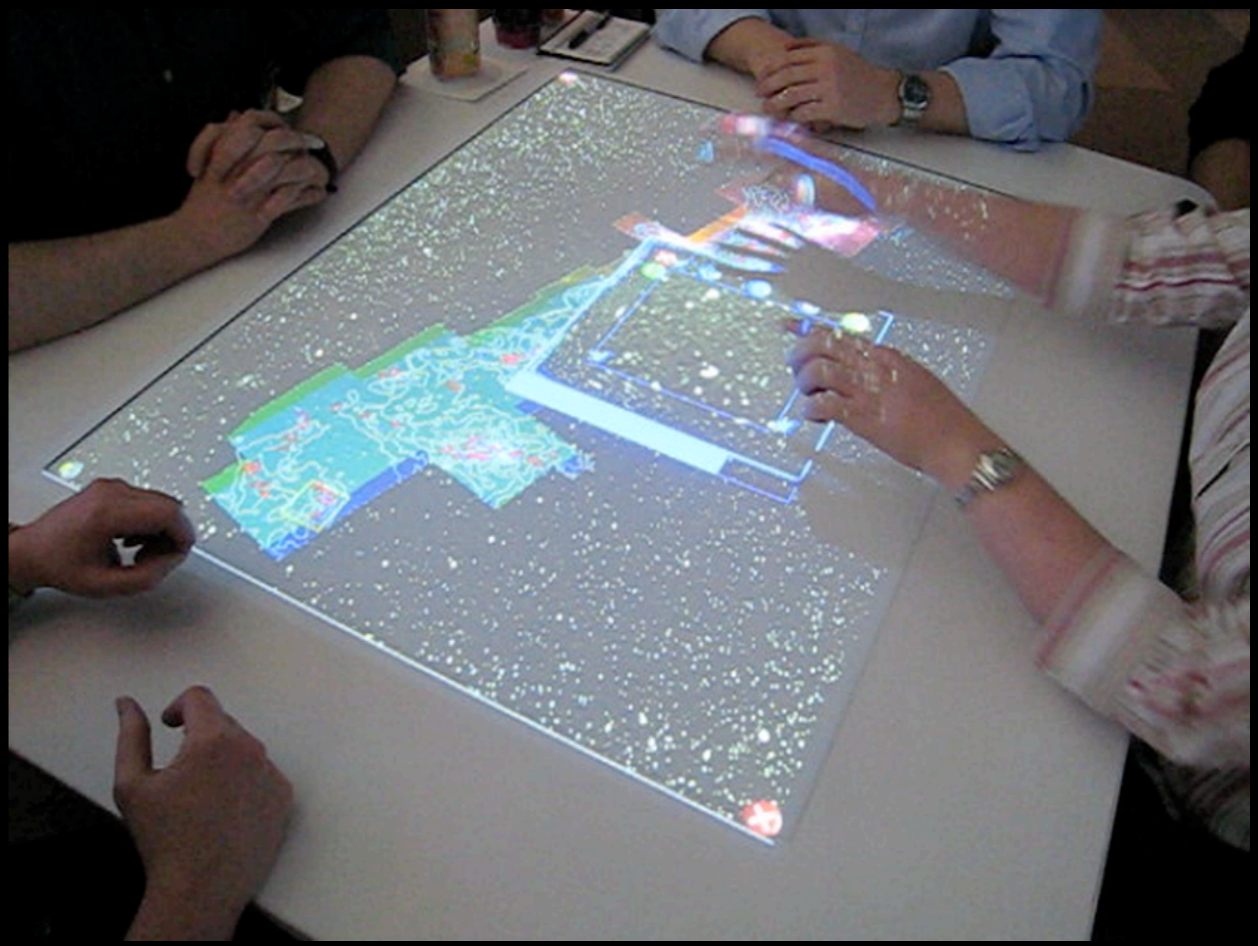
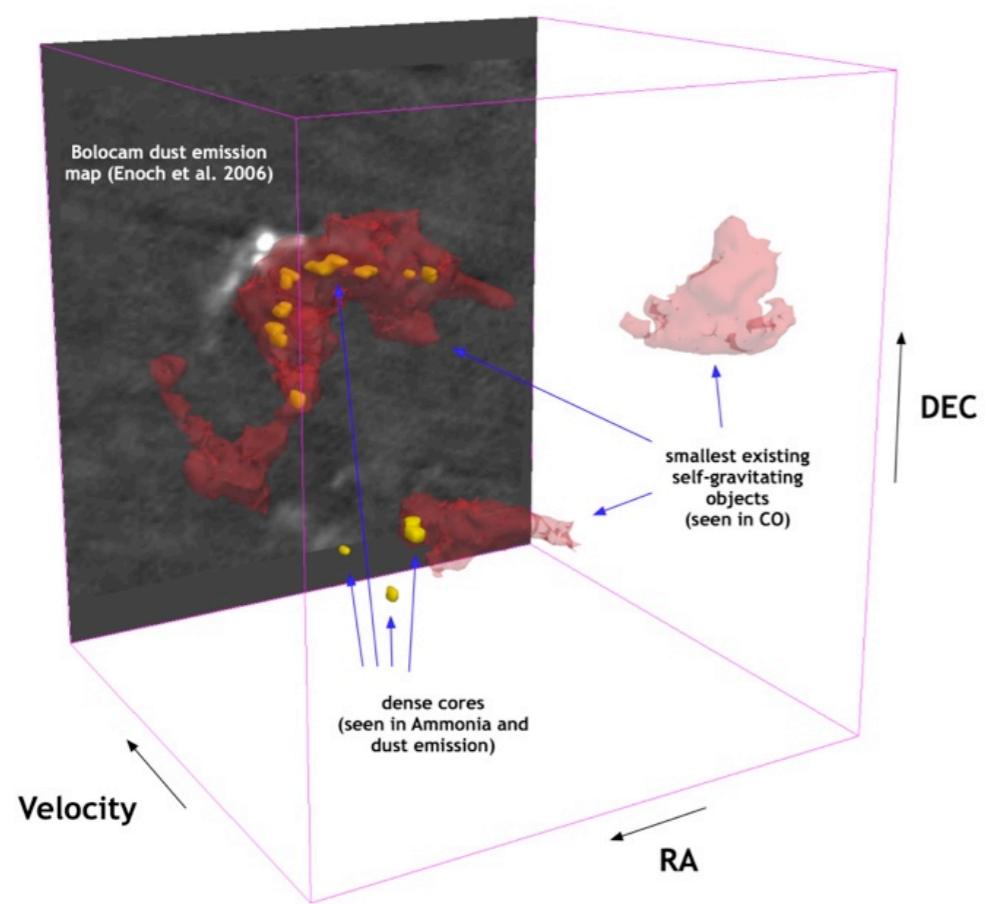
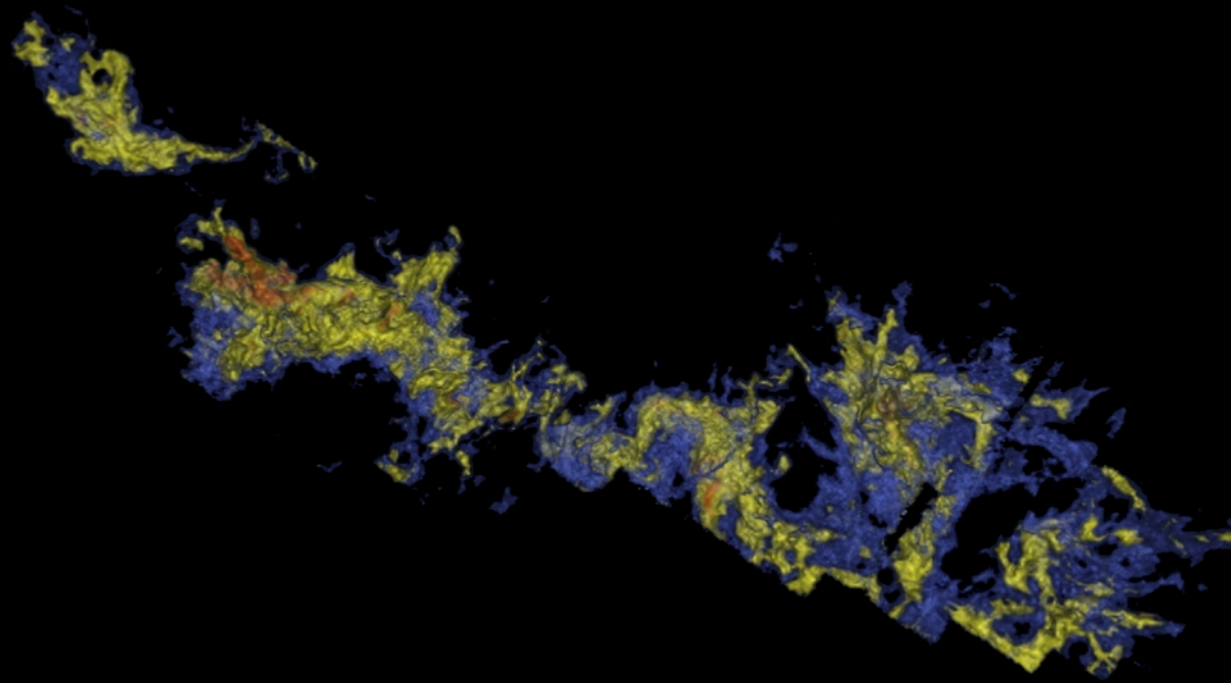
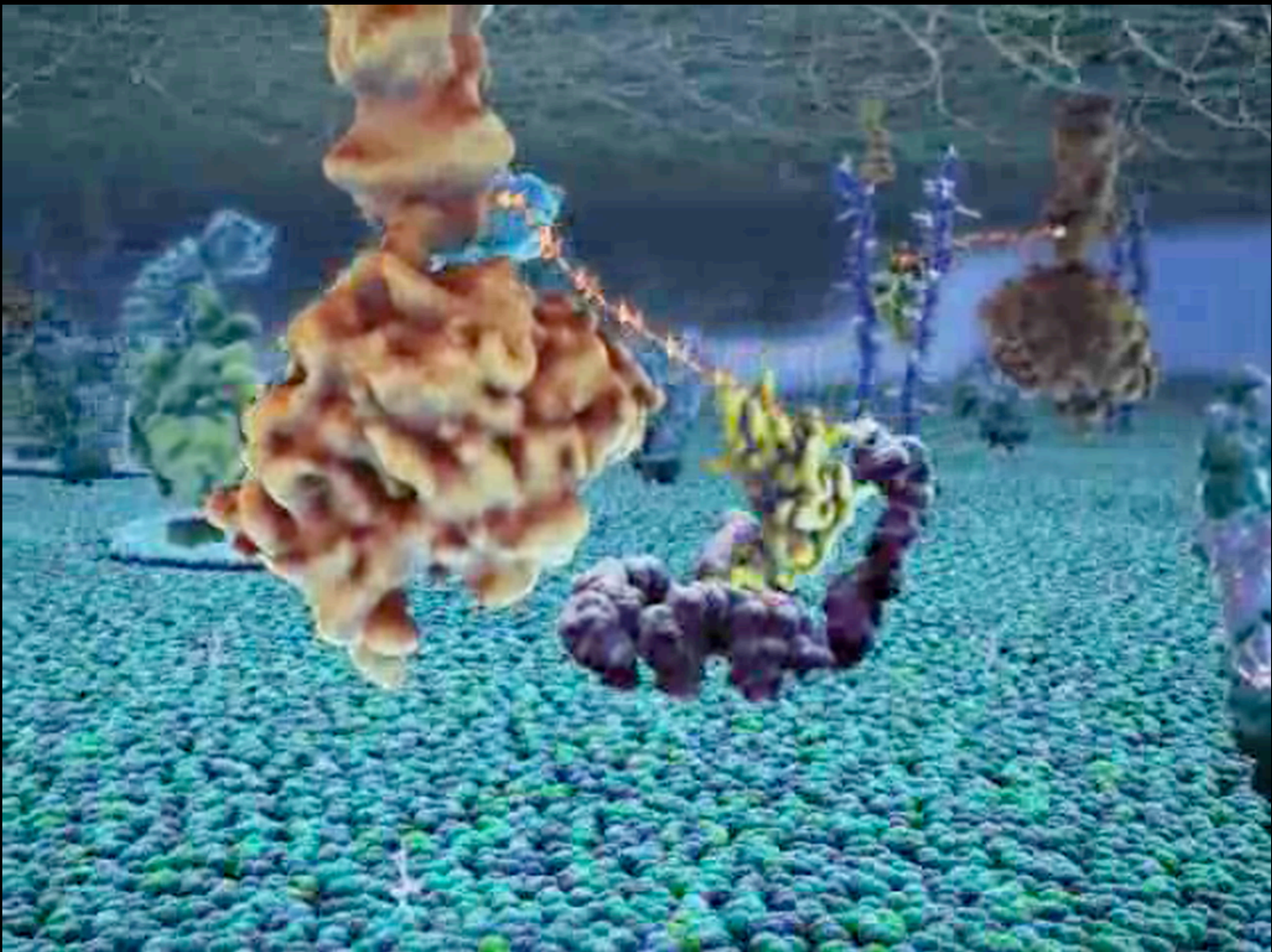


Seeing



Science



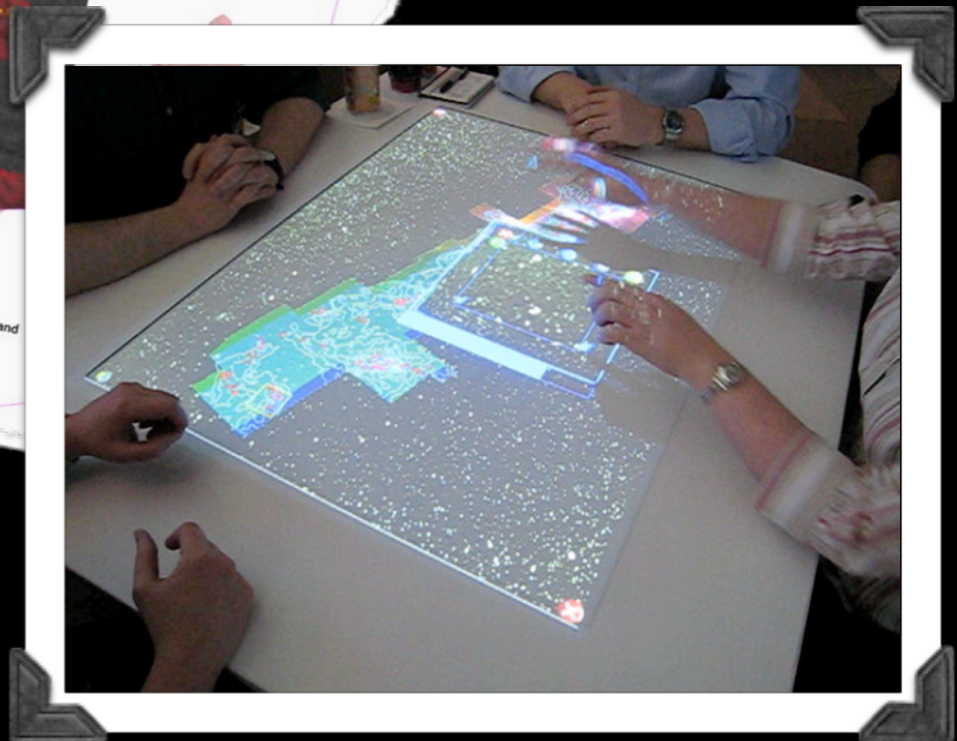
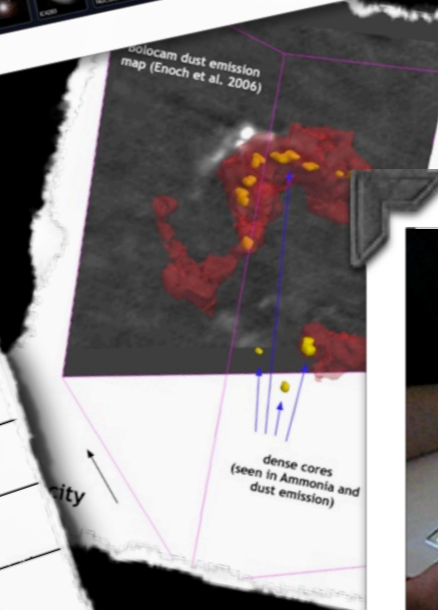
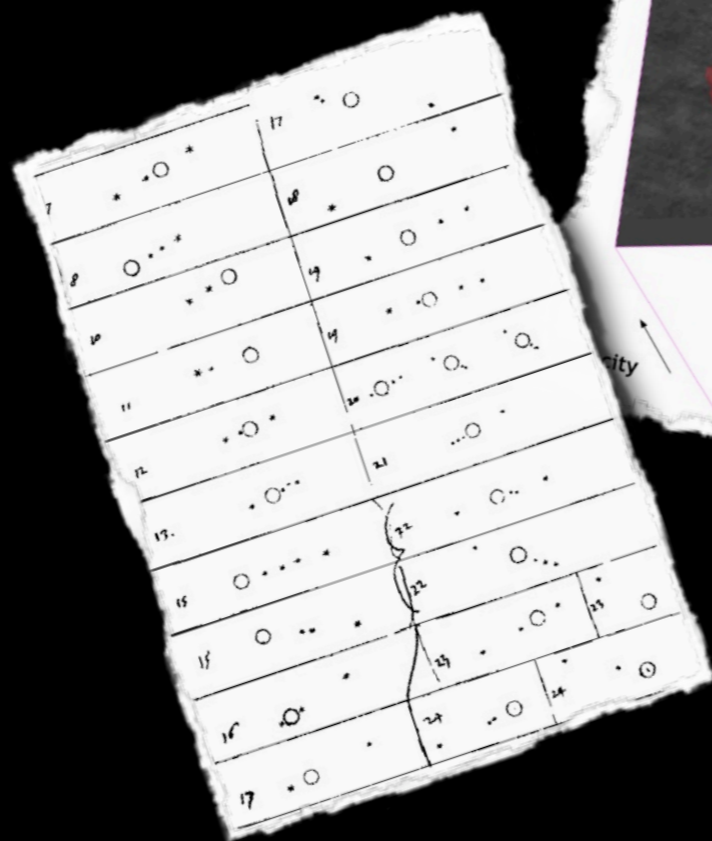
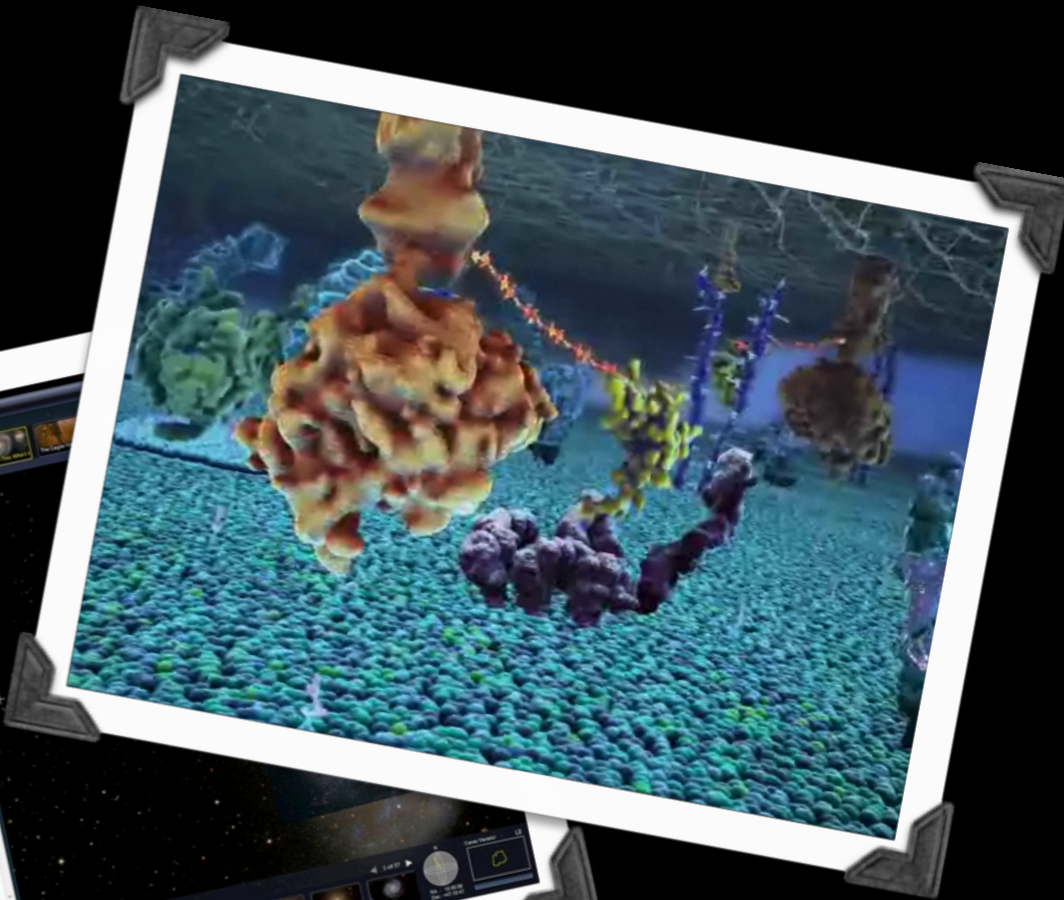
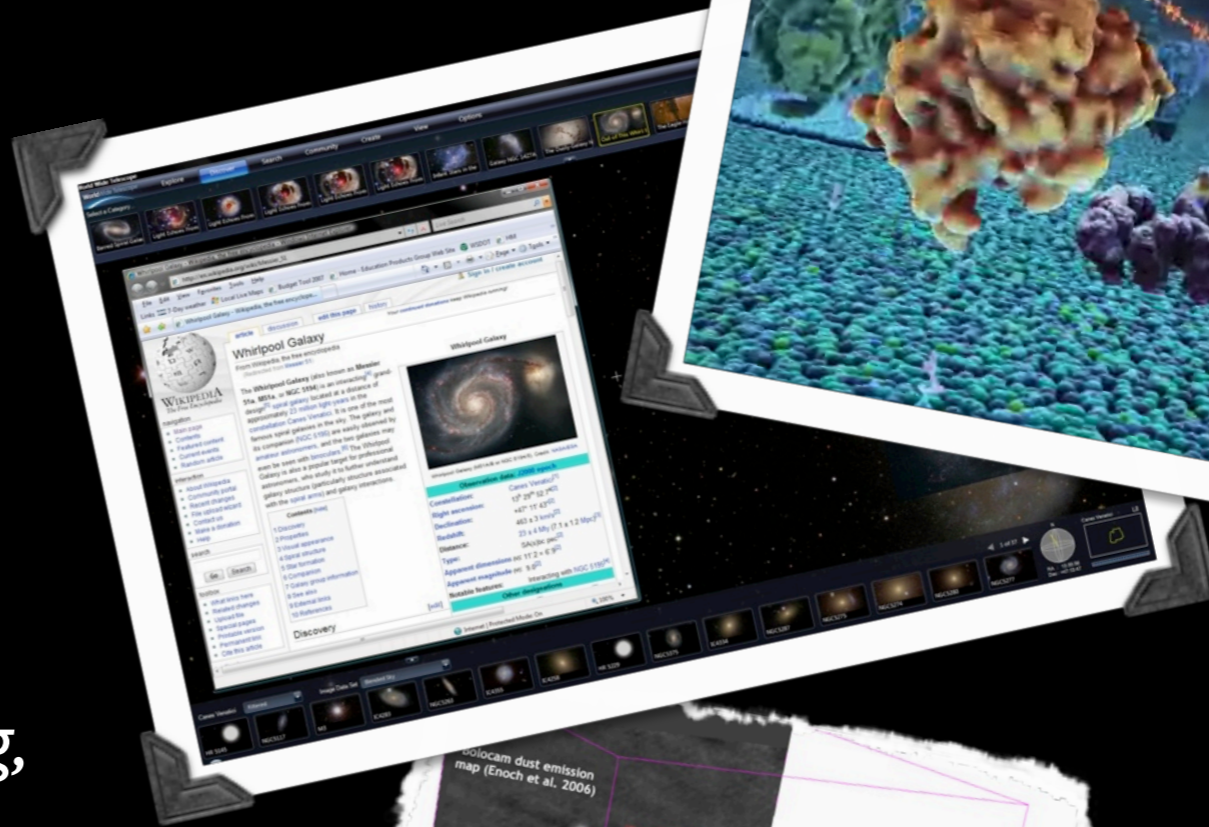


Seeing Science

Alyssa A. Goodman

Professor of Astronomy
& Founding Director of the
Initiative in Innovative Computing,
Harvard University

Scholar-in-Residence,
WGBH Boston





Who am I?

...my interest(s) in "Seeing Science"...

Astronomy

A screenshot of the COMPLETE website. The header features the COMPLETE logo and the text "The COordinated Molecular Probe Line Extinction Thermal Emission Survey of Star Forming Regions". A navigation menu on the left includes buttons for Data, Results, Projects, People, Learn, and Restricted. The main content area contains a "Project Description" section with text about the survey and its phases. At the bottom, there is a "Referencing Data from the COMPLETE Survey" section with a citation: "Ridge, N.A. et al., 'The COMPLETE Survey of Star Forming Regions: Phase 1 Data', 2006. AJ, 131, 2921-2935".

Scientific Computing

A screenshot of the Initiative in Innovative Computing (IIC) website. The header includes the IIC logo and "Harvard University". A navigation menu on the left lists: home, about the iic, research, education, people, events, employment, and reaching the iic. The main content area is divided into three columns: "Mission of the IIC", "Astronomical Medicine" (with a sub-section "UPCOMING EVENT 'IIC Colloquium' Feb 4, 2009 4:00pm"), and "NEWS & EVENTS" (with a sub-section "Application Deadline Extended for Graduate Research Fellowships in Computational Science").

Teaching

A screenshot of the Quantitative Reasoning 46 course website. The header includes the course title and "my.harvard" branding. A navigation menu on the left lists: Homepage, Syllabus, Texts & Software, Lecture Materials, Reading List, Project Sets & Drop Box, Section Graphics, Statistics Information, Resources, Teaching Staff, Archive (Hidden), Teaching Staff Only (Hidden), and Tuesday Sections. The main content area includes "Announcements" (stating there are currently no announcements), "Course Information" (listing the course title "The Visual Display of Information: The Art of Numbers", location, meeting time, and exam group), and an "Emailbag" section with a table for subject, sender, and date sent. A note at the bottom states: "Note: Due to University privacy policies this topic is available only to members of the class list." A "GAPMINDER" logo is visible at the bottom.

Relative Strengths



Pattern Recognition
Creativity



Calculations



“Interocularity”

(see work of John Tukey)

“Image and Meaning”

(see work of Felice Frankel,
and imageandmeaning.org)

Seeing Science

Data • Dimensions • Display

What...

...is easier now than before?

fast computation, animation, 3D

...was easier before than now?

craftsmanship

...should be easier in the future?

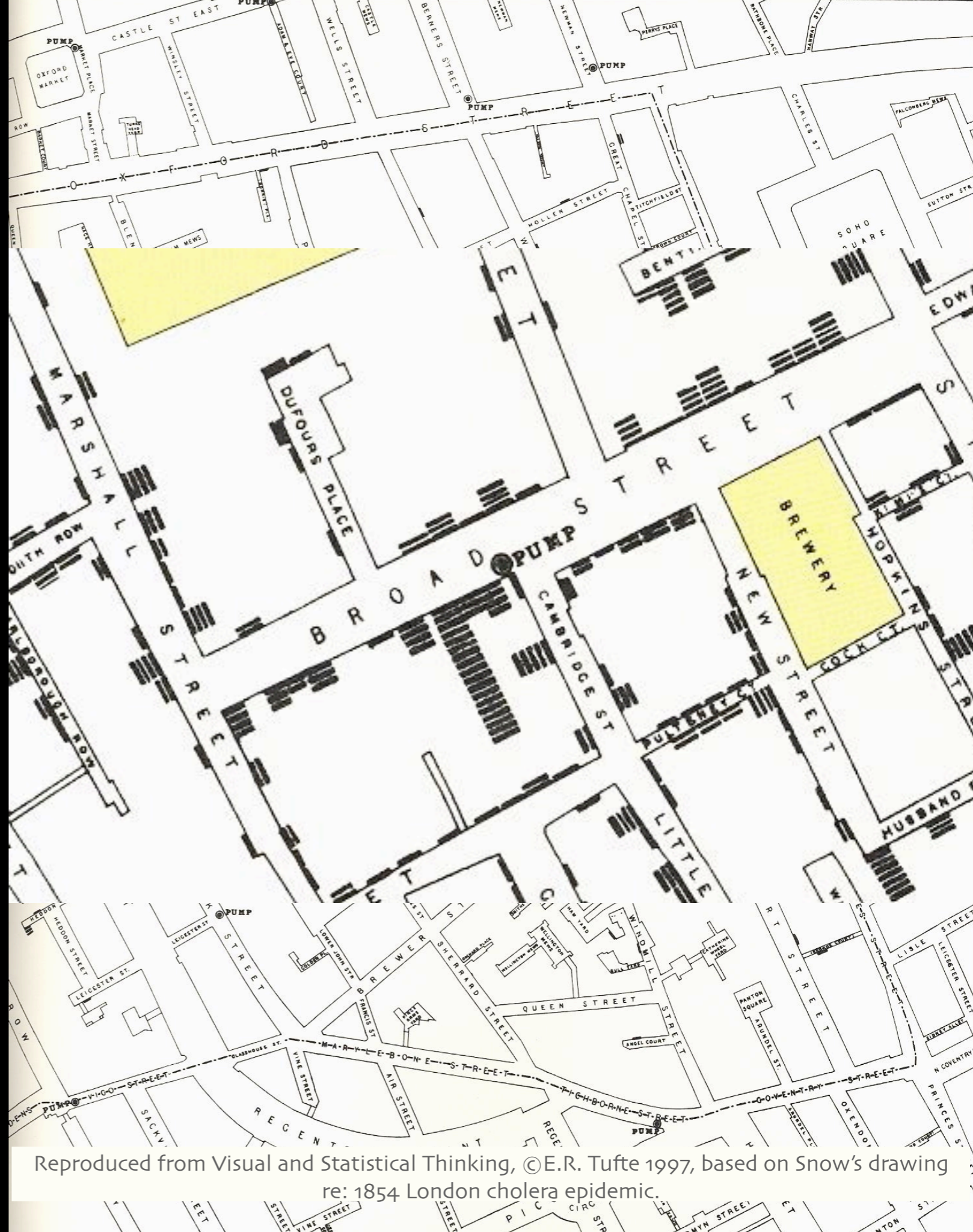
modular craftsmanship

Craftsmanship (in 1854)

Displaying
“high-dimensional” data

with

“multi-functioning
graphical elements”



What Computers *Can* Let us Craft

Elements...

✓ Maps

✓ Tables

✗ Graphs

✓ Charts

✓ Illustrations

✓ Combinations

Live Scoreboard | Celtics.com

SCOREBOARD

DEN	116	WAS	72	POR	97	PHI	46	MIL	34	DAL	26-11	LAL	25-11
CHA	119	BOS	79	NJN	70	SAS	52	UTA	34	SAC	14-21	SEA	9-27
FINAL		2-34	4th	0:50	4th	Halftime	5:36	2nd	10:00		10:00		

COURTSIDE LIVE

19-16 STANDINGS

Fouls 1 4 0

02:46

1 2 3 4 OT T

18 17 24 13 72

18 19 26 16 79

Fouls 1 3 1

30-5 STANDINGS

COURTSIDE LIVE BOX SCORE PLAY-BY-PLAY Highlights Watch the Game Listen to the Game

WAS SELECT: ○ ALL ● ACTIVE 5

PLAYER NAME	PTS	REB	RST	F
<input type="checkbox"/> Daniels, Antonio	7	2	8	0
<input checked="" type="checkbox"/> Stevenson, DeSha	11	3	4	2
<input checked="" type="checkbox"/> Jamison, Antawn	18	10	0	3
<input checked="" type="checkbox"/> Butler, Caron	14	3	1	3
<input checked="" type="checkbox"/> Haywood, Brenda	12	5	0	3
<input type="checkbox"/> Blatche, Andray	3	5	0	3
<input checked="" type="checkbox"/> Mason, Roger	3	1	1	5
<input type="checkbox"/> Songaila, Darius	2	1	1	2
<input type="checkbox"/> Young, Nick	2	0	0	0
<input type="checkbox"/> Pecherou, Oleksiy	0	1	0	0
<input type="checkbox"/> Arenas, Gilbert				
<input type="checkbox"/> McGuire, Dominic				

BOS SELECT: ○ ALL ● ACTIVE 5

PLAYER NAME	PTS	REB	RST	F
<input type="checkbox"/> Rondo, Rajon	4	2	2	2
<input checked="" type="checkbox"/> Allen, Ray	16	6	3	2
<input checked="" type="checkbox"/> Garnett, Kevin	21	6	6	3
<input checked="" type="checkbox"/> Pierce, Paul	16	4	2	3
<input type="checkbox"/> Perkins, Kendrick	9	3	1	3
<input checked="" type="checkbox"/> House, Eddie	5	6	3	1
<input type="checkbox"/> Allen, Tony	4	4	0	0
<input type="checkbox"/> Davis, Glen	1	0	0	2
<input checked="" type="checkbox"/> Posey, James	3	2	0	2
<input type="checkbox"/> Pollard, Scot				
<input type="checkbox"/> Scalabrine, Brian				
<input type="checkbox"/> Powe, Leon				

TD Banknorth GARDEN

TD Banknorth GARDEN

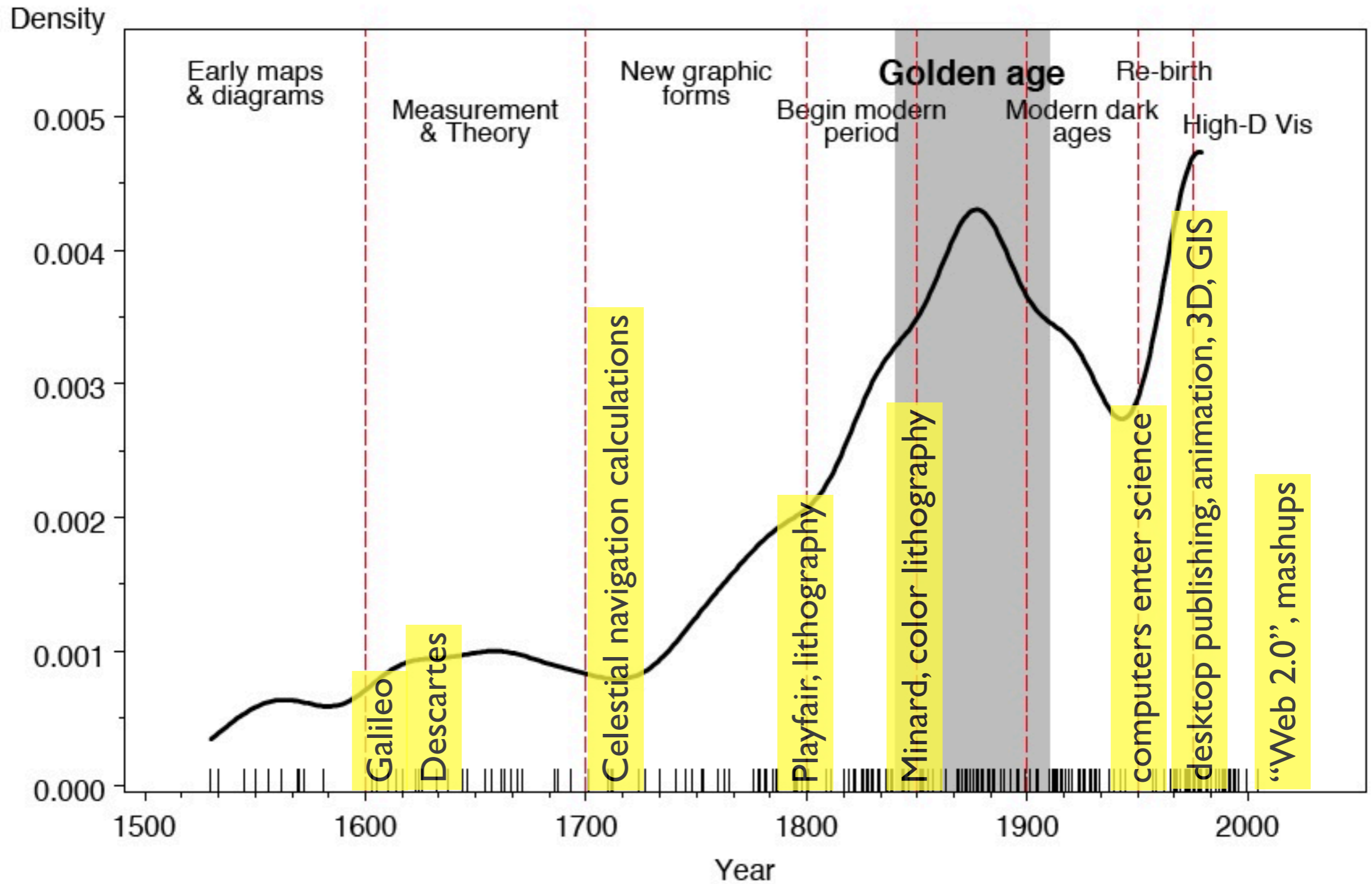
WIZARDS

CELTICS

WAS show: ● made shots ✓ X missed shots ✓

BOS show: ● made shots ✓ X missed shots ✓

Milestones: Time course of developments



adapted from Friendly, "The Golden Age of Statistical Graphics," *Statistical Science*, in press (2008)

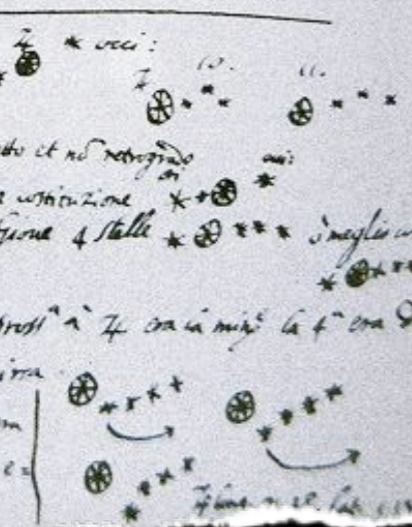
Galileo Galilei (1564-1642)

Sex^{mo} Principe.

Galileo Galilei Humilis^o Servus della Ser.^a V.^a inuigilando
 ad assidue et ad ogni spirito di bere no solo in sabis
 alvario che non della stessa di Matematico nelle Scuole
 di Padova,

Inuere diuere determinato di presentare al Sex^{mo} Principe
 l'Orbicle et il p^o essere di giuamento inestimabile p^o ogni
 negozio et in iresa marittima o terreste stimo di tenere per
 il nuovo artificio ne l'ingegno segreto et solam a disposizione
 di l'Orbicle cauato dalle piu uide speculazioni di
 prospettua na l'uantaggio di scoprire Legni et Vele dell'inimico
 p^o Val hore et piu di tempo prima di essi suspra noi et distinguend
 il numero et la qualita dei Vasselli giudicare le sue forze
 ballastarsi alla caccia al combattimento o alla fuga, o pure essi
 nella campagna aperta uedere et particolarmente distinguere ogni suo
 moto et propriamento.

Adi 7. di gennaio
 Giove si uide usti
Adi 8. usti
 4 ora d'uy diretto et no retrogrado
Adi 12. si uide in tale uisione
 Il 13 si uide usti in Giove 4 stelle
Adi 14. di agosto
 Il 15 si uide in Giove 4 stelle
 stante dalla 3^a al doppio la sua
 Lo spazio delle 3 stelle uide ad om
 maggiore del diametro di 7 et e
 in linea retta.



7	* * ○ *	17	* ○
8	○ * * *	18	* ○ *
10	* * ○	19	* ○ * *
11	* * ○	19	* ○ * *
12	* ○ *	20	○ ○ ○ ○ ○
13	* ○ * *	21	... ○ *
15	○ * * * *	22	* ○ .. *
15	○ * * *	22	○ .. *
16	* ○ *	23	* ○ *
17	* ○ *	24	* ○ *

SIDERIUS NUNCIUS

On the third, at the seventh hour, the stars were arranged in this
 quence. The eastern one was 1 minute, 30 seconds from Jupiter
 the closest western one 2 minutes; and the other western one wa

East * ○ * * West

10 minutes removed from this one. They were absolutely on the
 same straight line and of equal magnitude.

On the fourth, at the second hour, there were four stars around
 Jupiter, two to the east and two to the west, and arranged precise

East * * ○ * * West

on a straight line, as in the adjoining figure. The easternmost wa
 distant 3 minutes from the next one, while this one was 40 second
 from Jupiter; Jupiter was 4 minutes from the nearest western one
 and this one 6 minutes from the westernmost one. Their magnitude,
 ere nearly equal; the one closest to Jupiter appeared a little smaller
 than the rest. But at the seventh hour the eastern stars were only
 10 seconds apart. Jupiter was 2 minutes from the nearer eastern

East ** ○ * * West

one, while he was 4 minutes from the next western one, and this
 one was 3 minutes from the westernmost one. They were all equal
 and extended on the same straight line along the ecliptic.

On the fifth, the sky was cloudy.

On the sixth, only two stars appeared flanking Jupiter, as is seen

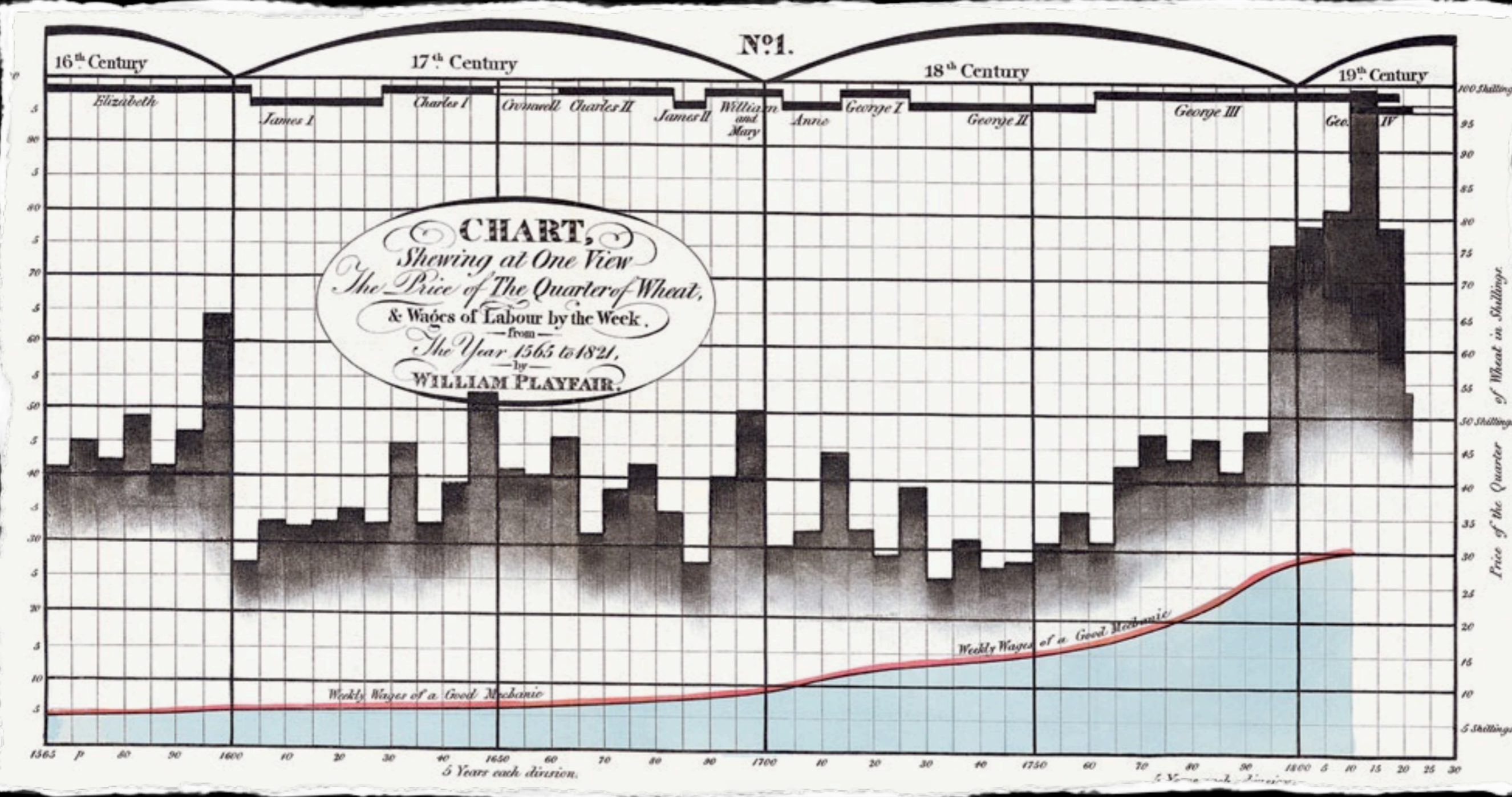
East * ○ * West

in the adjoining figure. The eastern one was 2 minutes and the
 western one 3 minutes from Jupiter. They were on the same straight
 line with Jupiter and equal in magnitude.

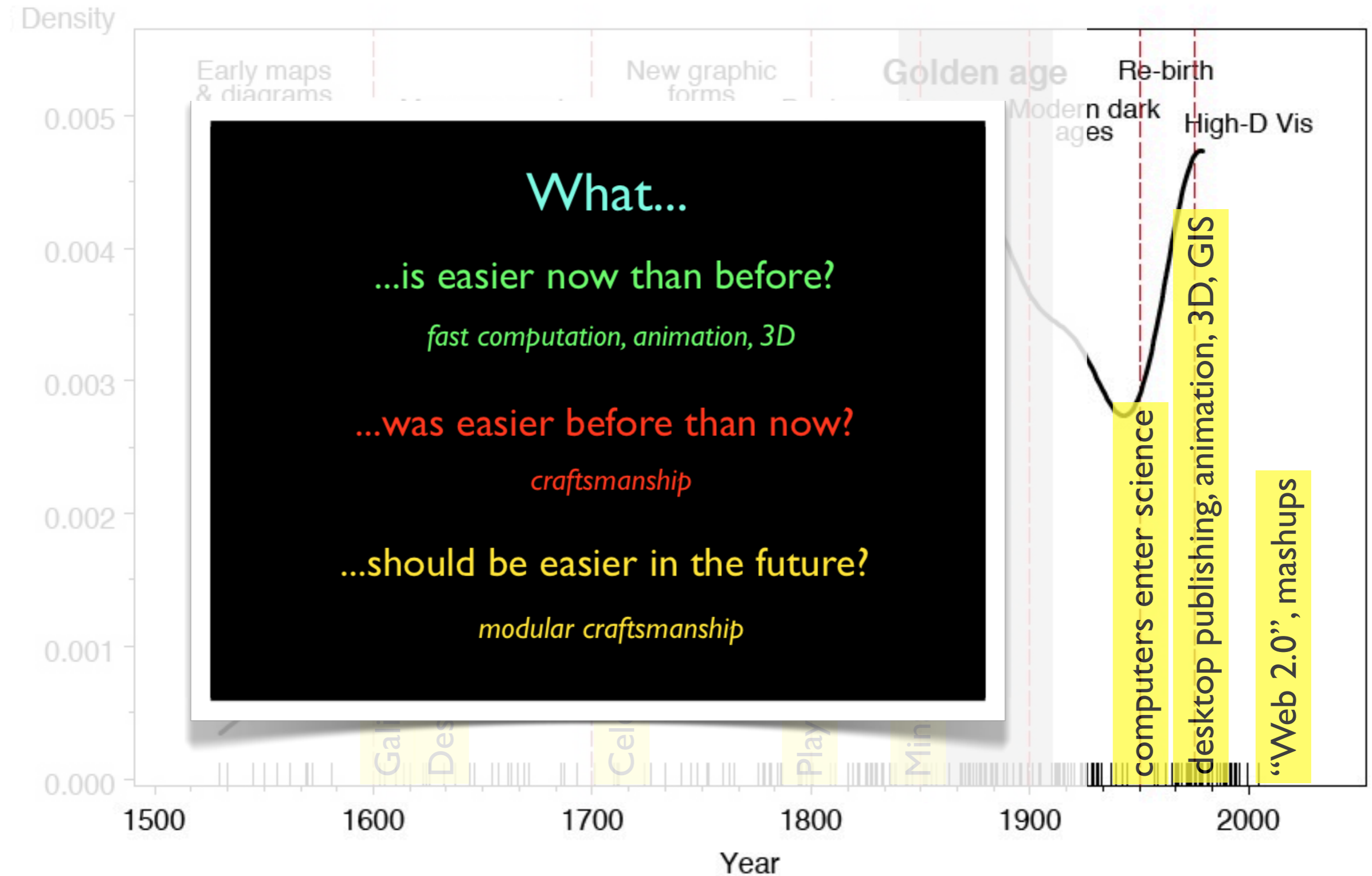
On the seventh, two stars stood near Jupiter, both to the east

Notes for & re-productions of Siderius Nuncijs

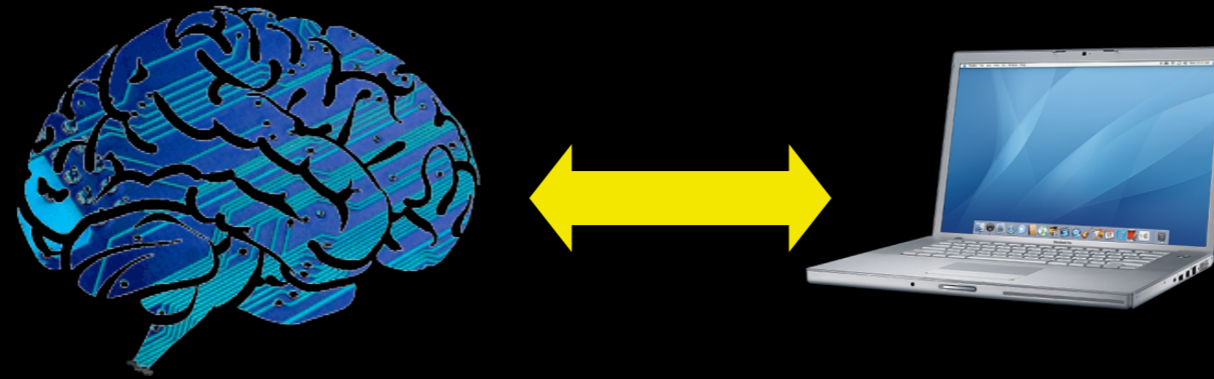
William Playfair (1759-1823)



Milestones: Time course of developments



adapted from Friendly, "The Golden Age of Statistical Graphics," *Statistical Science*, in press (2008)



Data Reduction

Data Display

Context (e.g. journals + online data)

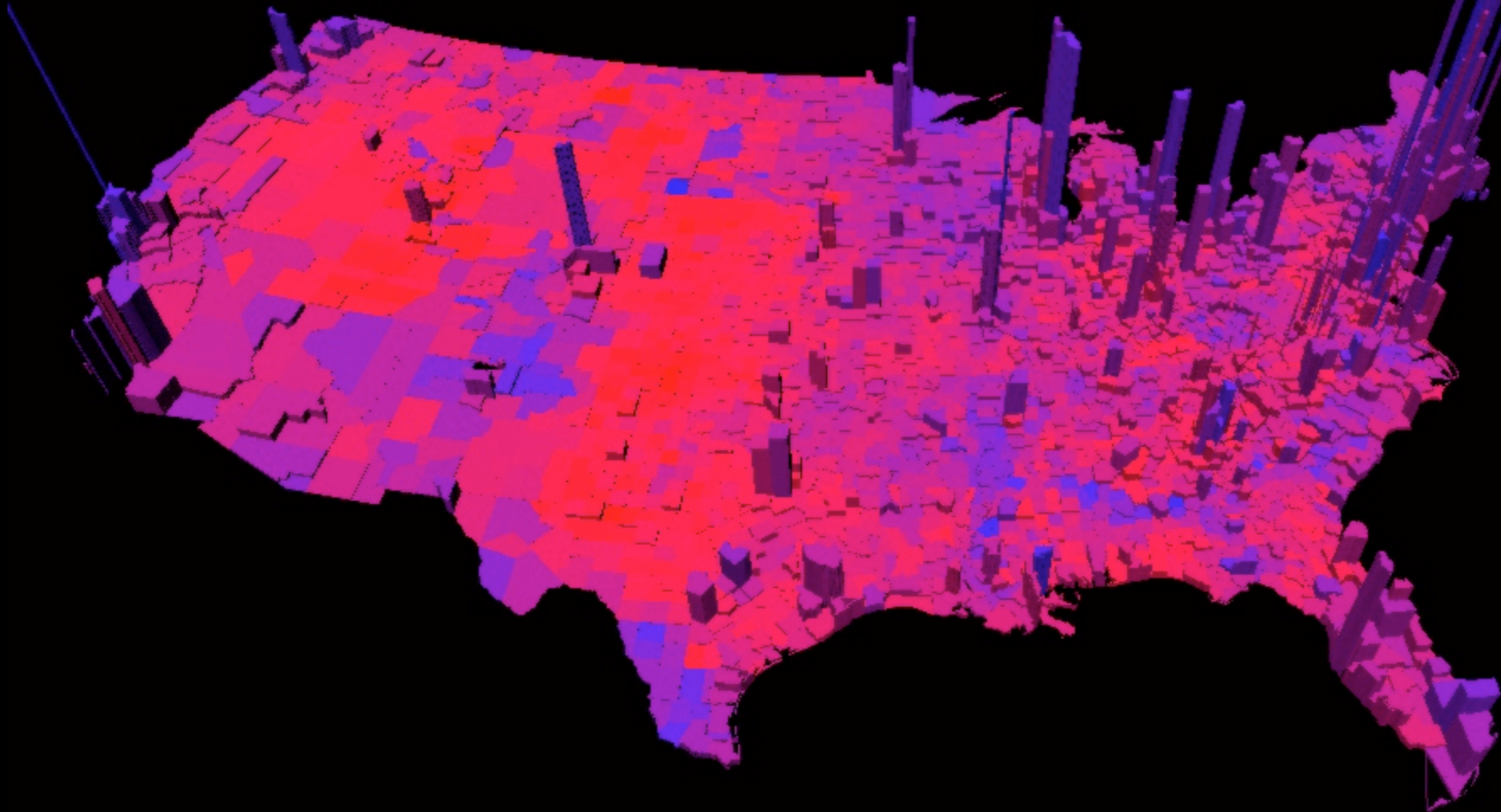
Simulation Design

Statistics Design

Data Exploration (Visualization)

Data • Dimensions • Display

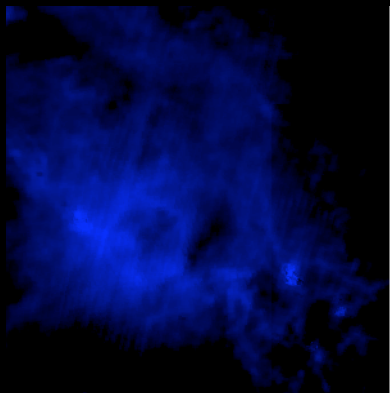
“High-dimensional” or “Multivariate” Data and High(er) Dimensional Displays



*This map **displays** 2 quantities as a function of 2 spatial dimensions.
...Is that 4 dimensions?*

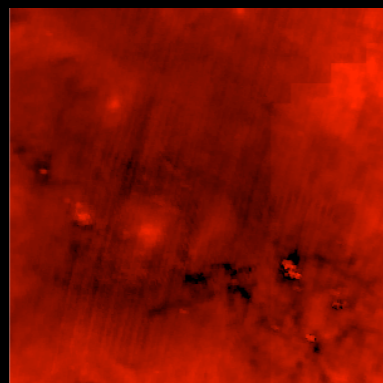
Note: Computers make this Easy

Column
Density

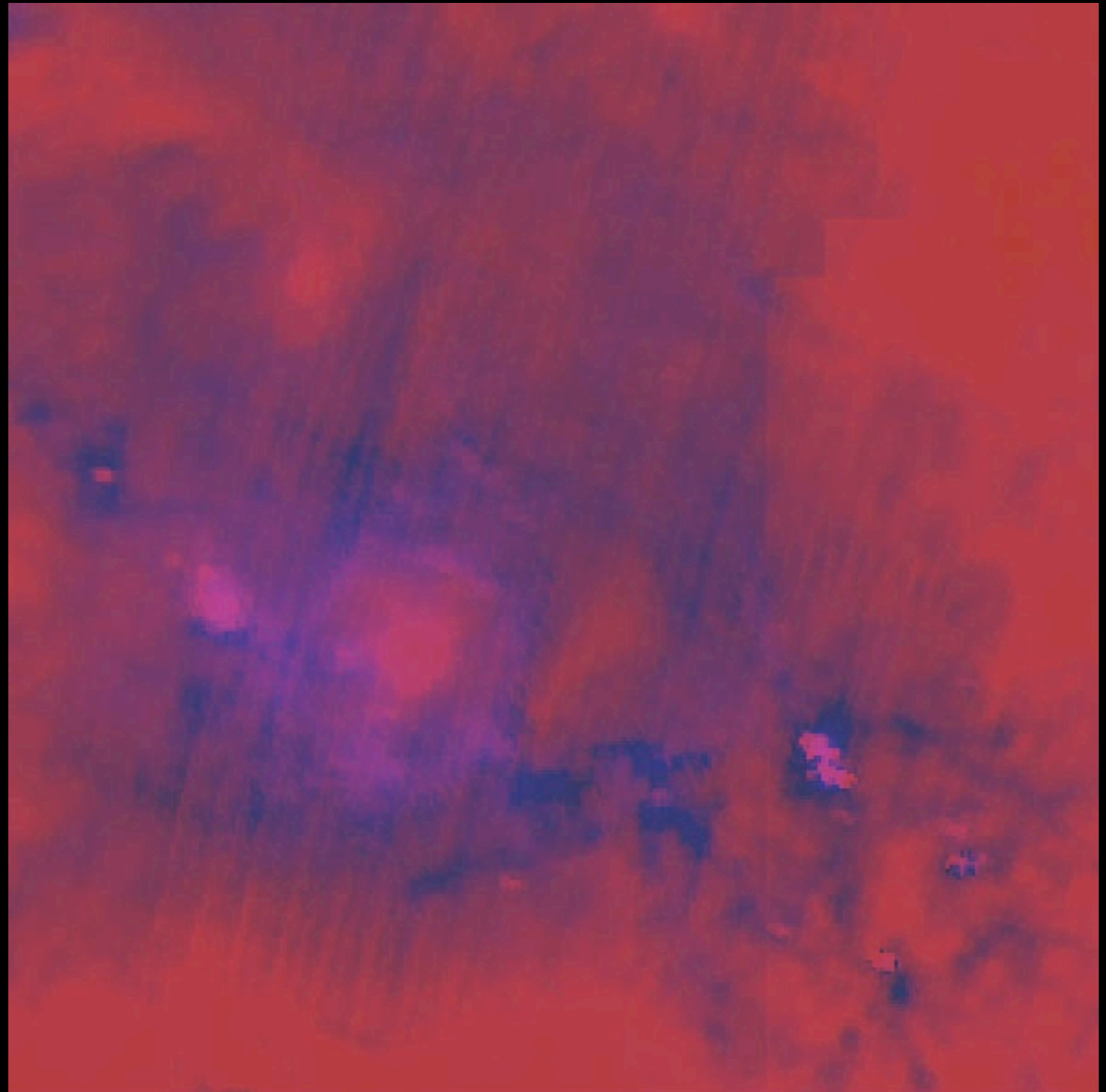


+

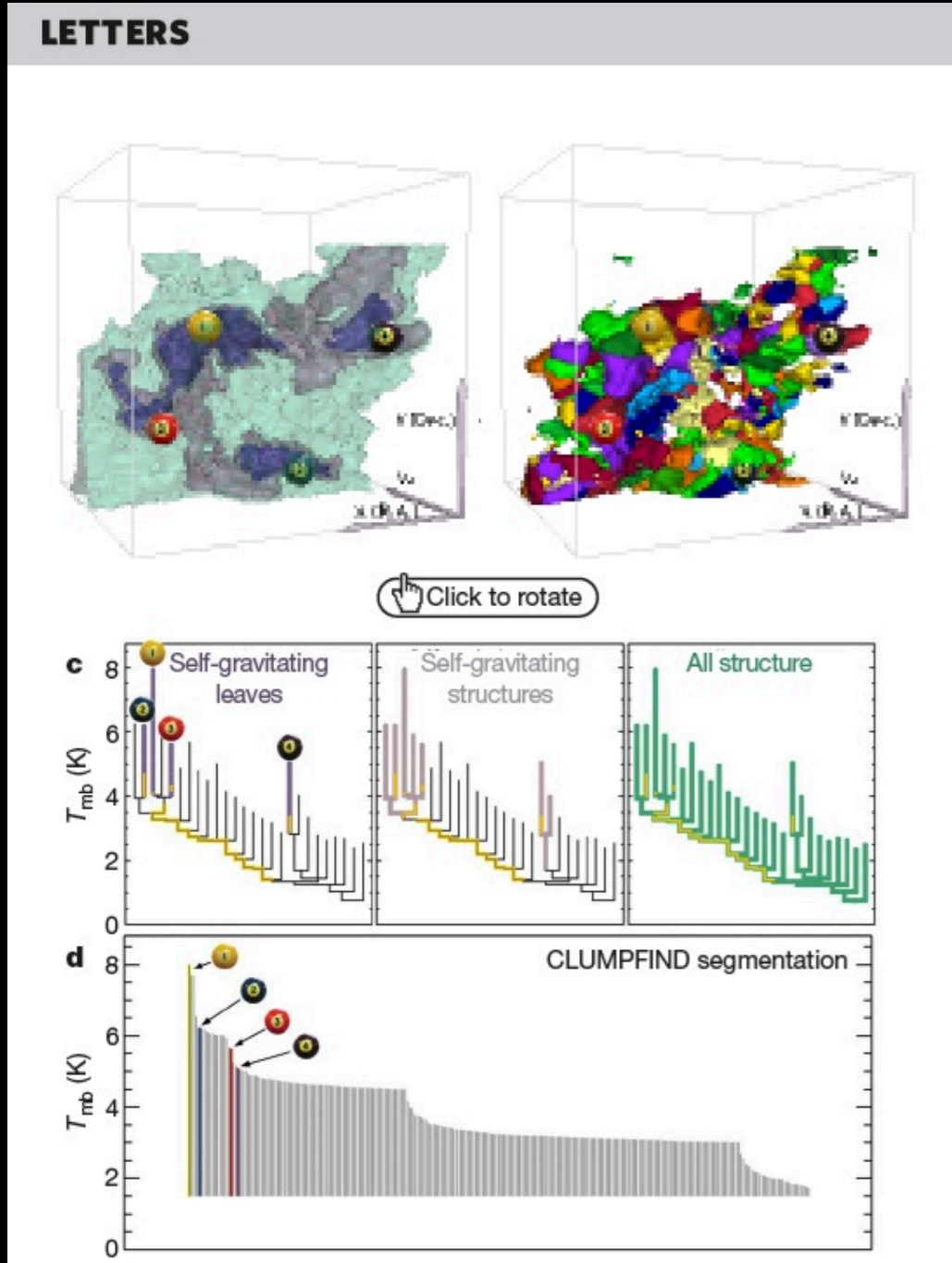
Temperature



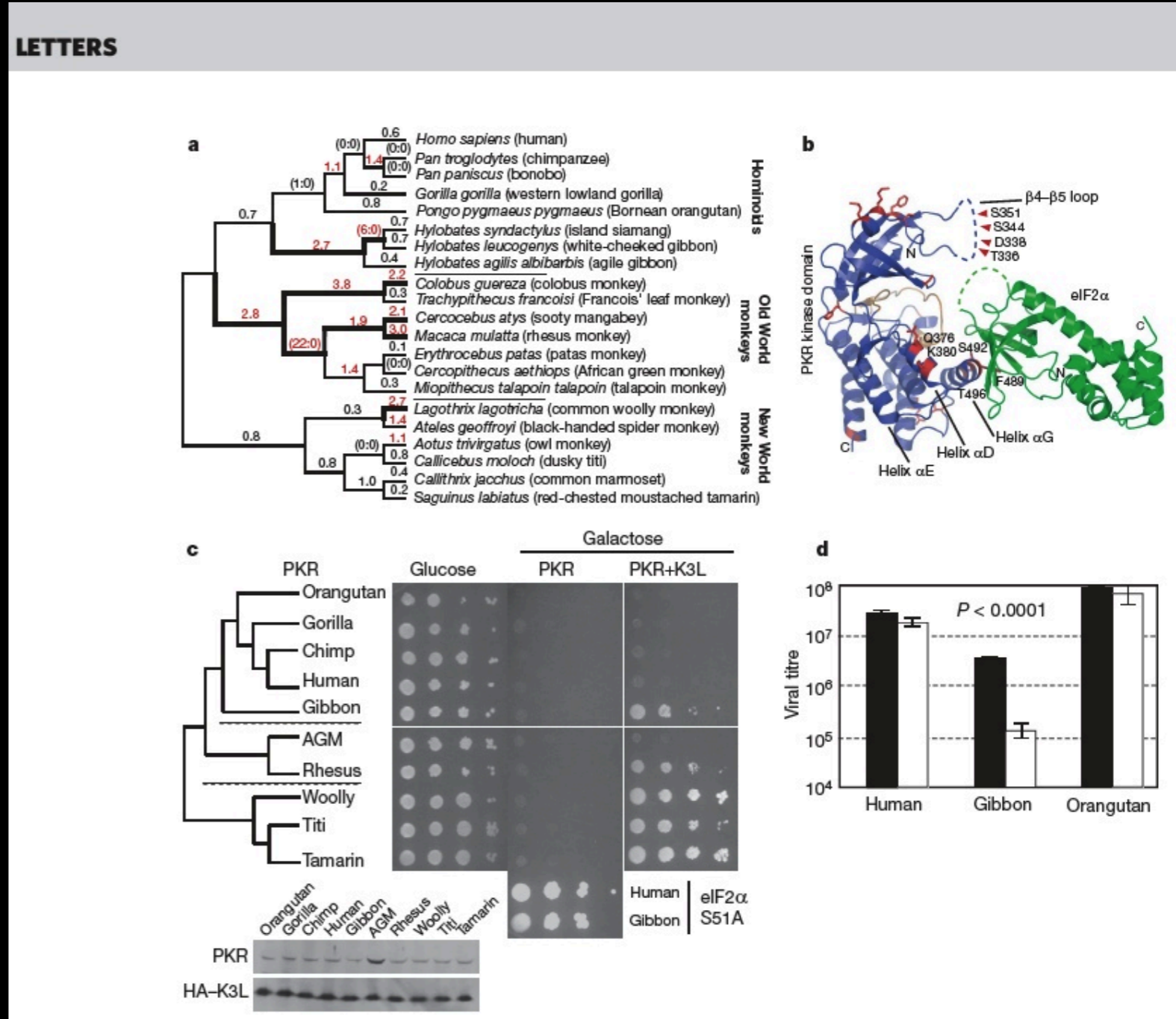
=



“High-dimensional” or “Multivariate” Data (Astronomy=Biology)



Goodman et al. *Nature*, 2009



Elde et al. *Nature*, 2008

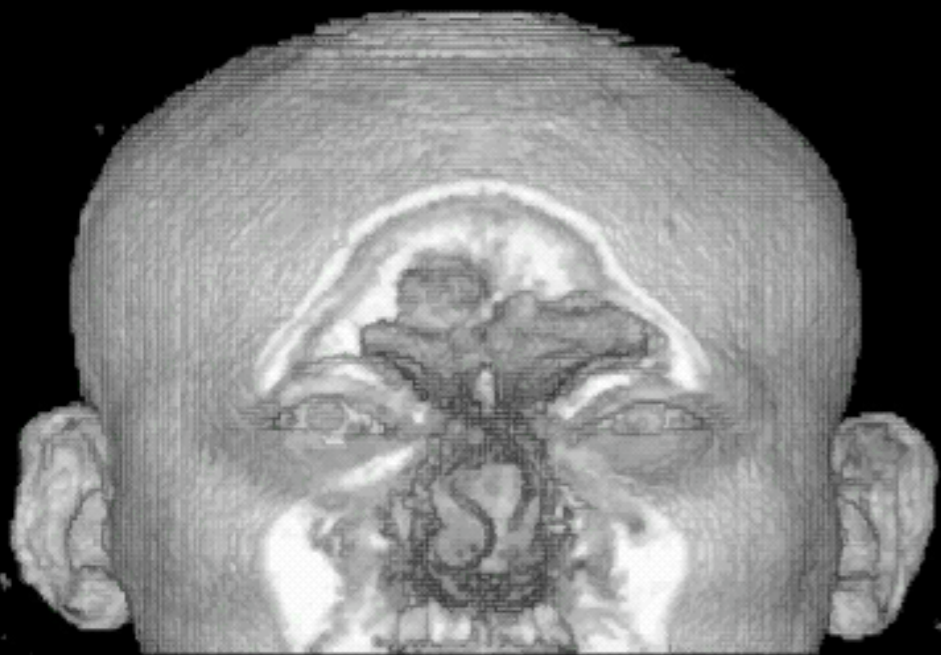
What about Animation?



How many dimensions at once?

Can/should time (animation) substitute for dimensions?

"KEITH"



"PERSEUS"



"z" is depth into head

"z" is line-of-sight velocity

(This kind of "series of 2D slices view" is known in the Viz as "the grand tour")



Astronomical Medicine

am.iic.harvard.edu

Alyssa Goodman (IIC/CfA/FAS)

Michael Halle (IIC/SPL/HMS)

Ron Kikinis (SPL/HMS)

Douglas Alan (IIC)

Michelle Borkin (IIC)

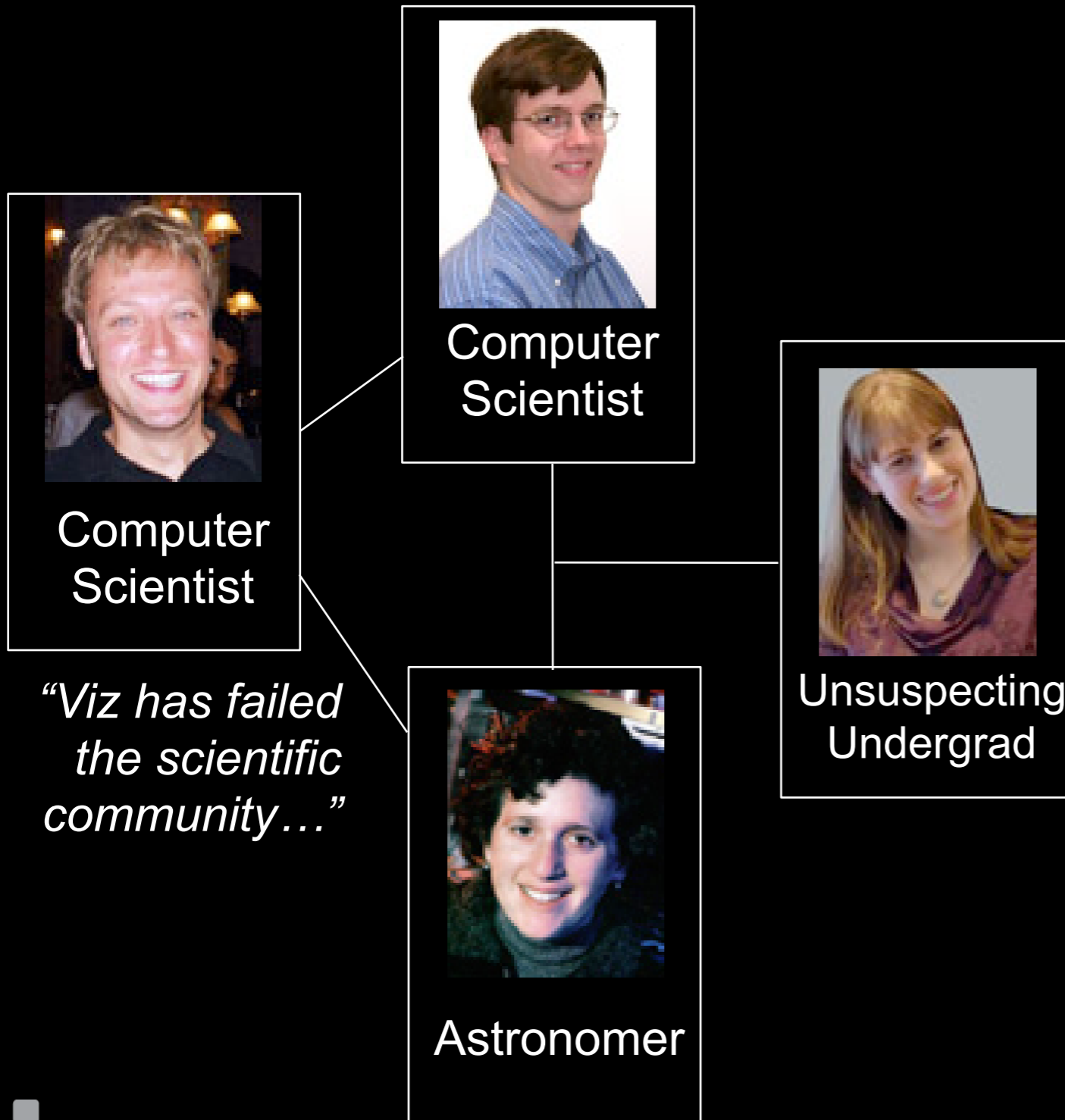
Jens Kauffmann (CfA/IIC)

Erik Rosolowsky (CfA)

Nick Holliman (U. Durham)



The AstroMed Story



“Viz has failed the scientific community...”

iic

Initiative in Innovative Computing at Harvard

projects

Astronomical Medicine

Lead Investigators
Alyssa Goodman (FAS/Astronomy, IIC), Mike Halle (HMS/SPL of BWH, IIC), Ron Kikinis (HMS/SPL of BWH), David Kennedy (HMS/Martinos Center of Harvard, MIT and MGH)






Project Staff
Doug Alan, IIC-Sr. Software Engineer
Michelle Borkin, IIC-Research Associate
Jens Kauffmann - IIC-Post Doc

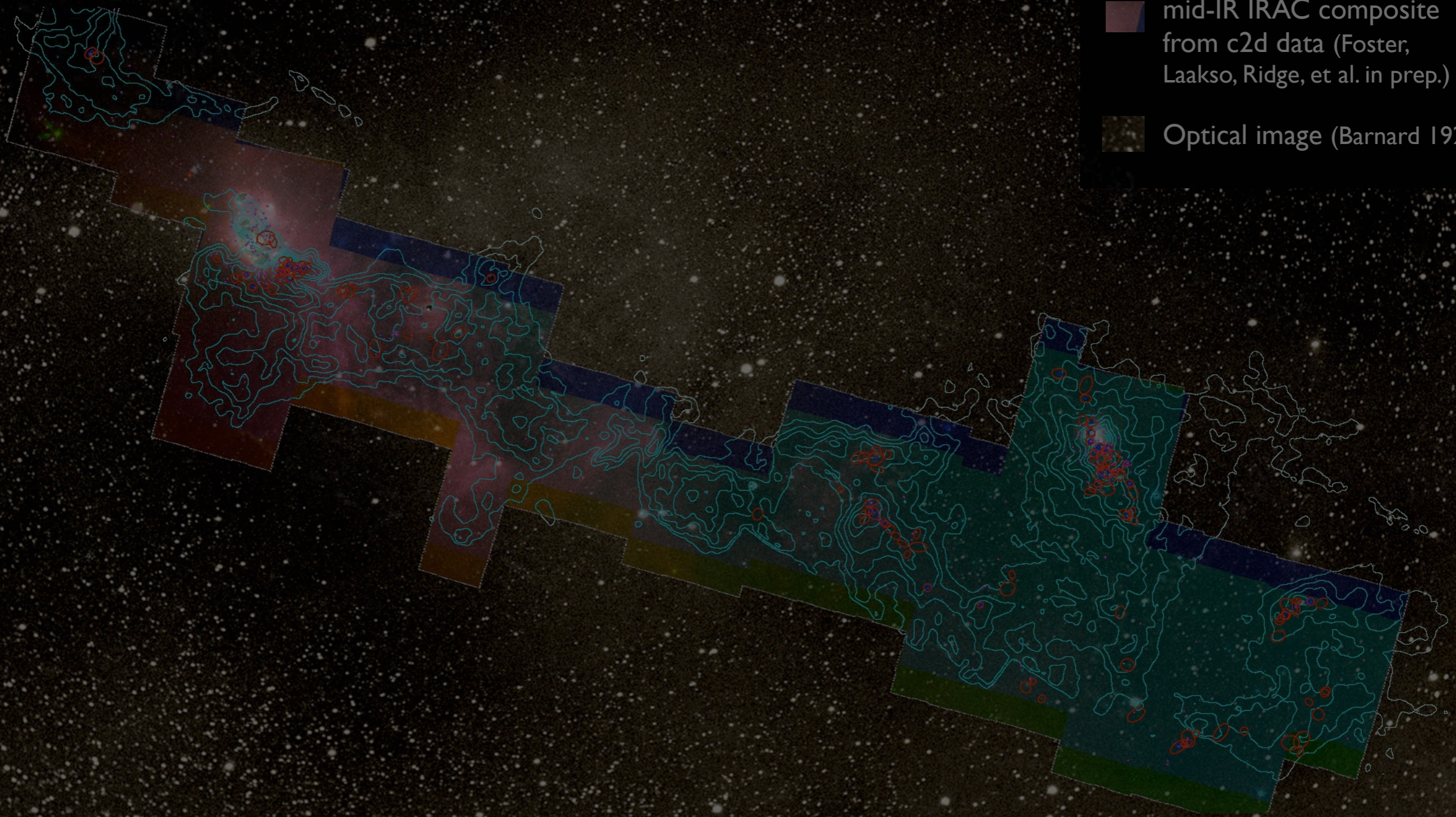
Description
The goal of the "AstroMed" project is to extend the state of the art of complex data understanding in two very different fields, astronomy and medical imaging, using a broad-based approach to data exploration and analysis.



COMPLETE Perseus

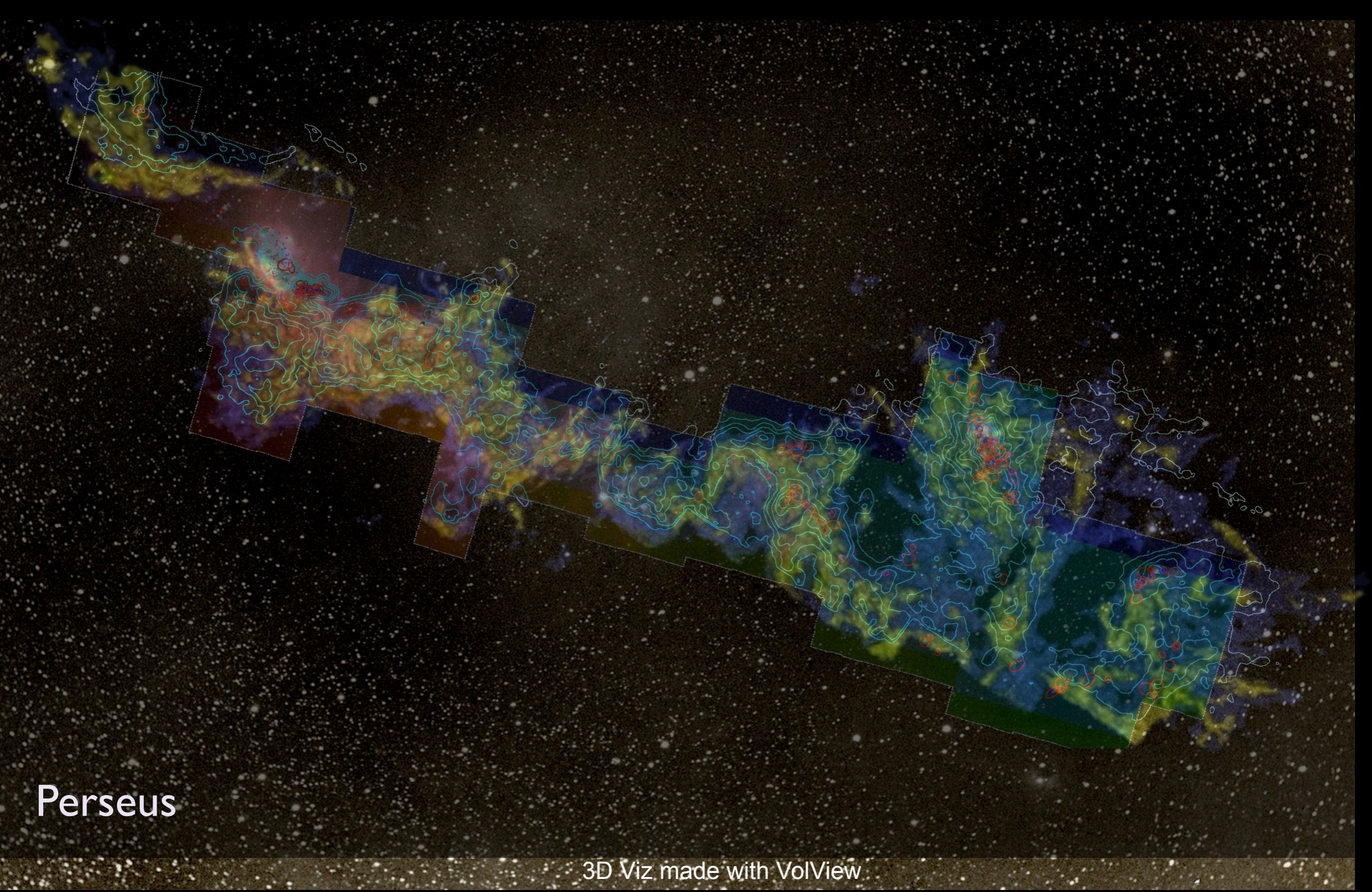
Image size: 1305 x 733
WL: 63 WW: 127

-  mm peak (Enoch et al. 2006)
-  sub-mm peak (Hatchell et al. 2005, Kirk et al. 2006)
-  ^{13}CO (Ridge et al. 2006)
-  mid-IR IRAC composite from c2d data (Foster, Laakso, Ridge, et al. in prep.)
-  Optical image (Barnard 1927)



m: 1/249
Zoom: 227% Angle: 0





Perseus

3D Viz made with VolView

AstronomicalMedicine@iig

COMPLETE

What...

...is easier now than before?

fast computation, animation, 3D

...was easier before than now?

craftsmanship

...should be easier in the future?

modular craftsmanship

The “Easier” Future: Modular Craftsmanship

The Future we can see from “now”...

“live” interaction with data (DataDesk, WWT)

more display modes available (3D PDF, touch tables/walls, stereo+)

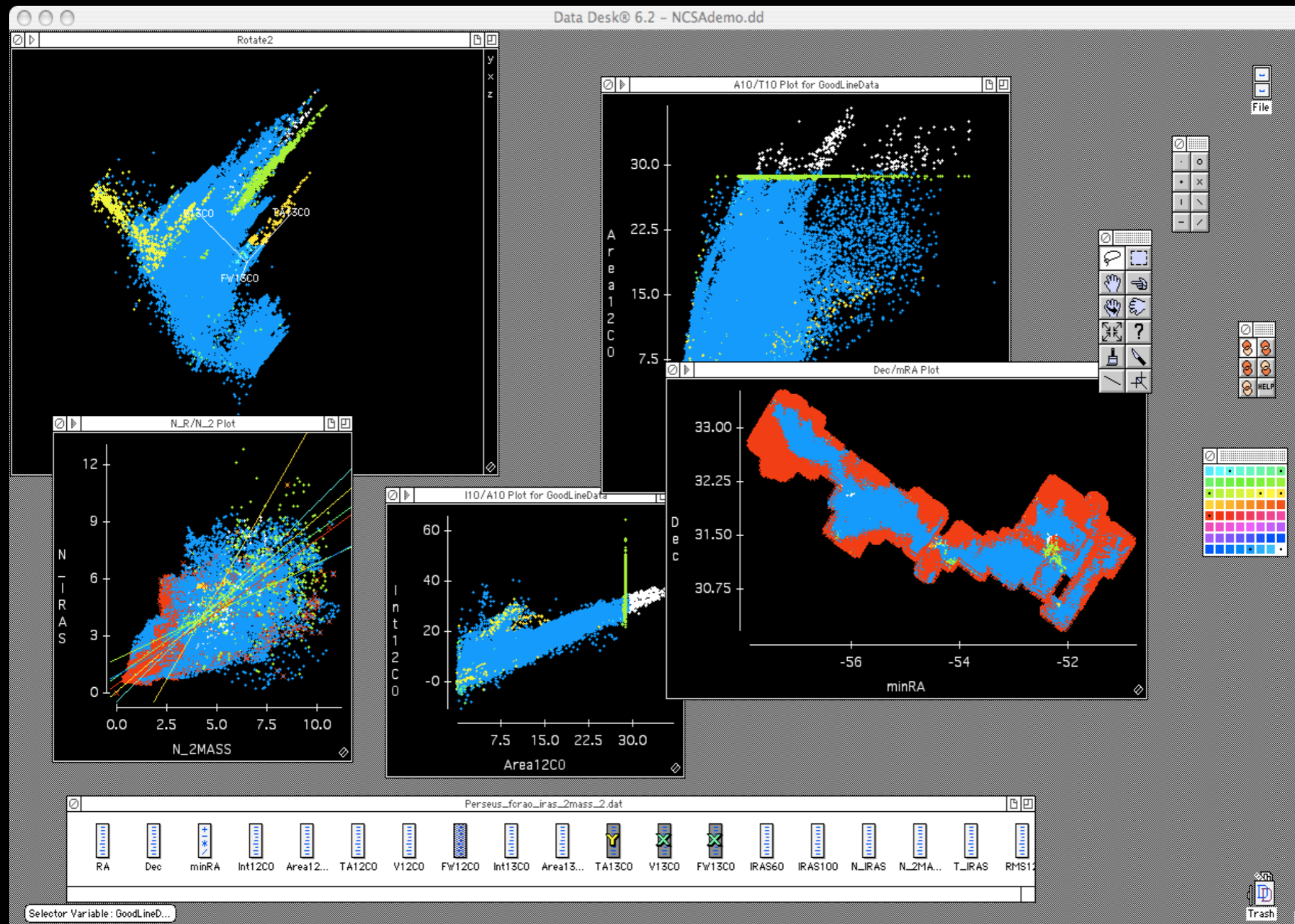
re-usable tools/mashups (Many Eyes, UFOmaps.com)

Unsolved Questions...

(feasibility of) templates/language (e.g. Grammar of Graphics)

improved graphical representation of uncertainty

“Data Desk”



If only **DataDesk** were >2D...??

Mirage (Bell Labs)

Tasks

Task	Status	Message
SDSSDR2-I-SIAP-RA_9.89...	Completed	Done.
SDSSDR2-JPG-SIAP-RA_9...	Completed	Done.
SDSSDR2-R-SIAP-RA_9.8...	Completed	Done.
SDSSDR2-U-SIAP-RA_9.8...	Completed	Done.
SDSSDR2-Z-SIAP-RA_9.8...	Completed	Done.
Loading SDSS-DR2-RA_9...	Completed	Loaded 1 datasets.

Console Options Help

/tmp/SDSS-DR2-RA_9.895-Dec_0.86-Radius_0.25_Resource0_Tab

File Image Scale Color Data/Axes

fpC-003325-r6-0174.fit.gz x0.25

(9.88868, 1.01311) (1686, 479) 1115.0

File Image Scale Color Data/Axes

.aspx?ra=9.895&dec=0.86&height=512&width=512&scale=3.5 x1.0

(282, 223) (3, 7, 6)

z

	U	G
587731187282019071	24.18713	24.20689
588015510347318143	25.97617	23.60485
587731187281953508	21.4283	20.91666
587731187282018784	23.57881	22.82347
587731187282018888	23.81209	22.60126
587731187281953860	19.15922	17.97867
587731187282084911	23.8728	25.90358
587731187281887870	25.03652	22.63719
588015510347513898	25.59181	23.56613
587731187281888417	24.52932	25.09906
587731187818823841	21.79988	20.83762
587731187818824258	24.73024	22.97165

cf. Avizo (Mercury Systems); some aspects of GenePattern; Taverna...

3D PDF

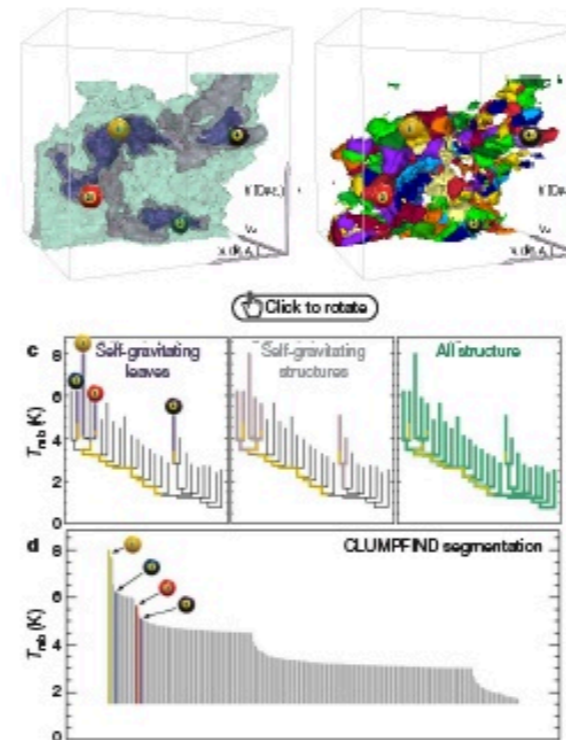


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ¹³CO emission from the L1448 region of Perseus. **a**, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating structures in the region corresponding to the leaves of the dendrogram; pink shows the smallest surfaces that contain distinct self-gravitating leaves within them; and green corresponds to the surface in the data cube containing all the significant emission. Dendrogram branches corresponding to self-gravitating objects have been highlighted in yellow over the range of T_{mb} (main-beam temperature) test-level values for which the virial parameter is less than 2. The x - y locations of the four 'self-gravitating' leaves labelled with billiard balls are the same as those shown in Fig. 1. The 3D visualizations show position-position-velocity (p - p - v) space. RA, right ascension; dec., declination. For comparison with the ability of dendrograms (**c**) to track hierarchical structure, **d** shows a pseudo-dendrogram of the CLUMPFIND segmentation (**b**), with the same four labels used in Fig. 1 and in **a**. As 'clumps' are not allowed to belong to larger structures, each pseudo-branch in **d** is simply a series of lines connecting the maximum emission value in each clump to the threshold value. A very large number of clumps appears in **b** because of the sensitivity of CLUMPFIND to noise and small-scale structure in the data. In the online PDF version, the 3D cubes (**a** and **b**) can be rotated to any orientation, and surfaces can be turned on and off (interaction requires Adobe Acrobat version 7.0.8 or higher). In the printed version, the front face of each 3D cube (the 'home' view in the interactive online version) corresponds exactly to the patch of sky shown in Fig. 1, and velocity with respect to the Local Standard of Rest increases from front (-0.5 km s^{-1}) to back (8 km s^{-1}).

data, CLUMPFIND typically finds features on a limited range of scales, above but close to the physical resolution of the data, and its results can be overly dependent on input parameters. By tuning CLUMPFIND's two free parameters, the same molecular-line data set⁶ can be used to show either that the frequency distribution of clump mass is the same as the initial mass function of stars or that it follows the much shallower mass function associated with large-scale molecular clouds (Supplementary Fig. 1).

Four years before the advent of CLUMPFIND, 'structure trees'⁹ were proposed as a way to characterize clouds' hierarchical structure

using 2D maps of column density. With this early 2D work as inspiration, we have developed a structure-identification algorithm that abstracts the hierarchical structure of a 3D (p - p - v) data cube into an easily visualized representation called a 'dendrogram'¹⁰. Although well developed in other data-intensive fields^{11,12}, it is curious that the application of tree methodologies so far in astrophysics has been rare, and almost exclusively within the area of galaxy evolution, where 'merger trees' are being used with increasing frequency¹³.

Figure 3 and its legend explain the construction of dendrograms schematically. The dendrogram quantifies how and where local maxima of emission merge with each other, and its implementation is explained in Supplementary Methods. Critically, the dendrogram is determined almost entirely by the data itself, and it has negligible sensitivity to algorithm parameters. To make graphical presentation possible on paper and 2D screens, we 'flatten' the dendrograms of 3D data (see Fig. 3 and its legend), by sorting their 'branches' to not cross, which eliminates dimensional information on the x axis while preserving all information about connectivity and hierarchy. Numbered 'billiard ball' labels in the figures let the reader match features between a 2D map (Fig. 1), an interactive 3D map (Fig. 2a online) and a sorted dendrogram (Fig. 2c).

A dendrogram of a spectral-line data cube allows for the estimation of key physical properties associated with volumes bounded by isosurfaces, such as radius (R), velocity dispersion (σ_v) and luminosity (L). The volumes can have any shape, and in other work¹⁴ we focus on the significance of the especially elongated features seen in L1448 (Fig. 2a). The luminosity is an approximate proxy for mass, such that $M_{\text{lum}} = X_{13\text{CO}} L_{13\text{CO}}$, where $X_{13\text{CO}} = 8.0 \times 10^{20} \text{ cm}^2 \text{ K}^{-1} \text{ km}^{-1} \text{ s}$ (ref. 15; see Supplementary Methods and Supplementary Fig. 2). The derived values for size, mass and velocity dispersion can then be used to estimate the role of self-gravity at each point in the hierarchy, via calculation of an 'observed' virial parameter, $\alpha_{\text{obs}} = 5\sigma_v^2 R / GM_{\text{lum}}$. In principle, extended portions of the tree (Fig. 2, yellow highlighting) where $\alpha_{\text{obs}} < 2$ (where gravitational energy is comparable to or larger than kinetic energy) correspond to regions of p - p - v space where self-gravity is significant. As α_{obs} only represents the ratio of kinetic energy to gravitational energy at one point in time, and does not explicitly capture external over-pressure and/or magnetic fields⁶, its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.

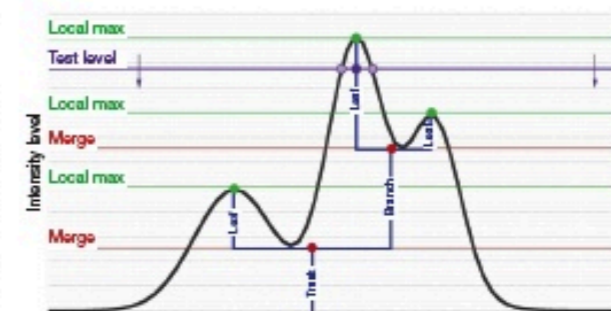


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in size here, light lines) until all the local maxima and mergers are found, and connected as shown. The intersection of a test level with the emission is a set of points (for example the light purple dots) in one dimension, a planar curve in two dimensions, and an isosurface in three dimensions. The dendrogram of 3D data shown in Fig. 2c is the direct analogue of the tree shown here, only constructed from 'isosurface' rather than 'point' intersections. It has been sorted and flattened for representation on a flat page, as fully representing dendrograms for 3D data cubes would require four dimensions.

Off the desktop

IIC Member login



Initiative in Innovative Computing at Harvard

home > research

scientists' discovery room lab (sdr lab)

Lead investigators
Chia Shen (IIC), Hanspeter Pfister (SEAS/IIC) and Robert Lue (FAS/Molecular and Cellular Biology)

Project staff
Michael Horn, Hao Jiang and Meekal Bajaj

Description

The Scientists' Discovery Room (SDR) is a next-generation visual digital laboratory for science discovery, collaborative learning and education. Our research focuses on experimenting with new modalities of human-computer interaction and visualization, to create a new genre of navigation, exploration and detailed analyses in multi-dimensional information spaces. All projects in SDR are in close collaboration with domain scientists and educators.



CThru, currently a collaborative endeavor with Molecular and Cellular Biology faculty, aims to develop a self-guided educational environment. In CThru, we examine methods for constructing interactive video-based educational modules. Using the animation "The Inner Life of the Cell" as a testbed, CThru addresses research issues of embedding interactive visible objects, extensive multimedia information and manipulatable 3D models within a video flow for self-explanatory learning, replacing sequential video viewing with the experience of exploring and manipulating in a multi-dimensional information space.

INVOLV is a generalizable multi-user interactive visualization framework for large hierarchical data sets. In this project, we address the visual layout of both the primary data representation and the overlay of alternate structures of the same data. Our first case study is the visualization of life on earth based on the Encyclopedia of Life (www.eol.org). We address the challenge of allowing free-form exploration of more than 1.2 million named species while communicating issues of biodiversity and phylogeny. The current visualization, designed for biodiversity science education settings, combines a Voronoi Treemap tessellation (see photo) with innovative human-computer interaction designs to support collaborative exploration and learning.

Slideshow: Tabletop Computers *Continued* By Meredith Ringel Morris

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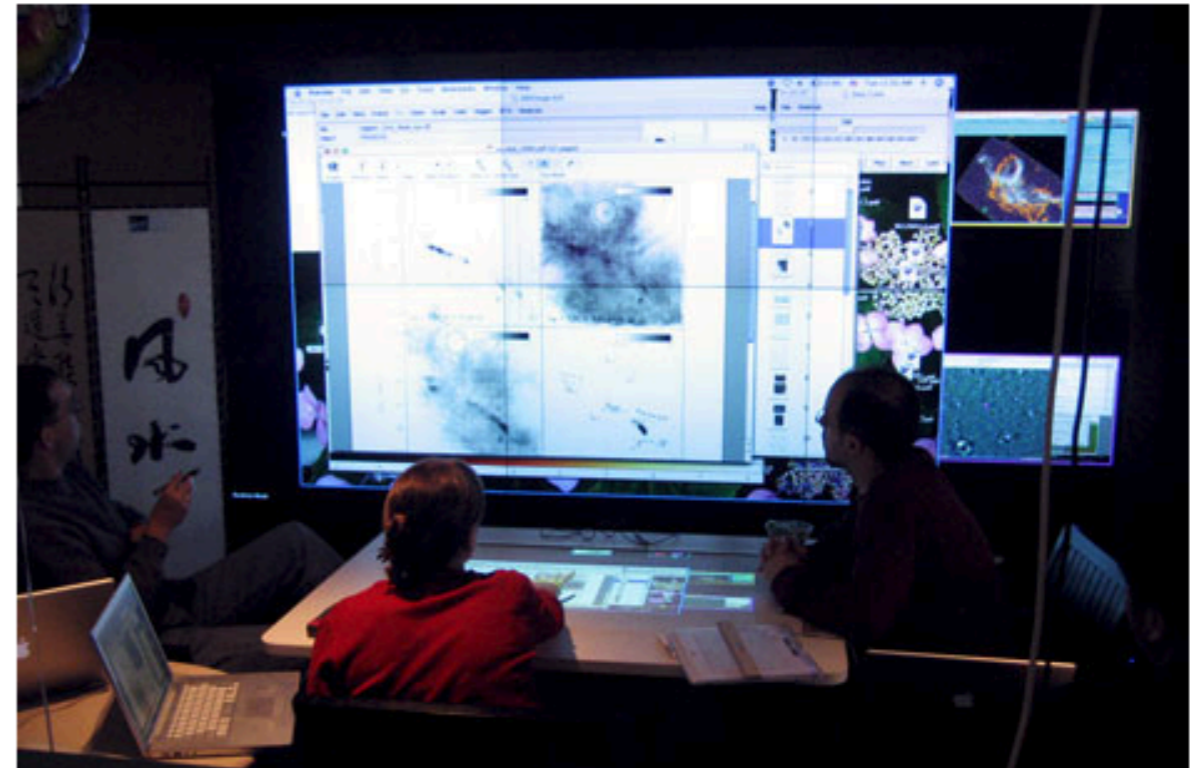


PHOTO: HAO JIANG, DANIEL WIGDOR, CLIFTON FORLINES, AND CHIA SHEN

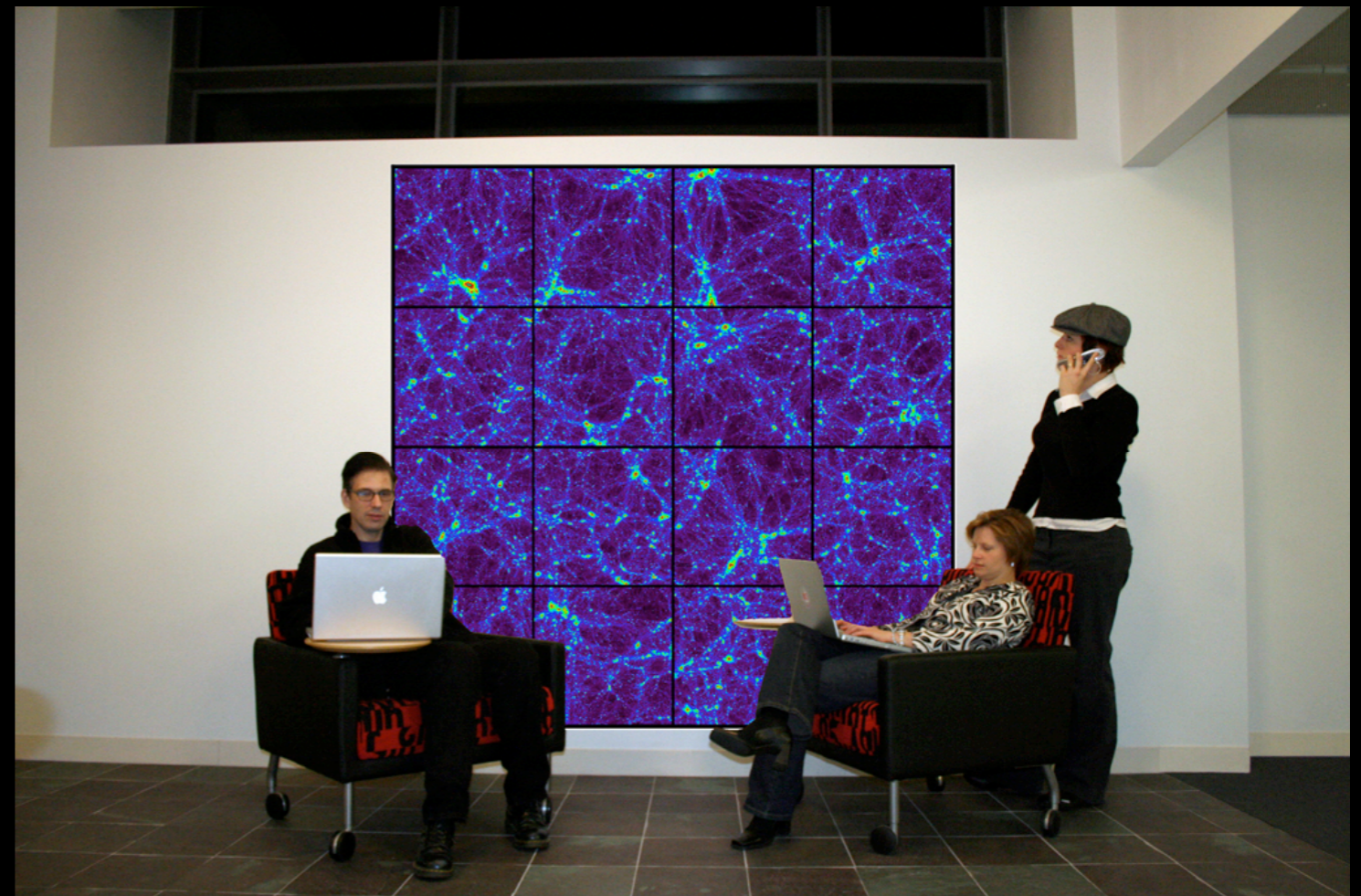
UBITABLE: Users can interact with surface computers through auxiliary devices, such as laptops, phones, and PDAs. The display on the auxiliary device can convey private or sensitive content to a single user, while group-appropriate content can appear on the tabletop display. Chia Shen and her colleagues at Mitsubishi Electric Research Laboratories, in Cambridge, Mass., have explored auxiliary interactions with surface computers in their UbiTable project, in which two people with laptops collaborate over a tabletop display. Recently, Shen expanded the UbiTable into an interactive room called the WeSpace. People can share data on their laptops with other people in the room, using both a table and a large display wall. Here, three Harvard University astrophysicists discuss radio and IR spectrum images using the WeSpace.

The Scientists' Discovery Room: Version 0.01



movie courtesy Daniel Wigdor, taken at MERL, Kendall Square, Cambridge

...why we must
explain that...



“This is not art.”



Many Eyes: Martin Wattenberg & Fernanda Viegas (IBM)

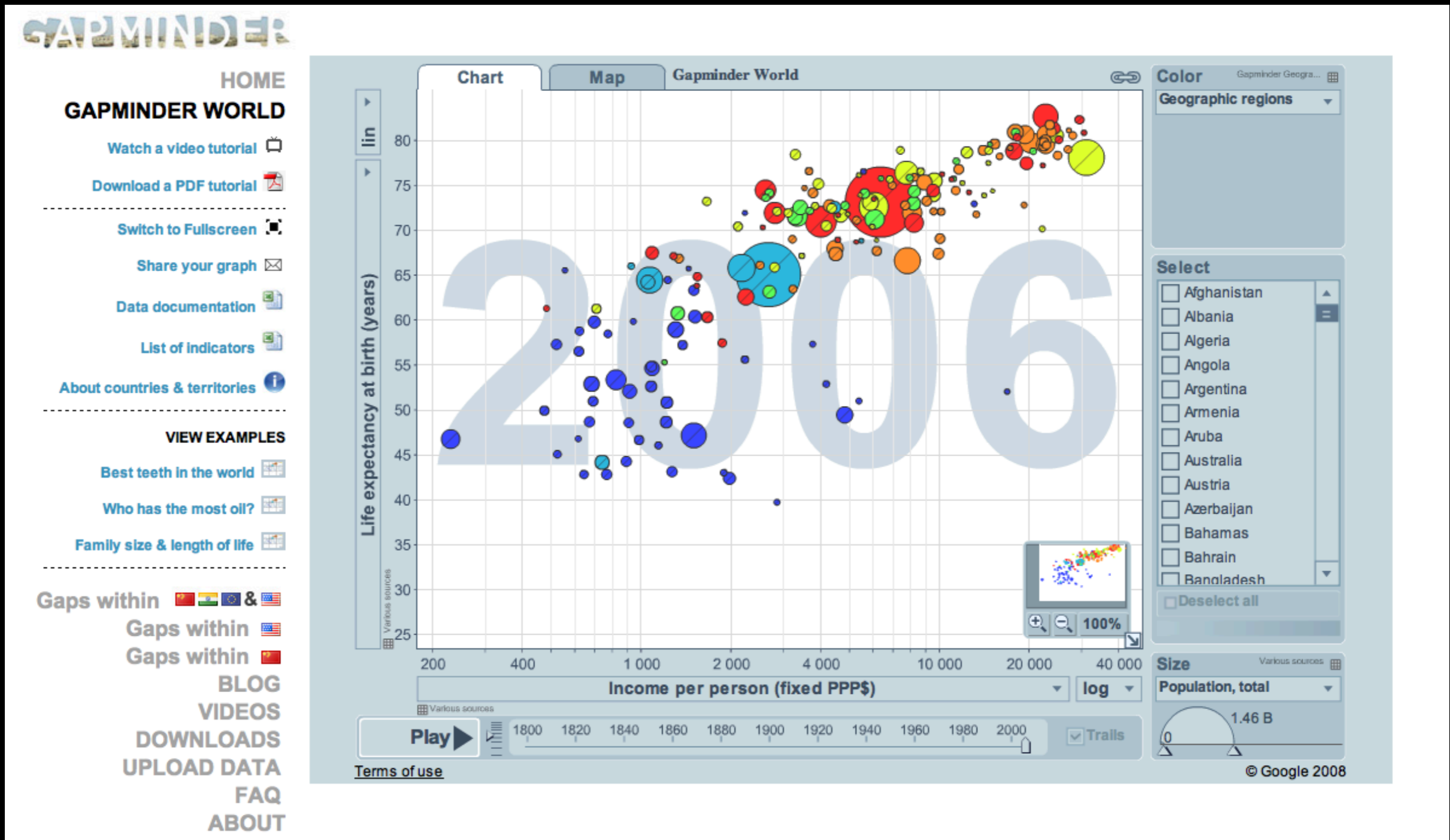
The screenshot shows the Many Eyes website interface. At the top, there is a browser window with the URL <http://maneyeyes.alphaworks.ibm.com/maneyeyes/> and a search bar containing 'maneyeyes'. The main content area is divided into several sections:

- Left Navigation Menu:**
 - explore**
 - visualizations
 - data sets
 - comments
 - topic hubs
 - my stuff
 - my topic hubs
 - my watchlist
 - my contributions
 - messages to me
 - participate**
 - create visualization
 - upload data set
 - create topic hub
 - learn more**
 - quick start
 - visualization types
 - about Many Eyes
 - blog
- Try Our Featured Visualizations:**
 - World Cup Finals Facts:** A bar chart comparing soccer stats across countries. *by Kyle C*
 - Leaves of Grass:** A wordle visualization of Walt Whitman's classic. *by amyp*
 - OECD Economic Outlook:** A map showing GDP growth projections for 40 countries over 2008-2010. *by OECD*
 - Bhagavad Gita:** A word tree visualization of the Hindu sacred text. *by I Love GOD (www.ishwar.com)*
- Featured Topic Hubs:**
 - Convention Coverage 2008:** For the US presidential election.
 - Sports:** All things sports.
 - OECD Factbook 2007:** Official statistics.

At the bottom left, there is a stylized illustration of two faces. The text 'many eyes beta' is displayed, followed by the tagline 'for shared visualization and discovery'. On the bottom right, there is a 'WORDLE!' section with the text 'debut on many eyes' and a word cloud featuring the name 'Alice' prominently. The IBM logo is visible in the bottom right corner with the text 'brought to you by IBM'.

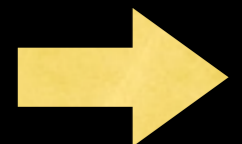
Gapminder:

Re-usable, interactive graphical tools



<http://gapminder.org>

Facilitating re-usabilty...
Mashups, Resource Hubs, APIs



More on re-usability

Exemplar mashup c. 2006

UFO Maps Sighting reports, as they happen. [Comments?](#)

July Year: 2006

Map Satellite Hybrid

Norfolk, MA • Jul 1st 2006 12:00:00 AM

It was a ball of opal or white with a little pink and green sheen to it. Not metal....

[Read full report](#)

Re-usable, standard interaction tools

“Social” (community) tags & data

Portals to deeper information

“Provenance” Information

Massive online data repository

Seamless dataset integration

Interactive Data Exploration

Commercial, but open-source, “API’s”

Google Maps’ “kml” format (GIS)

Massive online data repository

Open Source user contributions

Legal issues addressed openly

Wikipedia is all “social”

Easy information contribution

Wikipedia!

an excerpt of interest from Wikipedia's [Unidentified flying object](#) article...

UFO Sighting Report Form

Powered by Google Maps

UFO data from [National UFO Reporting Center](#), UFO icon by [Tom7](#), 24h project by [Poly9](#)

POWERED BY Google

UFO Atlas - [Terms of Use](#)

Google Gadgets & APIs

Add a Gadget

Featured

[All](#)

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[Web](#)

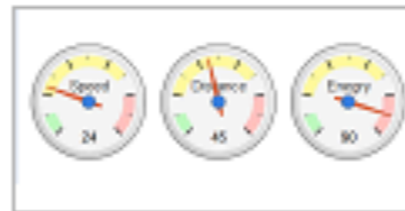
[Diagrams](#)

[Finance](#)

[Custom...](#)

Have a better idea?

[Write your own gadget](#) to display data in cool new ways. Want to see your gadget on this list? Submit it to us using the [submission form](#).



Gauges

By Google

Each numeric value is shown as a gauge.

[Add to spreadsheet](#)

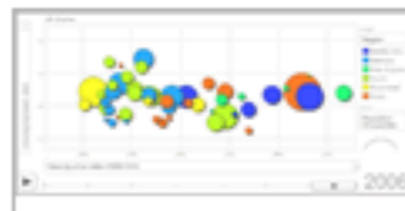


Interactive Time Series Chart

By Google

An interactive time series line chart like the one used in Google Finance. The first column contains dates and the second column contains values.

[Add to spreadsheet](#)



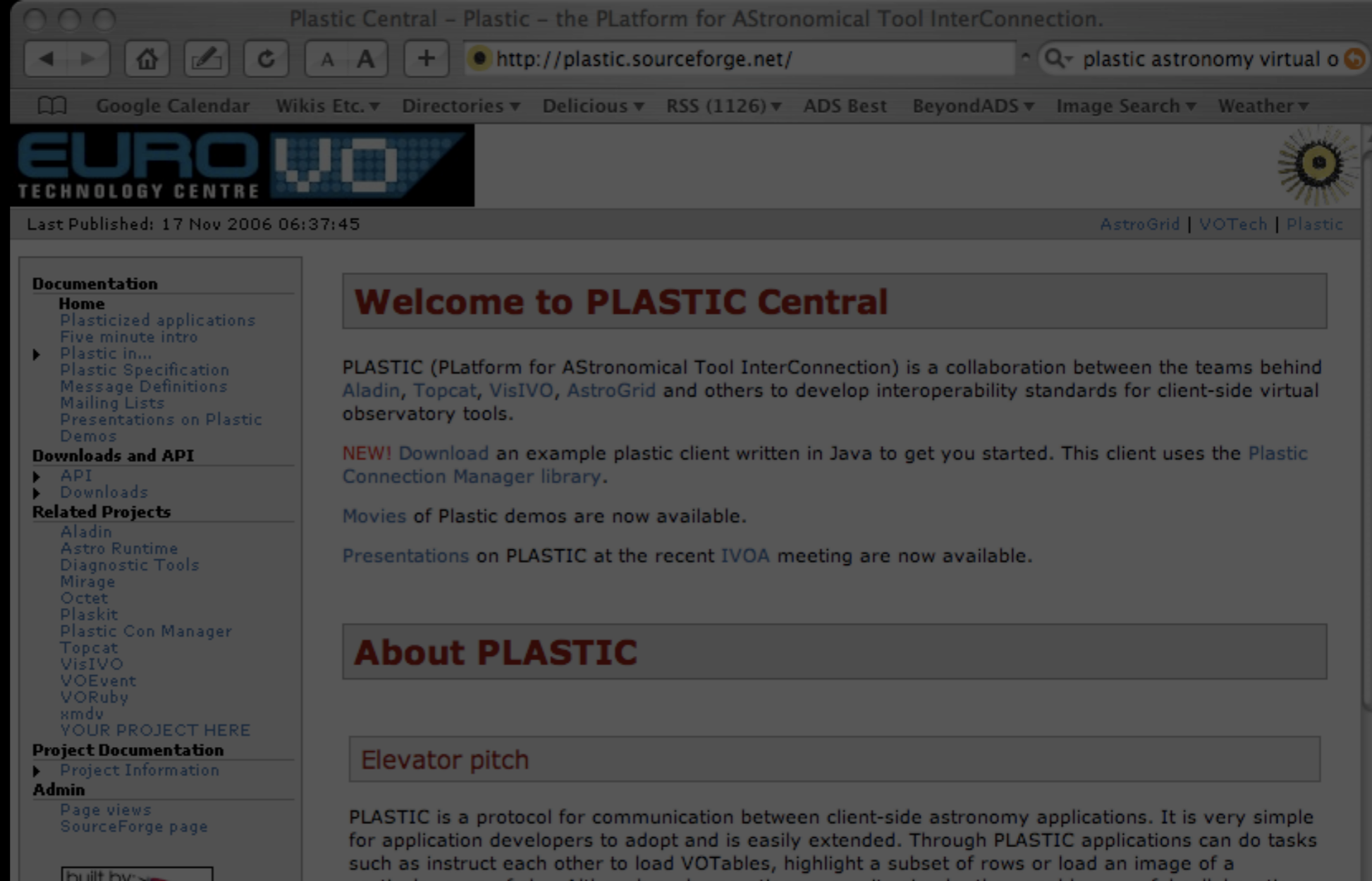
Motion Chart

By Google

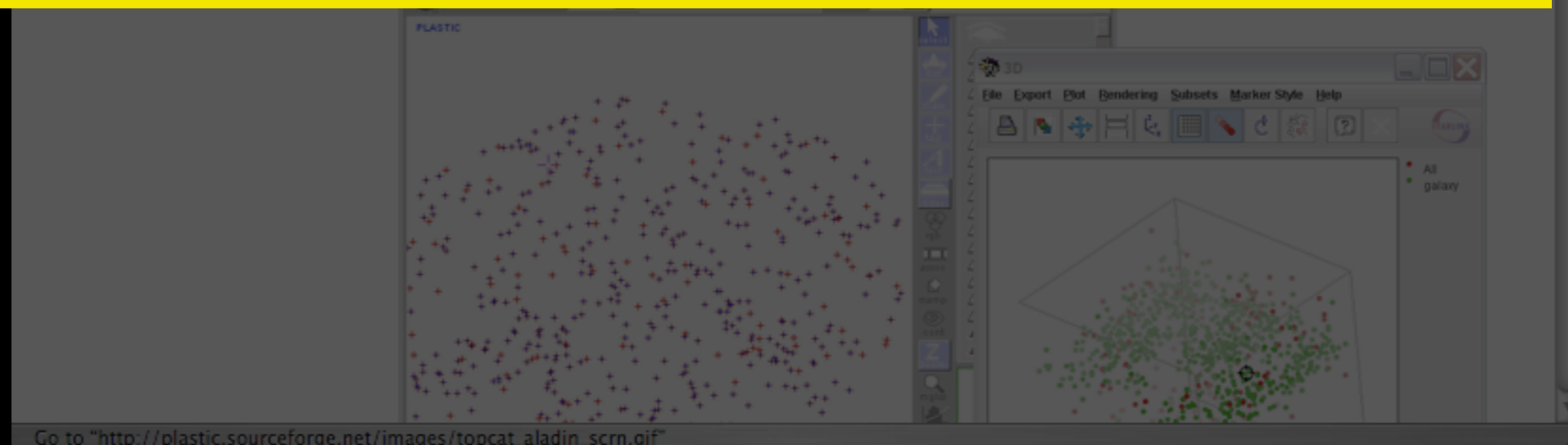
A dynamic flash based chart to explore several indicators over time. Required columns: bubble name, time and 2 columns of numeric values. Optional columns: Numeric values or categories.

[Add to spreadsheet](#)

“PLASTIC” (SAMP)



between tools. The philosophy is that the astronomer should have a suite of interoperating tools at his disposal, each of which does **one thing well** and which can be composed according to his particular needs



What...

...is easier now than before?

fast computation, animation, 3D

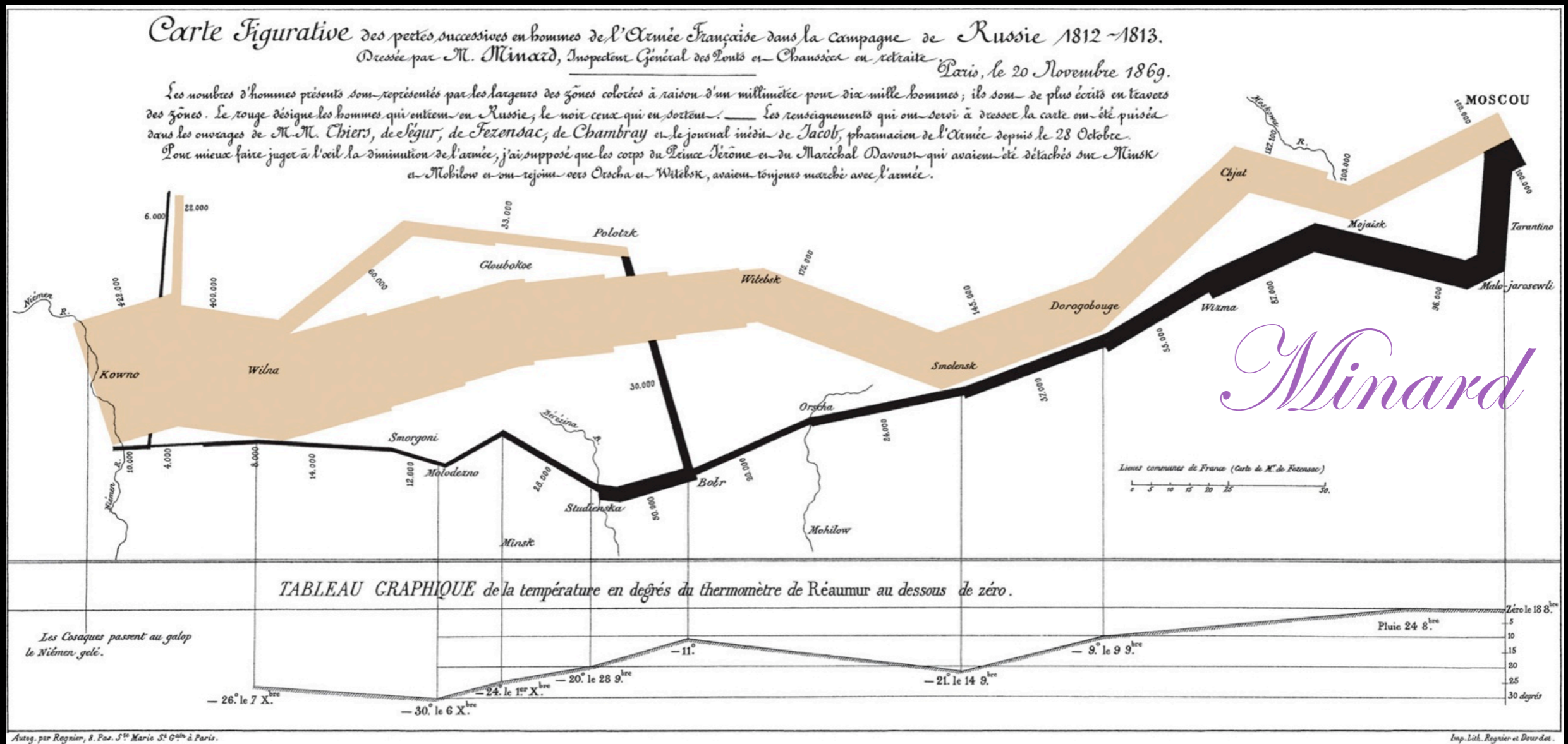
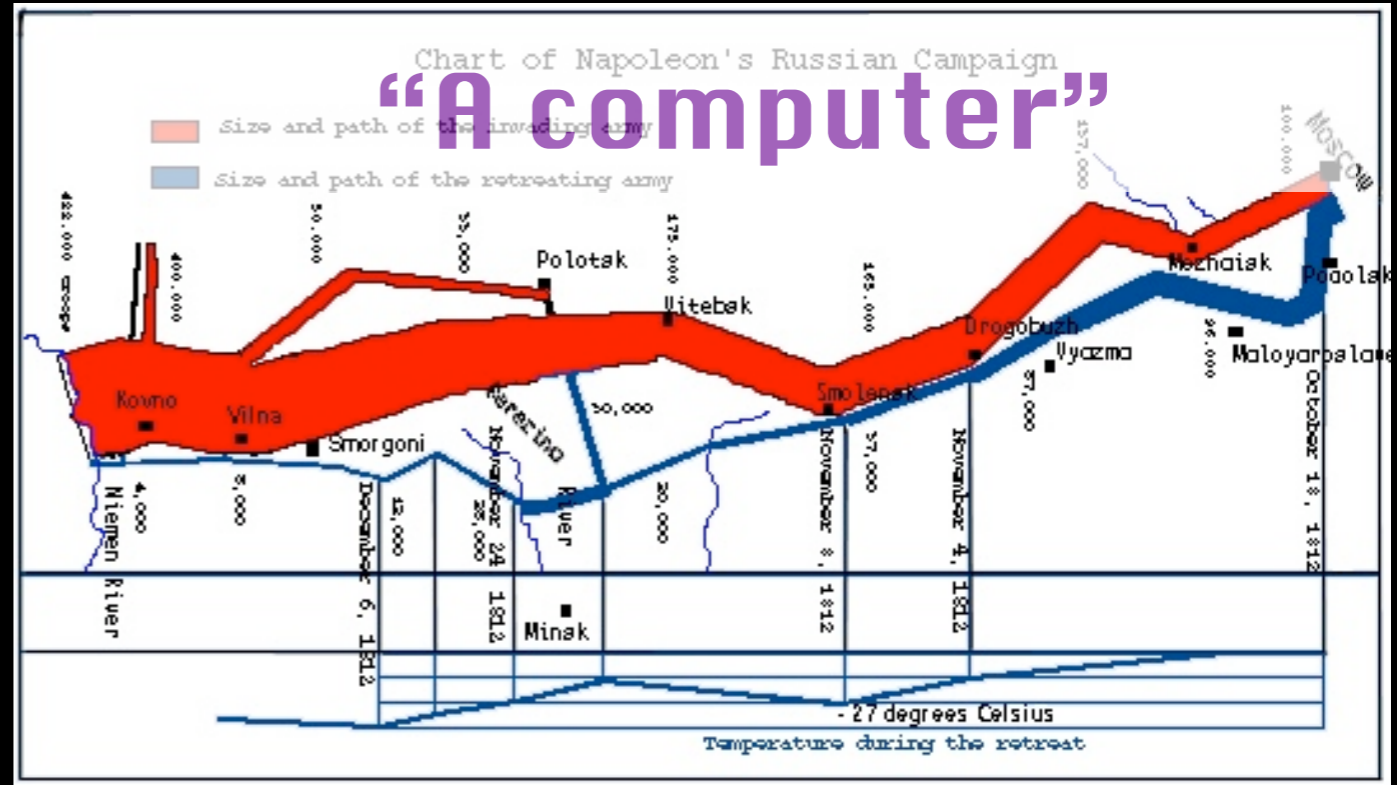
...was easier before than now?

craftsmanship

...should be easier in the future?

modular craftsmanship

Are we held back by confining tools?



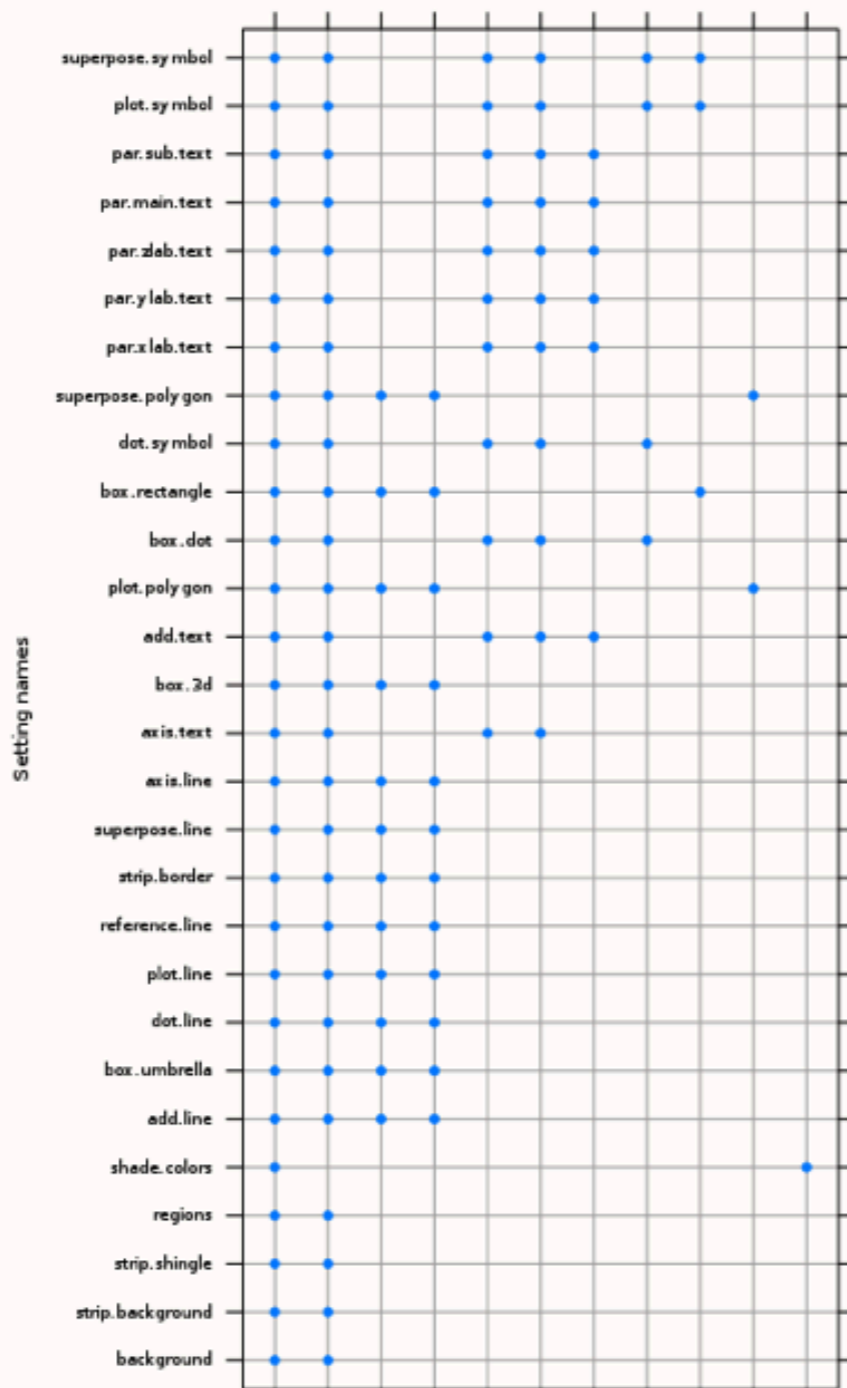
Lattice: Multivariate Data Visualization with R - Figures and Code

Black and White Theme **Default Color Theme** Classic Gray Theme

- Chapter 1
- Chapter 2
- Chapter 3
- Chapter 4
- Chapter 5
- Chapter 6
- Chapter 7**
- Figure 7.1
- Figure 7.2
- Figure 7.3**
- Figure 7.4
- Chapter 8
- Chapter 9
- Chapter 10
- Chapter 11
- Chapter 12
- Chapter 13
- Chapter 14

- Extracts
- Errata
- Reviews

Figure 7.3



```
## Chapter 7
vad.plot <-
  dotplot(reorder(Var2, Freq) ~ Freq | Var1,
    data = as.data.frame.table(VADeaths),
    origin = 0, type = c("p", "h"),
    main = "Death Rates in Virginia - 1940",
    xlab = "Number of deaths per 100")

## Figure 7.1
vad.plot

dot.line.settings <- trellis.par.get("dot.line")
str(dot.line.settings)
dot.line.settings$col <- "transparent"
trellis.par.set("dot.line", dot.line.settings)
plot.line.settings <- trellis.par.get("plot.line")
str(plot.line.settings)
plot.line.settings$lwd <- 2
trellis.par.set("plot.line", plot.line.settings)

## Figure 7.2
vad.plot

panel.dotline <-
function(x, y,
  col = dot.symbol$col, pch = dot.symbol$pch,
  cex = dot.symbol$cex, alpha = dot.symbol$alpha,
  col.line = plot.line$col, lty = plot.line$lty,
  lwd = plot.line$lwd, alpha.line = plot.line$alpha,
  ...)
{
  dot.symbol <- trellis.par.get("dot.symbol")
  plot.line <- trellis.par.get("plot.line")
  panel.segments(0, y, x, y, col = col.line, lty = lty,
    lwd = lwd, alpha = alpha.line)
  panel.points(x, y, col = col, pch = pch, cex = cex, alpha = alpha)
}
trellis.par.set(dot.line = dot.line.settings,
  plot.line = plot.line.settings)
trellis.par.set(dot.line = list(col = "transparent"),
  plot.line = list(lwd = 2))
trellis.par.set(list(dot.line = list(col = "transparent"),
  plot.line = list(lwd = 2)))

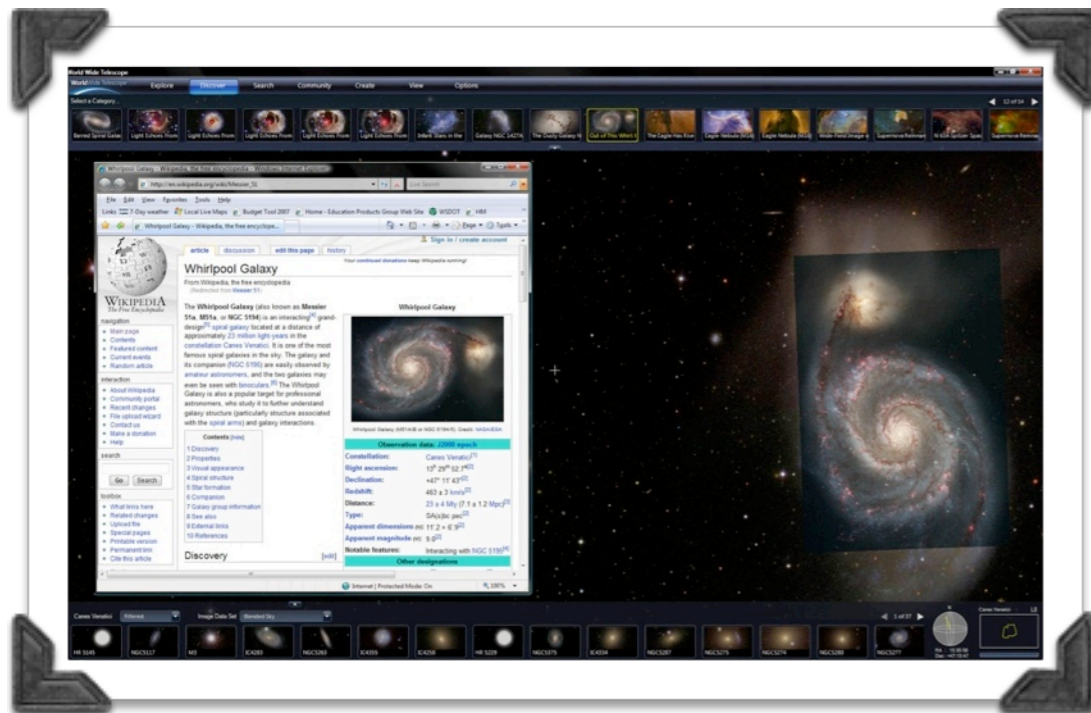
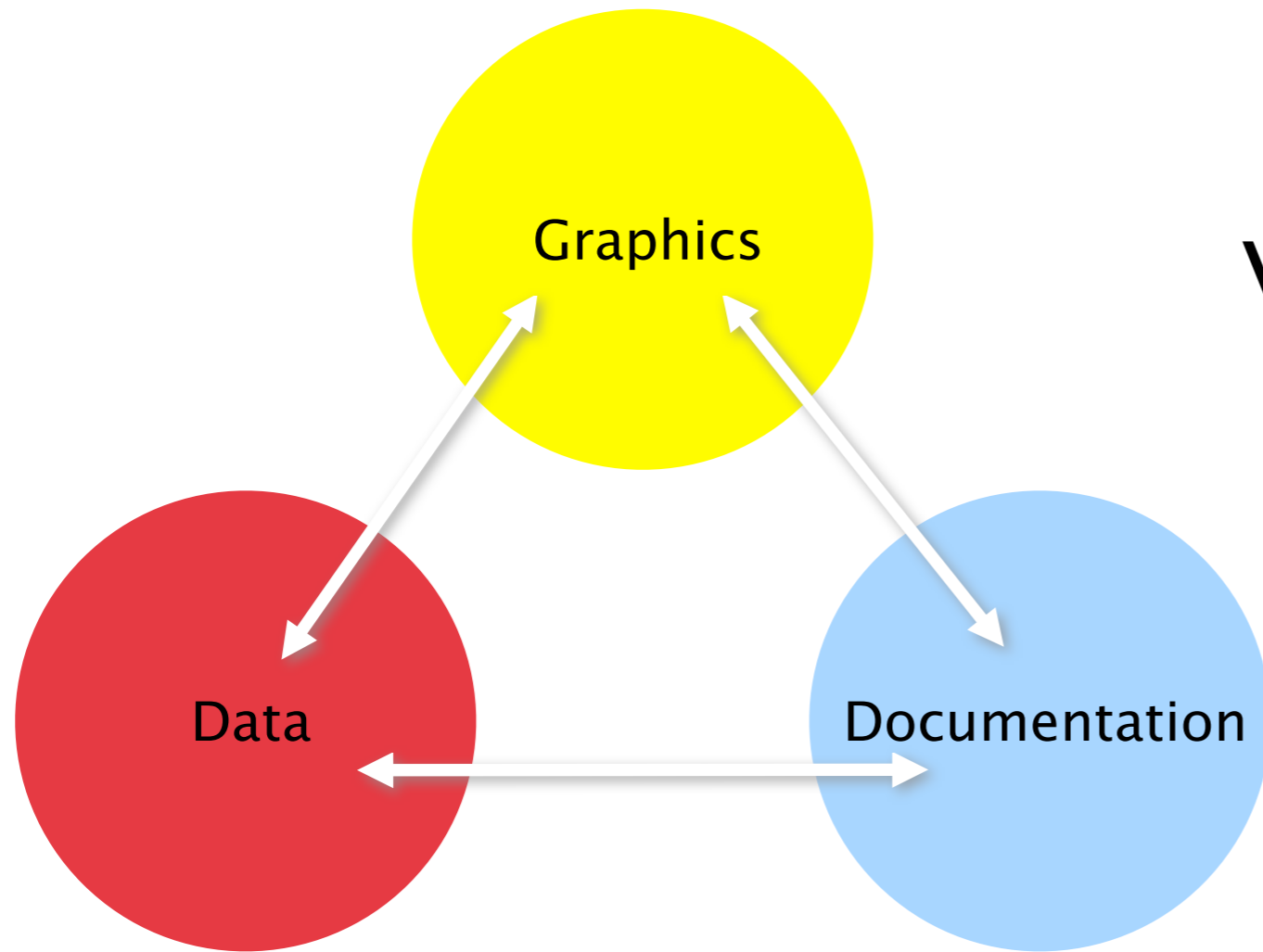
## Figure 7.2 (alternative)
update(vad.plot,
  par.settings = list(dot.line = list(col = "transparent"),
    plot.line = list(lwd = 2)))

tp <- trellis.par.get()
unusual <-
  c("grid.pars", "fontsize", "clip",
    "axis.components",
    "layout.heights", "layout.widths")
for (u in unusual) tp[[u]] <- NULL
names.tp <- lapply(tp, names)
unames <- sort(unique(unlist(names.tp)))
ans <- matrix(0, nrow = length(names.tp), ncol = length(unames))
```

we must do better....

The Future, Now

World Wide Telescope (ask for a demo...)





WorldWide Telescope

Microsoft
Research