



The Milky Way Skeleton

Catherine Zucker (U. of Virginia)

With advisors

Cara Battersby (CfA)

Alyssa Goodman (CfA)



NRAO Filaments: October 11, 2014

Spiral Galaxy M74



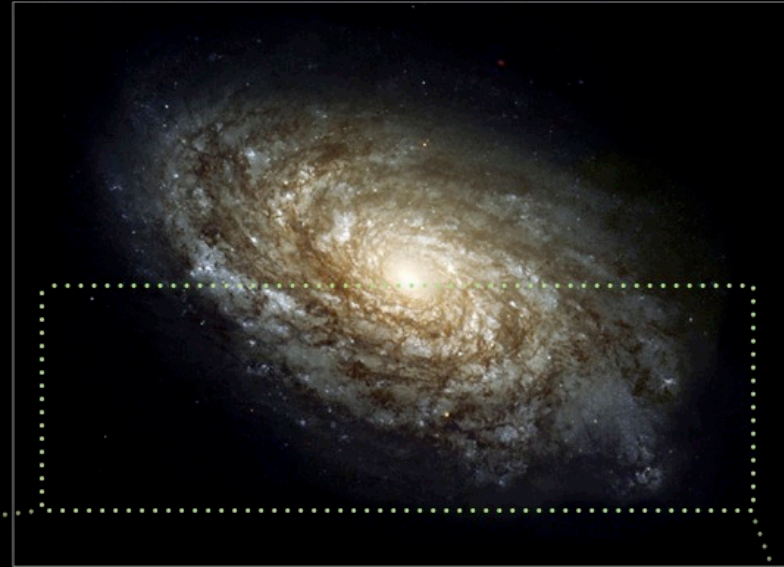
Hubble
Heritage

Whirlpool Galaxy • M51



Hubble
Heritage

Spiral Galaxy NGC 4414

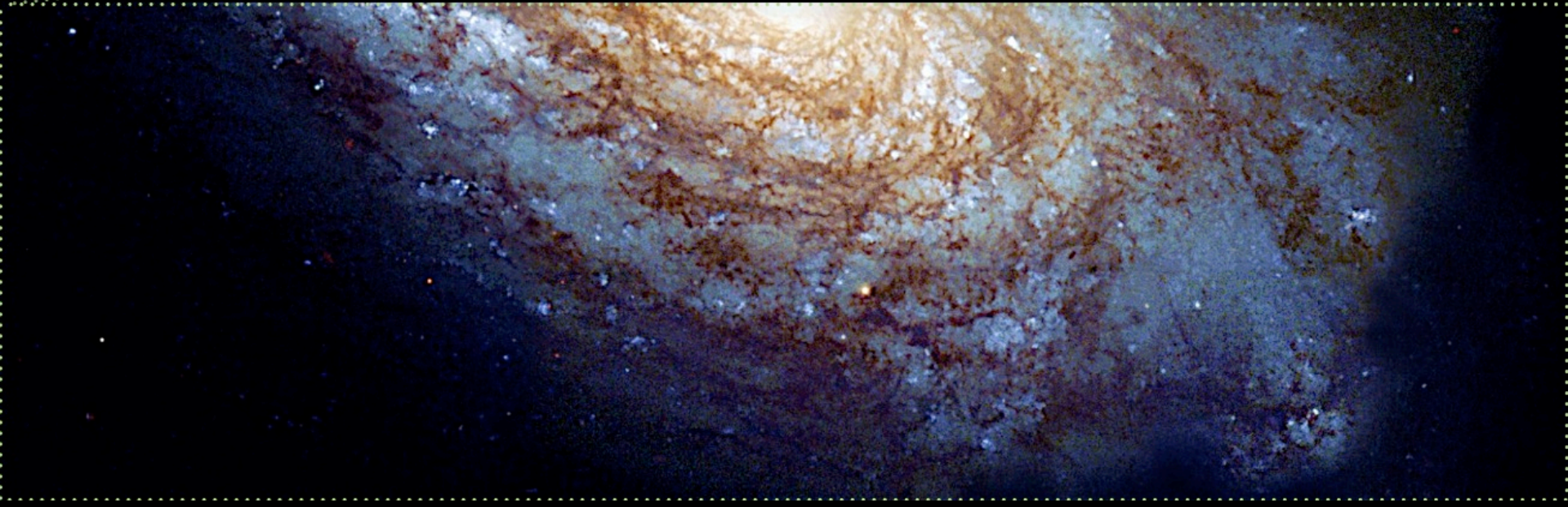


Hubble
Heritage

NASA, ESA, and the Hubble Heritage Team (STScI/AURA) ESA/Hubble Collaboration • HST/ACS • STScI-PRC07-41

NASA and The Hubble Heritage Team (STScI/AURA)
Hubble Space Telescope WFPC2 • STScI-PRC07-07

PRC99-25 • Hubble Space Telescope WFPC2 • Hubble Heritage Team (AURA/STScI/NASA)



Hubble
Heritage

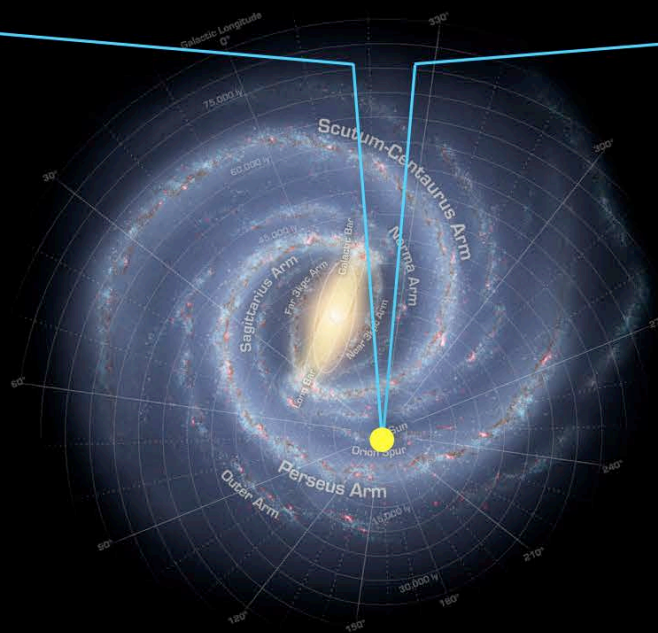
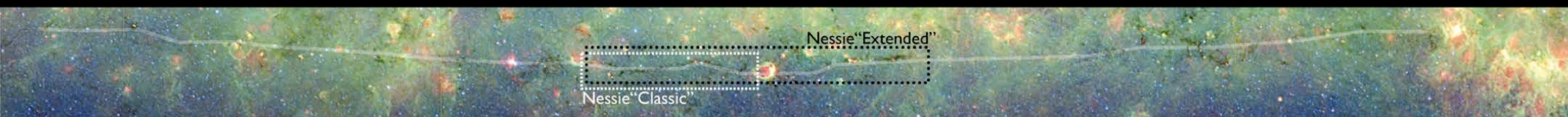


“Bones” of the Milky Way

There are certain very long, very thin infrared dark clouds (IRDCs) which

- 1) Lie within the physical Galactic mid-plane
- 2) Trace significant spiral features in p-p-v space
- 3) Can be used to map the “skeleton” of the Milky Way Galaxy

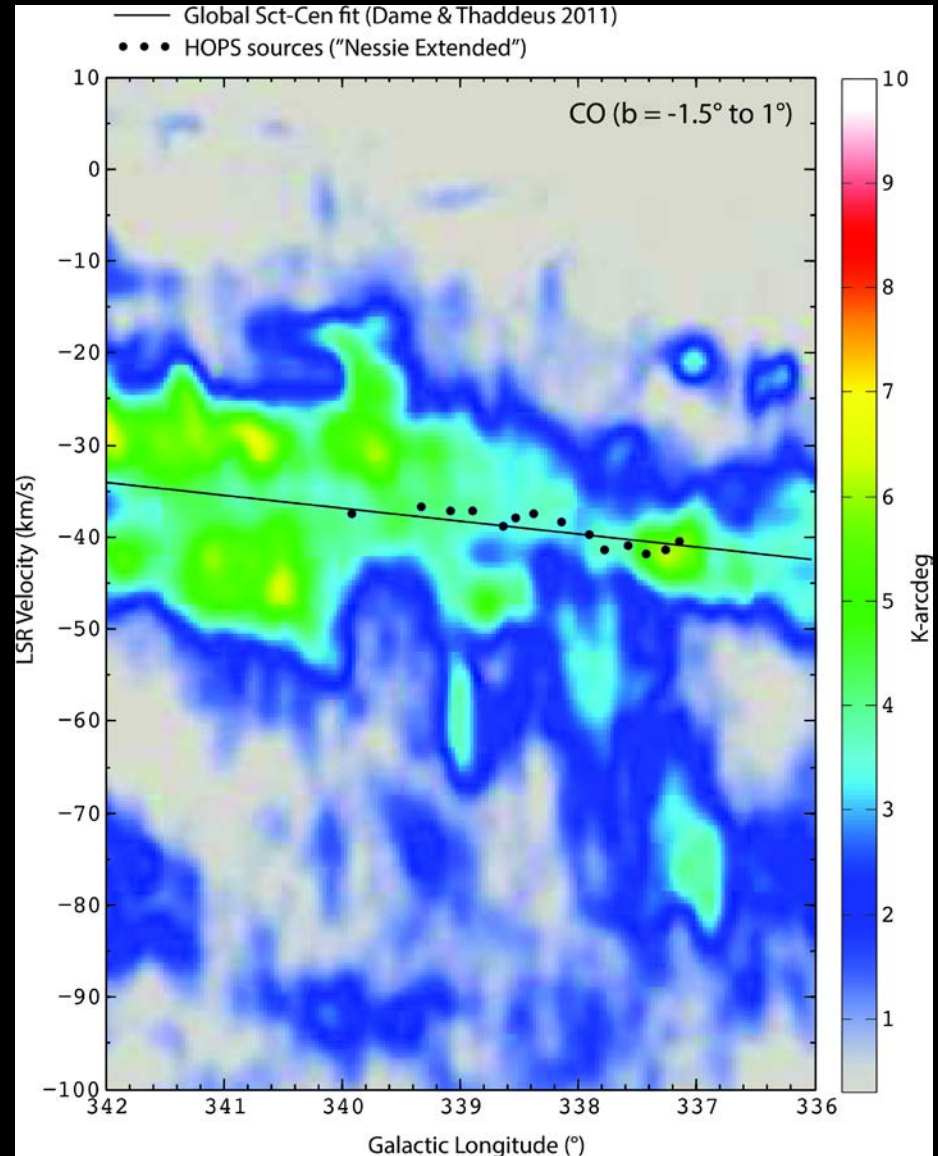
“Nessie”: The first “Bone” of the MW?



- IRDC
- Scutum-Centaurus arm
- ≥ 3 degrees in length
- Aspect ratio $\geq 300:1$

Slide courtesy of...

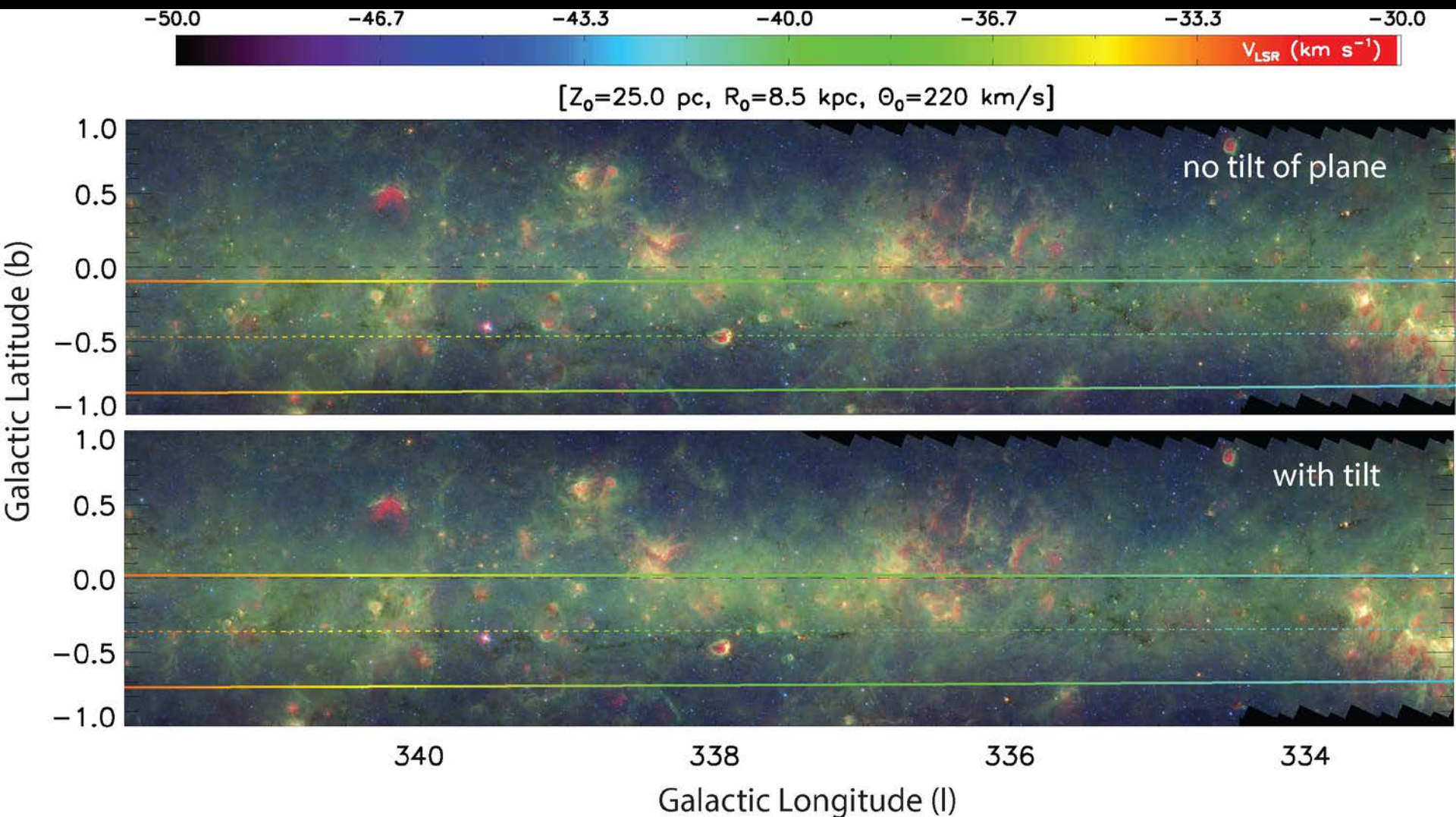
Nessie runs down the “spine” of the Scutum-Centaurus Arm, as best we can measure its position in CO position-velocity space.



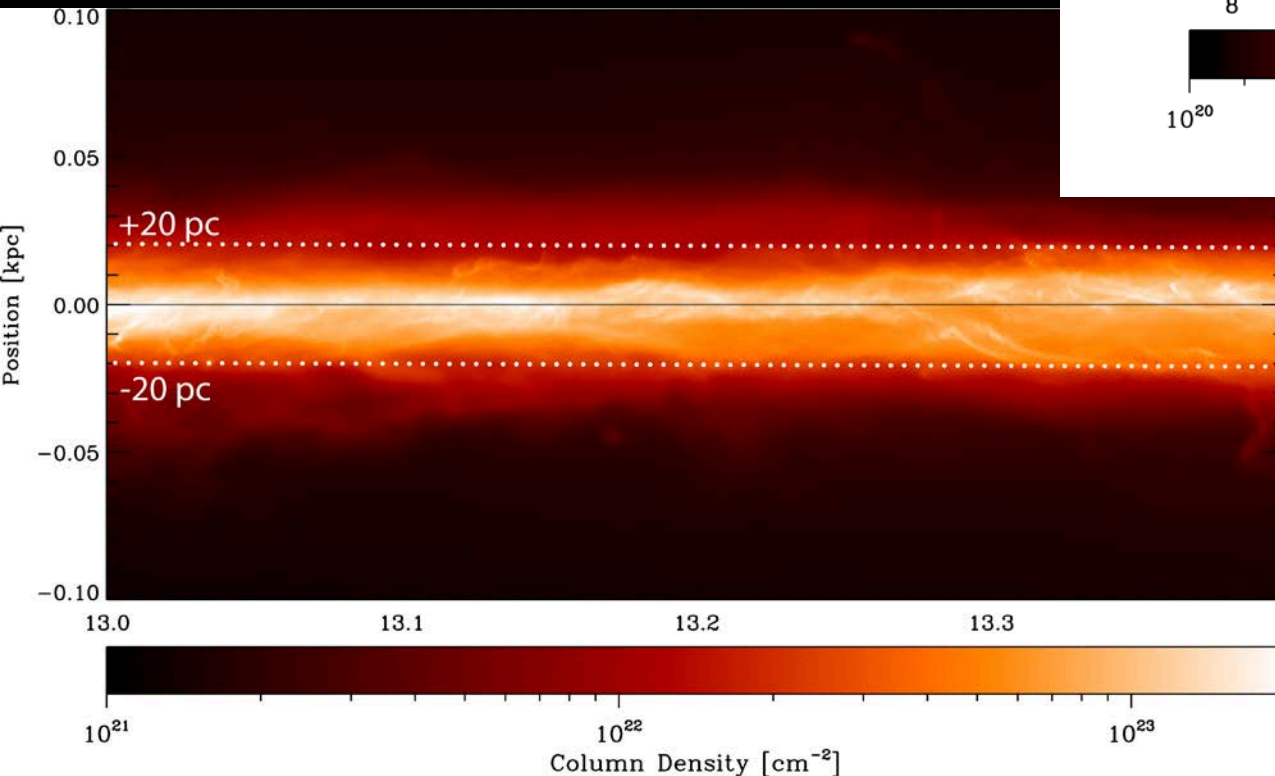
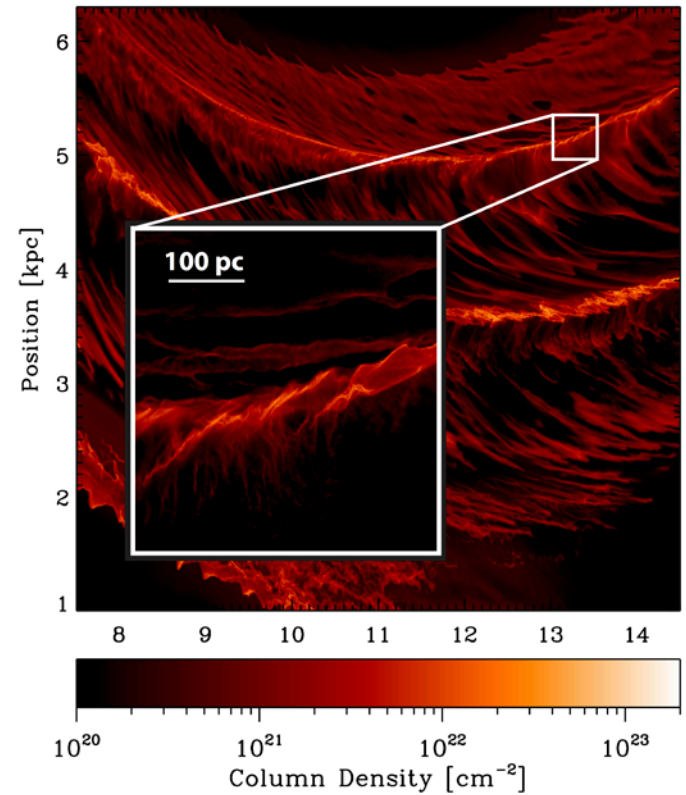
Goodman et al. 2014

Nessie lies within a few pcs of the physical Galactic mid-plane

Goodman et al. 2014



What do the simulations say?



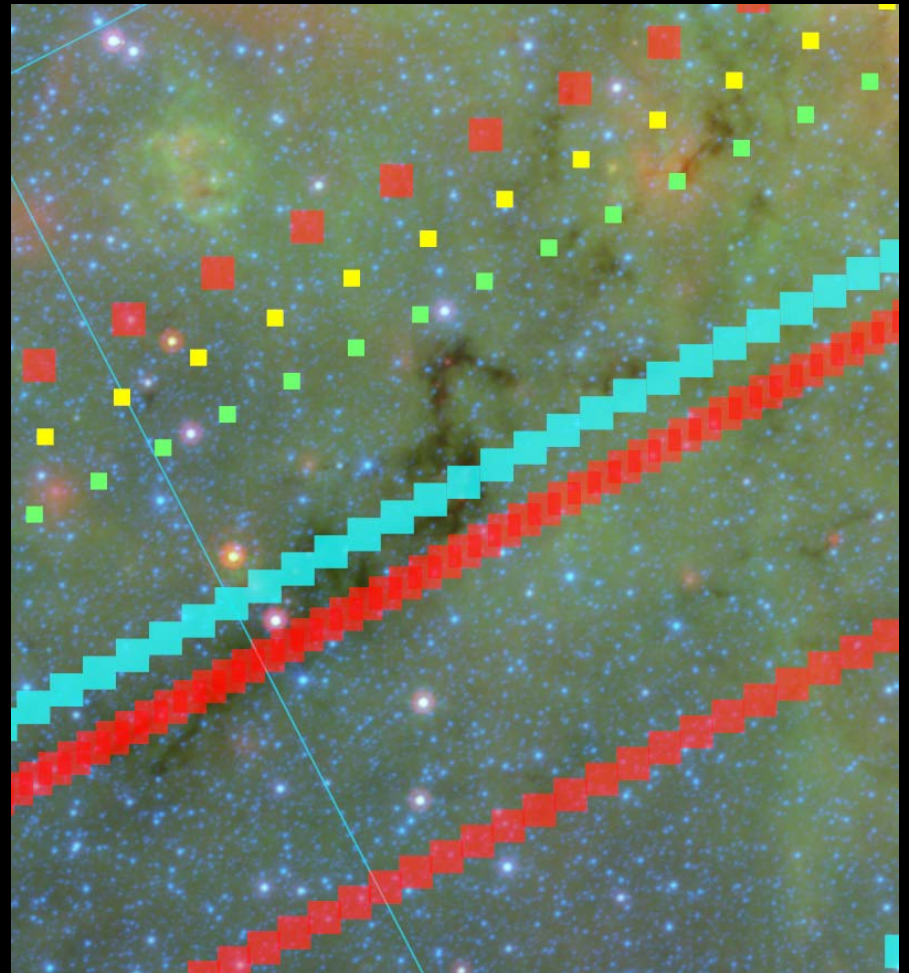
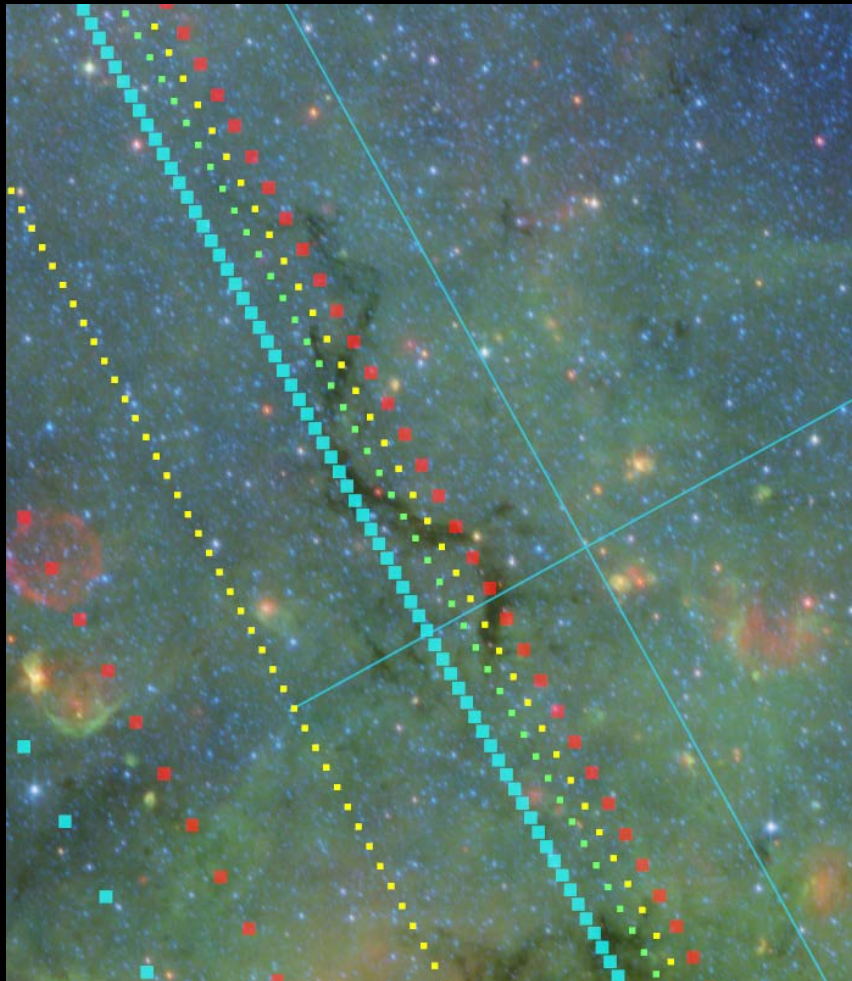
Rowan Smith,
Goodman et al. 2014

Can we find other bones of
the Milky Way?

Bone Criteria

1. Mid-infrared extinction feature
2. Roughly parallel to the Galactic plane
3. Within 20 pc of the physical Galactic mid-plane
4. Projected aspect ratio greater than or equal to 50:1
5. Contiguous in velocity space and within 10 km/s of the global-log spiral fit to any Milky Way arm

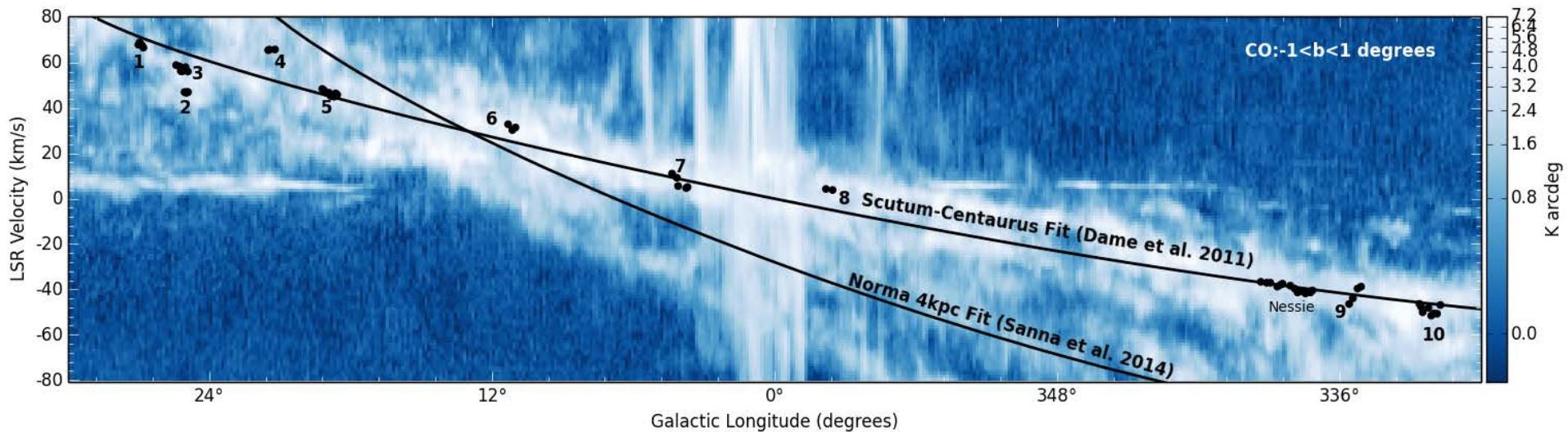
10 plausible candidates identified through visual search



Extracting Velocity Information

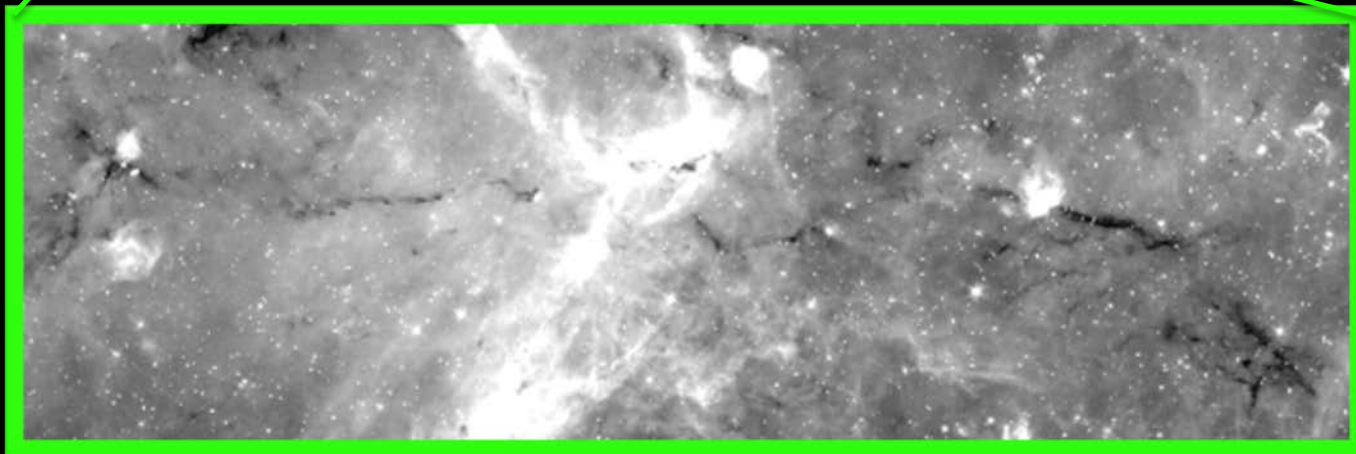
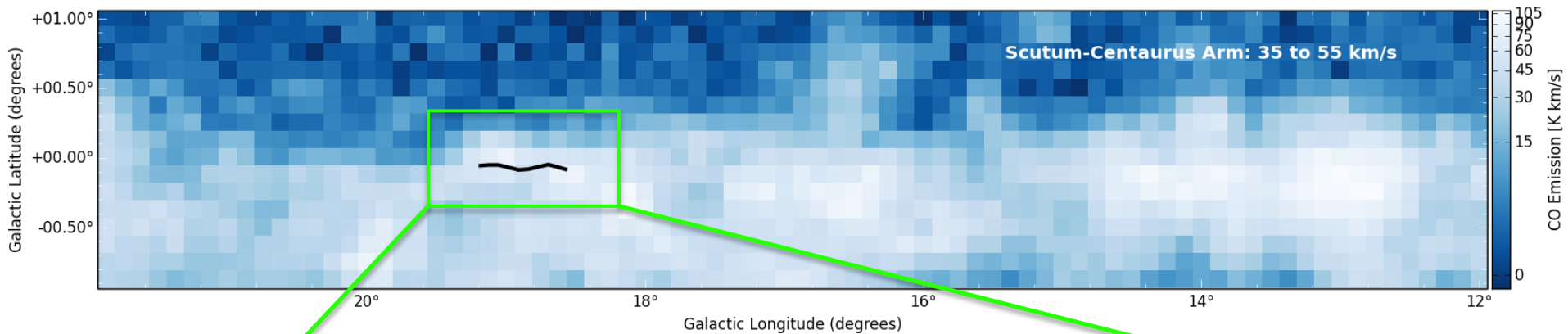
- HOPS catalog (NH_3 emission) \rightarrow high density gas tracer
- MALT90 catalog (N_2H^+ emission) \rightarrow high density gas tracer
- GRS spectra (high resolution CO emission) \rightarrow filling gaps in velocity info along filaments

10 plausible candidates identified through visual search

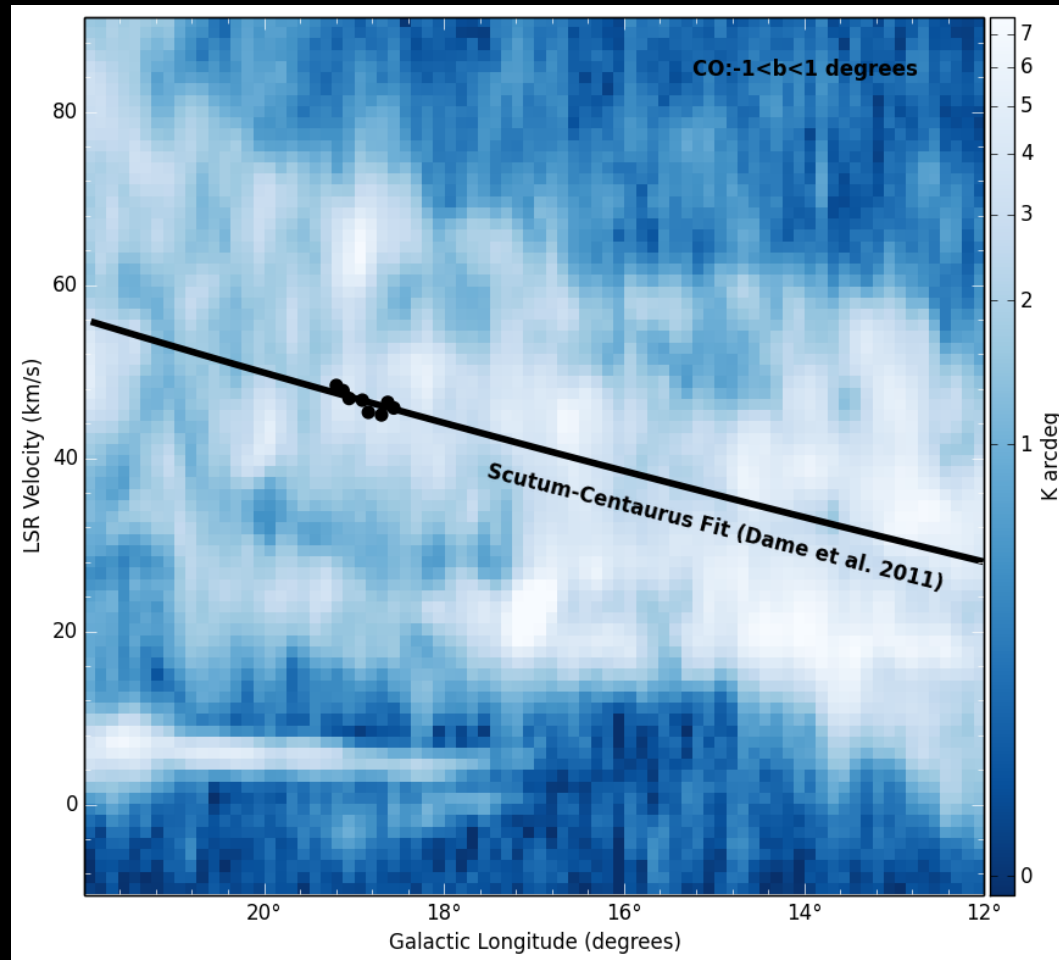


Strongest bone candidates → filaments 1,3,5

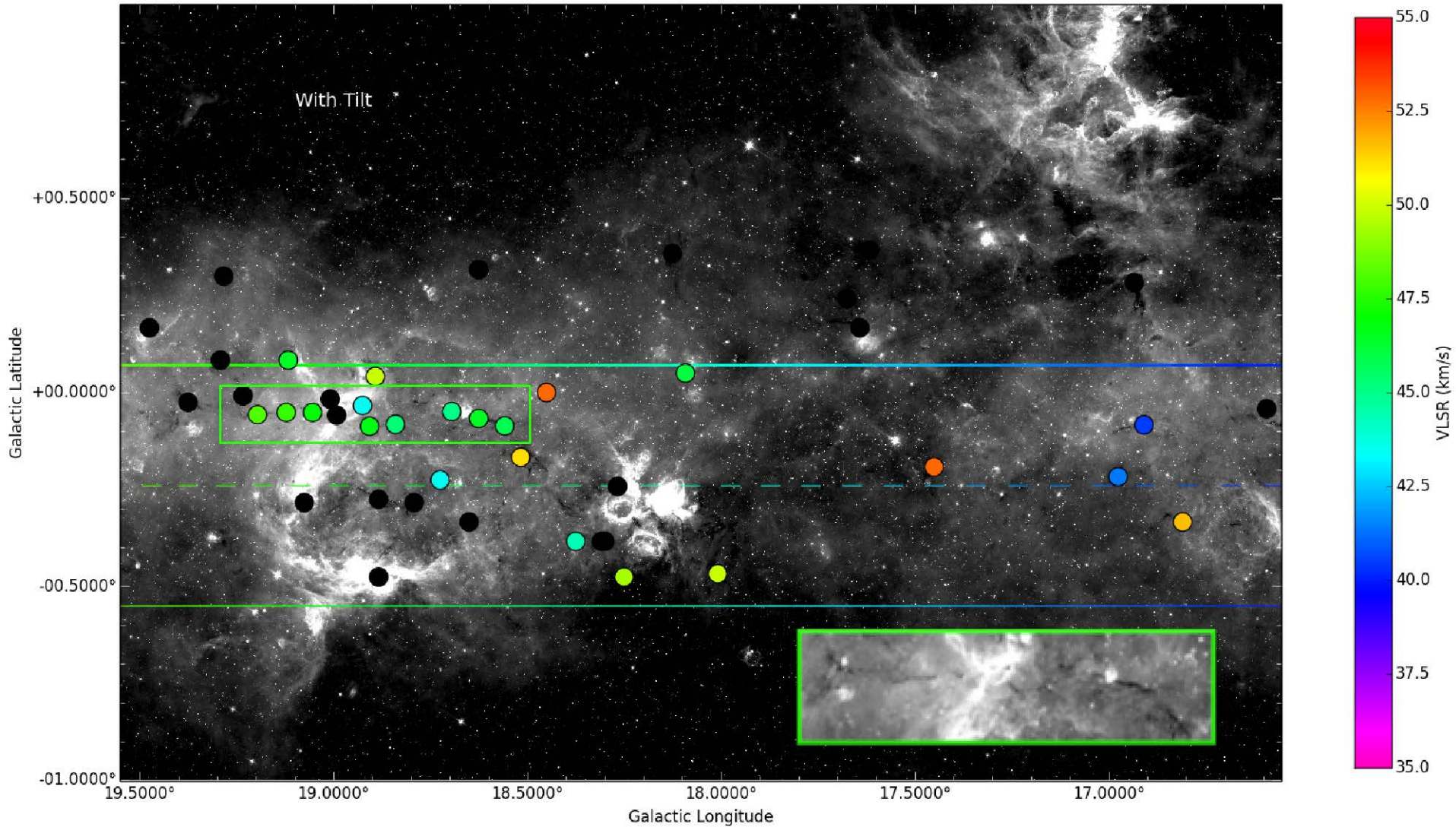
Filament 5: Nessie's 1st Quadrant Counterpart



Filament 5: Runs down the spine of of Scutum in P-P-V Space



Filament 5: Within 15 pc of the physical Galactic mid-plane



Conclusion

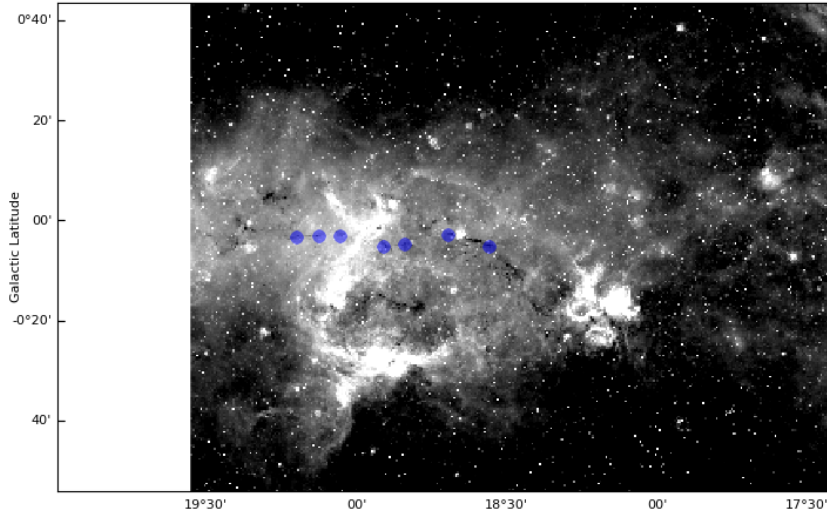
- We visually identified ten potential Milky Way “bones”
- Of several strong candidates, filament 5 is the most “Nessie-like”
- Other candidates could be spurs, feathers, or interarm filaments
- Nessie is NOT a “curiosity”

Questions?

Future Work

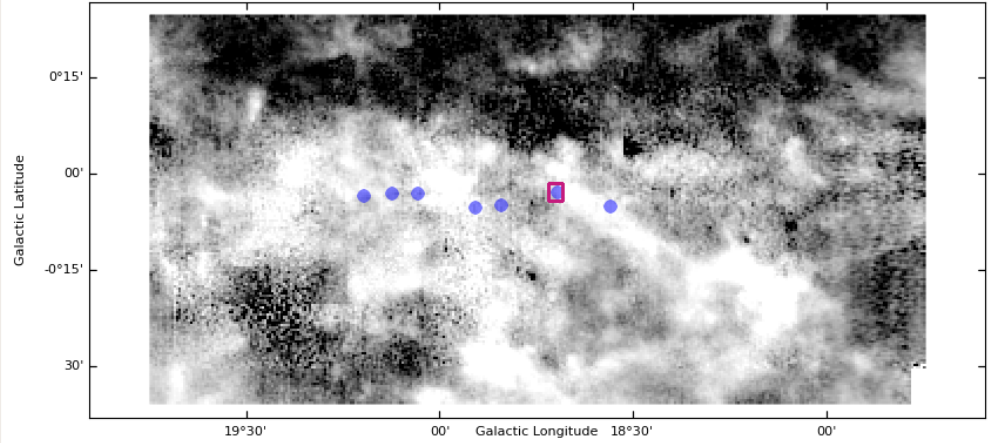
- Calculate physical aspect ratio of all candidates
- Statistical analysis—how many false positives should we expect?
- Look to simulations for more answers

mosaicv3_ch4_018 - PRIMARY



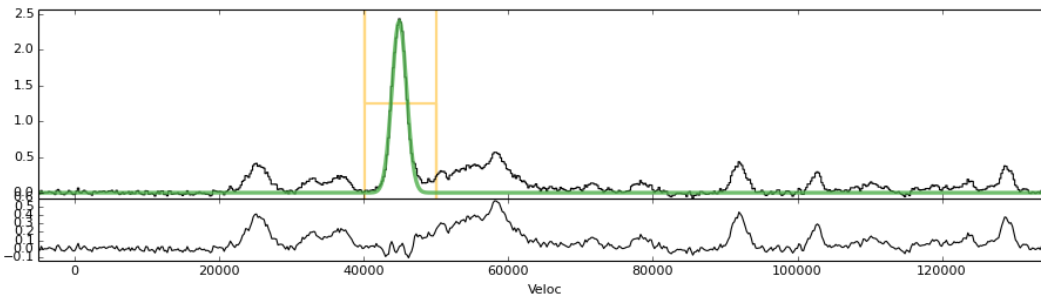
data: 71.2538
zoom rect Galactic Latitude=-0.00686218523157 Galactic Longitude=17.4816393844

197_177_6_4_14_07_10_11_39_Saebd - PRIMARY



Spectrum Veloc=65136.8331909 Galactic Latitude=-0.217082707764 Galactic Longitude=19.6903058075

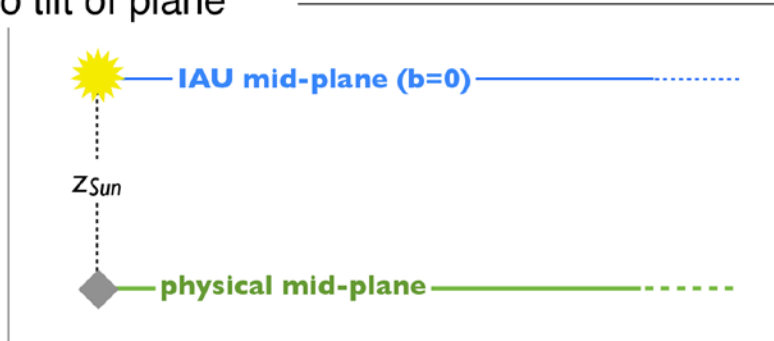
Profile






Profile window controls and fit statistics:

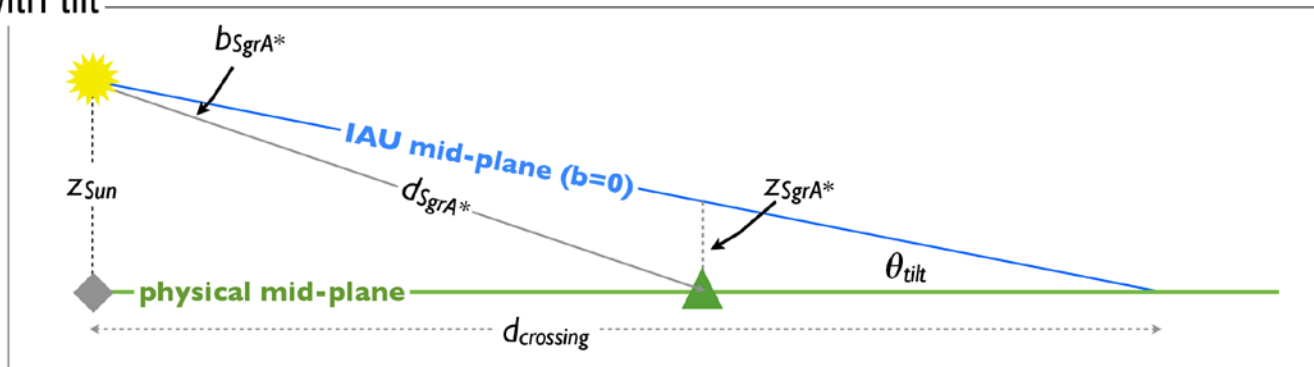
- Function: Gaussian
- Settings: [] Fit
- Converged in 7 iterations
- amplitude = 2.400368e+00
- mean = 4.493462e+04
- stddev = 1.012303e+03

no tilt of plane

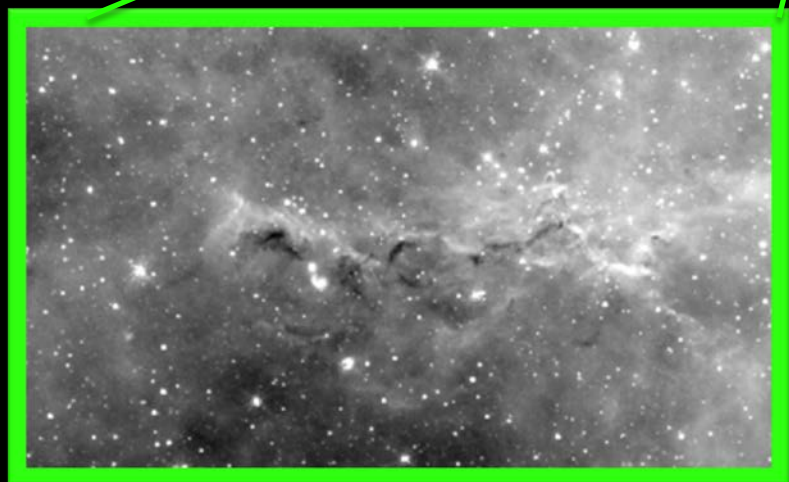
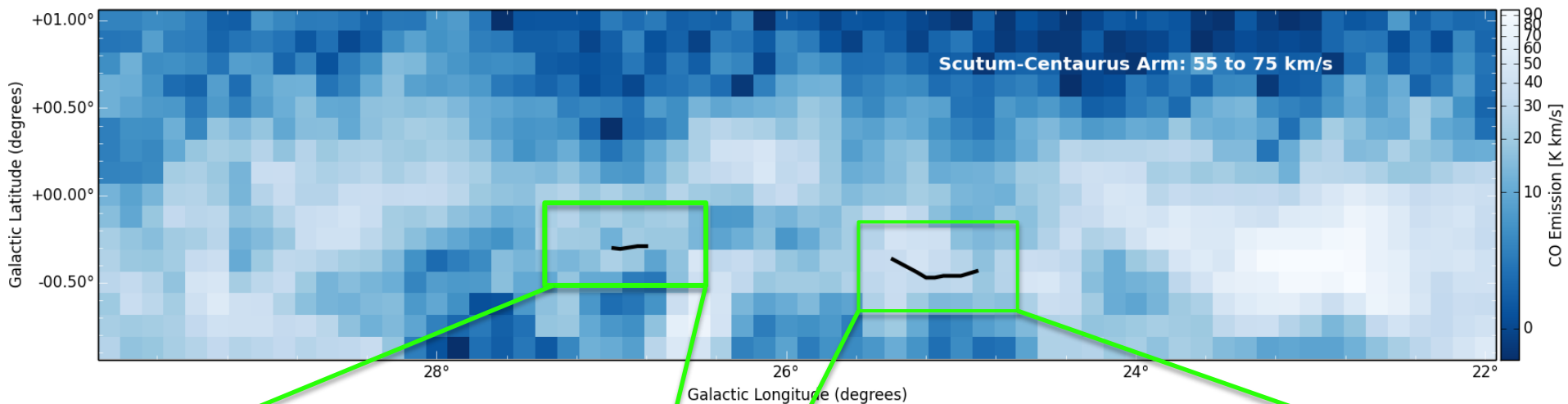


-  Sun
-  Projection of Sun onto physical midplane
-  Location of SgrA*

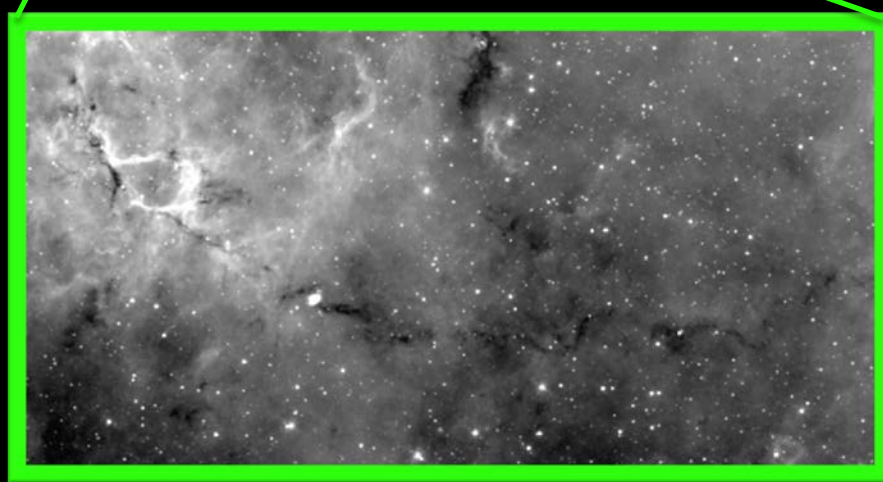
with tilt



Filaments 1 & 3: “Spines” of Scutum as traced by low density CO emission

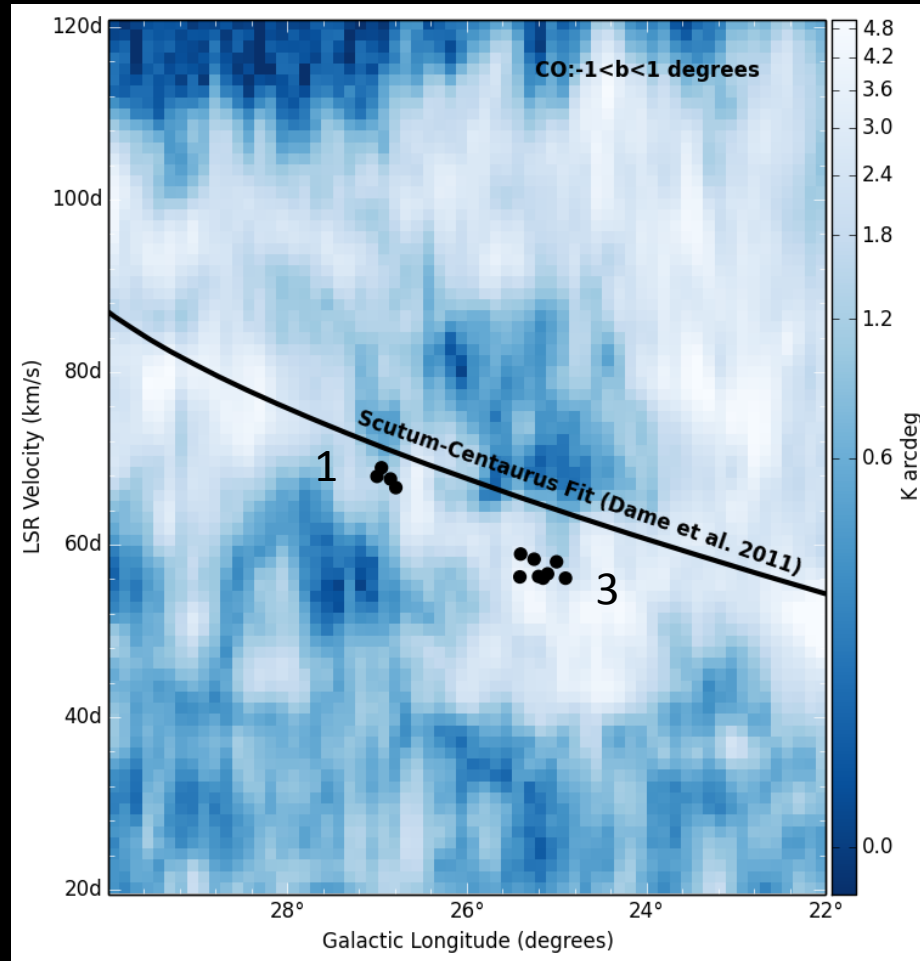


Filament 1

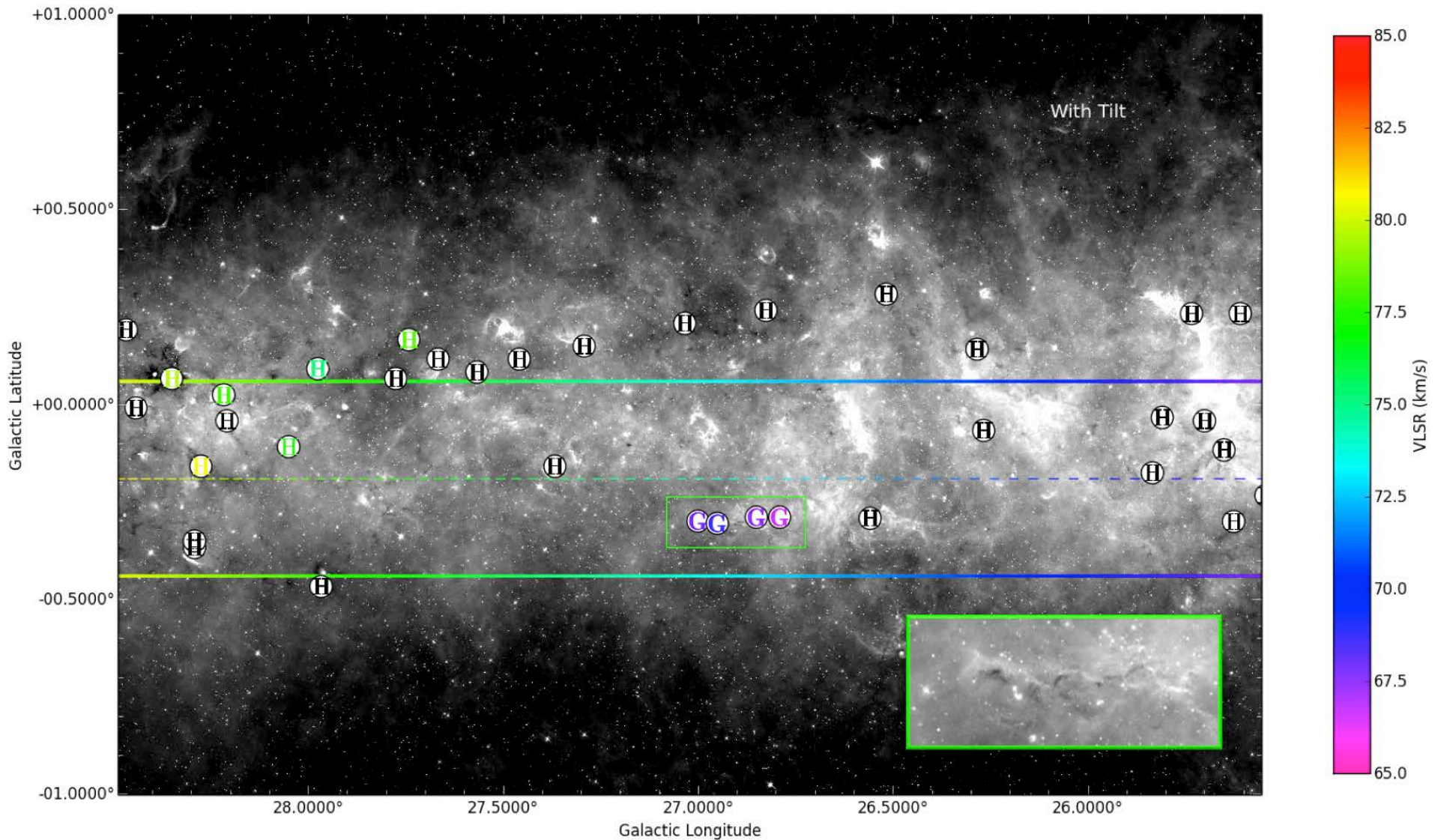


Filament 3

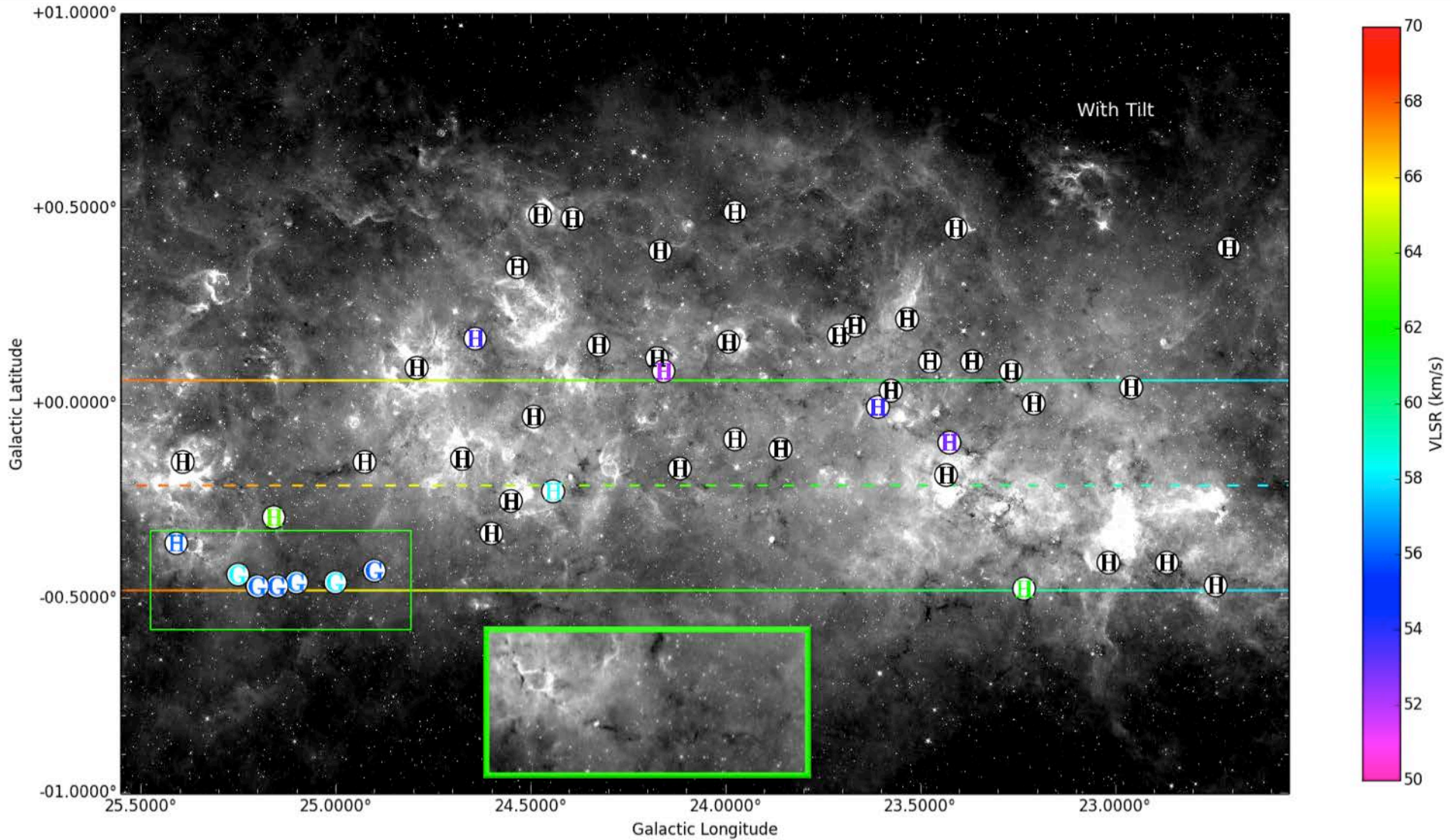
Candidates 1 & 3: Better localized fits to CO emission?



Filament 1: Within 10 pc of the physical Galactic mid-plane



Filament 3: Within 20 pc of the physical Galactic mid-plane



Filament 5: Within 15 pc of the physical Galactic mid-plane

