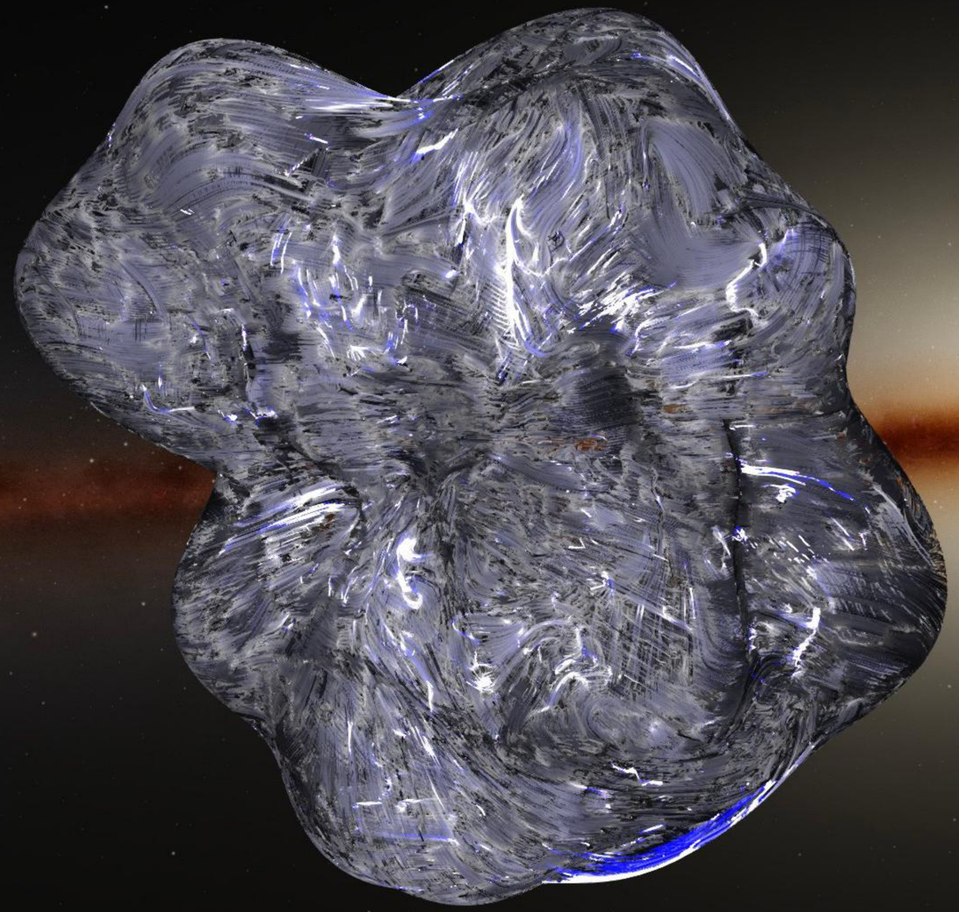
A 3D Map of the Local Bubble's Magnetic Field



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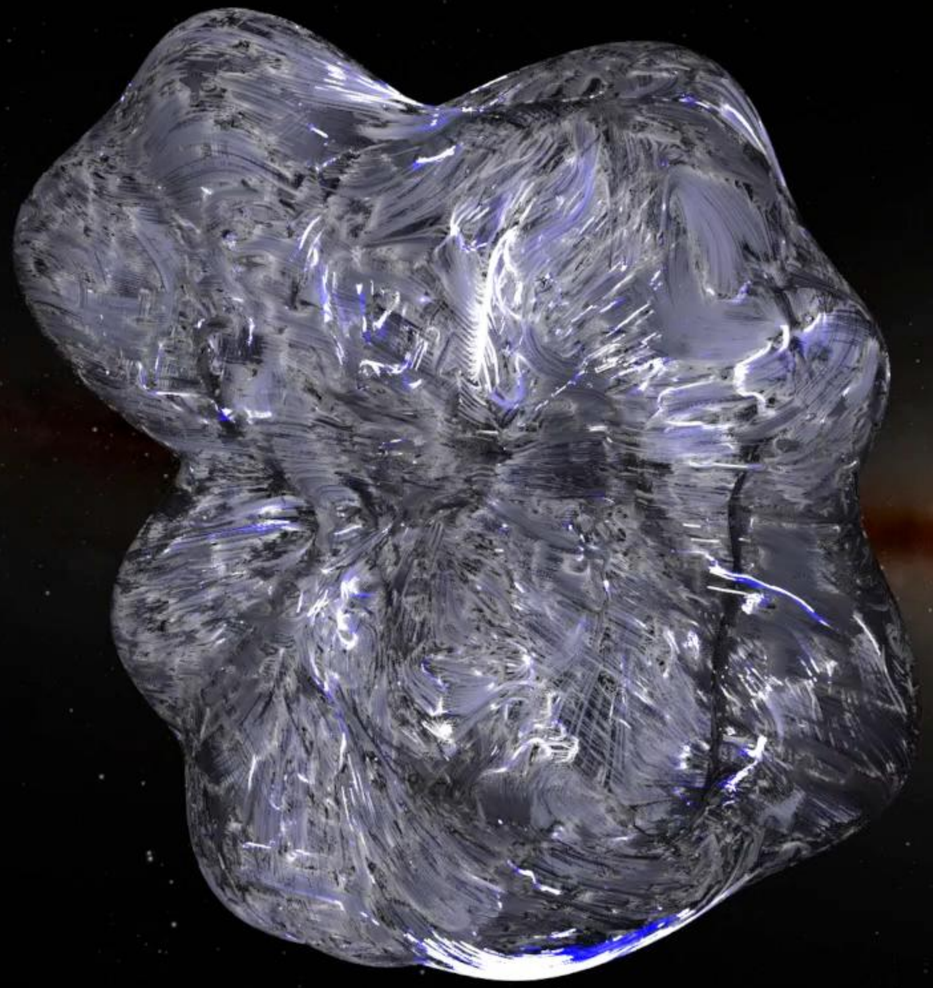
Alyssa **Goodman**[1], Juan **Soler**[3],
Jesse **Han**[1], Catherine **Zucker**[4]

(1) CfA | Harvard & Smithsonian; (2) Univ. Of Virginia;
(3) IAPS-INAF; (4) Space Telescope Science Institute

presented by Theo O'Neill

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

The magnetic field on the surface of the 1000-light-year-wide “Local Bubble” around us looks like ~this…



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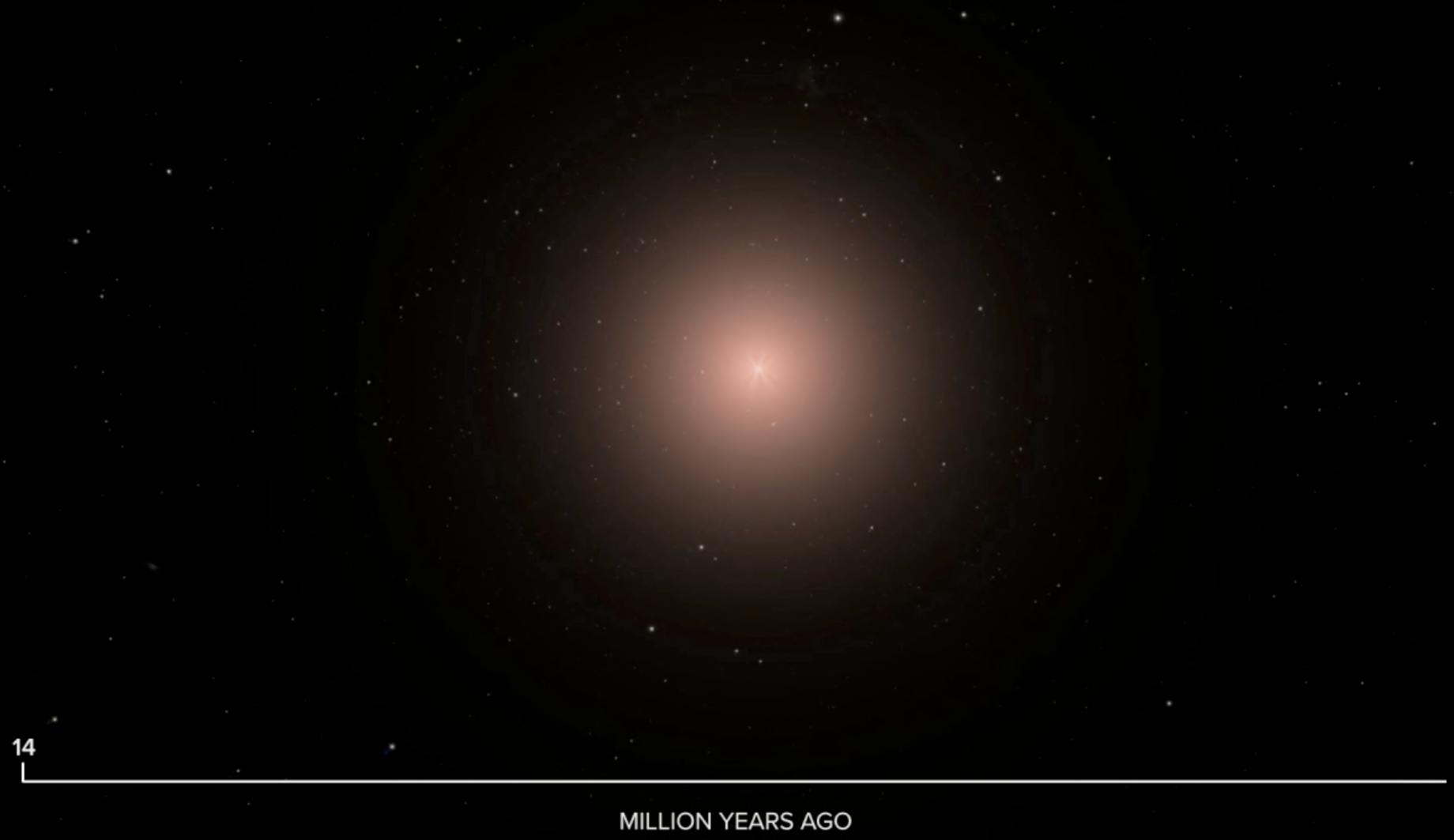
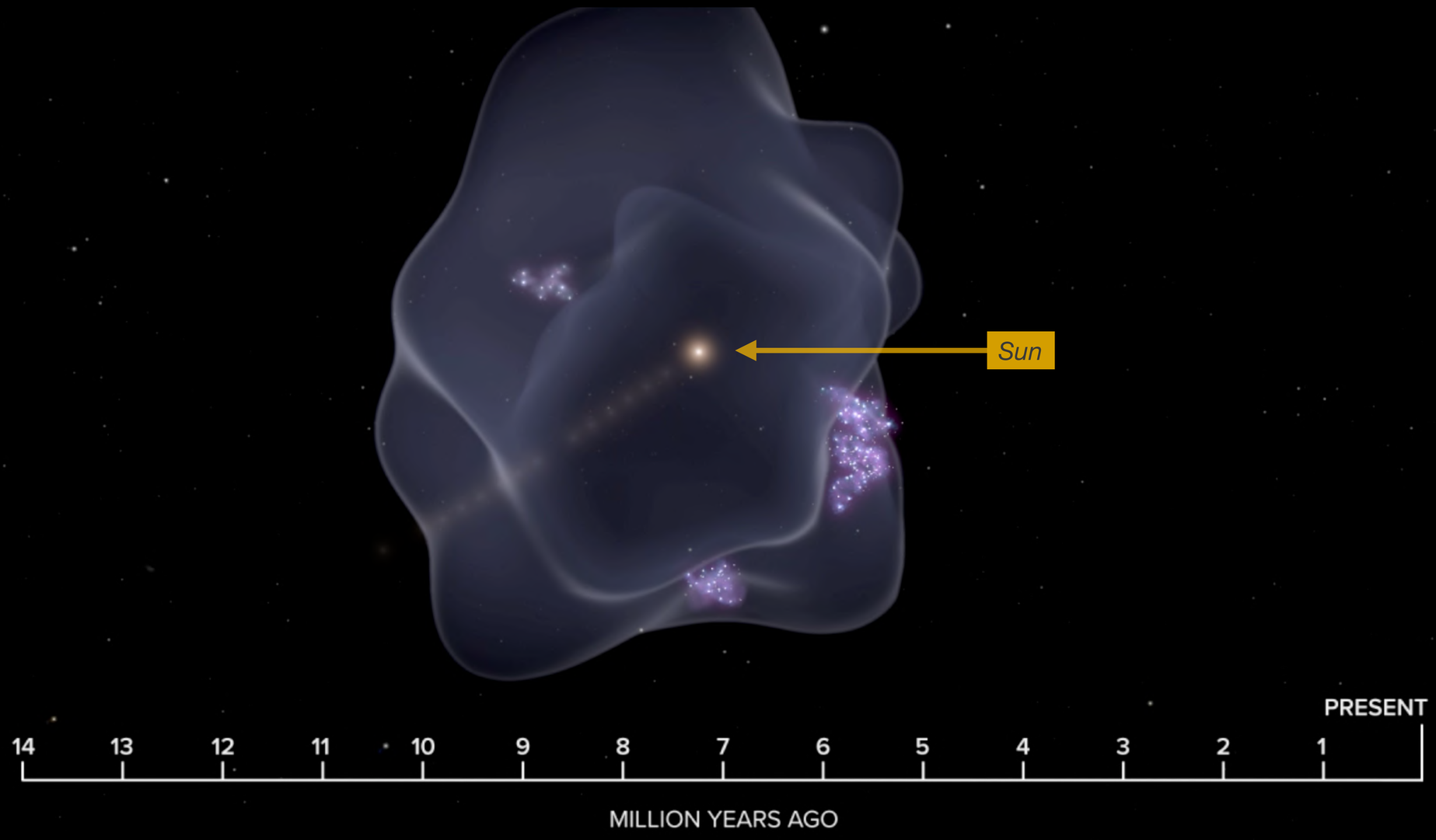
Why do we care about the Local Bubble? (star formation!)



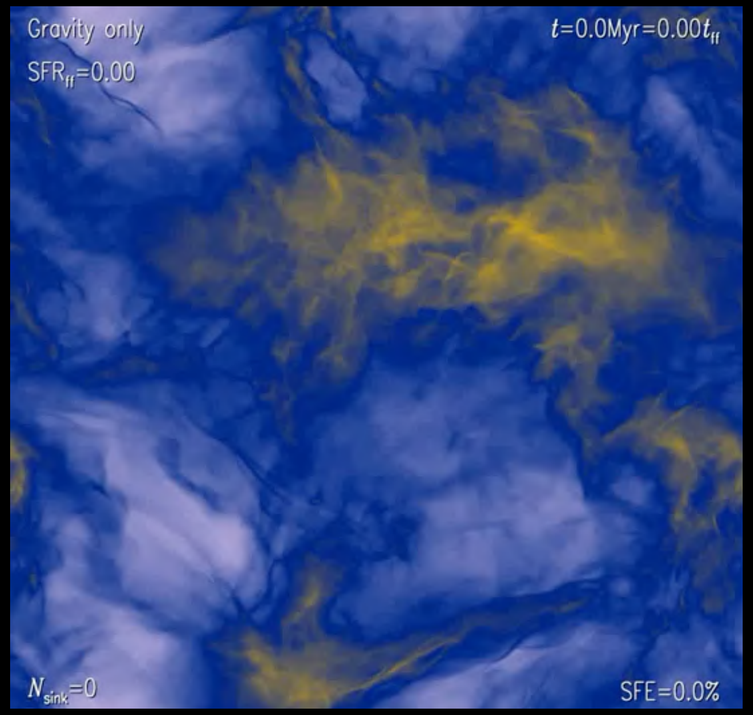
Zucker et al. (2022)

Why do we care about the Local Bubble? (star formation!)



Present-day Bubble model: Pelgrims et al. (2020)
fit to Lallement et al. (2019) 3D Dust Map

And, why do we care about magnetic fields? (also star formation!)

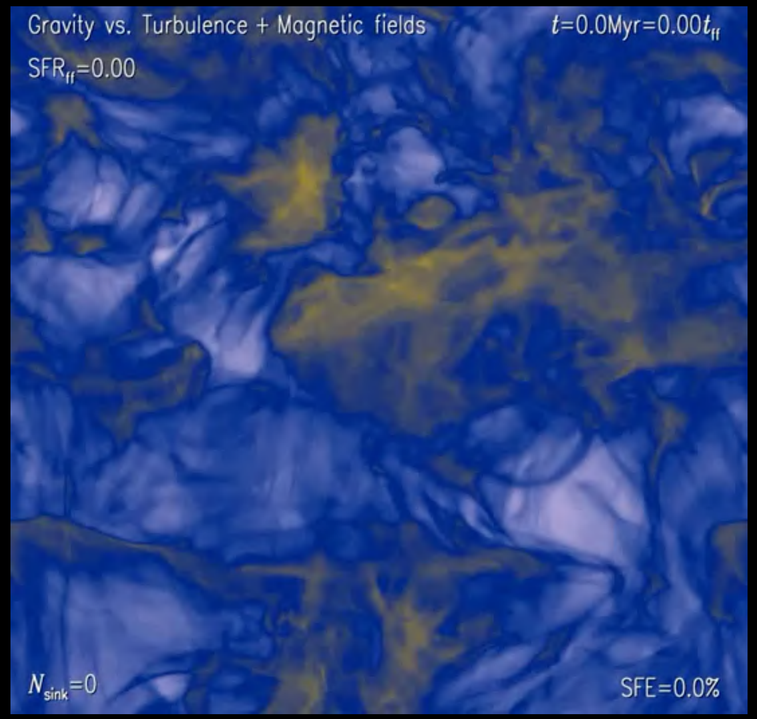


JUST GRAVITY
700 thousand years

Stars form
WAY too fast without
something to slow
gas clouds' collapse.

MAGNETIC FIELDS
likely do the trick.

Movie from: Inefficient star formation through turbulence, magnetic fields and feedback Federrath, C., 2015

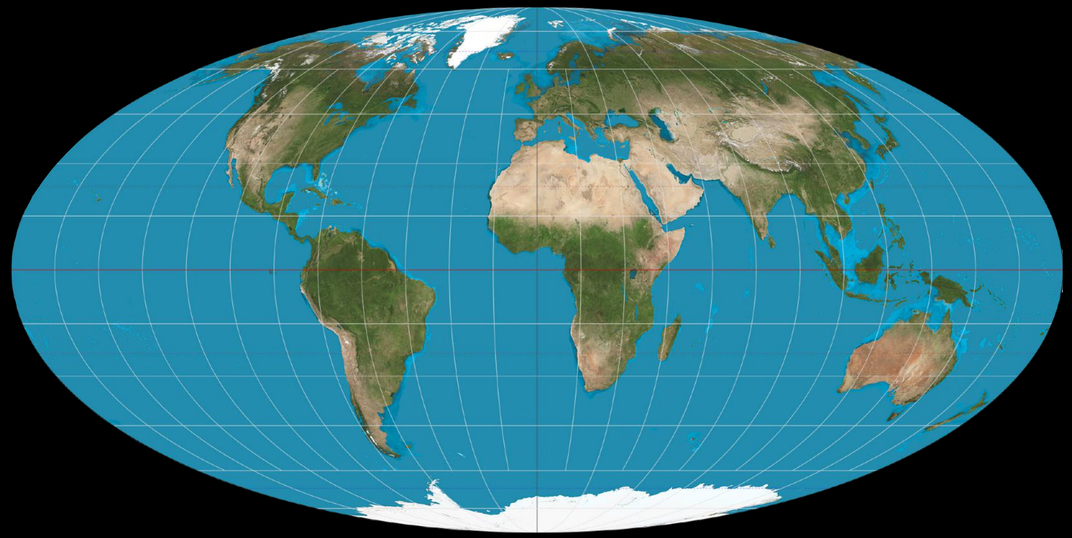


GRAVITY, with **TURBULENCE**
& **MAGNETIC FIELDS**
3.4 million years

What goes into a 3D “map” of the magnetic field?

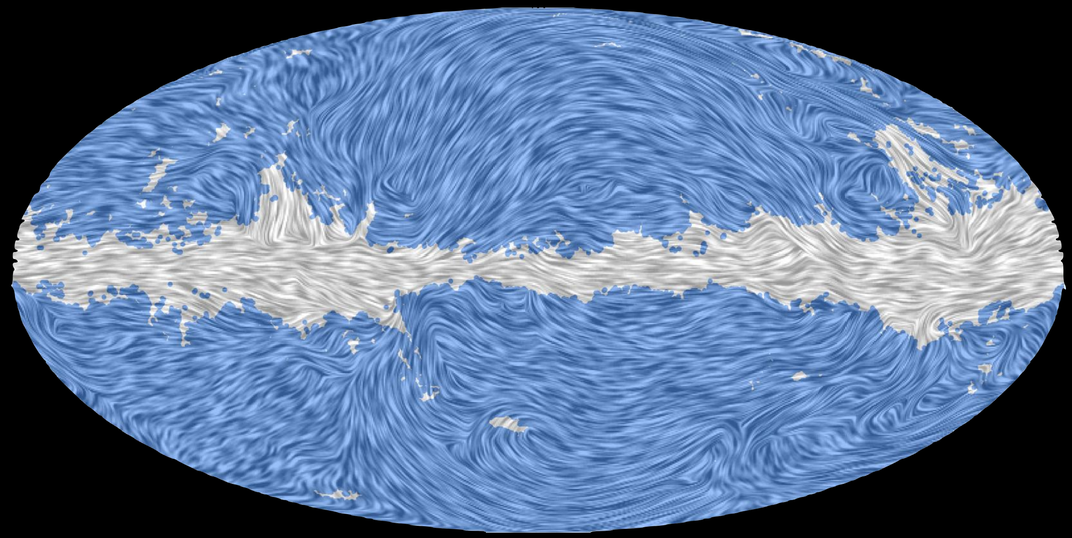
PROJECTIONS

(certain, but can be hard to appreciate in 2D)

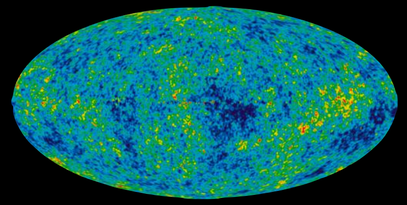


ASSUMPTIONS

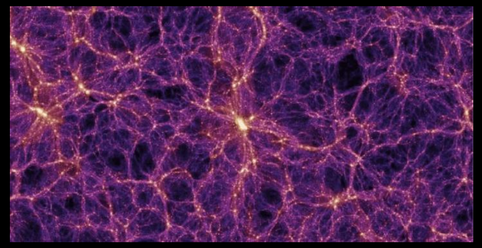
(uncertain, but a good guess)



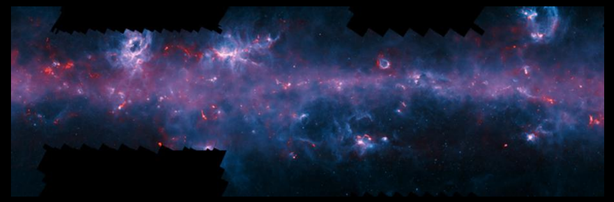
ASSUMPTION 1: The Local Bubble is the dominant source of observed polarization



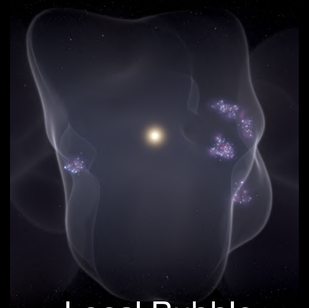
Cosmic Microwave Background



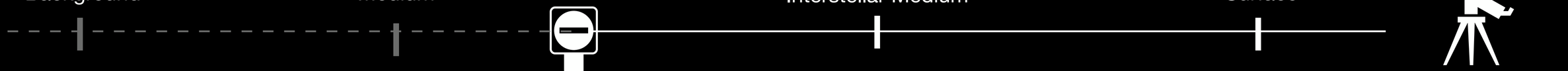
Intergalactic Medium



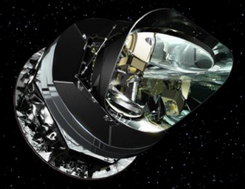
Milky Way Interstellar Medium



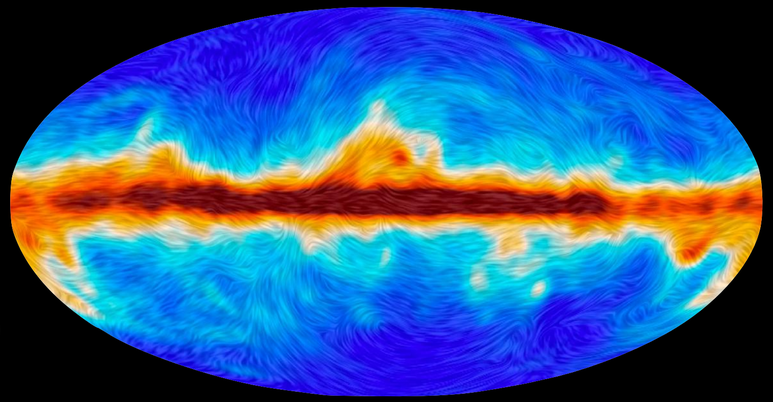
Local Bubble Surface



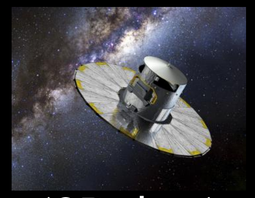
Planck



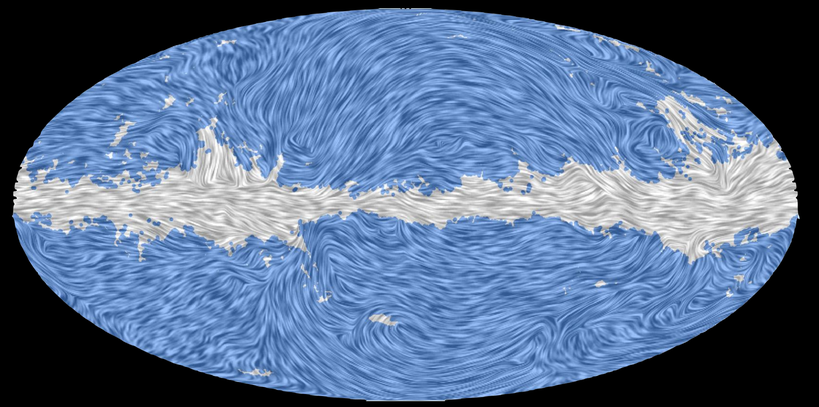
(polarization)



Gaia

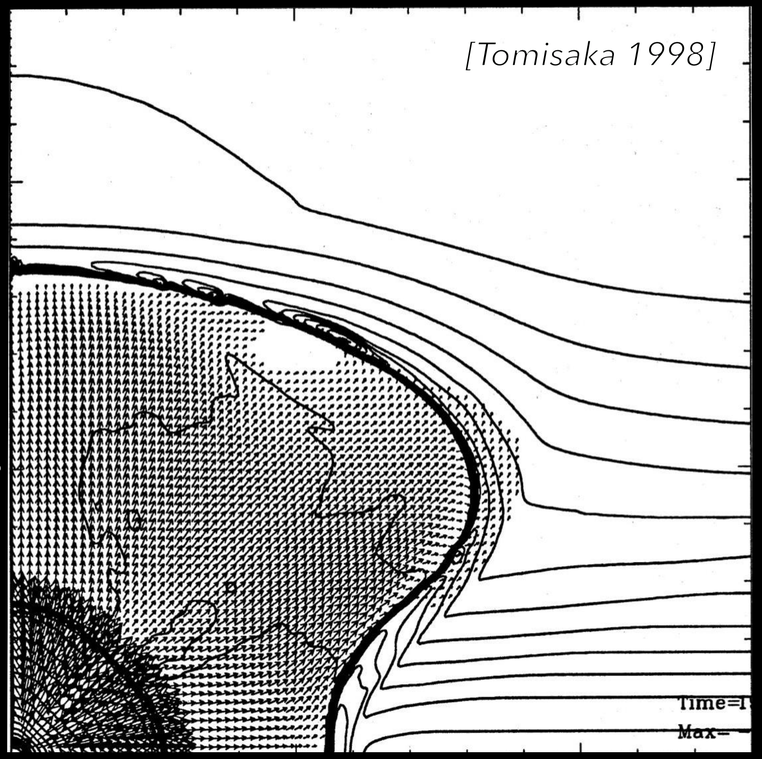


(3D dust)

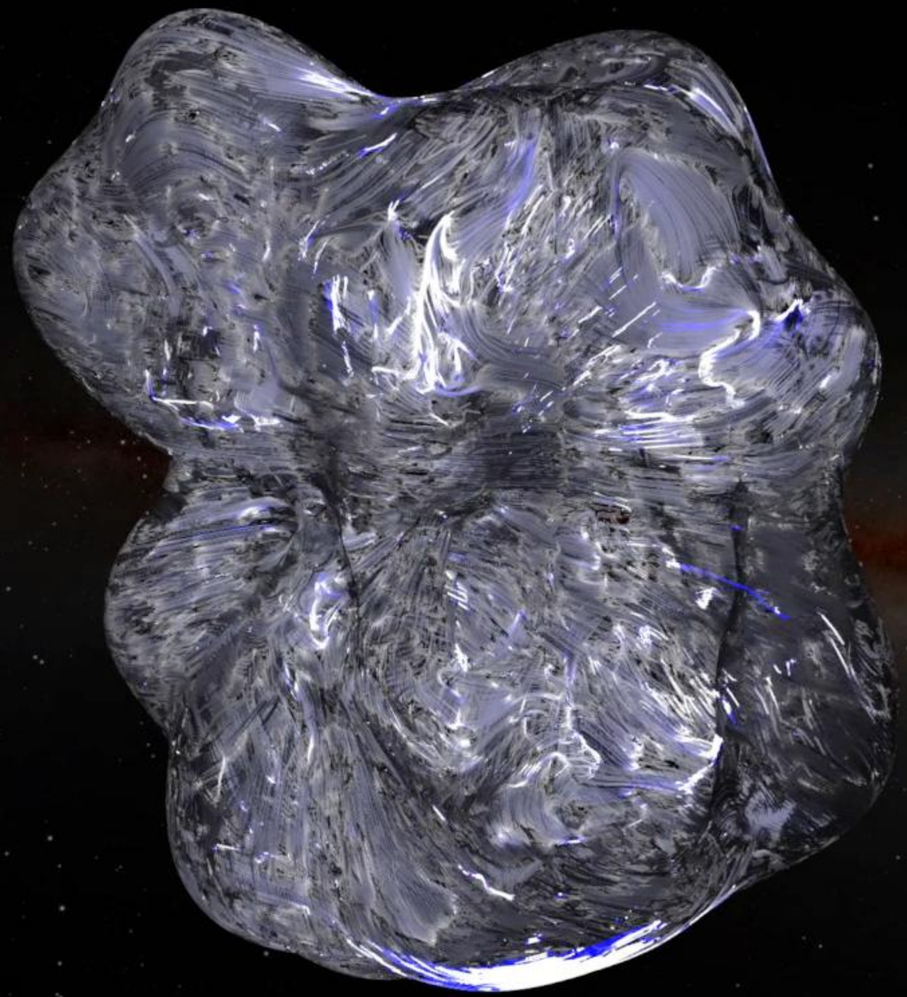


ASSUMPTION 2: Magnetic field is “swept up” into bubble surface, so tangent to it

Simulation



With these assumptions, we can create a 3D map of the magnetic field…



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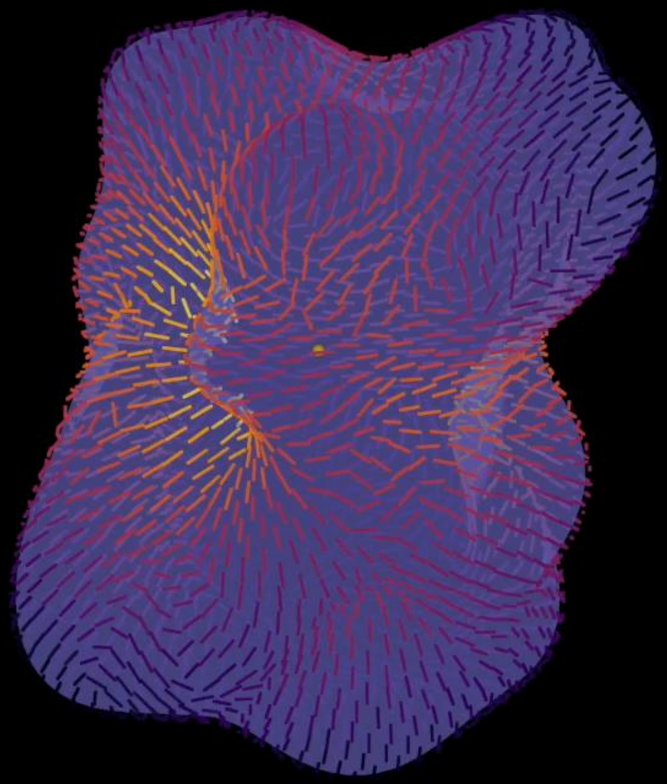
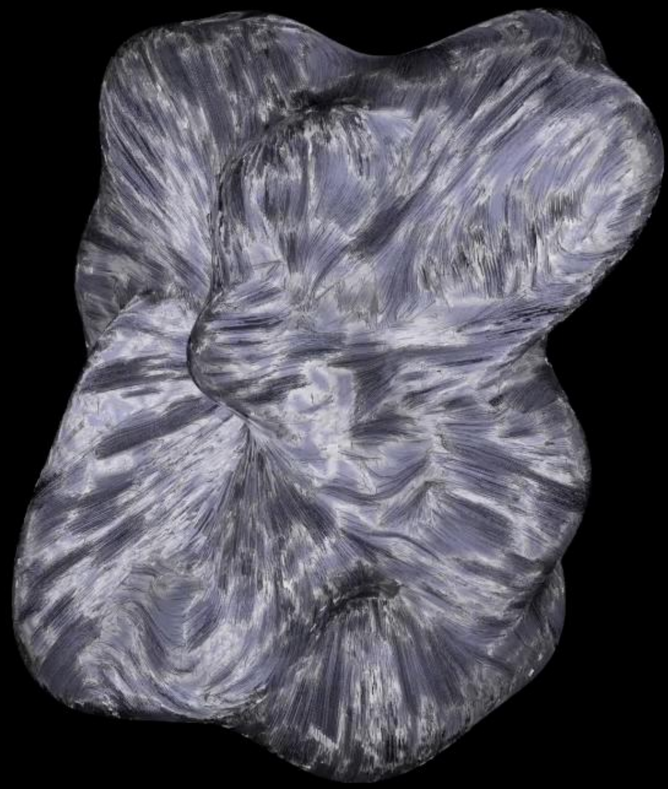
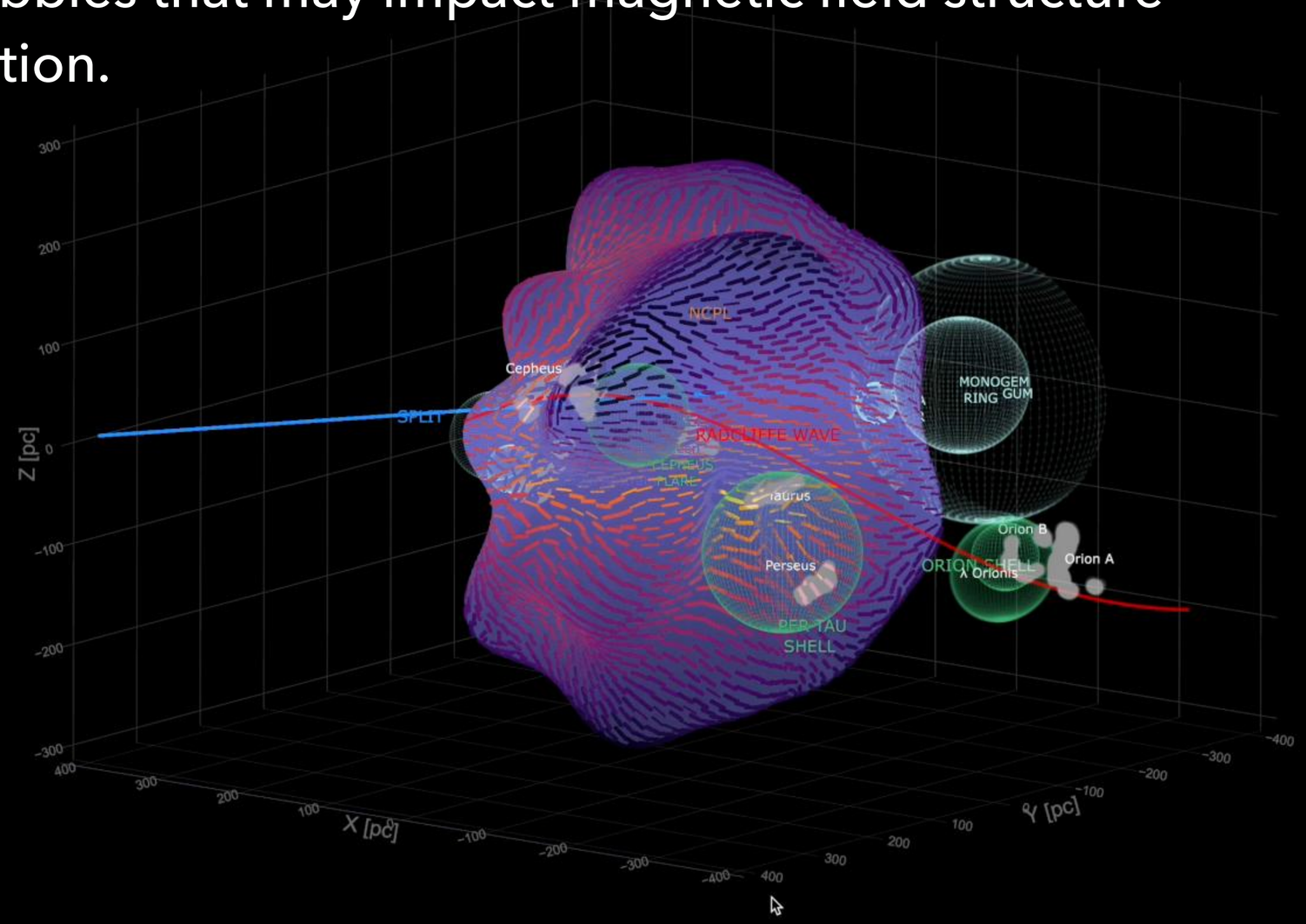
It’s a visualization challenge to find the best methods to explore what’s happening and inspire statistical tests for correlations.



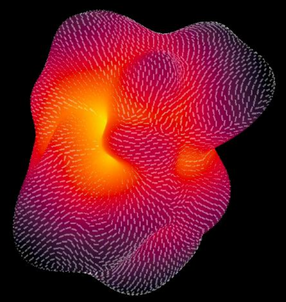


The interactive figure in our paper adds nearby “feedback” bubbles that may impact magnetic field structure and star formation.

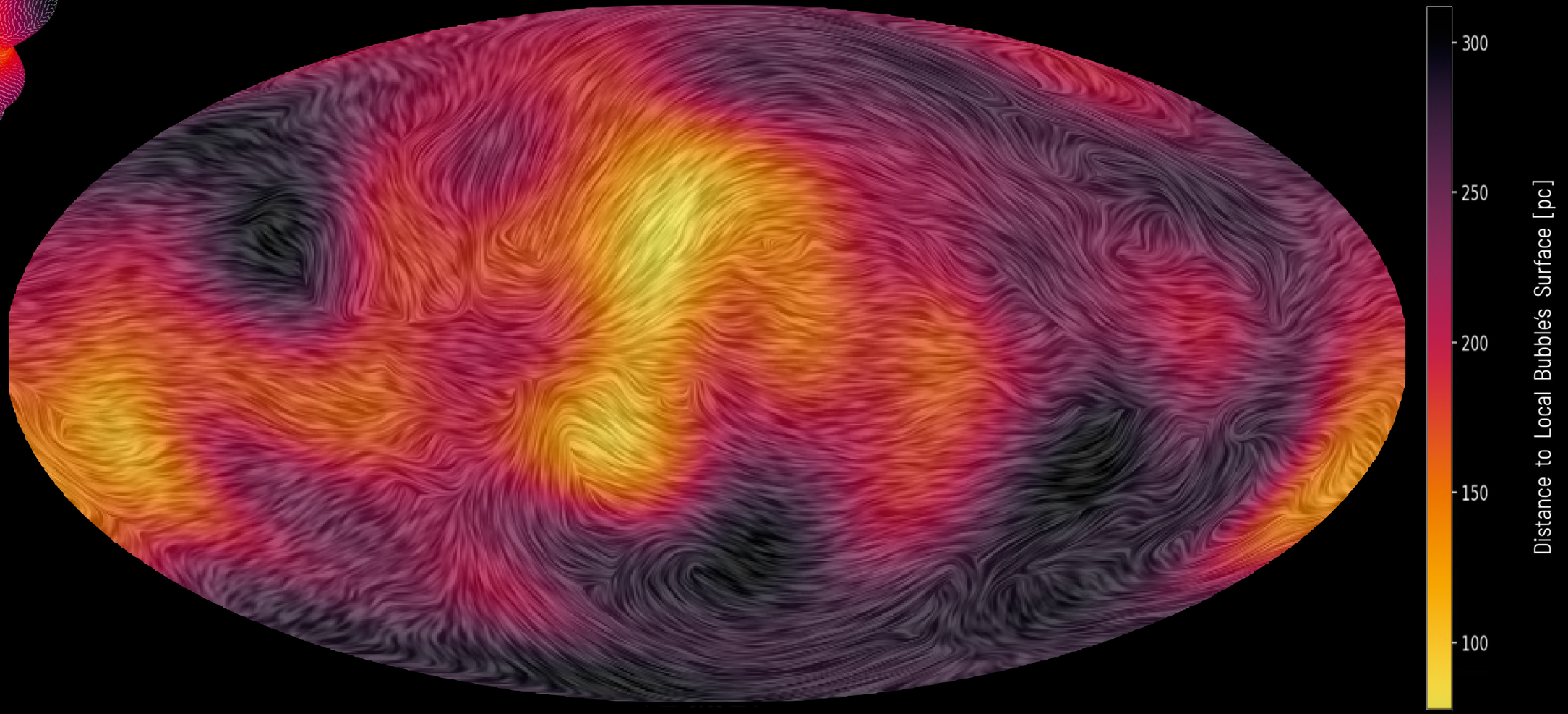


[try the interactive figure]

Surface ripples (shown in color) and field direction (swirls) often correlated…

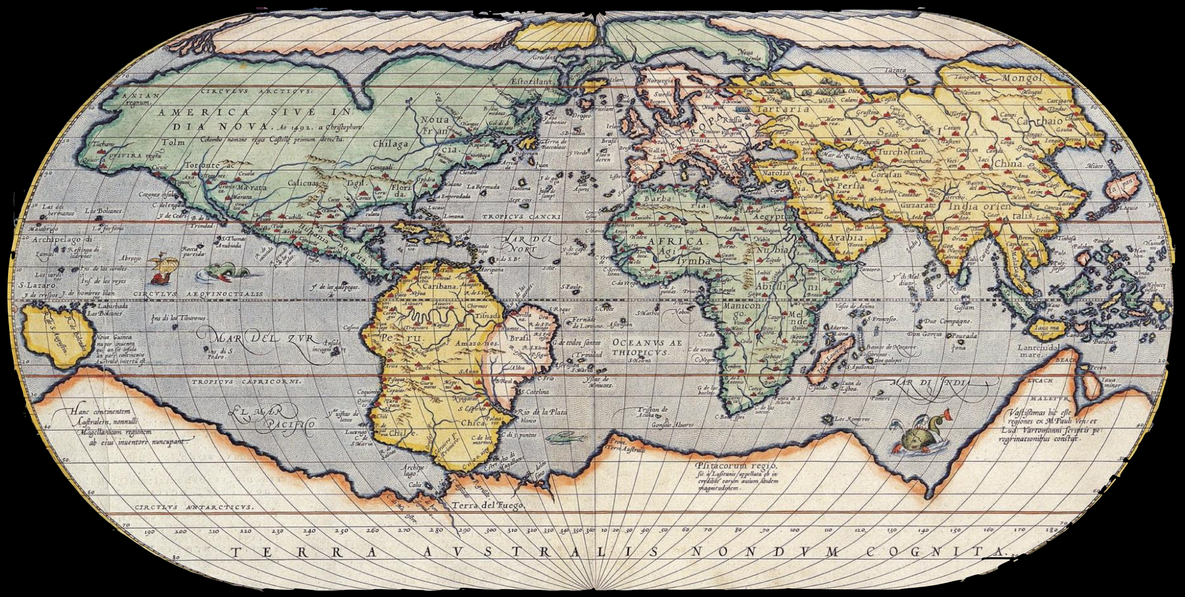


Distance from Sun to Surface of Local Bubble

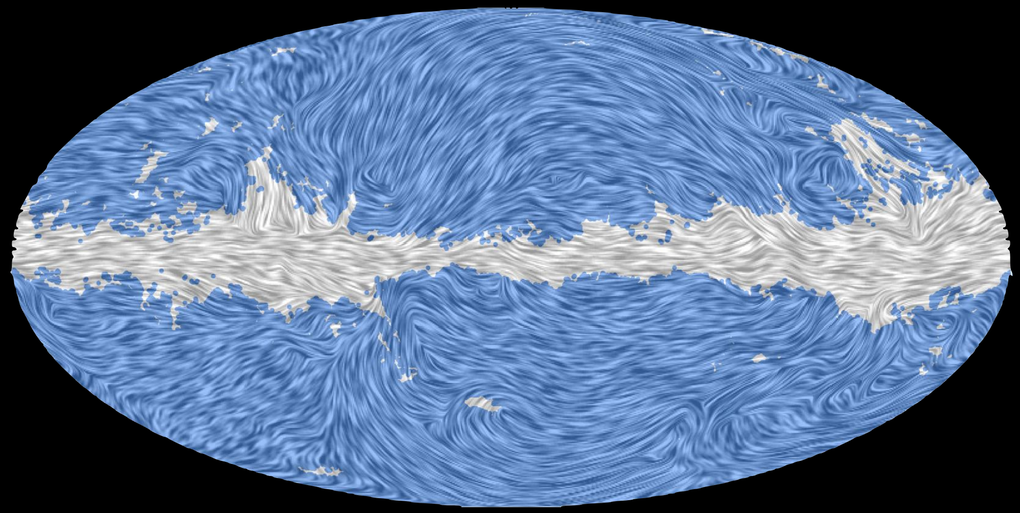


Distances from Pelgrims et al. (2020) Model

Where & how much should we trust this “map,” and how can we know?



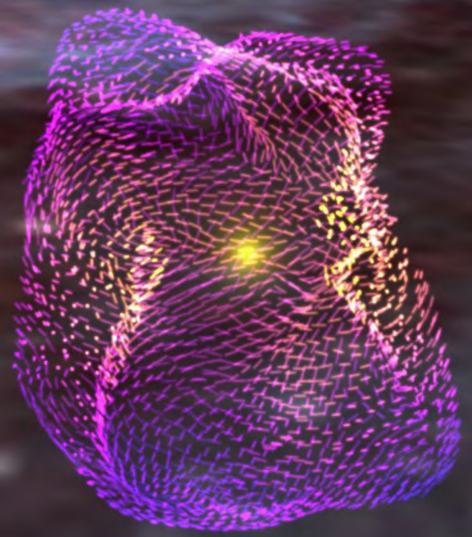
Blue = *likely dominated by Local Bubble*



… it’s an EARLY EXPLORATION– stay tuned for more!

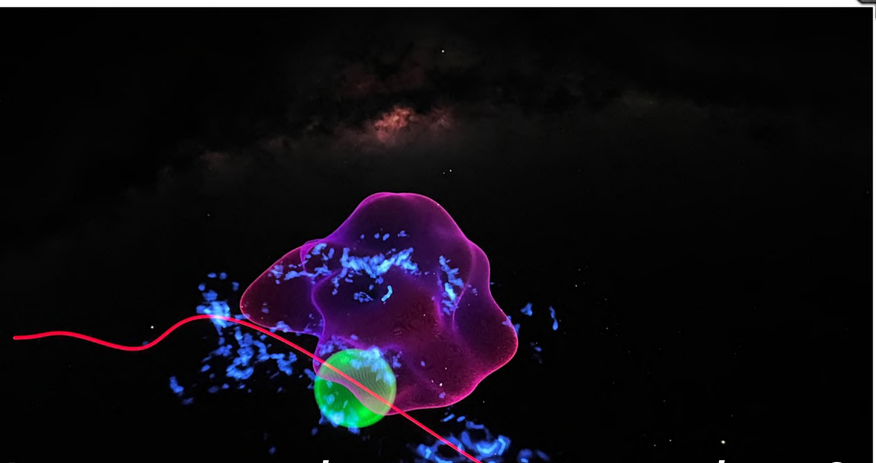
What's next?

What would a simulated polarization map of a magnetic superbubble look like from inside?



How do bubbles' interactions affect field structure?

What can this map tell us about how magnetized feedback bubbles set the star-formation rate in galaxies?



How can we best contextualize & share these & related results?
(more at MilkyWay3D.org)

Magnetized Local Bubble

Home News Publications & Talks Visuals Software Data & Credits

The Magnetized Local Bubble, in 3D

visit *tinyurl.com/local-bubble-b* for interactive figures, videos, and much more

Thanks to the work of many who came before, and publicly-shared vast data troves, we can draft a 3D map of the magnetic field on the surface of the Local Bubble. We are constantly improving our guess as to what the map looks like, so please use this page to find **news, publications** and **talks**, **visuals** (images, interactives, and videos), and **data.** Stay tuned for updates!

The first public showing of this work will be at the 241st AAS meeting, in Seattle in 2023, and a preprint by O'Neill et al. is available on Authorea.