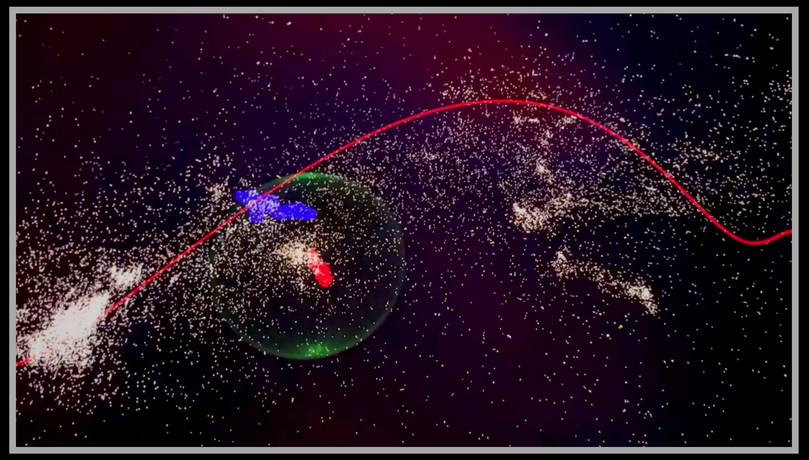
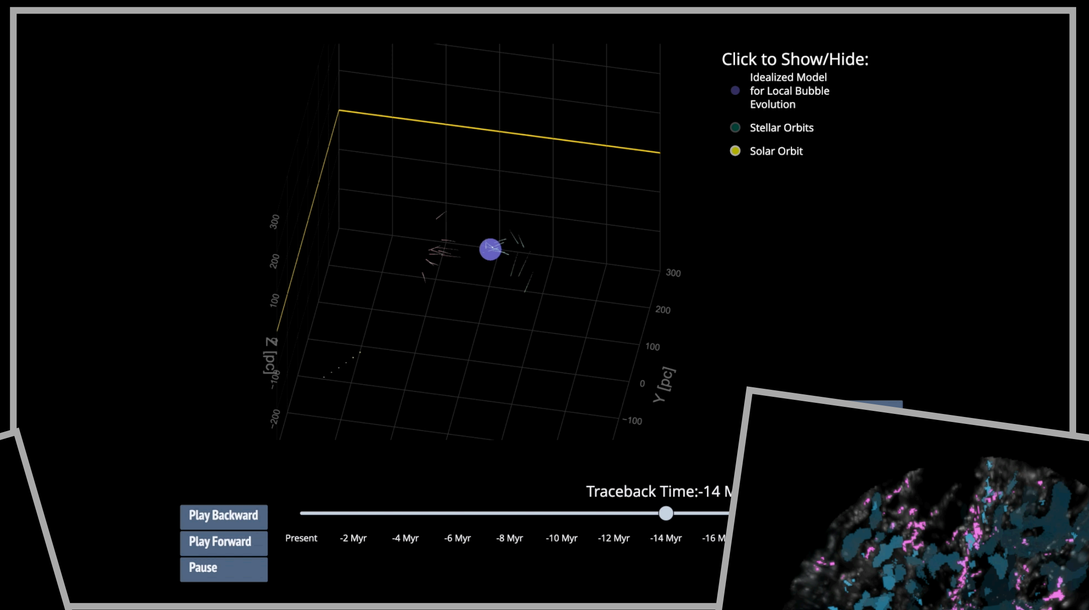
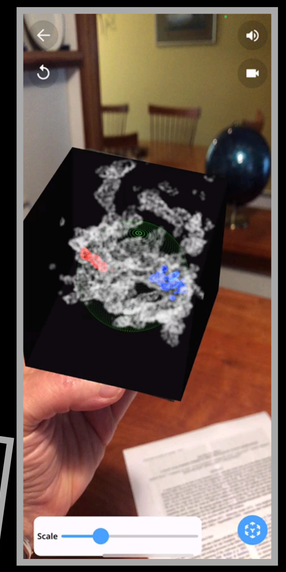
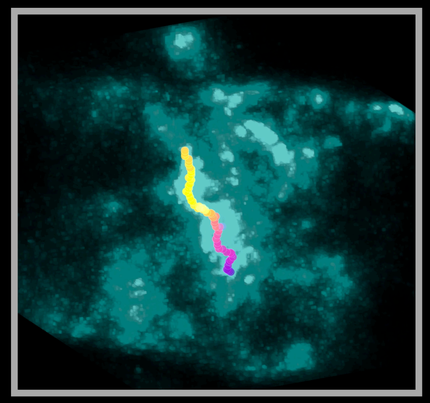
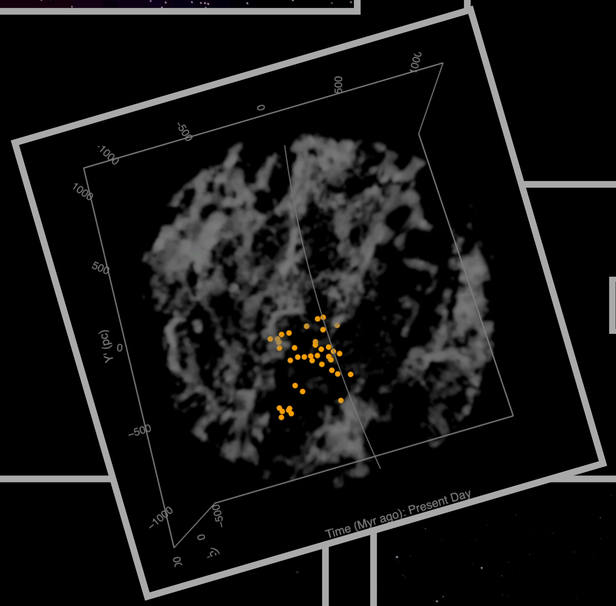


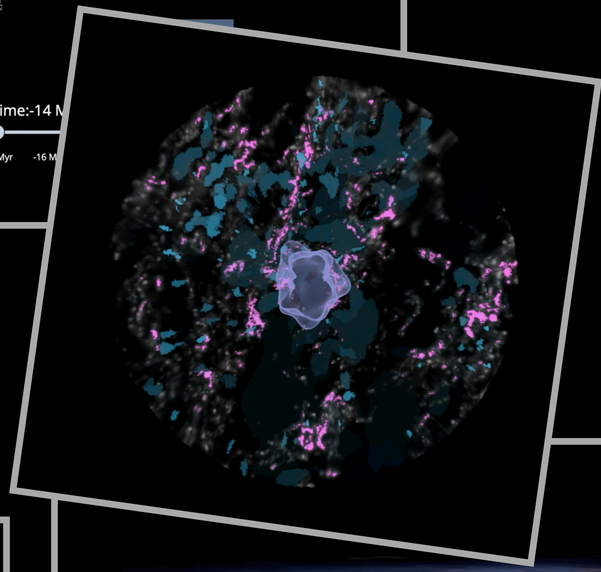


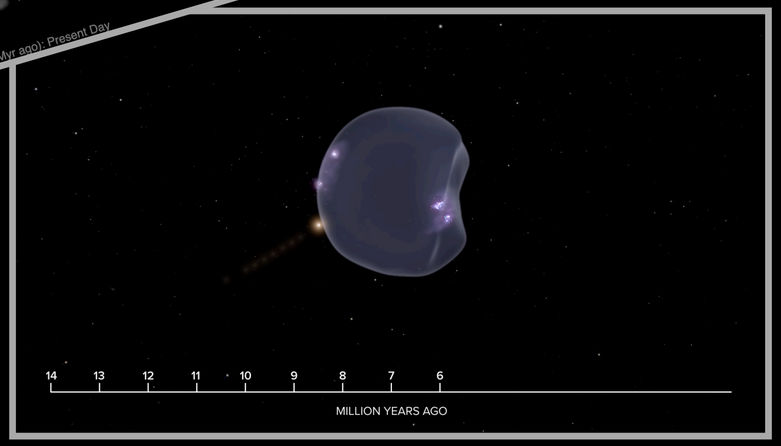






[AAS, June 2024]





Zucker et al. 2021, Bialy et al. 2021; Zucker et al. 2022, Konietizka et al. 2024, O'Neill et al. 2024, Swiggum et al. 2024. *embargoed*

VISUALIZATION

FOR ASTRONOMY

RESEARCH + EDUCATION + OUTREACH

Alyssa Goodman • Center for Astrophysics | Harvard & Smithsonian

+ so many (vis) collaborators! e.g., here at AAS: Michelle Borkin (NEU), Jon Carifio (CfA), Mackenzie Creamer (NEU) Jackie Faherty (AMNH), Robert Hurt (IPAC), Gus Muench (AAS) Cami Pacifici (STScI), Josh Peek (STScI/JHU), Erik Tollerud (STScI) Pat Udomprasert (CfA) et al.!

VISUALIZATION

FOR ASTRONOMY

RESEARCH + EDUCATION + OUTREACH

INFRASTRUCTURE

standalone computers

open-source software

web browsers

cloud services

2009

INFRASTRUCTURE

standalone computers

open-source software

web browsers

cloud services

2025

LIVE

LIVE Environments

About LIVE | Capabilities | Tech | Who are we? | Learn More

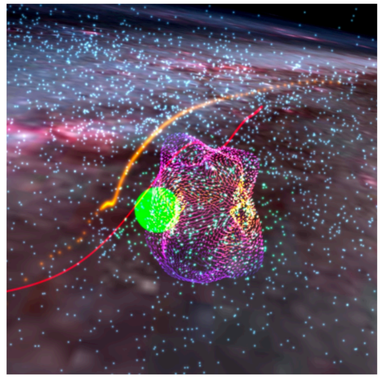
Linkable Interactive Visualization Exploration (LIVE) Environments

What is LIVE?

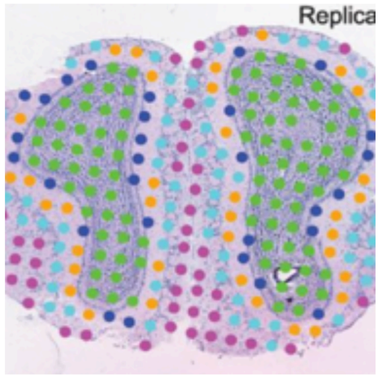
LIVE lets anyone build
"Linkable Interactive Visualization and Exploration" Environments.

LIVE is free, open-source, and helps with shared data and visualization challenges across astronomy (LIVE Astro), biology (LIVE Bio) and GIS (LIVE GIS).

As LIVE's infrastructure is being built, collaborators are ensuring its utility across Astronomy, Biology, and GIS by pursuing LIVE's science demonstration projects.



LIVE Astro



LIVE Bio

LIVE GIS

LIVE

LIVE-env.org

LIVE Astro

glue

python library to explore relationships within and between related datasets

Jdaviz

GUI-based tools link data visualization and interactive analysis(based on glue & Jupyter).

OpenSpace

interactive data visualization software designed to visualize the entire known universe.

WorldWide Telescope

a tool for showcasing astronomical data and knowledge

astropy

A community effort to develop a common core package for Astronomy in Python and foster an ecosystem of interoperable astronomy packages

ESA Sky

allows visualization and download public astronomical data (cf. Aladin)

LIVE

Tools & Integrations (Requested & Planned)

Leaders of several well-used astronomical tools and toolkits are eager to integrate their projects with LIVE Astro. (For reference, prototype plug-ins for the Aladin and yt services below already exist for glue, and discussions of MAST integration with LIVE Astro would be an expansion of the Jdaviz environment built by NASA for the James Webb Space Telescope Mission, using glue. The CARTA project is of special interest, in that it could serve to bring the "radio" astronomy community into better communication with shorter-wavelength-focused colleagues more reliant on MAST-based tools).

CARTA

Cube Analysis and Rendering Tool for Astronomy image visualization and analysis tool designed for the ALMA, the VLA, & SKA

Aladin Lite

lightweight version of the Aladin tool, running in the browser and geared towards simple visualization of a sky region

MAST

The Mikulski Archive for Space Telescopes is an astronomical data archive focused on the optical, ultraviolet, and near-infrared

Astro Data Lab

The overall goal of Astro Data Lab is to enable efficient exploration and analysis of the large datasets now being generated by instruments on NOIRLab and other wide-field telescope

TOPCAT

does what you want with tables

js9

brings astronomical image display to your browser and desktop

+ More Tools & Integrations useful in Astronomy & *Beyond* (Requested & Planned)

vaex

python library for lazy out-of-core DataFrames (similar to Pandas), to visualize and explore big tabular datasets

K3D

Jupyter Notebook 3D visualization package.

A 3D visualization tool designed with native interoperation with existing powerful libraries such as PyVista, without being strictly dependent on them.

yt

python package for analyzing and visualizing volumetric data

And more... stay tuned!

LIVE-astro.org

glue

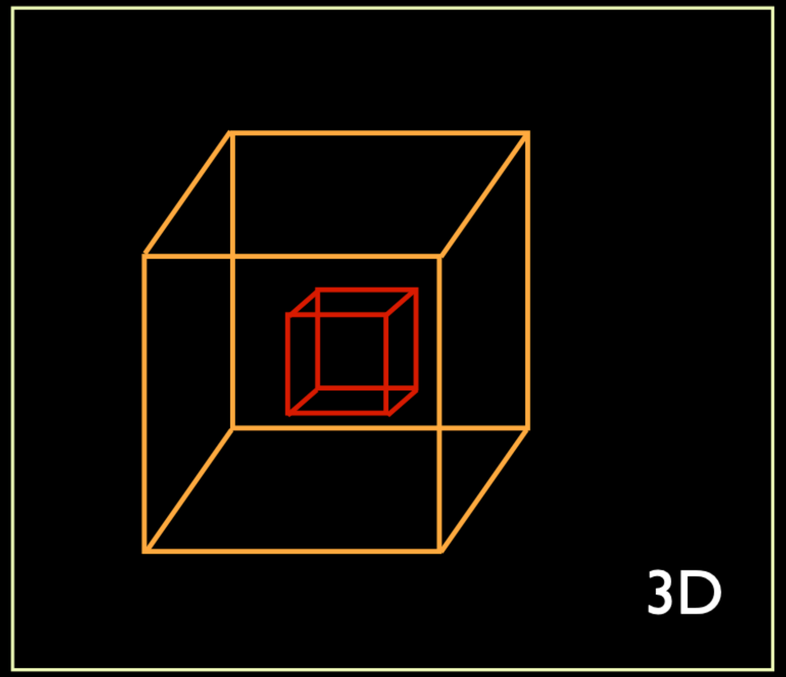
multidimensional data exploration

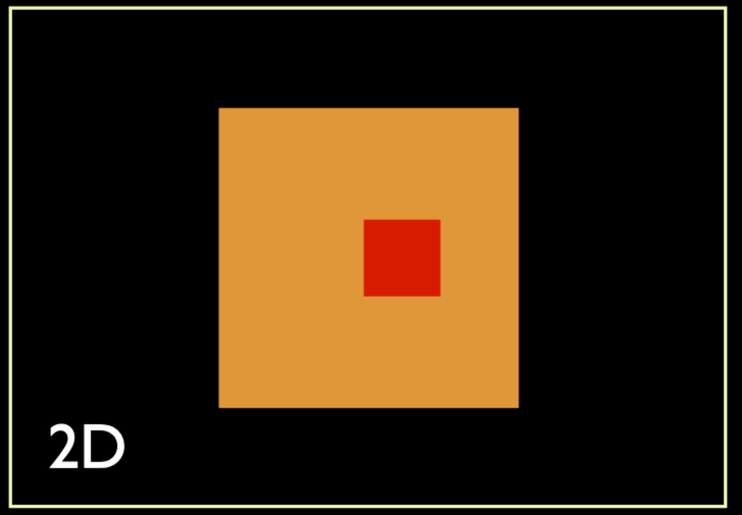
glueviz.org

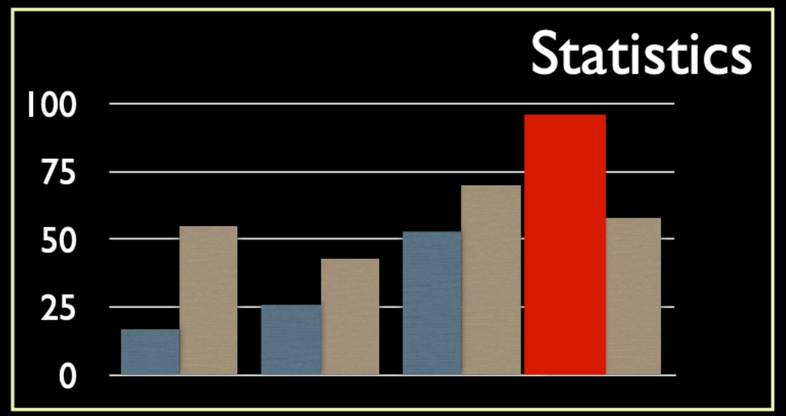
glupyter

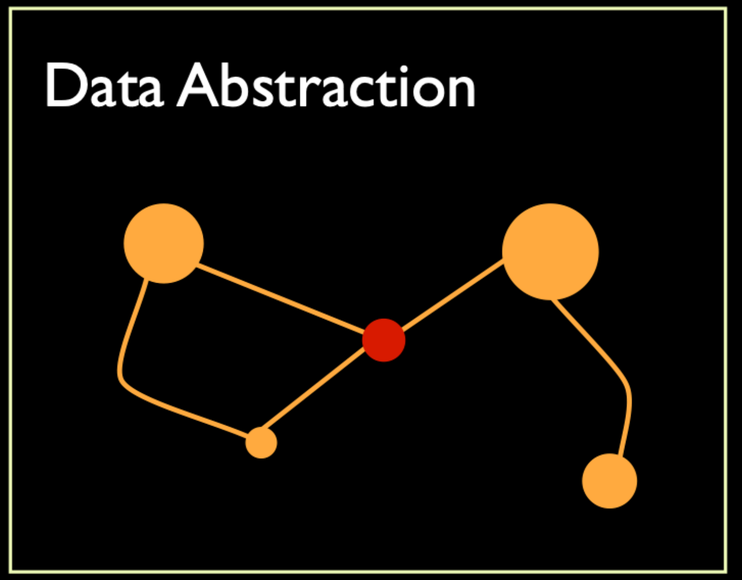
multidimensional data exploration

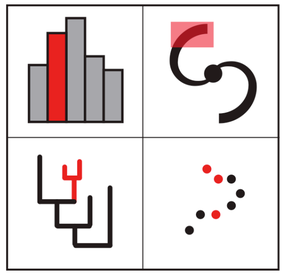
"Linked Views of High-dimensional Data"











glue

multidimensional data exploration

glues data,
glues graphs &
glues tools.

glueviz.org

Hot off the press! Sonification in glue

(cf. Sonification in glupyter/Jdaviz too!)

Creating an Intensity vs. Time and Frequency vs. Time Data Sonificati Tool for Glue

Joe Bradley, Harvard College

Advisor: Dr. Kimberly Arcand

Abstract

With almost all of observational astronomy and astrophysics being concerned with light-based phenomena, it follows that most data representations in the field are visual. That said, it is beneficial to contribute to a multi-sensory framework for data analysis. I sought, with the help of Dr. Kimberly Arcand, to supplement the data visualization software Glue with a tool that allows the user to create sonifications – that is, a meaningful data representation through sound – of their astrophysical data. This plug-in takes as input data in the intensity vs. time domain or frequency intensity vs. time domain and outputs an audio file that re-contextualizes the information typically identified visually (as part of a plot or diagram). The tool operates using many user inputs to specify the nature of the sonification – all of which are integrated into the pre-established operations of the Glue software. Multiple Python packages for data sonification already exist; I synthesized and brought together multiple complementary functions in Python to allow for a plug-in that can be pragmatic and widely useful for astrophysics data analysts. This sonification capability will be adapted for the Pulsar Science Collaboratory, which is looking to allow its crowd-sourced pulsar identification initiative to expand to those with visual impairments.

spacetelescope / jdaviz Public

Notifications | Fork 76 | Star 146

Code | Issues 316 | Pull requests 48 | Discussions | Actions | Projects | Wiki | Security

Create a data object for sonified cubes - hack image layer first #3329

New issue

Open stscijirahubjdat opened this issue on Dec 3, 2024 · 0 comments

stscijirahubjdat commented on Dec 3, 2024 • edited

Issue JDAT-4991 was created on JIRA by Jesse Averbukh:

Indigo tries using the image layer to index the sound layer as a first attempt. Depending how it goes, glue team can build something dedicated to sound in glue.

This will mean that the sonified cubes will act as layers in the image viewers, allowing us to use mouse over events independent of the spectrum-at-spaxel tool to trigger the sounds. This will also include having plot options know how to handle sound layers with some configuration options available in that plugin (slider for sound for each layer, ability to mute and unmute, etc.).

After discussion with glue folks (may need splitting into multiple tickets): the first pass of this could be an image layer consisting of lookup indices corresponding to the audio. The audio themselves would still live outside glue, perhaps in a dictionary with keys matching the labels of the layers containing a flat list of audio data. The image layers should either have the drawing methods overwritten to do nothing, or for a POC could just force the opacity to zero. Plot options should know to hide most options and only show "visible/audible" and volume (this might require subclassing the state or could be stored separately for the POC). The stylized layer icon should not show color, but somehow indicate that its an audio layer. Mouseover should skip audio layers in the iterator/top-layer logic. All mouseover events (removed from the tool) should then iterate through any enabled audio layers, use existing mouseover logic to get the index, retrieve the volume, mix all tracks, and play the audio.

Assignees: No one assigned

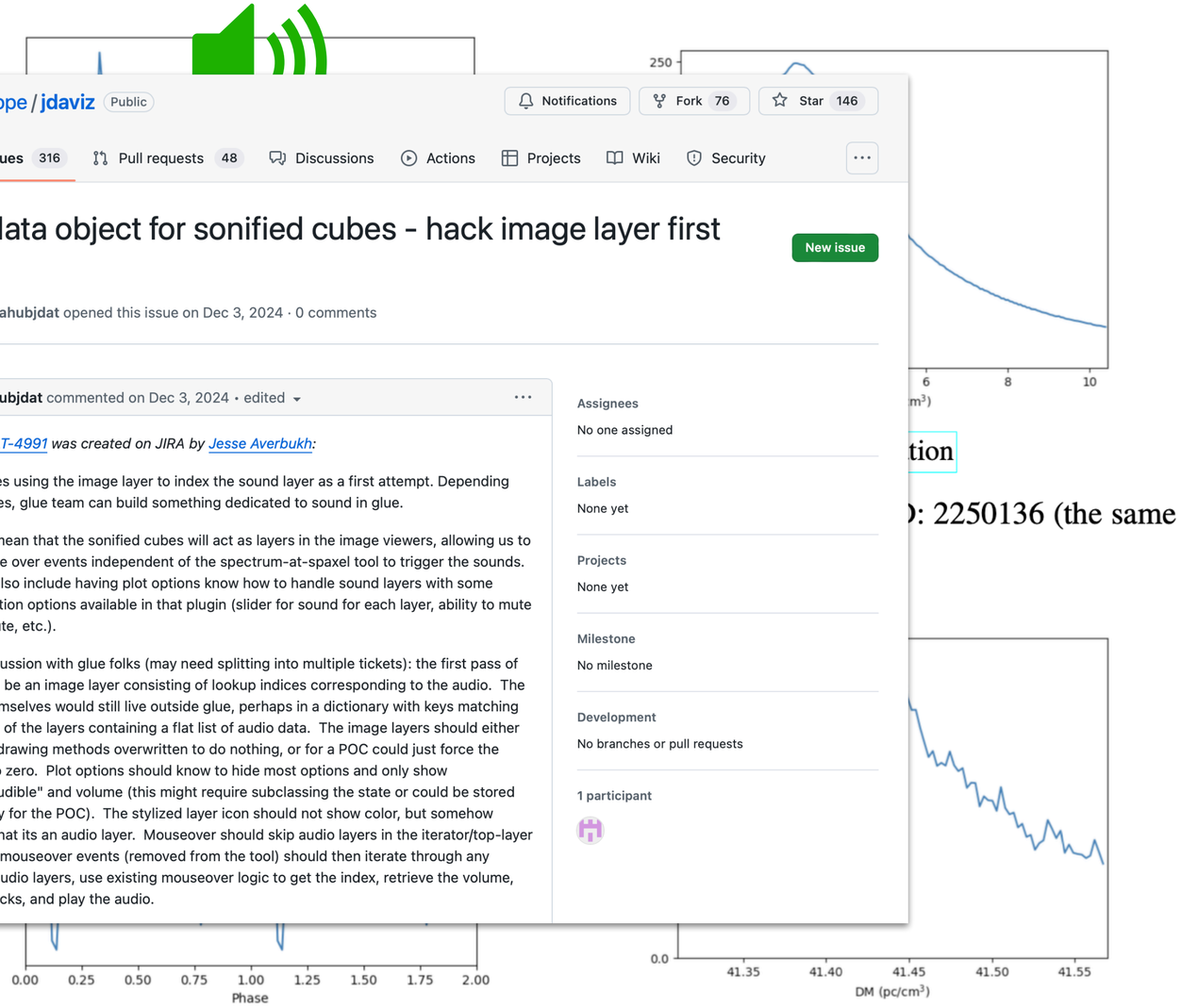
Labels: None yet

Projects: None yet

Milestone: No milestone

Development: No branches or pull requests

1 participant



(a) sonification (b) sonification

Fig. 4.—: Pulse and dispersion measure plots and sonifications for pulsar ID: 2046314 (the same unlikely pulsar from Fig. 2)

December 2024 Junior Tutorial paper by Harvard student Joe Bradley, supervised by Kim Arcand.

VISUALIZATION

FOR ASTRONOMY

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RESEARCH + EDUCATION + OUTREACH

MILKYWAY3D.org

Museum of Science

American Museum of Natural History

Harvard

Center for Astrophysics Harvard & Smithsonian

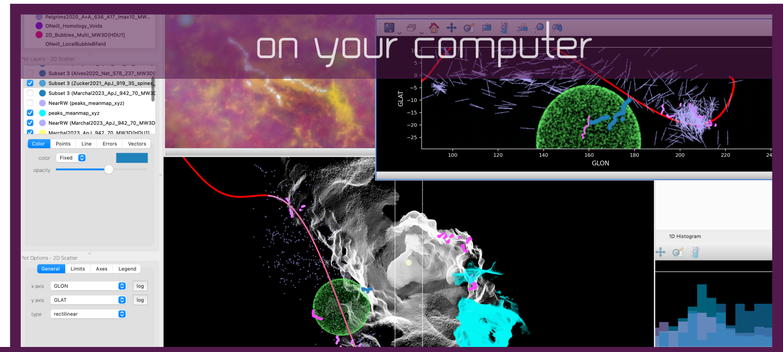
Smithsonian Institution

I2

Universität Heidelberg Zukunft seit 1386

universität wien

STScI Space Telescope Science Institute



CosmicDS

LIVE

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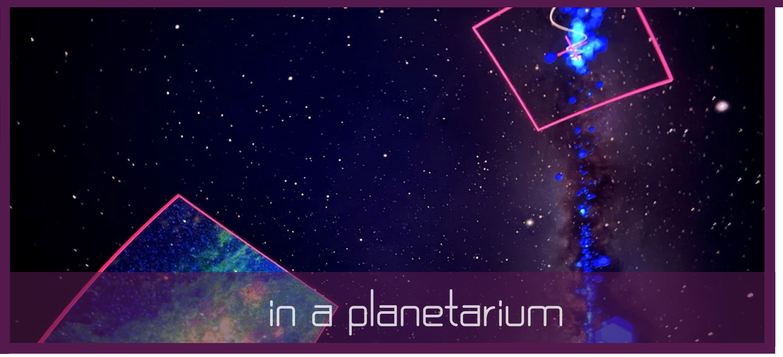


OpenSpace

glue multidimensional data exploration
glueviz.org

SEAMLESS SKY
HARVARD COLLEGE OBSERVATORY

The Dataverse® Project

Barbara A. Mikulski Archive for Space Telescopes

WORLDWIDE TELESCOPE

Visit the AAS booth to try out augmented reality!

RESEARCH

on your computer

Glue (/Users/agoodman/Library/CloudStorage/GoogleDrive-agoodman@cfa.harvard.edu/My Drive/Milky Way Takeover 2020/MilkyWay3D.ORG/Sessions/ NSF/magnetic_oddities.glu)

Export Session | Import Data | Export Data/Subsets | Link Data | Arithmetic attributes | Active Subset: None/Create New (the next selection will create a subset) | Terminal | Preferences | Error Console

Tab 1

Foley2022_arXiv_2212.01405_OrionShell_...
Dharmawardena2023_MNRAS_519_228_C...
Zucker2021_ApJ_919_35_spines_MW3D[...
Alves2020_Nat_578_237_MW3D[HDU1]
Bialy2021_ApJL_919_L5_MW3D[HDU1]
Pelgrims2020_A+A_636_A17_lmax10_MW...
ONeill_Homology_Voids
2D_Bubbles_Multi_MW3D[HDU1]
ONeill_LocalBubbleBfield

Plot Layers - 2D Scatter

Subset 3 (Alves2020_Nat_578_237_MW3D[
Subset 3 (Zucker2021_ApJ_919_35_spines_
Subset 3 (Marchal2023_ApJ_942_70_MW3D
NearRW (peaks_meanmap_xyz)
peaks_meanmap_xyz
NearRW (Marchal2023_ApJ_942_70_MW3D
Marchal2023_ApJ_942_70_MW3D[HDU1]

Color | Points | Line | Errors | Vectors

color: Fixed

opacity

Plot Options - 2D Scatter

General | Limits | Axes | Legend

x axis: GLON log

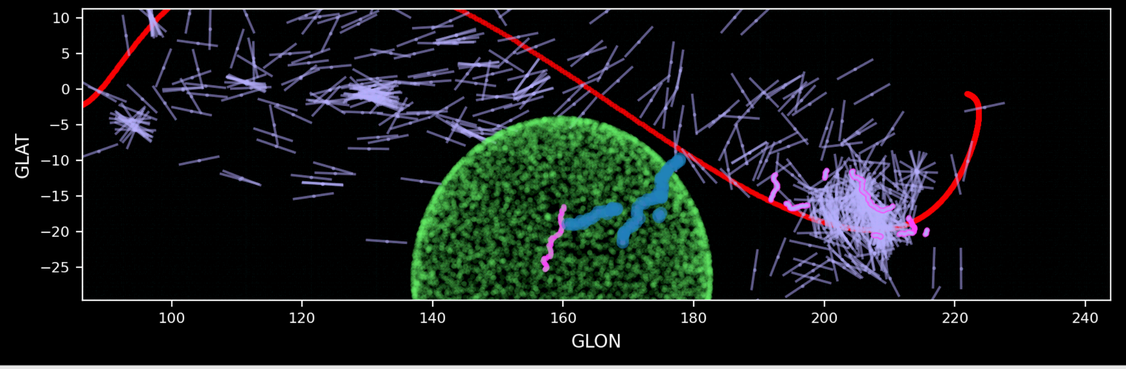
y axis: GLAT log

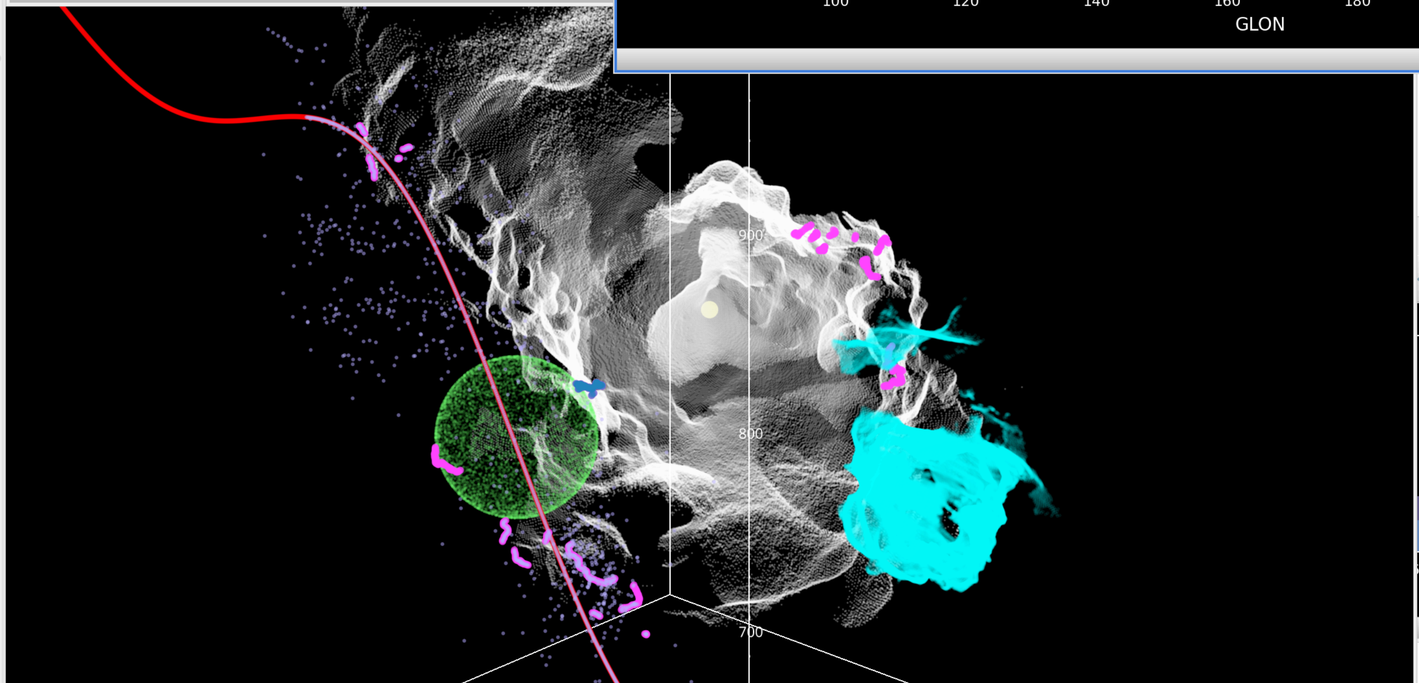
type: rectilinear

Earth/Planet/Sky Viewer (WWT)

WORLDWIDE TELESCOPE

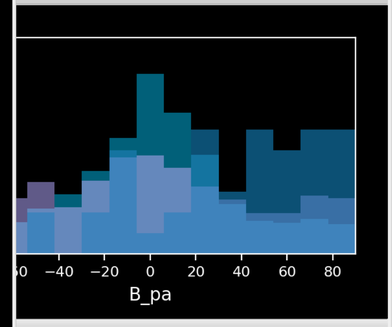
2D Scatter





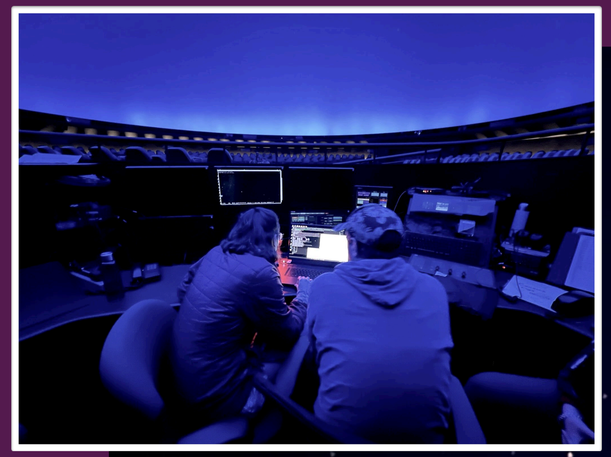
glue
multidimensional data exploration
glueviz.org

1D Histogram



in a planetarium

RESEARCH
+EDUCATION
+OUTREACH



MILKYWAY3D.org

OpenSpace

glue
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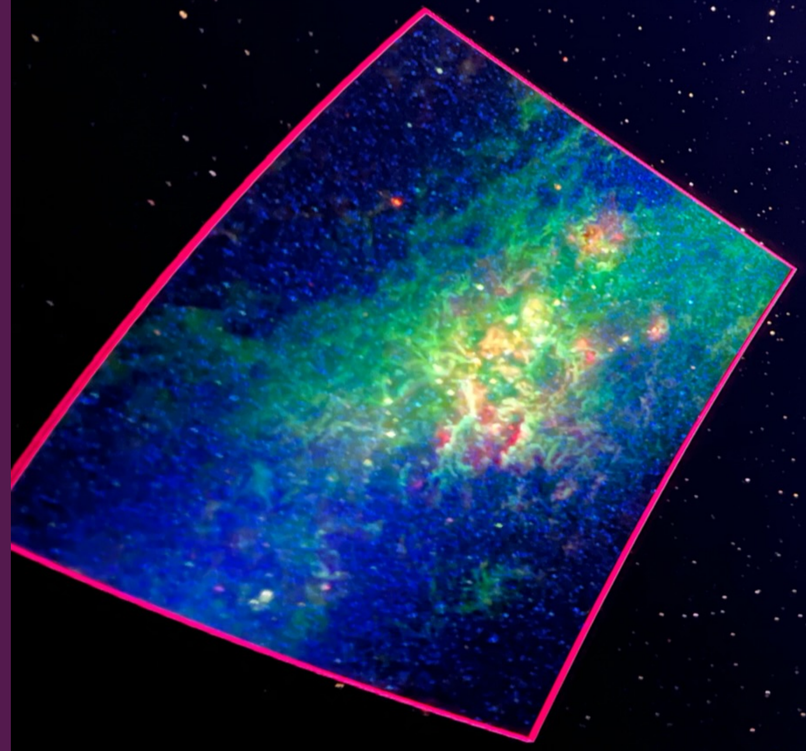
WORLDWIDE TELESCOPE



in a augmented reality, on your phone...

RESEARCH

+OUTREACH

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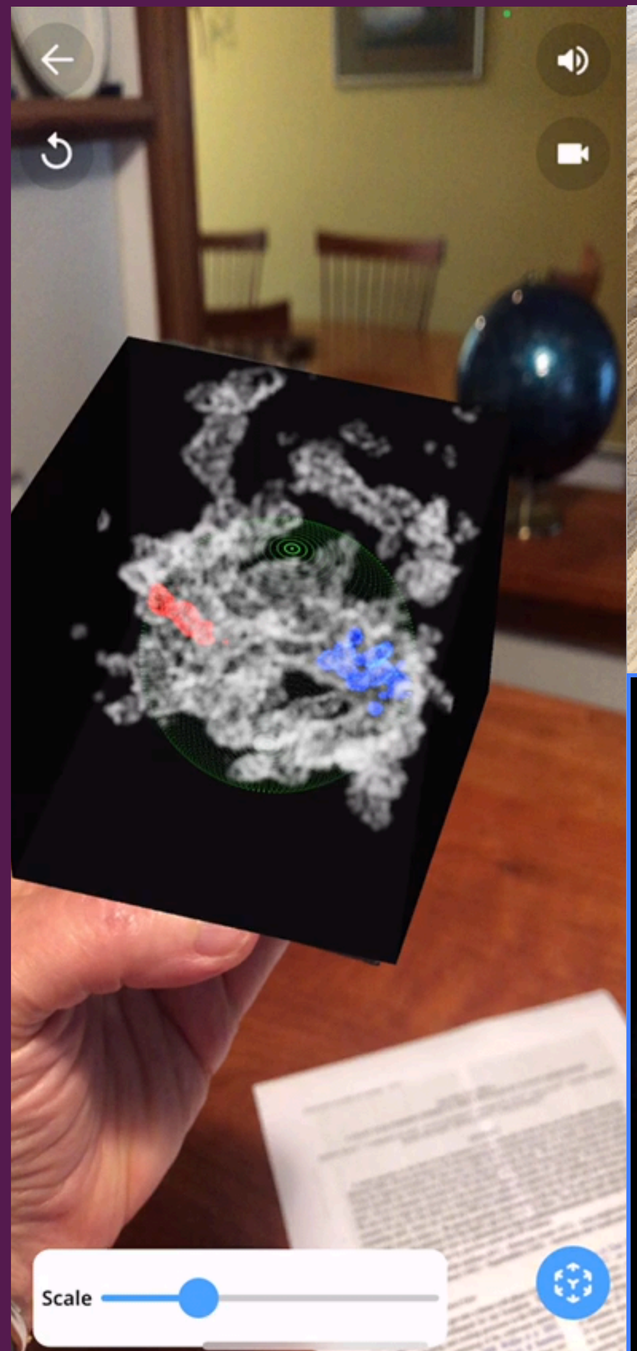
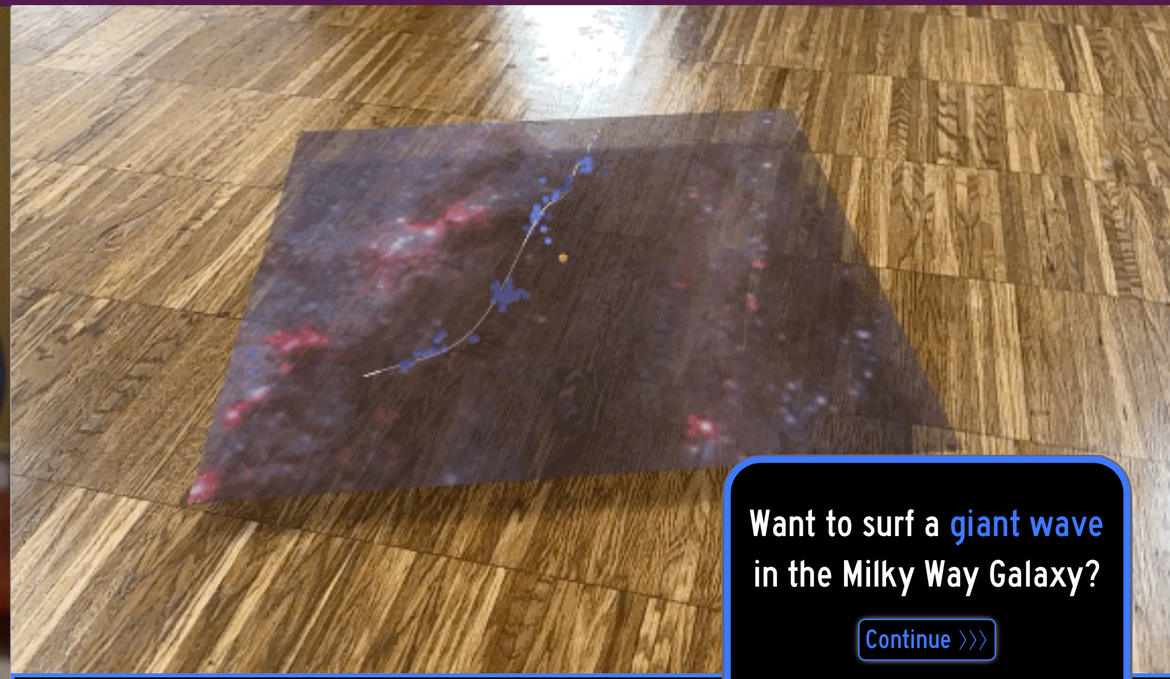
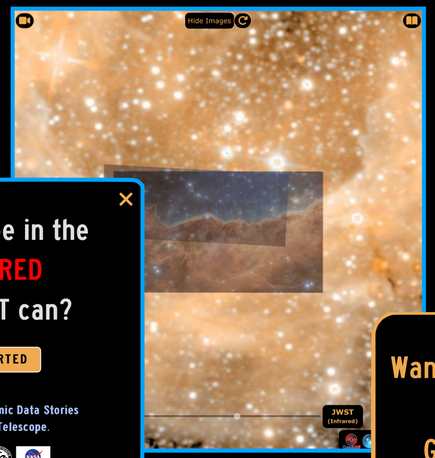
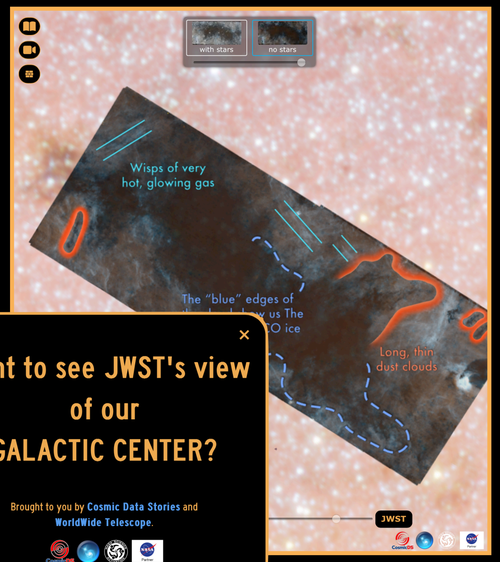




EDUCATION + OUTREACH





cosmicds.cfa.harvard.edu

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Want to see JWST's view of our **GALACTIC CENTER?**

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Want to surf a giant wave in the Milky Way Galaxy?

Continue

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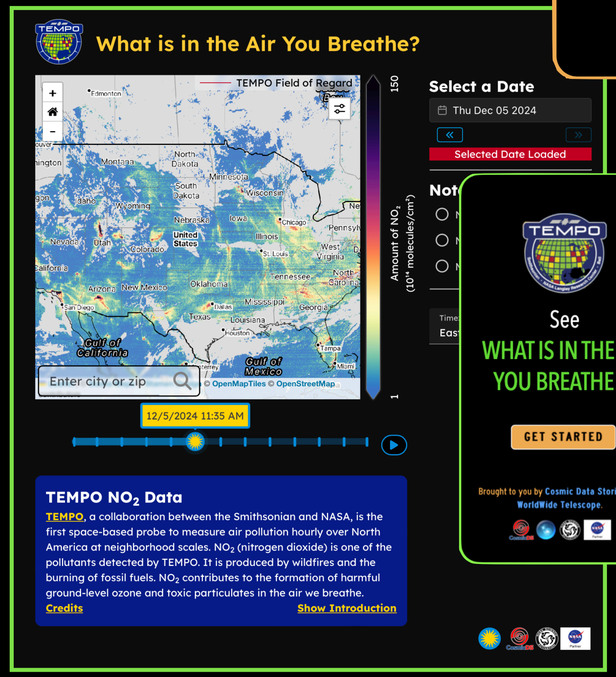
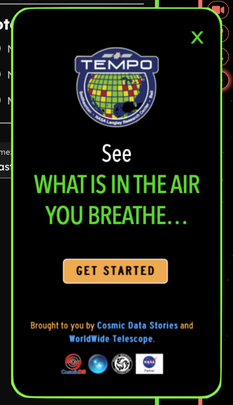
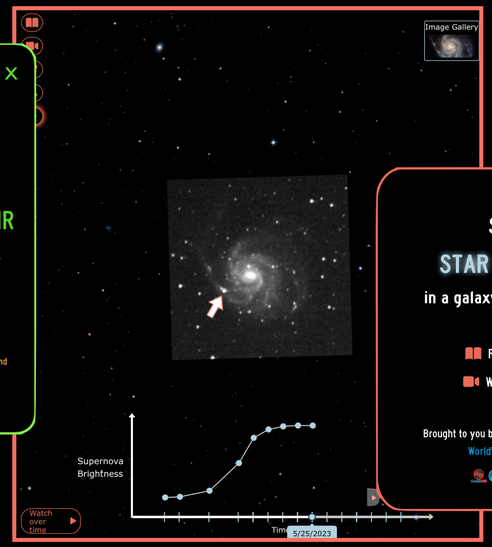
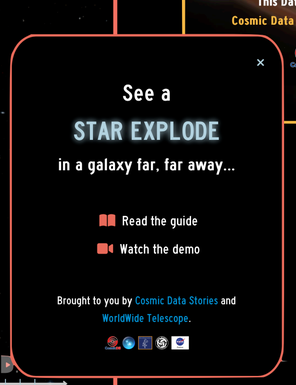
Cosmic DS

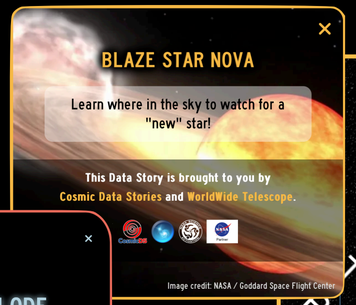
Stories of Earth and the Universe, in data.

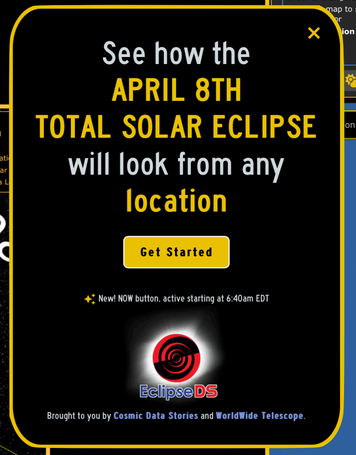


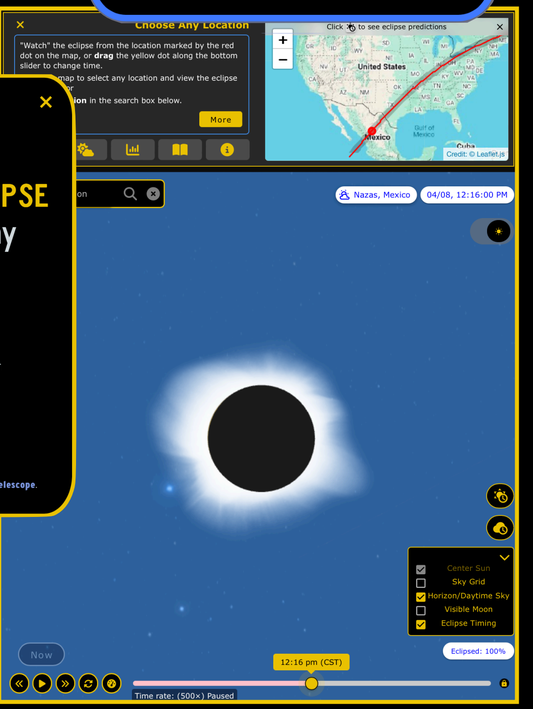












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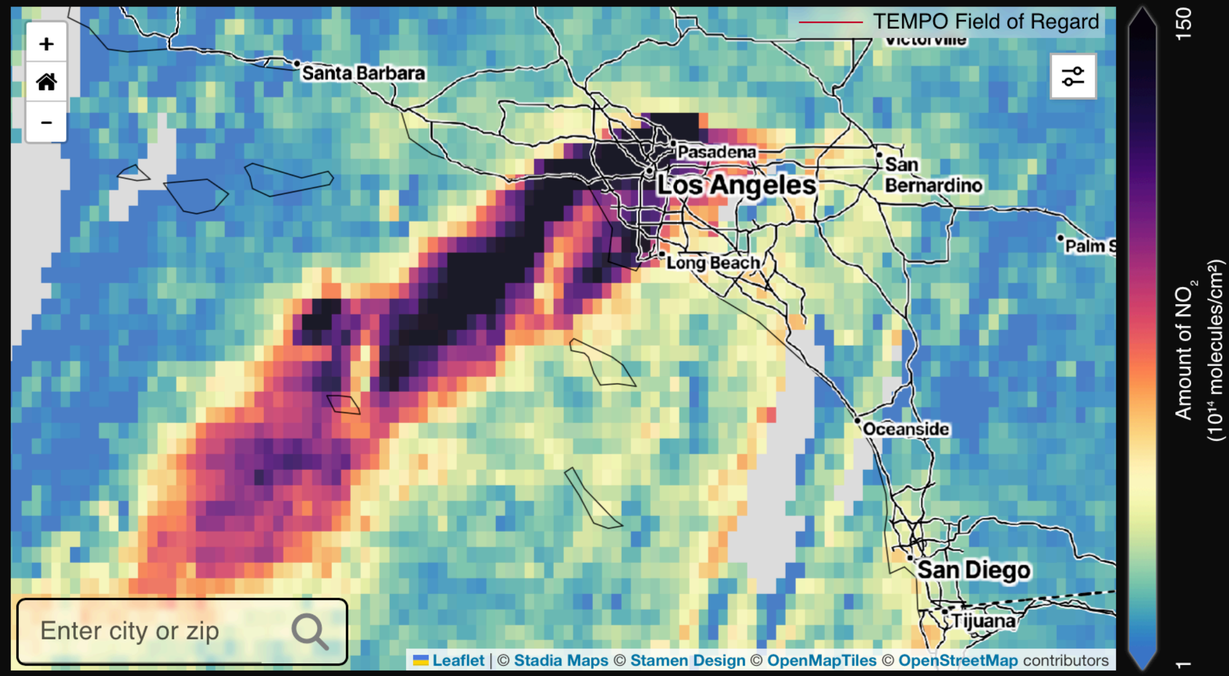
Cosmic DS

What is in the Air You Breathe?



1/8/2025 2:51 PM

Select a Date

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Notable Dates

- LA Wildfires (Jan 8, 2025)
- March 28, 2024
- November 3, 2023
- November 1, 2023

Featured Events for Jan 8

- Los Angeles Wildfires

Timezone
Eastern Standard

TEMPO NO_2 Data

TEMPO, a collaboration between the Smithsonian and NASA, is the first space-based probe to measure air pollution hourly over North America at neighborhood scales. NO_2 (nitrogen dioxide) is one of the pollutants detected by TEMPO. It is produced by wildfires and the burning of fossil fuels. NO_2 contributes to the formation of harmful ground-level ozone and toxic particulates in the air we breathe.

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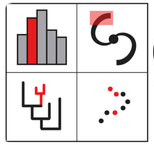
WHAT'S NEXT?

Jdaviz

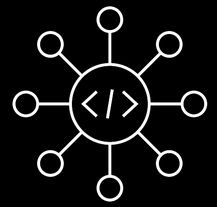
LIVE



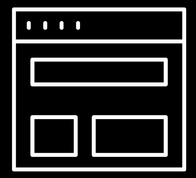
SOLARA

NANCY GRACE ROMAN SPACE TELESCOPE

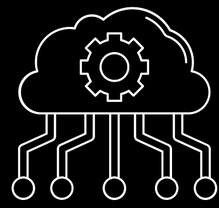
standalone computers



open-source software



web browsers



cloud services

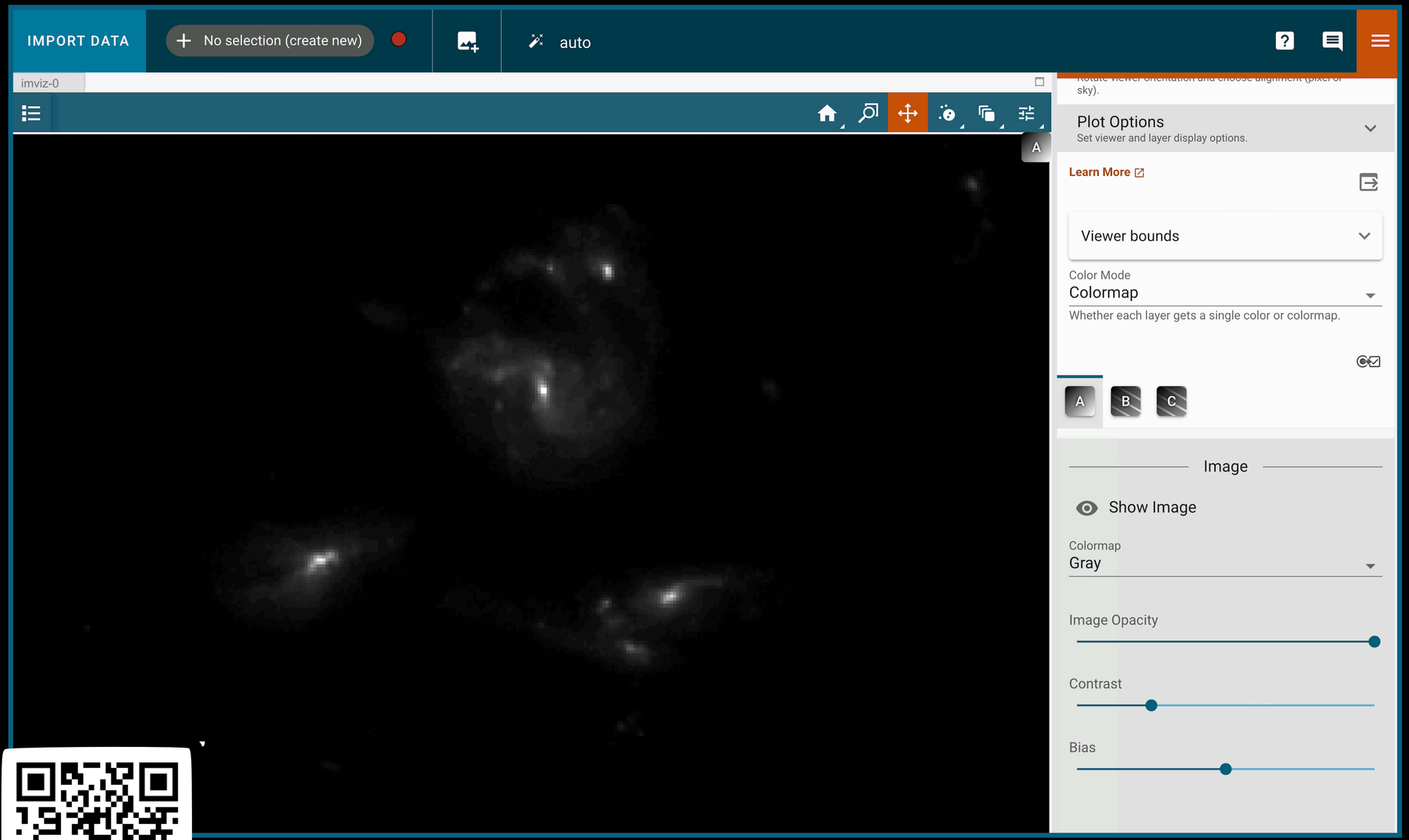
Jdaviz

video, created by C. Pacifici, shows JADES survey (NIRSpec GTO) in Jdaviz

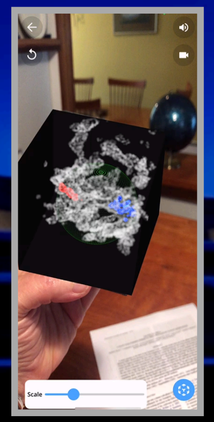
Data analysis and visualization of astronomical images and spectra in Python.

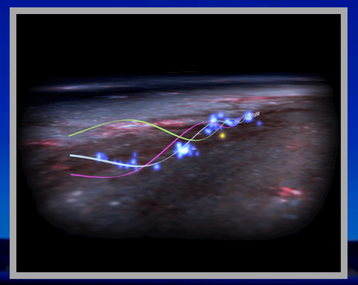
Works in Jupyter Notebooks, as a standalone application, and embedded in webpages.

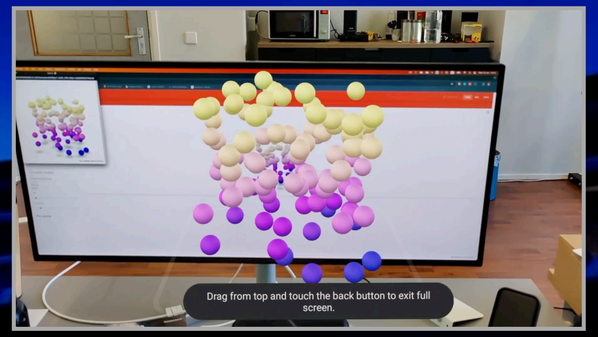
Links data & views using glue in the browser "glupyter."



Visit the JWST booth for demos and hands on sessions!



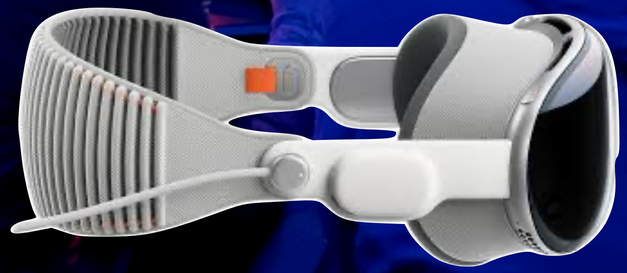


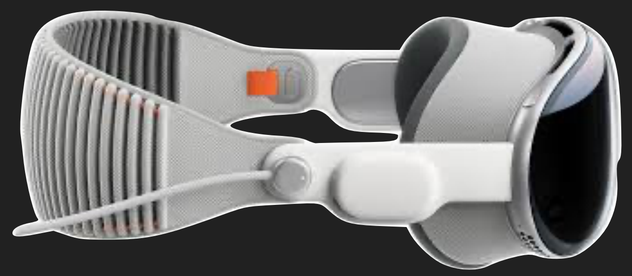


AR for Science and Outreach

WHAT'S NEXT IN AR?

glueviz.org/glue-ar





SOLARA

Visit the AAS booth to try out augmented reality!