Exploratory Data Analysis and The Future, with glue
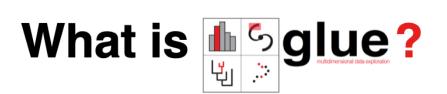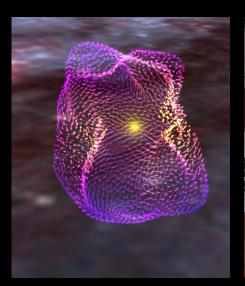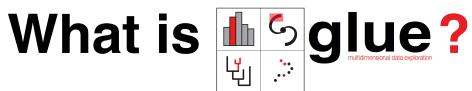

Alyssa Goodman, Center for Astrophysics | Harvard & Smithsonian

What is glue?

multidimensional data exploration

It's not an acronym.

It is open-source software that
glues data,
glues graphs &
glues tools.

data
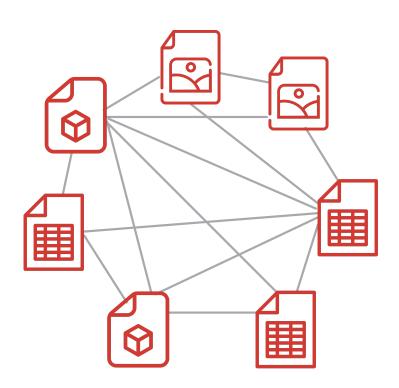
numbers (tables, arrays, spreadsheets)

images & maps (FITS, JPEG, GIS and more)

data cubes (3D, 4D, and more)

data files' common attributes are **glued**

avoiding the need to merge data files

"graphs"

common statistical graphics
(scatterplots, histograms, tables, curves, overlays)

maps & images
(greyscale, color, contours, layer control…)

3D displays
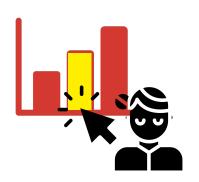(scatter plots, volumetric rendering, sliders…)

specialized & custom charts
(dendrograms, polar plots, + domain-specific options)
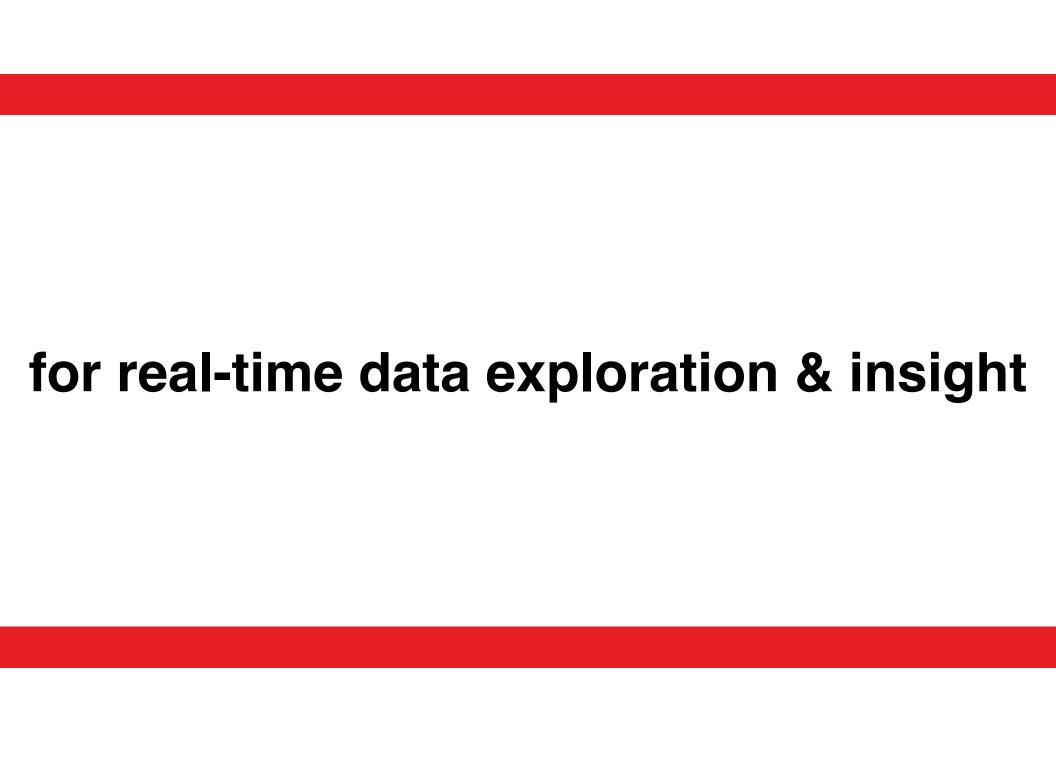
selections propagate across all graphs

for real-time data exploration & insight

tools

 plug-ins (user-defined formats, plots, layouts…)

 web services (across domains)

 command-line (built-in terminal, scriptable)

for easy customization

glue

multidimensional data exploration

glues data,
glues graphs &
glues tools.

glueviz.org

BONUS: **save**, **share**, or **publish** what you learn—

save **"sessions"** to continue where you left off

export **graphics**

use/export to **Jupyter** environments

export to **plot.ly** (javascript)

export to **augmented reality**

learn how at glueviz.org.

glue
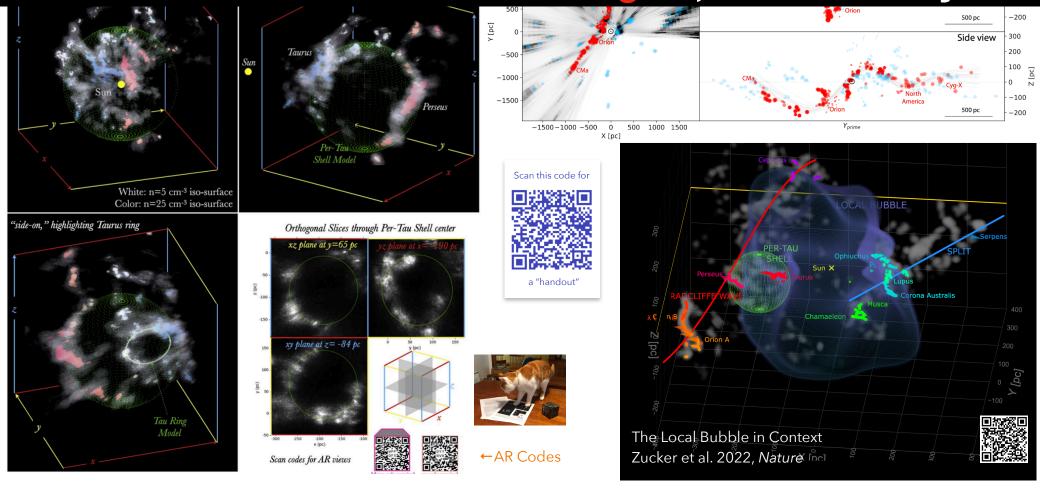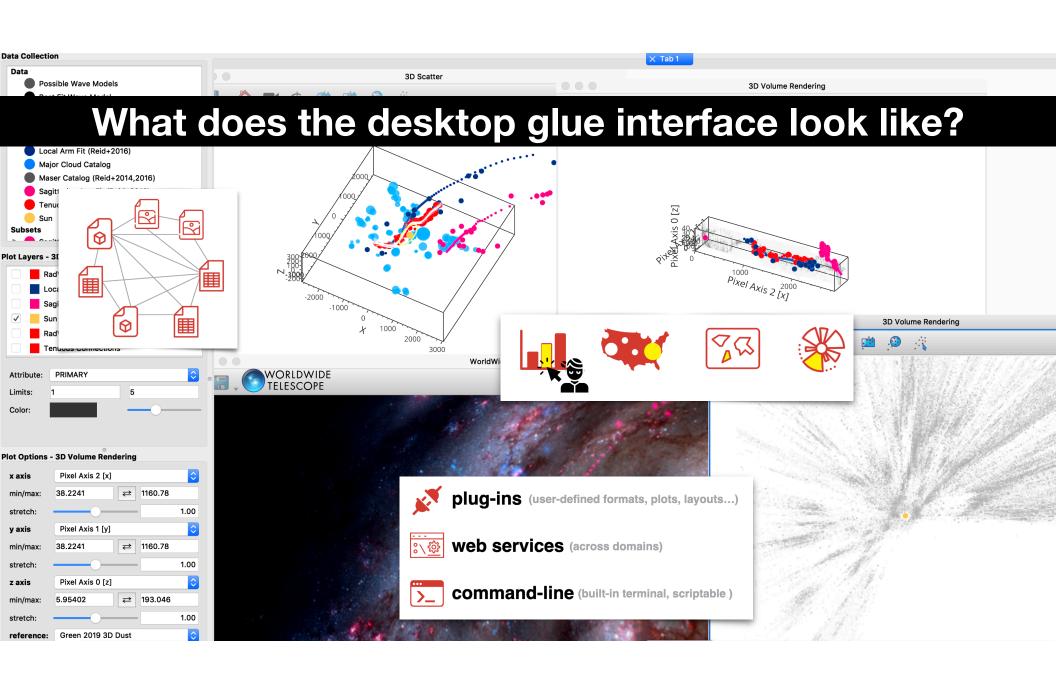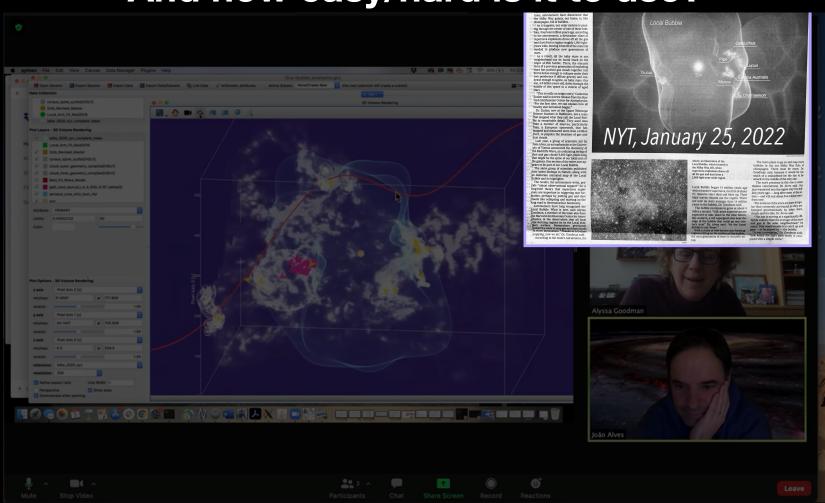
multidimensional data exploration

glueviz.org

Great…but what can I do with glue, in Astronomy?

The Magnetic Field of the Local Bubble, in 3D. O'Neill et al. 2023—image embargoed until AAS press conference 10:15 AM Wednesday

Great…but what can I do with glue, in Astronomy?

White: n=5 cm⁻³ iso-surface
Color: n=25 cm⁻³ iso-surface

Sun

Taurus

Perseus

Per-Tau Shell Model

"side-on," highlighting Taurus ring

Tau Ring Model

Orthogonal Slices through Per-Tau Shell center

xz plane at y=65 pc

yz plane at x=−190 pc

xy plane at z=−84 pc

Scan codes for AR views

←AR Codes

Scan this code for a "handout"

Top-down view

Side view

Orion

CMa

North America

Cyg-X

The Local Bubble in Context
Zucker et al. 2022, *Nature*

Cepheus

LOCAL BUBBLE

PER-TAU SHELL

Ophiuchus

Sun ✗

Serpens

SPLIT

Perseus

Taurus

Lupus

RADCLIFFE WAVE

Pl

Corona Australis

Musca

Chamaeleon

Orion A

What does the desktop glue interface look like?

And how easy/hard is it to use?

NYT, January 25, 2022

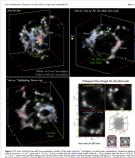The Future

The Future of

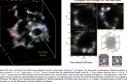TINYURL.COM/UNIVERSE-I... ...UGMENTED REALITY

Augmented Reality is here–in AAS Journals!

In 2021, the *Astrophysical Journal Letters* published the first **Augmented Reality (AR)** figure in an AAS Journal. The AR-enhanced figure (right) appears in a paper by Bialy et al. presenting the discovery of the Perseus-Taurus Supershell. An AAS Nova article describes the discovery and the technology in more detail.

Want to help the AAS bring you even-better AR experiences in the future?

Stop by the AAS booth (627) to help improve the AAS AR experience. If you participate in our user testing, you will leave with your very own augmented reality Merge Cube!

The video at tinyurl.com/Per-Tau-AR shows how it works.

WANT TO EXPLORE THE PERSEUS-TAURUS
SUPERSHELL IN 3D?

IN YOUR BROWSER AT TINYURL.COM/UNIVERSE-IN-MY-HAND   OR IN AUGMENTED REALITY (KEEP WATCHING)...

To try out an AR figure on your smartphone, scan one of the QR codes above.
The left-hand QR code does NOT require a "Merge Cube," and the right-hand code does. First-time users will be prompted to download a free app. The flat-screen interactive version of the figure, also showing the QR codes, is available at TinyURL.com/Universe-in-My-Hand. *AR funded by NSF.*
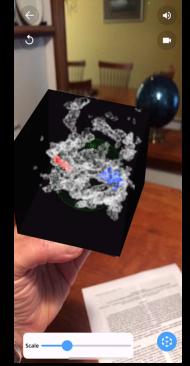
Next…

glue in the browser, for real.

plug-ins galore!

glupyter (a.k.a. "glue jupyter")

"glupyter" is a union of glue and Jupyter software environments. We think it may well be the future of glue, or "glue-qt" as experts sometimes call the desktop app version of glue. This webpage, hosted openly and freely by glue solutions, inc., serves as a clearinghouse for current information about glupyter-related projects. Some of these projects are funded by government agencies (notably NSF and NASA), others by private foundations (e.g. The Gordon and Betty Moore Foundation), some as part of corporate collaborations (e.g. Harvard+Google Data+Climate), and some by open-source consulting work carried out by glue solutions, inc.

The glue-jupyter GitHub repository is fully open,
and more detail can be found on this Read the Docs page.

Quick insights for Images, Spectra

JDAViz

includes: ImViz, CubeViz, SpecViz, MOSViz

Sponsor: NASA, James Webb Space Telescope

Read more (blog post at 10QViz.org)...

GitHub

Open-Source GIS Data Exploration

SAVE

Search-Analysis-Visualization-Environment

Sponsors: Harvard+Google Data+Climate

Read more
at Data+Climate site...

GitHub

Data Science Education

Cosmic Data Stories

Sponsor: NASA, Science Activation Program (funded proposal)

Read more
at CosmicDS website...

GitHub

bringing glue to JupyterLab

glupyter prototype

Sponsors: The Gordon and Betty Moore Foundation and the National Science Foundation

[Demo]

MilkyWay3D.org — Home Data **Software** Science Gallery Events Collaborators

Software

The Software Story

Thanks to digital data projection, today's planetariums can be used as immersive visualization spaces in both educational and research contexts. And, thanks to modern open-source, modular, approaches to software development, new visualization tools can be built by mixing, matching, and adding to established older ones. In 2019, a group of visualization experts meeting in Dagstuhl, Germany decided to try integrating elements of several astronomy data visualization packages, with the aim of creating new, flexible, data exploration environments that would be useful in both research and educational contexts, on any size screen, including a planetarium dome. Since then, a series of gatherings and experiments at New York's Hayden Planetarium has led to the successful development of "plug-ins" that insert elements of one of three software packages (glue, WorldWide Telescope, OpenSpace) into the other two.
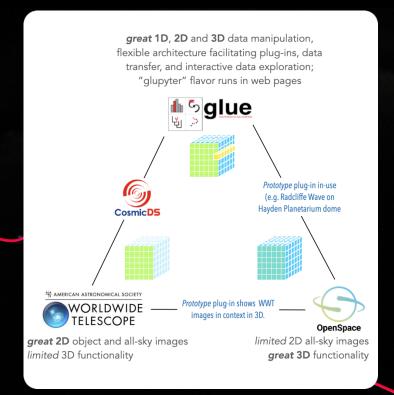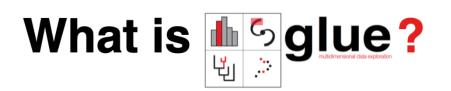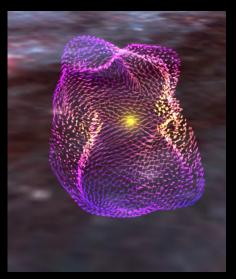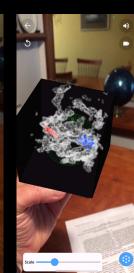
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glueviz.org

tinyurl.com/local-bubble-b
but EMBARGOED until Wednesday

gluesolutions.io/augmented-reality

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