Exploring & Explaining Science, with Pictures

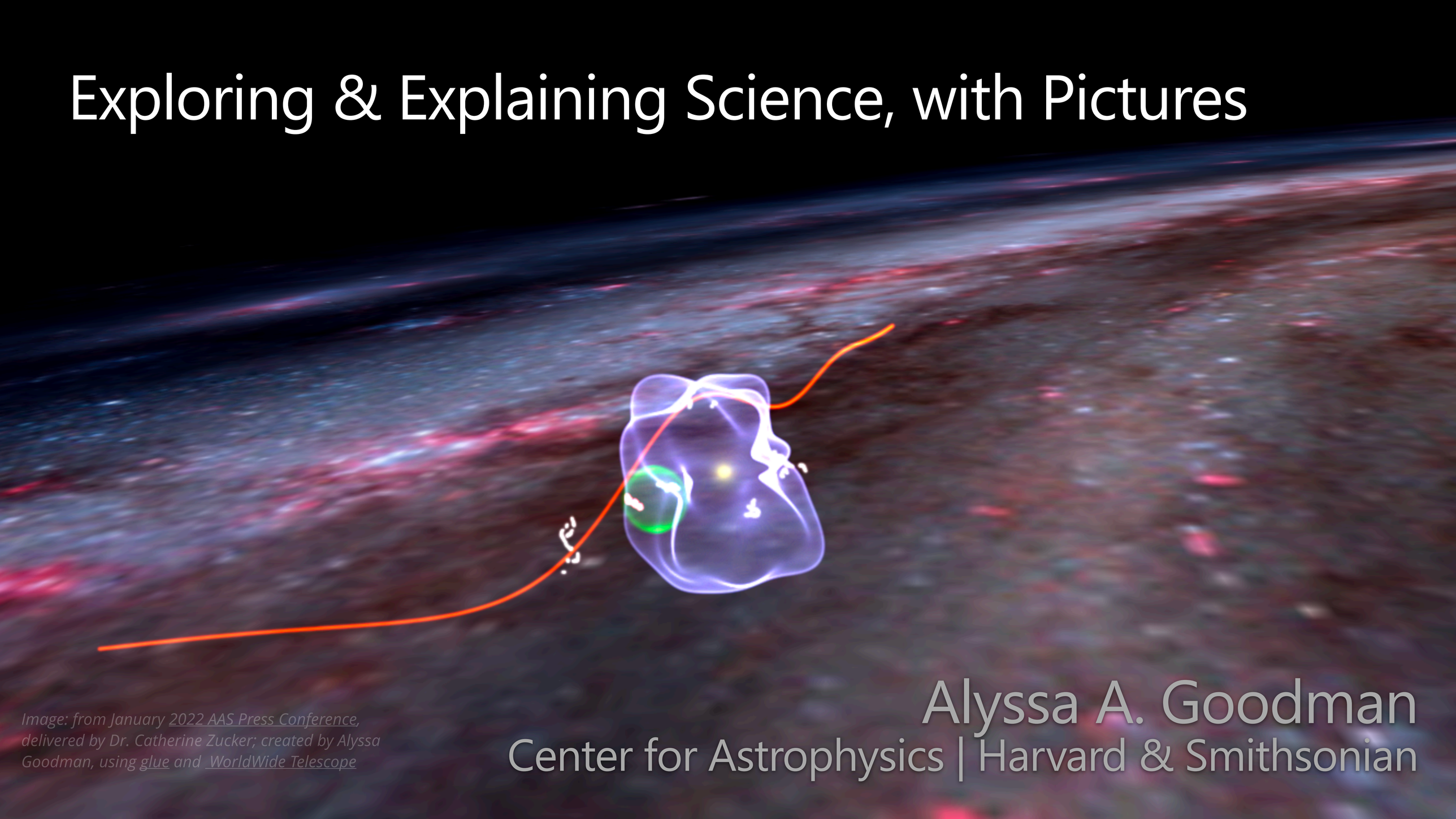

Image: from January 2022 AAS Press Conference, delivered by Dr. Catherine Zucker; created by Alyssa Goodman, using glue and WorldWide Telescope

Alyssa A. Goodman
Center for Astrophysics | Harvard & Smithsonian

≡ MENU

TEN QUESTIONS TO ASK WHEN CREATING A VISUALIZATION

Alyssa Goodman & Arzu Çöltekin

The 10 Questions

1. **Who** | Who is your audience? How expert will they be about the subject and/or display conventions?
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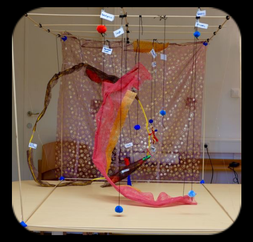
Now, visit the 10QViz conversation! There's so much more to talk about.

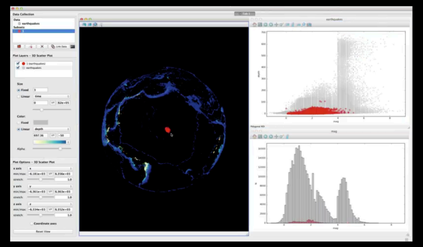
Curious about the **origins** of 10QViz? Try the About page.
Want to learn **how best to use** and **participate** in 10QViz? Try the How to page.
Want to read about the **scholarship** behind 10QViz.org's questions? Write to ask for a draft of our research paper, Coltekin & Goodman 2019.

10QViz.org

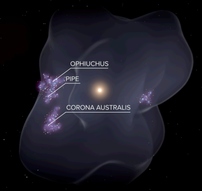
Who? 1 = The Public (today)



Data, **Dimensions, Display** 6, 10



Abstraction &. Accuracy 7



Interactivity+ 1, 2, 5, 6, 7, 9, 10

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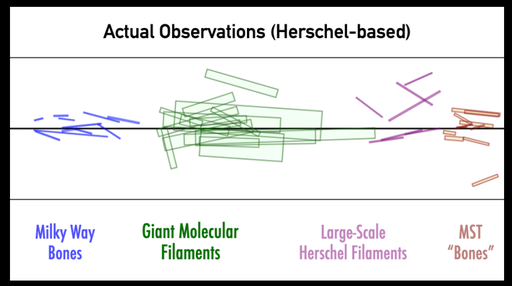
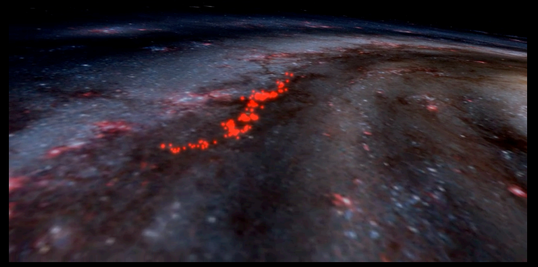
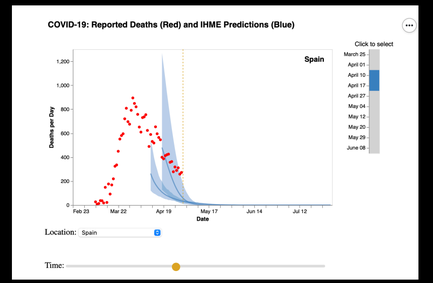


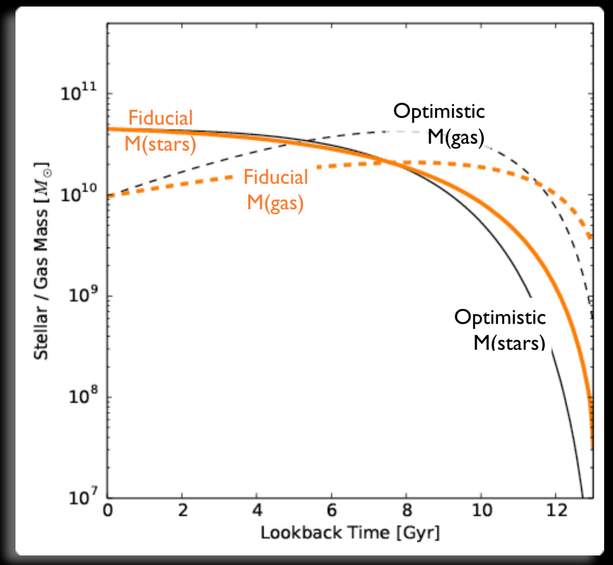
Context & Scale 8

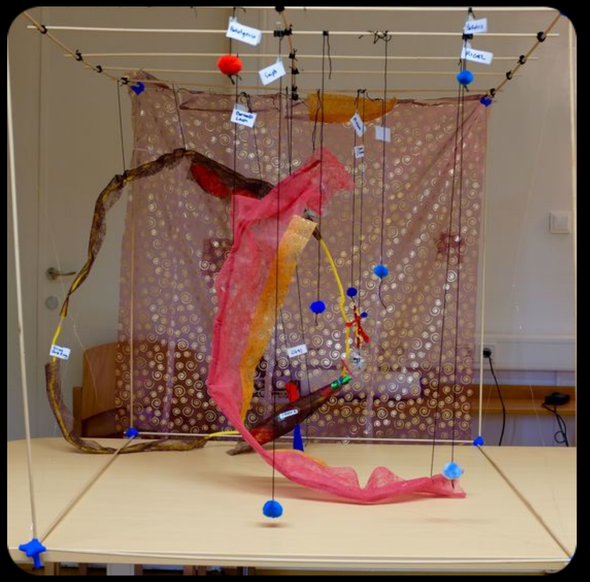


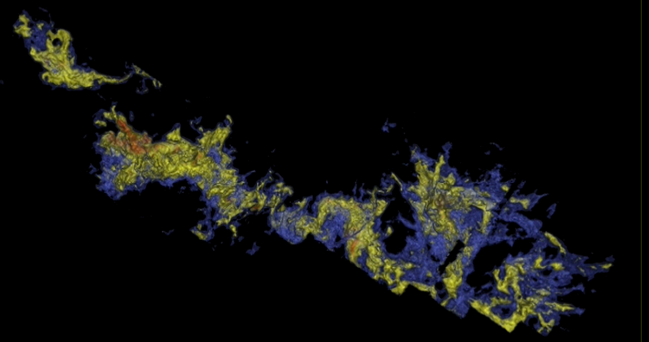
Predictions & Uncertainty 5

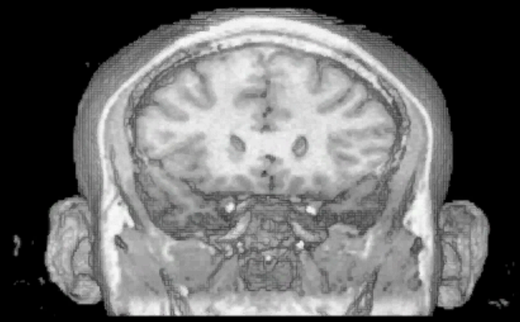


Data, Dimensions, Display









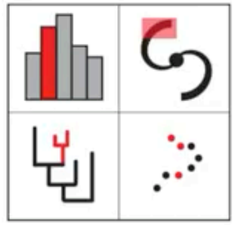
Abstraction & Accuracy

What is glue?

multidimensional data exploration

Multi-dimensional data exploration with

glue



http://www.glueviz.org

Interactivity+

OUT THERE | DENNIS OVERBYE

Where Our Bubble Ends, Our Understanding Begins

By mapping a region devoid of gas and dust, scientists learn more about star formation.

JUST A BIT TOO LATE for New Year celebrations, astronomers have discovered that the Milky Way galaxy, our home, is, like champagne, full of bubbles.

As it happens, our solar system is passing through the center of one of these bubbles. Fourteen million years ago, according to the astronomers, a firecracker chain of supernova explosions drove off all the gas and dust from a region roughly 1,000 light-years wide, leaving it bereft of the material needed to produce new generations of stars.

As a result, all the baby stars in our neighborhood can be found stuck on the edges of this bubble. There, the staccato force of a previous generation of exploding stars has pushed gas clouds together into forms dense enough to collapse under their own ponderous if diffuse gravity and condense enough to ignite, as baby stars. Our sun, 4.5 billion years old, drifts through the middle of this space in a coterie of aged stars.

"This is really an origin story," Catherine Zucker said in a news release from the Harvard-Smithsonian Center for Astrophysics. "For the first time, we can explain how all nearby star formation began."

Dr. Zucker, now at the Space Telescope Science Institute in Baltimore, led a team that mapped what they call the Local Bubble in remarkable detail. They used data from a number of sources, particularly Gaia, a European spacecraft, that has mapped and measured more than a billion stars, to pinpoint the locations of gas and dust clouds.

Last year, a group of scientists led by João Alves, an astrophysicist at the University of Vienna announced the discovery of the Radcliffe Wave, an undulating string of dust and gas clouds 9,000 light-years long that might be the spine of our local arm of the galaxy. One section of the wave now appears to be part of our Local Bubble.

The same group of scientists published their latest findings in Nature, along with an elaborate animated map of the Local Bubble and its highlights.

The results, the astronomers write, provide "robust observational support" for a long-held theory that supernova explosions are important in triggering star formation, perhaps by jostling gas and dust clouds into collapsing and starting on the long road to thermonuclear luminosity.

Astronomers have long recognized the Local Bubble. What is new, said Alyssa Goodman, a member of the team also from the Harvard-Smithsonian Center for Astrophysics, is the observation that all local star-forming regions lie on the Local Bubble's surface. Researchers previously lacked the tools to map gas and dust clouds in three dimensions. "Thanks to 3-D dust-mapping, now we do," Dr. Goodman said.

According to the team's calculations, the Local Bubble began 14 million years ago with a massive supernova, the first of about 15; massive stars died and blew up. Their blast waves cleared out the region. There are now no stars younger than 14 million years in the bubble, Dr. Goodman said.

The bubble continues to grow at about 4 miles a second. "Still, more supernovae are expected to take place in the near future, like Antares, a red supergiant star near the edge of the bubble that could go any century now," Dr. Alves said. "So the Local Bubble is not 'done.'"

With a score of well-known star-forming regions sitting on the surface of the bubble, the next generation of stars is securely on tap.

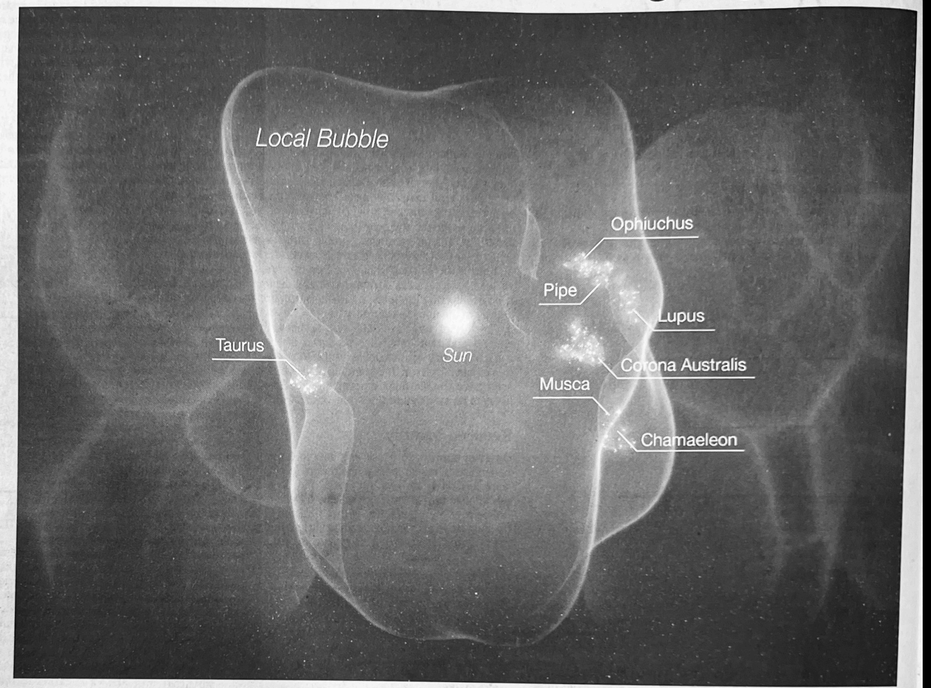
The team plans to go on and map more bubbles in the our Milky Way flute of champagne. There must be more, Dr. Goodman said, because it would be too much of a coincidence for the sun to be smack in the middle of the only one.

The sun's presence in this one is nonetheless coincidental, Dr. Alves said. Our star wandered into the region only five million years ago — long after most of the action — and will exit about five million years from now.

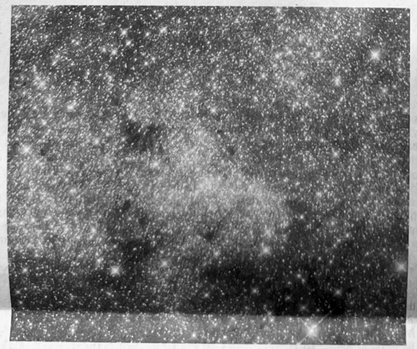
The motions of the stars are more irregular than commonly portrayed, as they are bumped gravitationally by other stars, clouds and the like, Dr. Alves said.

"The sun is moving at a significantly different velocity than the average of the stars and gas in the solar neighborhood," he noted. This would enable it to catch up and pass — or be passed by — the bubble.

"It was a revelation," Dr. Goodman said, "how kooky the sun's path really is compared with a simple circle."



LEAH HUSTAK (STSCI)/CFA



NASA

Above, an illustration of the Local Bubble, which formed in the Milky Way, left, when supernova explosions drove off all the gas and dust from a 1,000-light-year-wide region.

New York Times
January 25, 2022

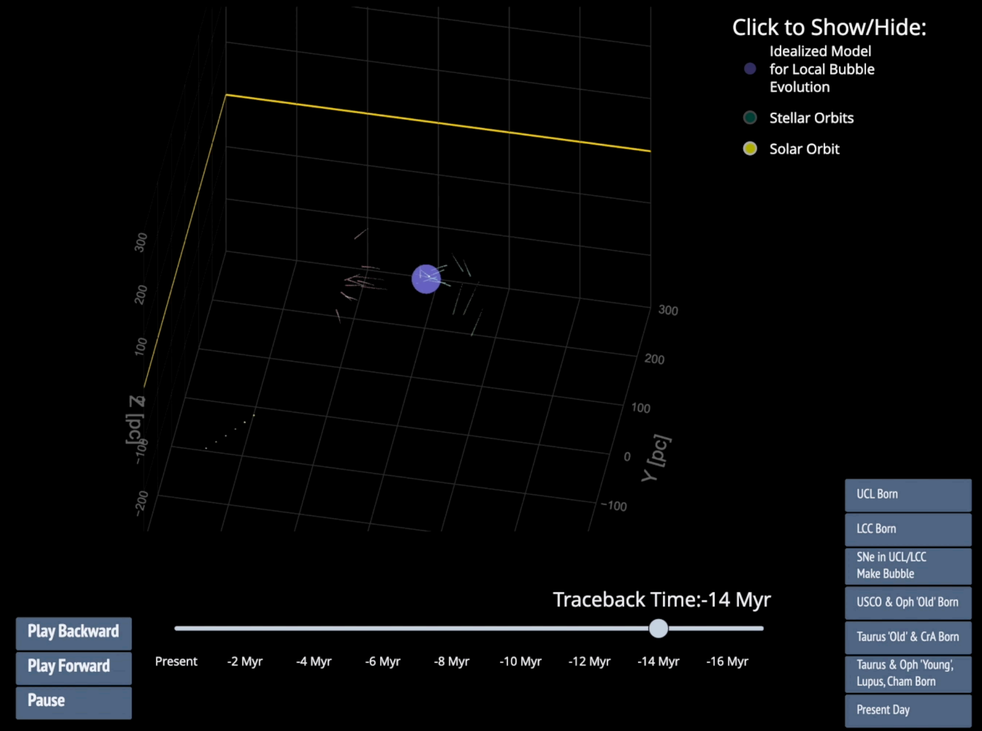
Interactivity+

“Cartoon” (Explanation)

Where Our Bubble Ends, Our Understanding Begins

“Real Data” (Exploration)

(Zucker et al. 2022, *Nature*)

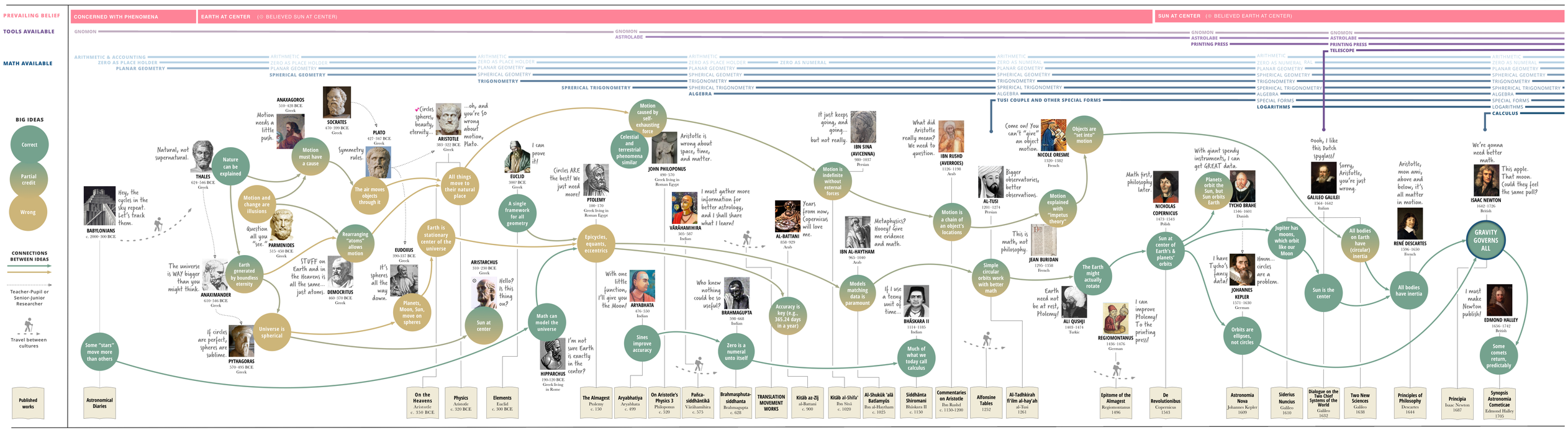


[try the interactive figure from Zucker et al. 2022]

Interactive Infographic: The Path to Newton

PREDICTIONX
predictionx.org

The Path to Newton



© Harvard University, created by Alyssa Goodman, Jais Brohinsky, Drew Lichtenstein & Katie Peek, re-use is allowed, with attribution, version 1, 2019

demo: path-to.org or LabXchange™ Science and learning–connected.

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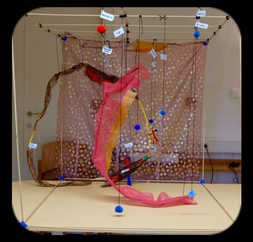

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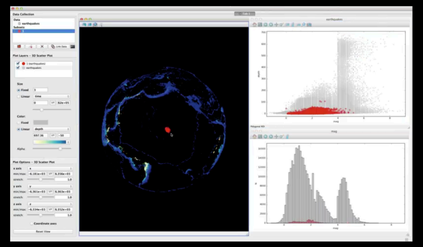

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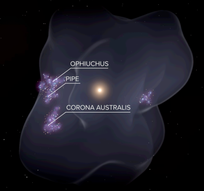

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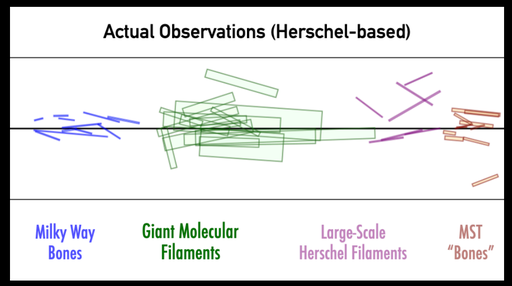

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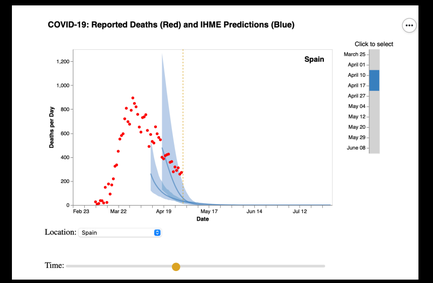

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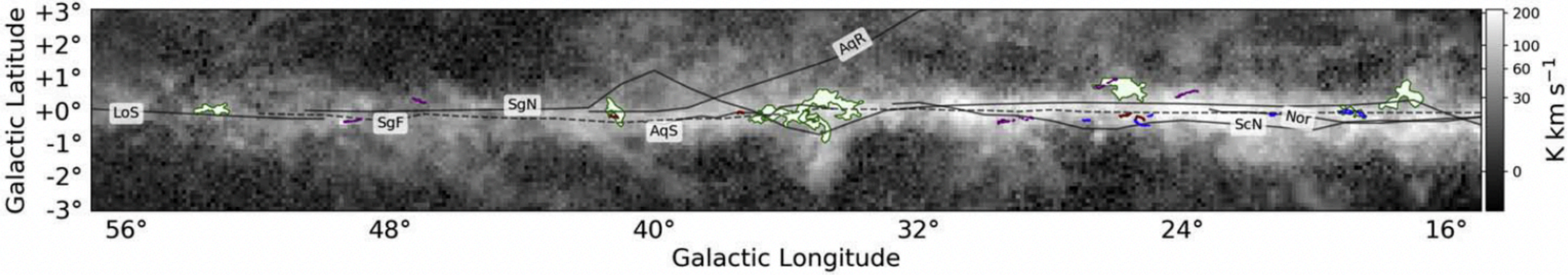
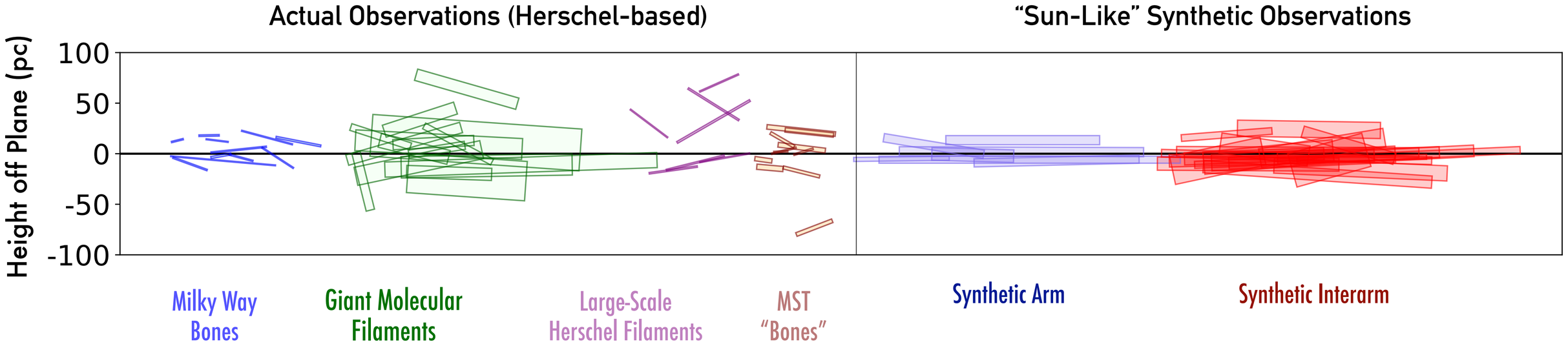


(Abstraction)



The Radcliffe Wave

Each **red** dot marks a star-forming blob of gas whose distance from us has been accurately measured.

The Radcliffe Wave is **2.7 kpc long**, and **130 pc wide**, with crest and trough reaching **160 pc** out of the Galactic Plane. Its gas mass is more than **three million solar masses**.

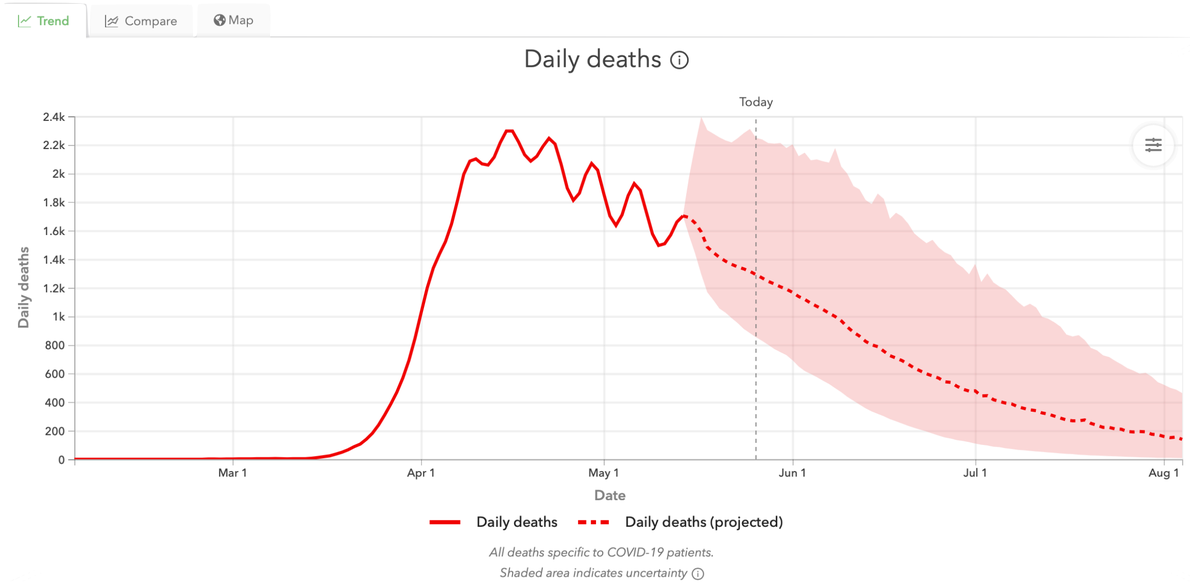
video created by the authors of Alves et al. 2020 using AAS WorldWide Telescope (includes cartoon Milky Way by Robert Hurt)

The Dataverse® Project

Predictions & Uncertainty 5

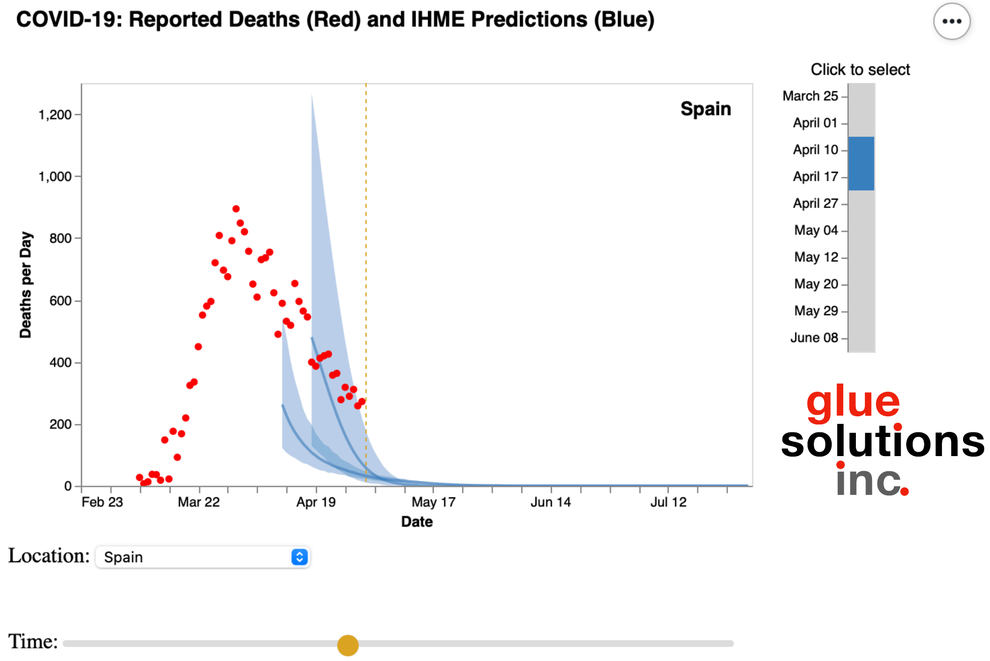
predictionx.org

Where did those COVID-19 predictions, and uncertainty ranges, come from?



covid19.healthdata.org/united-states-of-america

And how uncertain were the uncertainties?



glue solutions inc.

gluesolutions.io/social-impact

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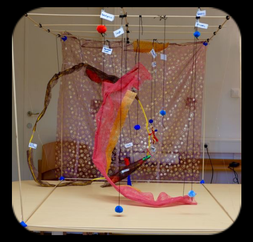

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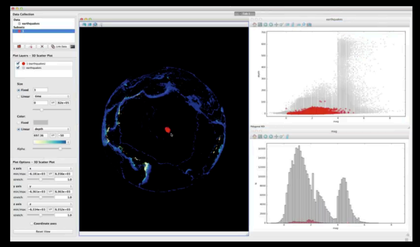

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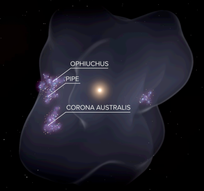

Interactivity+ 1, 2, 5, 6, 7, 9, 10

10 Viz

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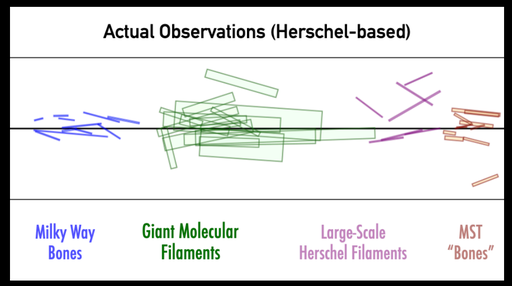

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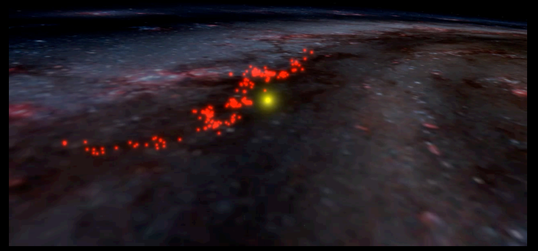

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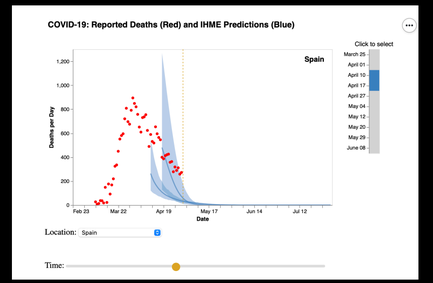
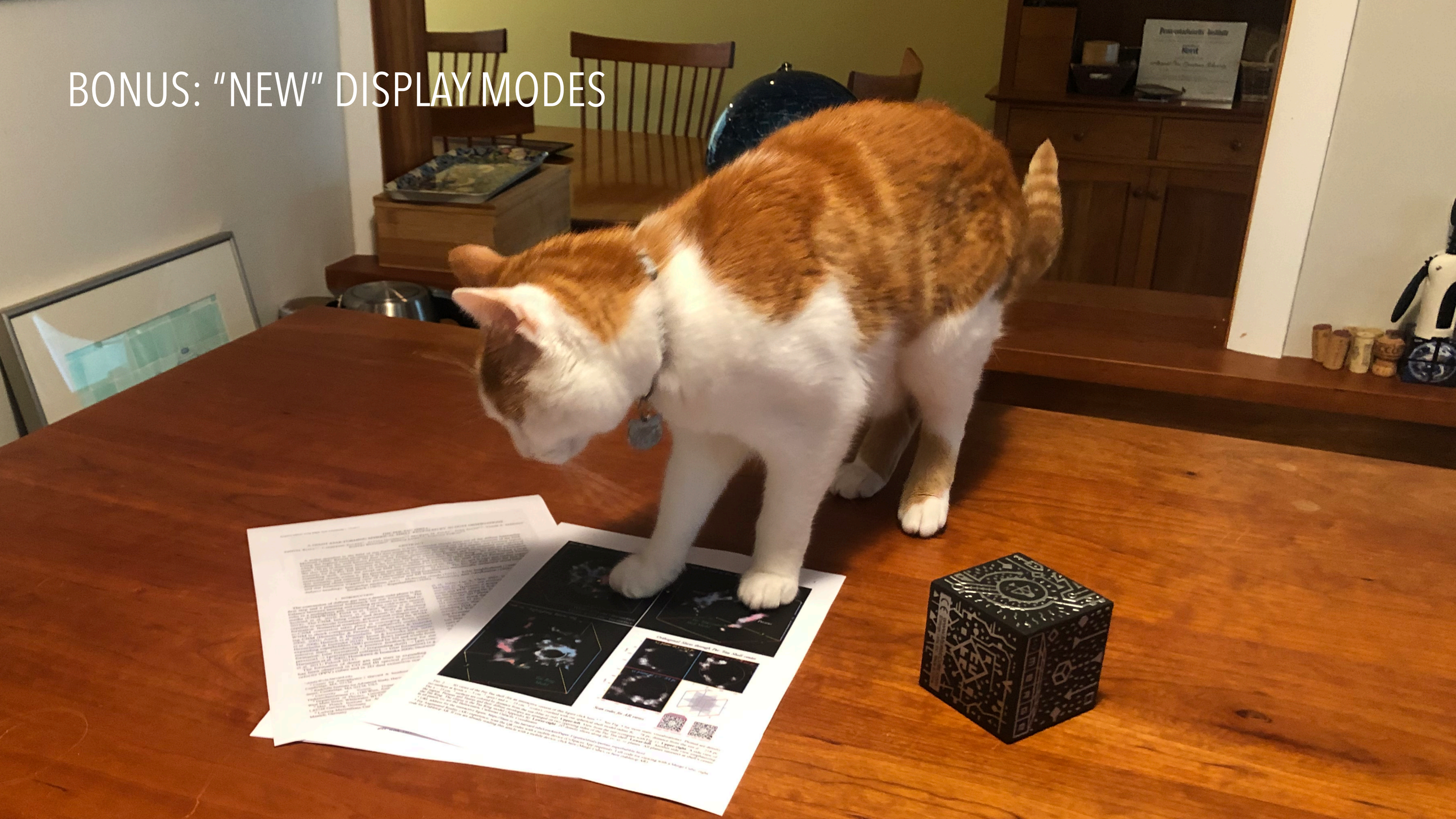


BONUS: “NEW” DISPLAY MODES



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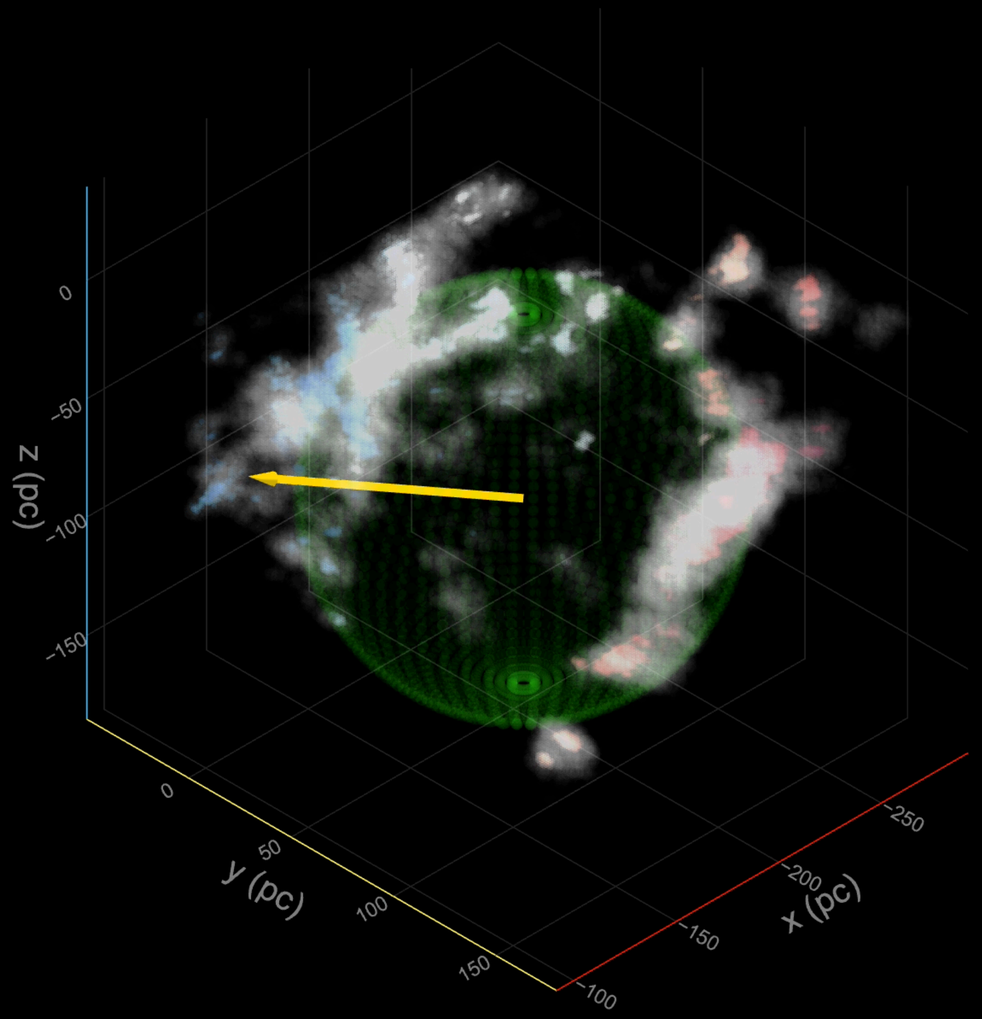
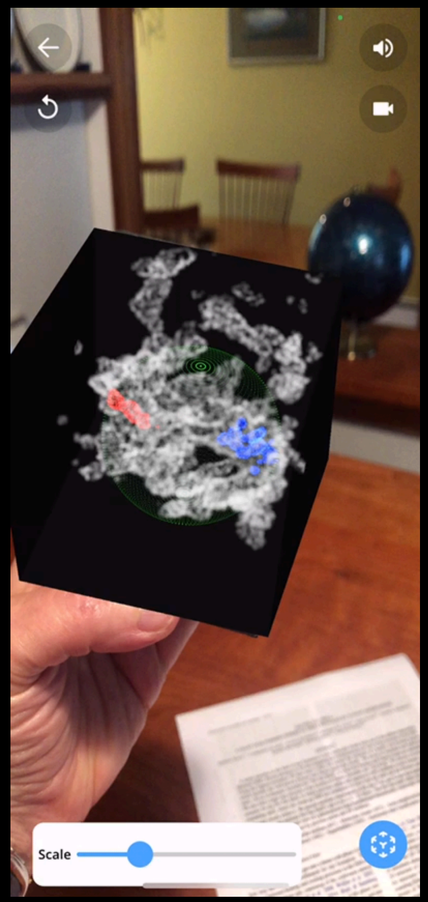
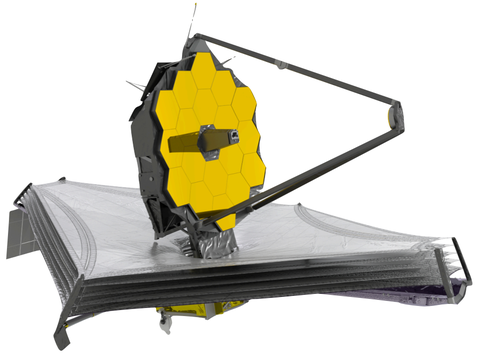


TINYURL.COM/UNIVERSE-IN-MY-HAND

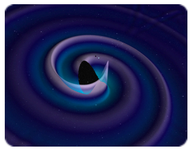


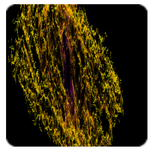
AUGMENTED REALITY

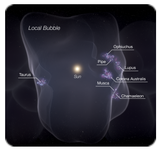


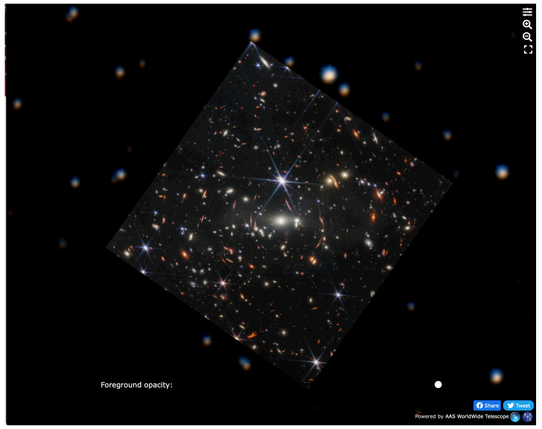
WHAT DO EXPENSIVE NEW TELESCOPES DO FOR HUMANITY TODAY?

Are mega-projects like ALMA, LIGO, JWST, and Gaia worth the billions?









Foreground opacity:

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Alyssa A. Goodman
@AlyssaAGoodman

Here's a 1-minute video showing--in the words of visualization hero @EdwardTufte--the "compared to what" factor for today's amazing @NASAWebb image. Thanks to the @WWTelescope for making this possible, and @ADavidWeigel. I only wish @NASA and @POTUS had shown the image this way!

A David Weigel @ADavidWeigel · Jul 11
Replying to @AlyssaAGoodman and @NASAWebb
And you can zoom on the first one (SMACS 0723) interactively here in @WWTelescope: web.wwtassets.org/specials/2022/...