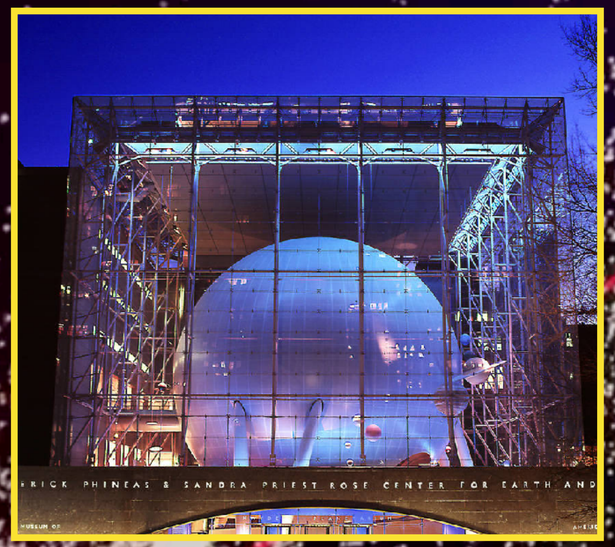
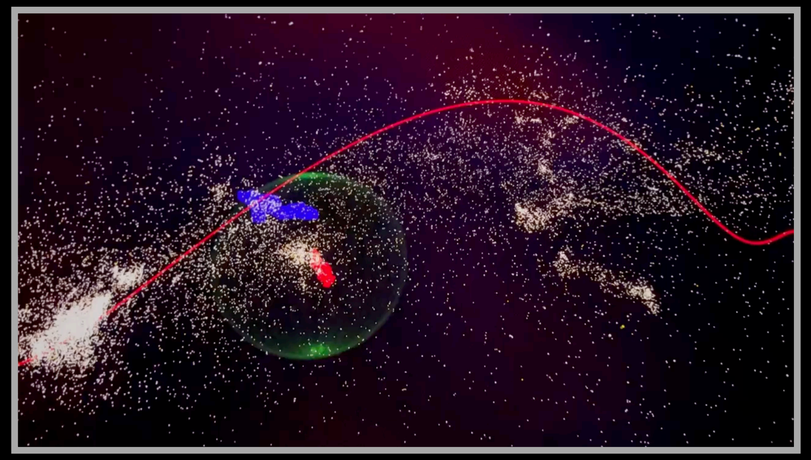
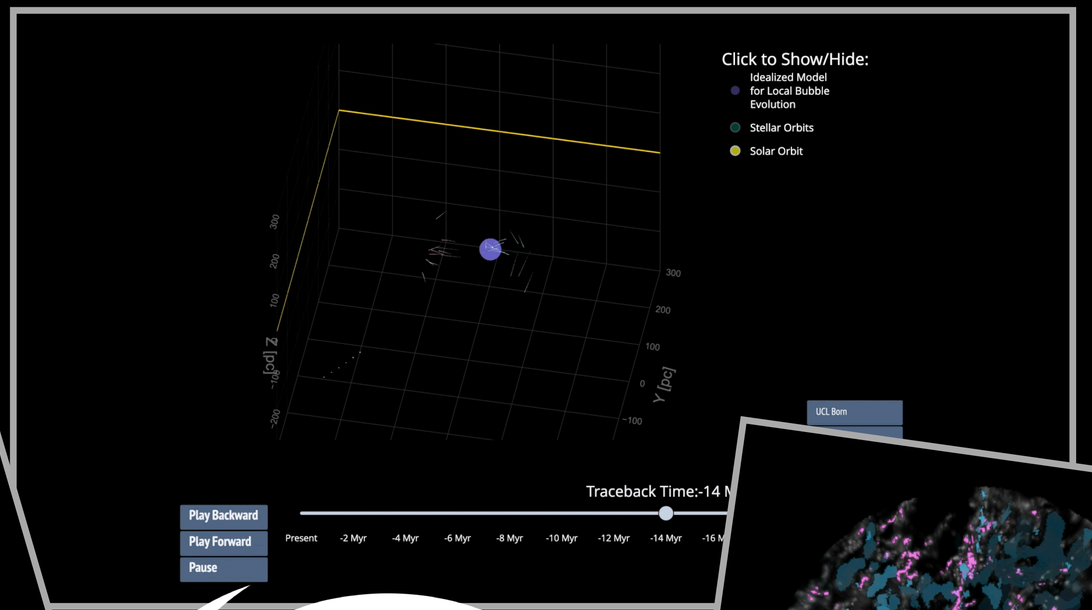
“Making a 3D Movie of the Star-Forming Milky Way I never thought I'd see”

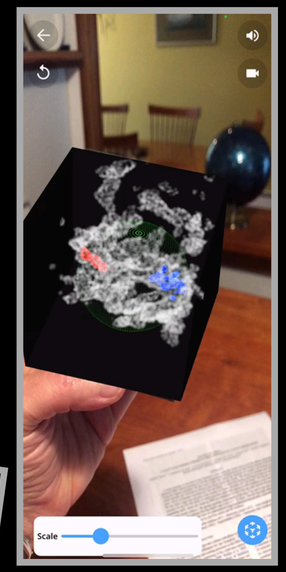


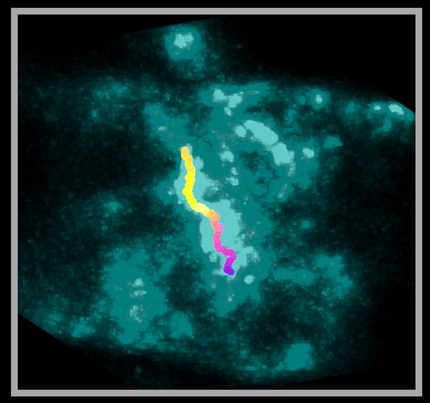
MILKYWAY3D.org

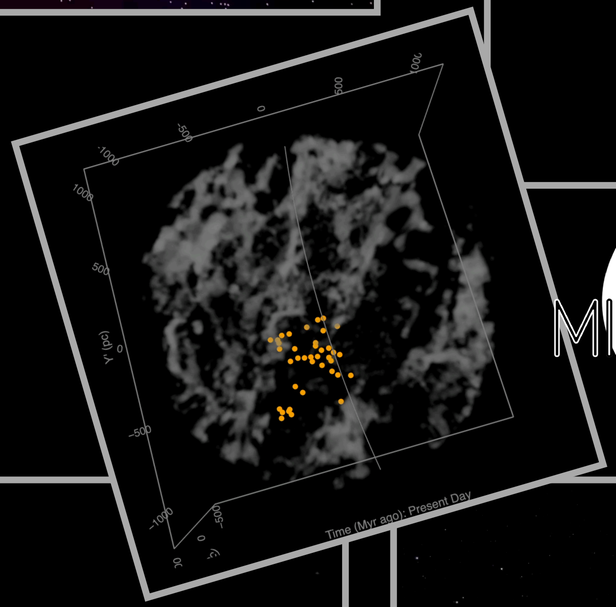
AG, with Catherine Zucker, Center for Astrophysics | Harvard & Smithsonian; Jacqueline Faherty, American Museum of Natural History; Joao Alves, University of Vienna; Brian Abbott, American Museum of Natural History; Micah Acinapura, American Museum of Natural History; Robert Benjamin, University of Wisconsin, Whitewater; Gordian Edenhofer, Max Planck Insitute for Astrophysics–> CfA; Carter Emmart, American Museum of Natural History; Douglas Finkbeiner, Center for Astrophysics | Harvard & Smithsonian; Ralf Konietzka, Center for Astrophysics | Harvard & Smithsonian; Theo O'Neill, Center for Astrophysics | Harvard & Smithsonian; Andrew Saydjari, Center for Astrophysics | Harvard & Smithsonian–>IAS; Robert Hurt, IPAC, and the Full MilkyWay3D.org Team, ++…see “Collaborators” at MilkyWay3D.org.

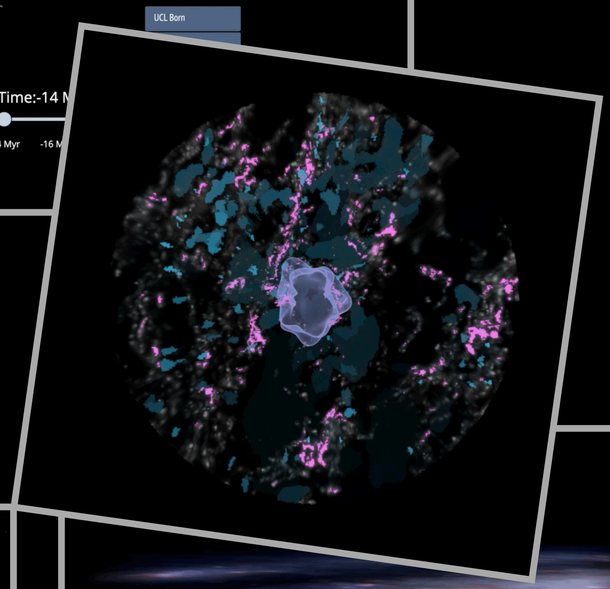












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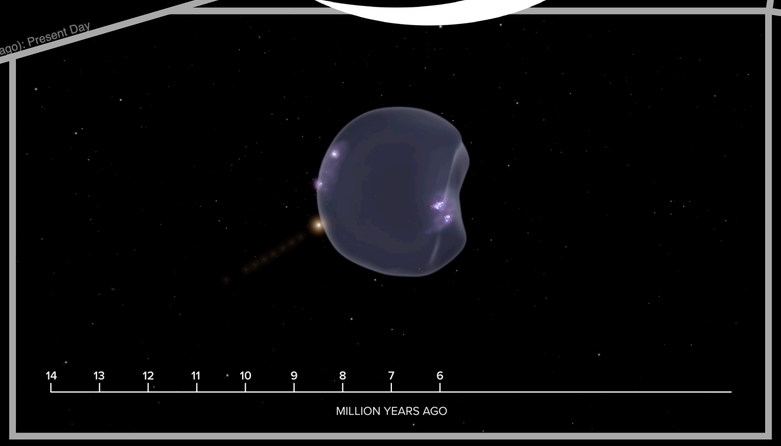
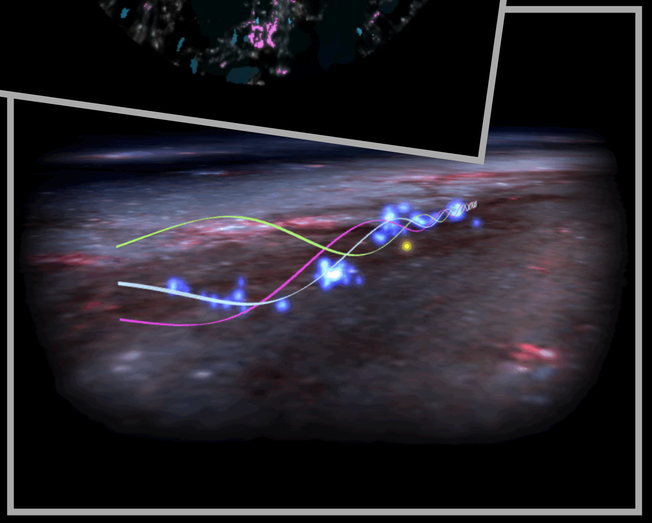


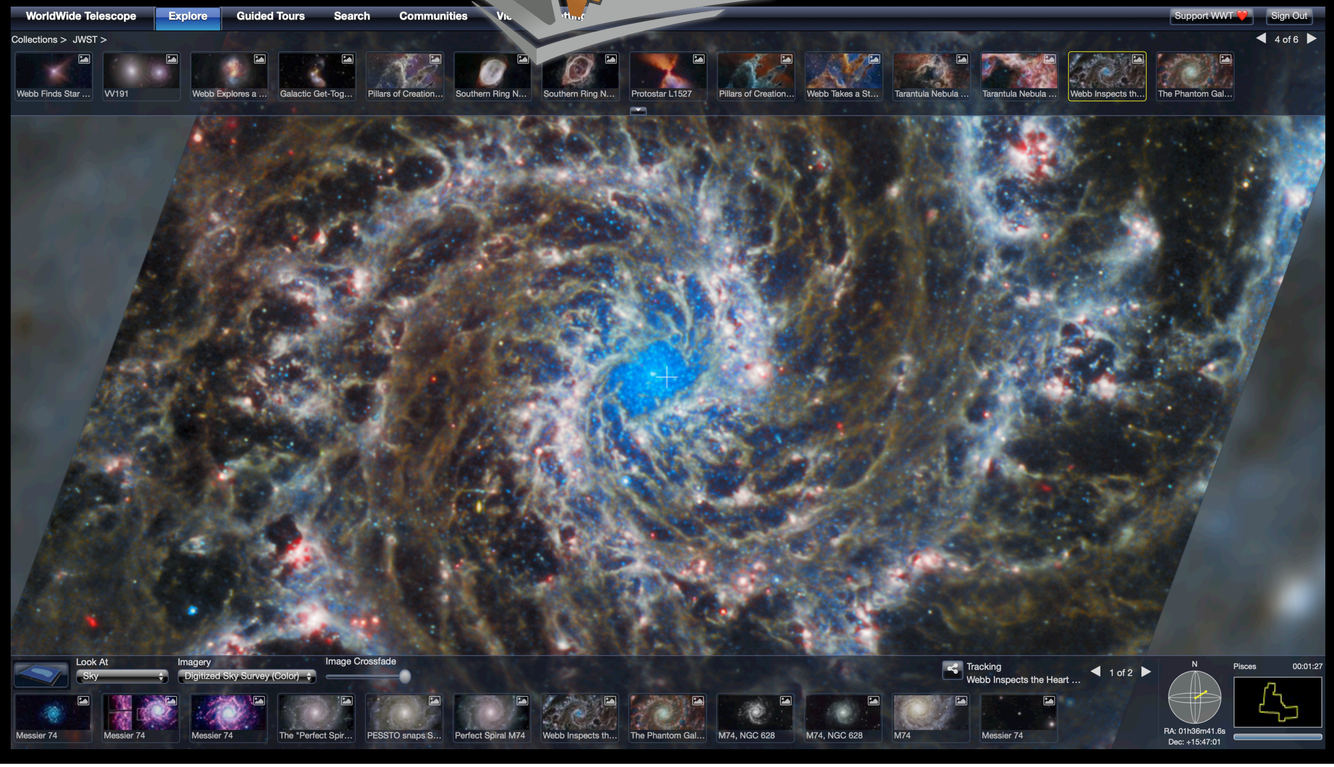


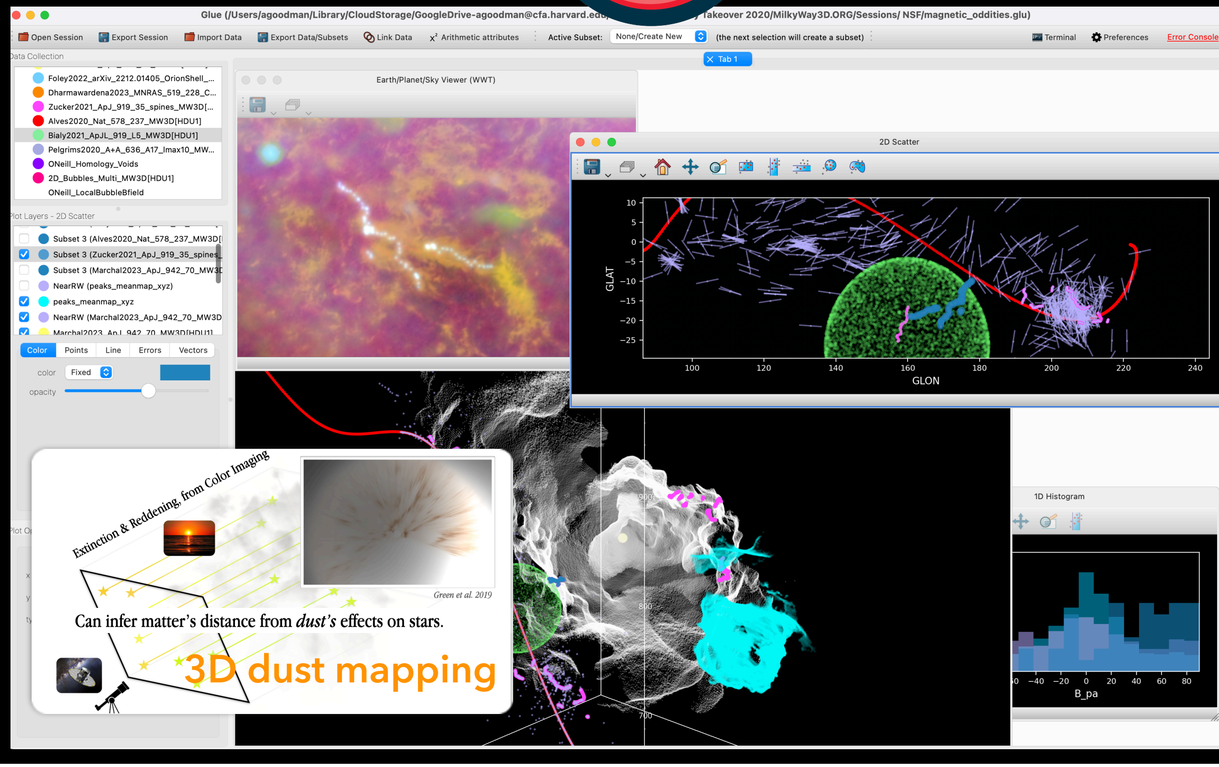
Zucker et al. 2021, Bialy et al. 2021; Zucker et al. 2022, Konietizka et al. 2024, O'Neill et al. 2024, Swiggum et al. 2024

unprecedented data

NASA WEBB SPACE TELESCOPE

esa gaia





WORLDWIDE TELESCOPE

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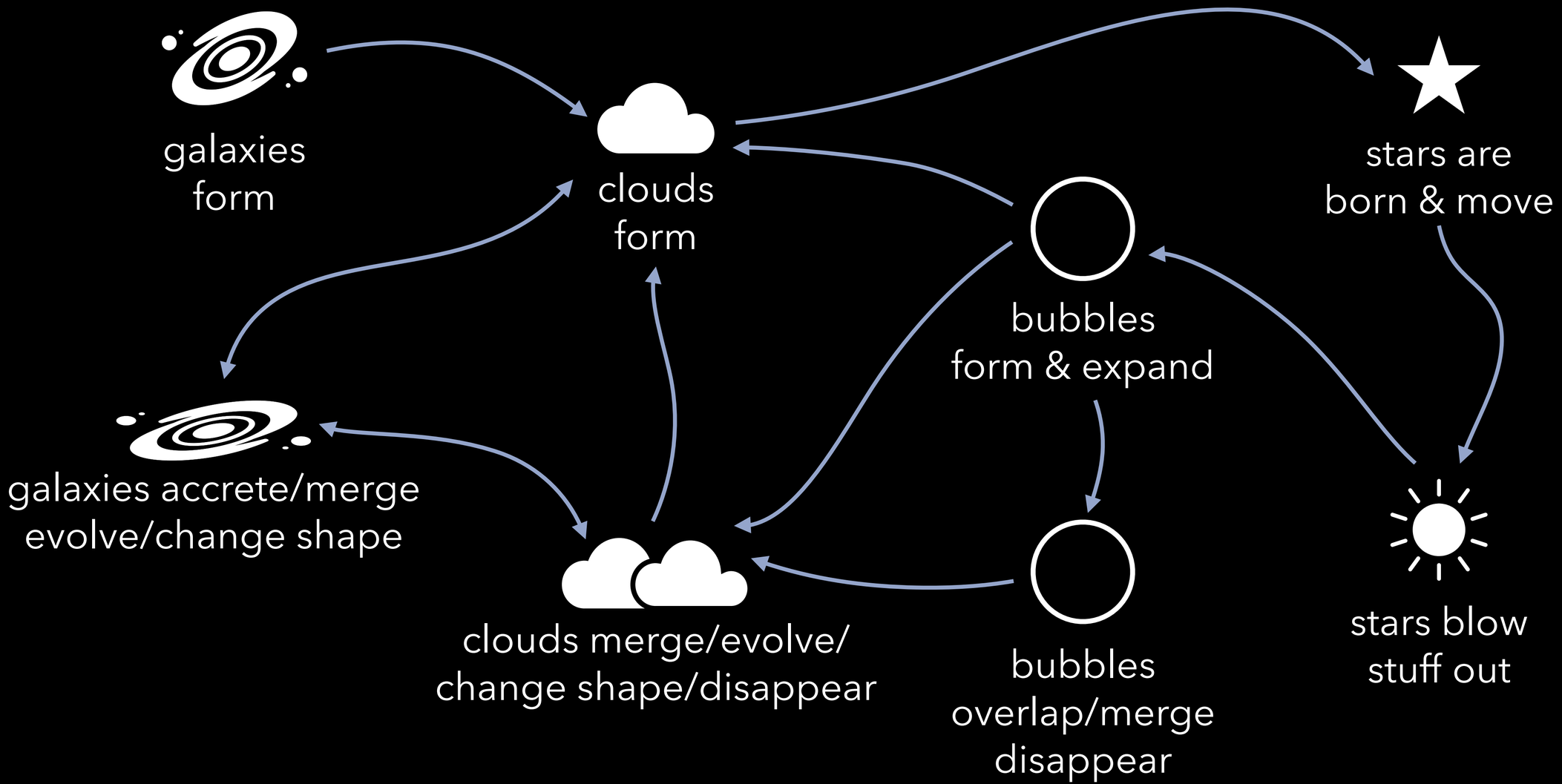
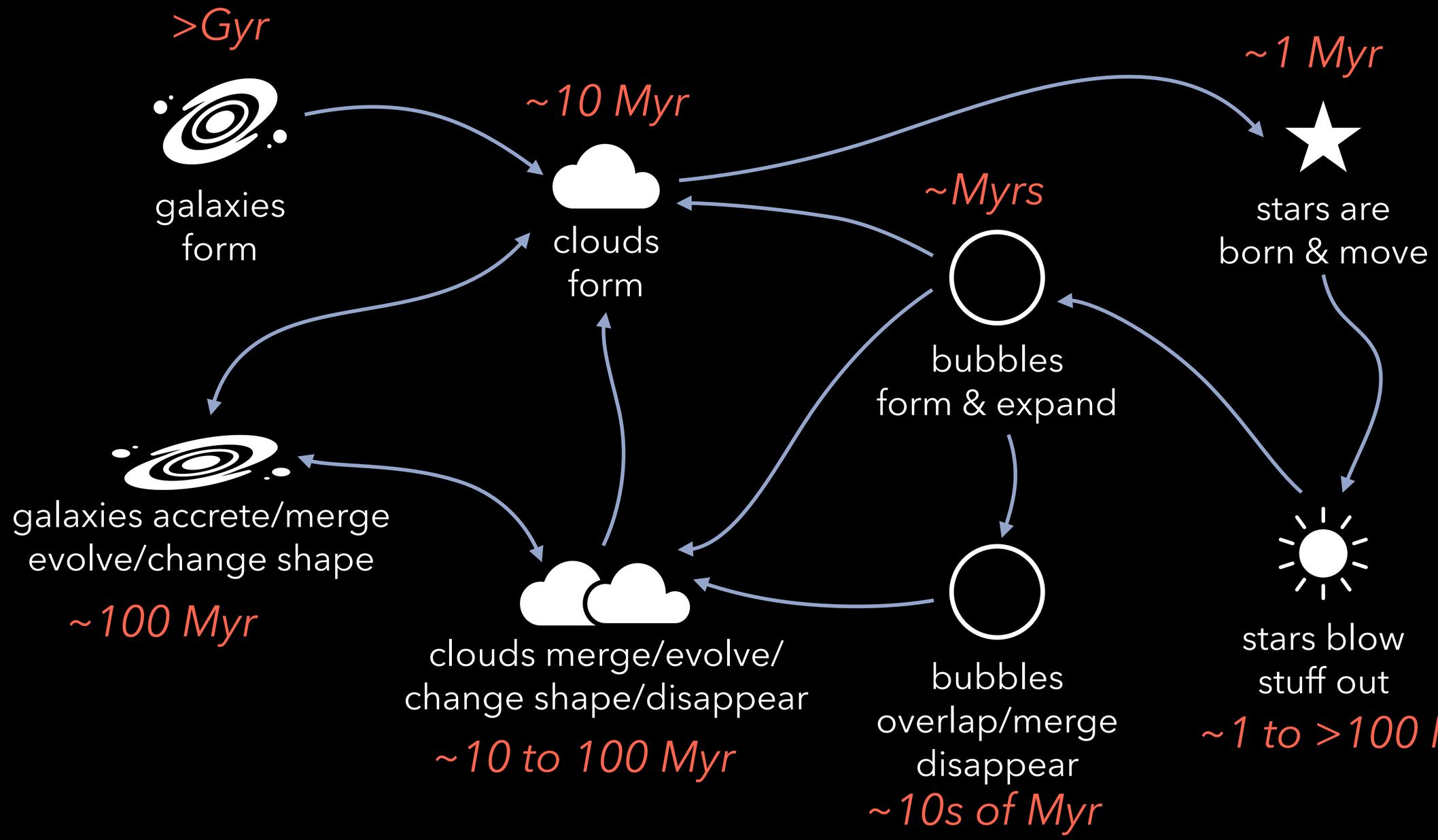
unprecedented software tools

"Everything, Everywhere, All at Once"



"Everything, Everywhere, All at Once"



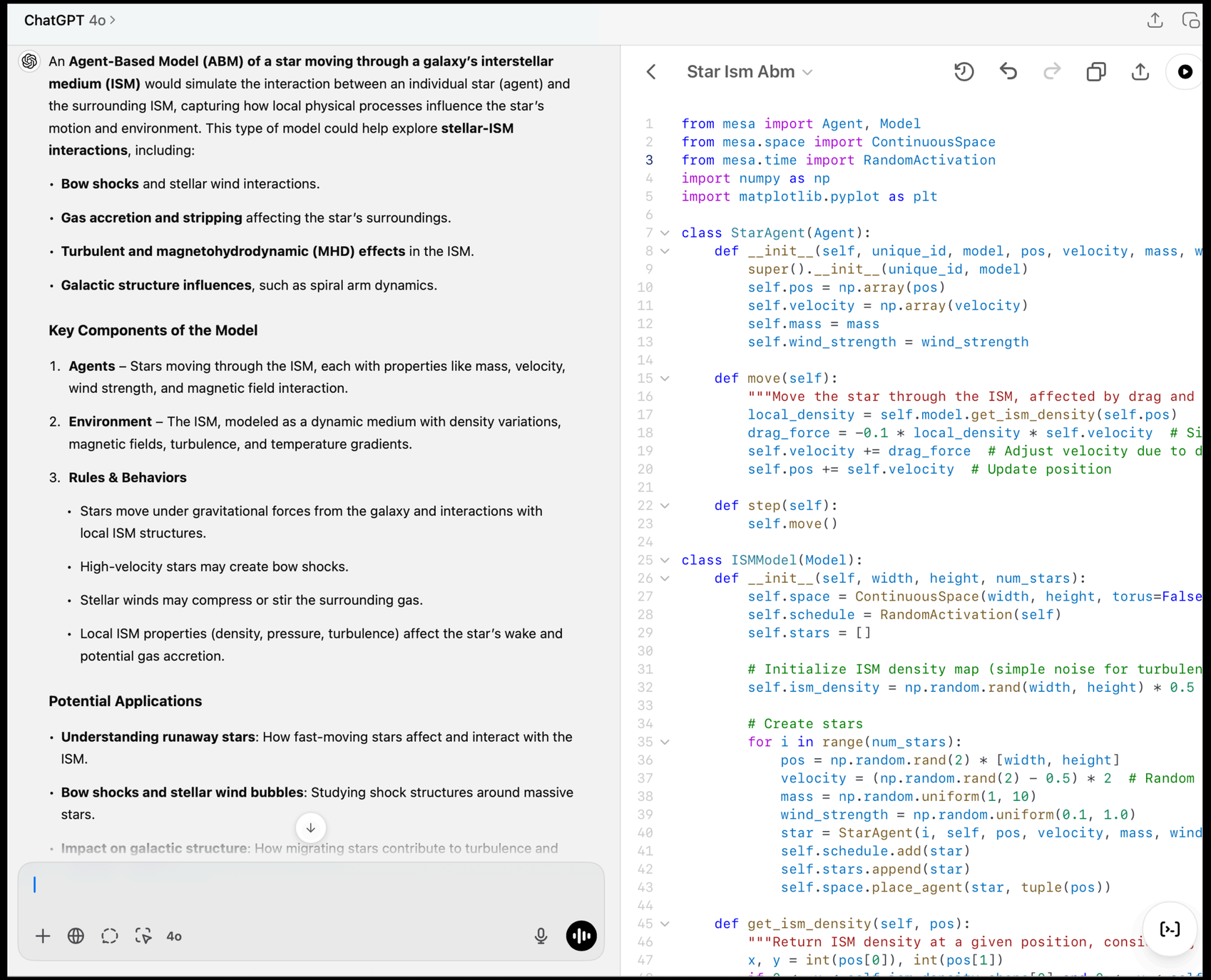
An "Agent-based" Model for a Star's Life in the Galactic ISM?

Much work, including my own, seeks to understand how stars form in galaxies, and how they interact with its ISM over time (e.g. via accretion/outflows, radiation, SNe, etc.)

Usually, a statistical approach is used, to look at a "region" over time & see what happens. How many stars, of what age, doing what, to that region.

NOW, though, using new observations of billions of stars, and the newest simulations, it has become possible to model the PATH of individual stars, as they form, and orbit the Milky Way.

So, we can create an "agent-based" model, where we track stars, one-at-a-time, in a Milky-Way-like galaxy, to monitor (and "see"!) what happens around them, from **100,000 year to 100Myr timescales.**

One early goal: "How do young stars leave home?" We know that stellar velocity dispersion increases from ~10 km/s for "young-ish" (~100 Myr-old) stars to >50 km/s for the oldest stars (>10 Gyr). BUT—we do NOT know **how VERY young stars go from ~1 km/s to 10 km/s, during the first Myr of their lives.** We should figure that out!

And, yes, we need to "partner" with AI