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THE BONES OF THE MILKY WAY

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NESSIE IS A "BONE" OF THE GALAXY.

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The Skeleton of the Milky Way

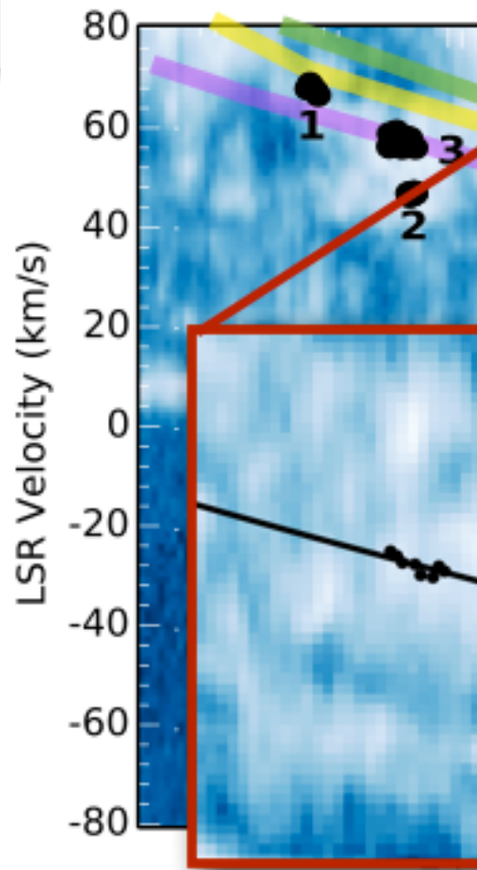
Catherine Zucker, Alyssa Goodman, Cara Battersby

Abstract

Recently, Goodman et al. (2014) argued that a very long, very thin infrared dark cloud "Nessie" lies

WE CAN BUILD A SKELETON FROM BONES.

potentially trace Galactic structure. Our ten bone candidates are all long, filamentary, mid-infrared extinction features which lie parallel to, and no more than twenty parsecs from, the physical Galactic midplane. We use CO, N_2H+, HCO^+ and NH_3 radial velocity data to establish the location of the candidates in p-p-v space. Of the ten filaments, six candidates also have a projected aspect ratio of $\geq 50:1$, run along, or extremely close to, the Scutum-Centaurus arm in p-p-v space, and exhibit no abrupt shifts in velocity. Evidence suggests that these candidates are Nessie-like filaments which mark the location of significant spiral features, with "filament 5" replicating Nessie's properties most strongly. As molecular spectral-line and extinction maps cover more of the sky at increasing resolution and sensitivity, we seek to find more bones in future studies, ultimately to create a global-fit to the Galaxy's spiral arms by piecing together individual skeletal features.



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

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

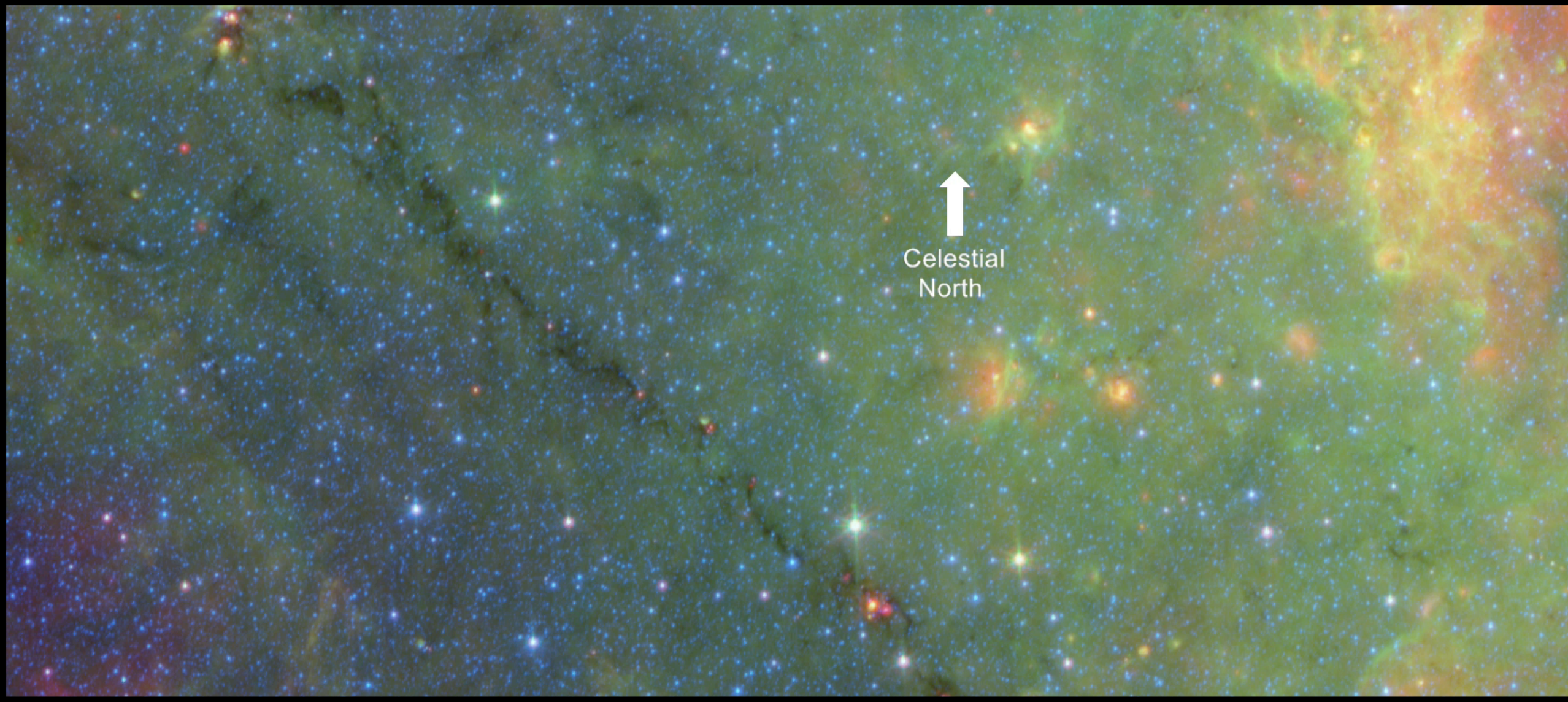
Andi Burkert asked a question:

Is Nessie "parallel to the Galactic Plane"?

No one knew.

image: Spitzer IRAC/MIPS, GLIMPSE/MIPSGAL composite

WorldWide Telescope to the rescue...



Yes, parallel to the plane...and much longer than had been realized.

But why not at Zero of Latitude (b=0)?

Where are we, really?

This is GOOD news. It means that we can see a (very foreshortened) "overhead" view of the Milky Way's structure, if the Galaxy is flat enough, and high-contrast features can be resolved.

the sun. It is a fortunate circumstance that, within the observational uncertainty, both the sun and Sagittarius A lie in the mean plane of the Galaxy as determined from the hydrogen observations. If the sun had not been so placed, points in the mean plane would not lie on the galactic equator. *[Blaauw et al. 1959]*

Sun is ~25 pc "above" the IAU Milky Way Plane

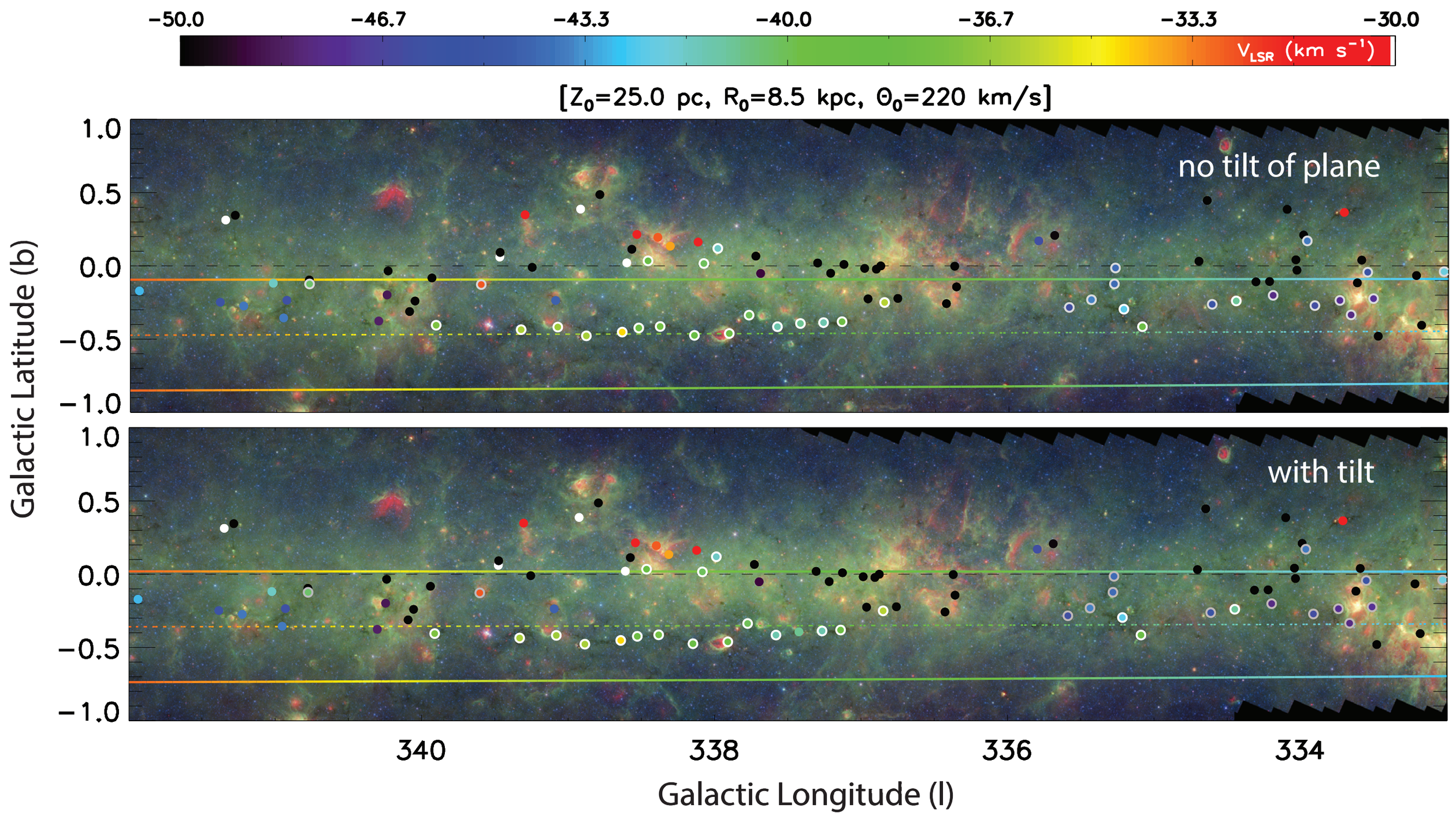
+

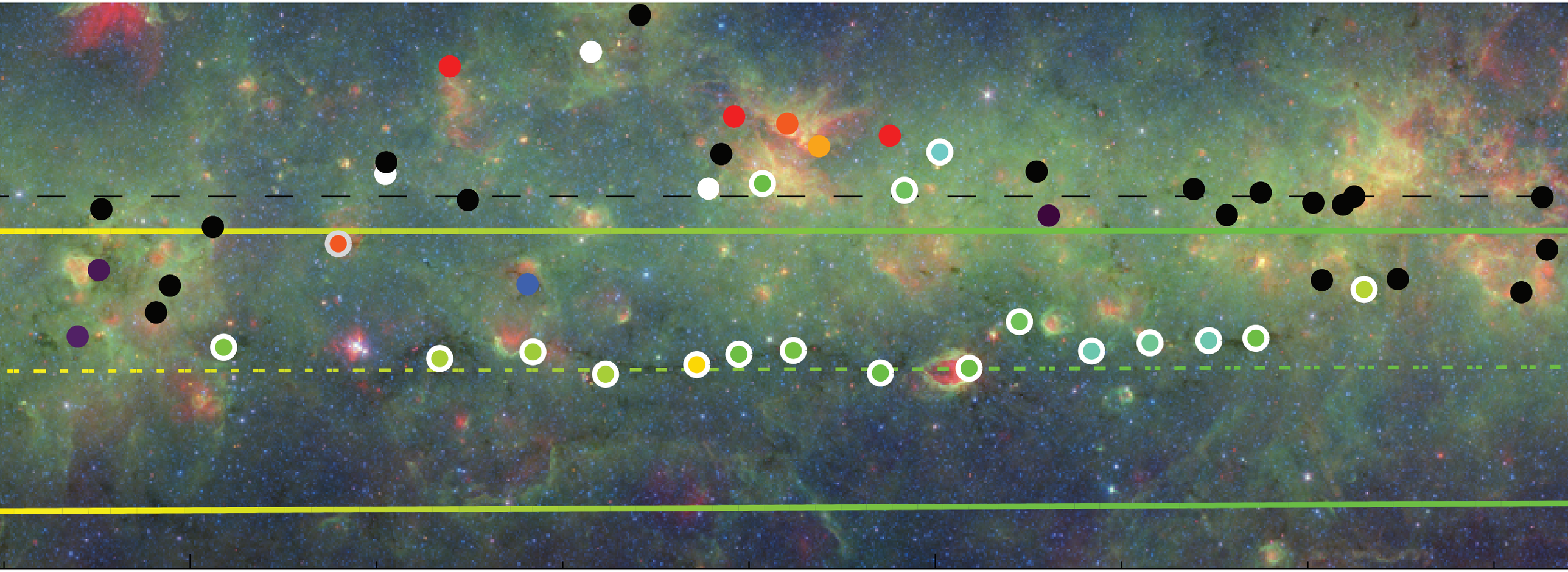
Galactic Center is ~7 pc offset from the IAU Milky Way Center

=

The **Galactic Plane is not quite where you'd think it is** when you look at the sky.

Nessie is in the plane. And at distance of spiral arm.



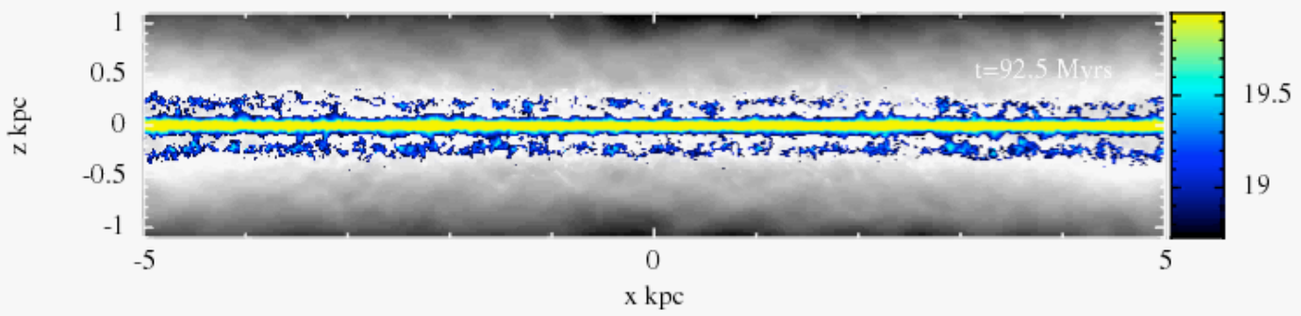


...eerily precisely...

How do we know the velocities?

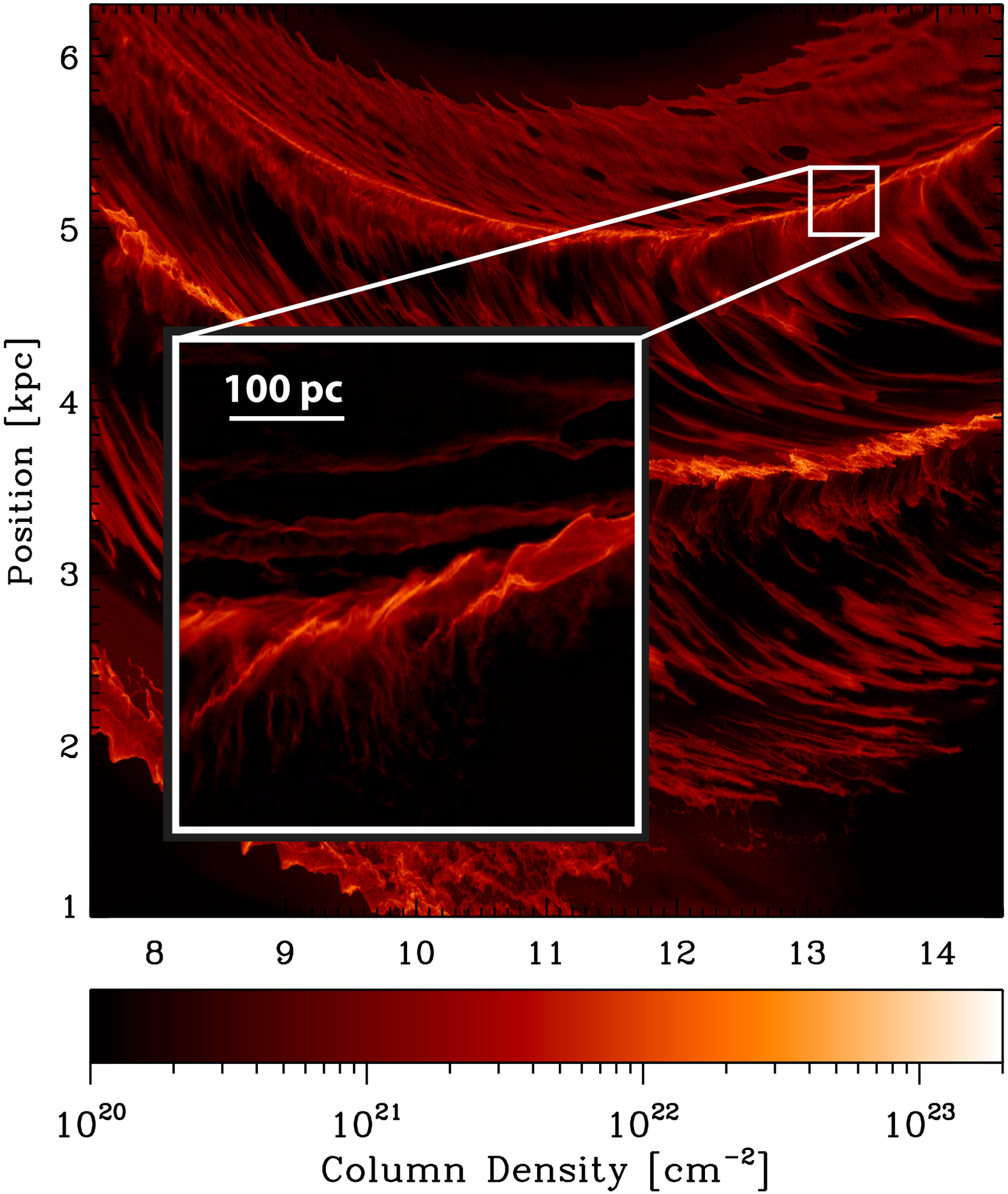
A full 3D skeleton?

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



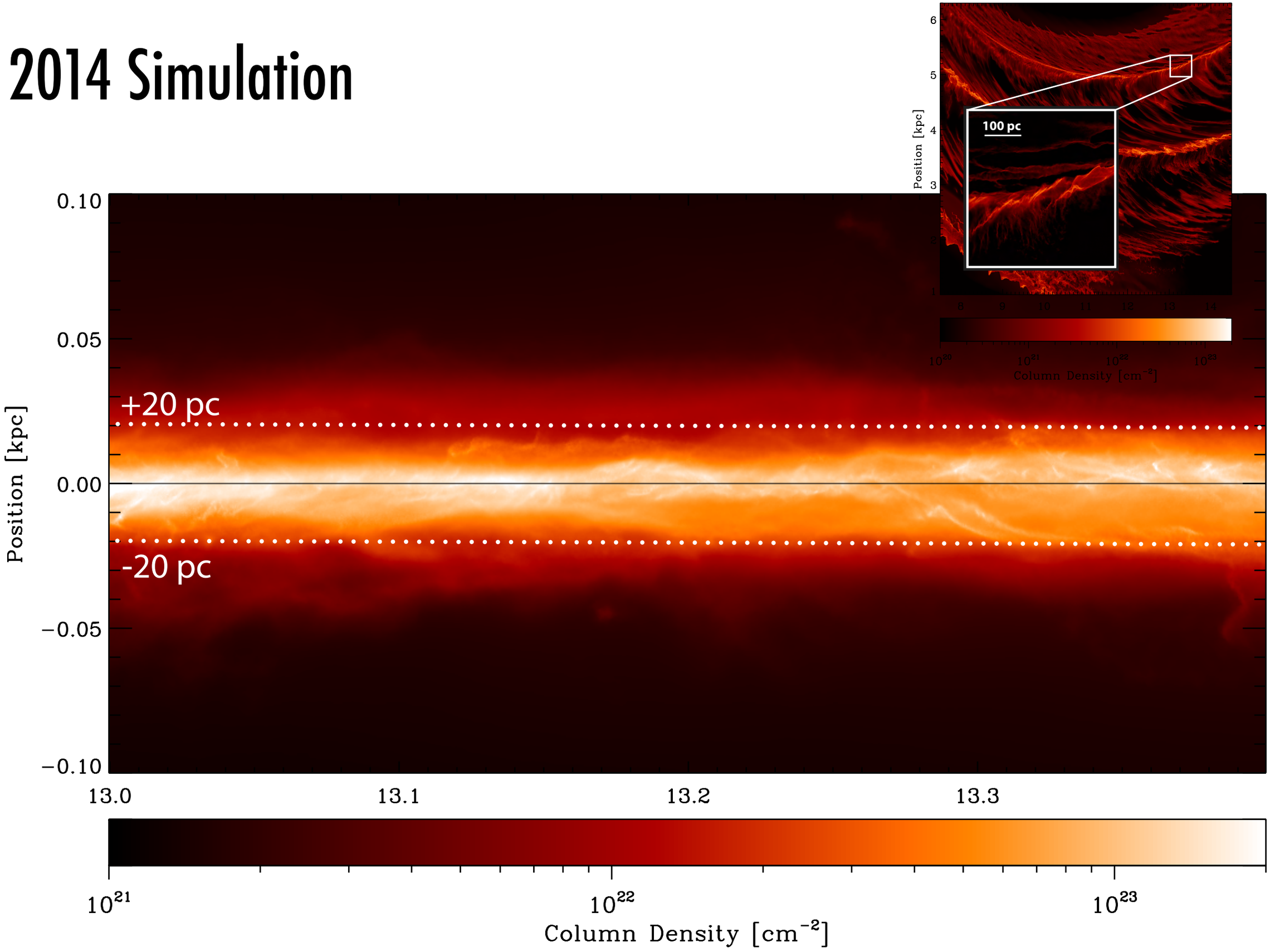
simulations courtesy Clare Dobbs

2014 Simulation



Smith et al. 2014, using AREPO

2014 Simulation



Smith et al. 2014, using AREPO (hydro+chemistry, imposed potential, no B-fields, no local (self-)gravity, no feedback)

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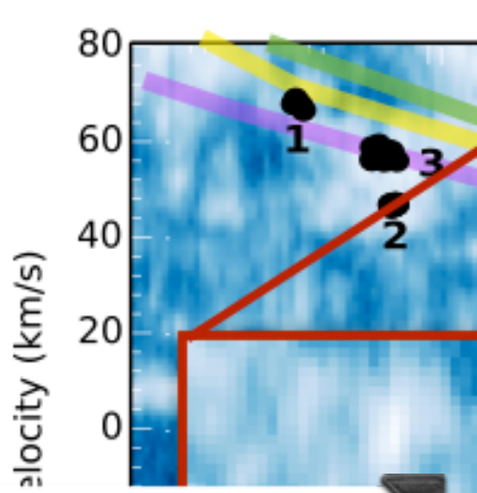
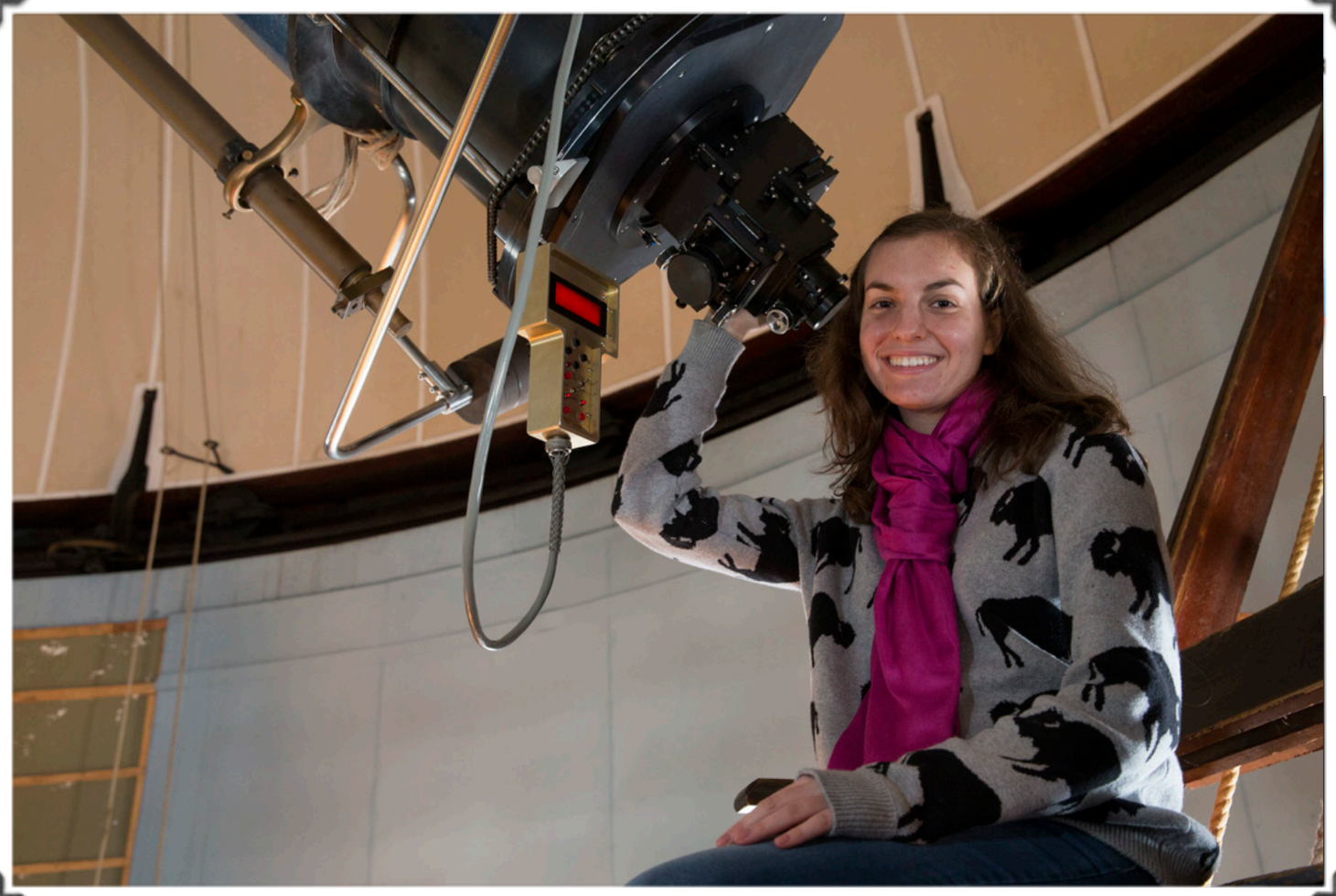
Abstract

Recently, Goodman et al. (2014) argued that a very long, very thin infrared dark cloud "Nessie" lies directly in the Galactic midplane and runs along the Scutum-Centaurus arm in position-position-velocity (p-p-v) space as traced by lower density CO and higher density NH_3 gas. Nessie was extraordinar present the f a curiosity bu ne candidates nore than twen H_3 radial veloci six candidates cutum-Centaur at these candi with "filament 5 ction maps c ones in future s ndividual skelet

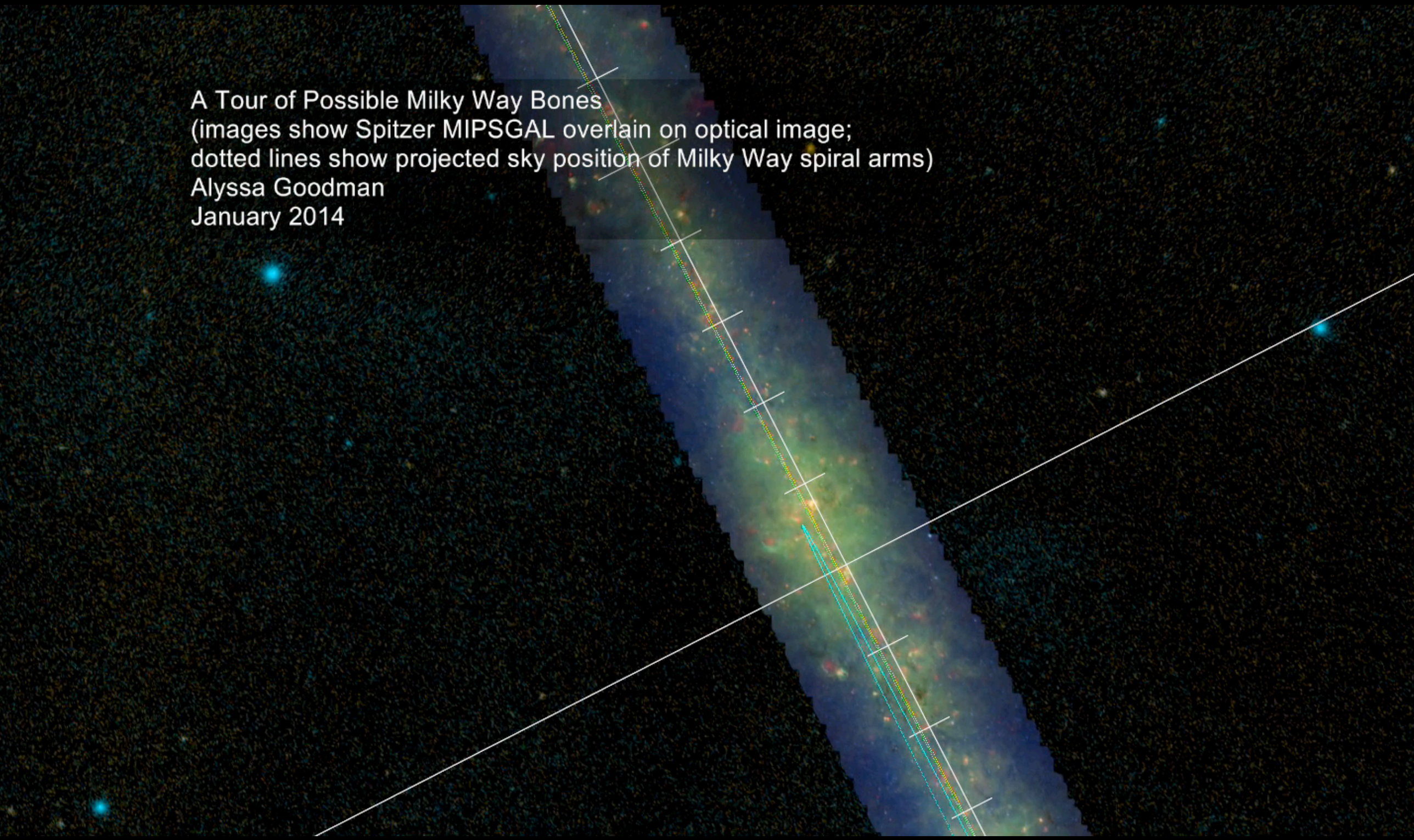


Cara Battersby
SMA Fellow

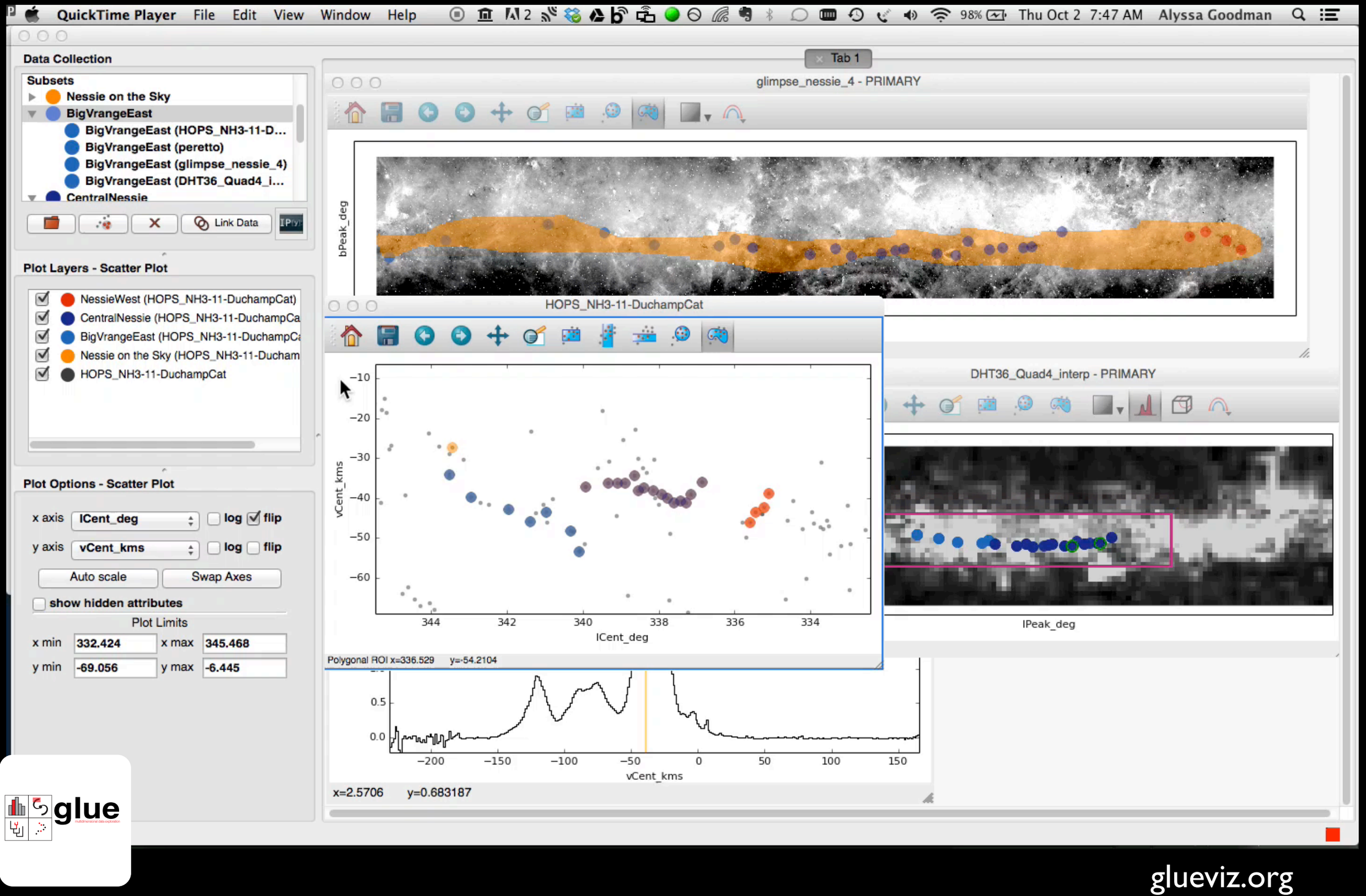


Catherine Zucker
2014 SAO REU from U. Virginia
just admitted to Harvard Astronomy PhD program!

SKELETON STEP 1: WHERE "SHOULD" THE BONES BE?



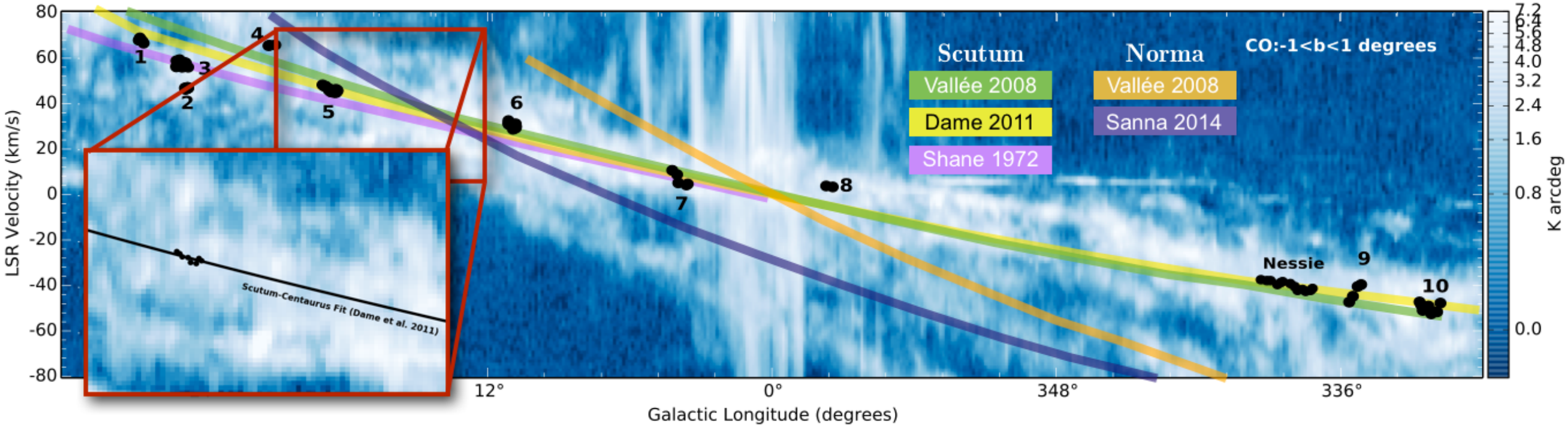
SKELETON STEP 2: ADDING VELOCITY INFORMATION



glueviz.org

6 OUT OF 10 BONE CANDIDATES LOOK EXCELLENT IN "3D"

(POSITON-POSITION-VELOCITY SPACE)



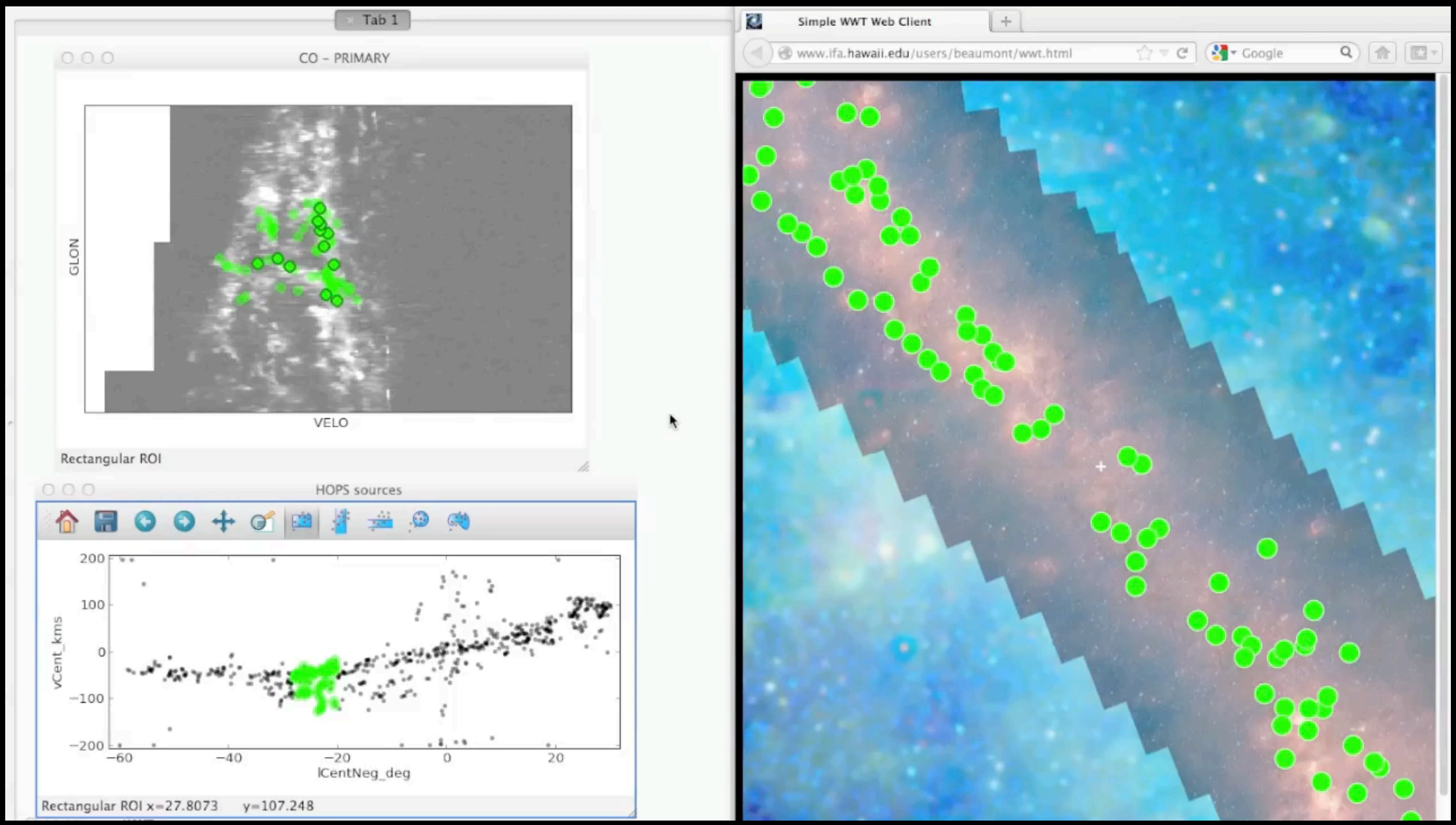
Blue image in the background shows CO position-velocity diagram based on Dame et al. 2001

"We present the first evidence of additional bones in the Milky Way Galaxy, arguing that Nessie is not a curiosity but one of several filaments that could potentially trace Galactic structure."

tinyurl.com/galaxyskeleton

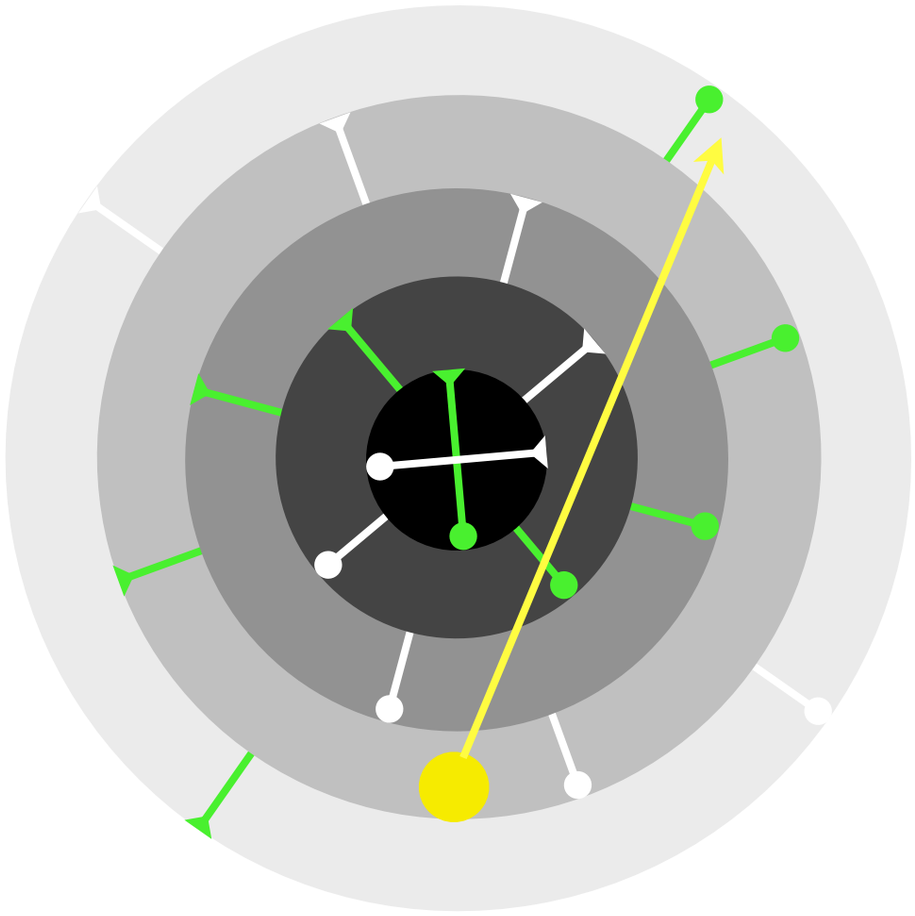
extra slides

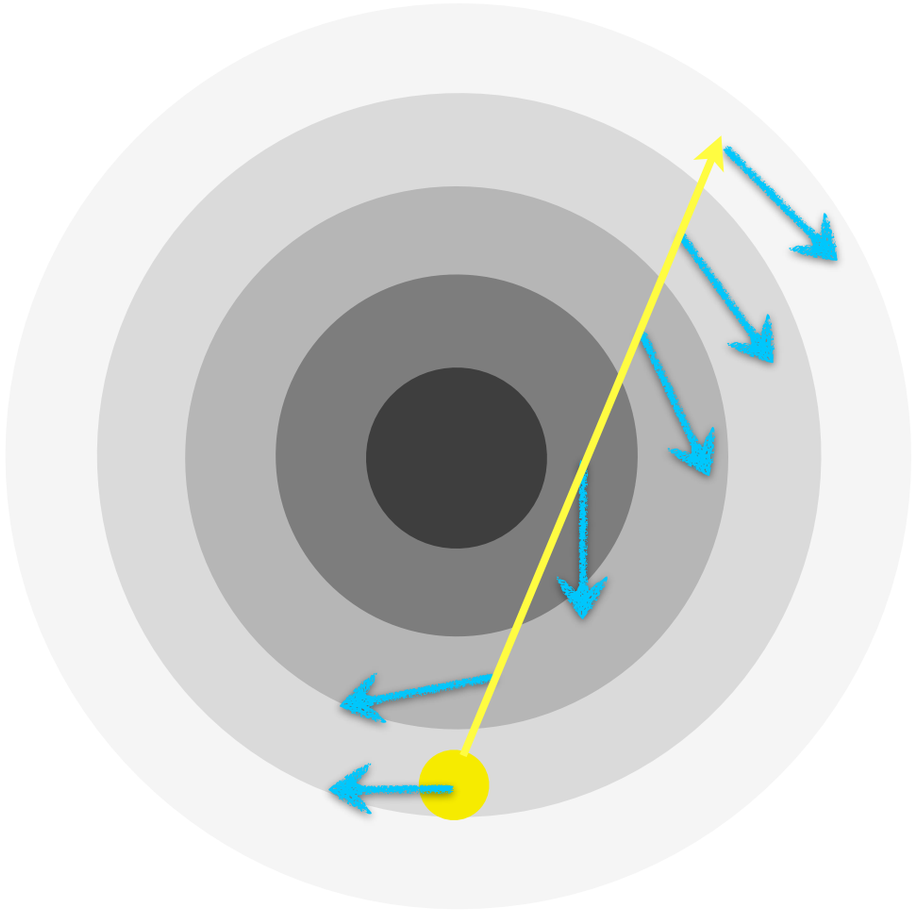
The Milky Way

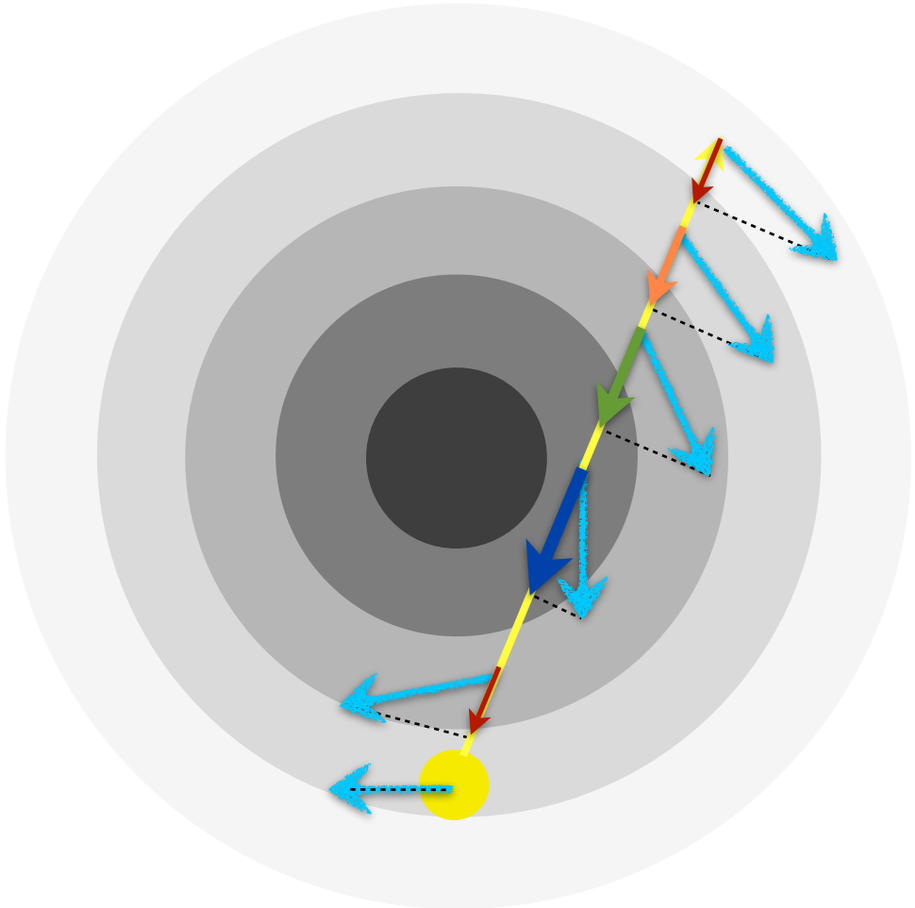


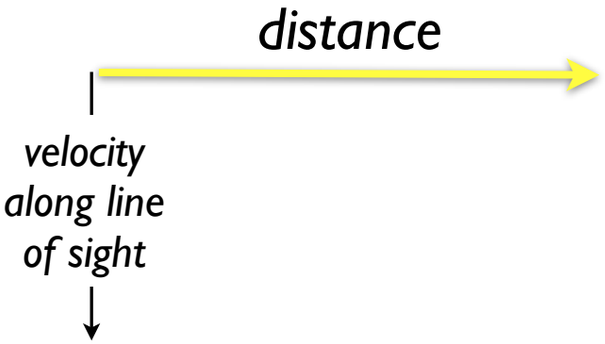
Video courtesy of Chris Beaumont, Lead Glue Architect

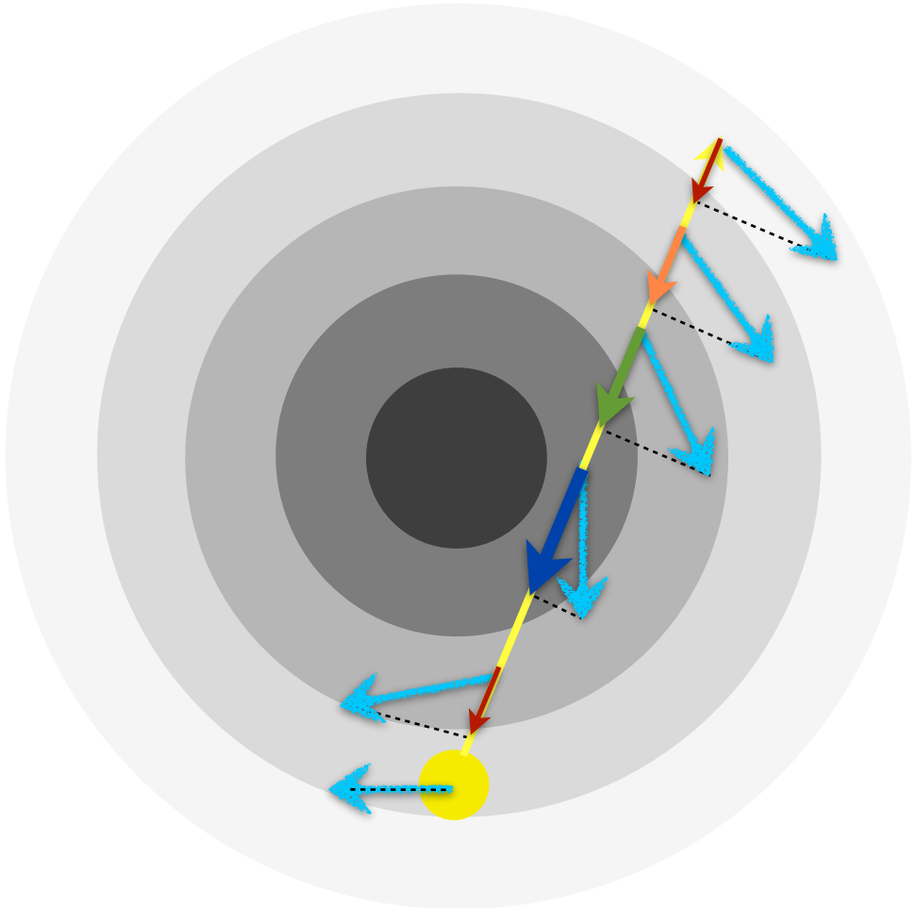
A Rotating (Spiral) Galaxy Observed from its Outskirts...

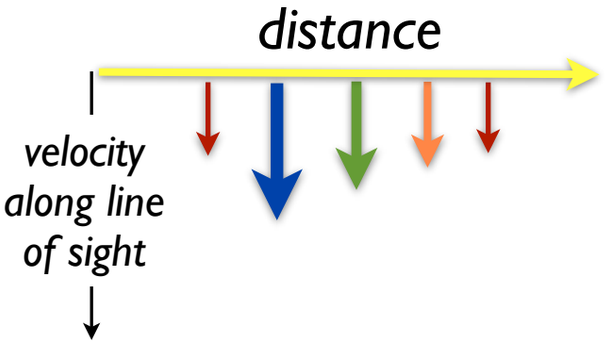







distance
velocity
along line
of sight





back