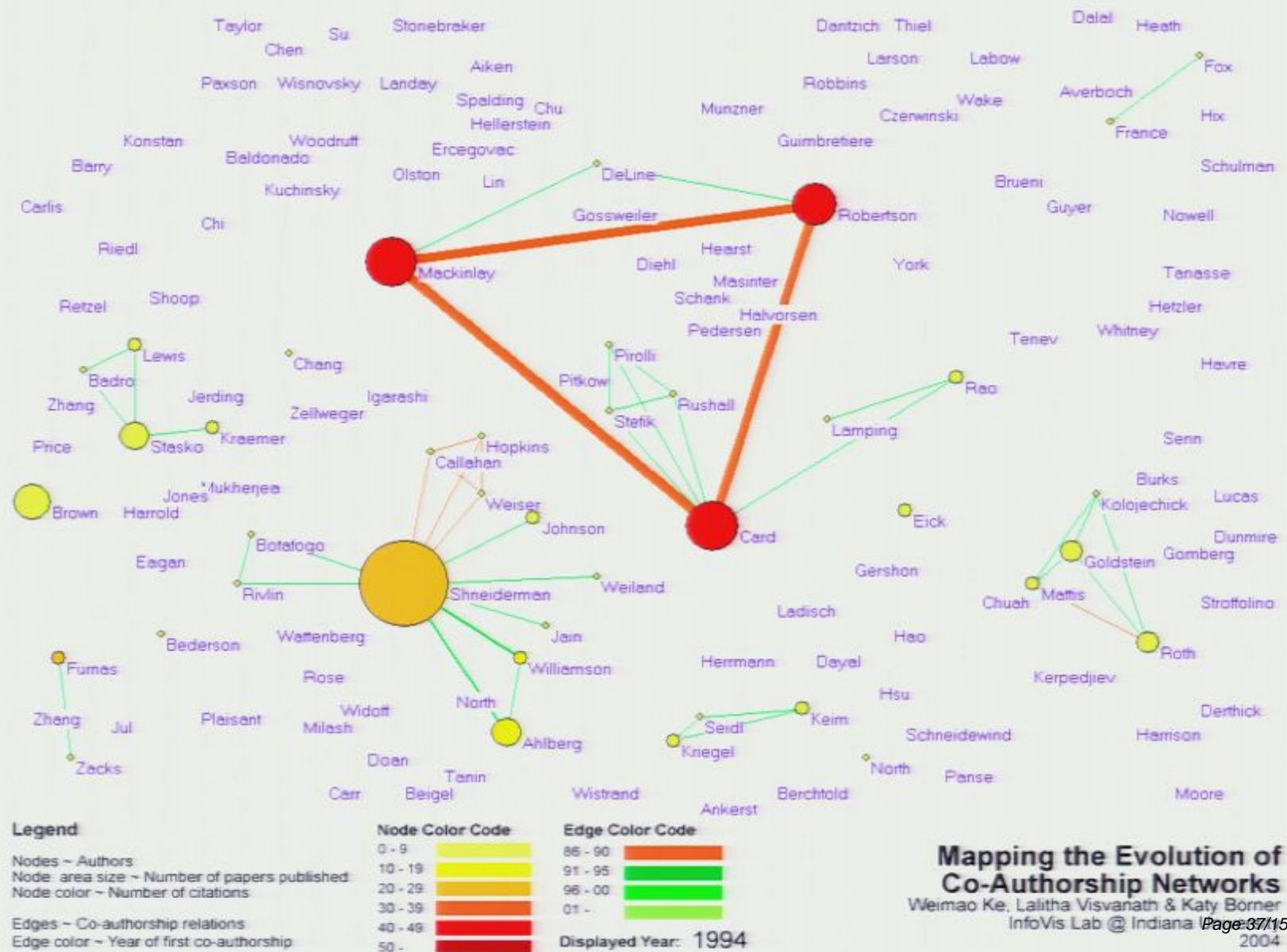
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



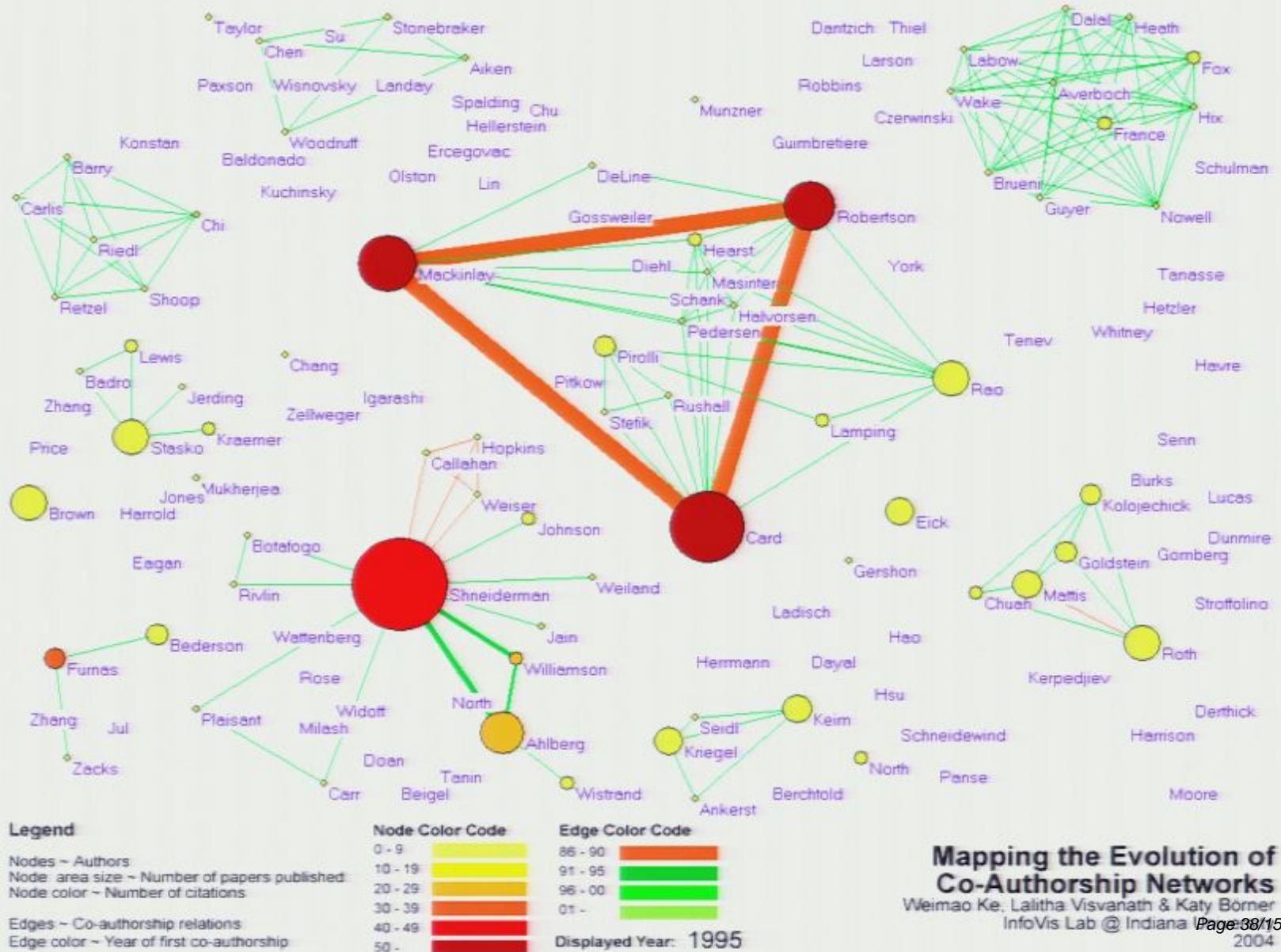
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



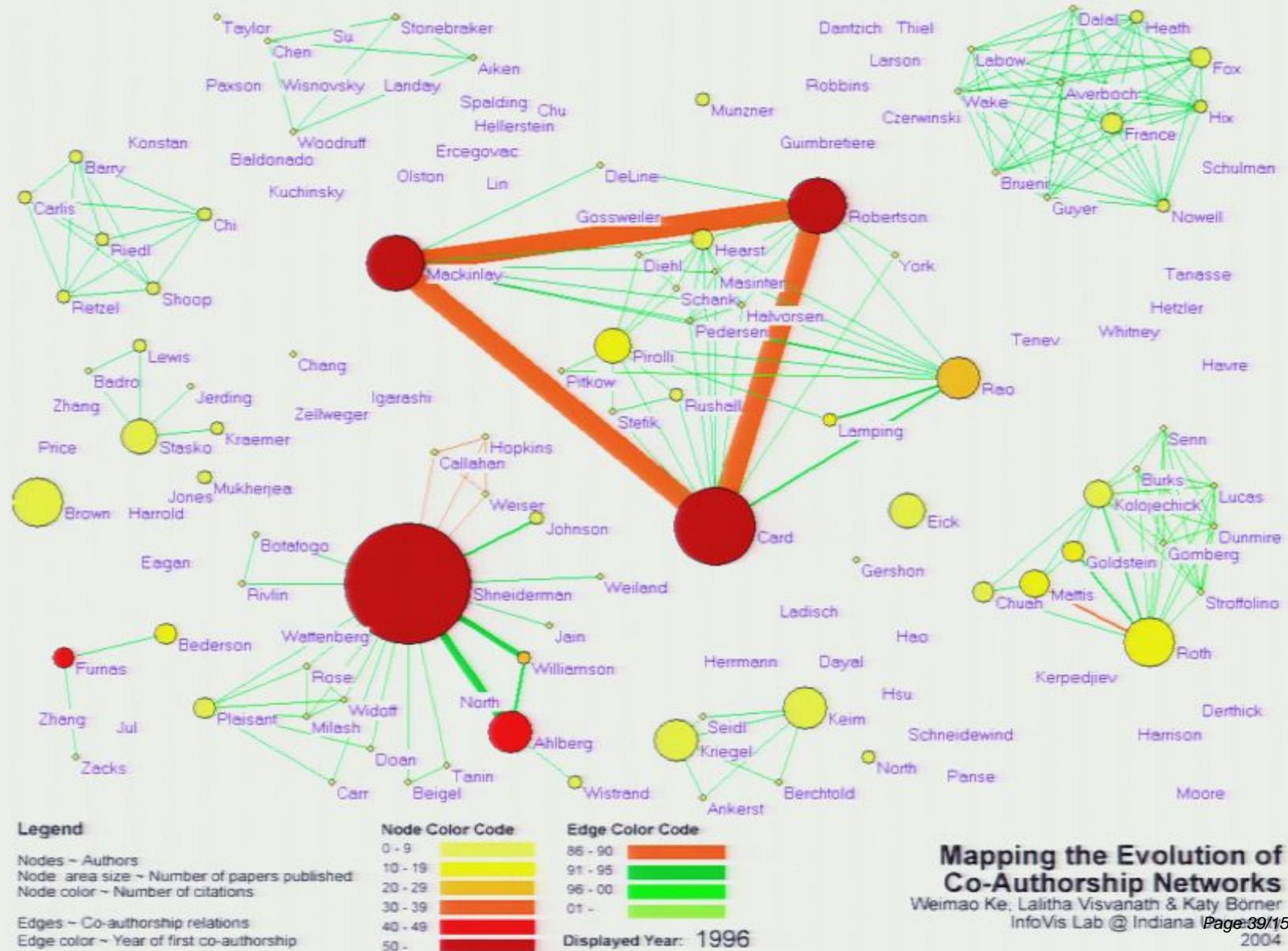
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



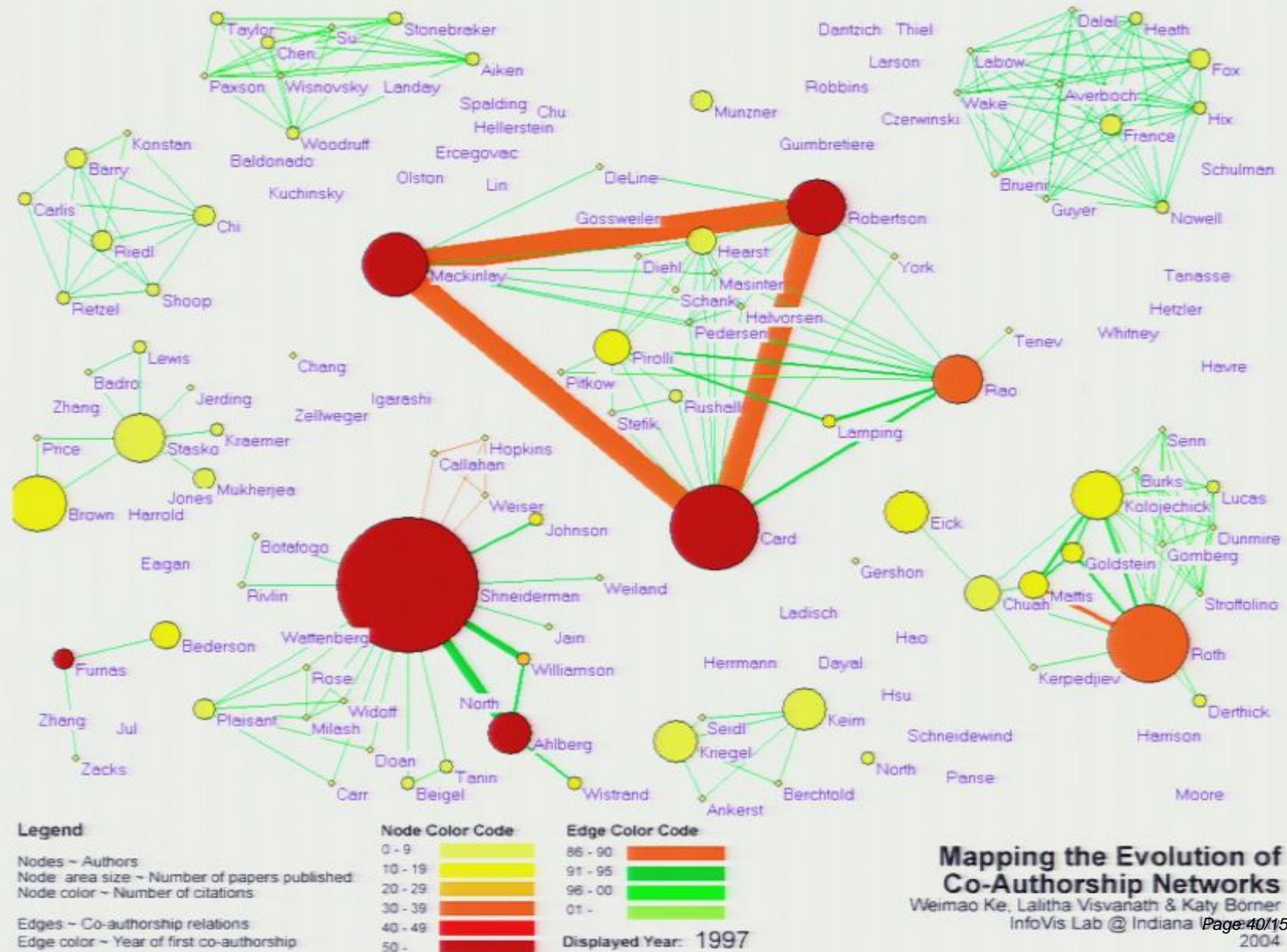
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



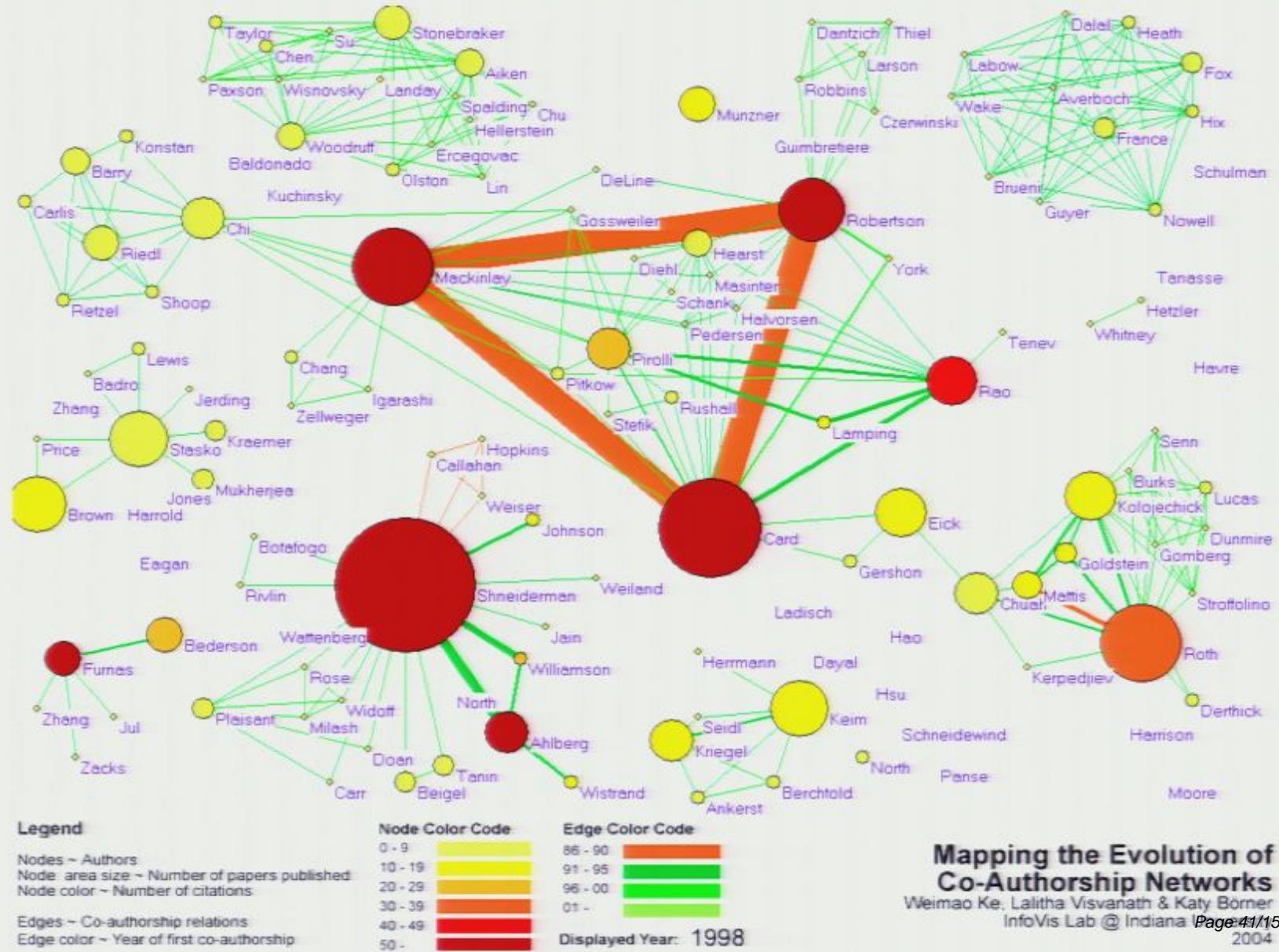
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



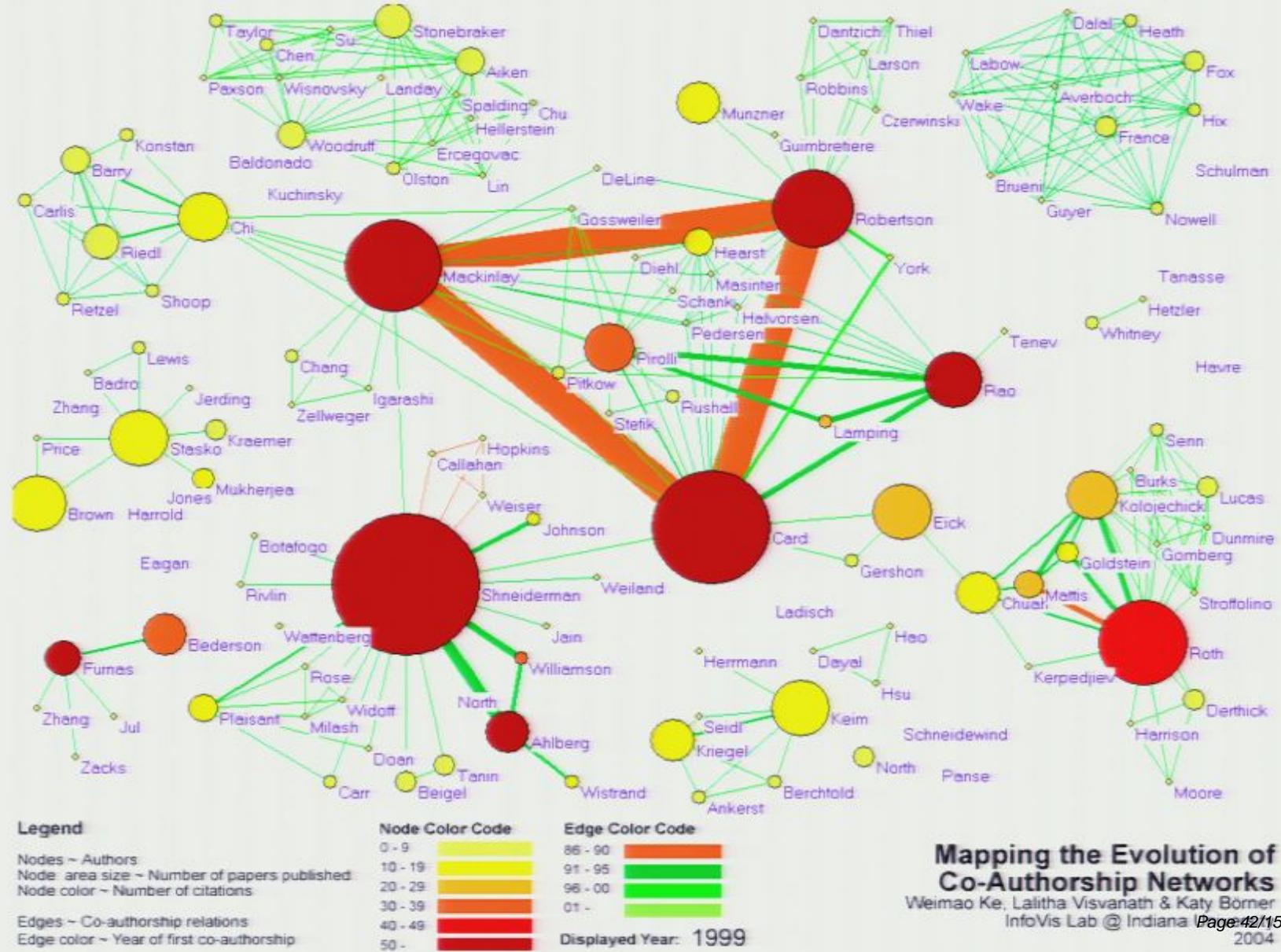
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



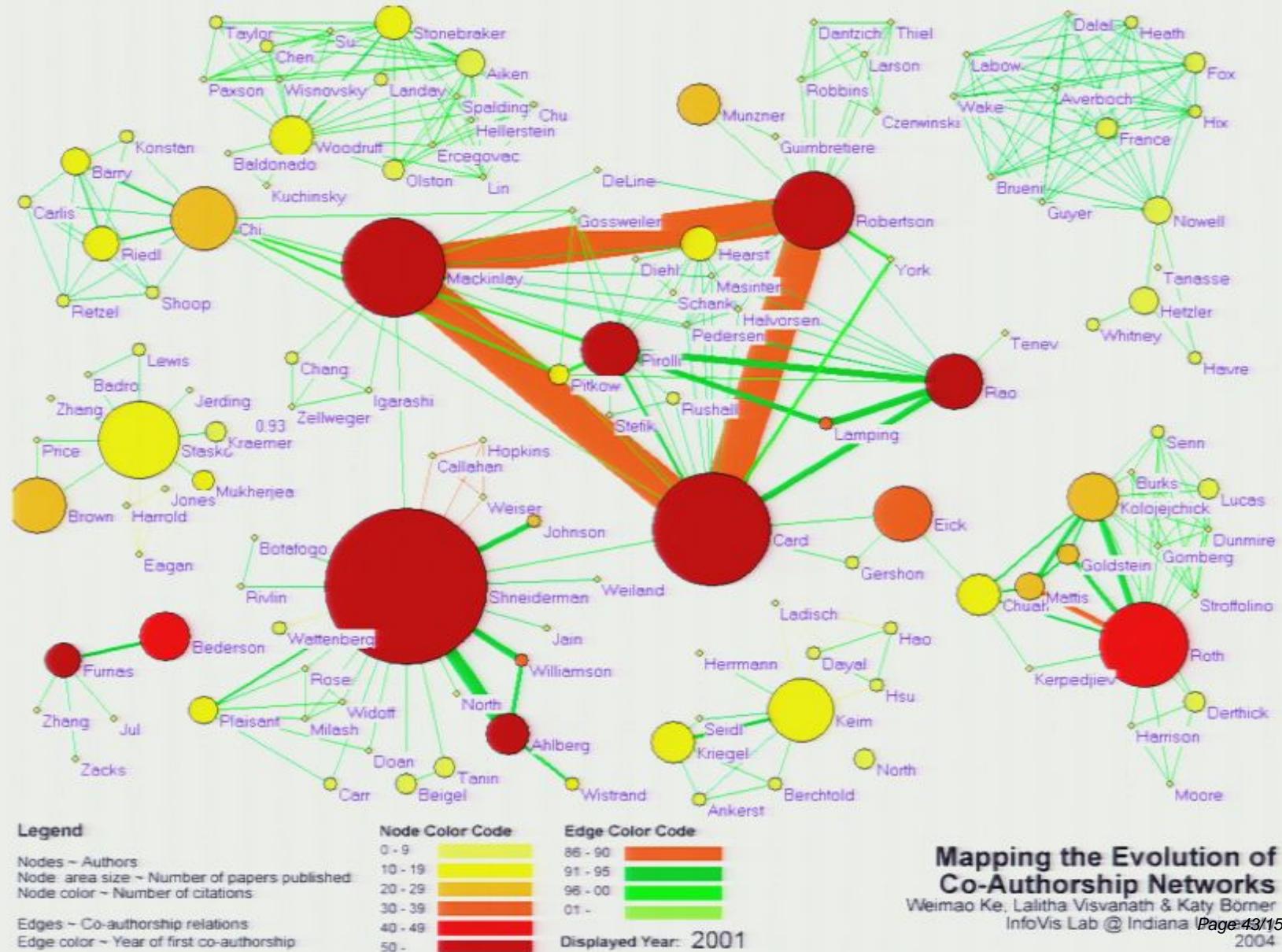
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



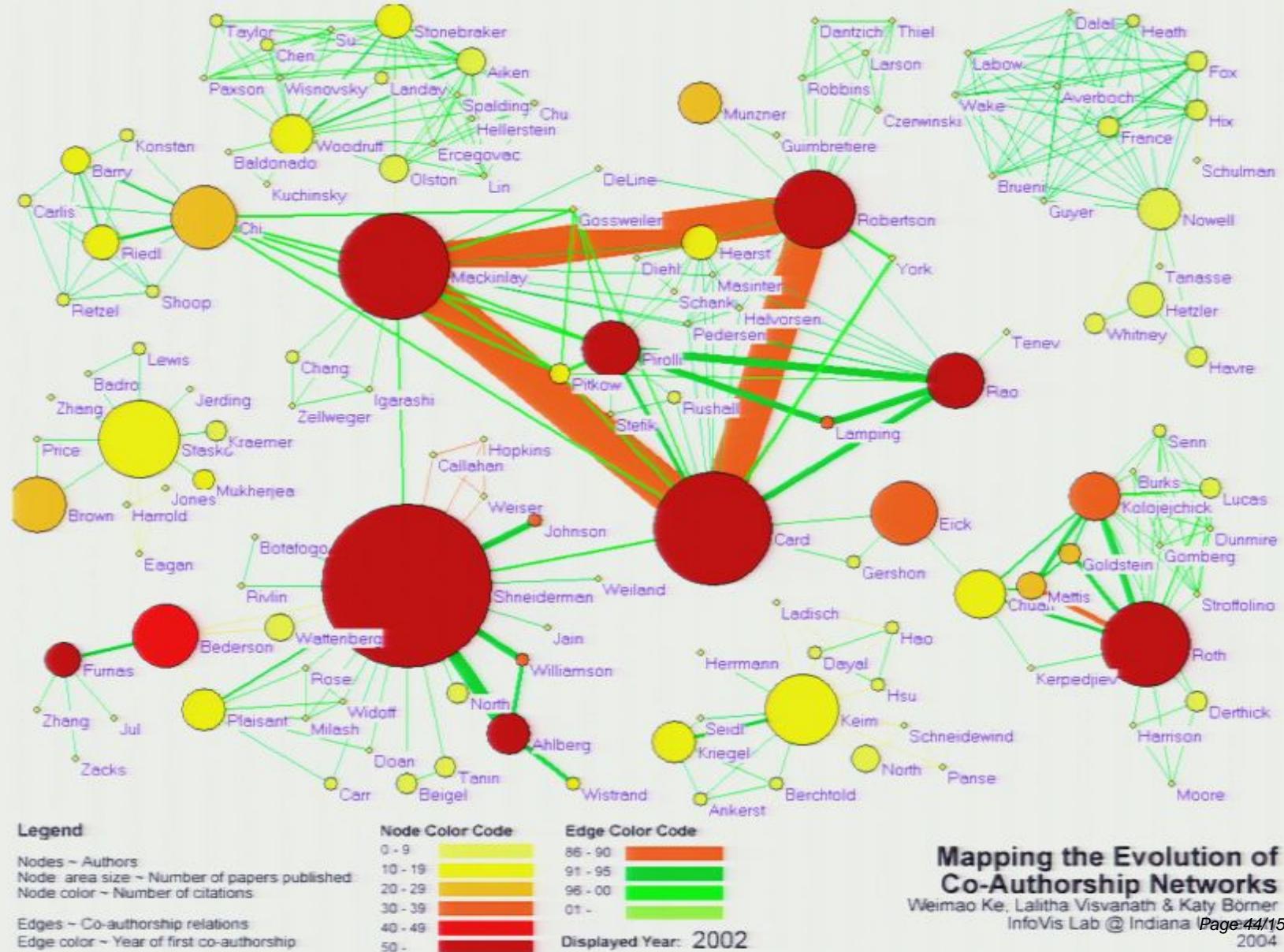
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



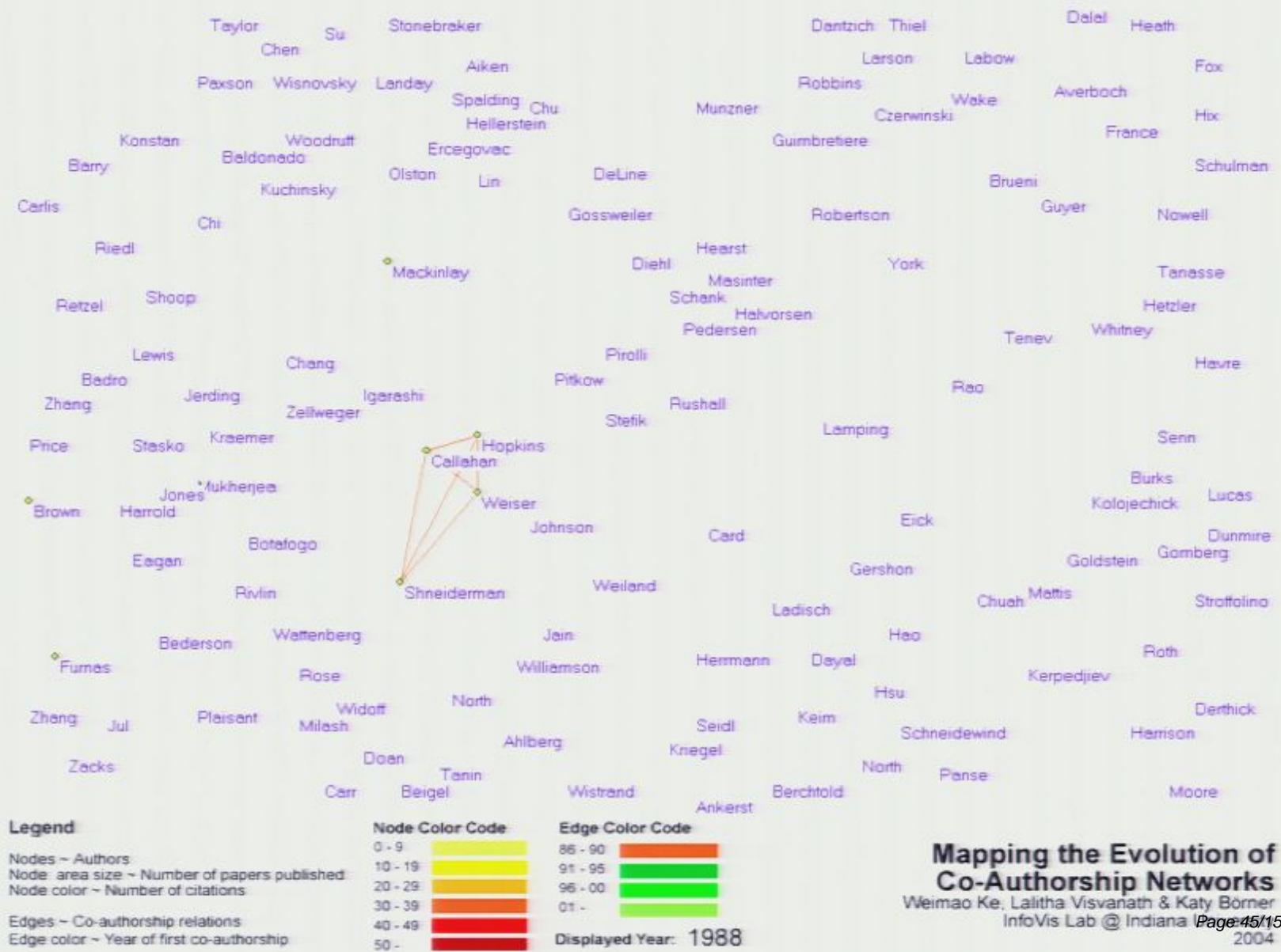
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



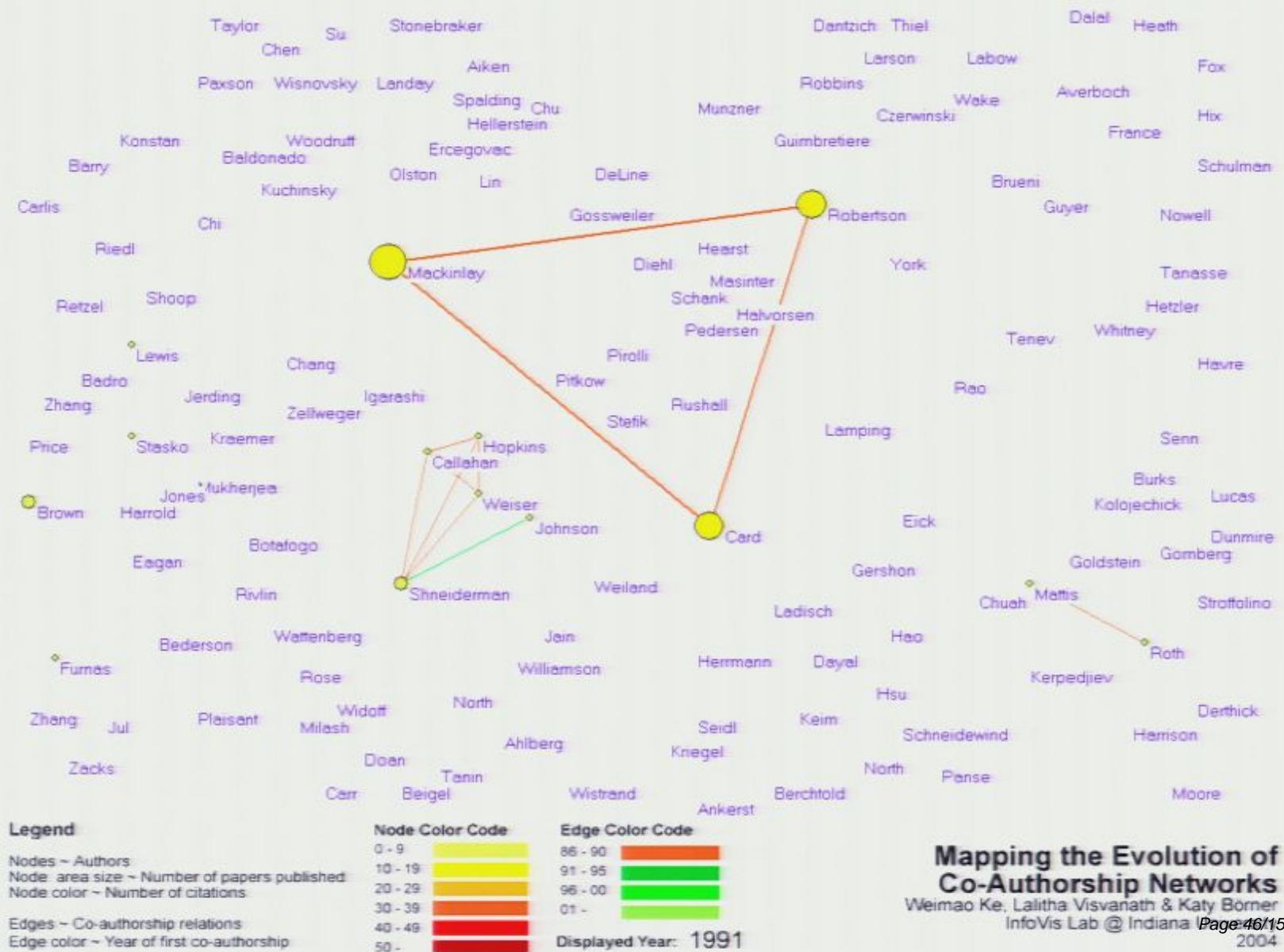
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



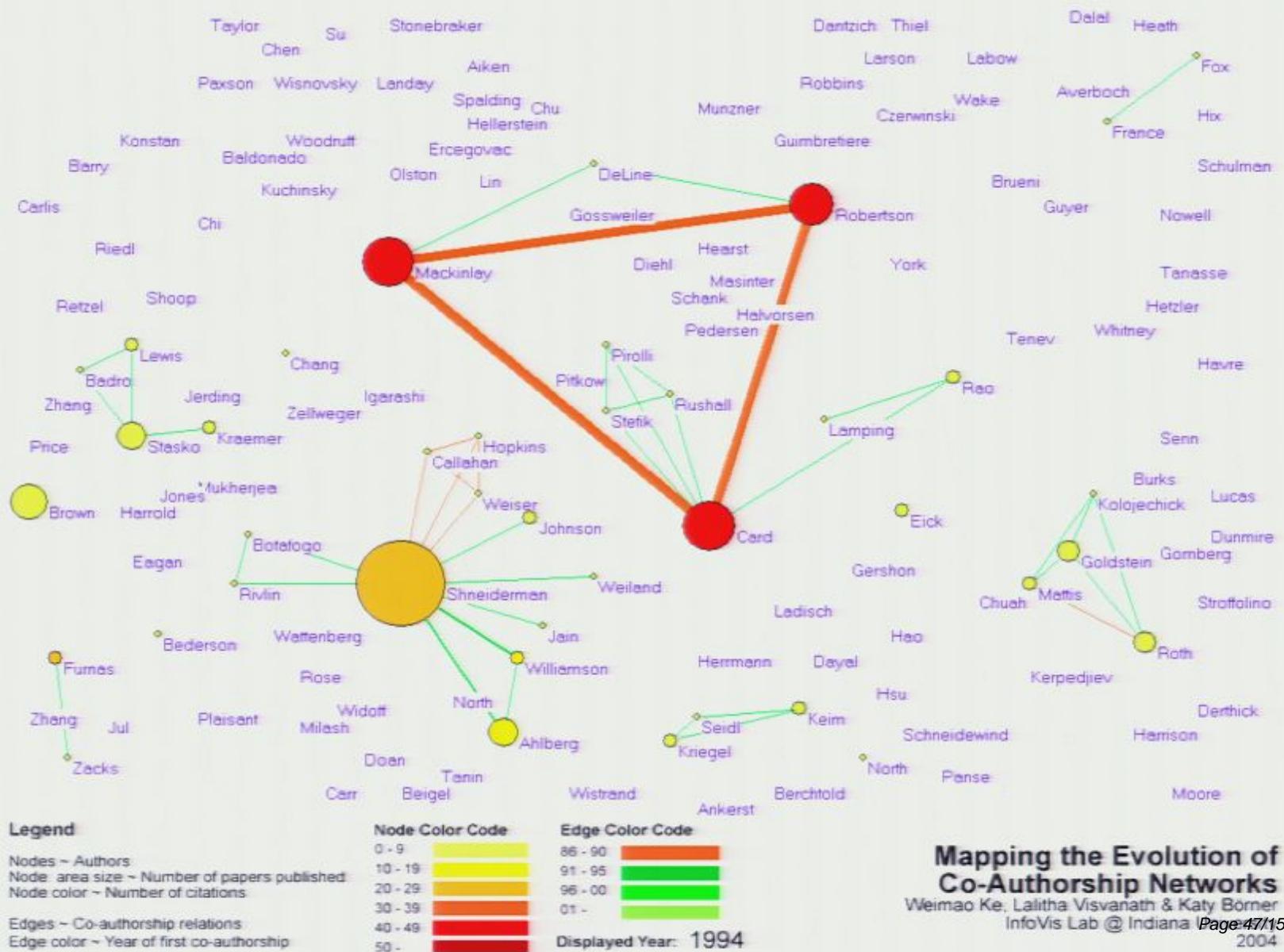
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



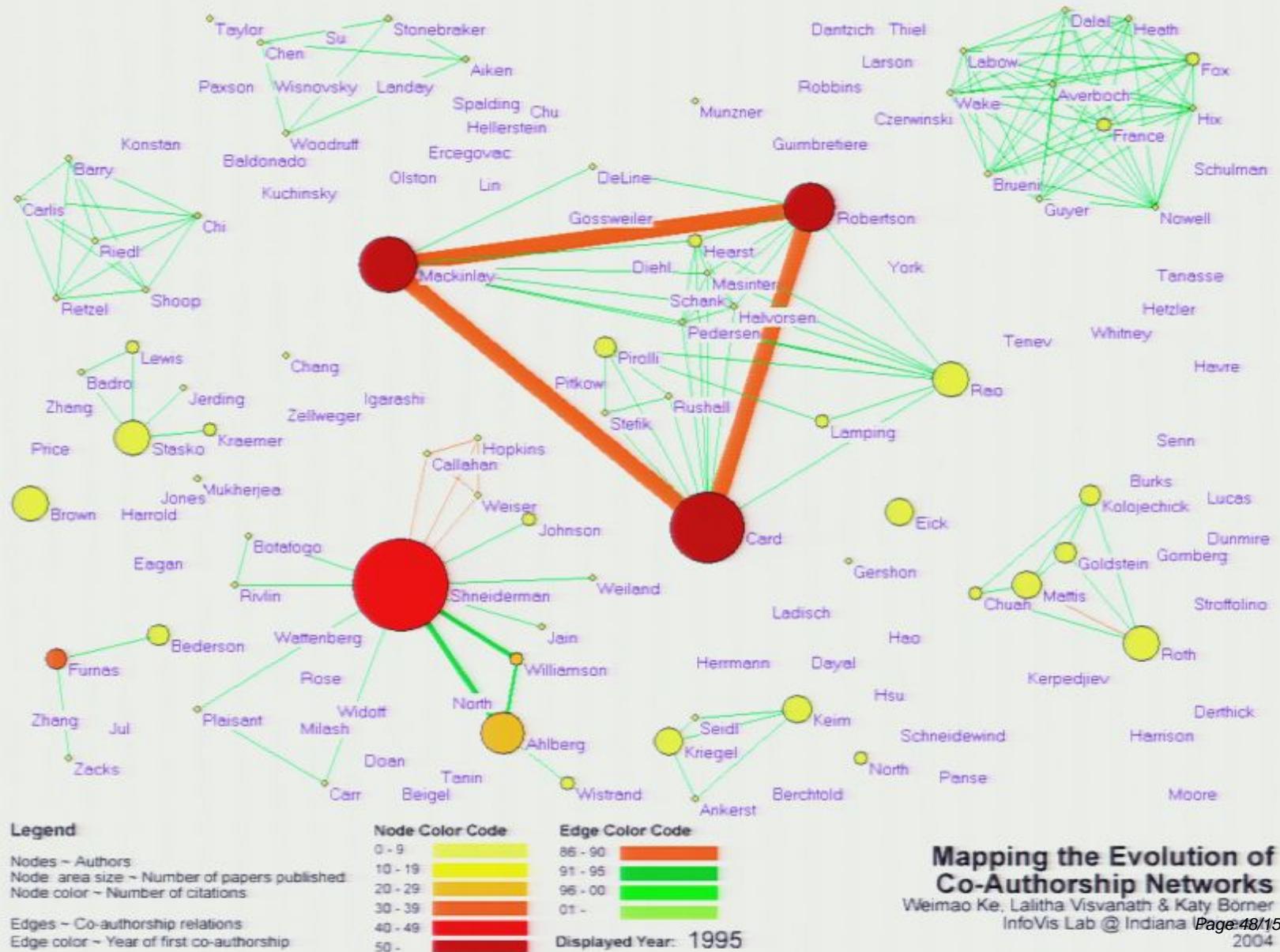
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



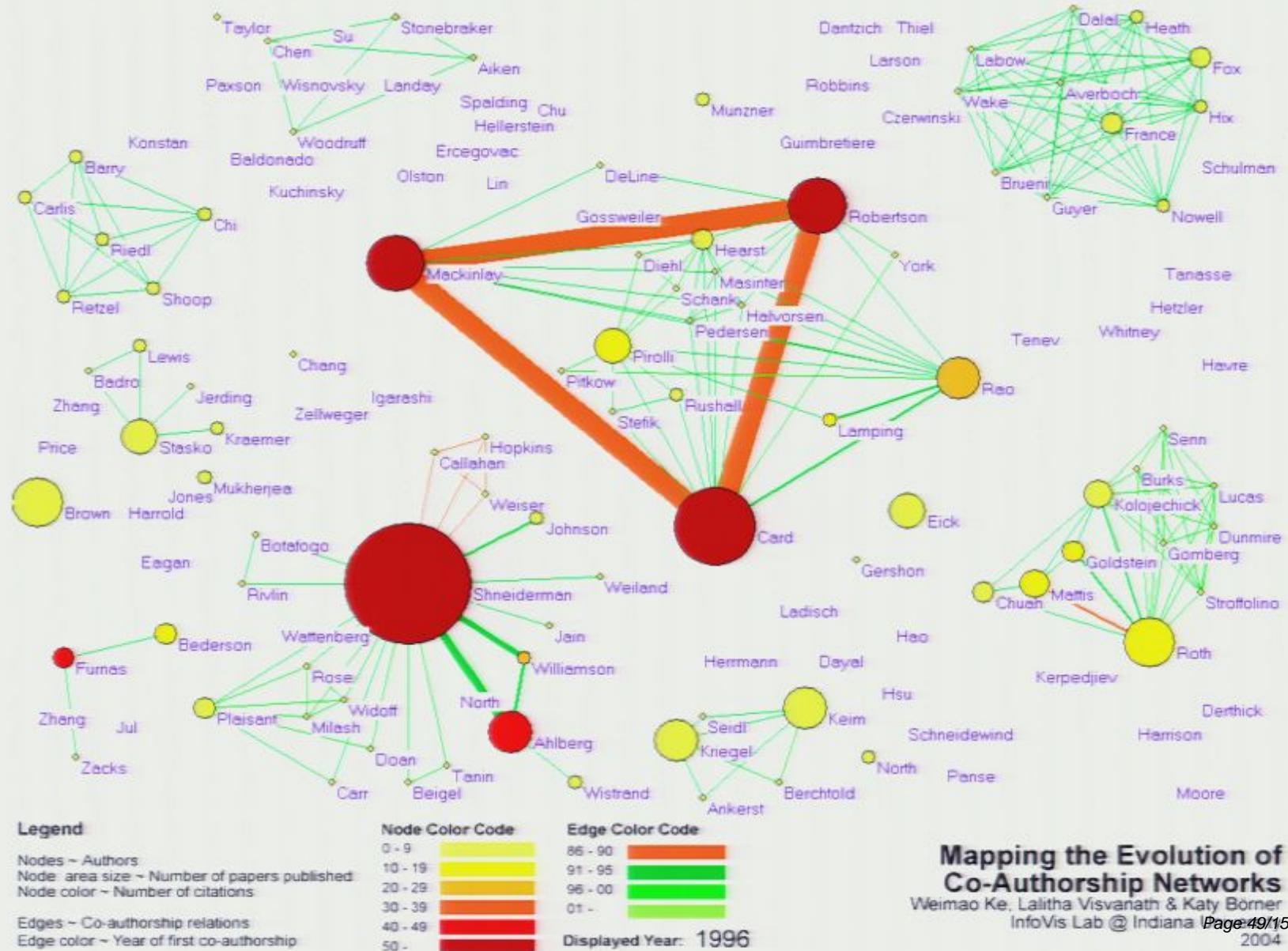
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Bornier (2004) Won 1st prize at the IEEE InfoVis Contest.



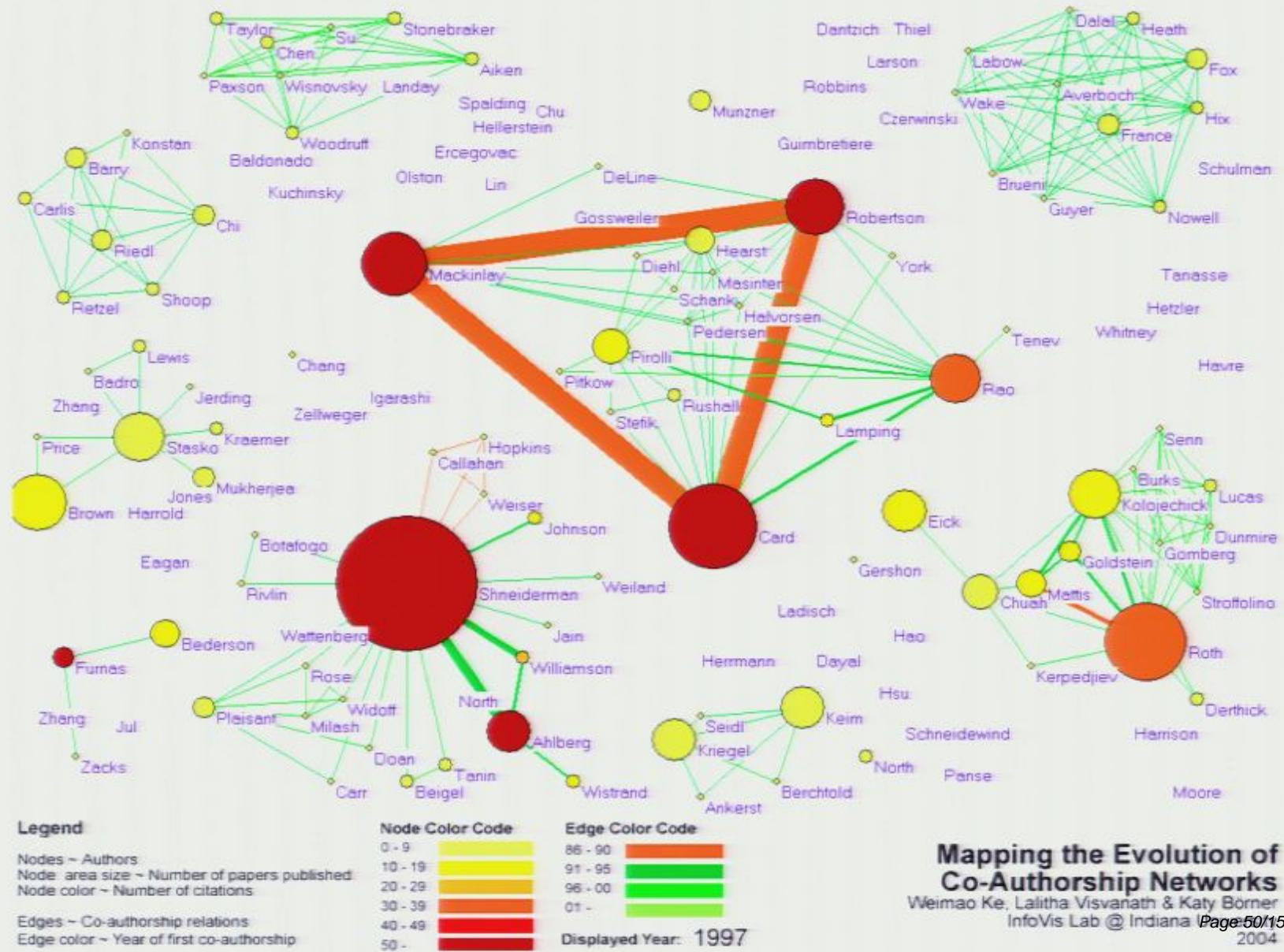
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



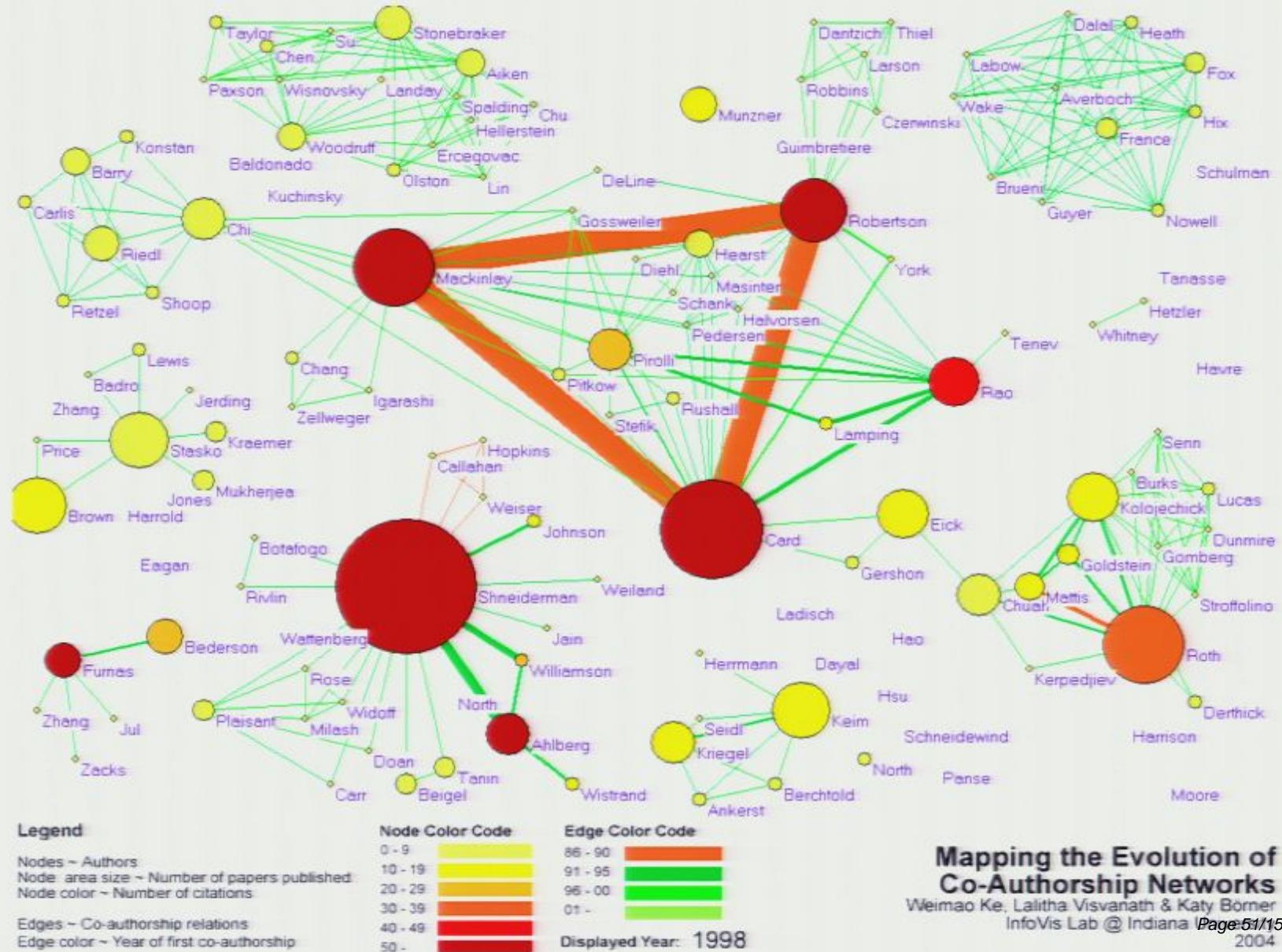
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



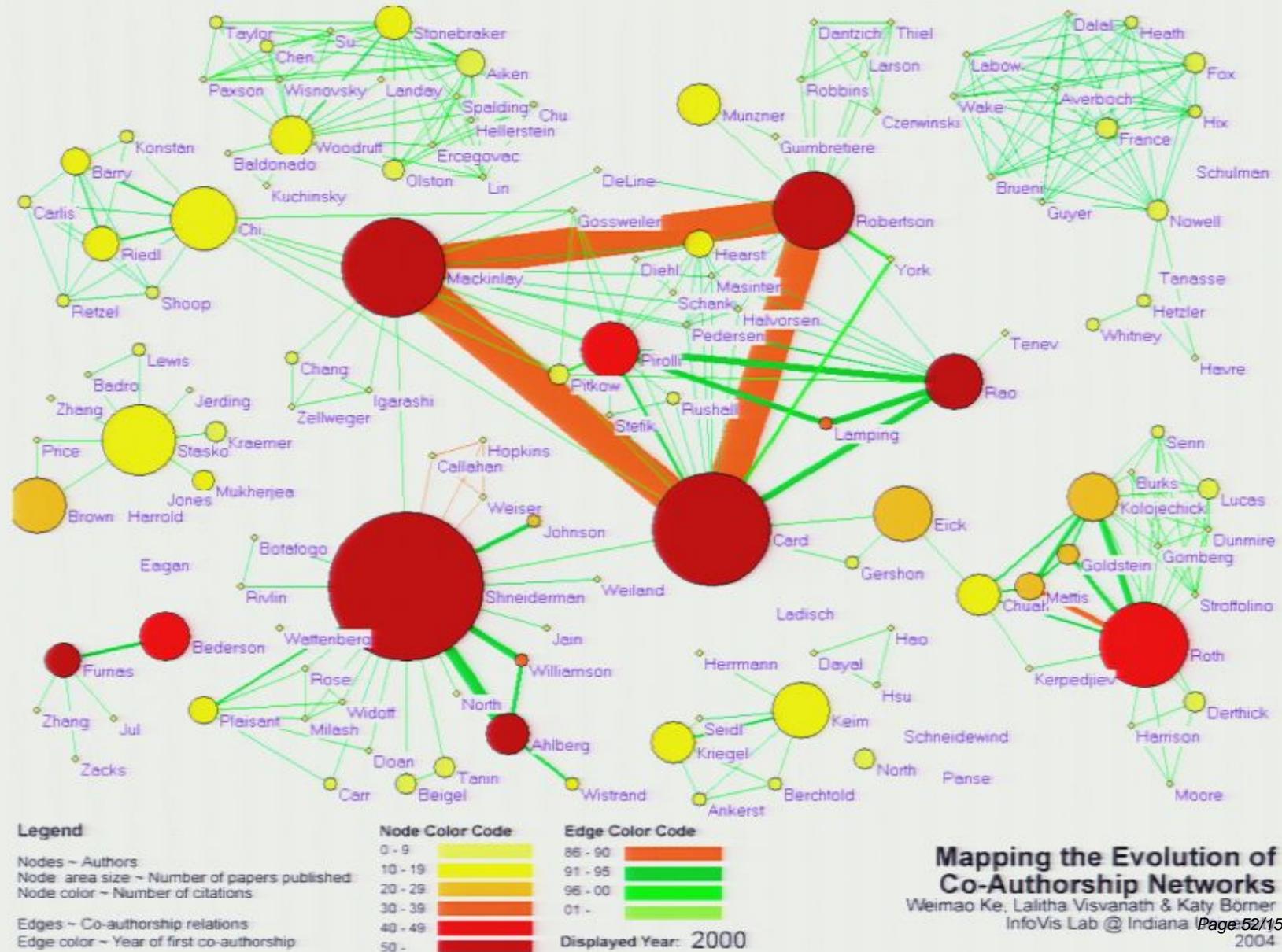
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



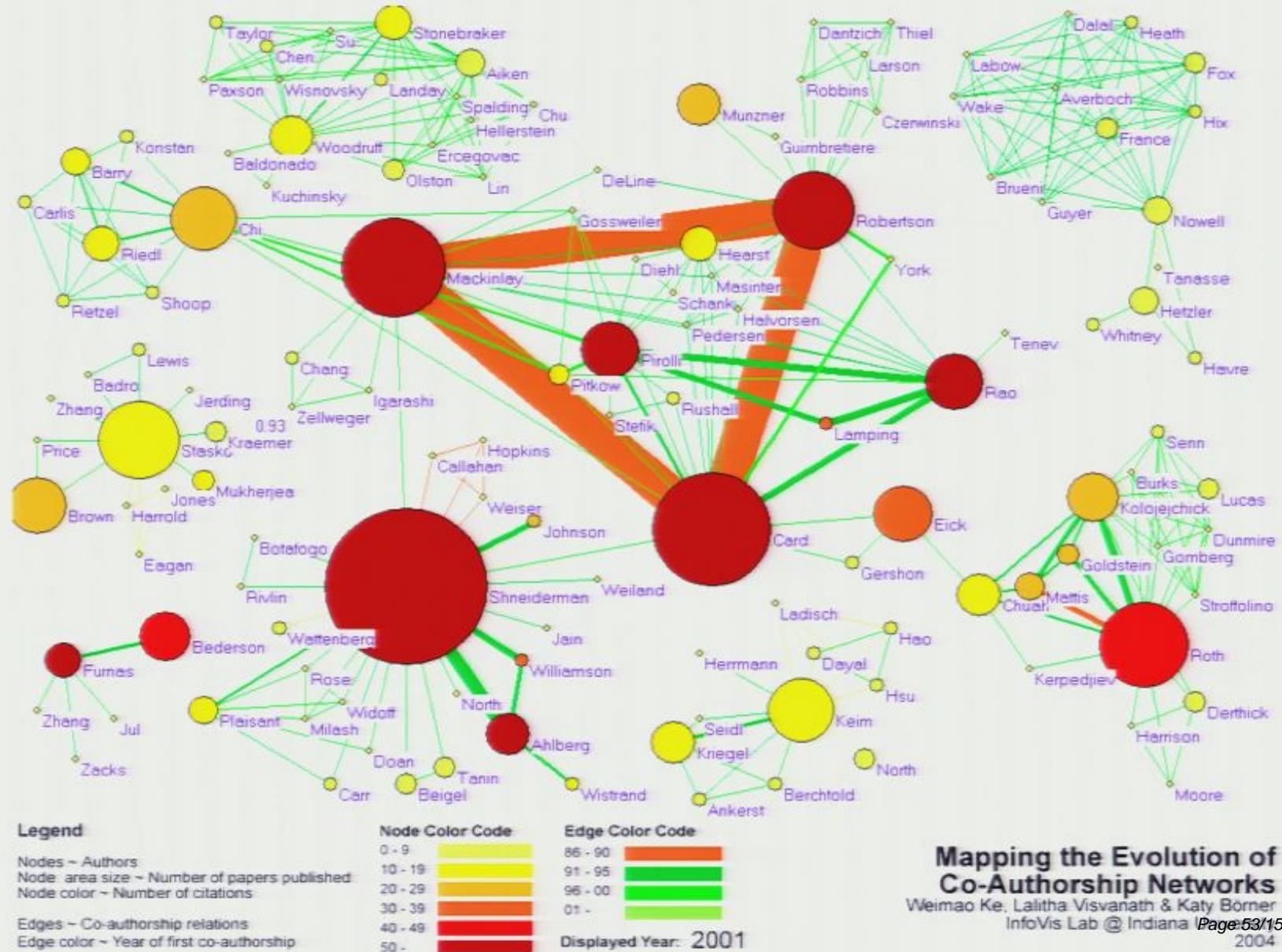
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



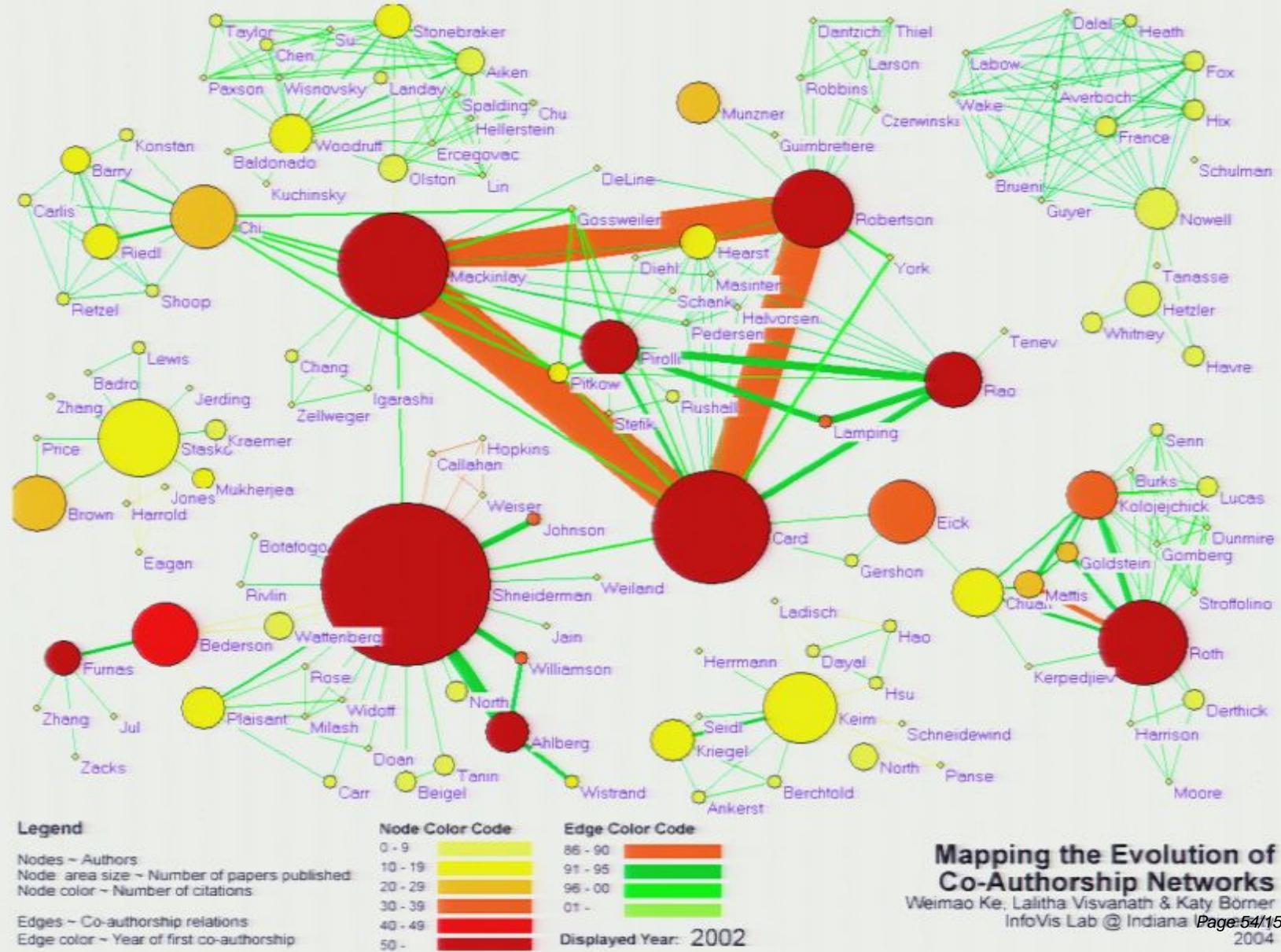
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



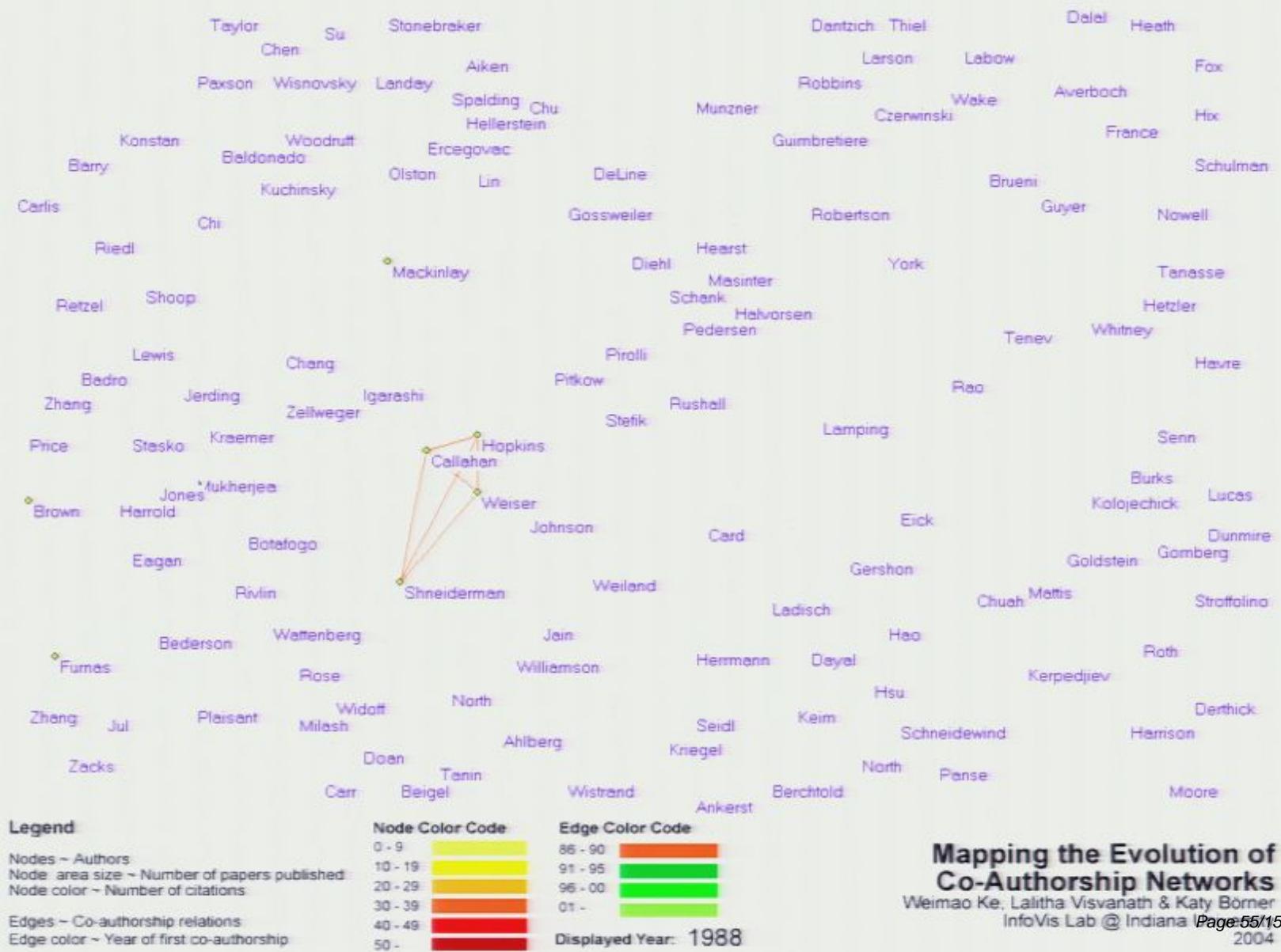
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



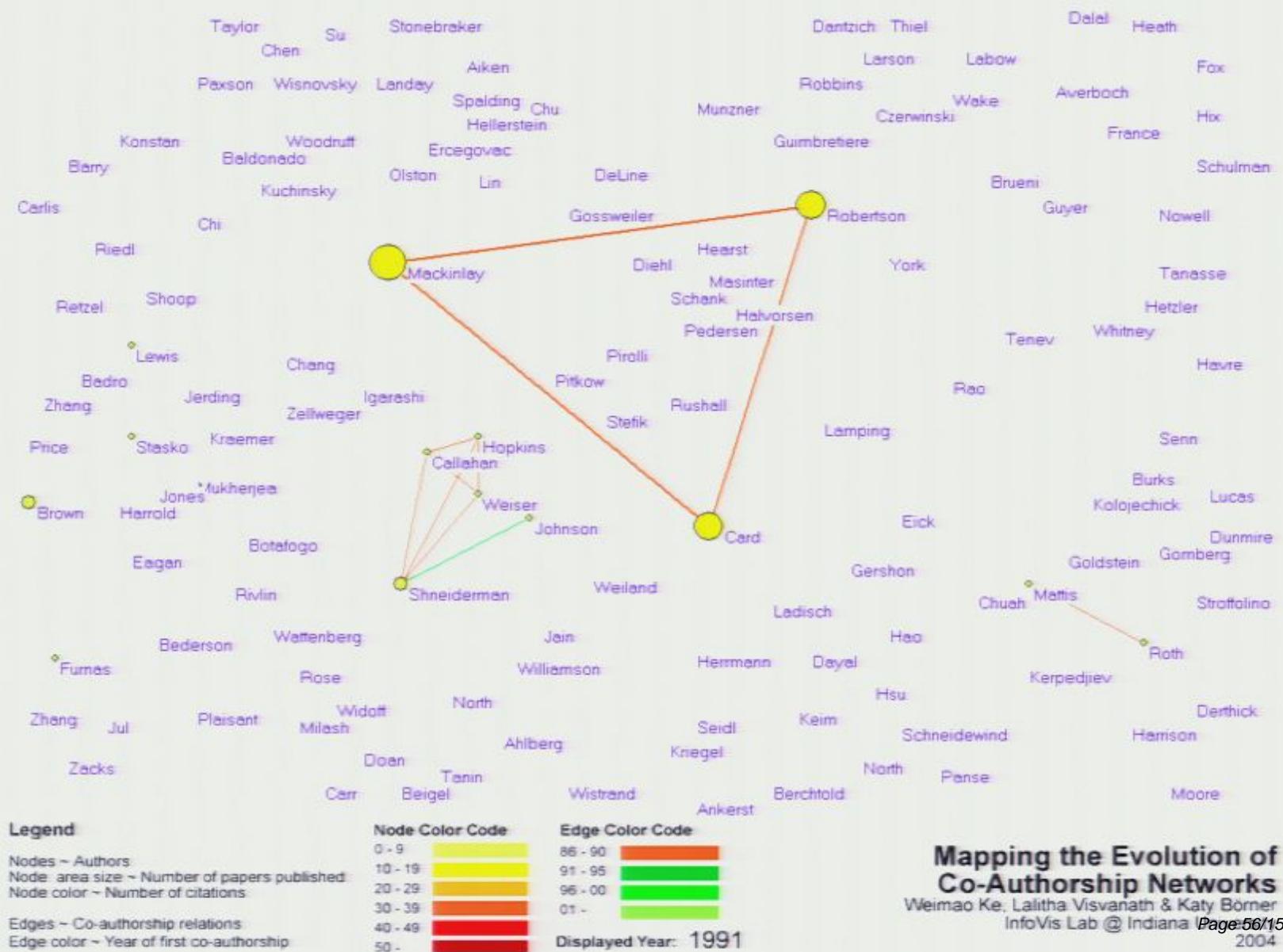
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



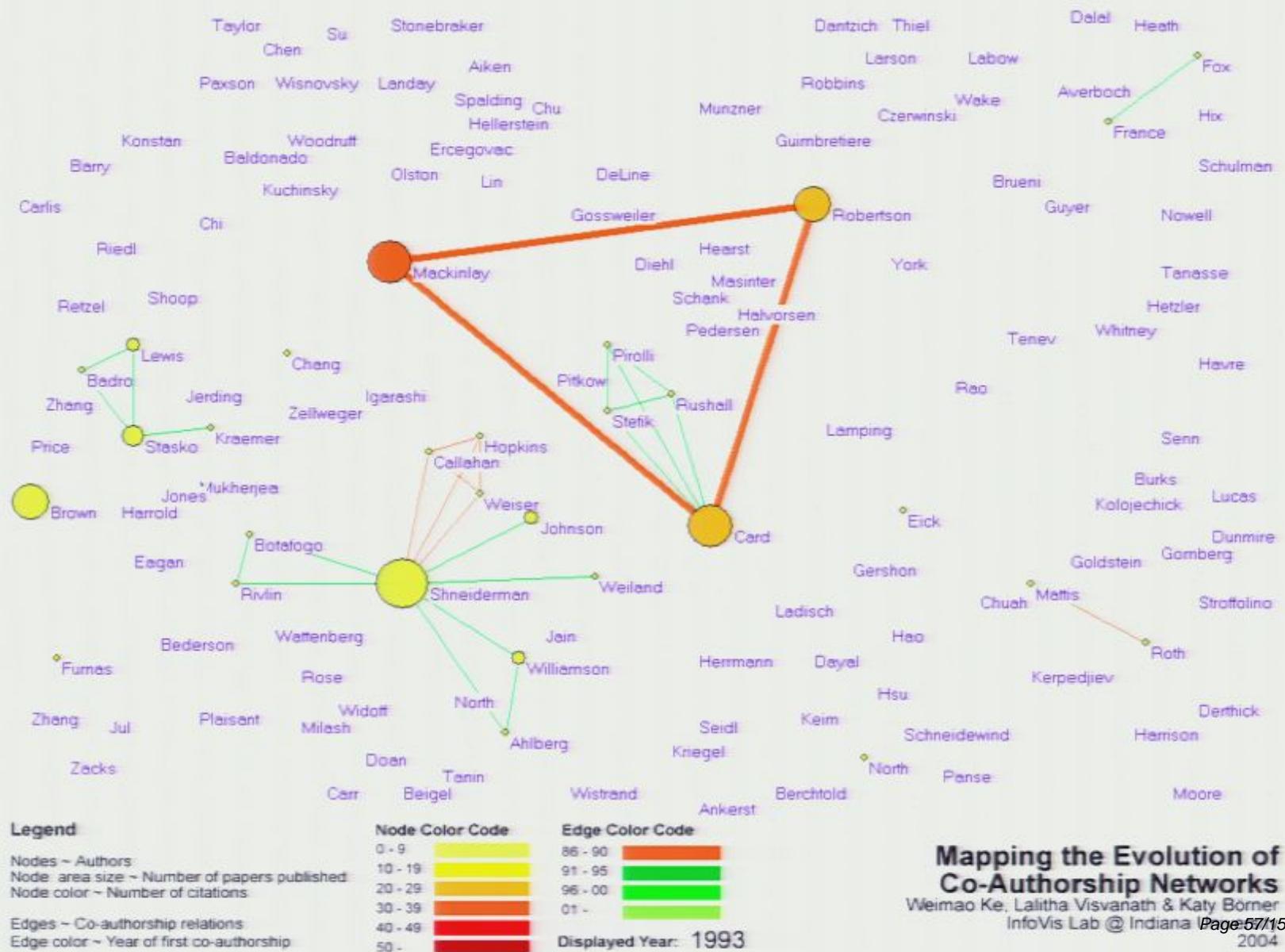
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



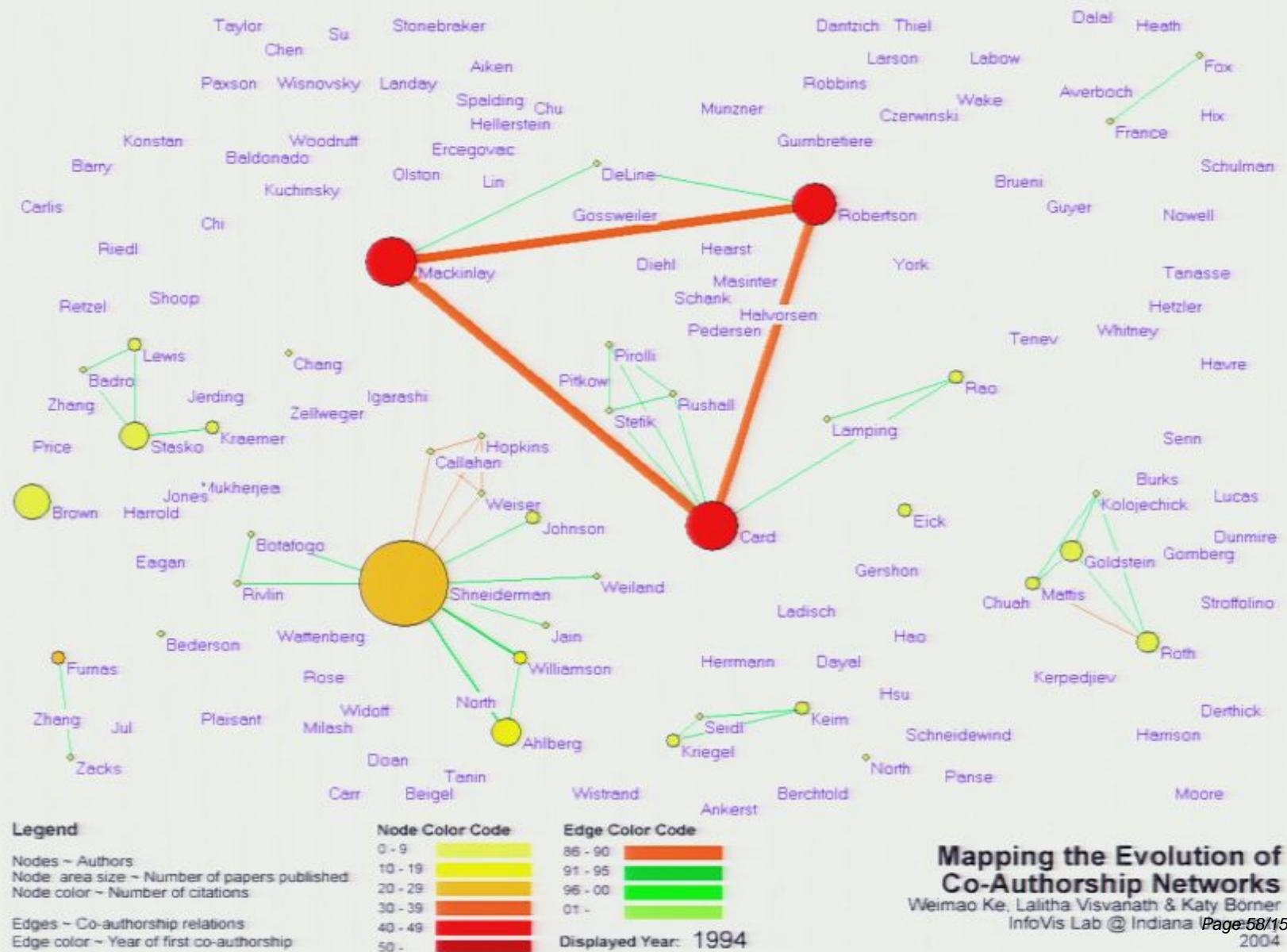
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



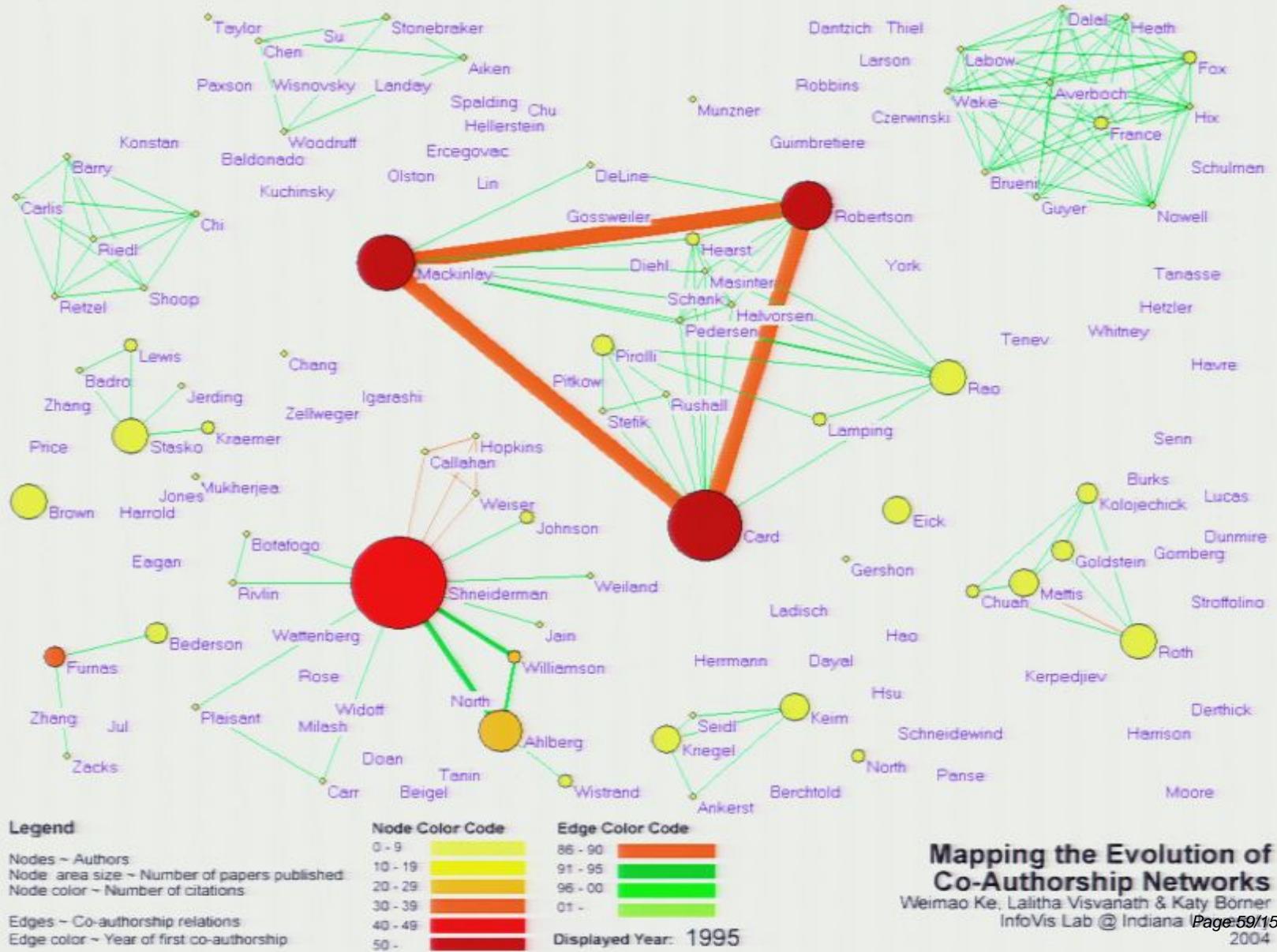
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



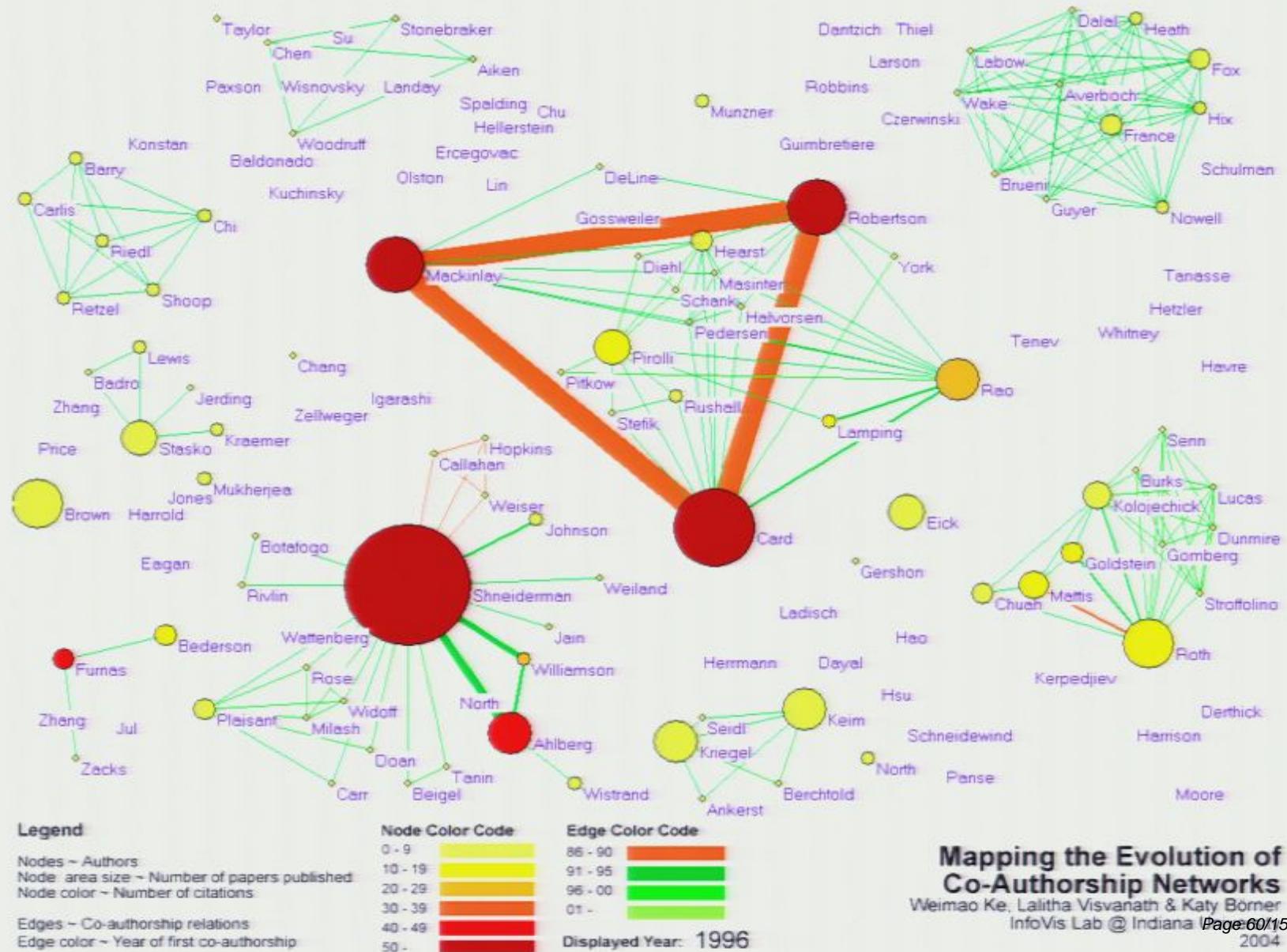
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



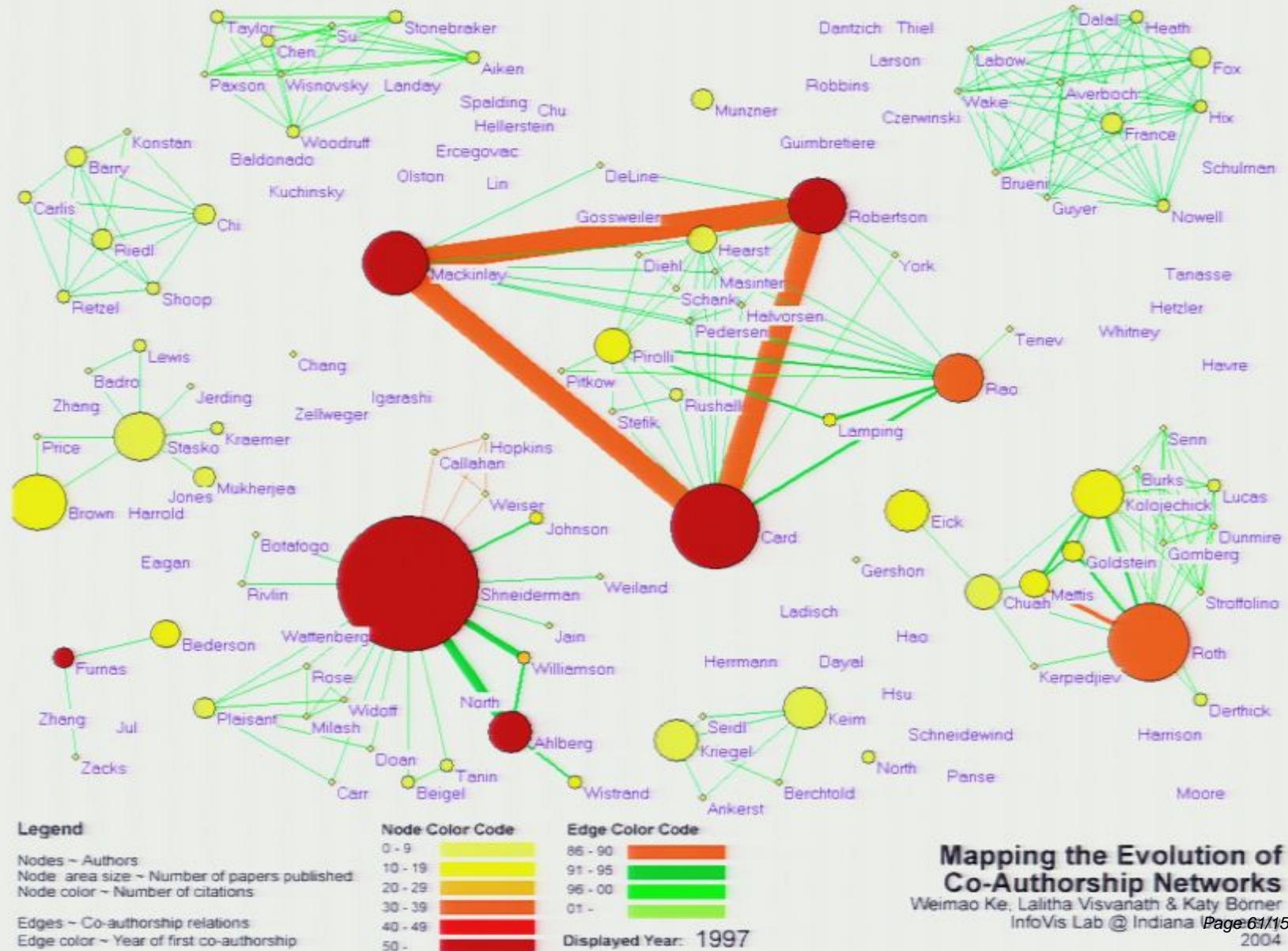
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



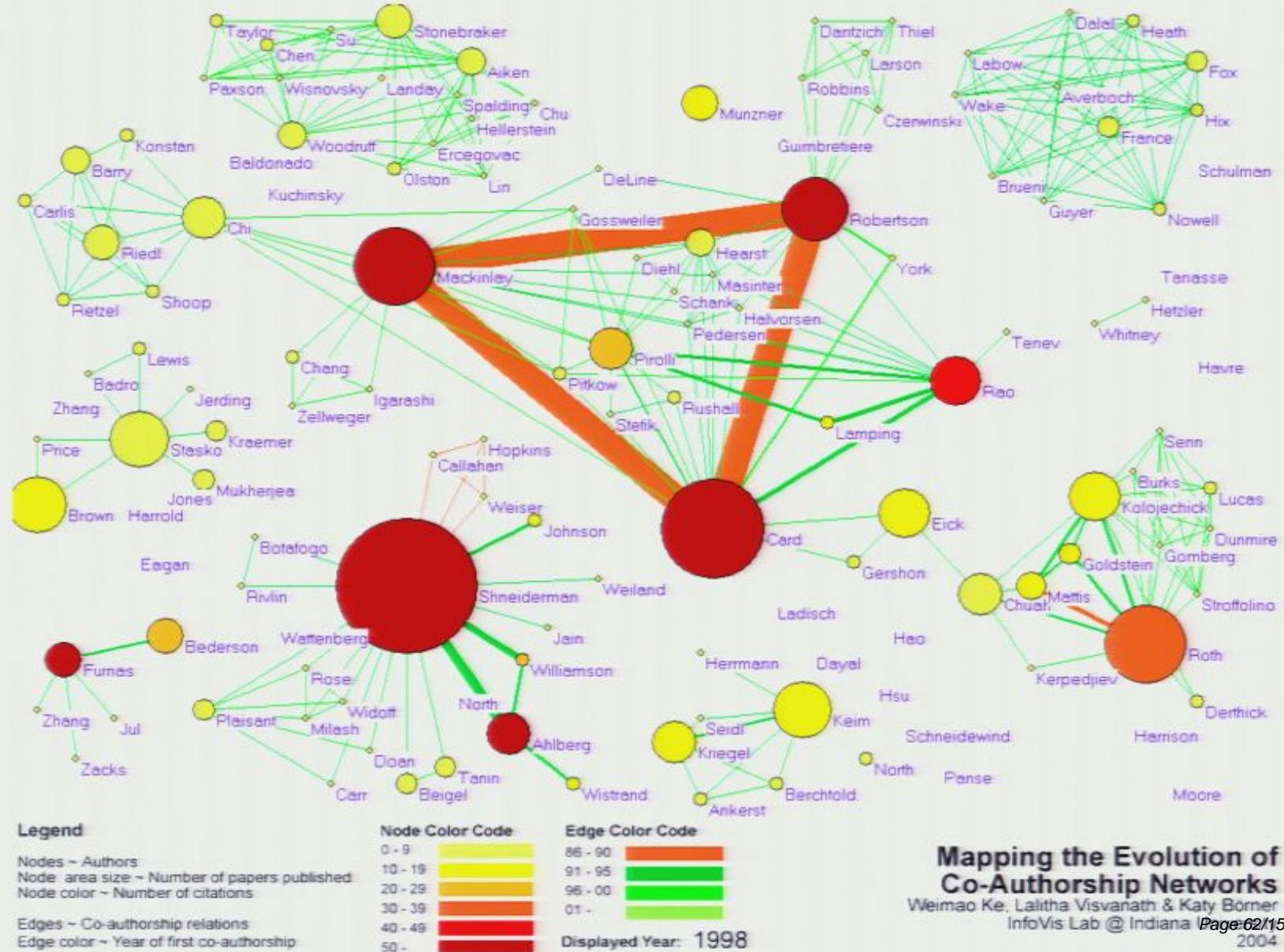
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



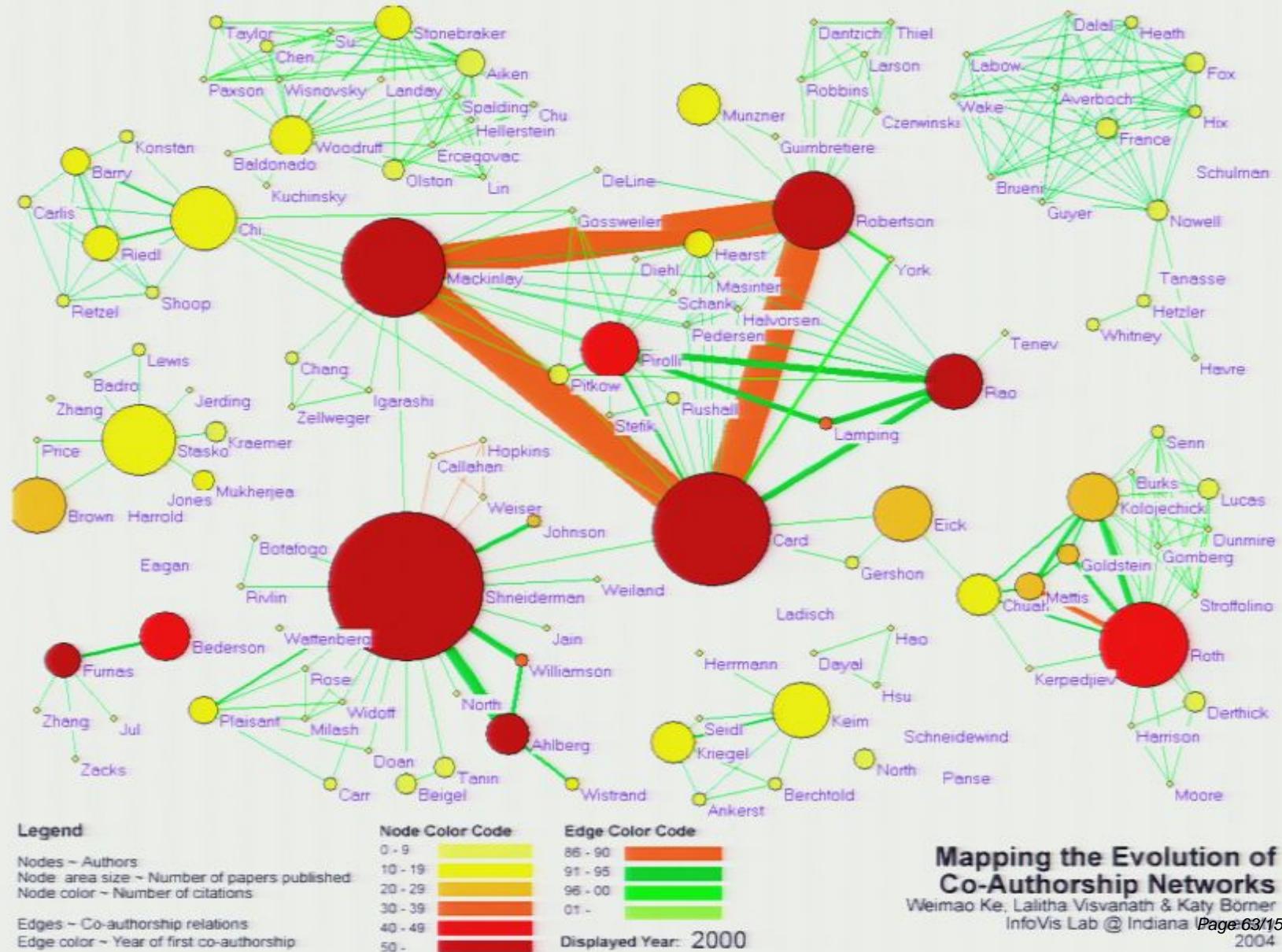
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



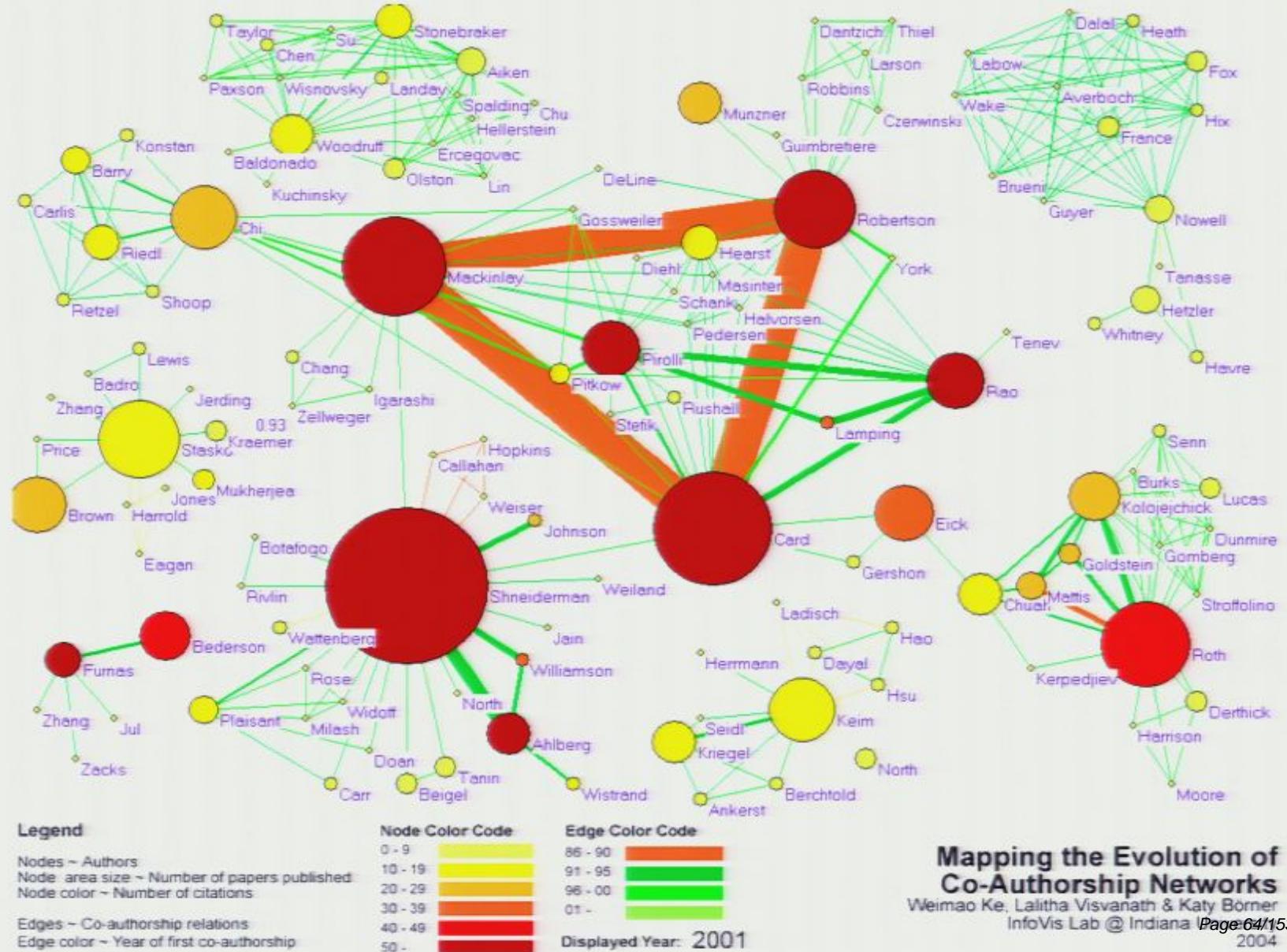
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



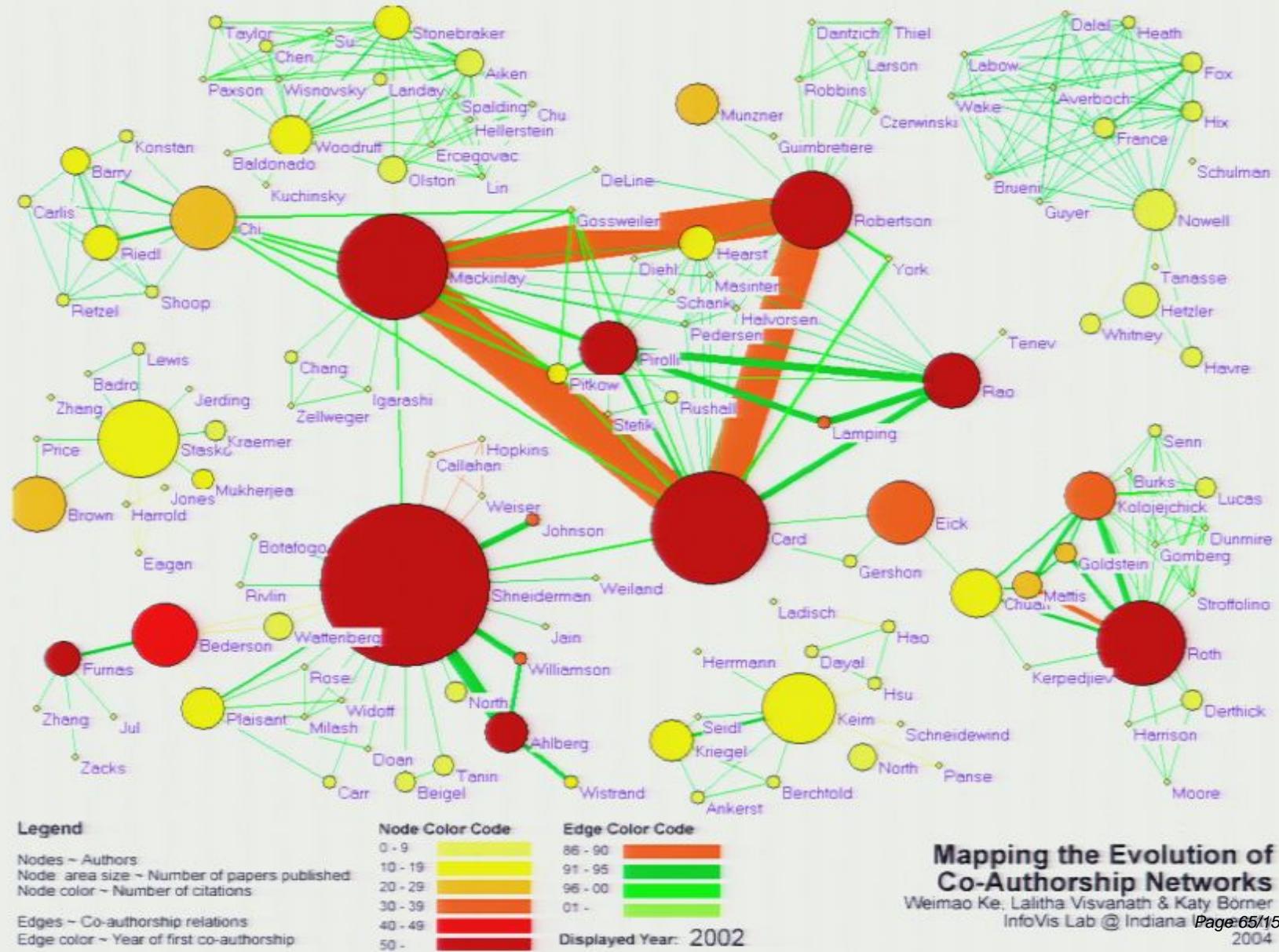
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



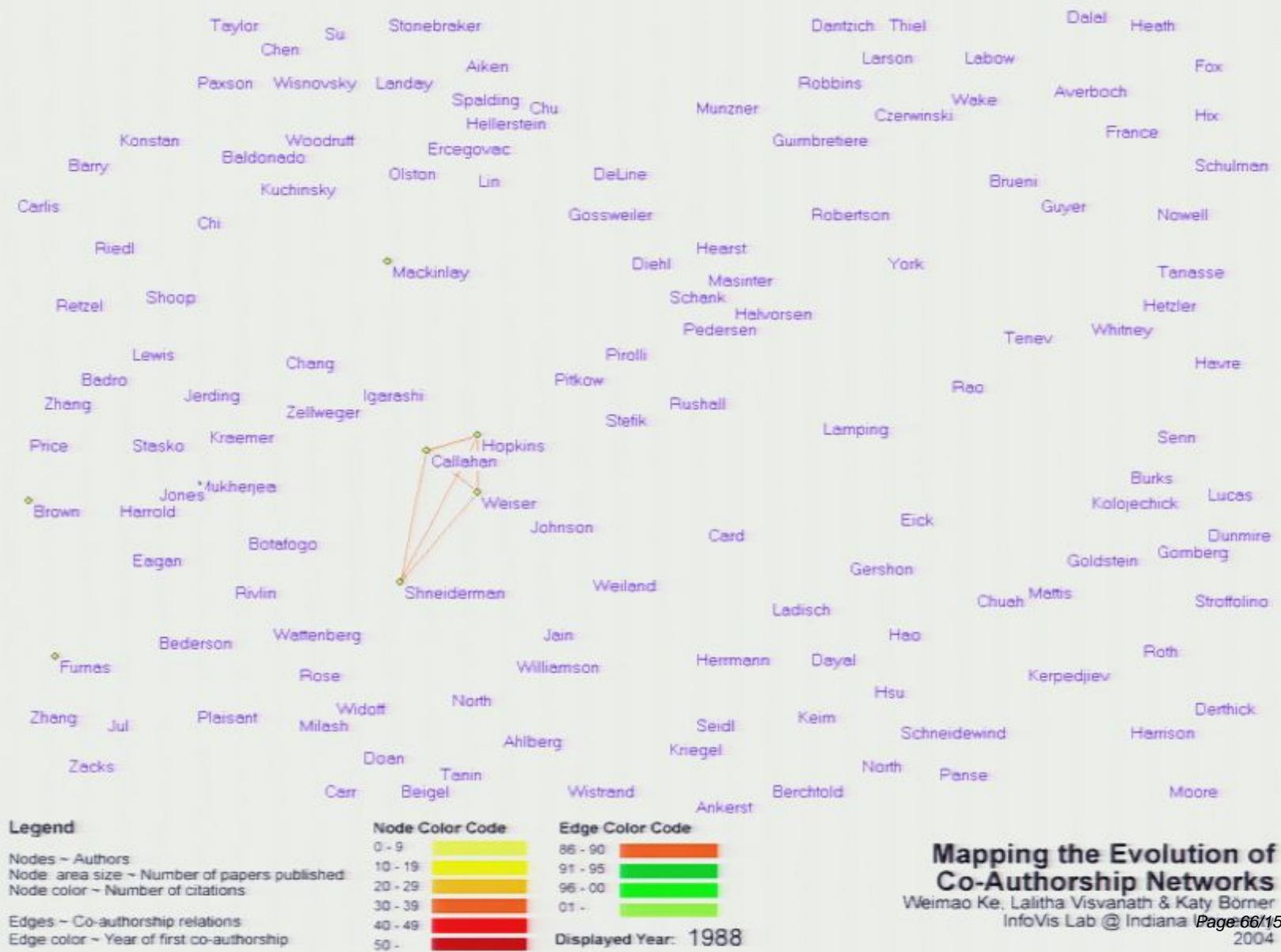
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



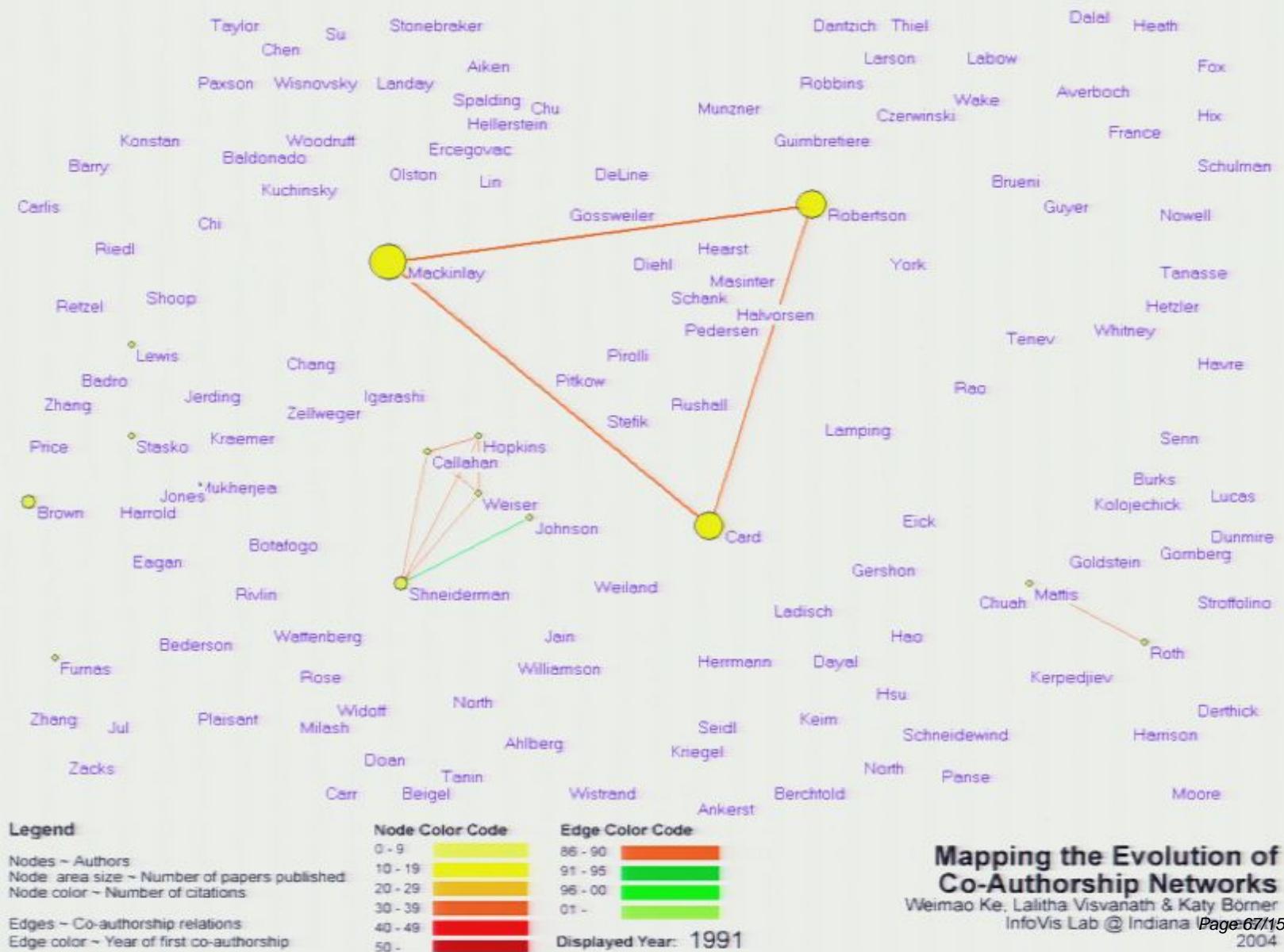
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



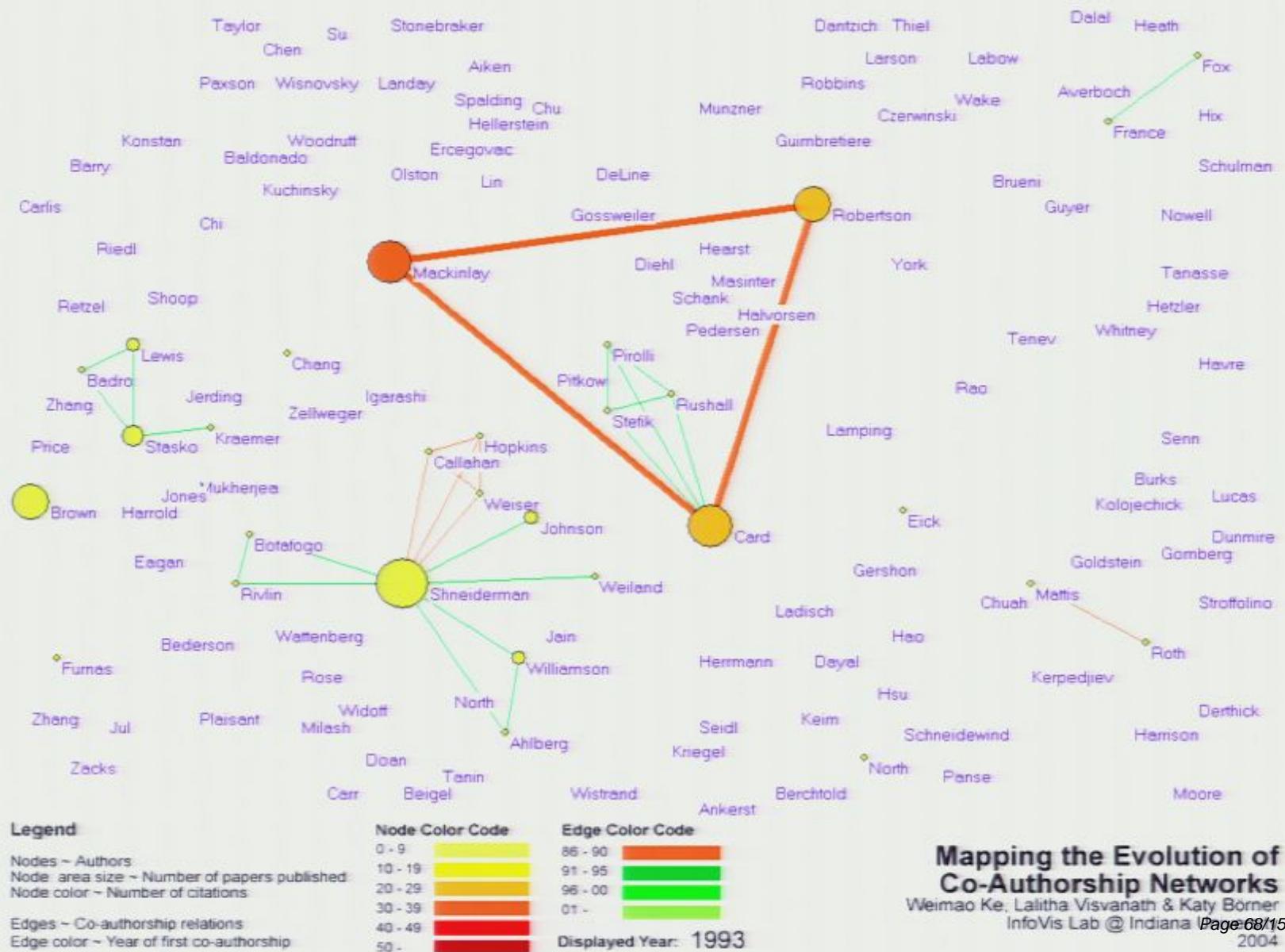
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



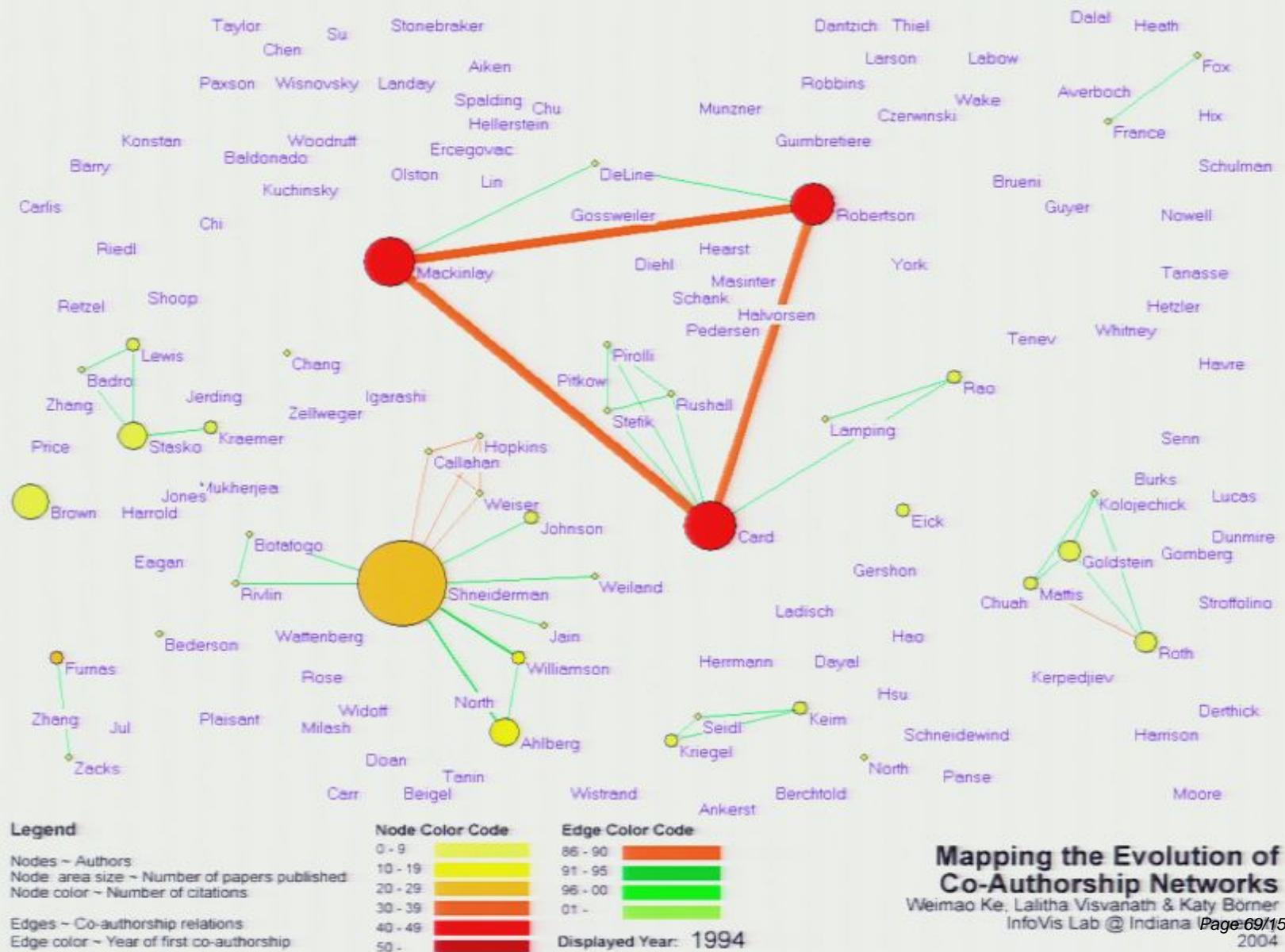
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



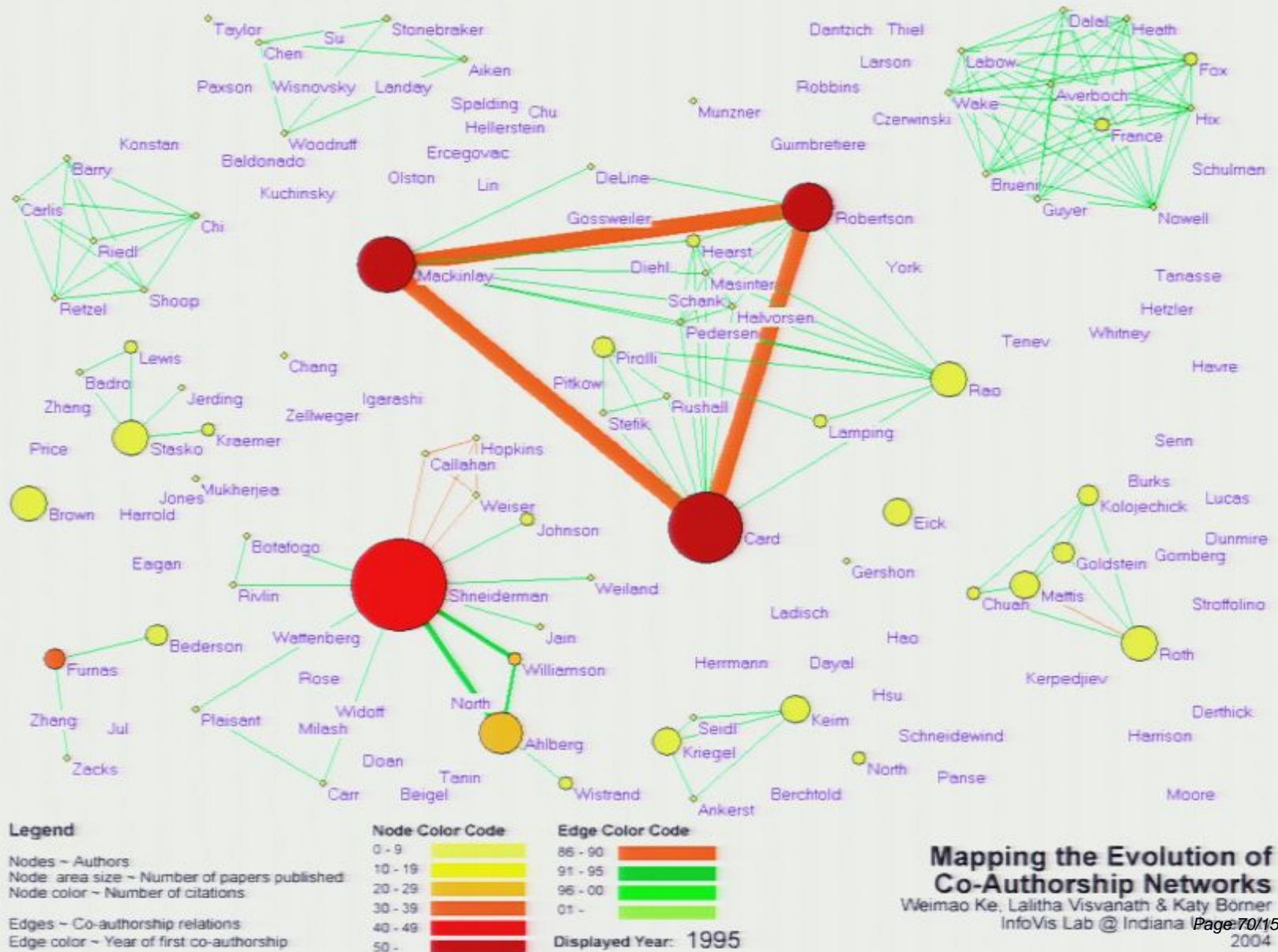
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st price at the IEEE InfoVis Contest.



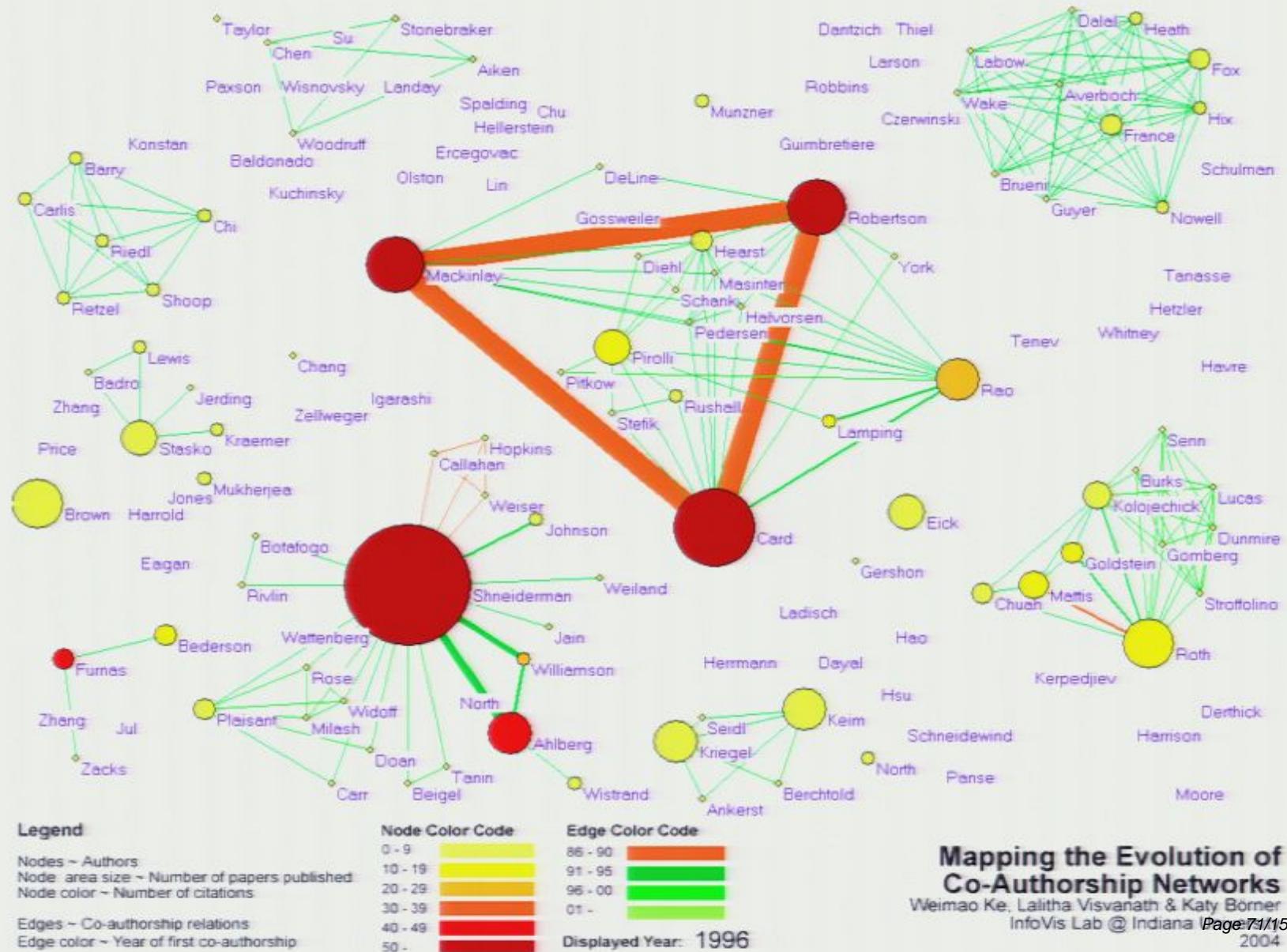
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



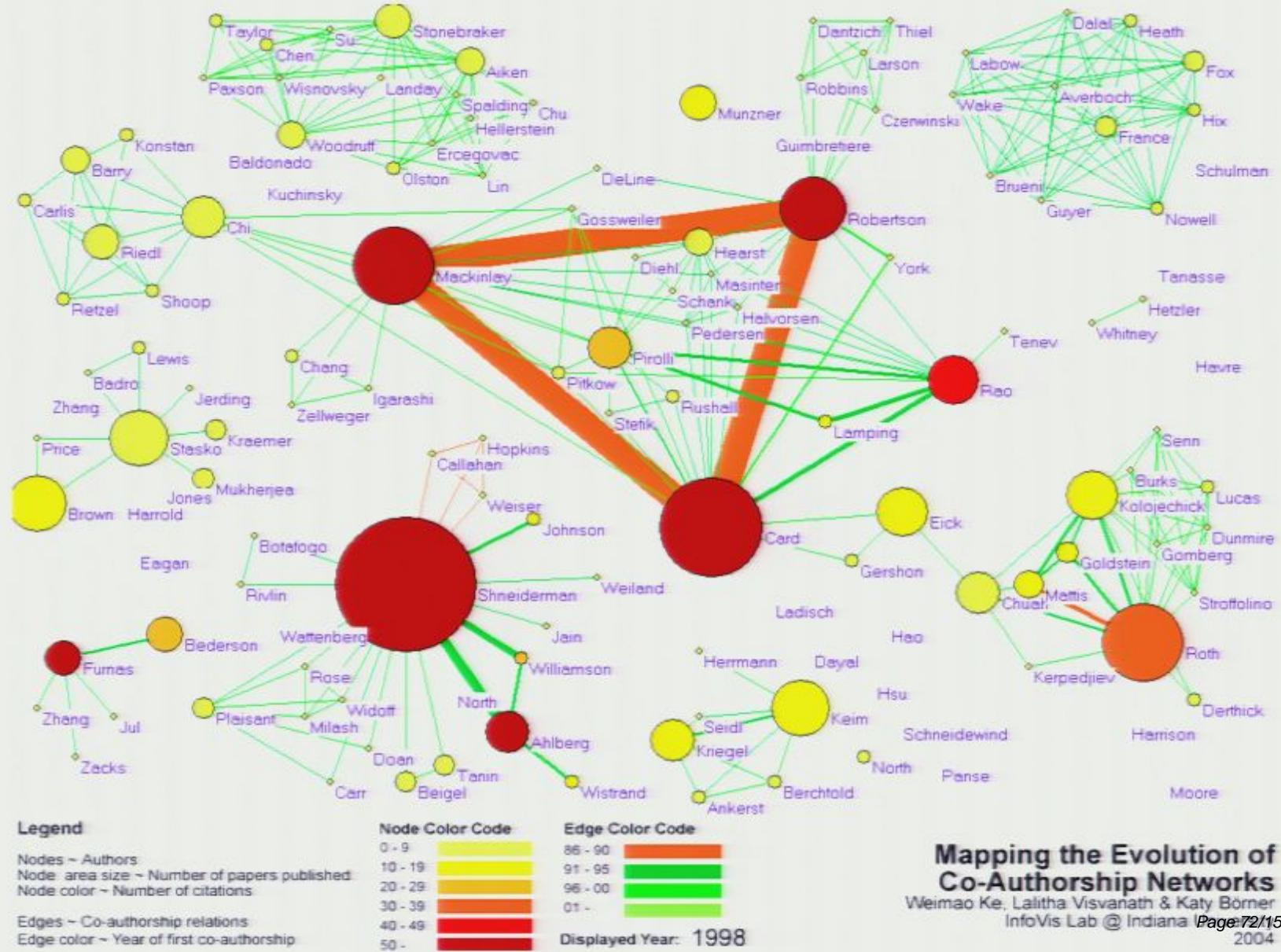
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



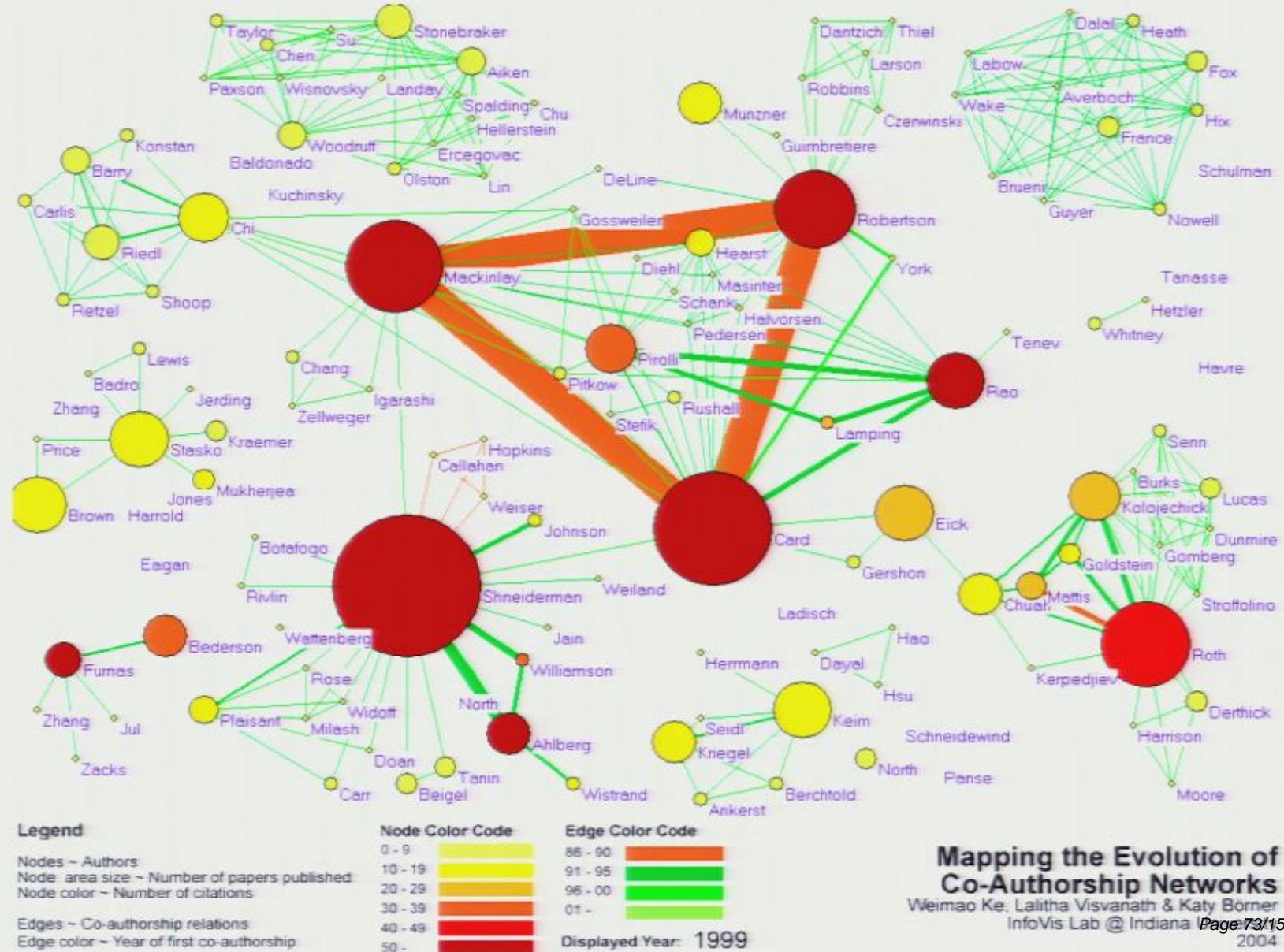
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



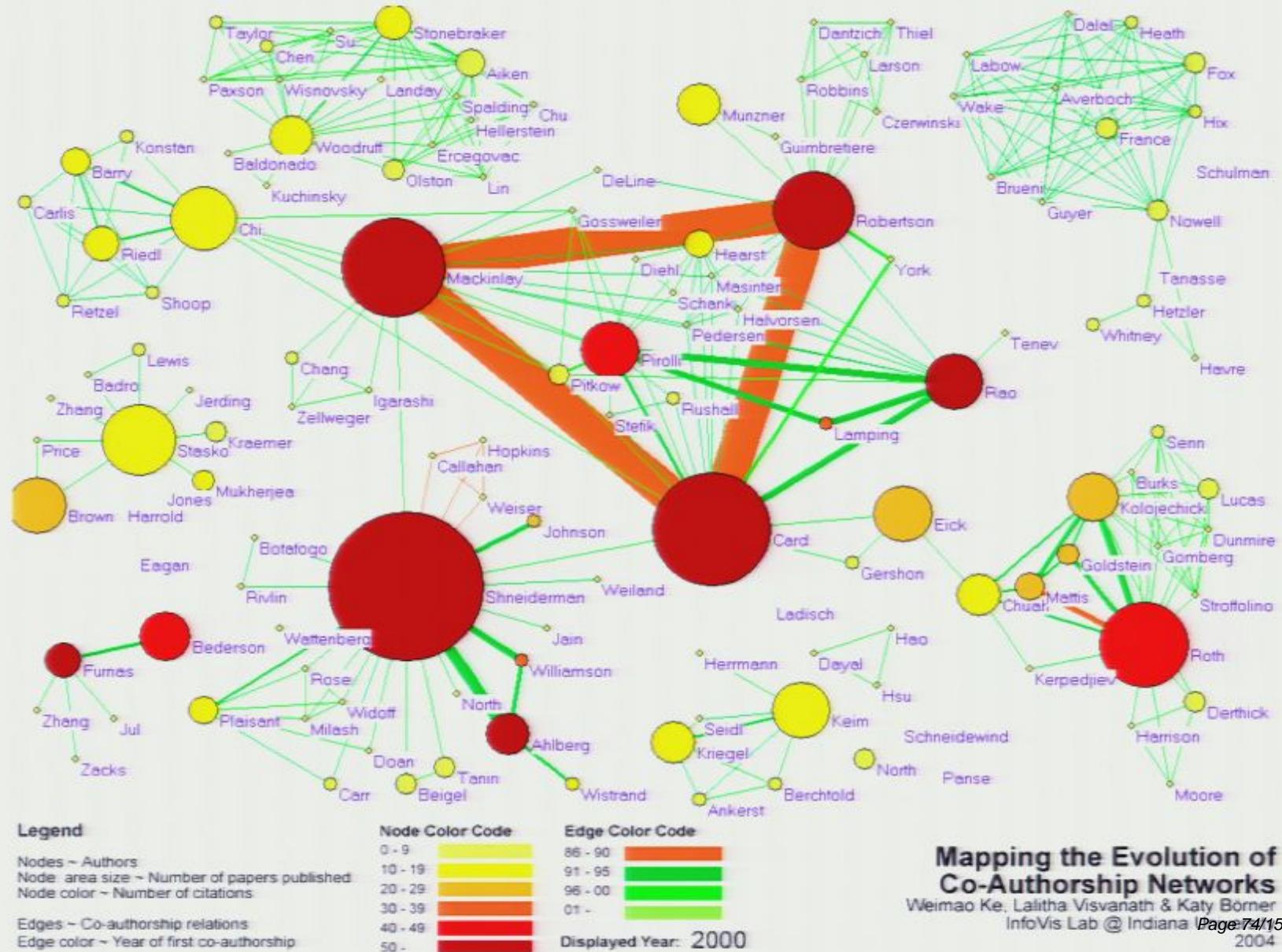
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



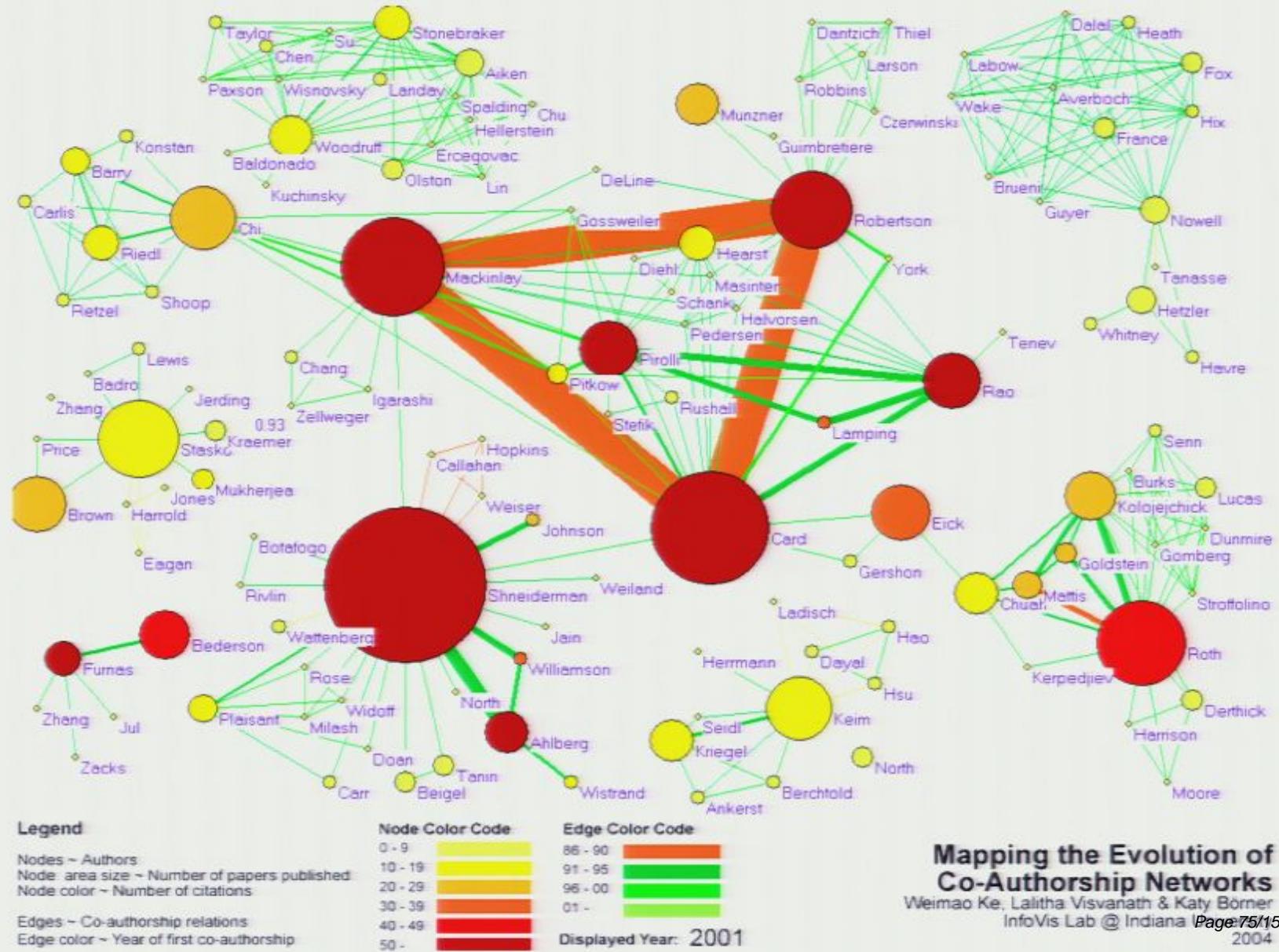
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



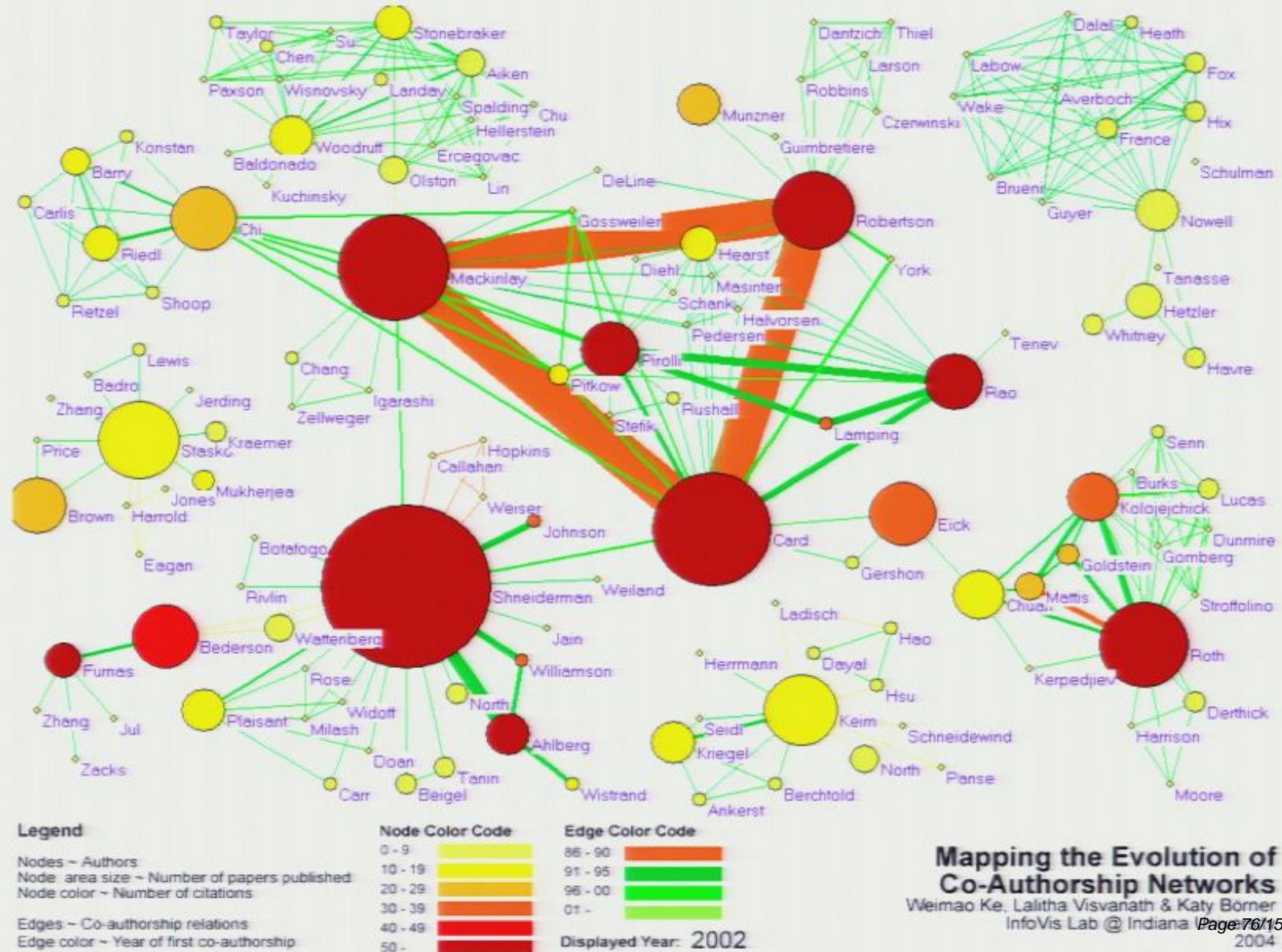
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



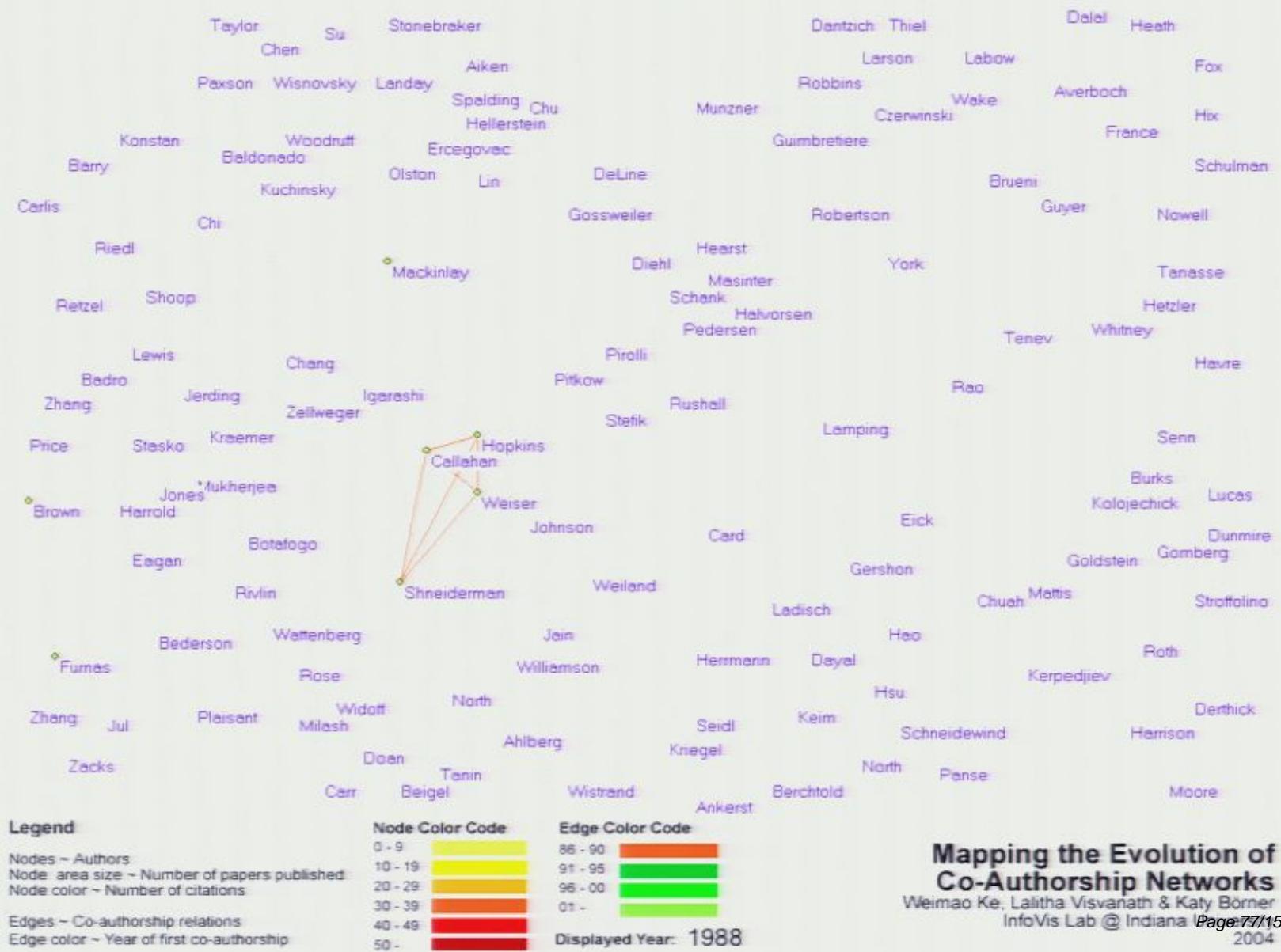
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



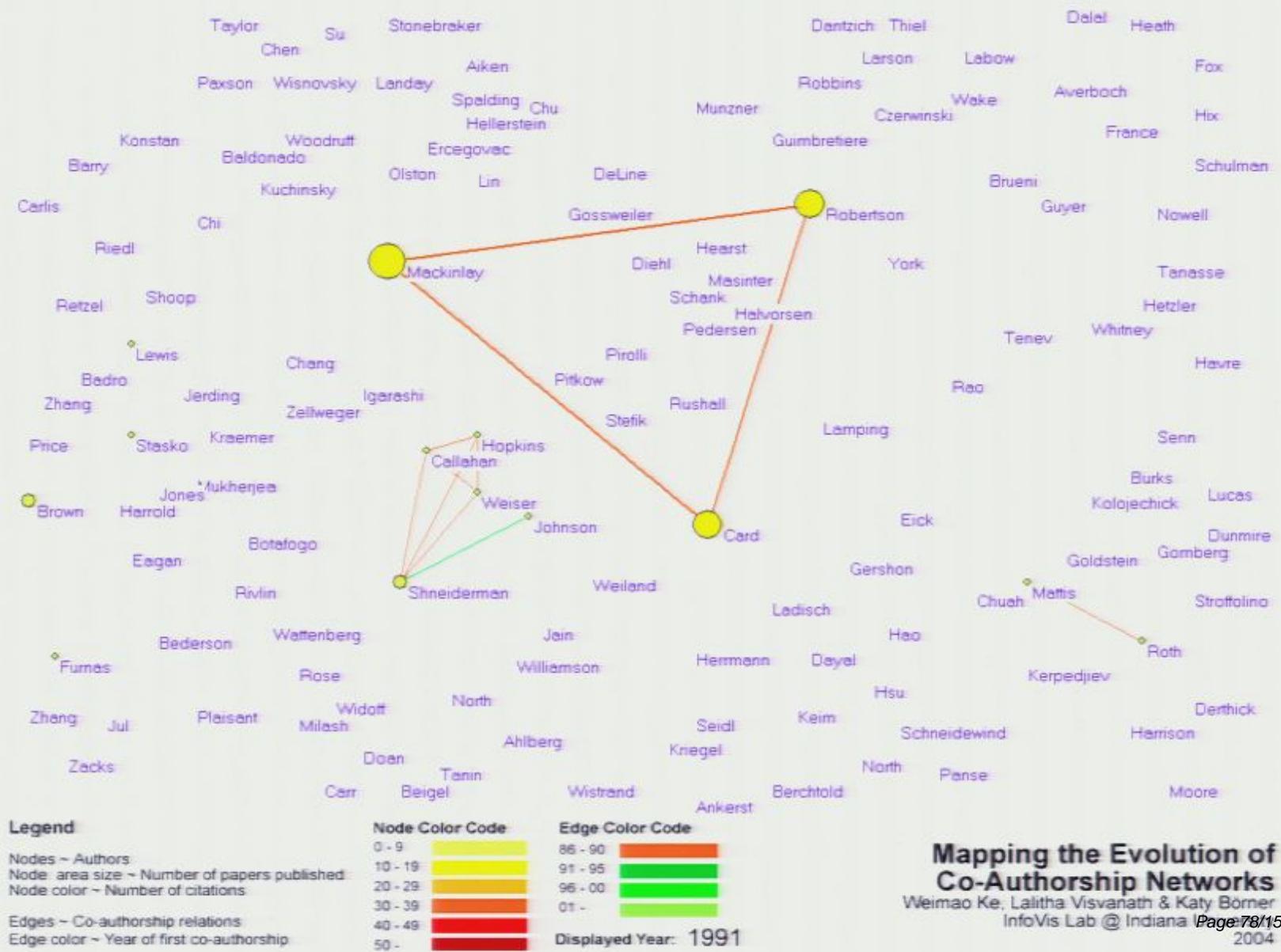
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



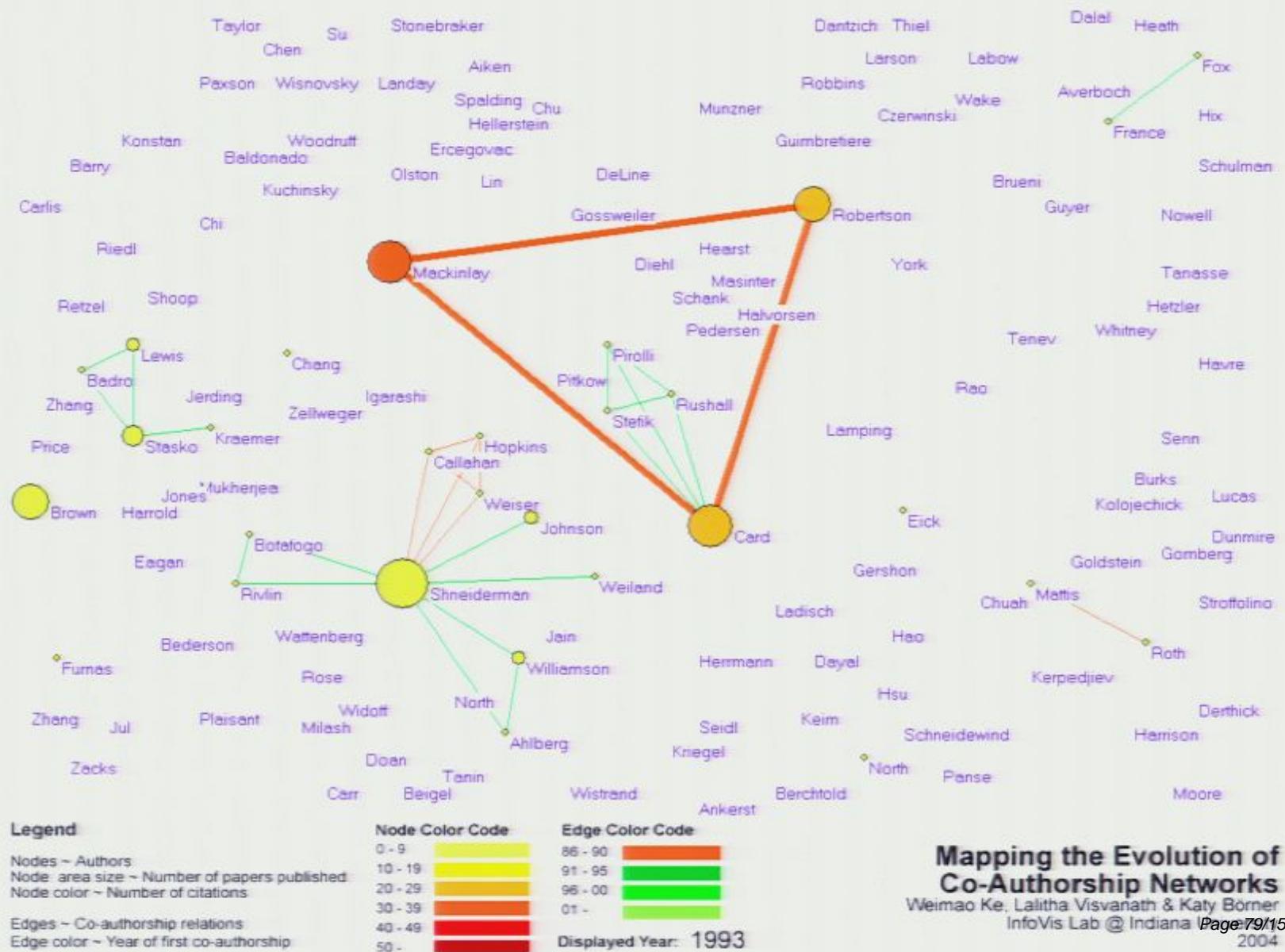
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



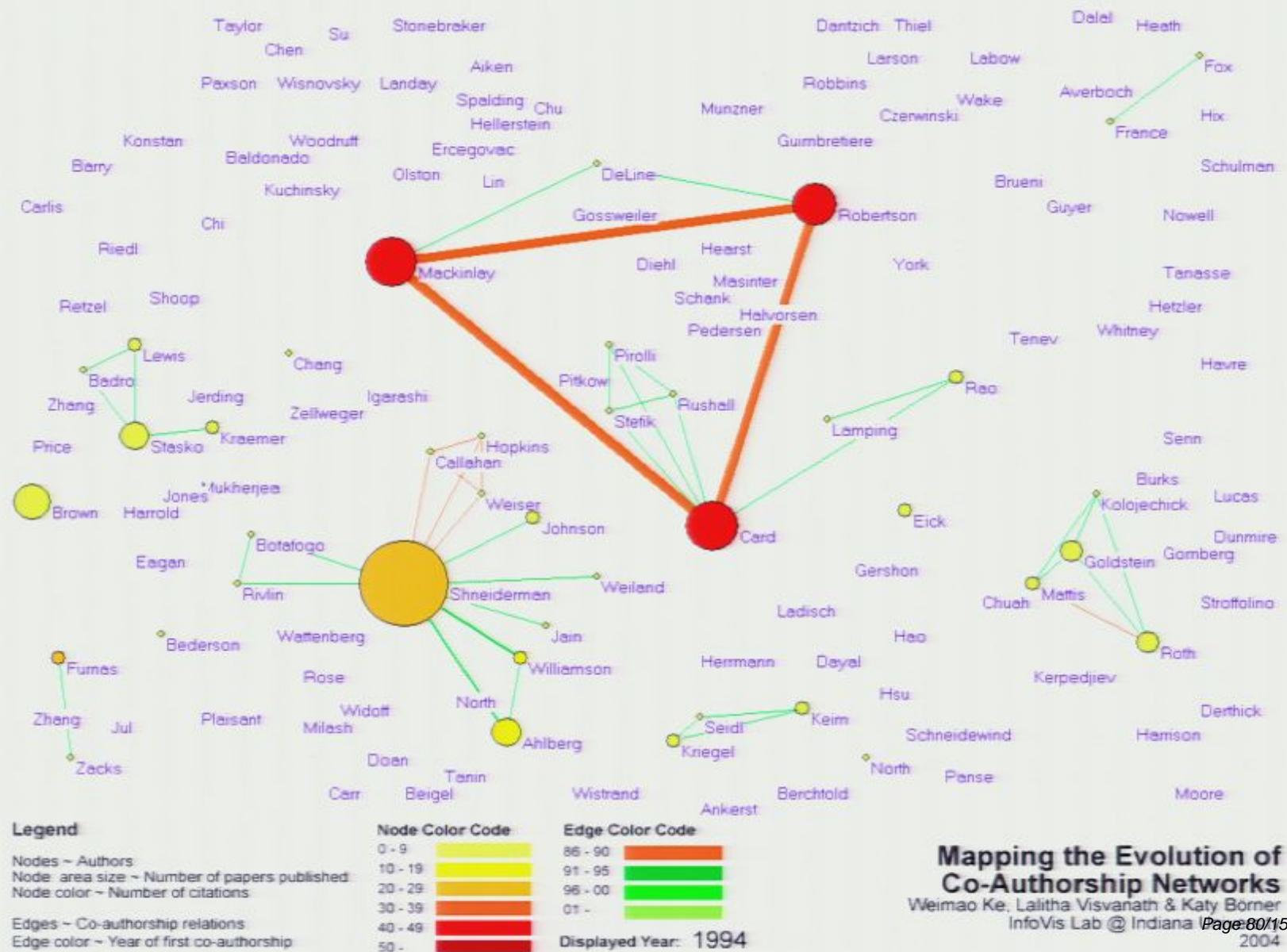
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



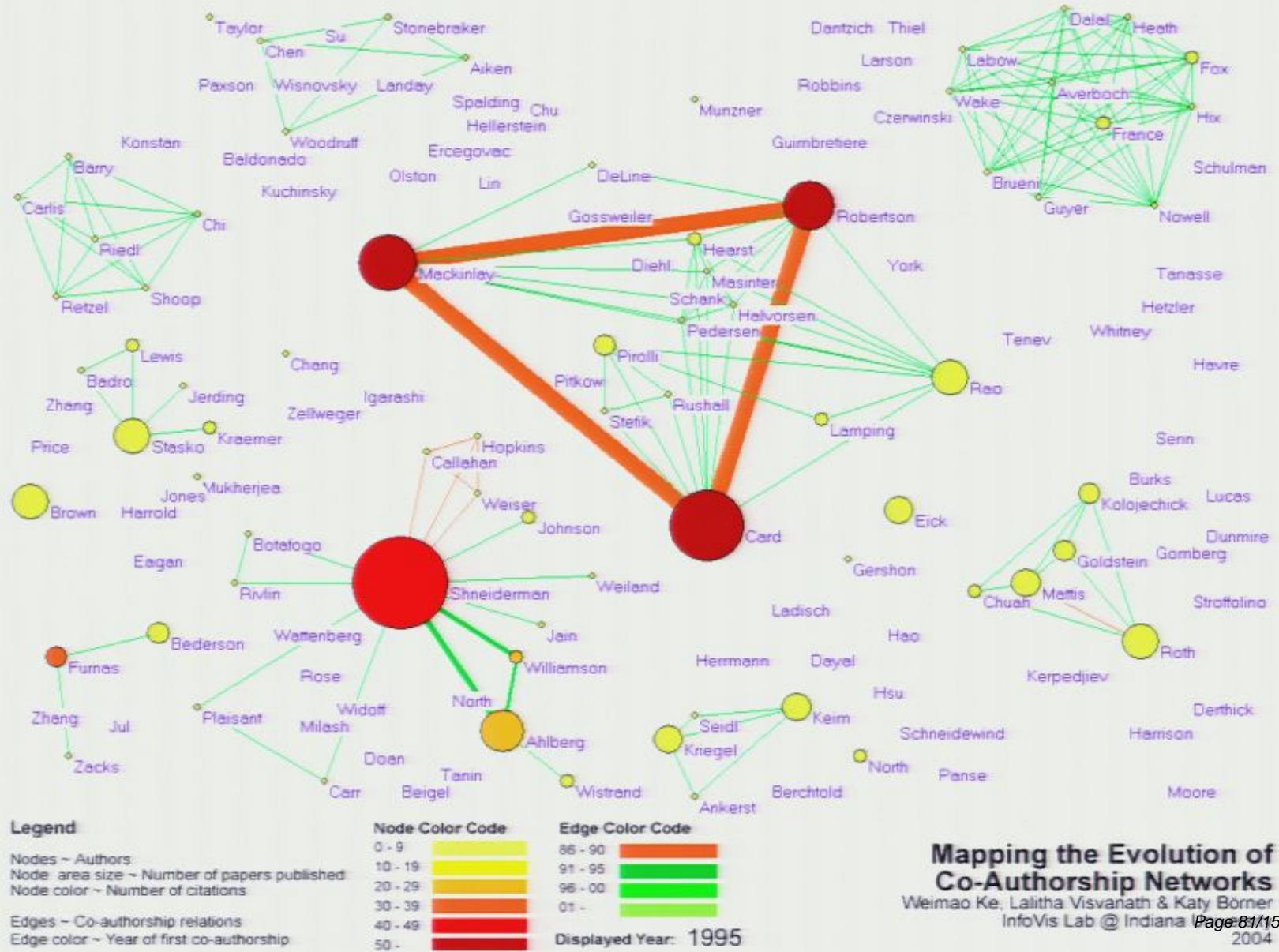
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



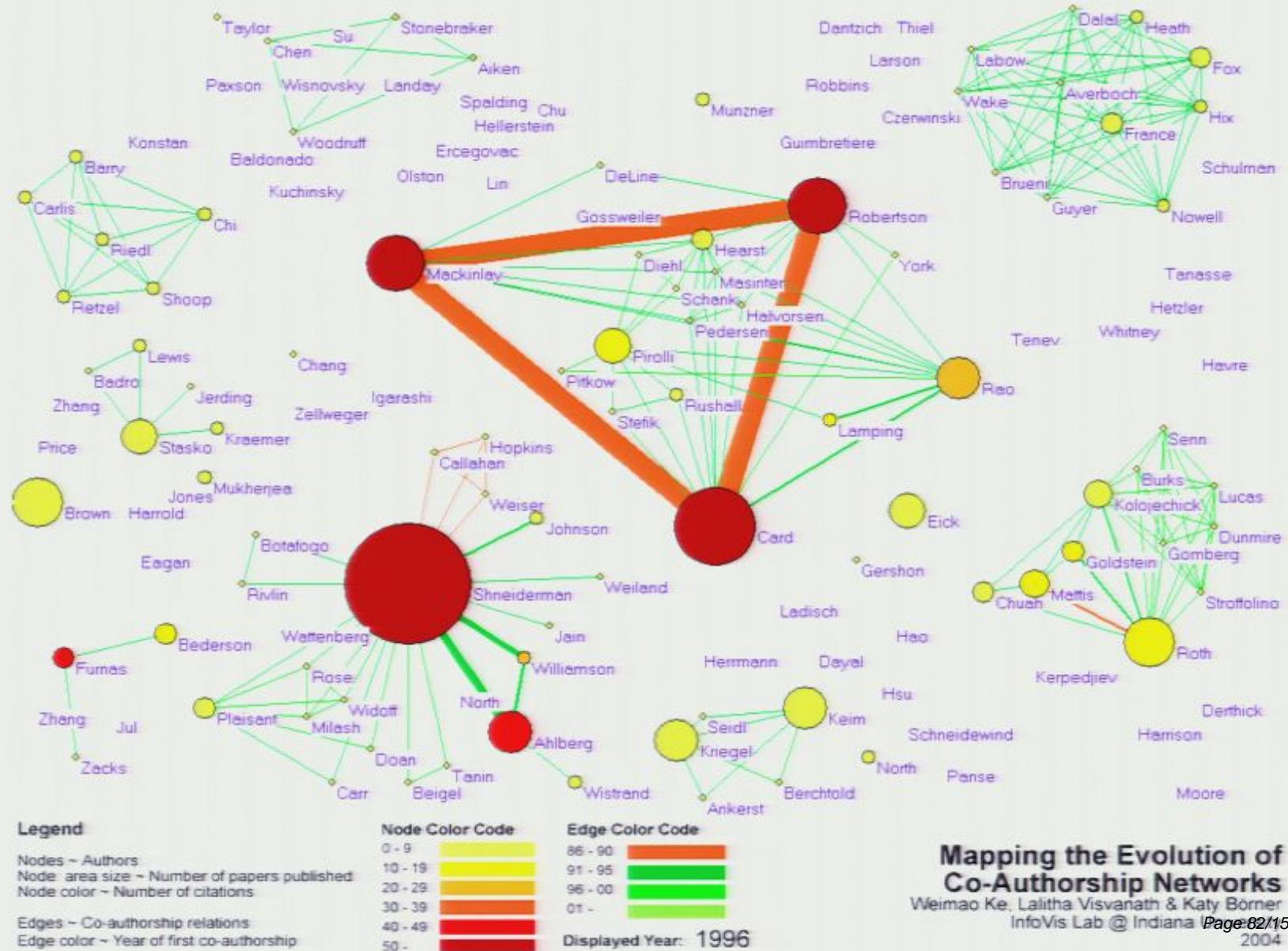
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



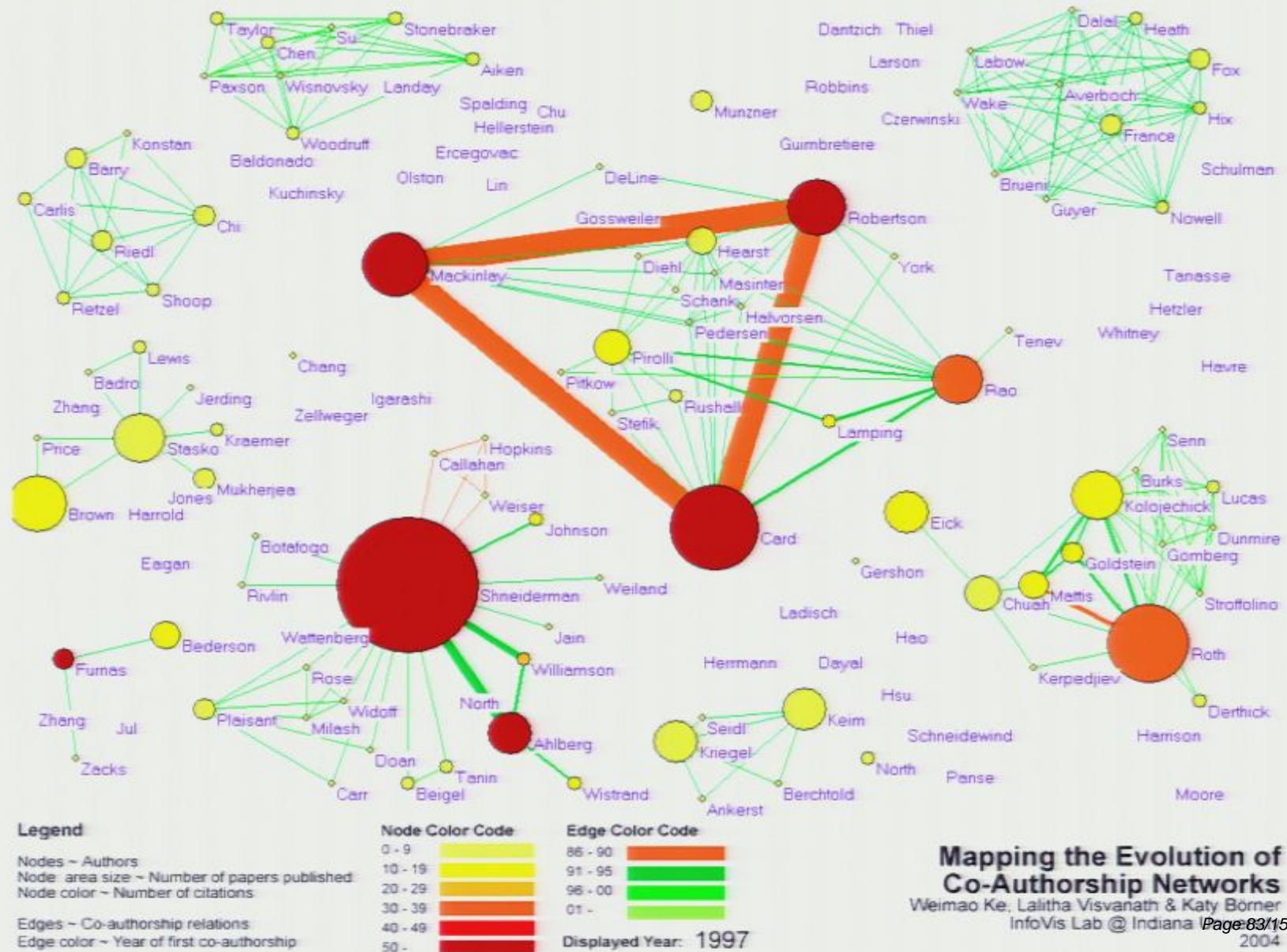
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



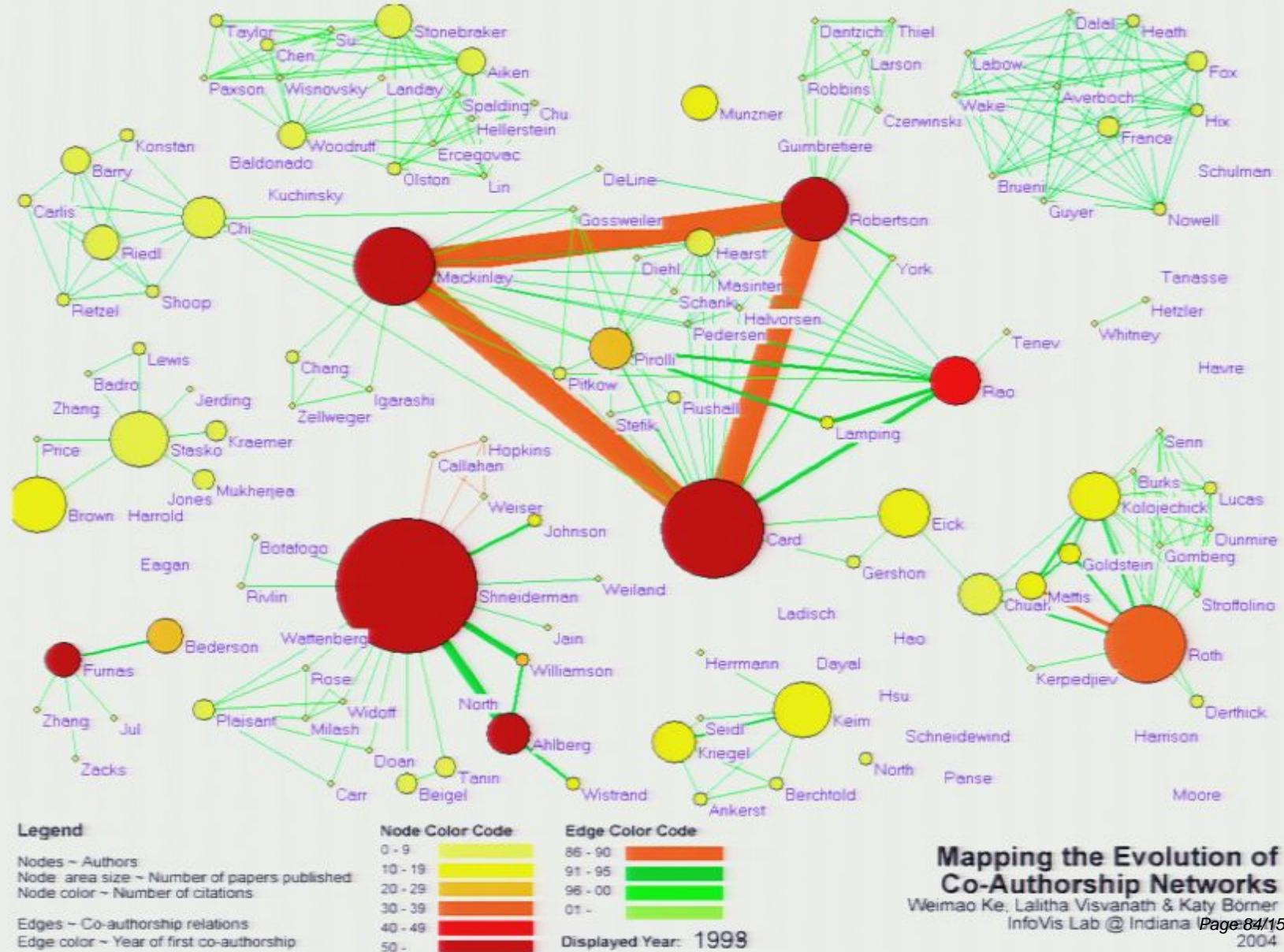
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



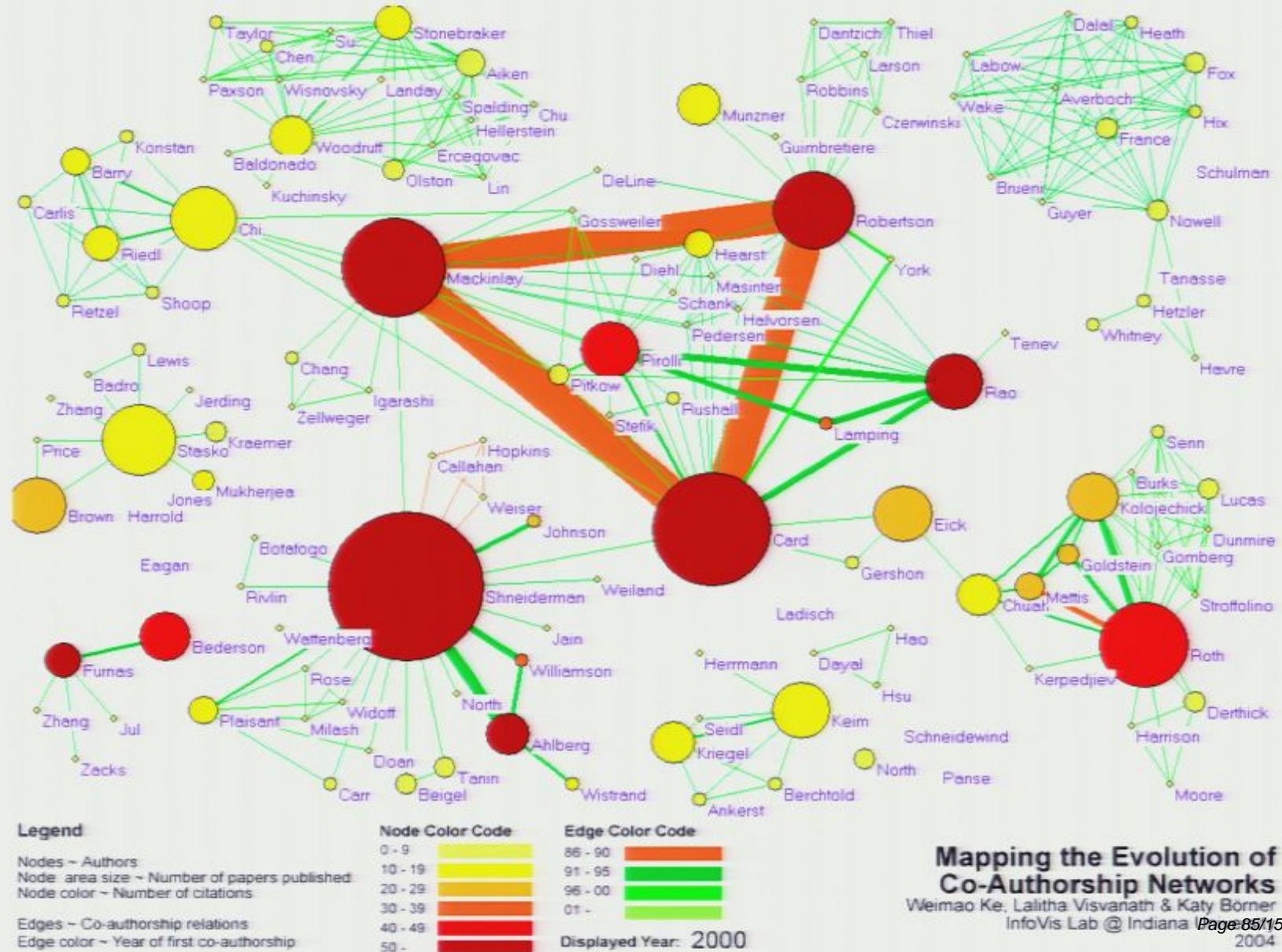
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



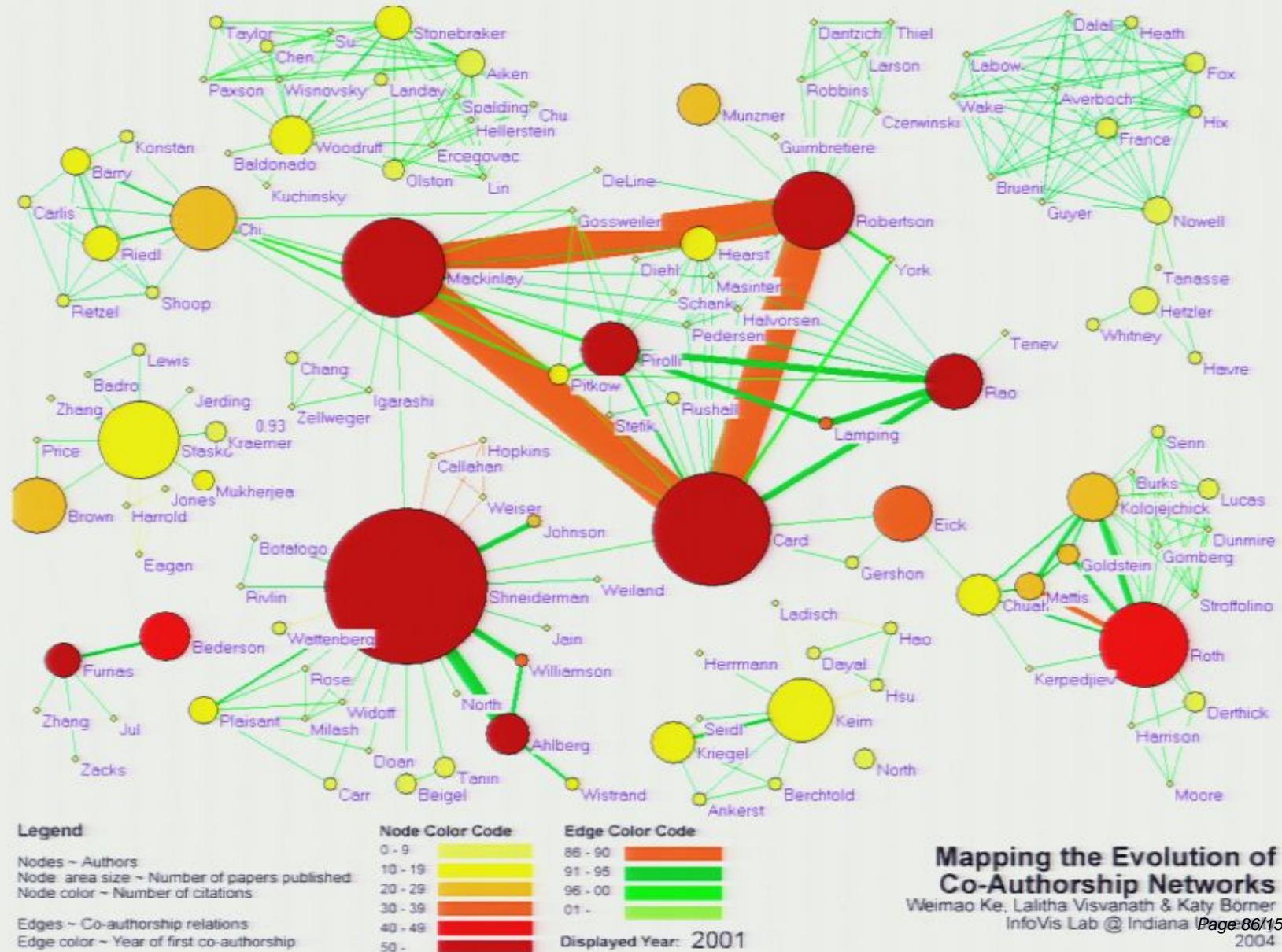
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Bornier (2004) Won 1st prize at the IEEE InfoVis Contest.



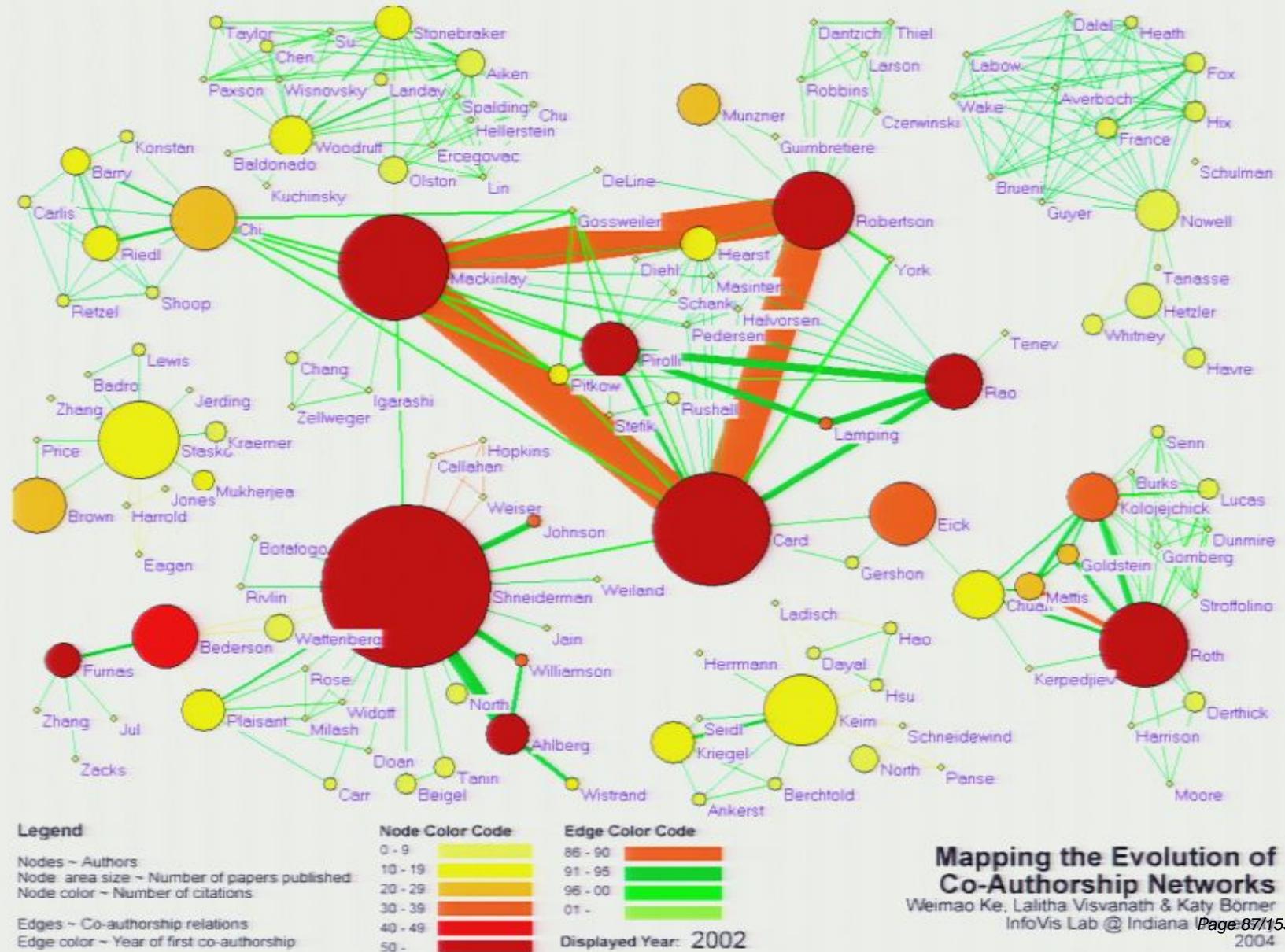
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



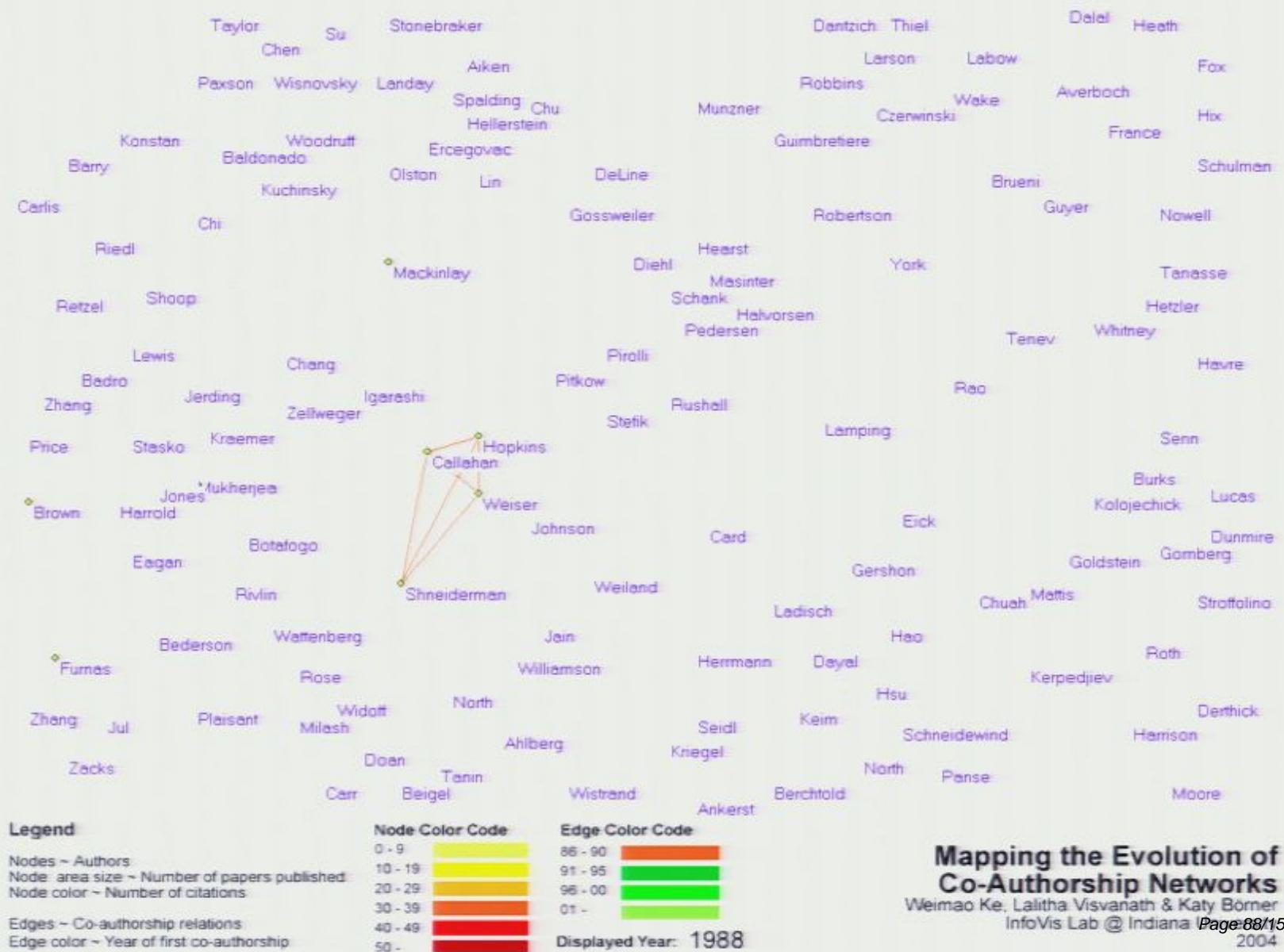
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



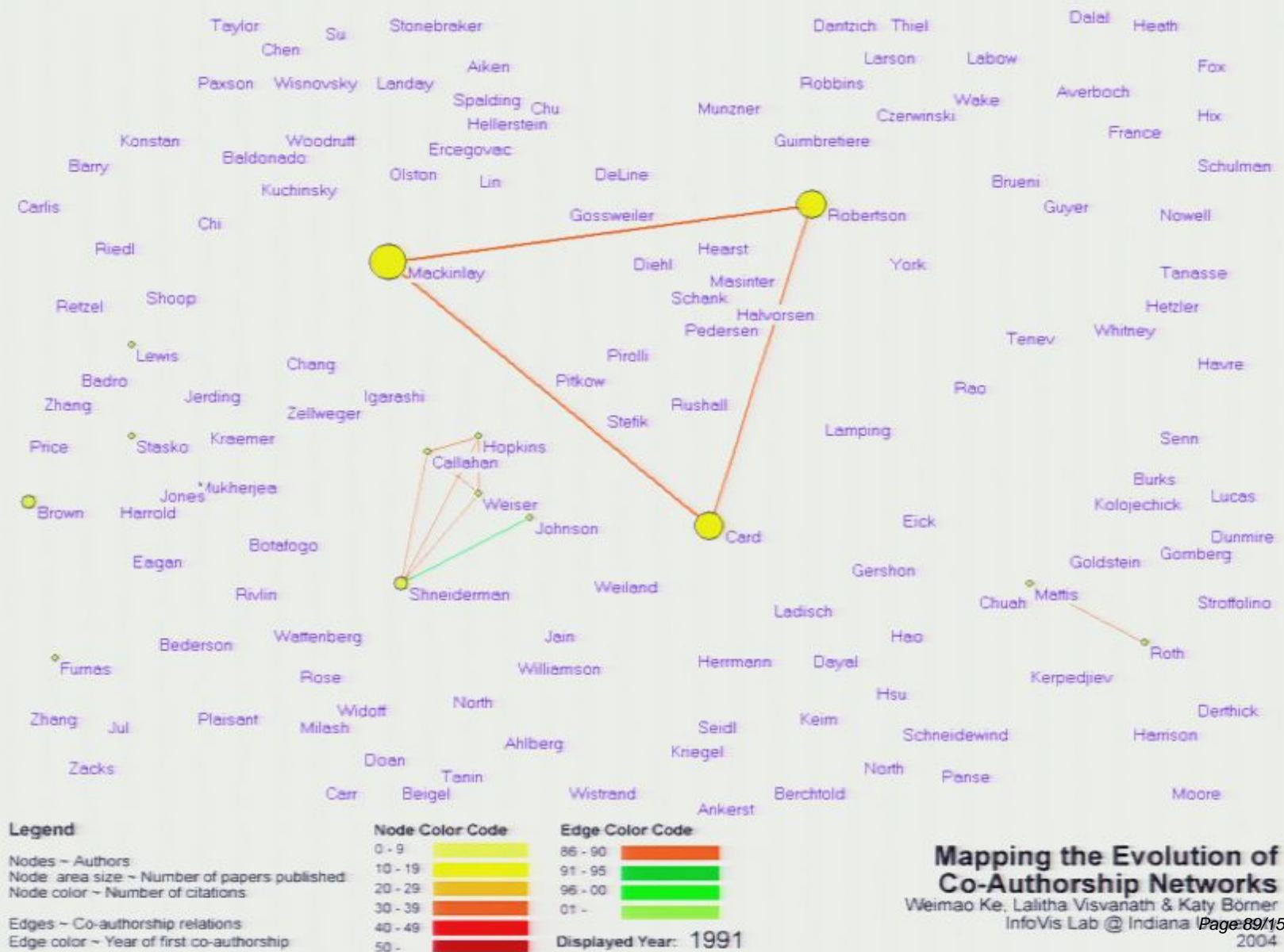
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



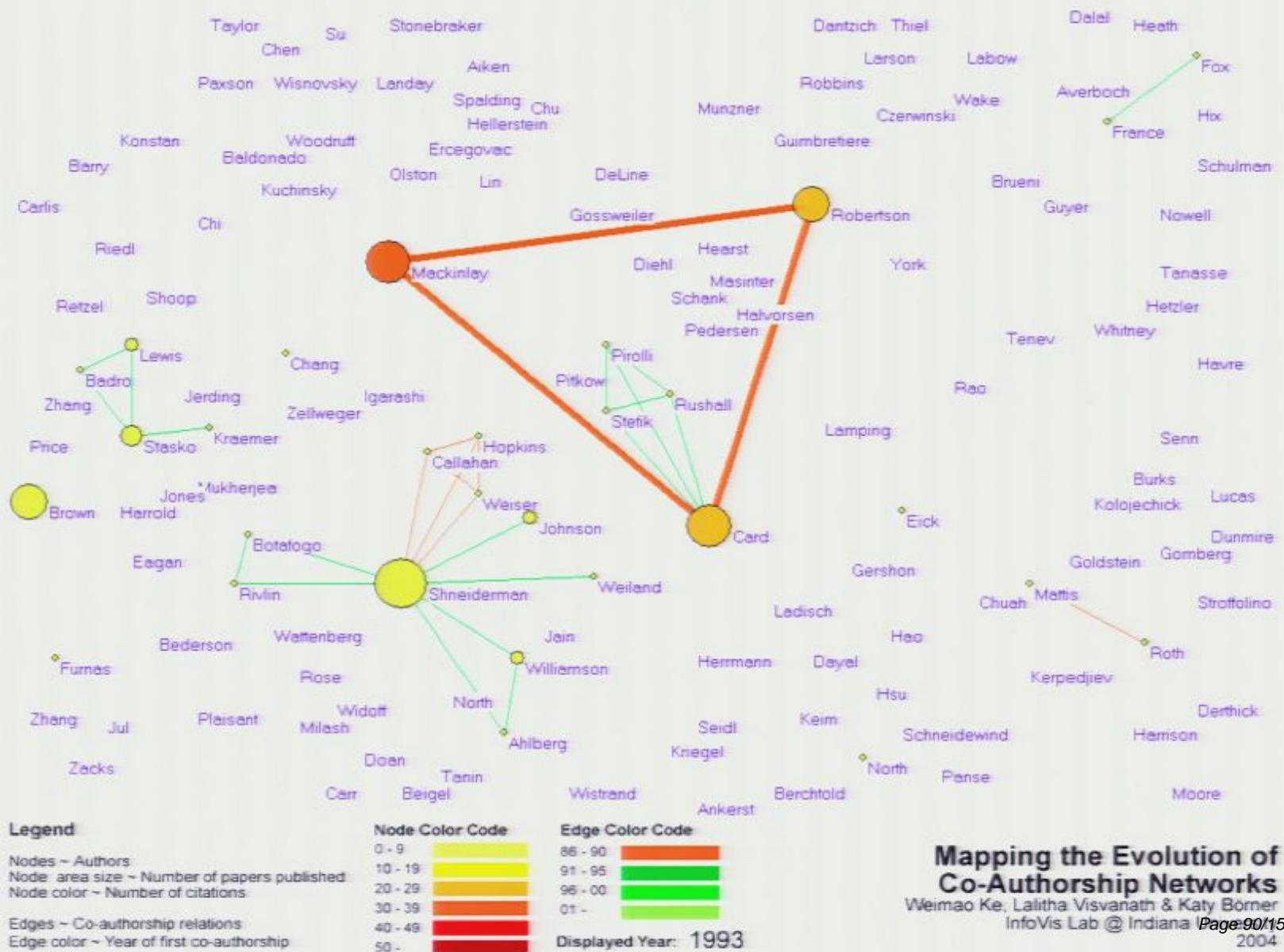
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



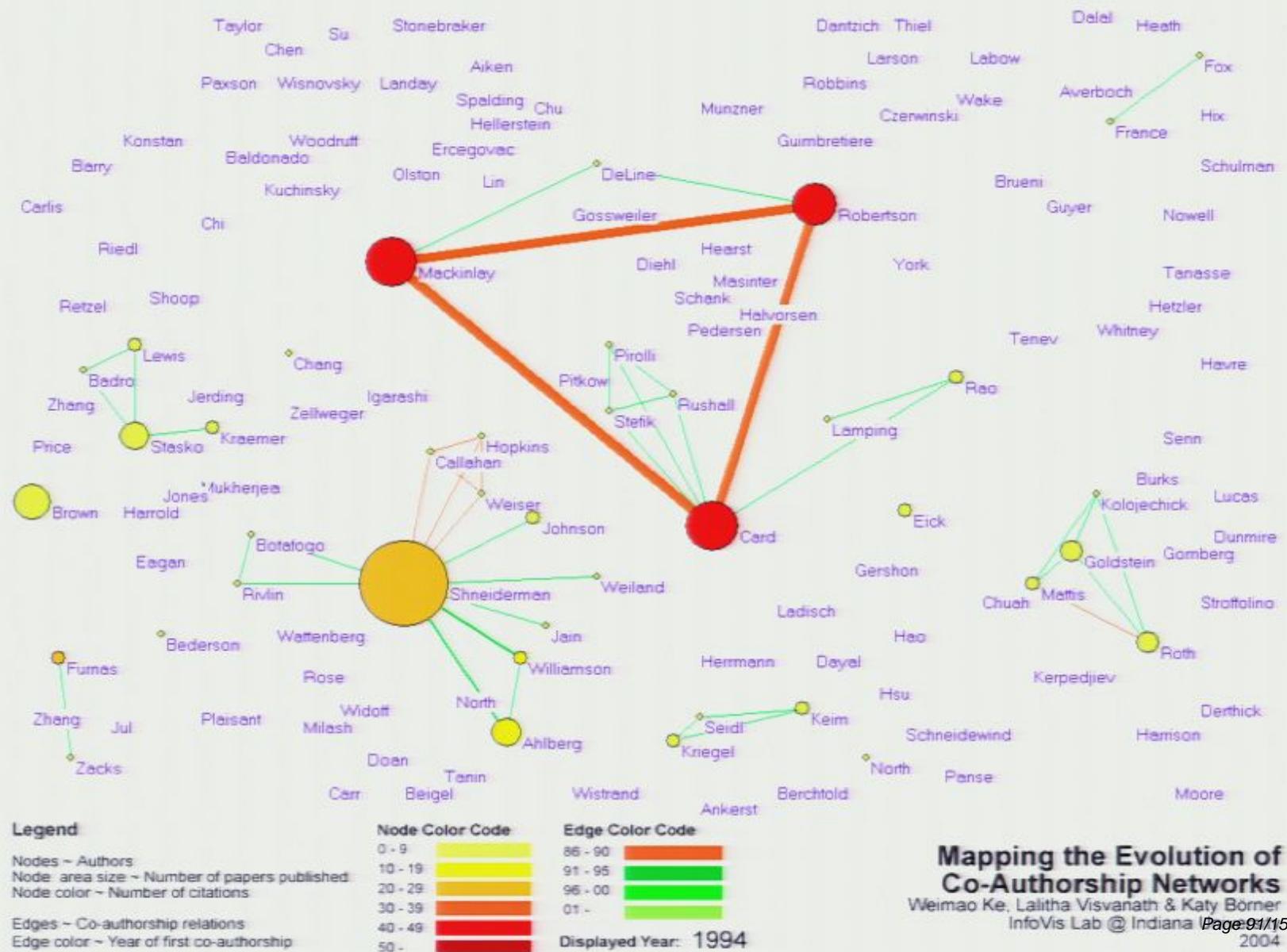
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



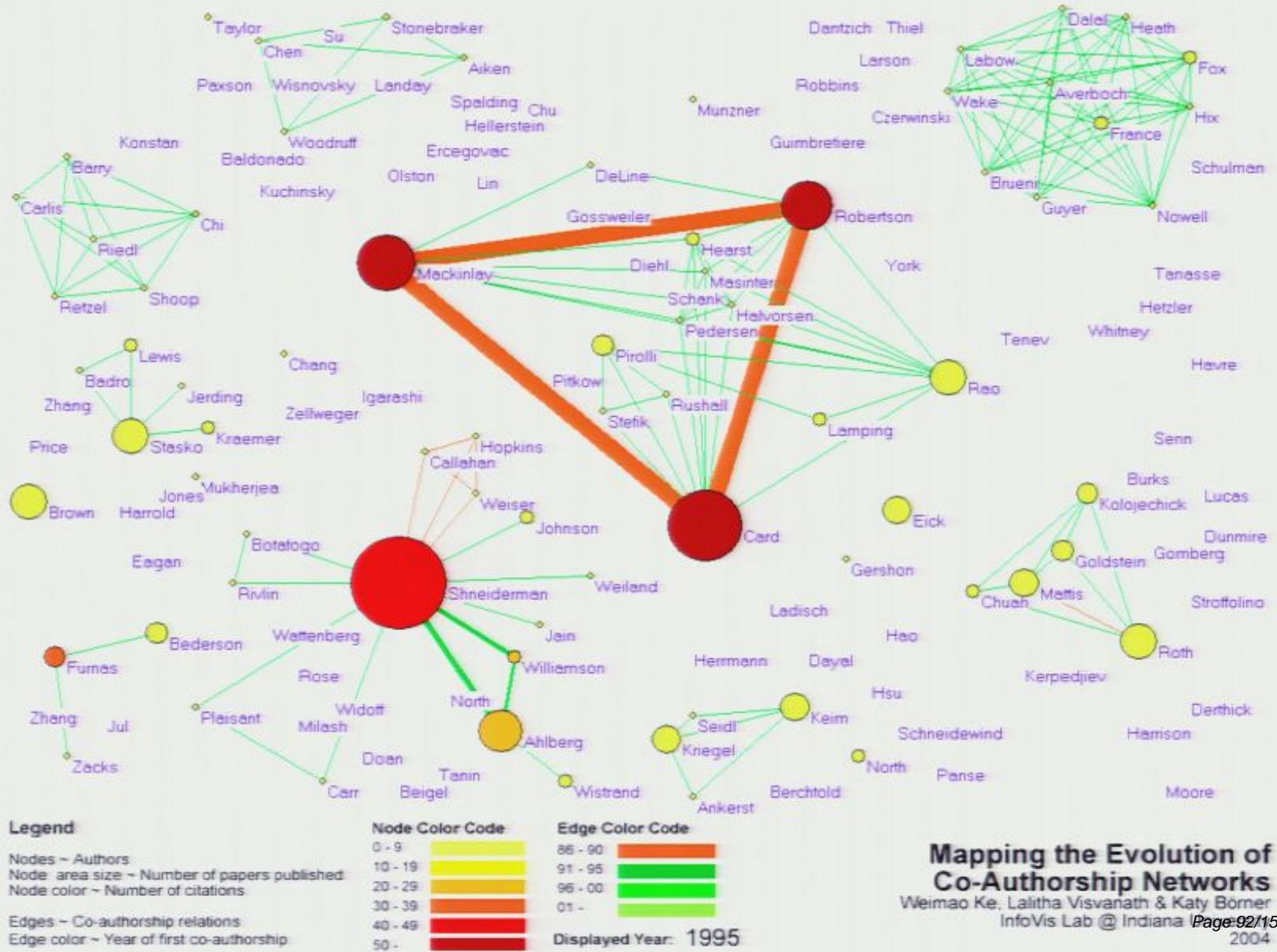
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



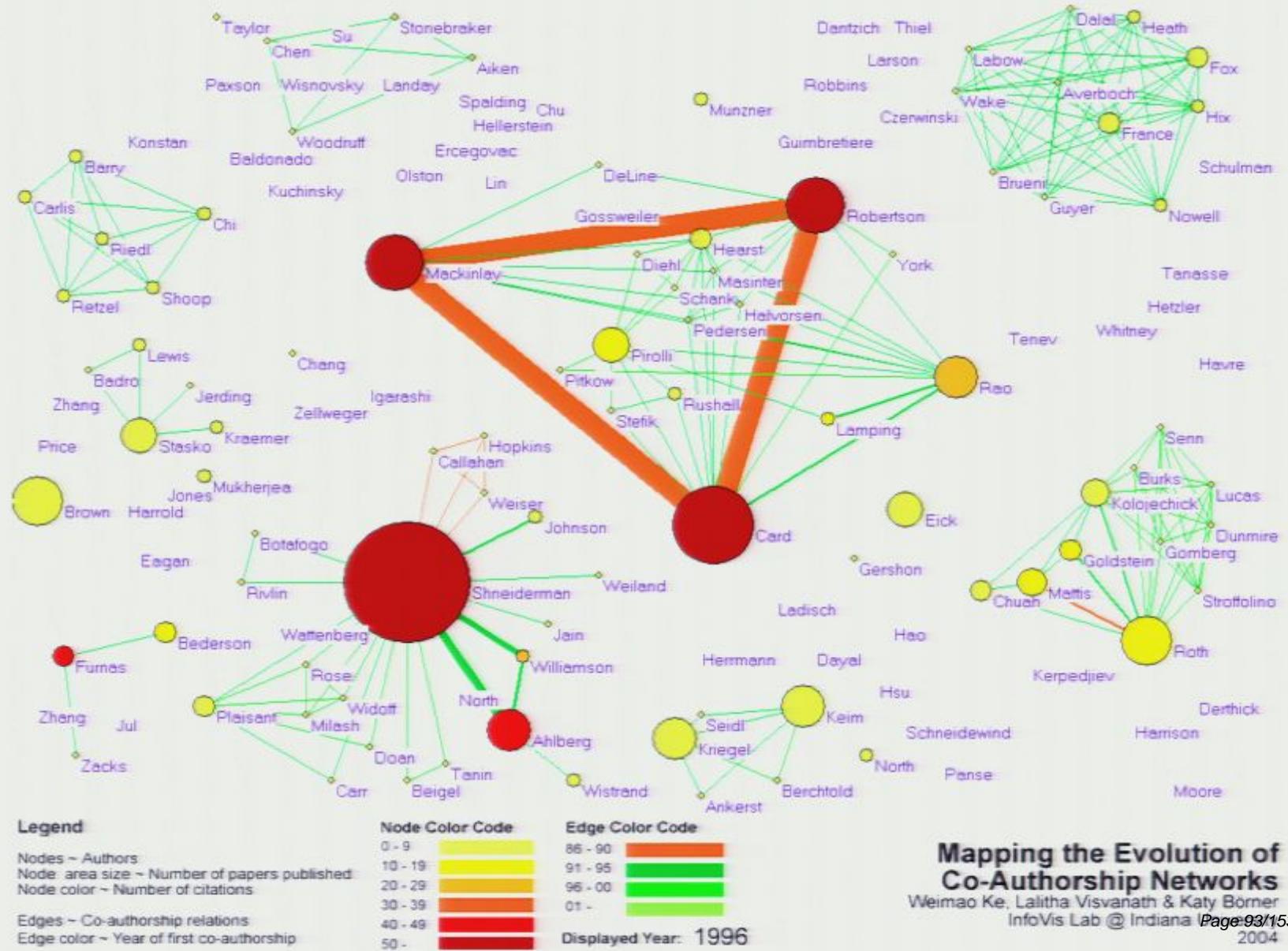
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



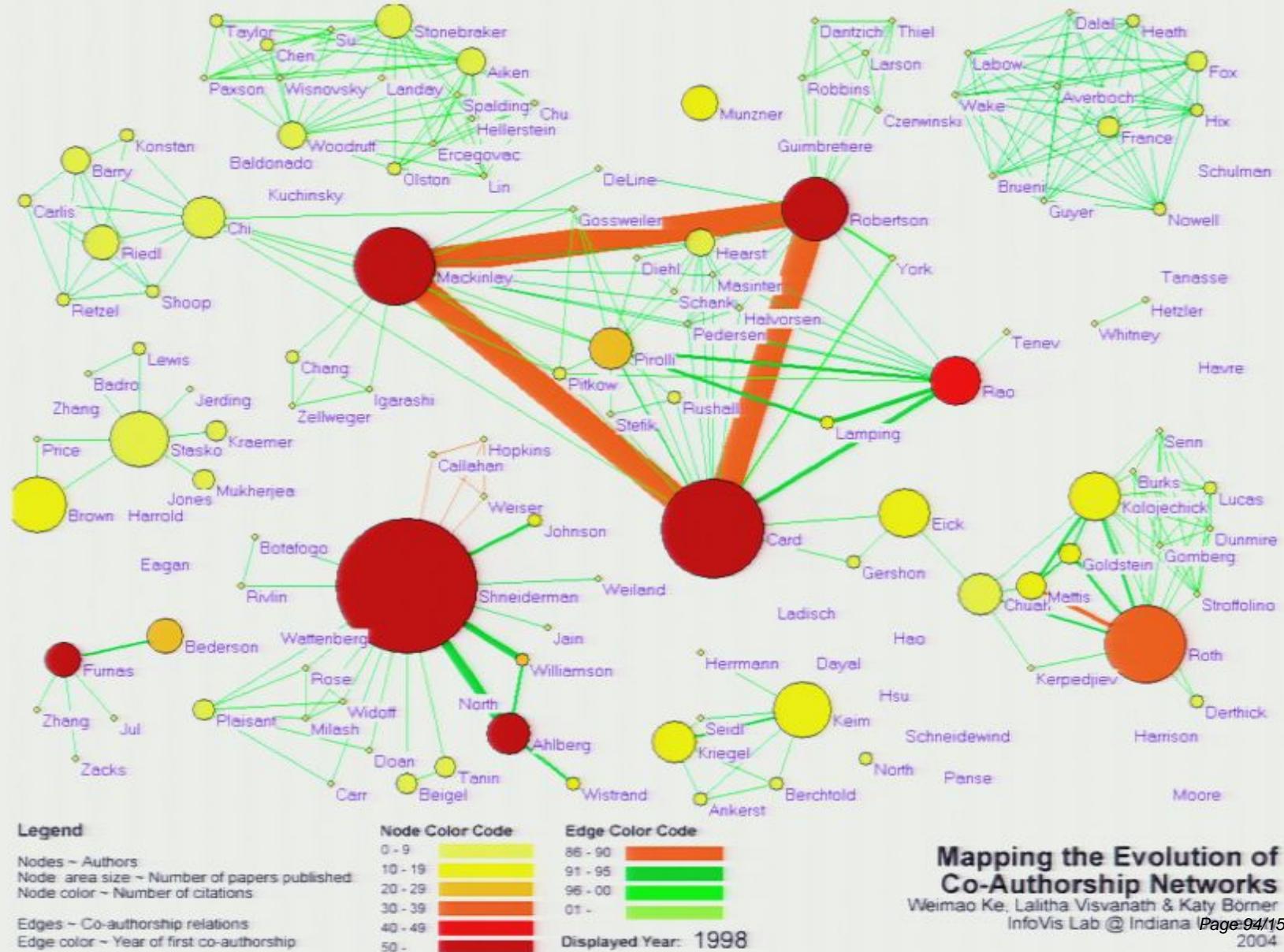
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



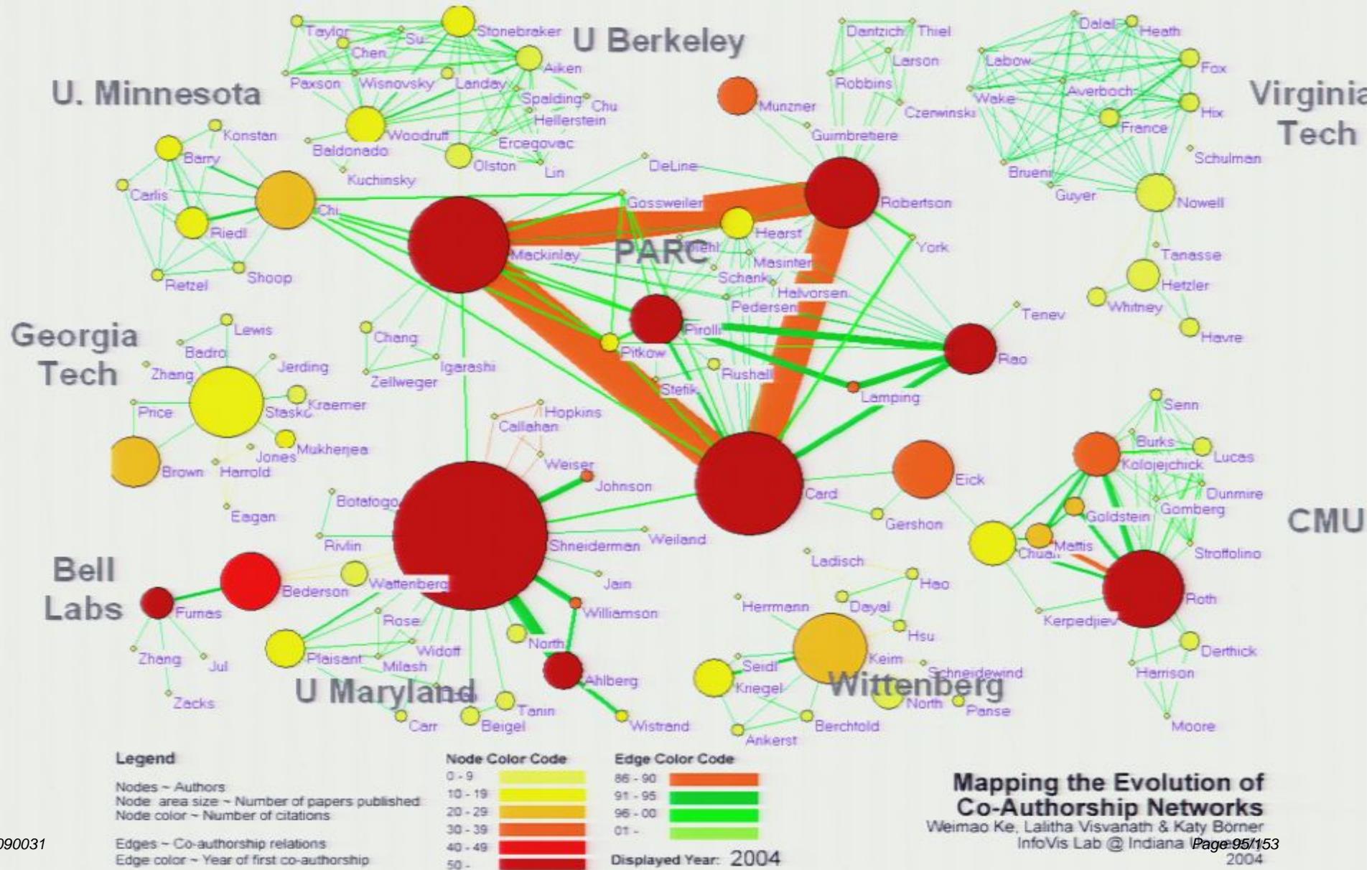
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner (2004) Won 1st prize at the IEEE InfoVis Contest.



113 Years of Physical Review

http://scimaps.org/dev/map_detail.php?map_id=171

Bruce W. Herr II and Russell Duhon (Data Mining & Visualization), Eltsha F. Hardy (Graphic Design), Shashikant Penumarthy (Data Preparation) and Katy Börner (Concept)

113 Years of Physical Review

The visualization aggregates 260,000 articles published in 113 issues of 11 journal volumes from 1898 to 2010. The 113 issues are represented by 11 horizontal layers. The top layer contains the most recent 113 issues, the second layer contains the previous 113 issues, and so on. The bottom layer contains the oldest 113 issues. The 113 issues are color-coded by journal volume: Physical Review A (red), Physical Review B (blue), Physical Review C (green), Physical Review D (orange), Physical Review E (purple), Physical Review Letters (yellow), and Physics Letters B (grey).

Each article has a publication date, title, journal, author(s), and abstract. The visualization allows users to search for specific terms in the abstracts and titles. The visualization also includes a search function for the journal names.

Nobel Prizes in Physical Review

Year of Nobel Prize: 1901-2010. Prizes are listed in chronological order of their award year.

- 1900 Pierre Curie, John C. H. Dill and Thilo von Hippel — 1900
- 1901 Charles Gossen, Clausius, and Paul Drude — 1901
- 1903 Alfred Kleemann predicted a series in this issue with the following sentence: "A theoretical discussion of the photoelectric effect." — 1903
- 1905 Arthur E. Lippmann — 1905
- 1908 Raymond Davis Jr., Masatoshi Koshiba, and Raymond Davis — 1908
- 1909 Eric A. Cornell, Wolfgang Ketterle, and Carl E. Wieman — 1909
- 1910 Robert S. Mulliken — 1910
- 1917 Niels Bohr and William D. Phillips — 1917
- 1918 David R. Lee, Douglas D. Osheroff, and Robert C. Richardson — 1918
- 1919 Maxime L. Boiselle — 1919
- 1919 Georges E. Brionneau and J. Ernest G. Hall — 1919
- 1919 Werner Heisenberg, Max Born, and Richard E. Tolman — 1919

Bar Graph

- Physical Review
- Physical Review Letters
- Physical Review A
- Physical Review B
- Physical Review C
- Physical Review D
- Physical Review E
- Physical Review Letters Accelerated Beams
- Physical Review Physics Educational Research
- Physical Review Modern Physics

Lines

- PACS 0 General
- PACS 2 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 Atoms and Molecular Physics
- PACS 5 Physics of Condensed Matter, Semiconductors, Superconductors, and Statistical Mechanics
- PACS 6 Condensed Matter Structure, Mechanical and Thermal Properties
- PACS 7 Condensed Matter Electronic Structure, Electrical, Magnetic, and Optical Properties



Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Katy, Penumarthy, Shashikant, Meiss, Mark and Ke, Weimao. (2006)
Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.



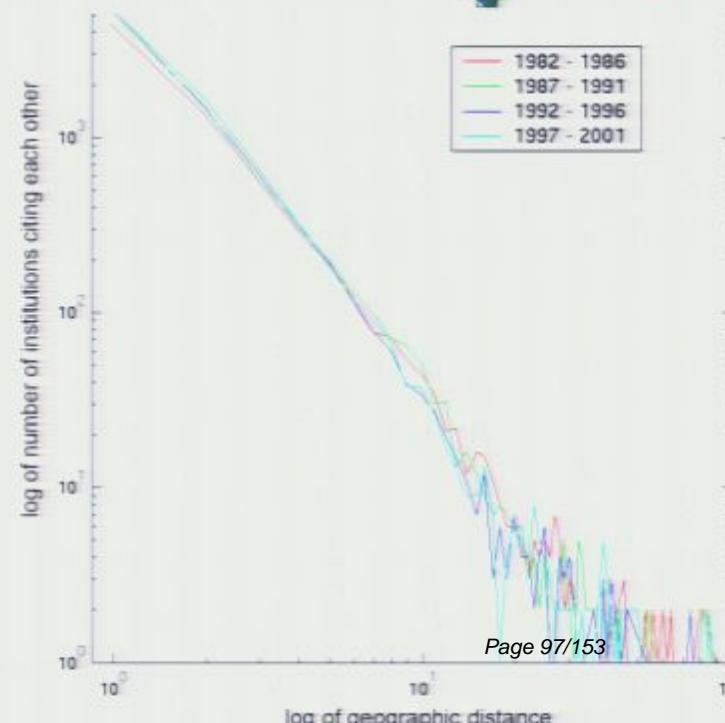
Research questions:

1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research institutions?



Contributions:

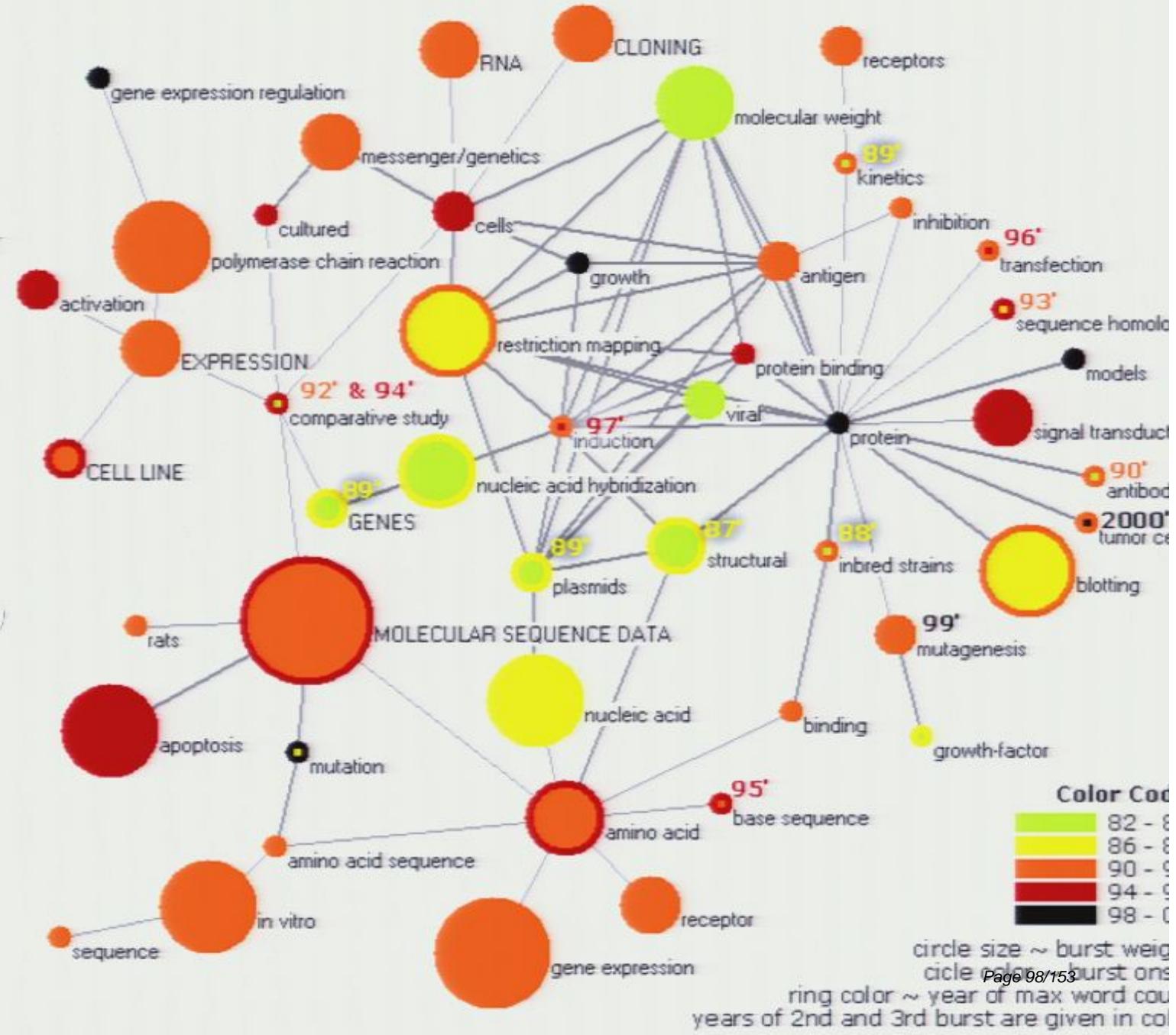
- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them



Mapping Topic Bursts

Co-word space of the top 50 highly frequent and bursty words used in the top 10% most highly cited PNAS publications in 1982-2001.

Mane & Birney (2004)
PNAS, 101 (Suppl. 1):
5287-5290.



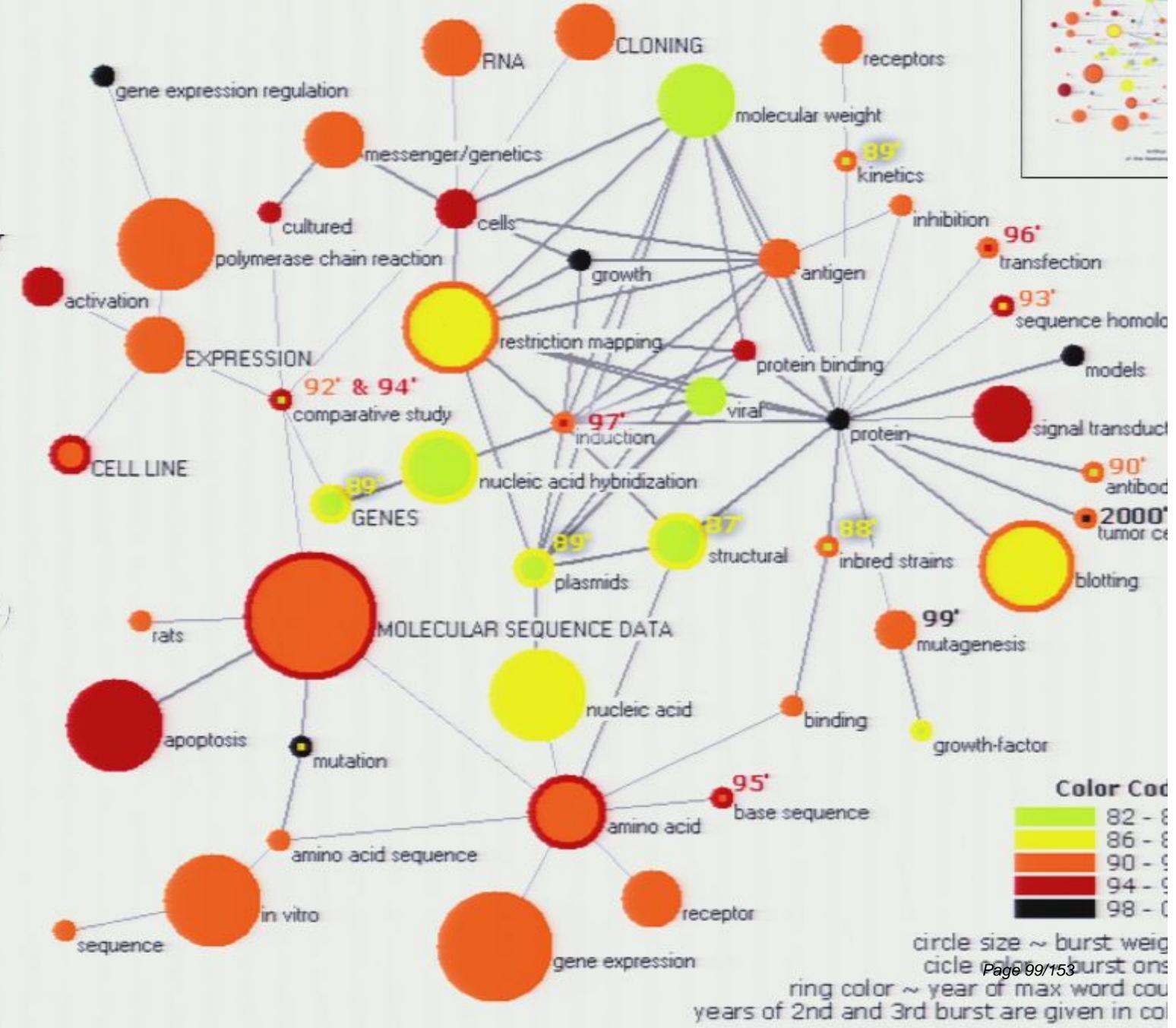
Mapping Topic Bursts

Co-word space of the top 50 highly frequent and bursty words used in the top 10% most highly cited PNAS publications in 1982-2001.

Mane & Birner. (2004)
PNAS, 101(Suppl. 1):
5287-5290.

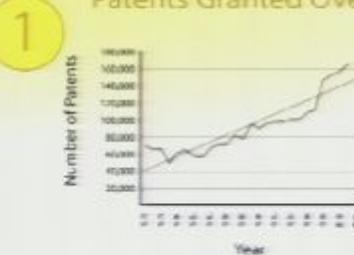


Pirsa: 08090031



Examining the Evolution and Distribution of Patent Classification

Patents Granted Over the Last 20 Years



Top Classes 1978 - 1982

Class	Age	Number
200	1	15,240
424	Drug/Bio-Affecting and Body-Treating Compositions	10,621
425	Compositions	1,064
147	Surgeons	1,044
138	Work Relating to Information Storage	1,034
31	Microbiology and Biochemistry	1,033
123	Internal-Combustion Engines	1,042
340	Communications-Electrical	1,043
204	Classical Computer and Data Processing Systems	1,789
22	Visual Display	2,094
Total		115,152

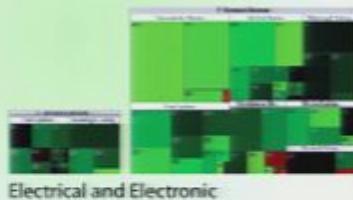
Top Classes 1998 - 2002

Class	Age	Number
310	1	16,778
424	Drug/Bio-Affecting and Body-Treating Compositions	13,775
411	Microelectronic Devices-Mechanical Principles	13,474
479	Drug/Bio-Affecting and Body-Treating Compositions	13,027
138	Work Relating to Microprocessor Architectures	13,114
227	Active Solid-State Devices (e.g., Transistors), Field-Effect Transistors	12,334
311	Information Processing-Update Organization	12,075
343	Computer Graphics Processing, Operation Interface	12,110
227	Information Processing-Selective Visual Display Systems	12,021
220	Optical Systems and Displays	12,074
Total		140,210

In the United States, each patent gets assigned to one out of more than 450 classes covering broad application domains. An examination of the size and growth of patent classes provides insight about patenting trends.

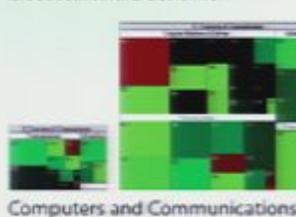
Treemaps, a space filling technique developed in the HCI Lab at the University of Maryland, are used to communicate major results. Treemaps represent a tree structure as nested rectangles with each rectangle representing a node. A rectangular area is first allocated to hold the representation of the tree, and this area is then subdivided into a set of rectangles that represent the top level of the tree. This process continues recursively on the resulting rectangles to represent each lower level of the tree. The parent-child relationship is indicated by enclosing the child rectangle by its parent rectangle. Typically, the size of each rectangle corresponds to the size of the node. Additional information about a node, e.g., its age or value, can be represented by the color of the respective rectangle.

Fast Growth Domains 1983 - 1987 / 1998 - 2002



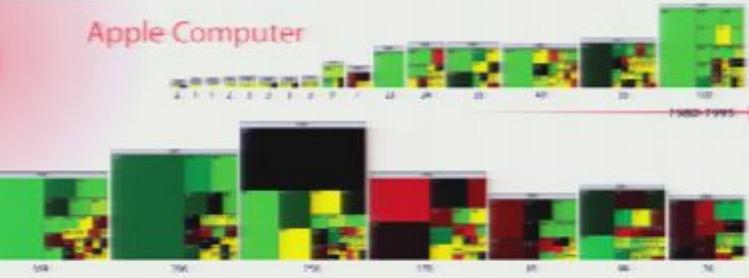
Electrical and Electronic

Slow Growth Domains 1983 - 1987 / 1998 - 2002



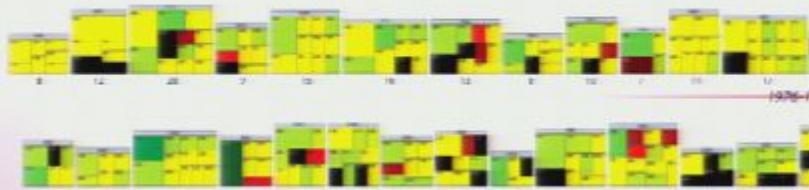
Shown is a comparison of the parent class space for 1983 to 1987 and 1998 to 2002. There is a predominance of growth in the 1998 to 2002 patent space, which correlates to the increase in patent grants during this period. By comparing the growth in categories, one can distinguish between domains that have been receiving a larger amount of patent grants.

Apple Computer



Depicted above is how Apple Computers' portfolio has changed in yearly increments from 1980 to 2002.

Lemelson's patent holdings below show a more even distribution over multiple classes. No class dominates over a majority of the years for granted patents; instead they are distributed more broadly over the intellectual space.



Jerome Lemelson

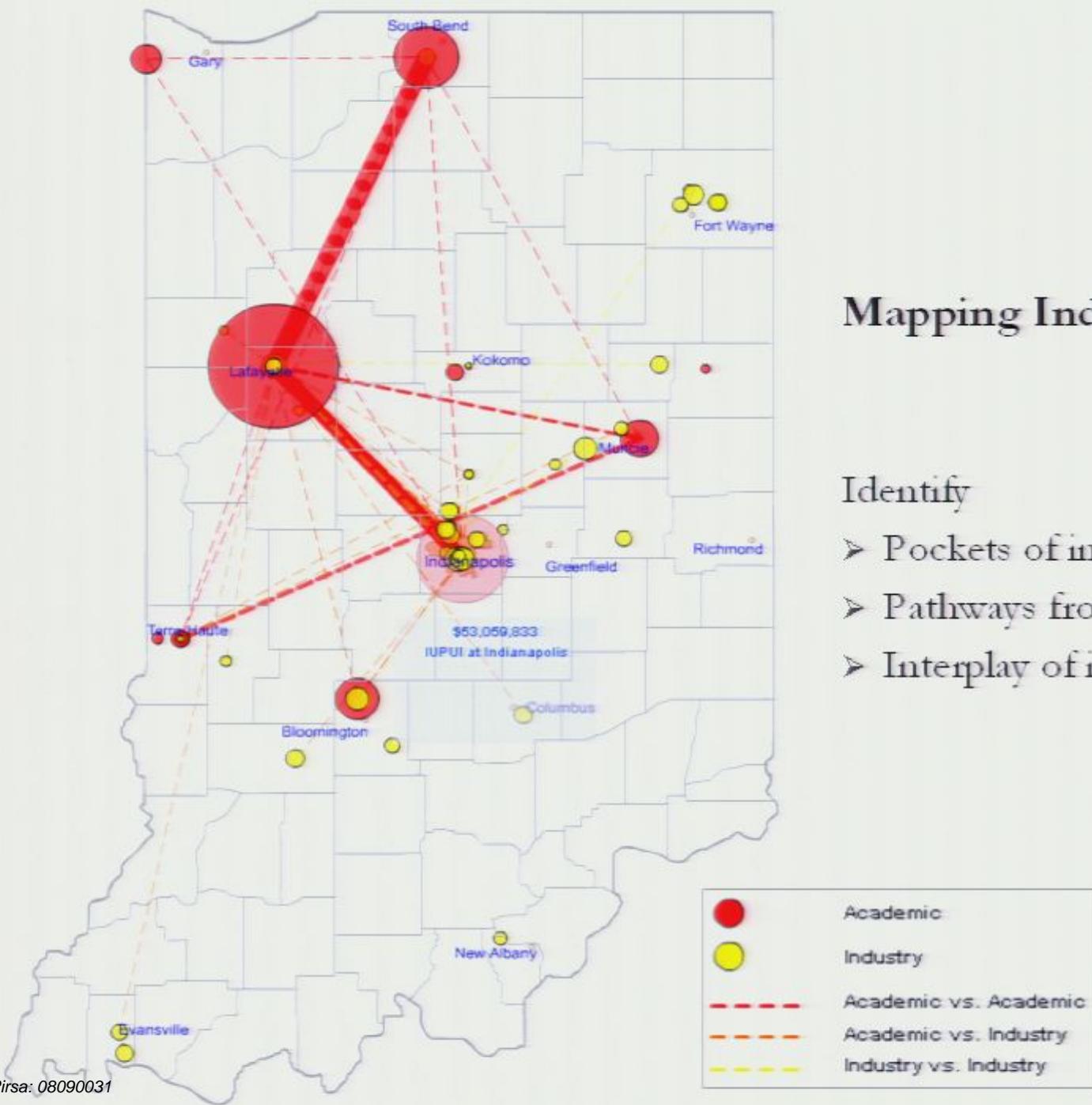


Kutz, Daniel O. Examining the Evolution and Distribution of Patent Classifications.
Accepted for the Information Visualization Conference, London, UK, July 2004.

The material is based upon work supported by the National Science Foundation under Grant No. IIS-0238261.



For more information, contact Katy Borner at katy@indiana.edu.



Mapping Indiana's Intellectual Space

Identify

- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity,
The NewScientist, May 19, 2007

Rendered as Google Map:

<http://scimaps.org/maps/wikipedia>

Jan 8th, 2008 Data Version on Gigapan:

<https://gigapan.org/viewGigapan.php?id=5042>



Pirsa: 08090031

Second sight

Image: Bruce W. Herr and Todd M.

Power struggle

How do you keep track of the bubbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are contained in the online encyclopedia, and those most hotly contested.

It's a mind-boggling task. About 4 million "Wikipedians" have made over 130 million edits, and the English-language version alone contains 1.7 million articles. Every second a new edit is made, and every day 2000 new articles spring up.

To make sense of it all, Bruce Herr and Todd Holloway of Indiana University, Bloomington, created clusters of 300 or so articles that touch on a related topic, such as a religion or a famous person. For each cluster they took one picture from the most popular article and laid them out in a circular grid.

Atop the grid are coloured dots showing how often and how recently each article has been edited. The larger, darker dots mean more intense activity. The list of blitzed articles reveals the idiosyncratic priorities of Wikipedians: Jesus, Adolf Hitler, Nintendo, Hurricane Katrina, Britney Spears and Albert Einstein.

Updating the image in real time would allow Wikipedia's administrators to spot where arguments are taking place, Herr suggests. If rival contributors are repeatedly changing each other's entries, for example, a page could be locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.



Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity,
The NewScientist, May 19, 2007

Rendered as Google Map:

<http://scimaps.org/maps/wikipedia>

Jan 8th, 2008 Data Version on Gigapan:

<https://gigapan.org/viewGigapan.php?id=5042>

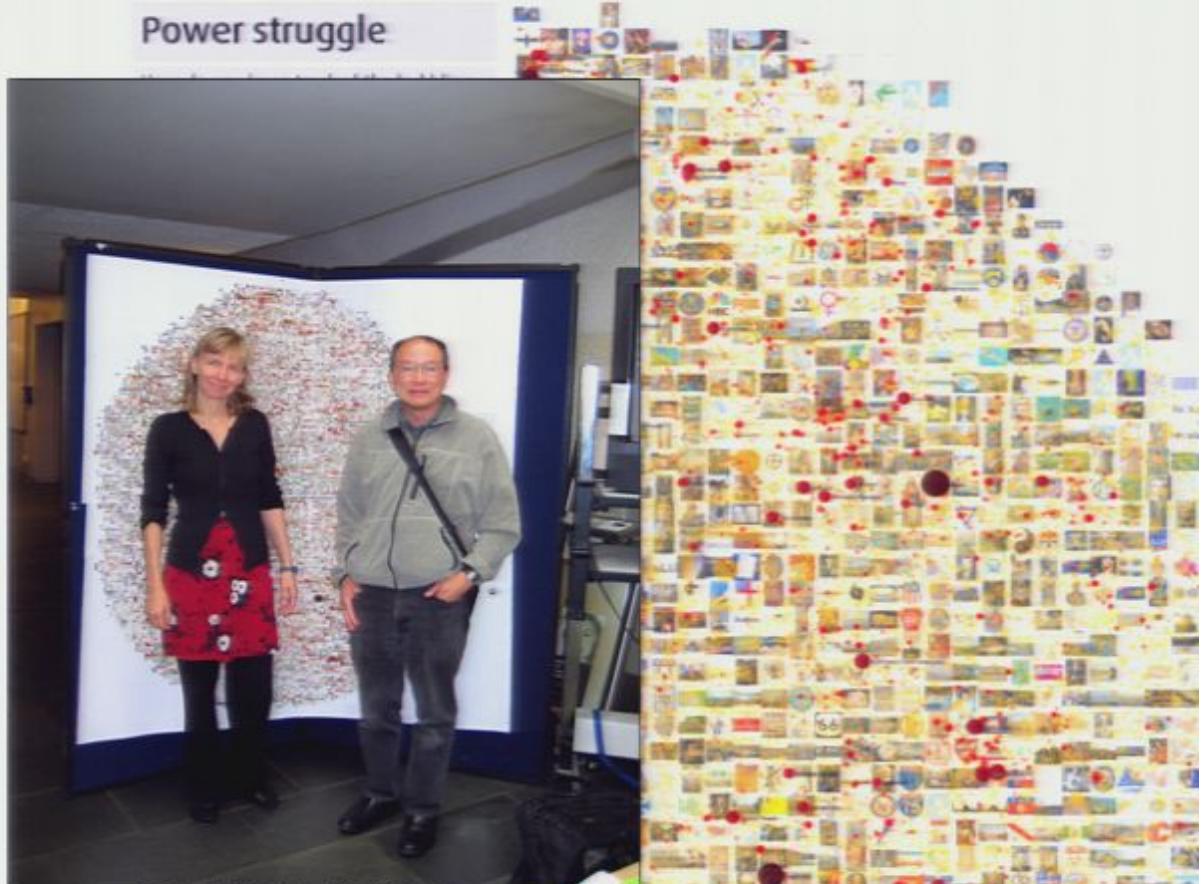


Pirsa: 08090031

Second sight

Image: Bruce W. Herr and Todd M.

Power struggle



To spot where arguments are taking place, Herr suggests. If rival contributors are repeatedly changing each other's entries, for example, a page could be locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.

Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity,
The NewScientist, May 19, 2007

Rendered as Google Map:

<http://scimaps.org/maps/wikipedia>

Jan 8th, 2008 Data Version on Gigapan:

<http://gigapan.org/viewGigapan.php?id=5042>



Pirsa: 08090031

Second sight

Image: Bruce W. Herr and Todd M.

Power struggle

How do you keep track of the bubbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are contained in the online encyclopedia, and those most hotly contested.

It's a mind-boggling task. About 4 million "Wikipedians" have made over 130 million edits, and the English-language version alone contains 1.7 million articles. Every second a new edit is made, and every day 2000 new articles spring up.

To make sense of it all, Bruce Herr and Todd Holloway of Indiana University, Bloomington, created clusters of 300 or so articles that touch on a related topic, such as a religion or a famous person. For each cluster they took one picture from the most popular article and laid them out in a circular grid.

Atop the grid are coloured dots showing how often and how recently each article has been edited. The larger, darker dots mean more intense activity. The list of blitzed articles reveals the idiosyncratic priorities of Wikipedians: Jesus, Adolf Hitler, Nintendo, Hurricane Katrina, Britney Spears and Albert Einstein.

Updating the image in real time would allow Wikipedia's administrators to spot where arguments are taking place, Herr suggests. If rival contributors are repeatedly changing each other's entries, for example, a page could be locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.



Science Related Wikipedian Activity

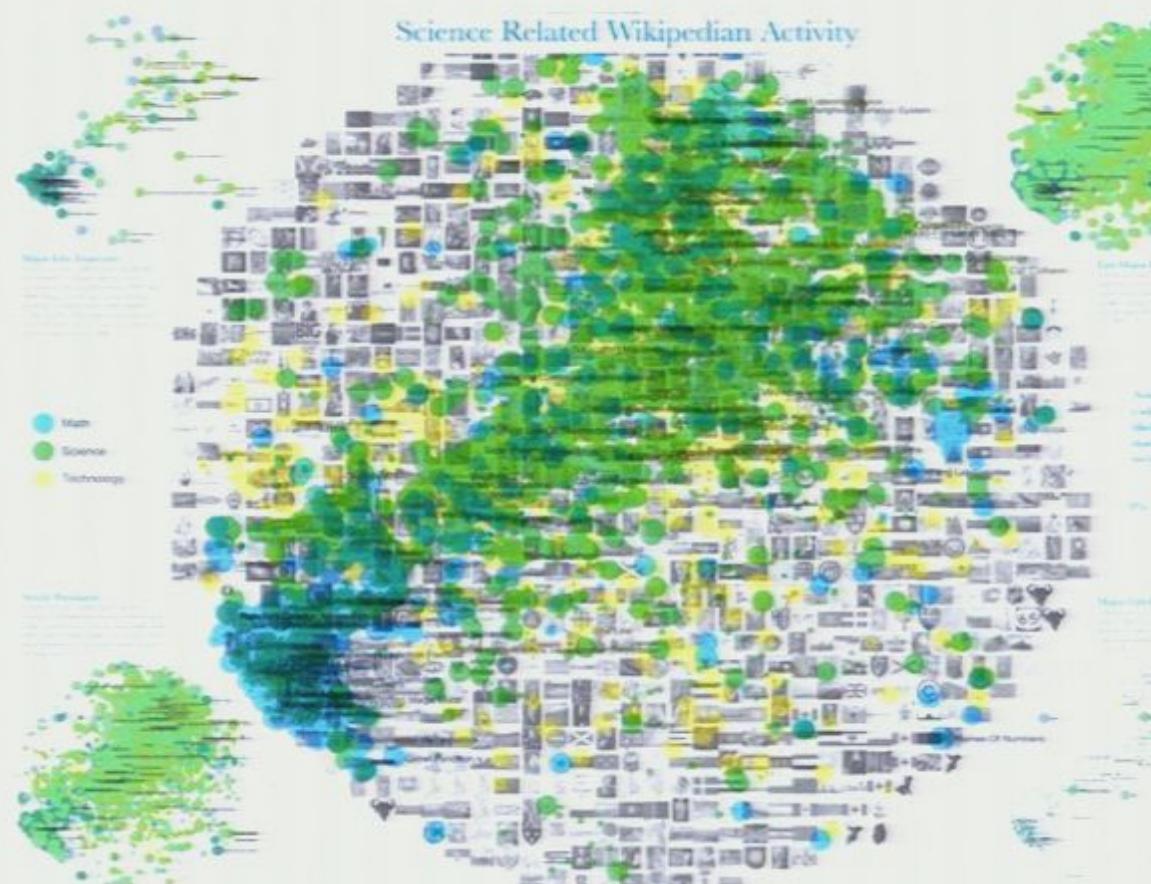
http://scimaps.org/dev/map_detail.php?map_id=165

Same base map.

Overlaid are 3,599 math (blue),
6,474 science (green), and 3,164
technology relevant articles
(yellow).

All other articles are given in grey.

Comers show articles size coded
according to
-article edit activity (top left),
- number of major edits (top right),
- number of bursts in edit activity
(bottom right)
- indegree (bottom left).



Science Related Wikipedian Activity

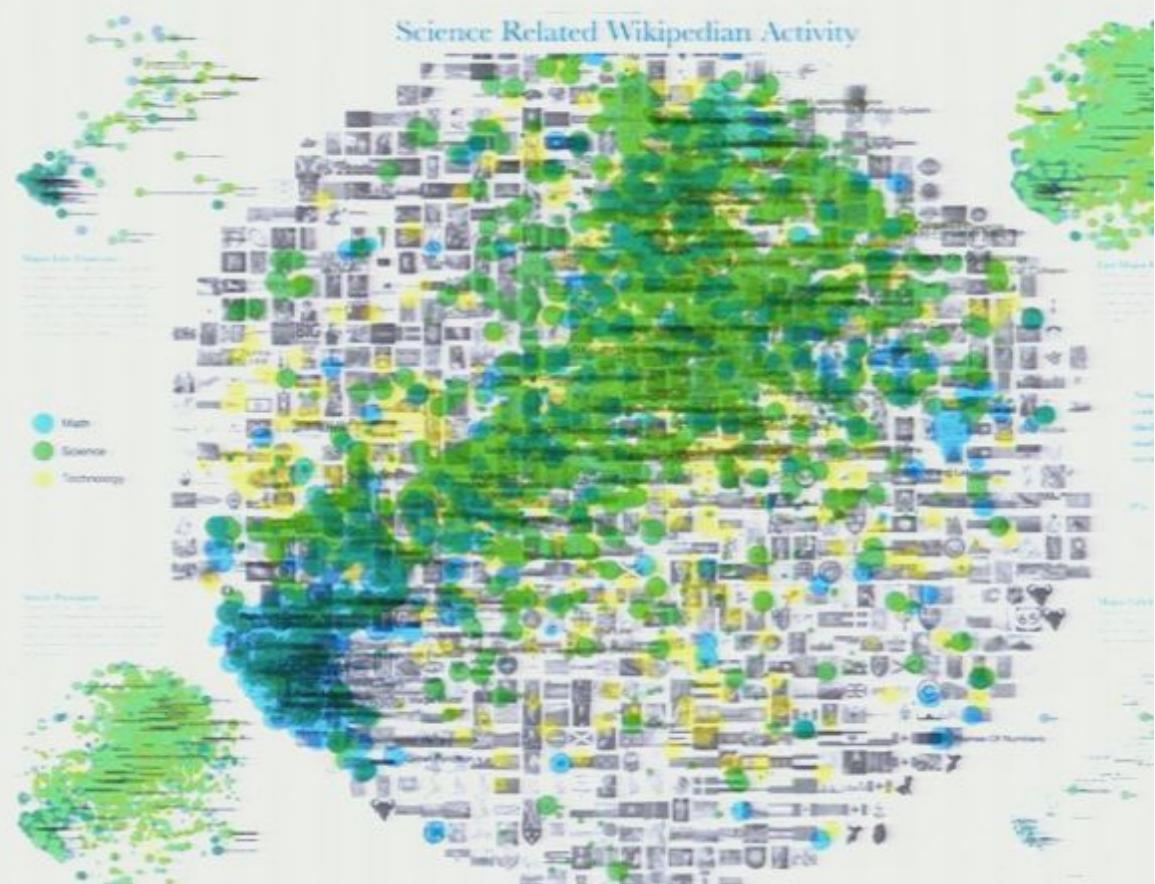
http://scimaps.org/dev/map_detail.php?map_id=165

Same base map.

Overlaid are 3,599 math (blue),
6,474 science (green), and 3,164
technology relevant articles
(yellow).

All other articles are given in grey.

Comers show articles size coded
according to
-article edit activity (top left),
- number of major edits (top right),
- number of bursts in edit activity
(bottom right)
- indegree (bottom left).



Pirsa: 08090031

Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity,
The NewScientist, May 19, 2007

Rendered as Google Map:

<http://scimaps.org/maps/wikipedia>

Jan 8th, 2008 Data Version on Gigapan:

<https://gigapan.org/viewGigapan.php?id=5042>



Second sight

Image: Bruce W. Herr and Todd M.

Power struggle



To spot where arguments are taking place, Herr suggests. If rival contributors are repeatedly changing each other's entries, for example, a page could be locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.

Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity,
The NewScientist, May 19, 2007

Rendered as Google Map:

<http://scimaps.org/maps/wikipedia>

Jan 8th, 2008 Data Version on Gigapan:

<http://gigapan.org/viewGigapan.php?id=5042>



Pirsa: 08090031

Second sight

Image: Bruce W. Herr and Todd M.

Power struggle

How do you keep track of the bubbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are contained in the online encyclopedia, and those most hotly contested.

It's a mind-boggling task. About 4 million "Wikipedians" have made over 130 million edits, and the English-language version alone contains 1.7 million articles. Every second a new edit is made, and every day 2000 new articles spring up.

To make sense of it all, Bruce Herr and Todd Holloway of Indiana University, Bloomington, created clusters of 300 or so articles that touch on a related topic, such as a religion or a famous person. For each cluster they took one picture from the most popular article and laid them out in a circular grid.

Atop the grid are coloured dots showing how often and how recently each article has been edited. The larger, darker dots mean more intense activity. The list of blitzed articles reveals the idiosyncratic priorities of Wikipedians: Jesus, Adolf Hitler, Nintendo, Hurricane Katrina, Britney Spears and Albert Einstein.

Updating the image in real time would allow Wikipedia's administrators to spot where arguments are taking place, Herr suggests. If rival contributors are repeatedly changing each other's entries, for example, a page could be locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.



Science Related Wikipedian Activity

http://scimaps.org/dev/map_detail.php?map_id=165

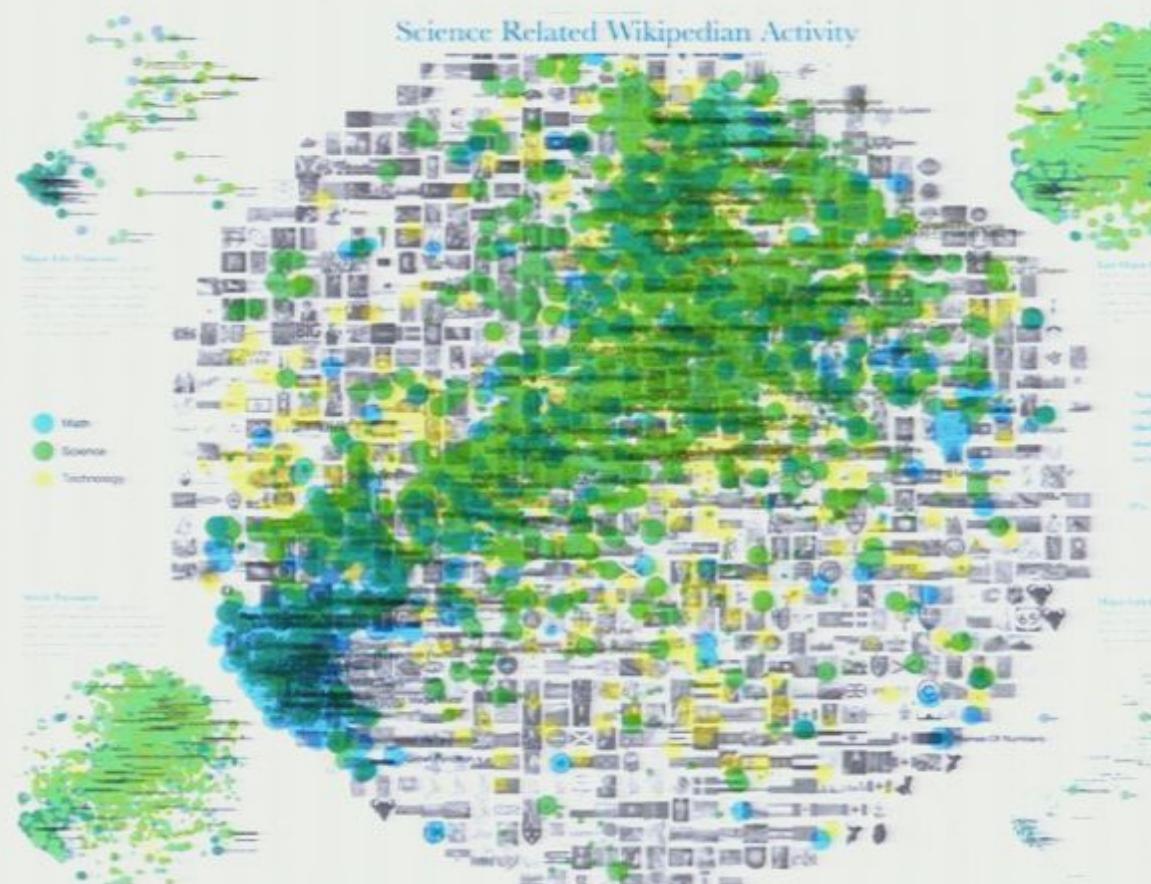
Same base map.

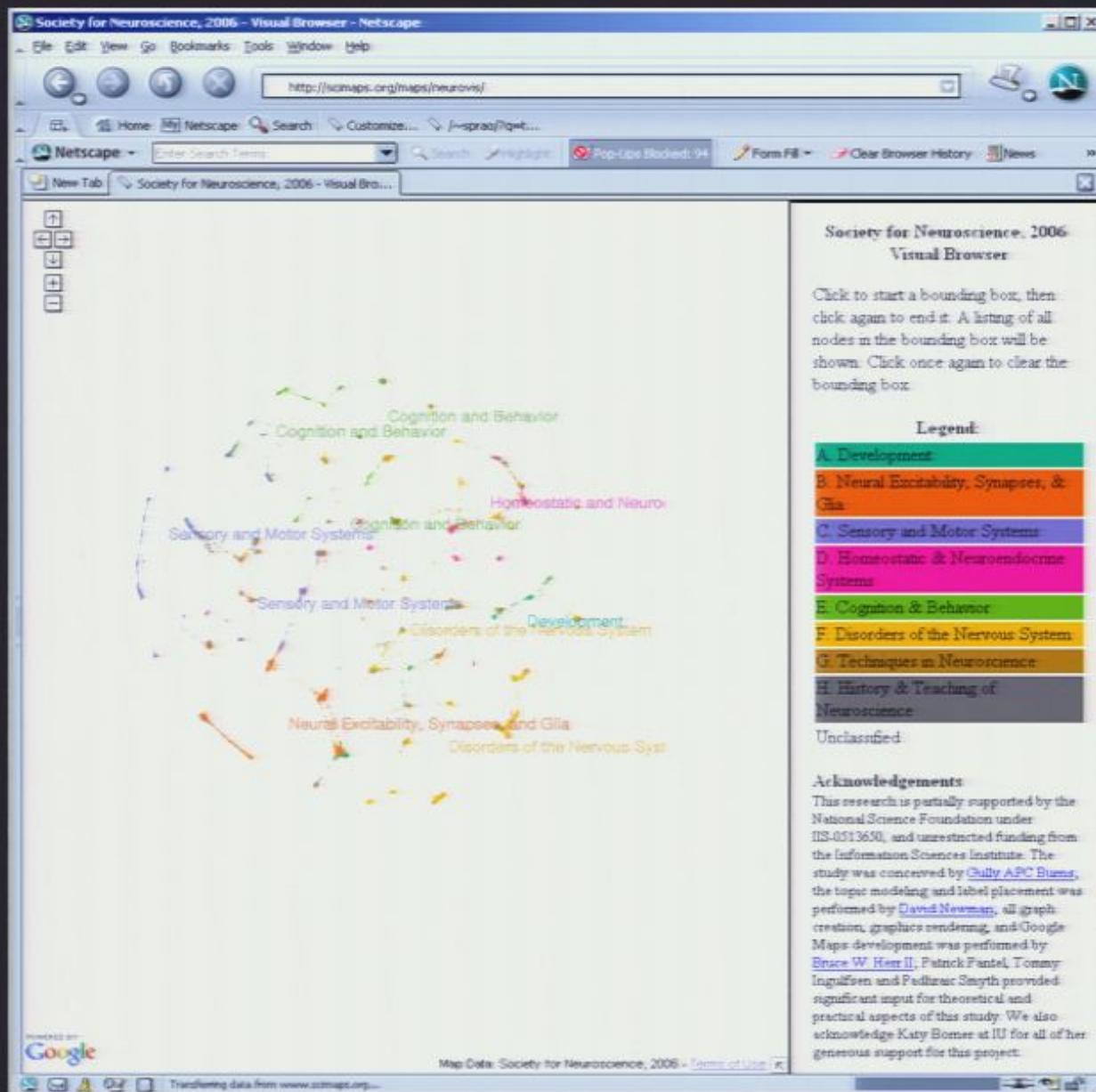
Overlaid are 3,599 math (blue),
6,474 science (green), and 3,164
technology relevant articles
(yellow).

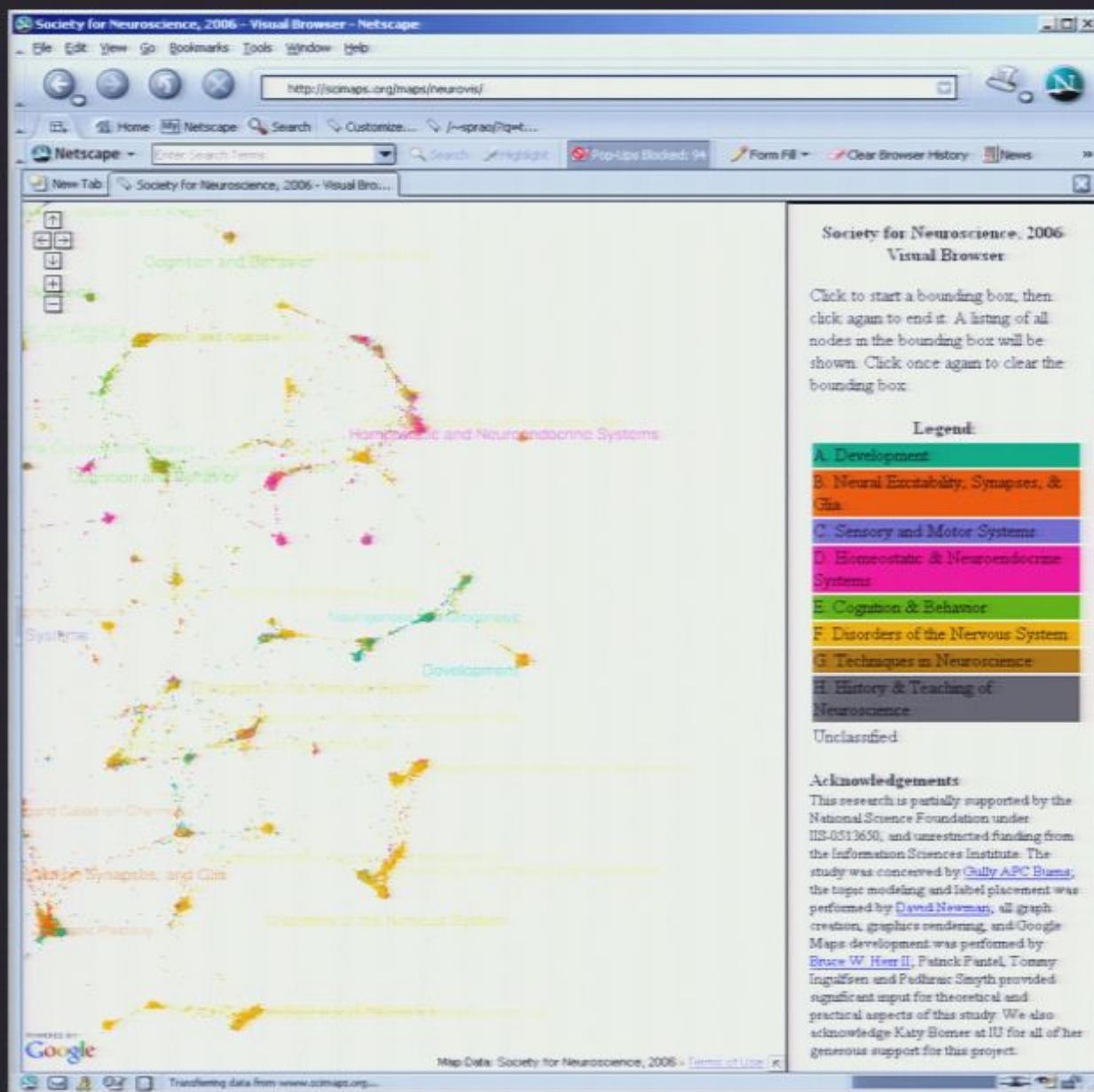
All other articles are given in grey.

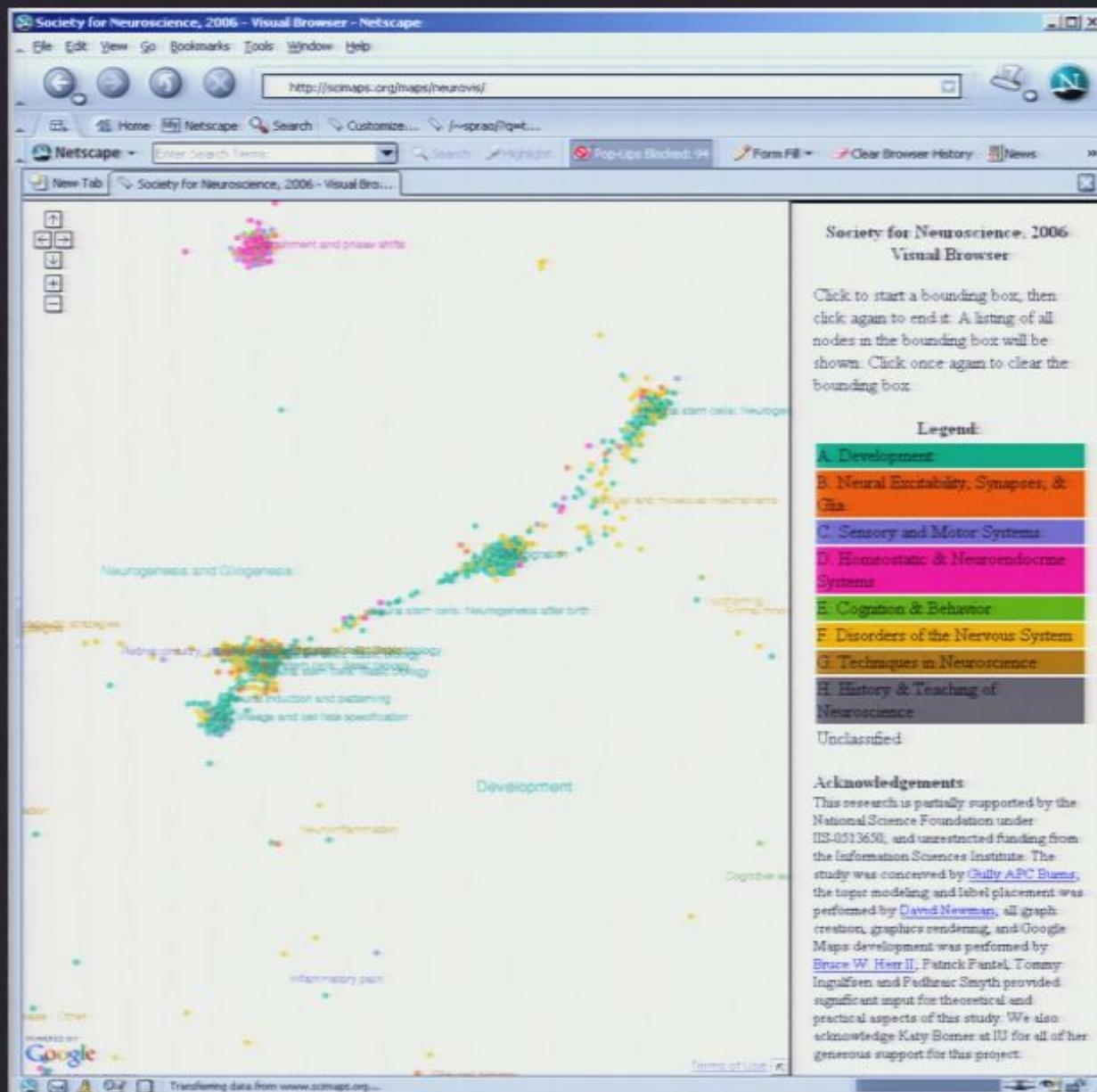
Comers show articles size coded
according to

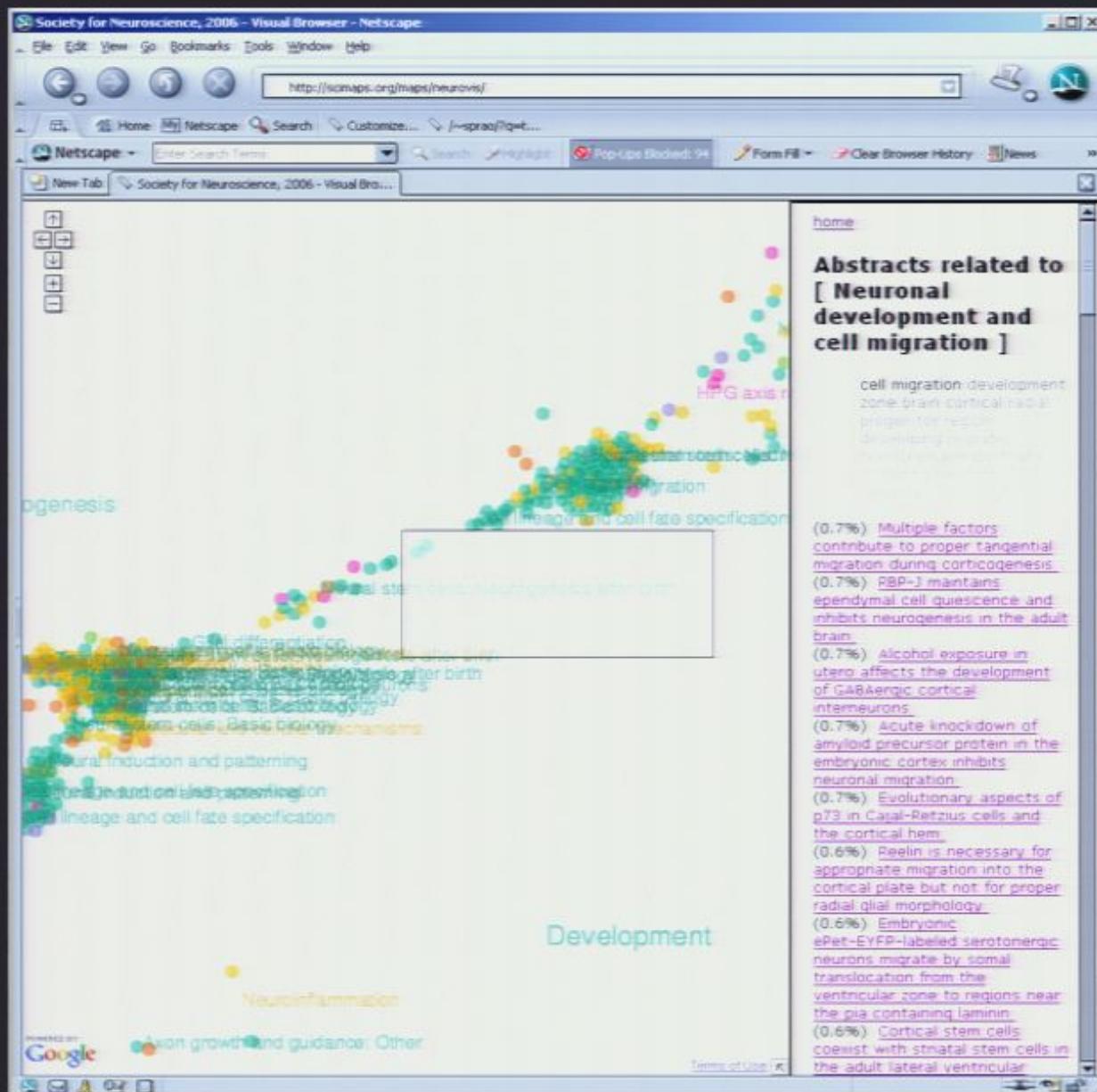
- article edit activity (top left),
- number of major edits (top right),
- number of bursts in edit activity
(bottom, right)
- indegree (bottom left).











Mapping Science Exhibit



Places & Spaces

Cartography of the Physical and the Abstract

An exhibition created for the conference "Mapping Humanity's Knowledge and Expertise in the Digital Domain" at the 2005 Meeting of the American Association of Geographers that is updated regularly with new maps and explanations.

Home Browse Maps Compare & Contrast Maps Connect

Home

Exhibit Purpose and Goals

The Places & Spaces exhibit has been created to demonstrate the power of maps.

An initial theme of this exhibit is to compare and contrast first maps of our entire planet with the first maps of all of science as we know it.

Come see with your own eyes the extent to which maps can be employed to help make sense of the flood of information we are confronted with and how domain maps can be used to locate complex and beautiful information.

This online part of the exhibit provides links to a selected series of maps and their makers along with detailed explanations of why these maps work. The physical counterpart supports the close inspection of high quality reproductions for display at conferences and education centers. It is meant to inspire cross-disciplinary discussion on how to best track and communicate human activity and scientific progress on a global scale.



Places & Spaces: Mapping Science

a science exhibit that introduces people to maps of sciences, their makers and users.

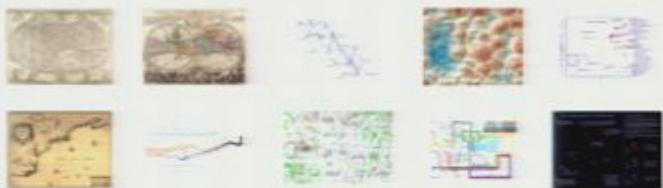
<http://scimaps.org>

Exhibit Curators: Dr. Katy Börner & Elisha F. Hardy



Mapping Science Exhibit – 10 Iterations in 10 years

The Power of Maps (2005)



Science Maps for Economic Decision Makers (2008)



The Power of Reference Systems (2006)



Science Maps for Science Policy Makers (2009)

Science Maps for Scholars (2010)

Science Maps as Visual Interfaces to Digital Libraries (2011)

Science Maps for Kids (2012)

Science Forecasts (2013)

How to Lie with Science Maps (2014)

scimaps.org

The Power of Forecasts (2007)



Illuminated Diagram Display

*W. Bradford Paley,
Kevin W. Boyack,
Richard Kalians, and
Katy Borner (2007)
Mapping,
Illuminating, and
Interacting with
Science.
SIGGRAPH 2007,
San Diego, CA.*



Pirsa: 08090031

TOPIC MAP: HOW SCIENTIFIC PARADIGMS RELATE



GEOGRAPHIC MAP: WHERE SCIENCE GETS DONE



You may run your finger over each of these maps to control the lighting on the other: touching a place on the world map will light up topics studied in that place; touching a paradigm on the topic map will light up the places that study that topic.

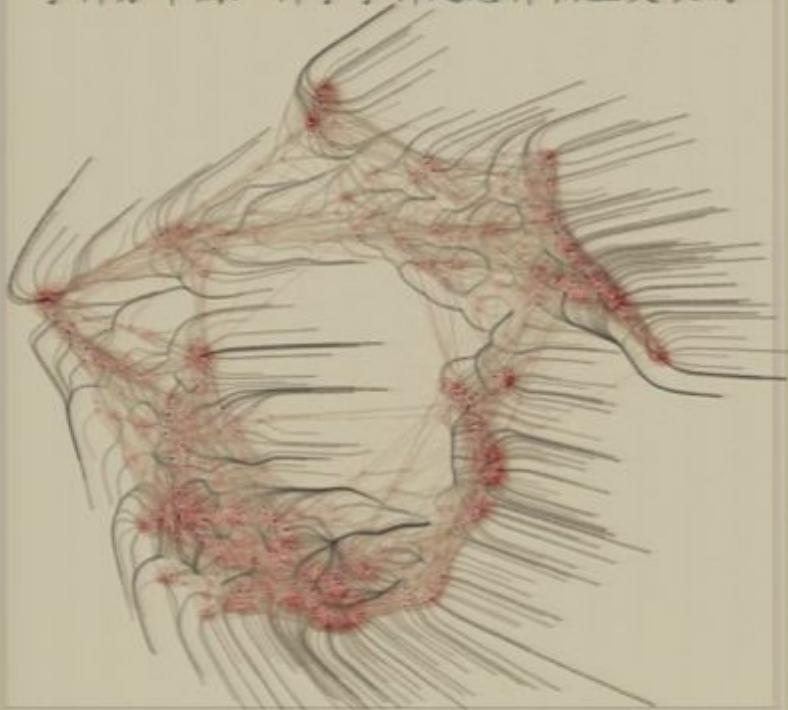
Nanotechnology

This overlay shows the distribution of nanotechnology within the paradigms of science. The majority of current work in nanotechnology takes places in physics, chemistry, and materials science, at the upper right portion of the map. However, an increasing amount of nanotechnology is being applied in the biological and medical sciences, at the lower right.

All Topics	Nanotechnology	Francis H. C. CRICK	Albert EINSTEIN	Michael E. FISHER	Susan T. FISKE
<i>Sweep through all 776 scientific paradigms</i>	<i>Science on the tiny scale of molecules</i>	<i>Co-discovered DNA's double helix</i>	<i>Revitalized physics with Relativity theories</i>	<i>Models critical phase transitions of matter</i>	<i>Connects perception and stereotypes</i>
Sustainability	Biology & Chemistry	Joshua LEDERBERG	Derek J. de Solla PRICE	Richard N. ZARE	About this display
<i>The science behind our long-term hopes</i>	<i>The interface between these two vital fields</i>	<i>Pioneer in bacterial genetic mechanisms</i>	<i>Known as the "Father of Scientometrics"</i>	<i>Uses laser chemistry in molecular dynamics</i>	<i>People & organizations that helped create</i>

We sweep slowly through adjoining related topics, lighting up the places in the world that study each topic. You may select a subset of the topics that deal with these three interesting subjects by touching it.

学科分布图：科学学科是怎样相互关联的



纳米技术

这里显示所有和纳米技术相关的科学学科。纳米技术是科学研究人类在无形的空间里改造世界的能力，这些空间存在于极其微小以至单个原子的结构中。目前大部分有关纳米的研究主要集中在物理、化学和材料科学领域。它们主要位于学科分布图上半部分的右面。不过，纳米技术在生物学和医药学研究里的应用也越来越多。生物学和医药学位于学科分布图下半部分的右面。

探索科学学科的相互关联性

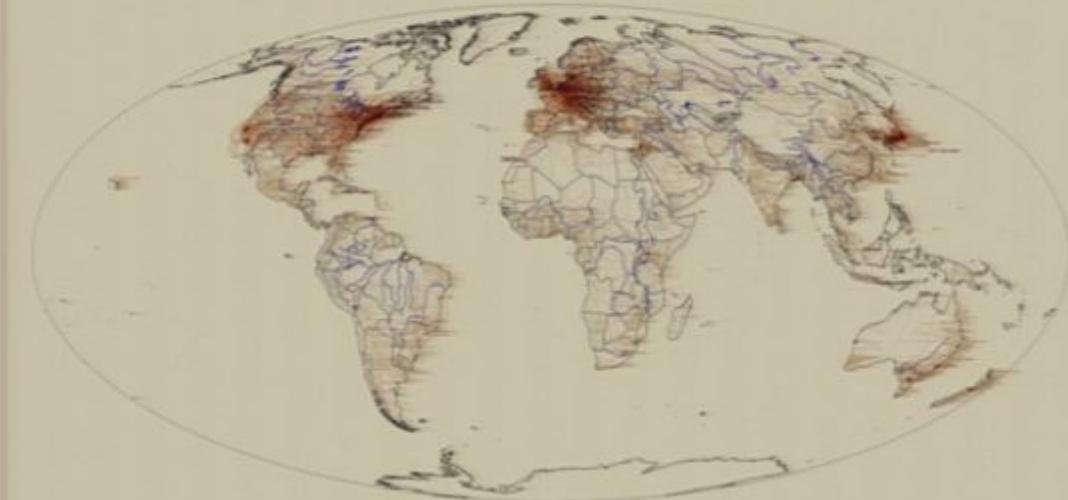
所有科学学科	纳米技术
显示所有776种科学学科	有关微观粒子的科学
可持续性	化学和生物
一些与人类寄予长期希望相关的科学	化学和生物科学的交叉部分

光标缓慢的扫过所有相互关联的科学学科。每一个学科以及从事这方面科学的研究机构在世界地图上的位置会被逐一点亮。首先，显示屏会点亮那些产出论文最多、最活跃的科学学科，然后那些小众科或冷门学科会被逐一点亮。



Pirsa: 08090031

世界地图：科学研究在哪里进行着



你可以通过触摸界面上随意点击来改变所到之处的光亮强度。当你触摸世界地图的某一点时，在那个位置上的所有研究机构会变点亮。同时在这些研究机构工作的学者的论文所属的学科会在学科分布图上被点亮。而当你触摸学科分布图的某一点时，在那个位置上的科学学科会变点亮。同时从事这些学科研究的研究机构在世界地图上的分布会被点亮。

探索某个学者的科学著作的影响力传播

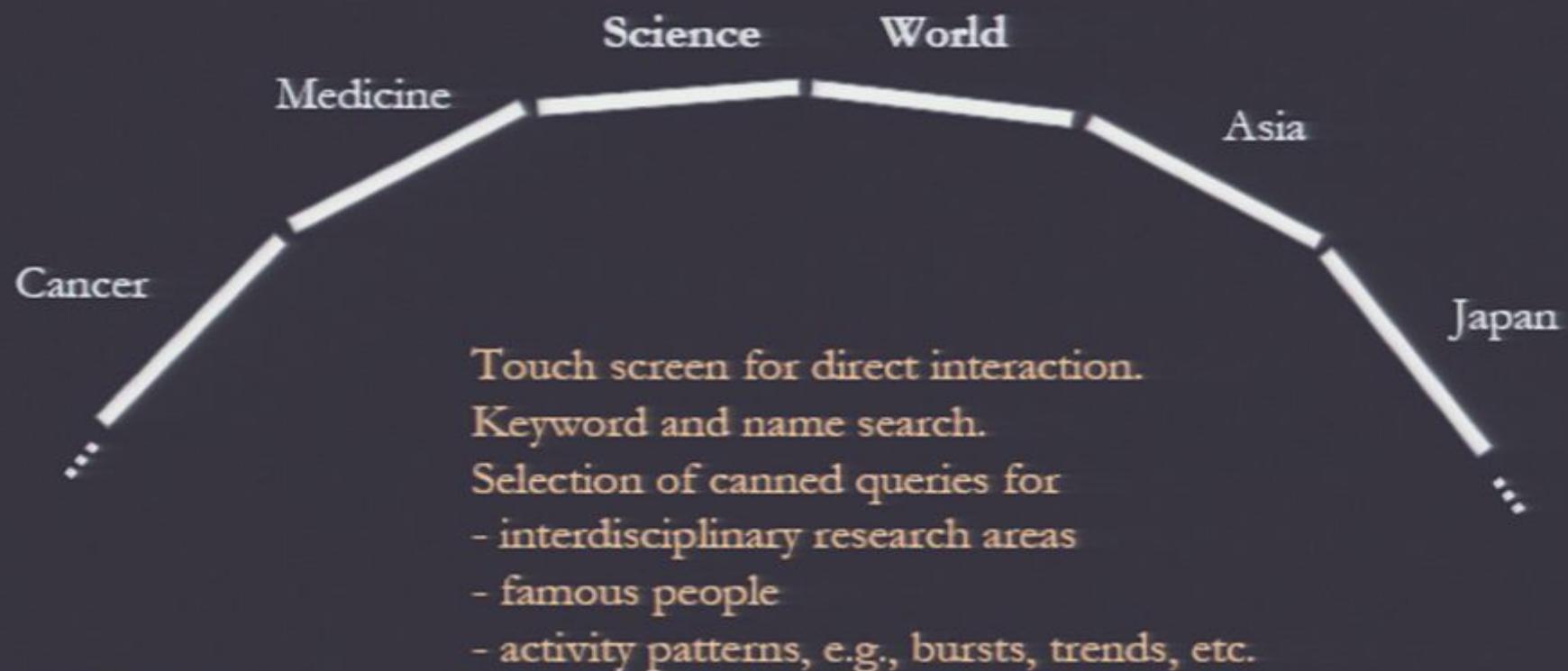
弗郎西·科里克	阿尔伯特·爱因斯坦	迈克尔·费舍尔	苏珊·费斯克
DNA双螺旋状的发现者之一	用相对论重新激活了物理学	发现了物质转变模式的关键步骤	研究人的认知是如何产生偏见的
约舒亚·雷德伯格	德里克·德索拉·普里斯	理查德·扎尔	关于本次展览
细菌遗传机制研究的先驱	著名的“科学计量学之父”	采用激光化学技术研究分子动态分布	与此展览相关人与机构

显示屏通过四步来展示某个学者对科学的贡献以及影响力的传播。首先，显示屏从光球学者的论文所属的学科在学科分布图上的位置以及该学者从事这项研究时所在的研究机构在世界地图上的位置。到目前为止，所有这些论文的引用率仍然很高。第二步，显示屏点亮所有引用了第一步中被点亮的原始论文的论文在学科分布图上的位置以及它们在世界地图上的位置。第三步，显示屏点亮所有引用了在第二步中被点亮的论文的学科在学科分布图上的位置以及它们在世界地图上的位置。第四步，显示屏点亮所有引用了在第三步中被点亮的论文的学科在学科分布图上的位置以及它们在世界地图上的位置。

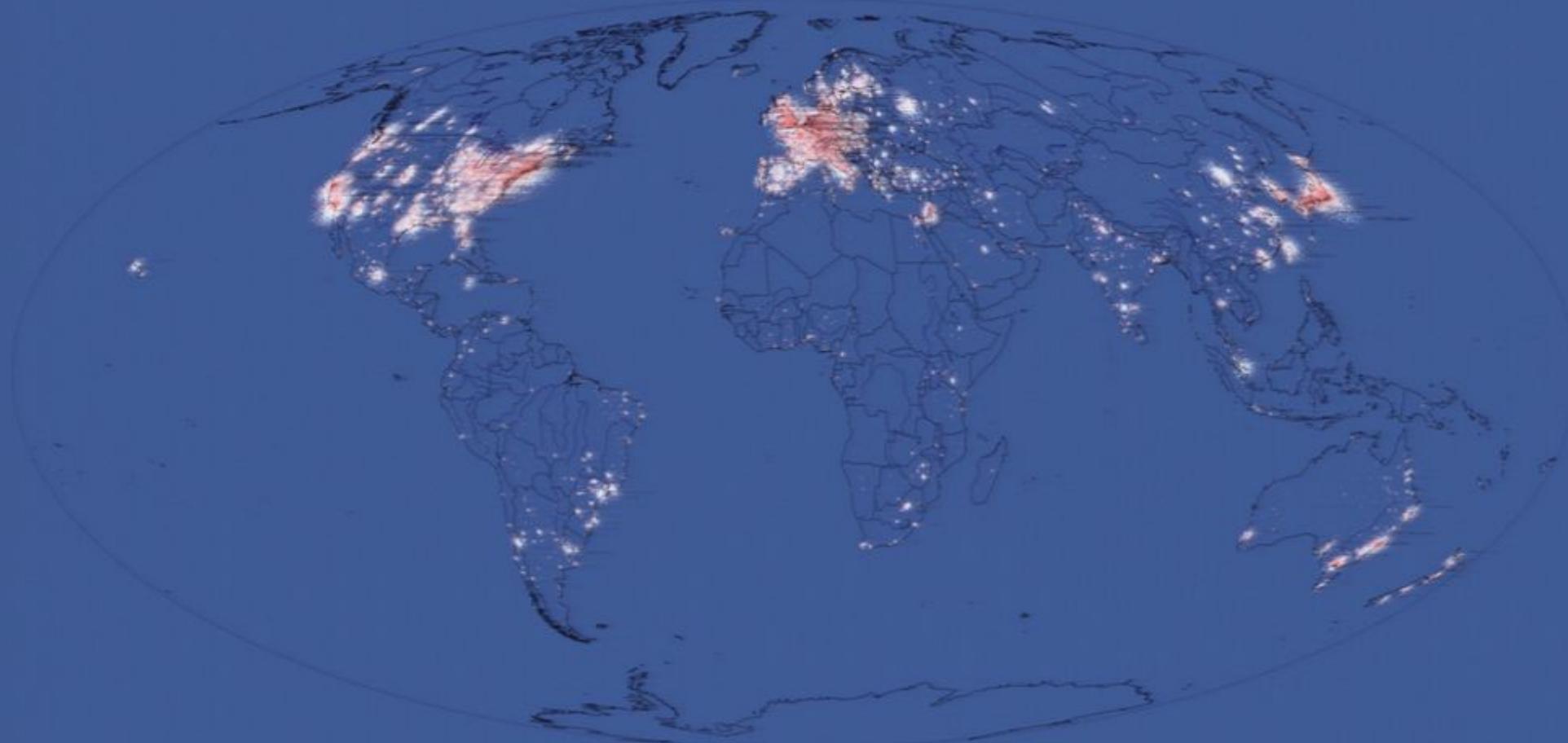
Re-implementation of Illuminated Diagram Software

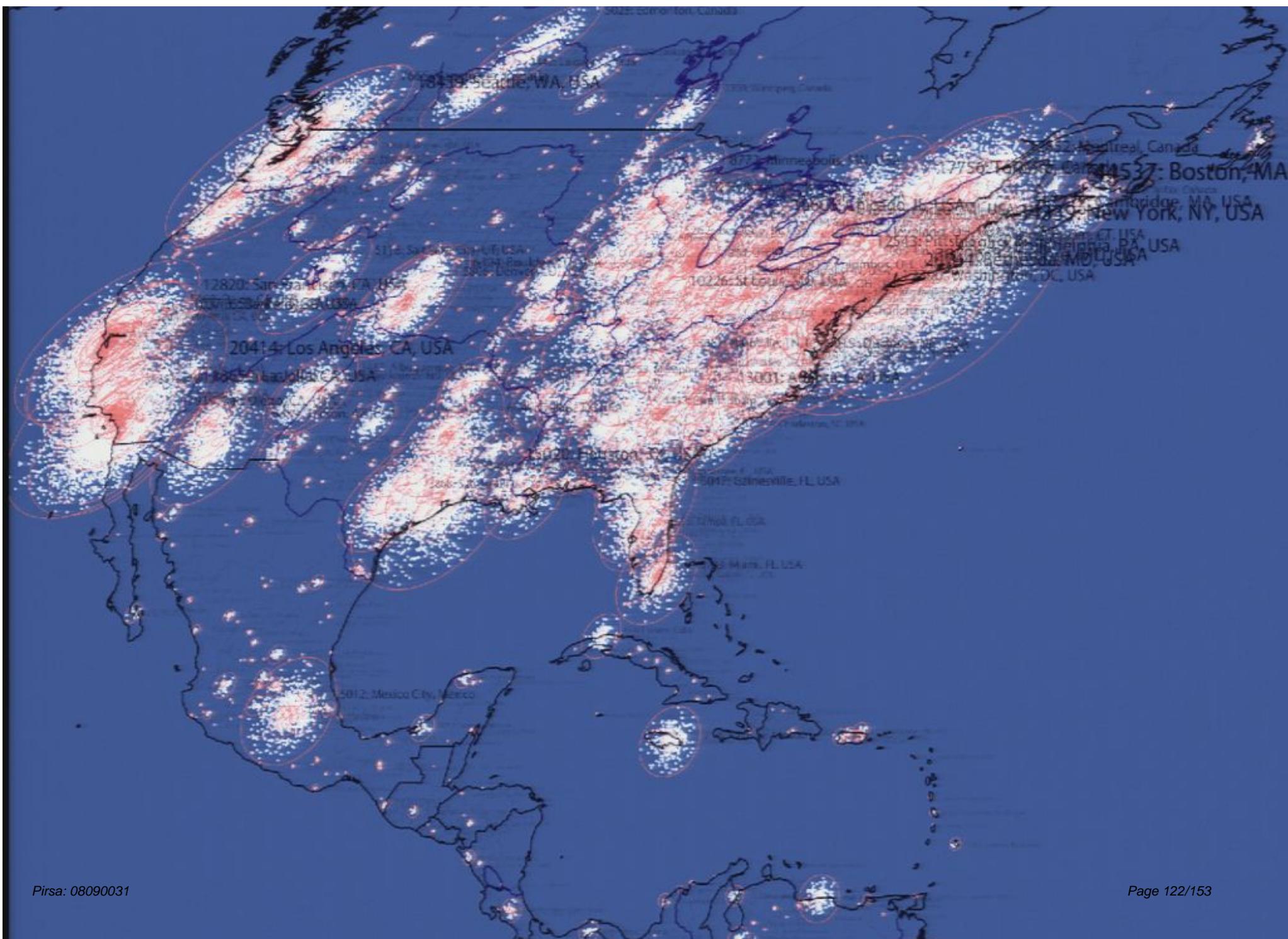
by Advanced Visualization Lab, Indiana University

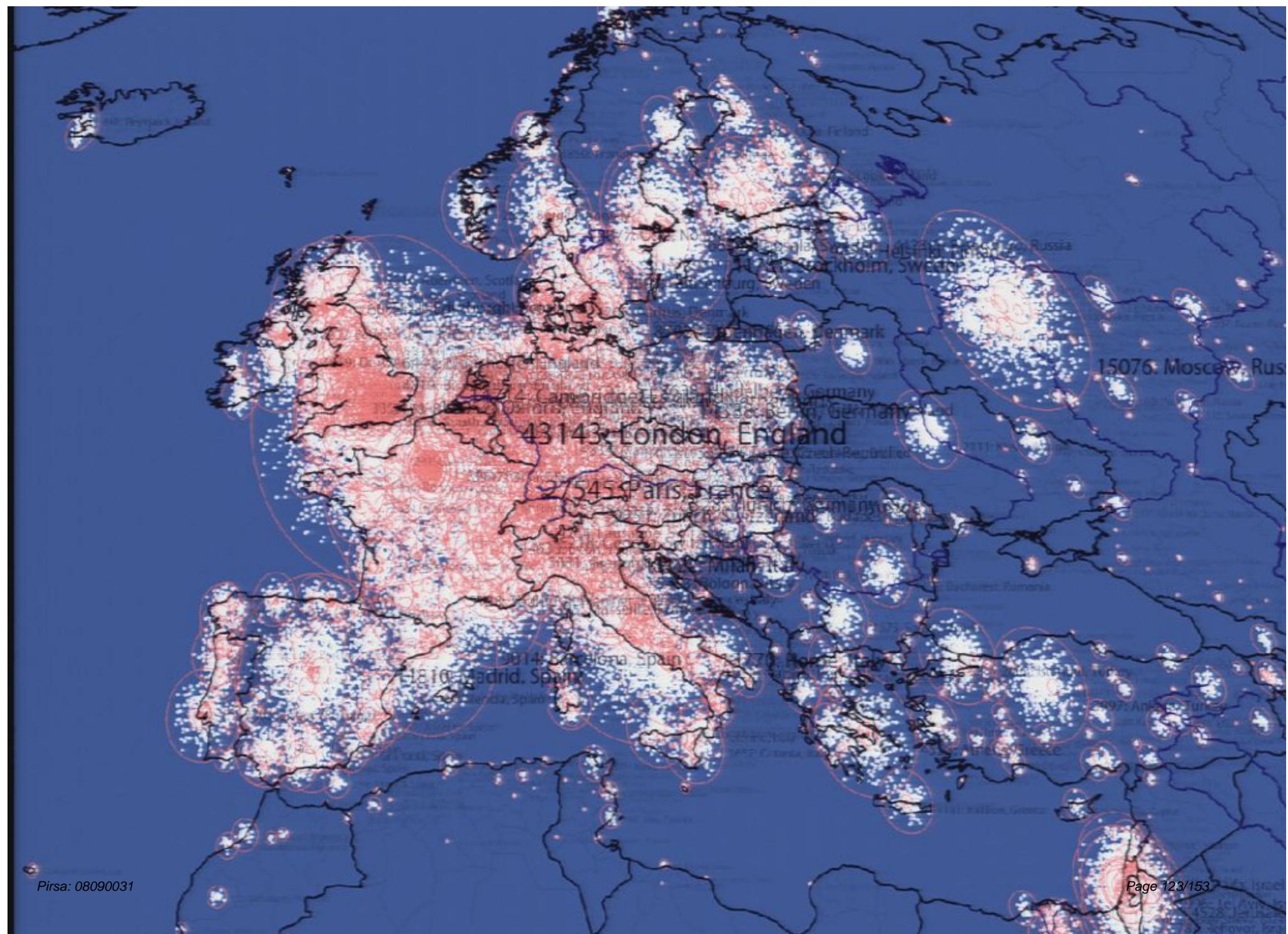
Drives unlimited number of ID screens.

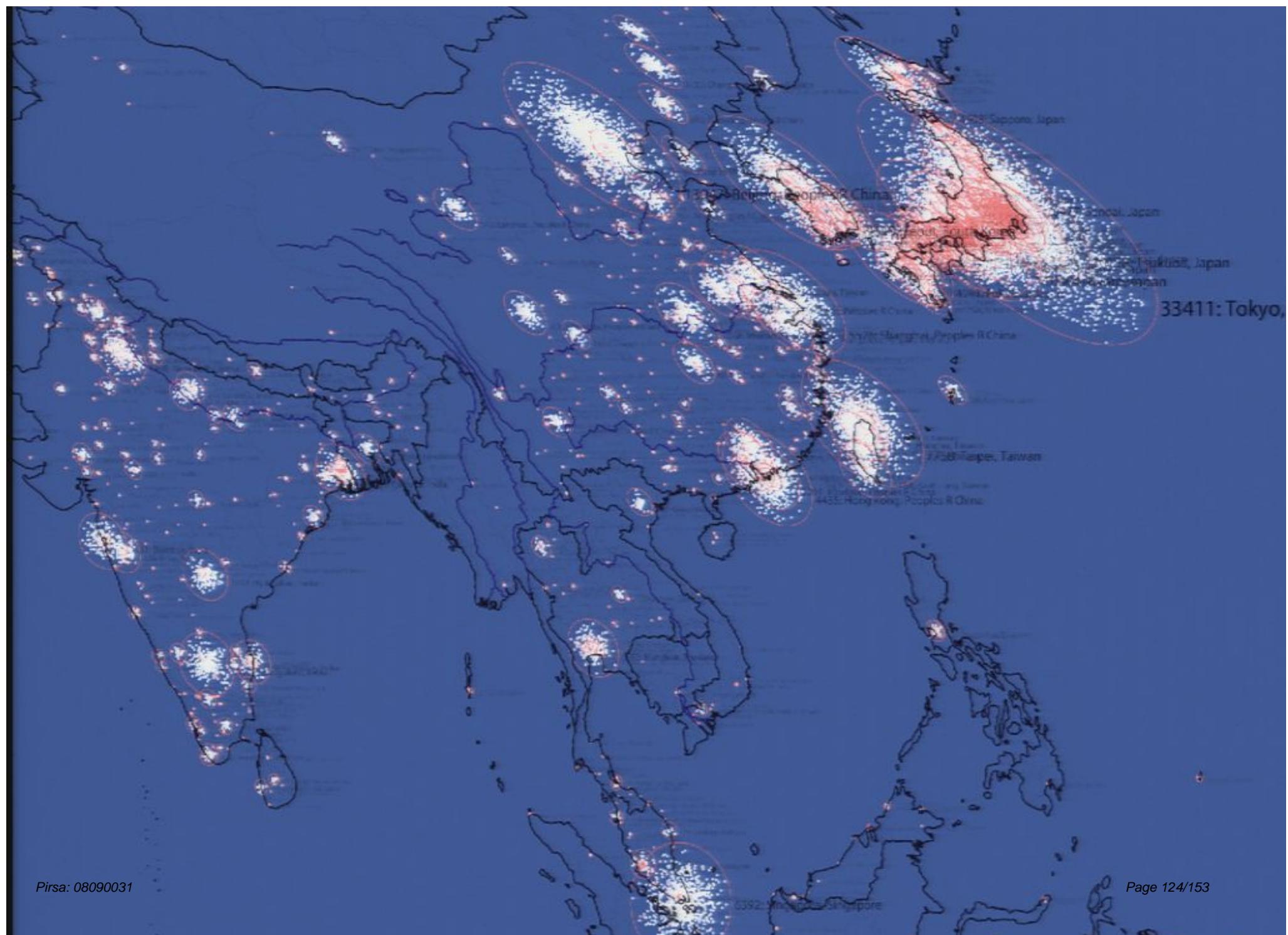


GEOGRAPHIC MAP: WHERE SCIENCE GETS DONE

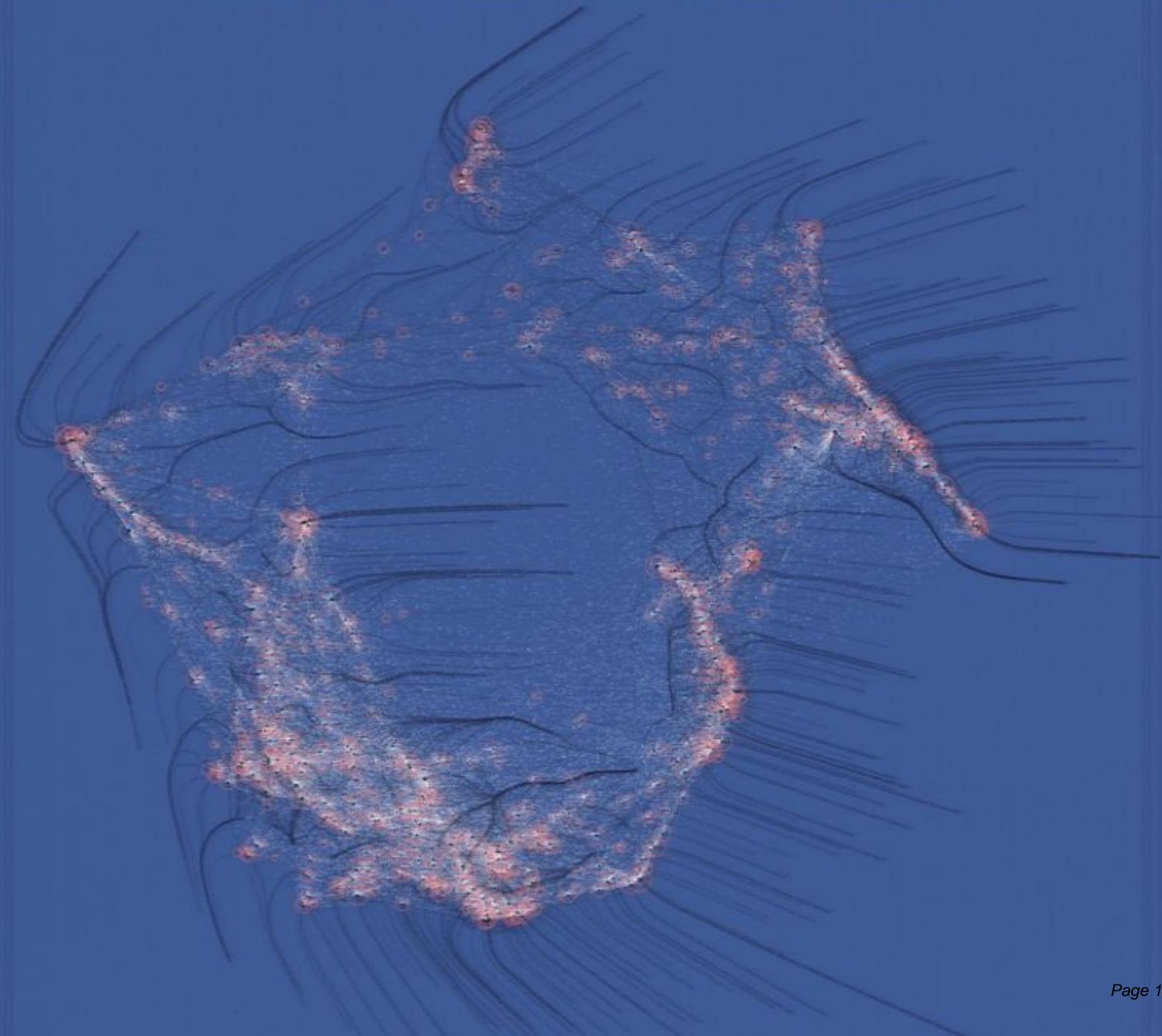


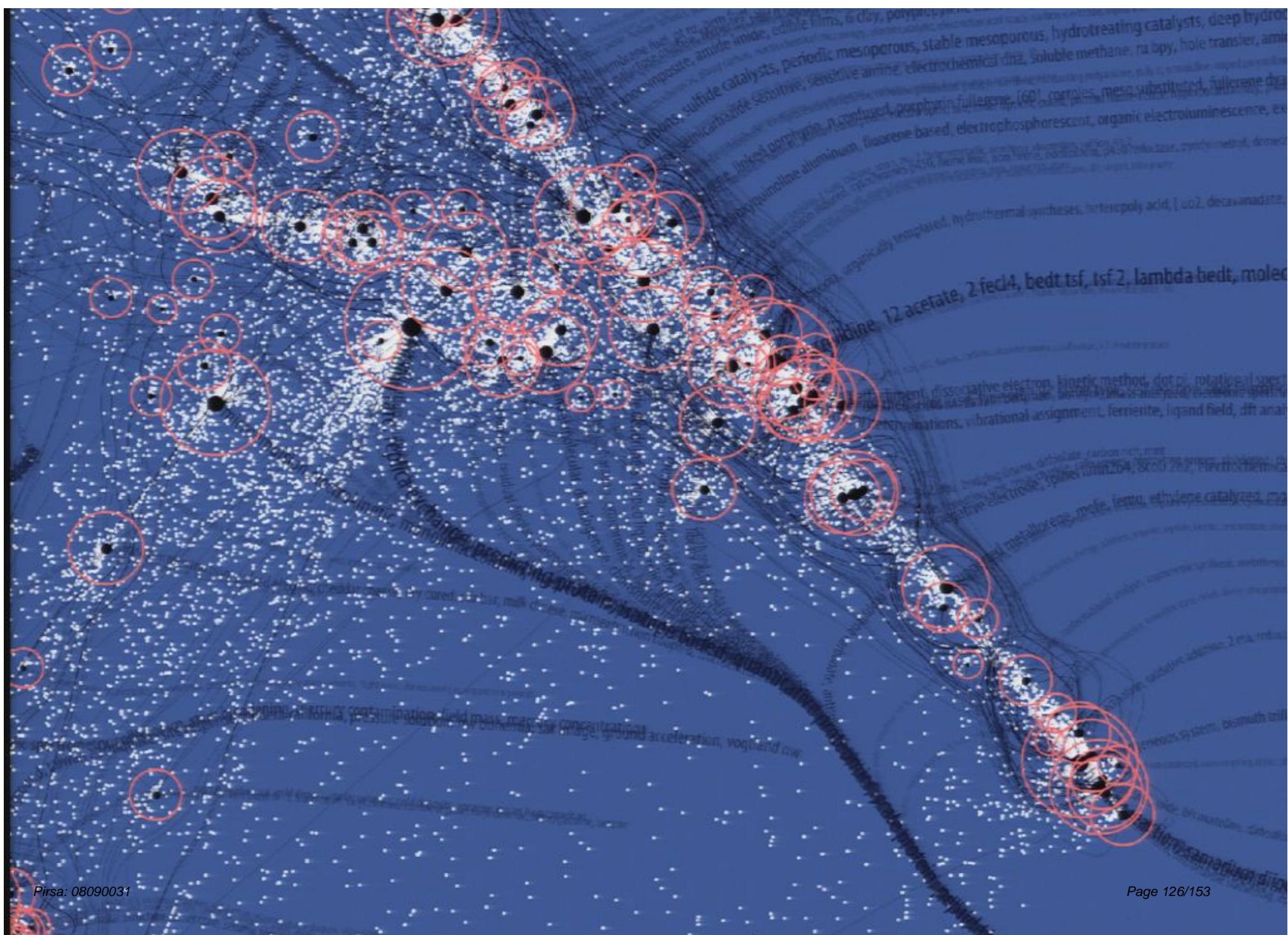






TOPIC MAP: How SCIENTIFIC PARADIGMS RELATE







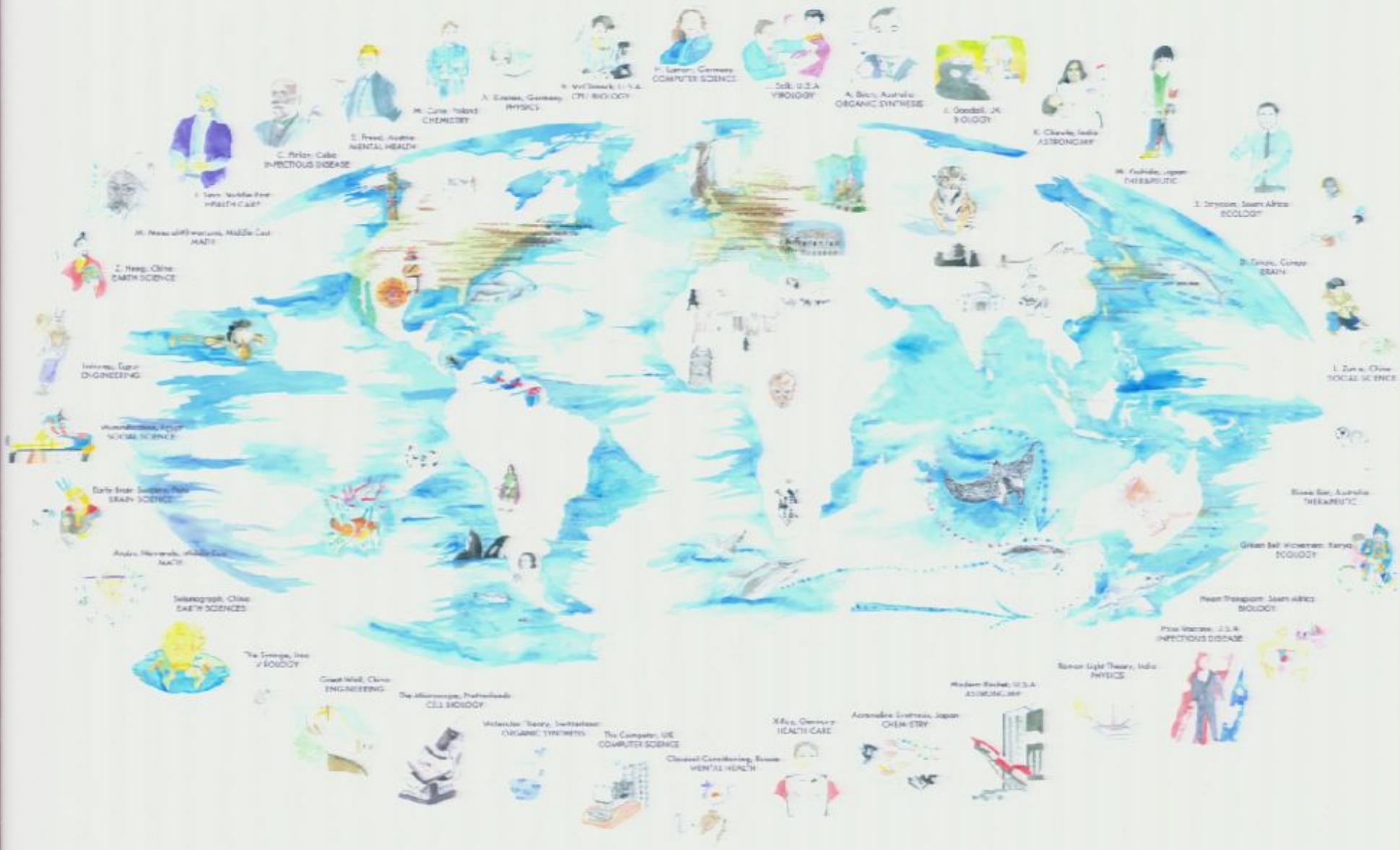
Inventors & Inventions



Inventors



Inventors & Inventions



Inventors



Hands-On Science Maps for Kids, by Eileie Polmer (Painting), Julie Smith (Data Acquisition), Diana Hanks and Katy Börner (Graphic Design). BLOOMINGTON, IN: 2006. Courtesy of Indiana University. Learn more at www.sciemap.org. This map plots the locations of where scientific papers were published; each light green dot represents three papers; they are scattered around the inset location for visibility; within a labeled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illuminated diagram" display which used a computer and two projectors, projecting spots of light on the prints to highlight clusters of scientific research (or a shifting map of scientific paradigms); and the areas in the world where such science was performed. Blue map research by Kevin Boyack and Clark Klaassen; cartography by John Eargan; data from Thompson ISI; graphics and typography by W. Bradford Paley. Copyright © 2006 W. Bradford Paley. All rights reserved.





My Science Story

By _____



Activities:

Solve the puzzle.

Navigate to 'Earth Science'.

Identify major inventions.

Place major inventors.

Find your dream job on the map.

Why is mathematics important?

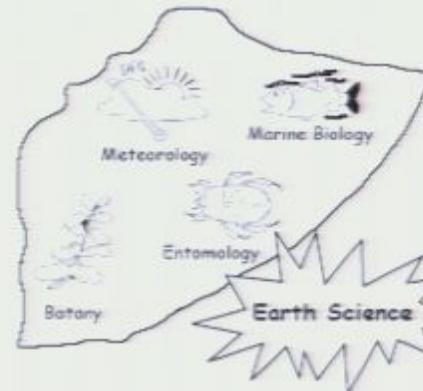
There are seven main fields of science. They are...



social science, mathematics, physics, chemistry, earth science, medicine, and psychology. I like to study earth science.

Color earth science green.

Earth scientists study the weather, plants and trees, marine life, insects, and much more.

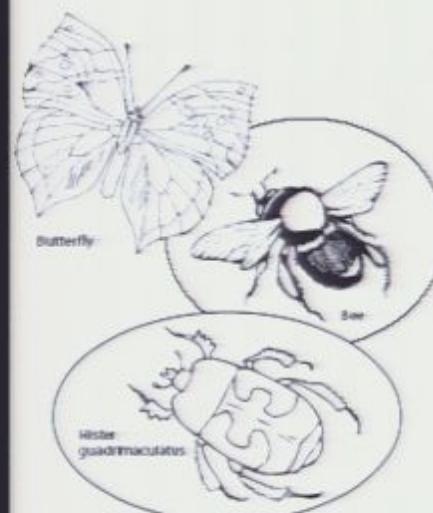


I like insects. They are interesting to look at and study.

Color in the insect.

For more information about the map of science for kids or this exercise, please contact Katy Birmer (katy@indiana.edu) or Nikki Roberg (nroberg@indiana.edu) at the School of Library and Information Science, Indiana University.

These materials were compiled by Nikki Roberg in 2006.



There are many types of insects in the world. Bees, butterflies, and beetles are just a few.



I want to be an entomologist when I grow up. Then I can study insects all the time.

What is Science? KIDS DRAWING CONTEST

WHAT

What is Science? Who does Science?
What is Science to you? Design a picture
of your favorite scientist or science
experiment and tell us about it!

WHEN

October 1st - 30th: Submit entries
November 5th: Winners notified
November 5th - 30th: Winning entries and
Top 50 on display at the American Museum
of Science and Energy.

Judging Criteria

- 25% Originality and Creativity
- 25% Artistic Quality
- 25% Description of the artist's
science experiment or scientist
- 25% Overall presentation

Requirements

- Artist ages: 4-15 yrs. old
- Art media: Color or black & white
watercolor paper, 8.5" x 11" paper
with a height of 11" or 25-100
words explaining their drawing
and the science their favorite
scientist or science experiment.

PRIZES

1 year family membership &
Science Kit from AMSE

2 Science Kit from the AMSE
Discovery Shop

3 Science Book from the AMSE
Discovery Shop

Bring in your contest submission and get
into AMSE for FREE!

Consent

Required for entry:
I, the parent/guardian of _____
hereby grant permission for my
child _____ to participate in
the American Museum of Science
and Energy's "What is Science?"
Drawing Contest.

Submitting

Mail submissions to:
The American Museum
of Science and Energy
300 S. Tennessee River
Court, Elizabethton, TN 37643
Or bring in your
submission to The American
Museum of Science and
Energy.



Winners @ AMSE

JoHanna Sanders, age 12, a picture of someone enjoying
nature and a theme that science is all around us.

Pins: 08090031

Sascha Richey, age 8, drew a picture of her mother and

My Favorite Scientist



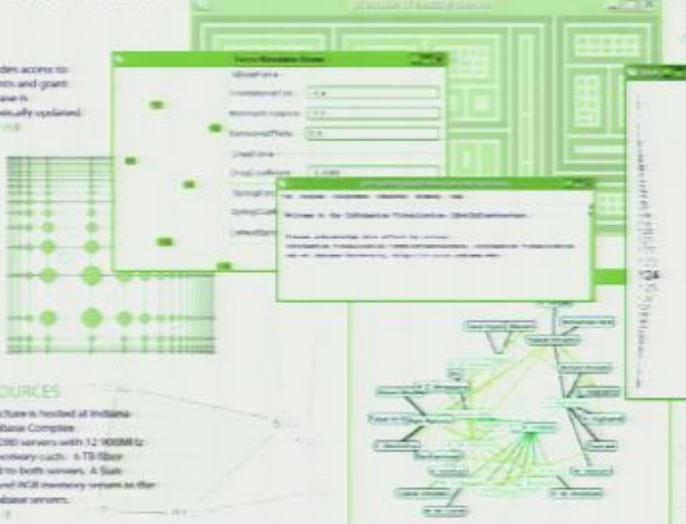
Science of Science Cyberinfrastructure

Information Visualization CyberInfrastructure

The InfoVis Cyberinfrastructure provides access to data, software code and learning modules as well as computing resources in support of the analysis, modeling and visualization of diverse data sets.

DATABASES

An Oracle database provides access to publications, patents, grants and grant opportunities. The database is continuously and automatically updated.
<http://infovis.cs.indiana.edu/>



COMPUTING RESOURCES

The InfoVis Cyberinfrastructure is hosted at Indiana University's Research Database Computer, consisting of two Sun V1280 servers with 12 160GB processors and 76 GB of memory each. 6 T9 fiber channel disks are attached to both servers. A Sun 3800 system with 4 cores and 128 memory seems as the next front-end for the database servers.
<http://infovis.cs.indiana.edu/>



InfoVis Lab, School of Library and Information Science, Indiana University - Bloomington
For more information, contact Katy Borner at

This material is based upon work supported by the National Science Foundation under Grants No. IIS-0238261 and CCF-0347385.

SOFTWARE

An open source MVC framework was designed to facilitate the integration of diverse data analysis, modeling and visualization algorithms. New algorithms, data persistence methods, look and feels for the interface and even online toolkits can be easily "plugged in" or "unplugged".
<http://infovis.cs.indiana.edu/>



LEARNING MODULES

A set of associated learning modules aims to equip learners with a practical skill set by providing code and advice to quickly modify and run different algorithms, test diverse interaction techniques and design features, and to quickly generate and compare information visualizations.
<http://infovis.cs.indiana.edu/>



Scholarly Database

<http://sdb.sls.indiana.edu>

CAREER: Visualizing Knowledge Domains. NSF IIS-0238261 award

(Katy Borner, \$451,000) Sept. 03-Aug. 08.

<http://ir.sls.indiana.edu/>

NetworkWorkbench

A Workbench for Network Scientists

SEI: NetworkWorkbench: A Large-Scale Network Analysis, Modeling and Visualization Toolkit for Biomedical, Social Science and Physics Research. N. IIS-0513650 award (Katy Borner, Albert-Laszlo Barabasi, Santiago Schnel, Alessandro Vespignani & Stanley Wasserman, Eric Wernert, Sean Persons, \$1,120,926) Sept. 05 - Aug. 09. <http://nwb.sls.indiana.edu>



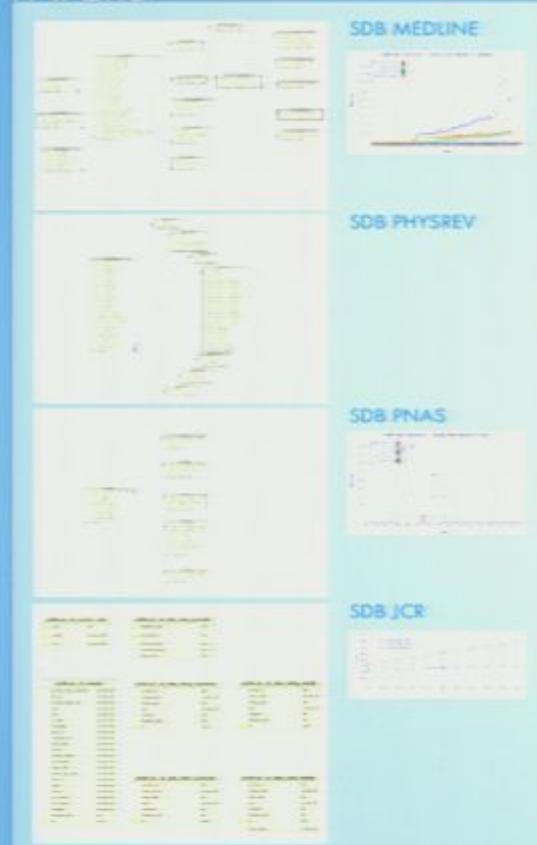
Pins: 08090031

High Performance Network Applications Program

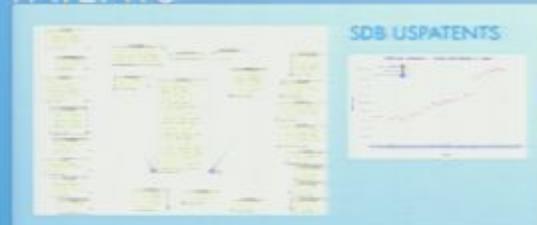


Page 136/153

PAPERS



PATENTS



SCHOLARLY DATABASE

SEARCH INTERFACE: <https://iv.slis.indiana.edu/cb/>
DOCUMENTATION: <http://iv.slis.indiana.edu/db/>

DB PROJECT LEAD

Gavin LaKowe
galarowicz@indiana.edu

PROJECT MANAGER

Katy Barner

DB DEVELOPER

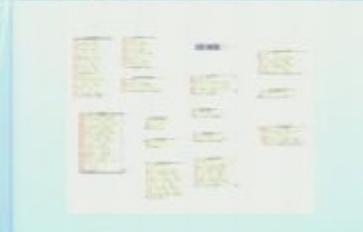
Sumeet Ambre
sambrell@indiana.edu

STATUS

as of 06.08.28

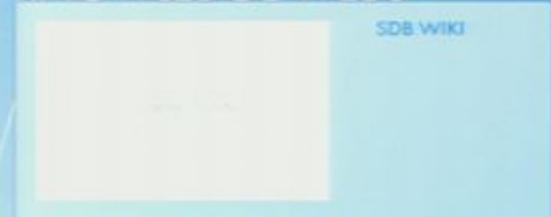
Information Visualization Laboratory
Cyberinfrastructure for Network Science Center
School of Library and Information Science
Indiana University
Bloomington, IN 47405, USA

DOCUMENT TABLE



DESIGN BY ELSHA HARDY

KNOWLEDGE WEBS

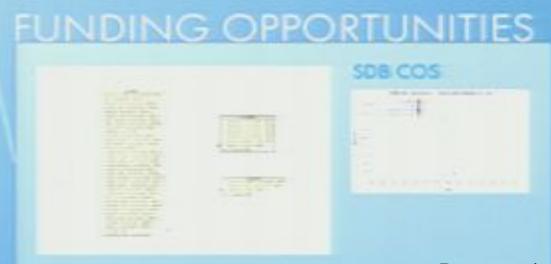


SDB WIKI

GRANT AWARDS



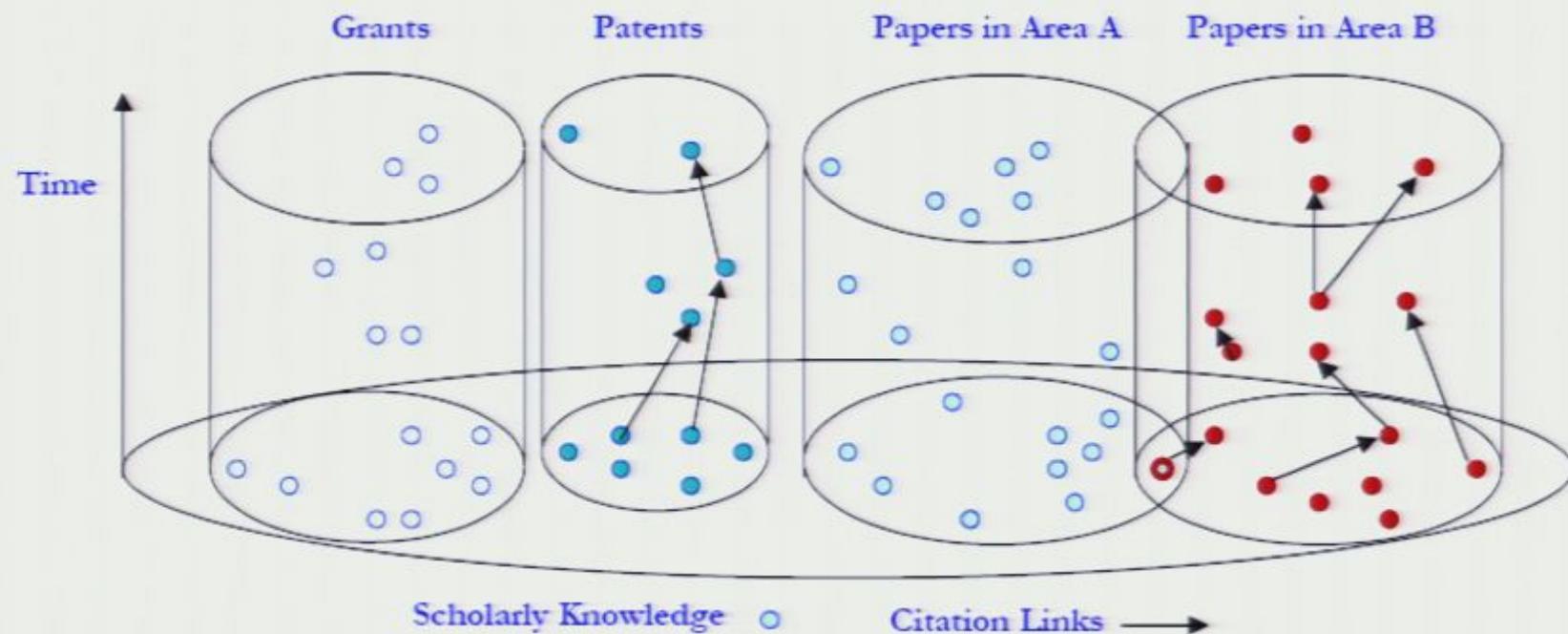
SDB NSF



SDB NIH

SDB COS

Challenges - Interlink \$ Input & Publication/Patent Citation Output

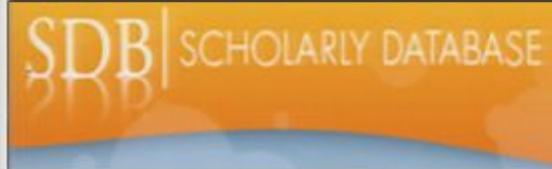


Need to interlink

- Grants and papers/patents.
- Grants/papers/patents and their PIs/authors/inventors, etc.

Use resulting networks to

- Count #papers, #citations, etc.
- Determine strength of co-PI/author/inventor relations, etc.



Scholarly Database: Web Interface

Search across publications, patents, grants.

Download records and/or (evolving) co-author, paper-citation networks.

SDB| SCHOLARLY DATABASE

Home Search Admin Logout

Select Database

COS NIH NSF USPAT MEDLINE PHYSREV
 PNAS

Last Name Middle Name First Name

Author(s): e.g. Classifying DNA

Title: e.g. Journal of Biological Sciences

Journal:

Publication Range

From to (default Year range is 1945-2005)

·

SDB| SCHOLARLY DATABASE

Home Search Admin Logout

NIH (336 Matching Records)

1. JAMES, ERIC (2001) GLUCOCORTICOID RECEPTOR-MEDIATED CATARACT.
DESCRIPTION (Applicant's Abstract) Cataracts are a serious risk to those undergoing steroid therapy, restricting the efficacy of these compounds. Steroid-induced cataracts are posterior subcapsular, frequently occlude the central visual axis and often...

2. JAMES, GARTH (2001) THE USE OF BIOFILMS TO COUNTER BIOTERRORISM.
DESCRIPTION (Verbatim from Applicant's Abstract) The possibility that terrorists will contaminate public drinking water supplies with bioterrorist agents, such as bacteria, viruses, or toxins, becomes greater every day. Recent cases of intentional food c...

3. JAMES, JUDITH (2001) Fine specificity of scleroderma autoantibodies.
DESCRIPTION (provided by applicant) Systemic sclerosis (scleroderma) is a disfiguring, multi-system disease of unknown etiology, which is characterized by a broad spectrum of disease manifestations with varying organ involvement. Raynaud's phenomenon...

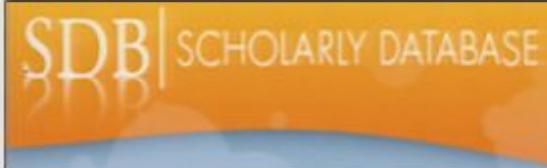
4. JAMES, LAURA (2001) NOVEL THERAPIES FOR ACETAMINOPHEN TOXICITY.
DESCRIPTION (adapted from the application) The long term goal of this award is to develop therapies, based on new mechanistic data, that can be utilized in the treatment of the acetaminophen (APAP) overdose patient. At therapeutic doses, APAP is metab...

5. JAMES, LAURA (2001) NOVEL THERAPIES FOR ACETAMINOPHEN TOXICITY.
DESCRIPTION (adapted from the application) The long term goal of this award is to develop therapies...

<< Prev 1 2 3 4 5 6 7 8 9 10 Next >>

New Search | Refine Search | Download Records |

Register for free access at <https://sdb.slis.indiana.edu>.

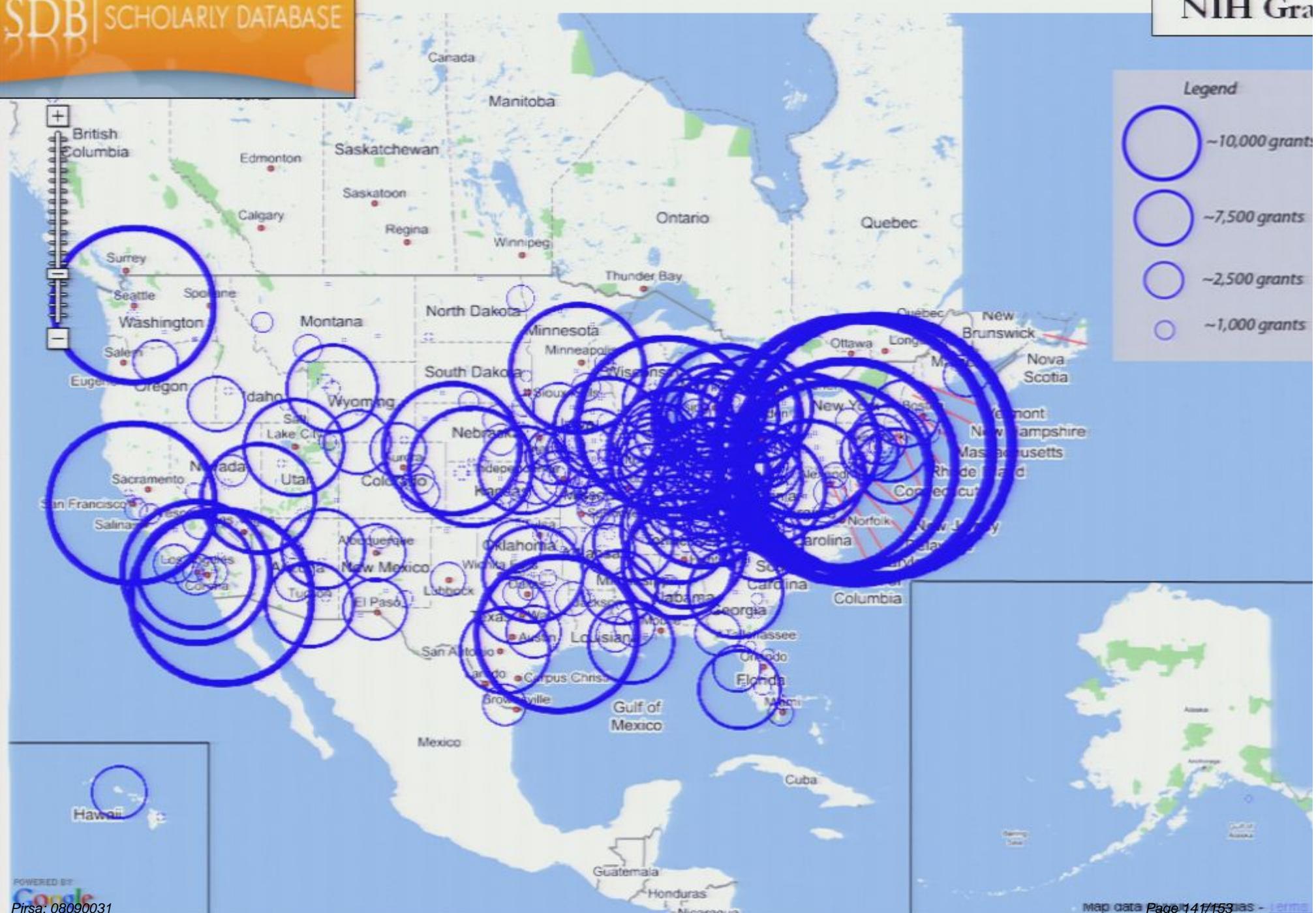


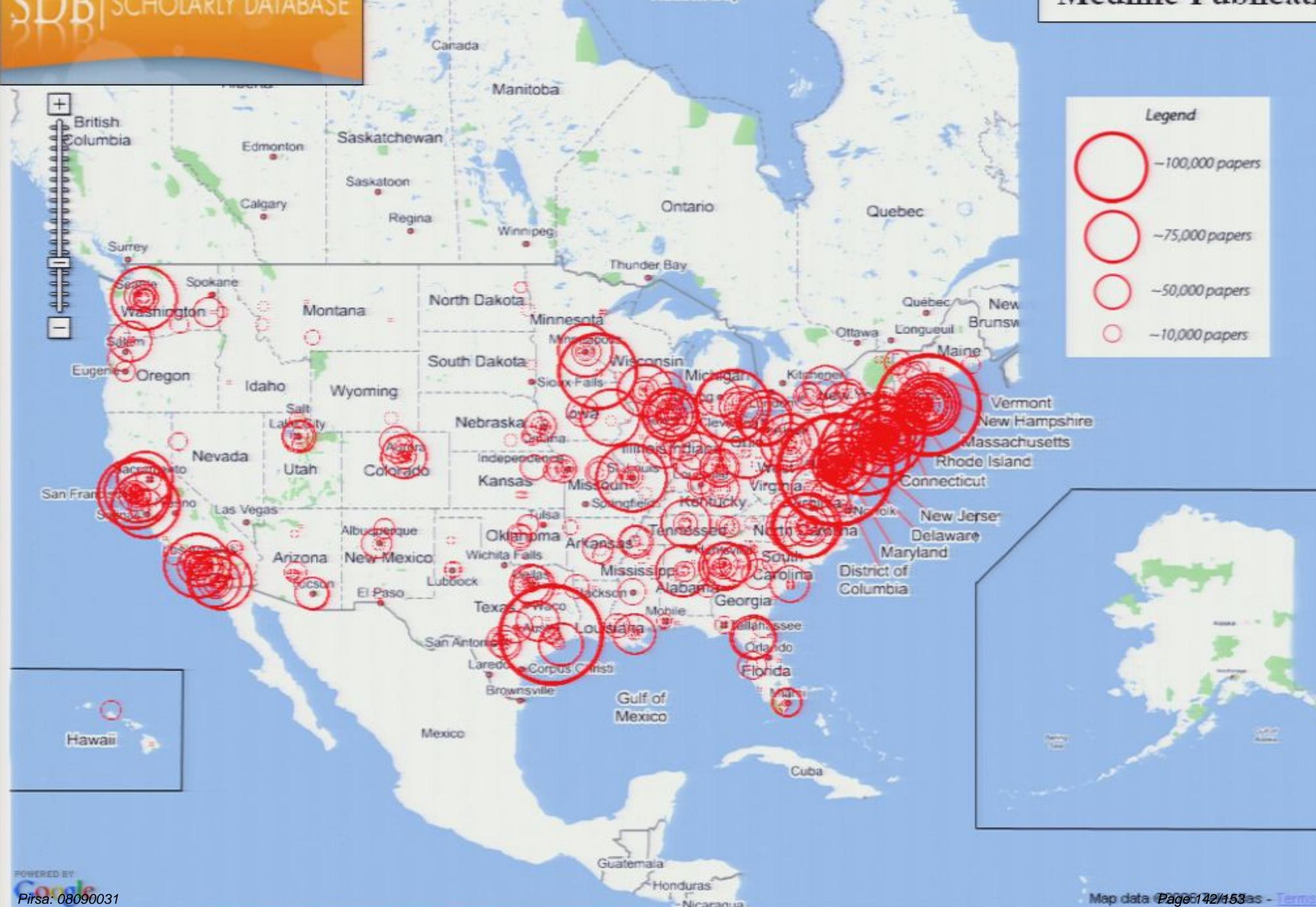
Scholarly Database: # Records & Years Covered

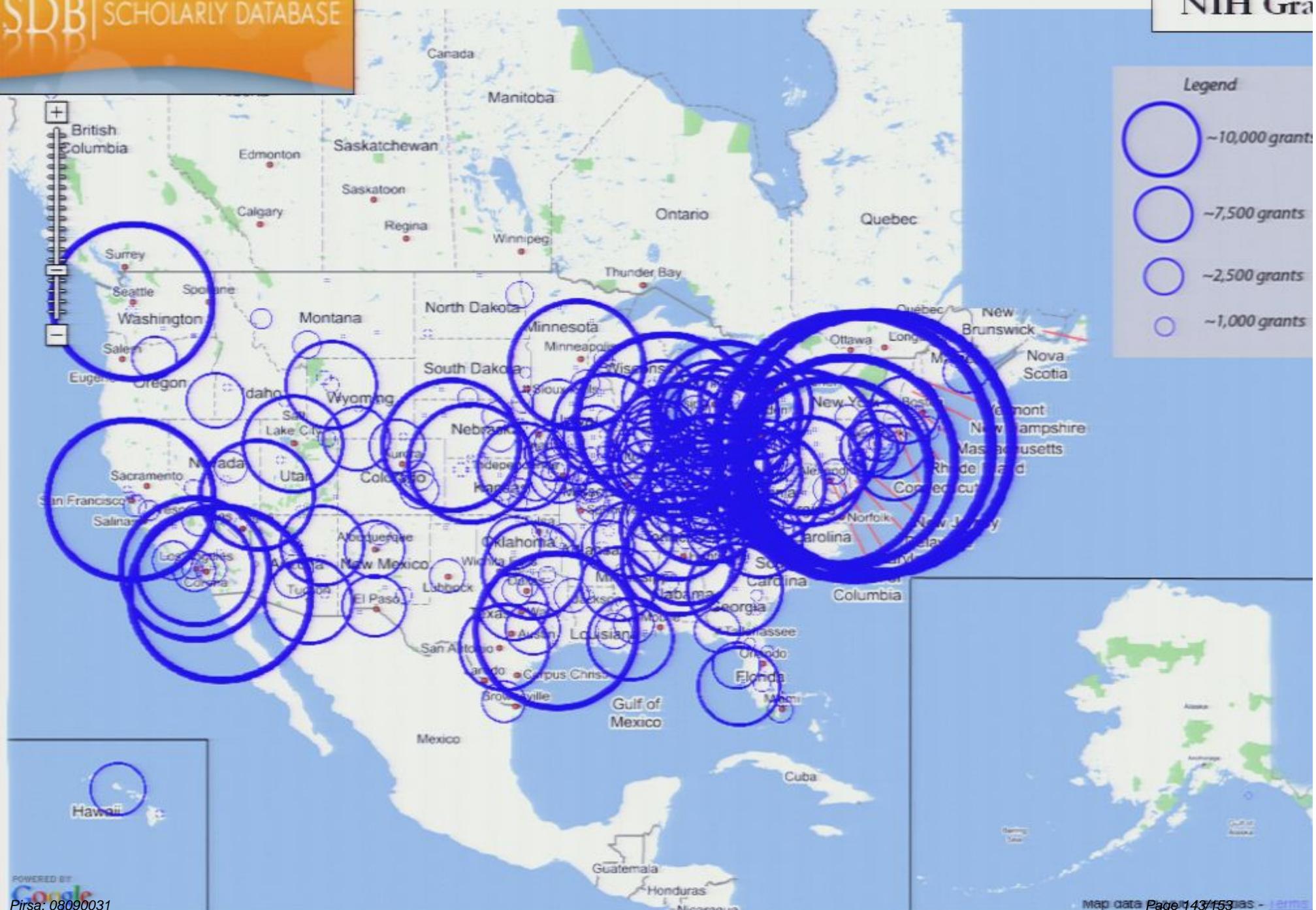
Datasets available via the Scholarly Database (* future feature)

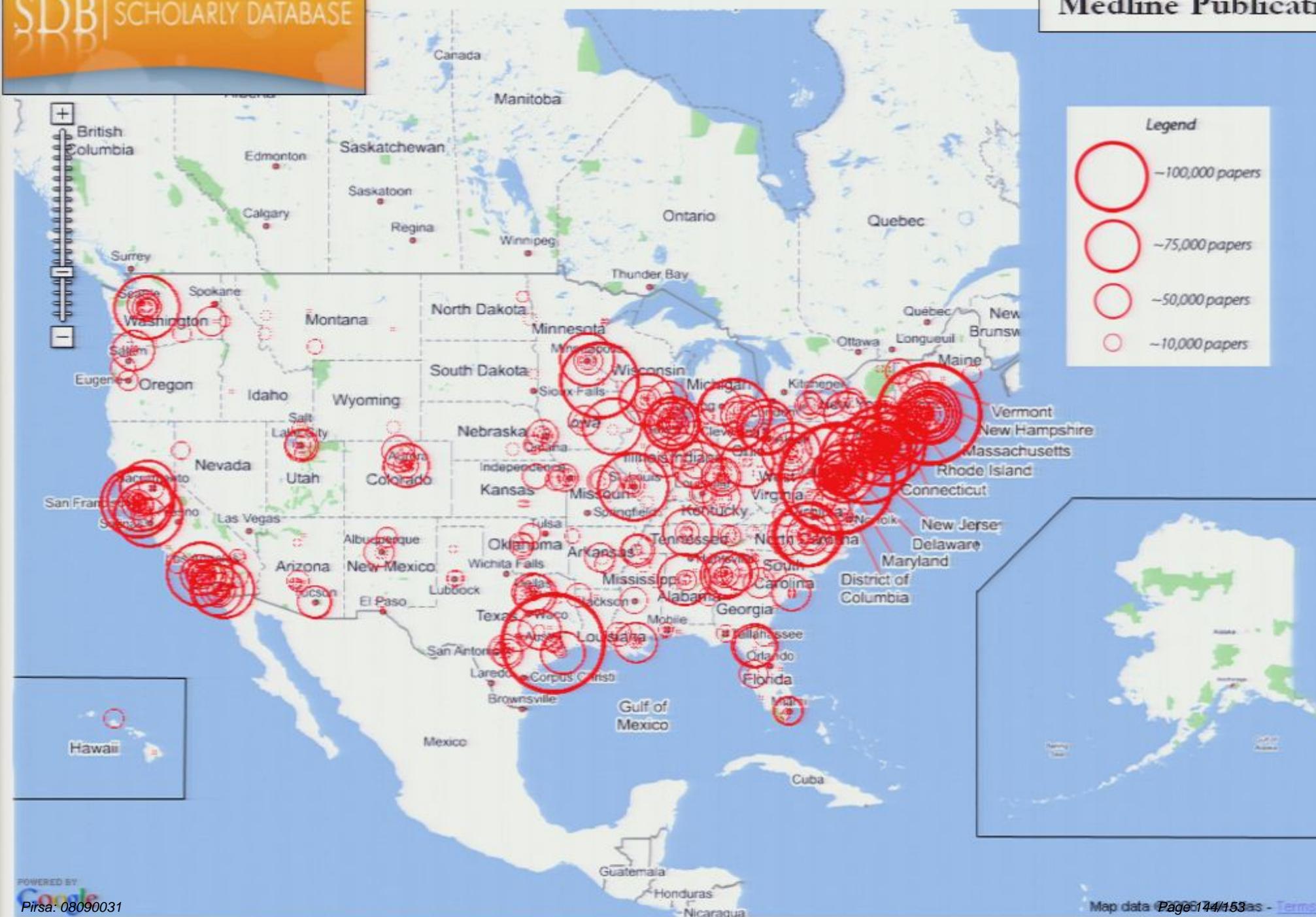
Dataset	# Records	Years Covered	Updated	Restricted Access
Medline	13,149,741	1965-2005	Yes	
PhysRev	398,005	1893-2006		Yes
PNAS	16,167	1997-2002		Yes
JCR	59,078	1974, 1979, 1984, 1989 1994-2004		Yes
USPTO	3,179,930	1976-2004	Yes*	
NSF	174,835	1985-2003	Yes*	
NIH	1,043,804	1972-2002	Yes*	
Total	18,021,560	1893-2006	4	3

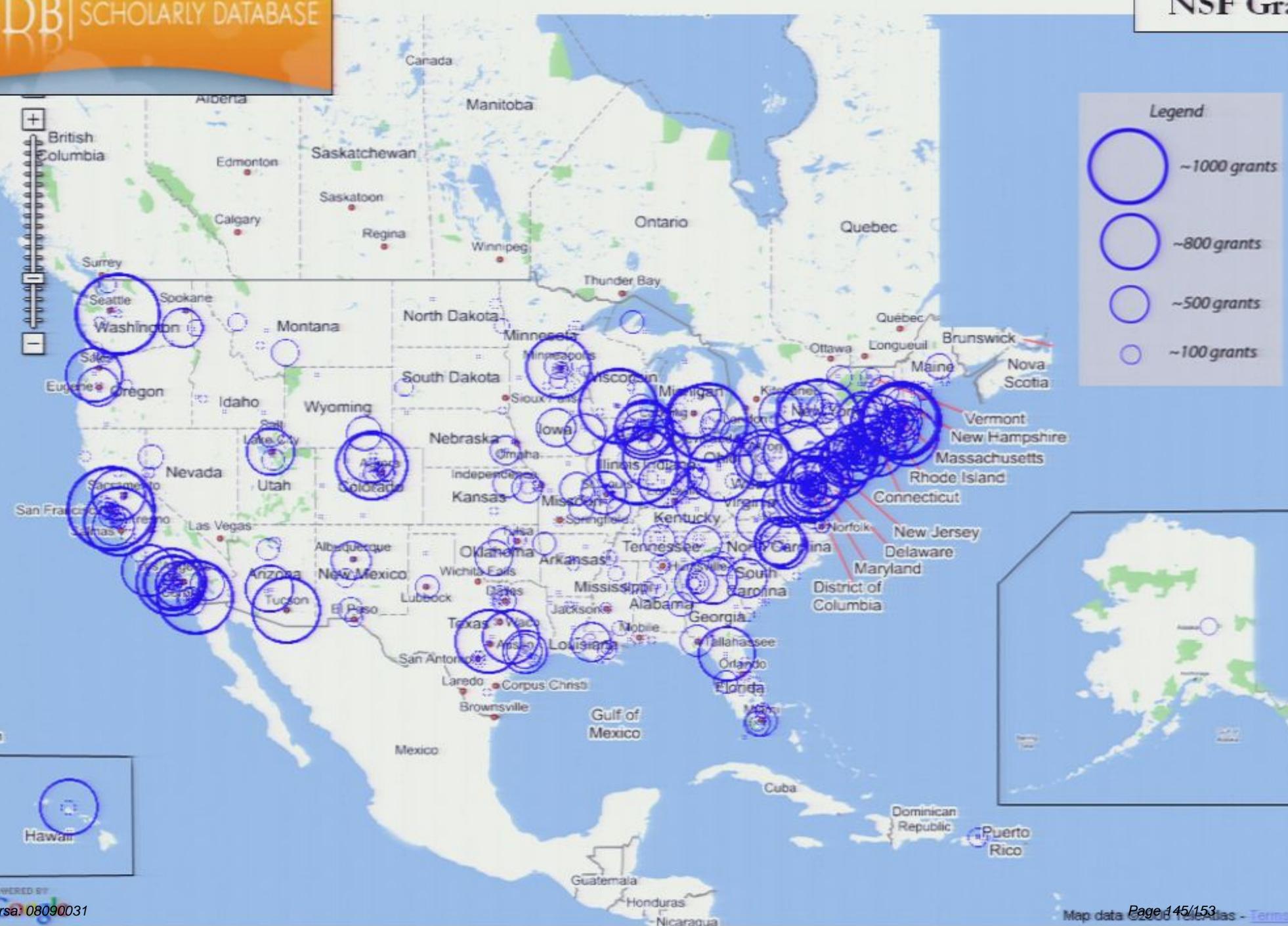
Aim for comprehensive time, geospatial, and topic coverage.

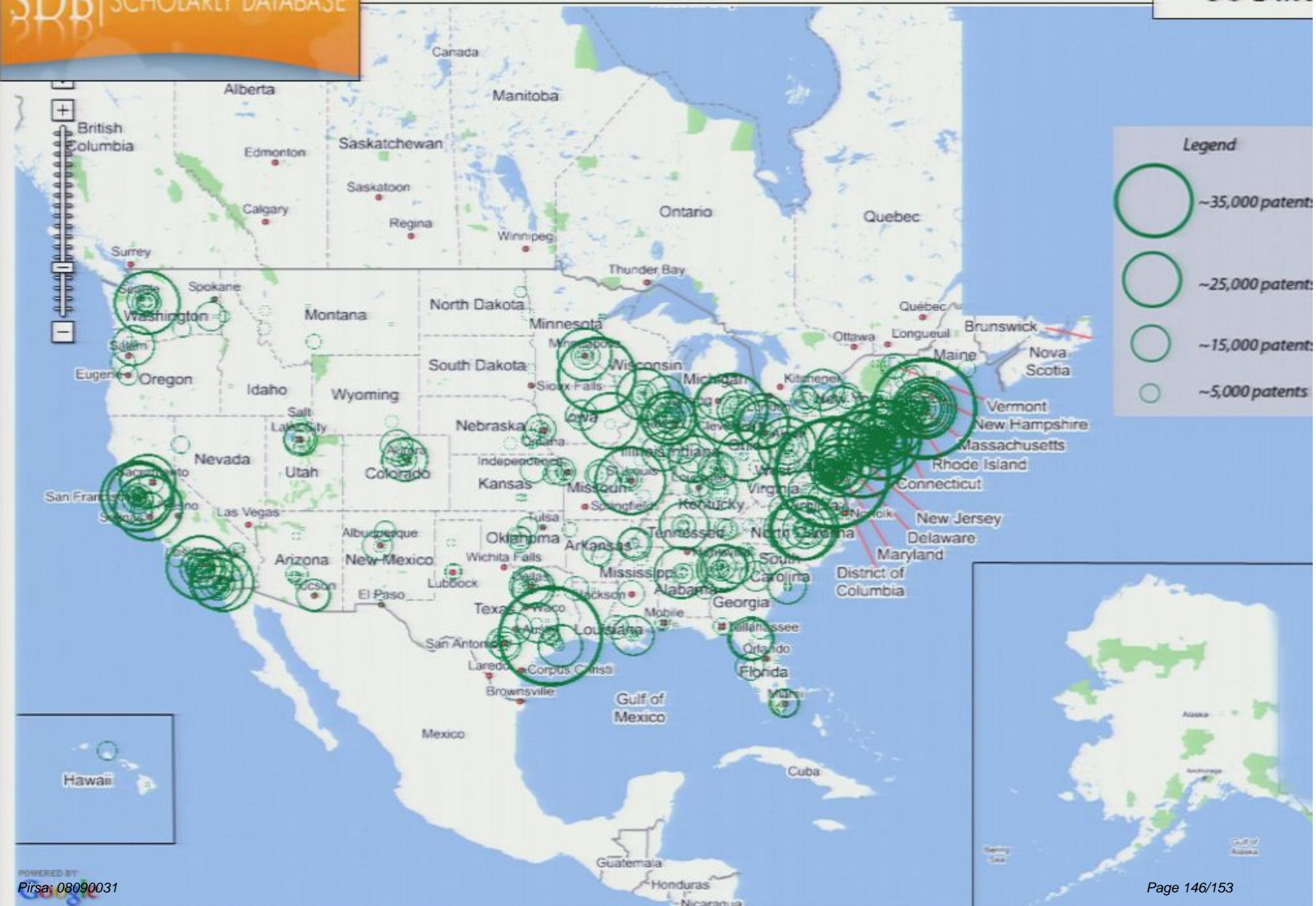












NetworkWorkbench

A Workbench for Network Scientists

[LOGIN](#)

[Home](#) [People](#) [Research](#) [Publications](#) [Community](#) [Download](#) [Documentation](#) [Dev Zone](#) [About](#)

Summary

Network Workbench: A Large-Scale Network Analysis, Modeling and Visualization Toolkit for Biomedical, Social Science and Physics Research. This project will design, evaluate, and operate a unique distributed, shared resources environment for large-scale network analysis, modeling, and visualization, named Network Workbench (NWB). The envisioned data-code-computing resources environment will provide ..

[more](#)

[How to cite this project](#)



News & Updates

- 2.26.08 [NWB Tool 0.9.0 Release](#)
- 1.30.08 [NWB Tool pre 0.9.0 v5 Release](#)
- 1.29.08 [NWB Flyer](#) Update (added supported file formats)
- 1.23.08 [NWB at Sunbelt 08 \(Poster\)](#)
- 1.22.08 [NWB Flyer](#) Update (now two-sided!)
- 1.22.08 New [Tutorials](#)
- 1.22.08 [NWB Basic Tutorial: Getting Started](#)

Download Latest Release

Note: save the download as .jar

Select Your Operating System

Windows XP

[DOWNLOAD](#)

Get Involved

- Sign up for NWB [mailing lists](#)
- [Bug Tracking System](#)

NetworkWorkbench

A Workbench for Network Scientists

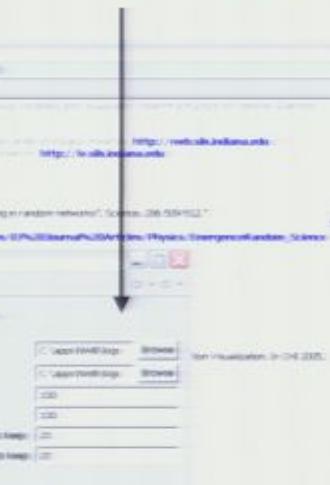
NWB Tool: Interface Elements

<http://nwb.csis.indiana.edu>

Load Data



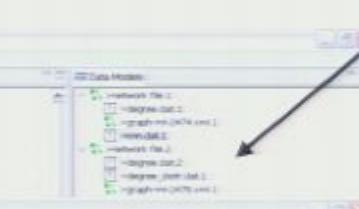
Select Preferences



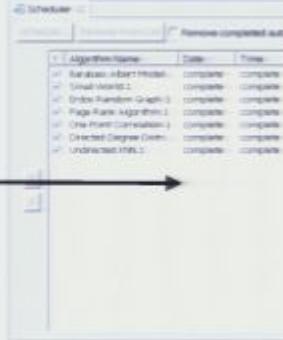
Console



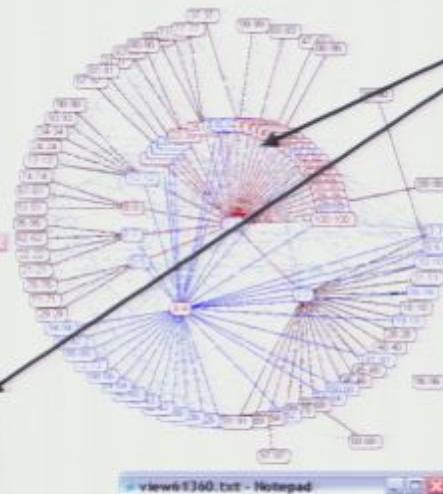
List of Data Models



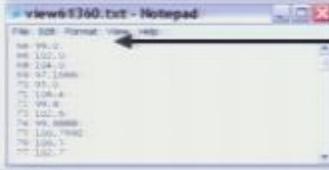
Scheduler



Visualize Data



Open Text Files



Preprocessing [Edit](#)**Remove Nodes**

- [Extract Top Nodes](#)
- [Extract Nodes Above or Below Value](#)
- [Delete High Degree Nodes](#)
- [Delete Random Nodes](#)
- [Delete Isolates](#)

Remove Edges

- [Extract Top Edges](#)
- [Extract Edges Above or Below Value](#)
- [Remove Self Loops](#)
- [Trim By Degree?](#)
- [Pathfinder Network Scaling](#)

Sampling

- [Snowball Sampling \(n nodes\)](#)
- [Node Sampling](#)
- [Edge Sampling](#)

Transformations

- [Symmetrize](#)
- [Dichotomize](#)
- [Multipartite Joining](#)

Modeling [Edit](#)**General**

- [Random Graph](#)
- [Watts-Strogatz Small World](#)
- [Barabási-Albert Scale-Free](#)

Structured

- [CAN](#)
- [Chord](#)

Unstructured

- [Hypergrid](#)
- [PRU](#)

Other

- [TARL](#)
- [Discrete Network Dynamics](#)

Analysis [Edit](#)**General Purpose**

- [Network Analysis Toolkit?](#)

Unweighted & Undirected

- [Based on degree/](#)

- [Node Degree](#)
- [Node Distribution](#)

- [Based on clustering](#)

- [k-Nearest Neighbor](#)

- [Watts Strogatz Clustering Coefficient](#)

- [Watts Strogatz Clustering Coefficient](#)

- [Based on path](#)

- [Diameter](#)

- [Average Shortest Path](#)

- [Shortest Path Distribution](#)

- [Node Betweenness Centrality](#)

- [Based on components](#)

- [Connected Components](#)

- [Weak Component Clustering](#)

- [K-Core](#)

- [Extract K-Core?](#)

- [Annotate K-Corenness?](#)

Unweighted & Directed

- [Based on degree](#)

- [Node Indegree](#)

- [Node Outdegree](#)

- [Indegree Distribution](#)

- [Outdegree Distribution](#)

- [Based on local graph structure](#)

- [k-Nearest Neighbor](#)

- [Single Node In-Out Degree Correlation](#)

- [Unnamed Category?](#)

- [Page Rank](#)

- [Based on local graph structure #:](#)

- [Dyadic Reciprocity?](#)

- [Arc Reciprocity?](#)

- [Adjacency Transitivity?](#)

- [Based on components](#)

- [Weak Component Clustering](#)

Visualization [Edit](#)**Tools**

- [GUESS](#)

- [GnuPlot?](#)

Predefined Positions Layout

- [DrL \(VxOrd\)](#)

- [Pre-defined Positions \(prefuse beta\)?](#)

Move

- [Circular](#)

Tree Layouts

- [Radial Tree \(prefuse alpha\)](#)

- [Radial Tree with Annotations \(prefuse beta\)?](#)

- [Tree Map](#)

- [Tree View](#)

- [Balloon Graph \(prefuse alpha\)?](#)

Network Layouts

- [Force Directed with Annotation \(prefuse beta\)](#)

- [Kamada-Kawai \(JUNG\)](#)

- [Fruchterman-Reingold \(JUNG\)](#)

- [Fruchterman-Reingold with Annotation \(prefuse beta\)](#)

- [Spring \(JUNG\)](#)

- [Small World \(prefuse alpha\)](#)

Other Layouts

- [Parallel Coordinates \(demo\)?](#)

- [LaNet \(k-Core Decomposition\)](#)

Scientometrics [Edit](#)**Extract Network From Table**

- [Extract Co-Authorship Network](#)

- [Extract Co-Occurrence Network From Table?](#)

- [Extract Directed Network From Table?](#)

Extract Network From Another Network

- [Extract Bibliographic Coupling Similarity Network](#)

- [Extract Co-Citation Similarity Network?](#)

Cleaning

- [Remove ISI Duplicate Records](#)

- [Detect Duplicate Nodes Page 149/153](#)

- [Remove Rows With Multitudinous Fields?](#)



CISShell – Serving Non-CS Algorithm Developers & User

Developers



CISShell Wizards

New Plugin Project

Plug-in Content

Enter the data required to generate the plug-in.

Plugin Properties:

- Plugin ID: Algorithm
- Plugin Version: 1.0.0
- Plugin Name: Algorithm Plugin
- Plugin Provider: OpenIC
- Runtime Library: Algorithm

Plugin Class:

- Generate the java class
- This plugin will be a service
- Intended for use with all

Templates

Select one of the available templates to generate a fully functioning plugin.

Create a plugin using one of the templates

Available Templates:

- Custom plugin wizard
- Hello, world
- OSGi Placeholder
- OSGi Progressive Algorithm
- OSGi Perspective
- Plug-in with a multi-page editor
- Plug-in with an editor
- Plug-in with a plugin menu
- Plug-in with a property page
- Plug-in with a view
- Plug-in with perspective extensions

Action bar - This template creates a simple action bar that adds a menu item to the menu bar. The menu item invokes the new Plugin class. Its role is to launch the code for your basic Algorithm Plugin.

Extensions used:

- org.eclipse.ui.activities
- org.eclipse.ui.startup

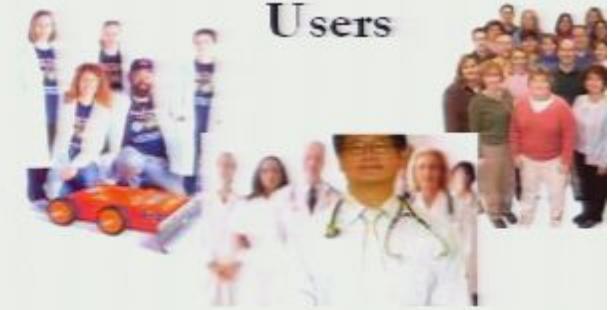
< Back | Save > | Finish | Cancel



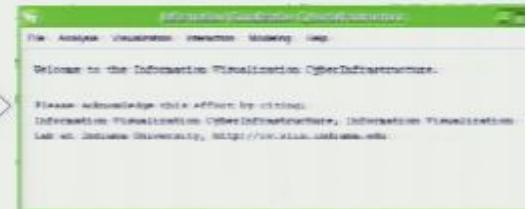
CISShell



Users



IVC Interface



NWB Interface





CIShell – Builds on OSGi Industry Standard

CIShell is built upon the Open Services Gateway Initiative (OSGi) Framework.

OSGi (<http://www.osgi.org>) is

- A standardized, component oriented, computing environment for networked services.
- Successfully used in the industry from high-end servers to embedded mobile devices since 8 years.
- Alliance members include IBM (Eclipse), Sun, Intel, Oracle, Motorola, NEC and many others.
- Widely adopted in open source realm, especially since Eclipse 3.0 that uses OSGi R4 for its plugin model.

Advantages of Using OSGi

- Any CIShell algorithm is a service that can be used in any OSGi-framework based system.
- Using OSGi, running CIShells/tools can connect via RPC/RMI supporting peer-to-peer sharing of data, algorithms, and computing power.

Ideally, CIShell becomes a standard for creating OSGi Services for algorithms.

IU News Room

Sunday, May 4, 2008

IU News from all eight campuses

[Browse by Campus](#)[Services & Resources](#)

Browse by Topic

-  [Arts & Humanities](#)
-  [Athletics](#)
-  [Business](#)
-  [Education](#)
-  [General](#)
-  [Health & Medicine](#)
-  [Law](#)
-  [Public & Environmental Affairs](#)
-  [Science](#)
-  [Social Science](#)
-  [Technology](#)

Search

[For Journalists](#) | [Archives](#) | [Site Index](#) | [Contact Us](#) | [Public Affairs](#)[Newsroom Home](#) > [Indiana University Media Relations](#) > [News Release](#)

Last modified: Tuesday, April 8, 2008

\$1.2 million NIH project will help track and predict epidemics

[!\[\]\(f181a93fa623e78e9762f2ec0eddb211_img.jpg\) E-mail this page](#)[!\[\]\(893233d1b6c4ce8e6e89e330a8b2343d_img.jpg\) Print this page](#)

FOR IMMEDIATE RELEASE

April 8, 2008

BLOOMINGTON, Ind. -- The National Institutes of Health has given \$1.2 million to Indiana University researchers to build the ultimate international epidemic research tool.

Media Contacts

- Neal Moore
ngmoore@indiana.edu
317-278-9208
- David Bricker
brickerd@indiana.edu
812-856-9035

News by Topic

- General News
- Graduate Studies
- Life Sciences
- Science
- Technology

[More Topics](#)

News by Category

[Multimedia News](#)



cyberinfrastructure for NETWORK SCIENCE CENTER

School of Library and Information Science | Indiana University Bloomington

The website features a central collage of images. At the top left is a group photo of people in front of a building labeled "LIBRARY & INFO. SCIENCE". To the right is a colorful abstract graphic with yellow and red dots and small portraits. Below these are four smaller images: a group photo, a person at a laptop, a modern building, and a map. Below the collage are several sections with labels:

- People:** A group photo of people sitting and standing.
- Events:** A group photo of people.
- Jobs:** A person's hands on a laptop keyboard.
- Contact:** An image of a modern building.
- Cyberinfrastructures:** Silhouettes of people looking at a large circular visualization.
- News:** A small image of people.
- Teaching:** A small image of people.
- Outreach:** An image of an exhibition booth with displays and a globe.
- Visiting Artists:** Logos and names of visiting artists.
- Funding:** Logos and names of funding sources.