Once upon a time (2012), in an enchanted castle (in Bavaria)

...at a conference about "The Early Phases of Star Foration"

Andi Burkert asked a question:

Is Nessie "parallel to the Galactic Plane"?

No one knew.

The Milky Way

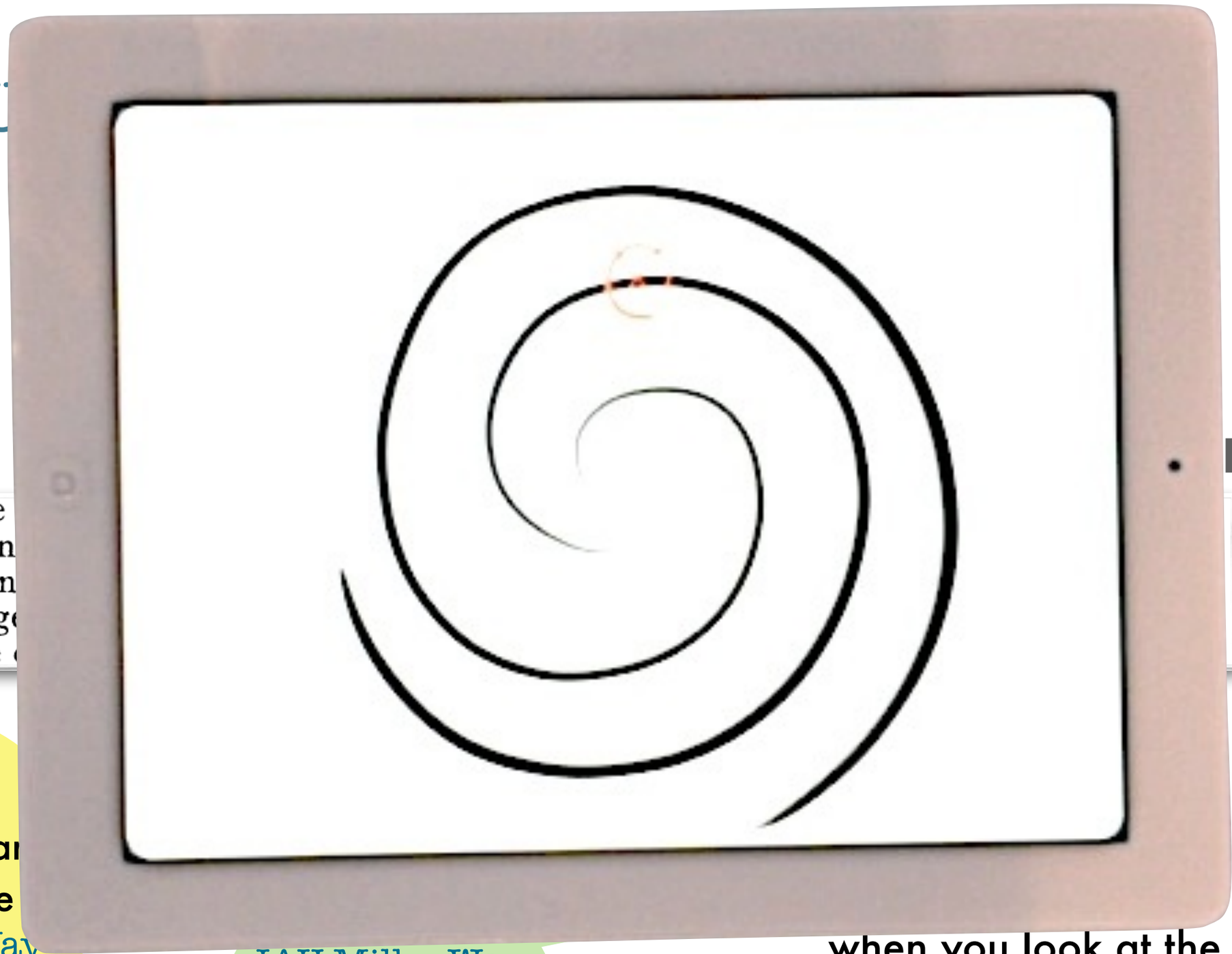
“Galactic Plane”

The Milky Way
(Artist's Conception)

“Is Nessie Parallel to the Galactic Plane?”

Where are we, really?

"IAU



rn

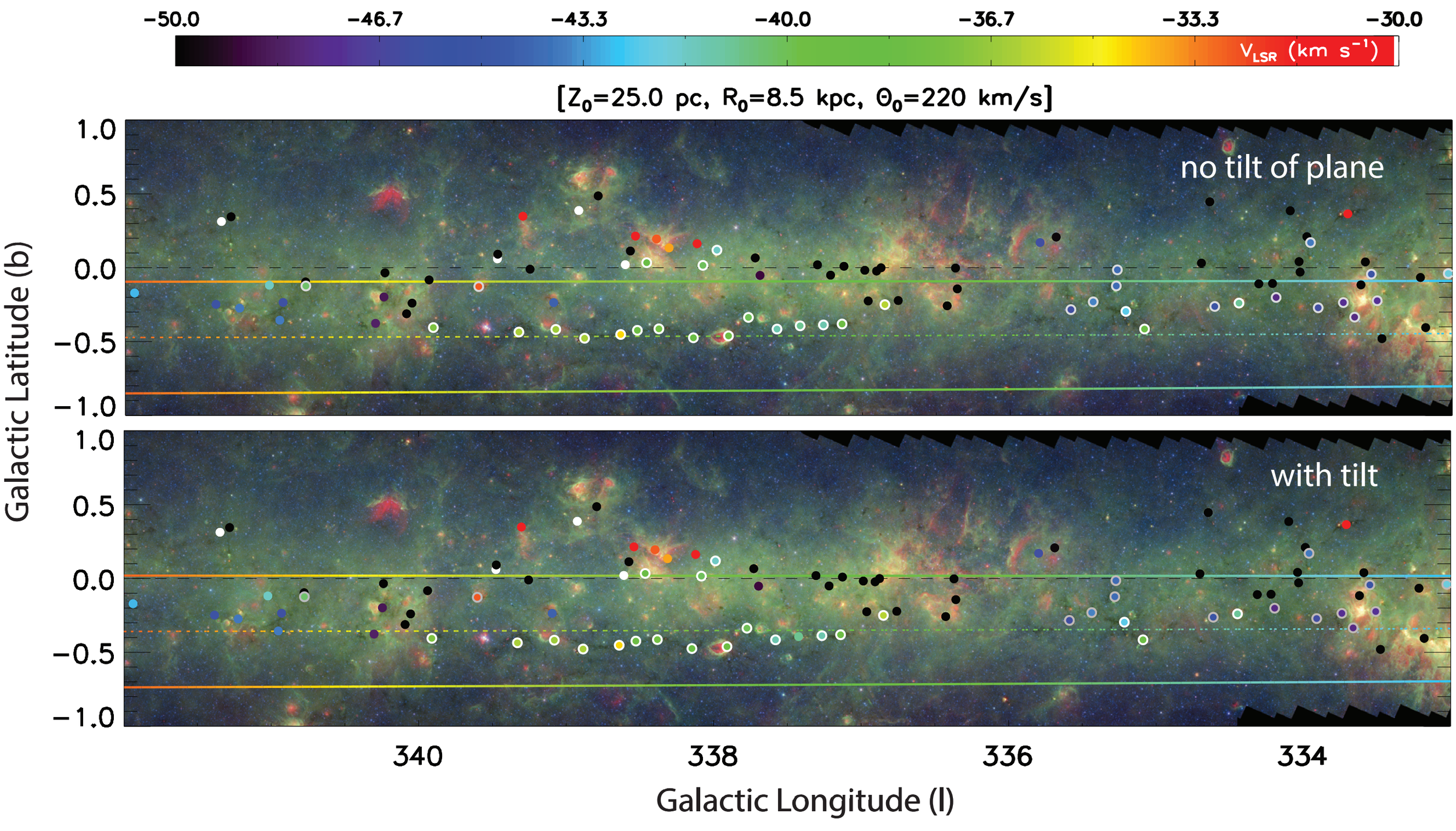
The
the sun
the sun
hydroge
not lie

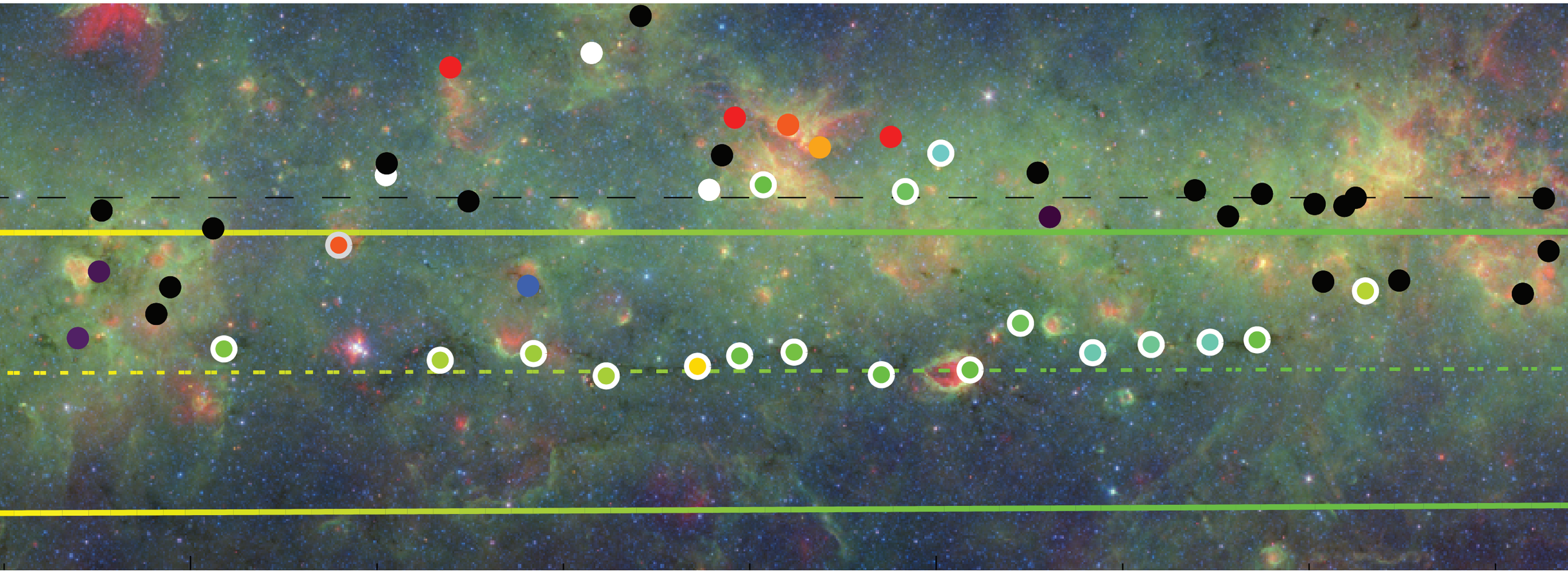
Sun is
~75 light year
"above" the
IAU Milky Way
Plane

IAU Milky Way
Center

quite
is
when you look at the sky

In the plane, at distance of spiral arm!

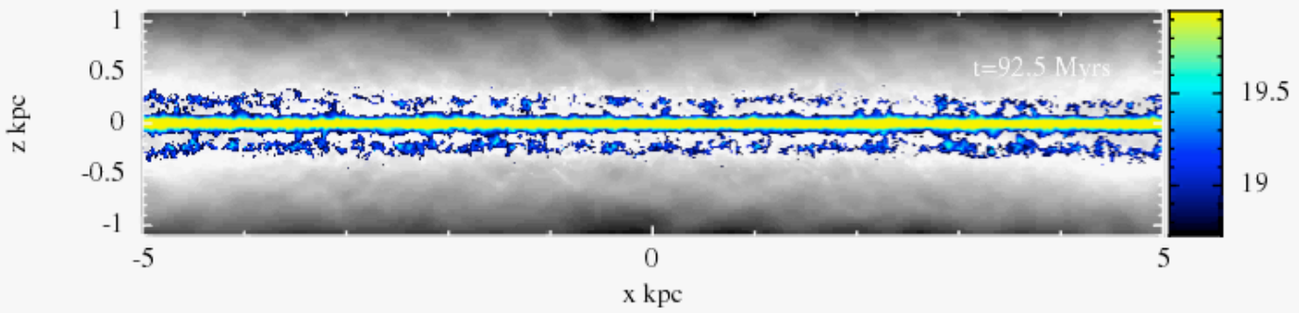




...eerily precisely...

A full 3D skeleton?

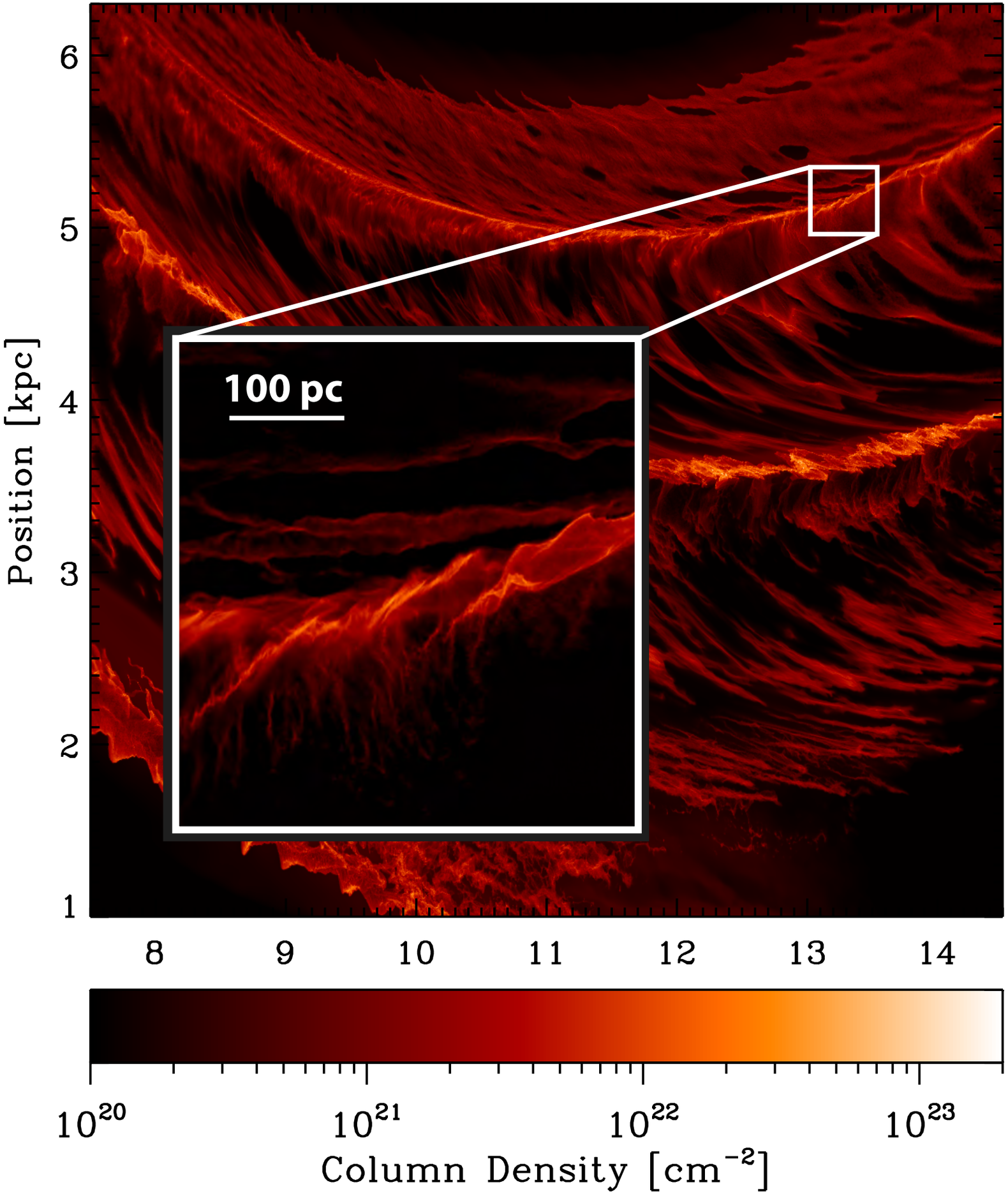
(flipped) image of IC342 from Jarrett et al. 2012; WISE Enhanced Resolution Galaxy Atlas



simulations courtesy Clare Dobbs

Breaking News

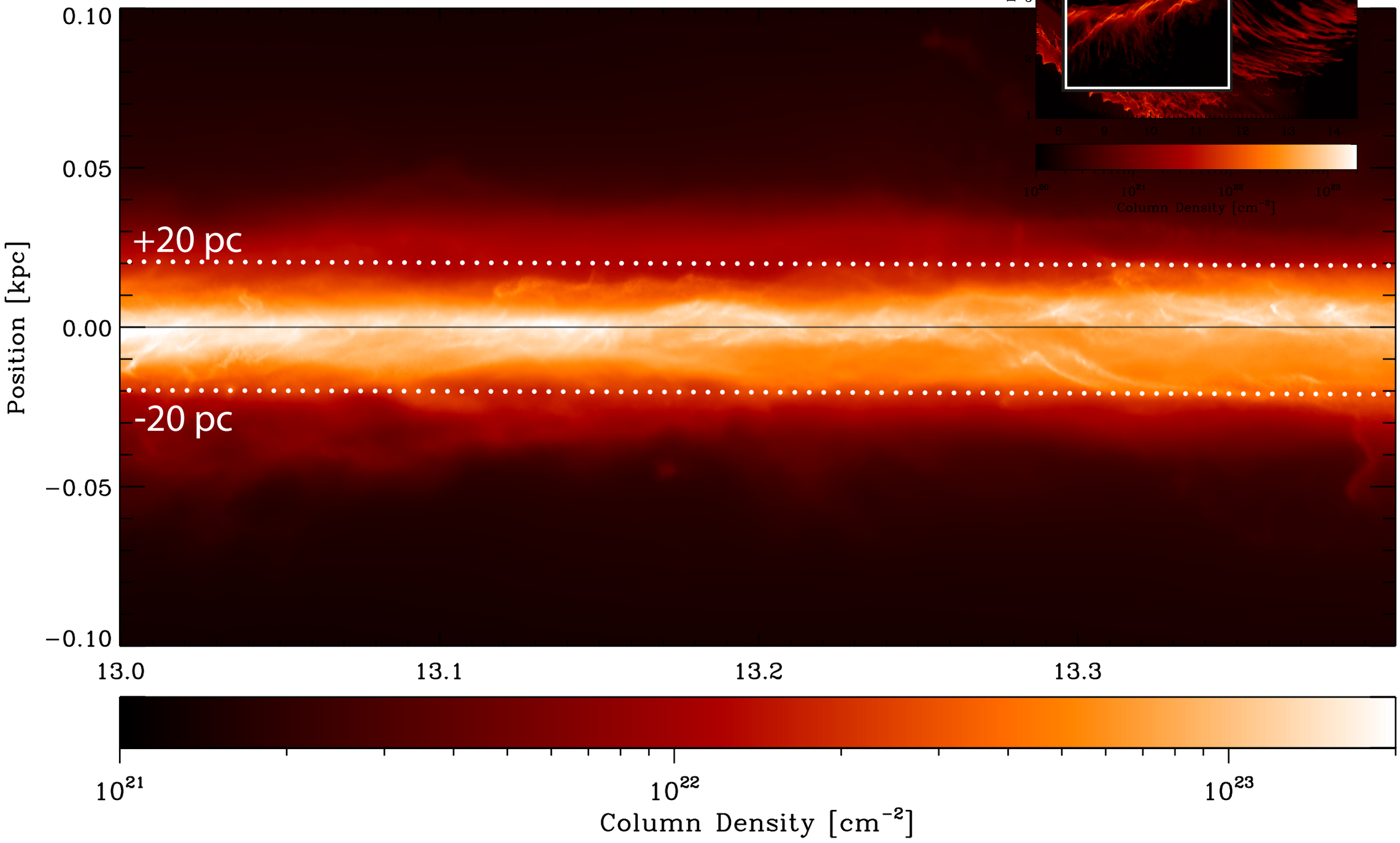
2014 Simulation



Smith et al. 2014, using AREPO

Breaking News

2014 Simulation



Smith et al. 2014, using AREPO

The Bones of the Milky Way

Alyssa Goodman, João Alves, Chris Beaumont, Tom Dame, James Jackson, Jens Kauffmann, Thomas Robitaille, Alberto Pepe, Michelle Borkin, Andreas Burkert, Robert A Benjamin + Add author

NOTES TO ONLINE READERS

This article was submtted to the Astrophysical Journal in December 2013. It was accepted, and submitted to arXiv in July 2014. The arXiv preprint is here: http://arxiv.org/abs/1408.0001.

This online version, published in December 2012, is citable as an online "Authorea" preprint, and you can use the article's URL to do that.

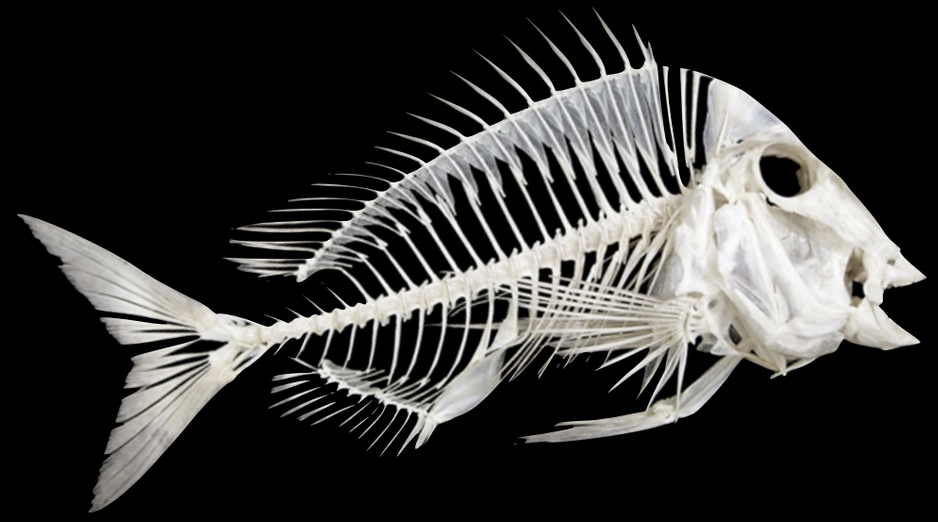
Abstract

ABSTRACT The very long, thin infrared dark cloud ``Nessie" is even longer than had been previously claimed, and an analysis of its Galactic location suggests that it lies directly in the Milky Way's mid-plane, tracing out a highly elongated bone-like feature within the prominent Scutum-Centaurus spiral arm. Re-analysis of mid-infrared imagery from the Spitzer Space Telescope shows that this IRDC is at least 2, and possibly as many as 8 times longer than had originally been claimed by Nessie's discoverers, Jackson et al. (2010); its aspect ratio is therefore at least 150:1, and possibly as large as 800:1. A careful accounting for both the Sun's offset from the Galactic plane (~ 25 pc) and the Galactic center's offset from the $(l^{II}, b^{II}) = (0,0)$ position defined by the IAU in 1959 shows that the latitude of the true Galactic mid-plane at the 3.1 kpc distance to the Scutum-Centaurus Arm is not $b = 0$, but instead closer to $b = -0.5$, which is the latitude of Nessie to within a few pc. Apparently, Nessie lies *in* the Galactic mid-plane. An analysis of the radial velocities of low-density (CO) and high-density (NH_3) gas associated with the Nessie dust feature suggests that Nessie runs along the Scutum-Centaurus Arm in position-position-velocity space, which means it likely forms a dense 'spine' of the arm in real space as well. No galaxy-scale simulation to date has the spatial resolution to predict a Nessie-like feature, but extant simulations do suggest that highly elongated over-dense filaments should be associated with a galaxy's spiral arms. Nessie is situated in the closest major spiral arm to the Sun toward the inner Galaxy, and appears almost perpendicular to our line of sight, making it the easiest feature of its kind to detect from our location (a shadow of an Arm's bone, illuminated by the Galaxy beyond). Although the Sun's (~ 25 pc) offset from the Galactic plane is not large in comparison with the half-thickness of the plane as traced by Population I objects such as GMCs and HII regions (~ 200 pc; Rix et al. (2013)), it may be significant compared with an extremely thin layer that might be traced out by Nessie-like "bones" of the Milky Way. Future high-resolution extinction and molecular line data may therefore allow us to exploit the Sun's position above the plane to gain a (very foreshortened) view ``from above" of dense gas in Milky Way's disk and its structure.

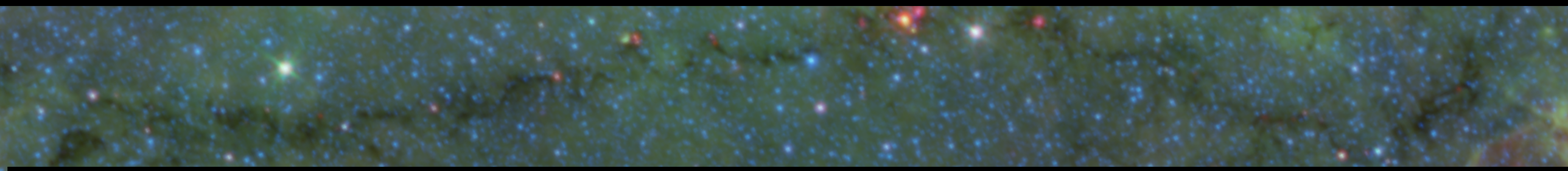
1 Introduction

Determining the structure of the Milky Way, from our vantage point within it, is a perpetual challenge for astronomers. We know the Galaxy has spiral arms, but it remains unclear exactly how many, cf. (Vallée et al., 2008). Recent observations of maser proper motions give unprecedented accuracy in determining the three-dimensional position of the Galaxy's center and rotation speed (Reid et al., 2009, Brunthaler et al., 2011). But, to date, we still do not have a

open preprint on Authorea.com December 2012;
arXiv preprint of accepted version July 2014



milkywaybones.org



worldwidetelescope.org