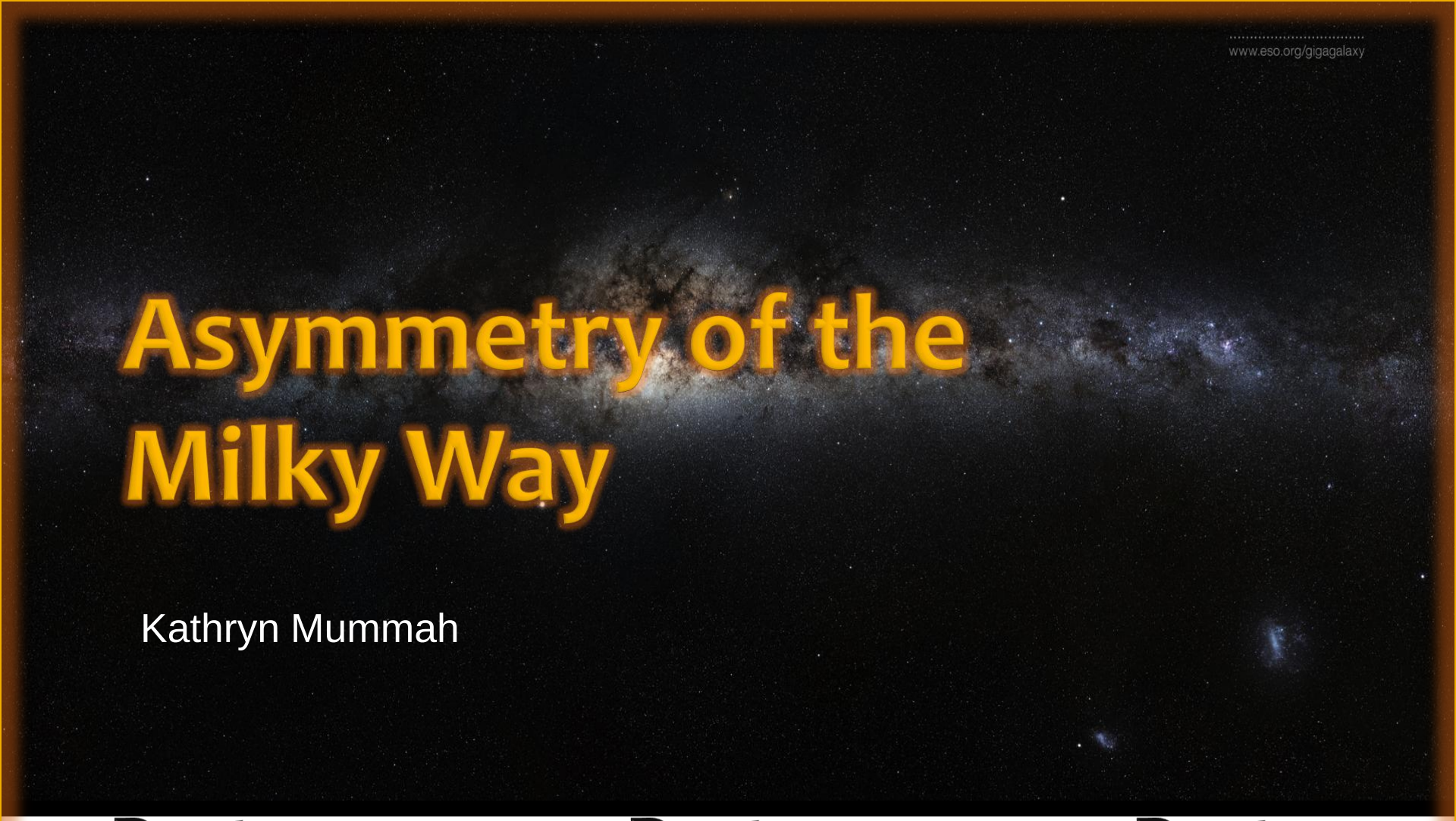



# Asymmetry of the Milky Way

Kathryn Mummah

## Part 1

What you need to know astronomically

## Part 2

What happened before I showed up

## Part 3

What I did & the results of my summer at Fermi

Part 1

# Milky Way and SDSS

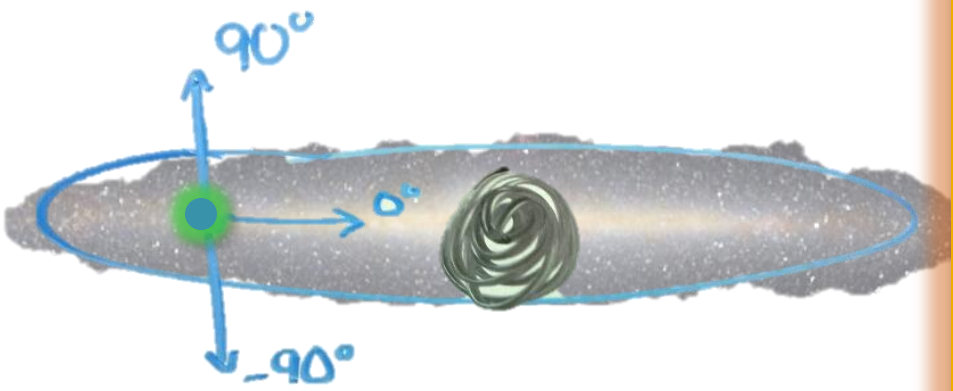
- Artists rendition
- SDSS

Part 1

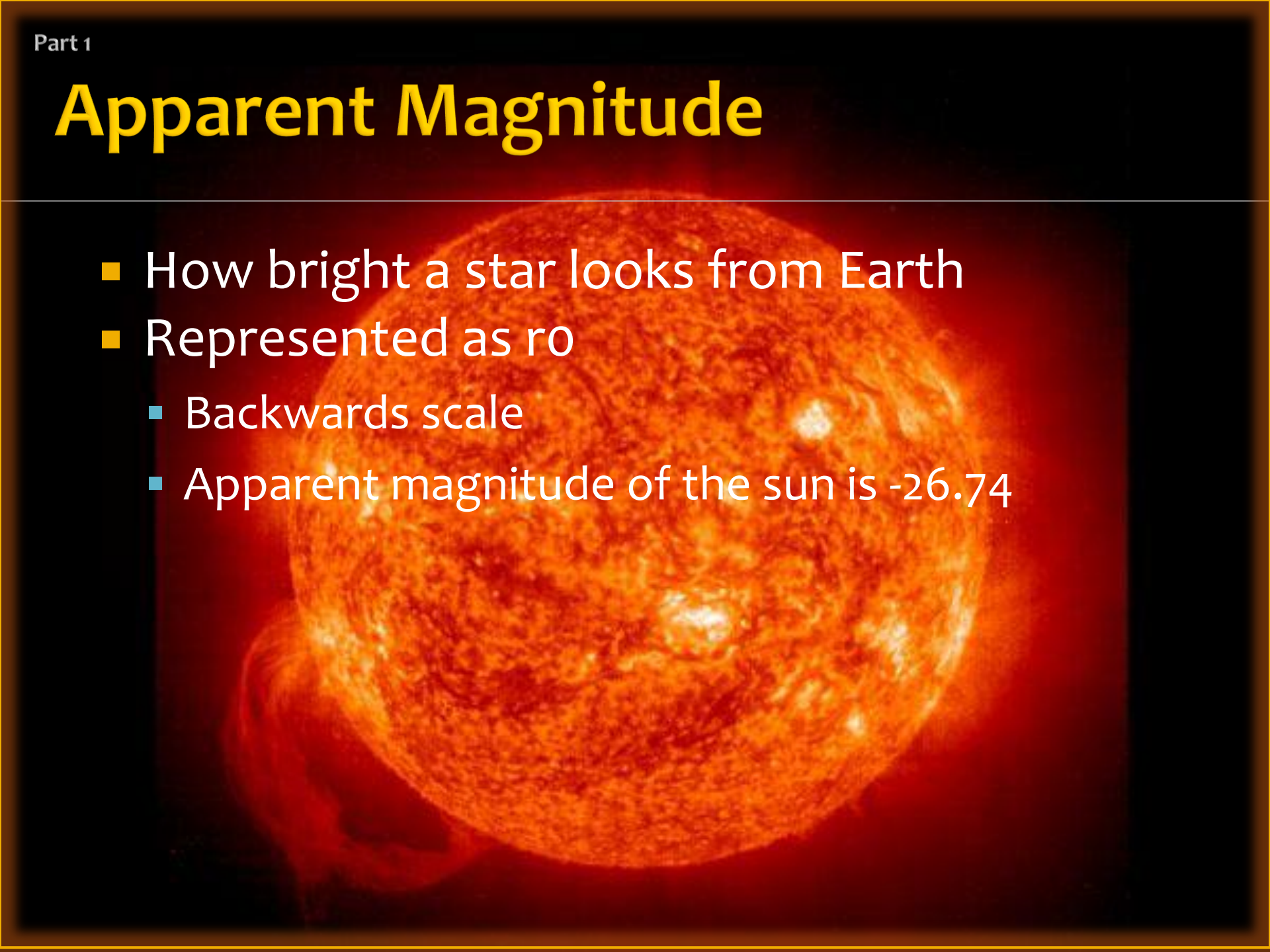
# Galactic Coordinates—l and b

l


b



# Apparent Magnitude



- How bright a star looks from Earth
- Represented as r0
  - Backwards scale
  - Apparent magnitude of the sun is -26.74

# Absolute Magnitude

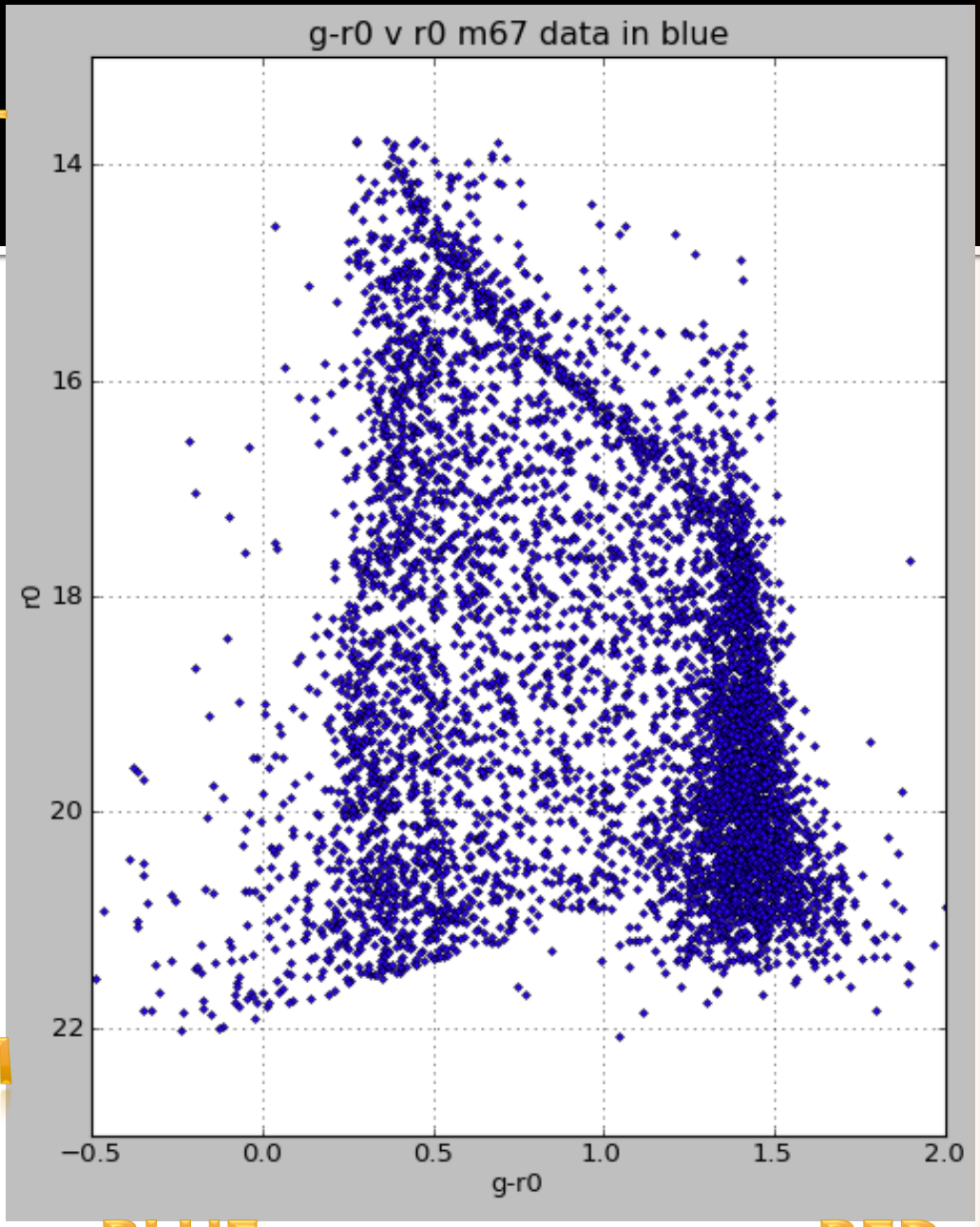
- Absolute is how bright a star would look if it was 10 pc away
  - Pc = 3.26 ly = = 19.2 trillion miles
  - 10 pc = 192 trillion miles
- Also a backwards scale
- Absolute magnitude of the Sun is 4.83
- SCR 0740-4257 would have basically the same absolute and apparent

Part 1

# $(G - r)_0$

BRIGHT

- Color measurement
- X-axis goes from blue to red
- Y-axis goes from faint to bright
  - Remember- Backwards scale



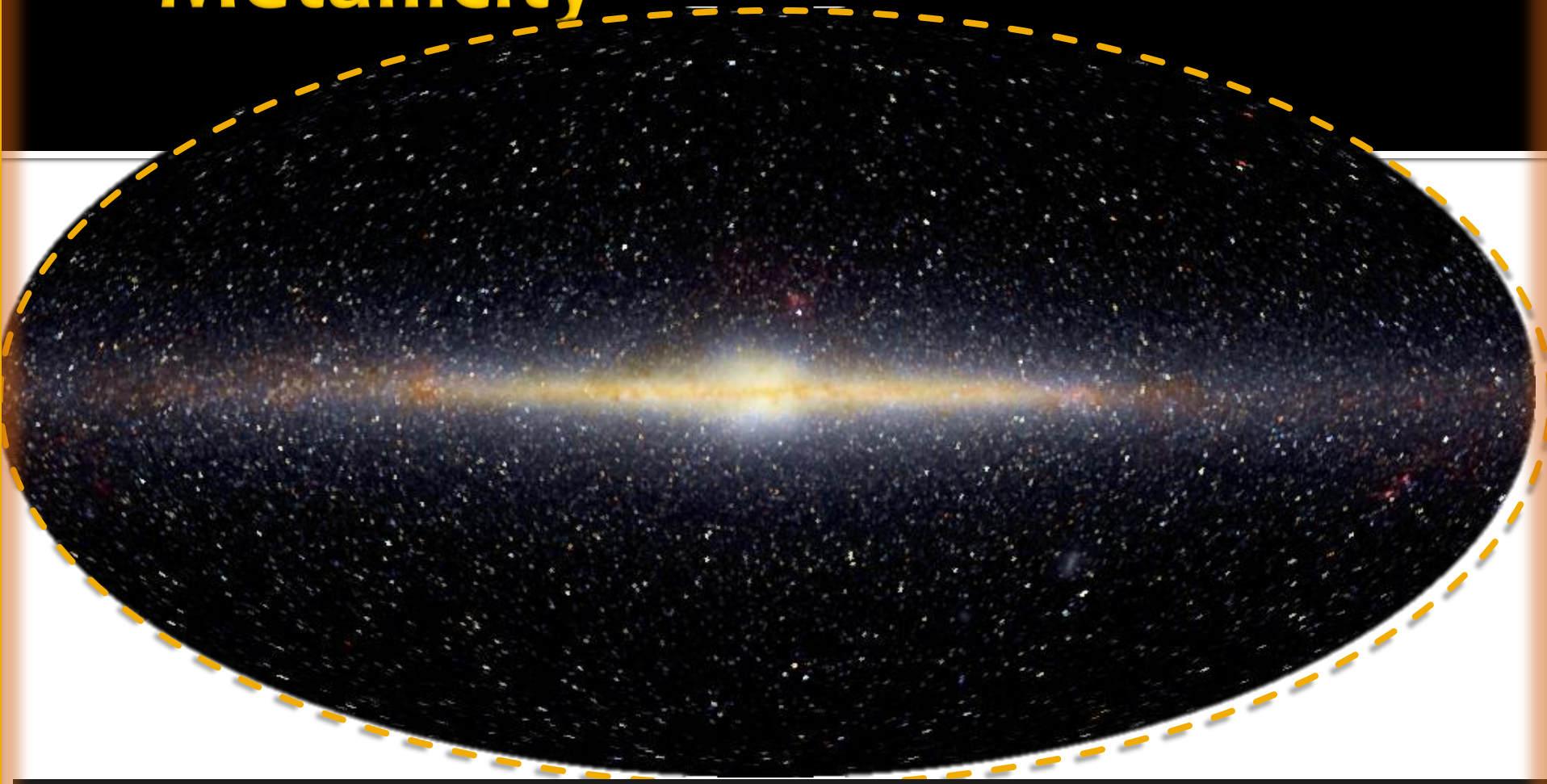

DIM

BLUE

RED

Part 1

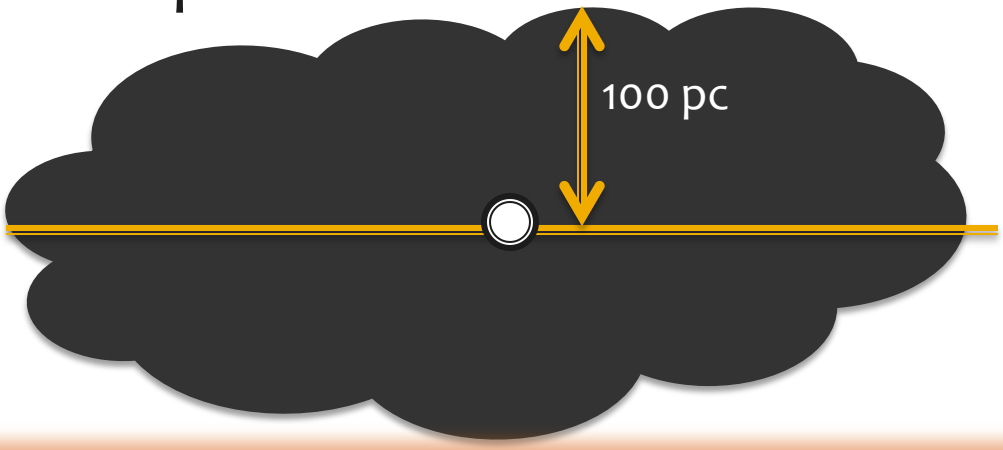
# Metallicity

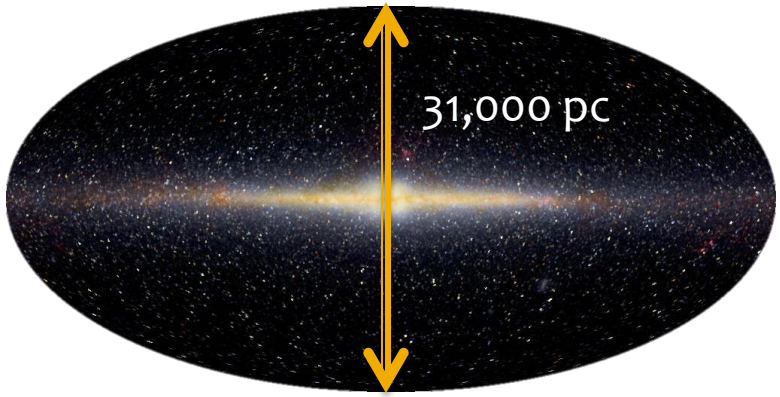


| Where | Halo | Thick Disc | Thin Disc |
|---|---|---|---|
| Age | Oldest- up to 13.5 Gyr | Intermediate- > 10 Gyr | Youngest- 1-10 Gyr |
| Made of | Mostly H and He | H and He + some metal | H, He, large amount of metal |
| Color | Bluest | | Reddest |

# Dust

- Dust makes everything redder
- Most dust is assumed to be less than 100 pc from plane
- Cobe
  - Dust map
  - Measured infrared from plane to 100 pc from plane

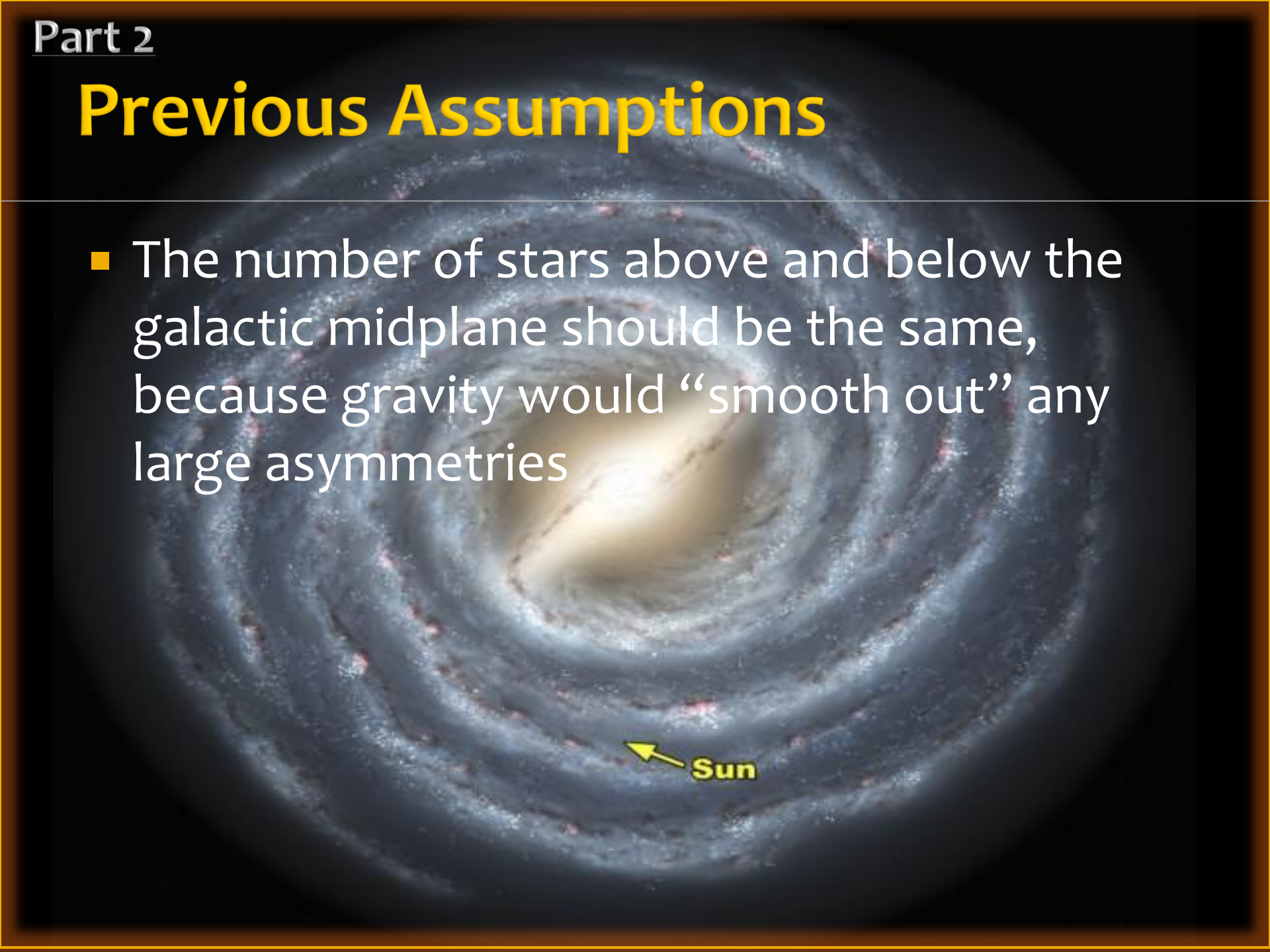


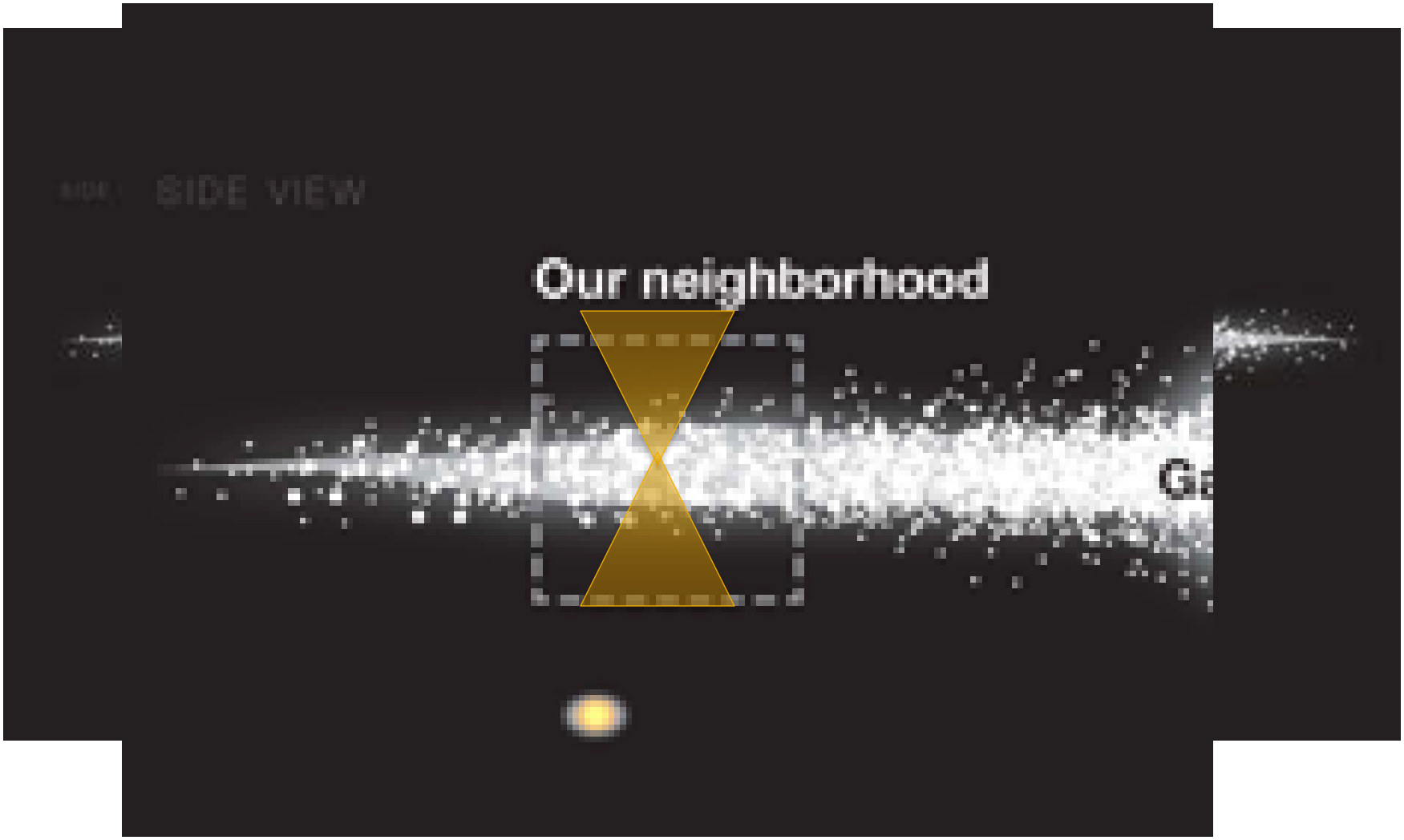
Part 2

# Previous Assumptions

- The number of stars above and below the galactic midplane should be the same, because gravity would "smooth out" any large asymmetries



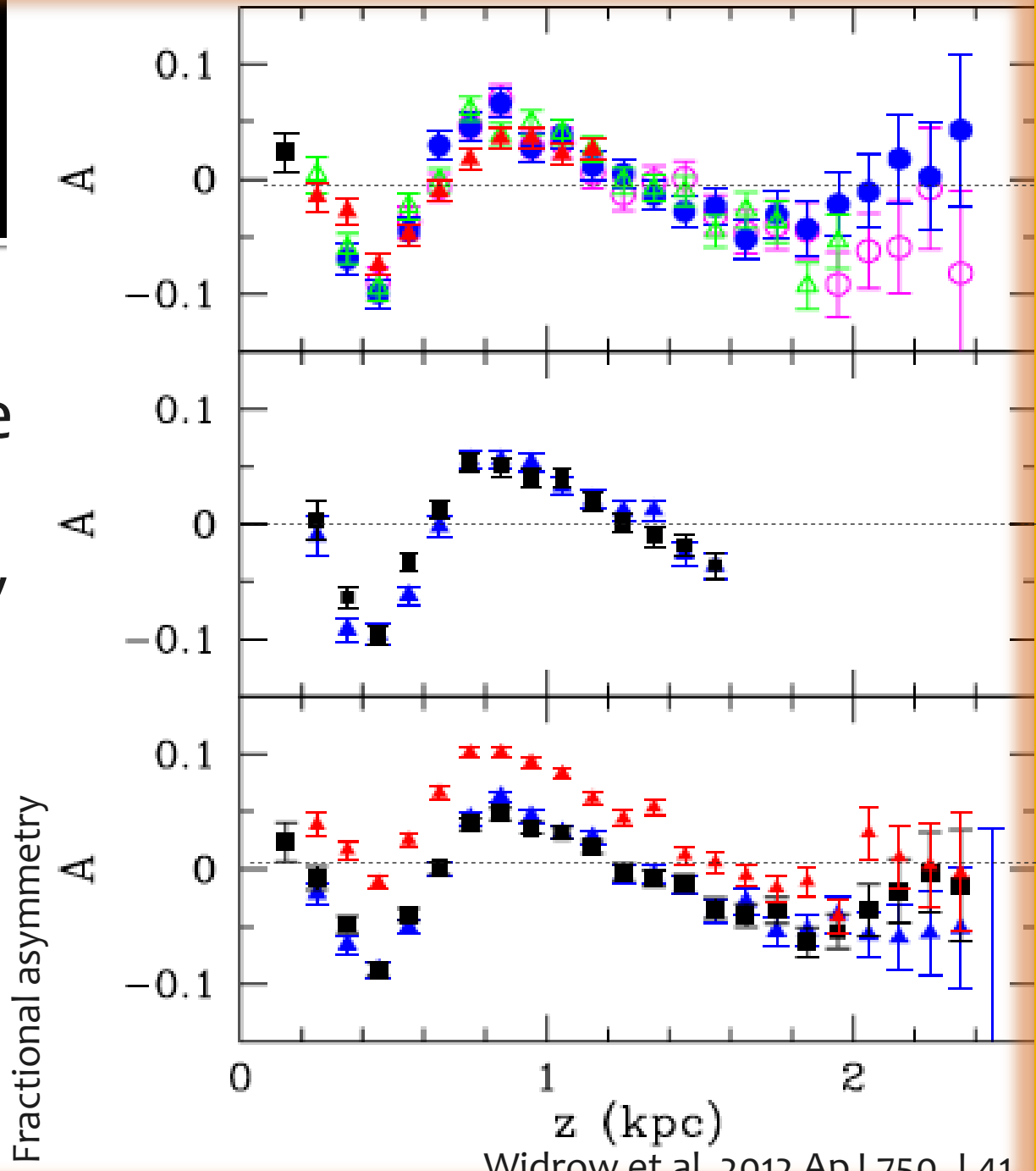
# Milky Way and SDSS



Part 2

# Results (not mine)

- There is an asymmetry in the number of stars above and below the galactic midplane
- 400 pc
- 800 pc




Widrow et al. 2012 ApJ 750, L41

Part 3

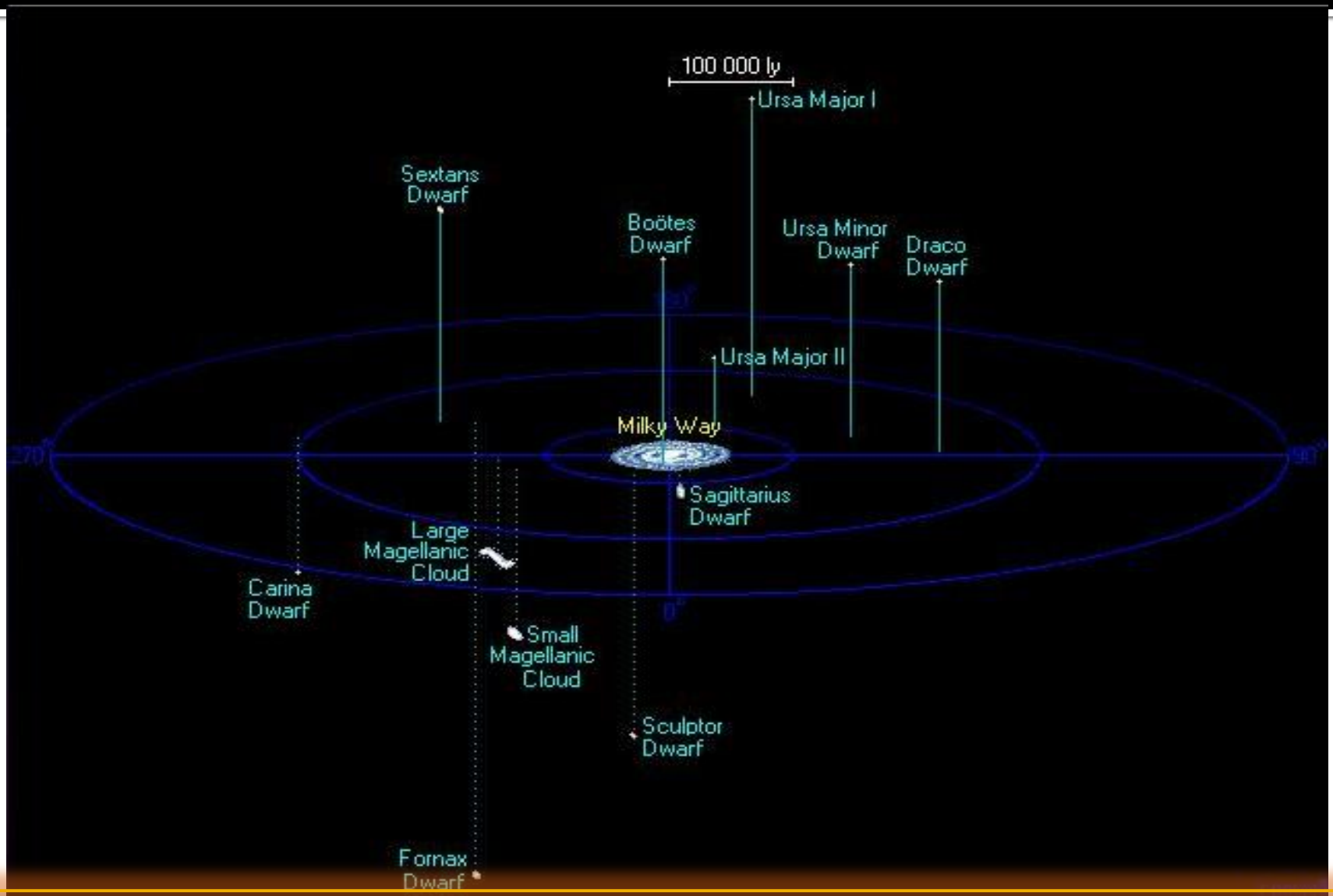
# My purpose for the summer

- Look at the data from the paper "Galactoseismology: Discovery of Vertical Waves in the Galactic Disc" in more detail
  - Look at color measurements
  - Break up data into smaller chunks
  - Figure out if a more detailed paper is needed

Part 3

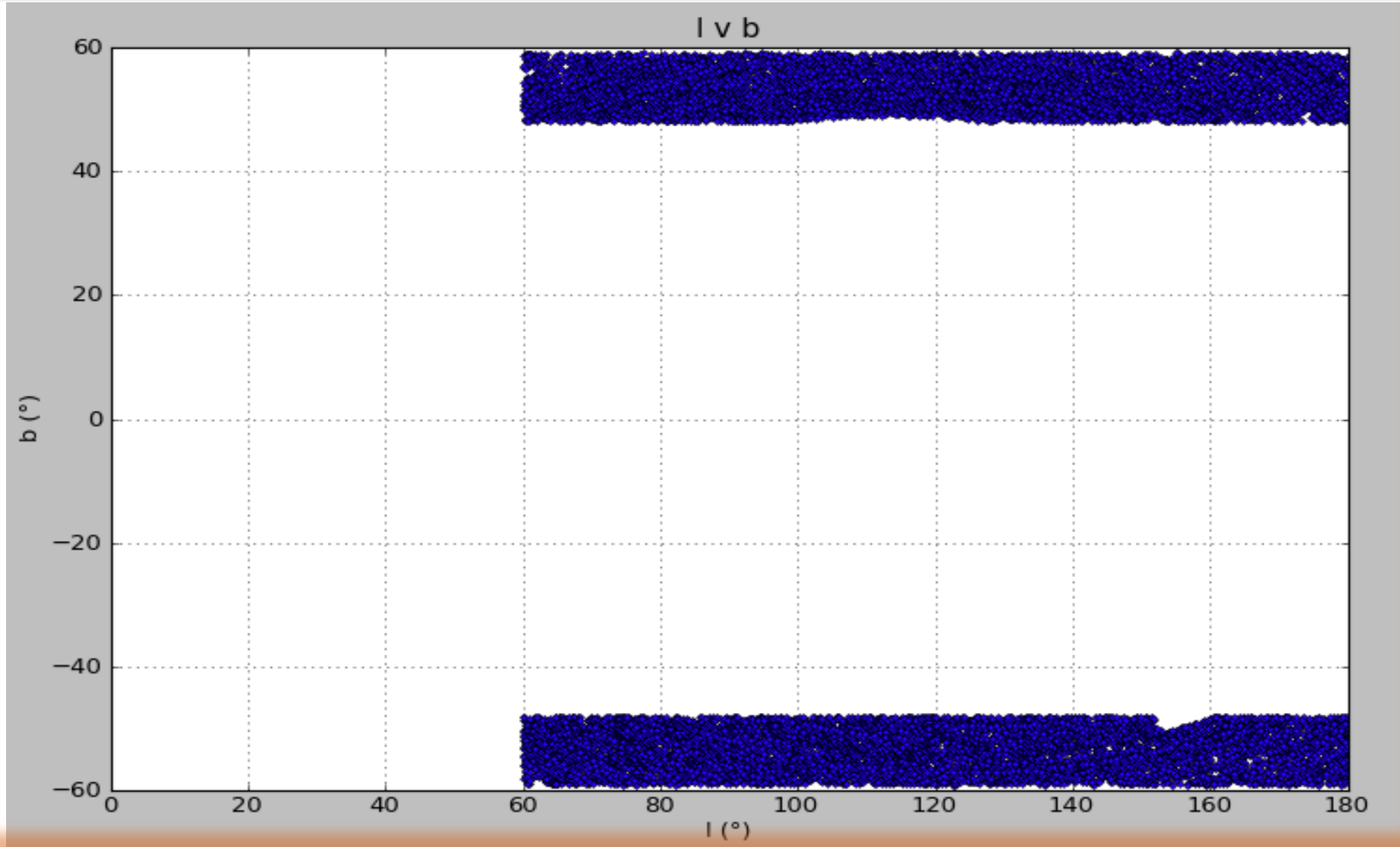
# Three explanations

1. Dust
2. Satellite Galaxy
3. Dark Matter Halo



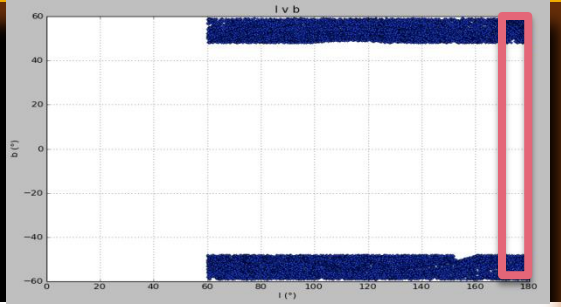
Part 3

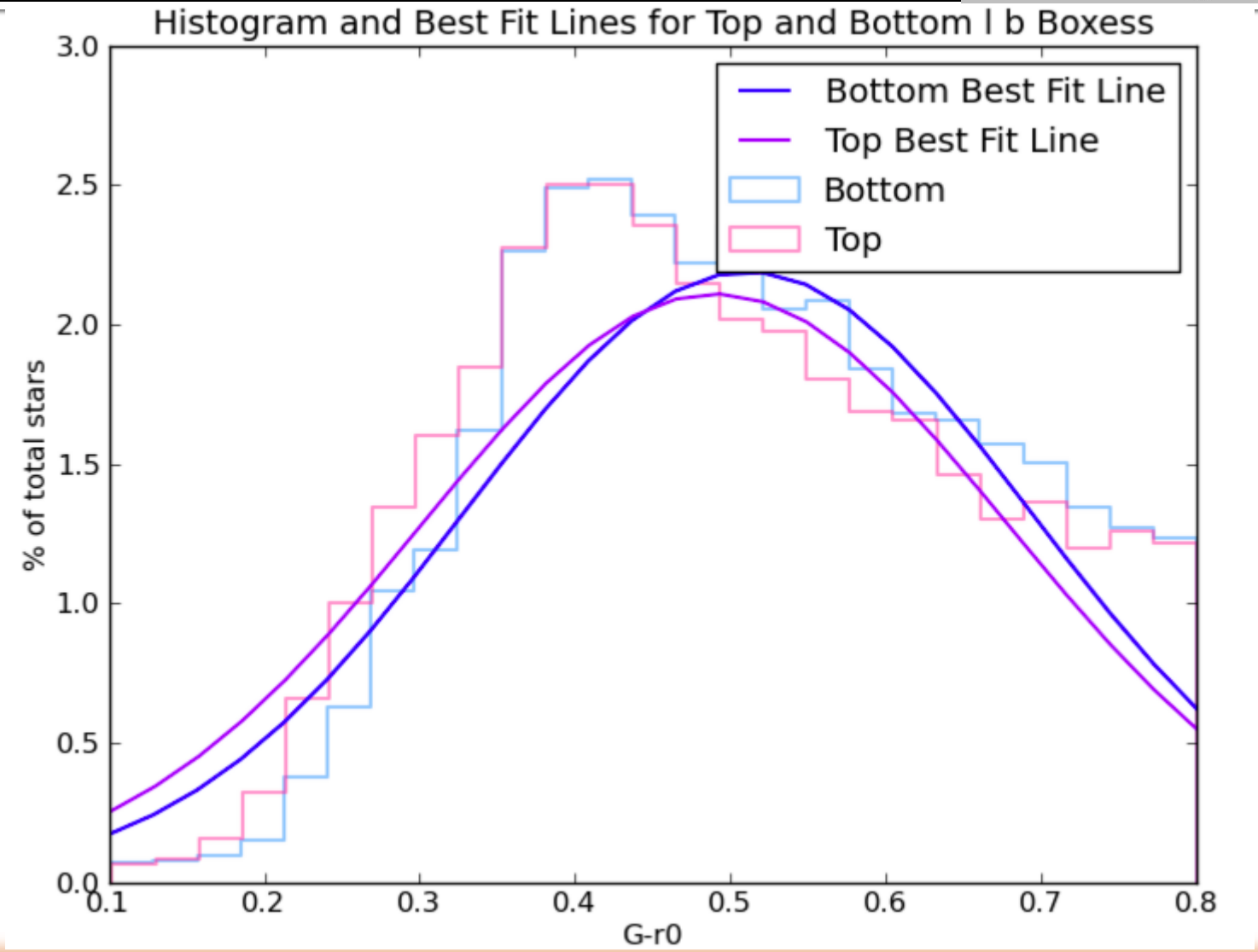
# l and b plot



Part 3

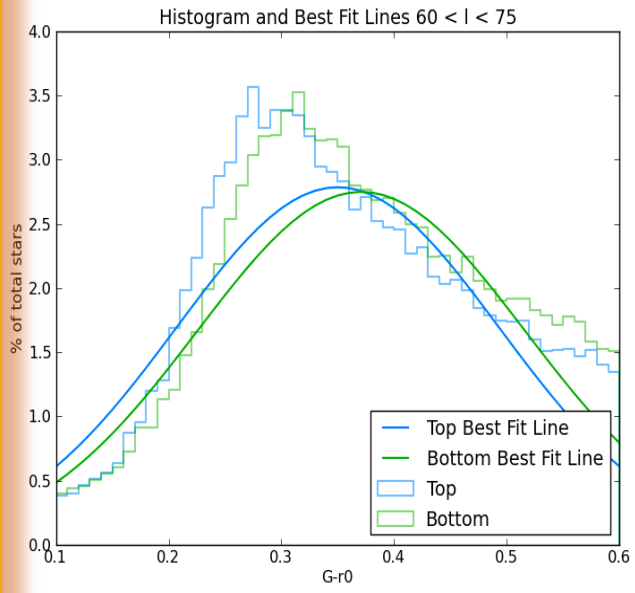
# Gaussian for 170 < l < 180

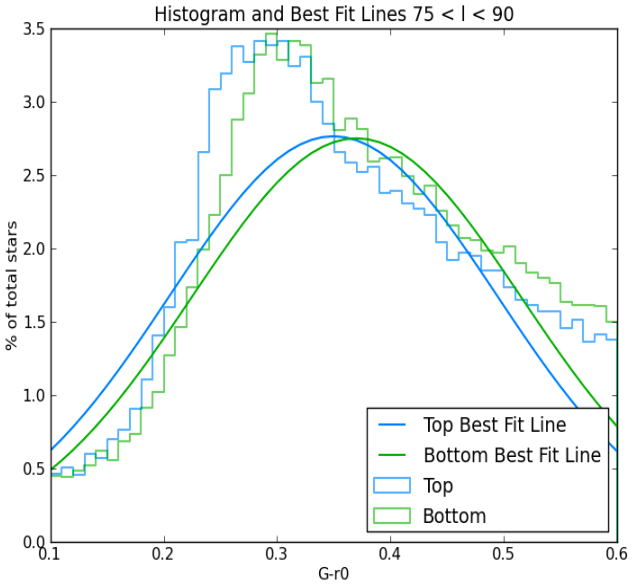


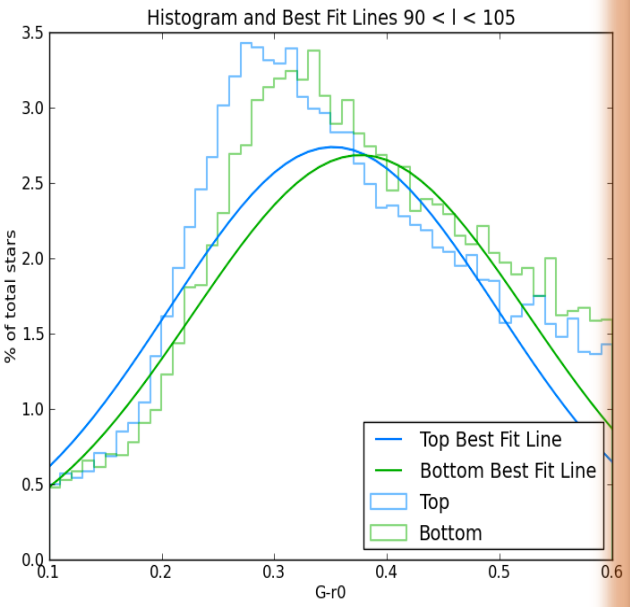



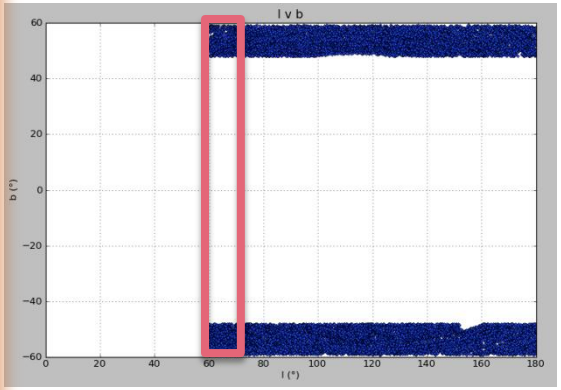
Part 3

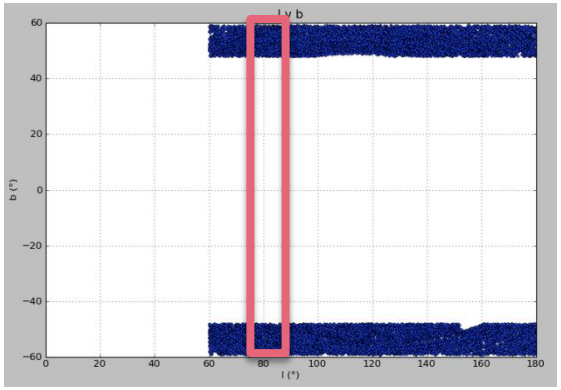
# Final Plots

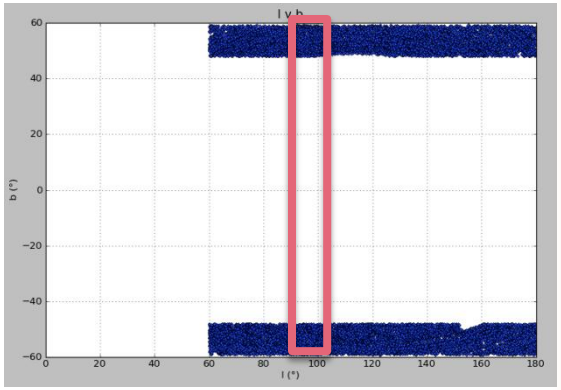


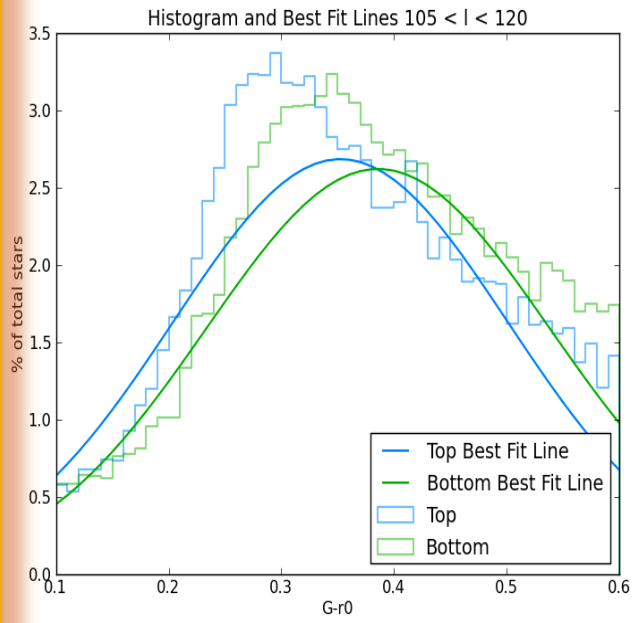



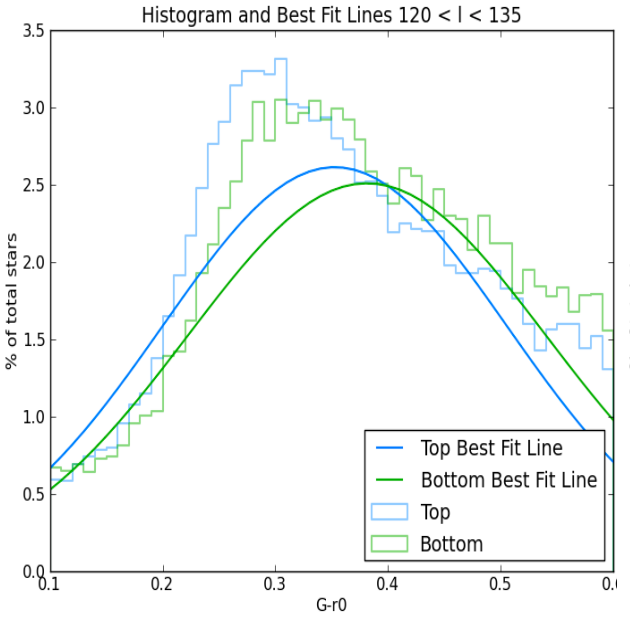



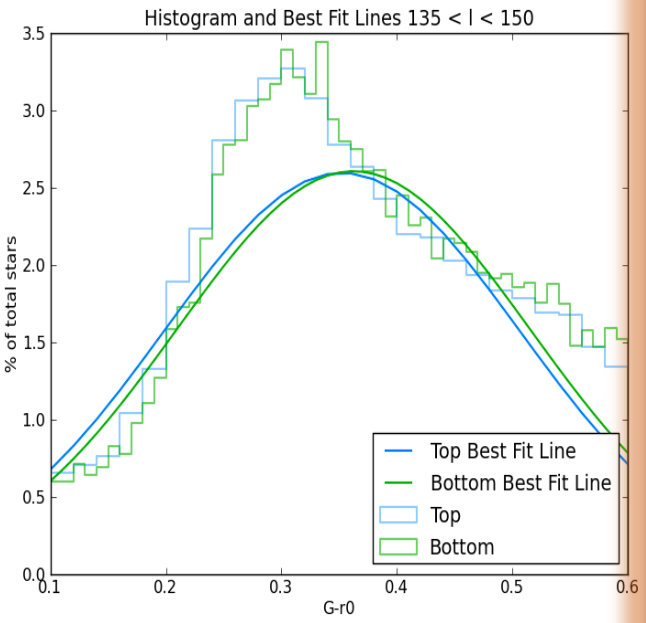



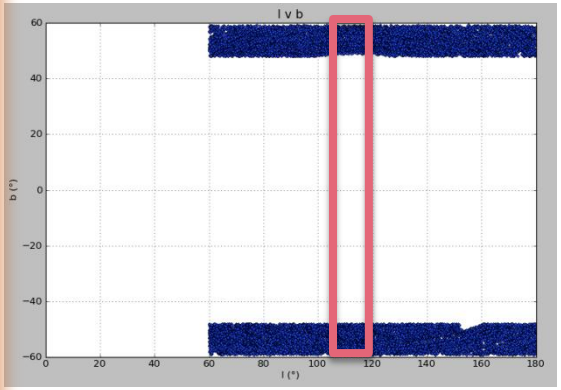
Part 3

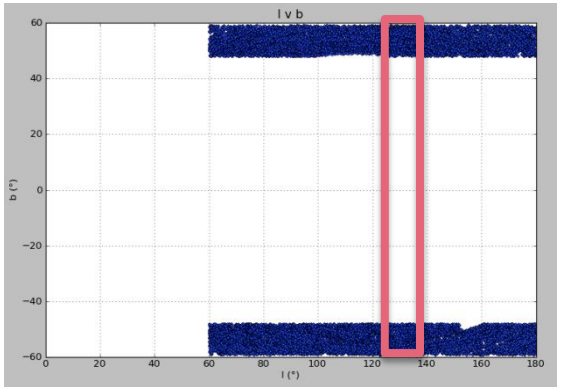
# Final Plots

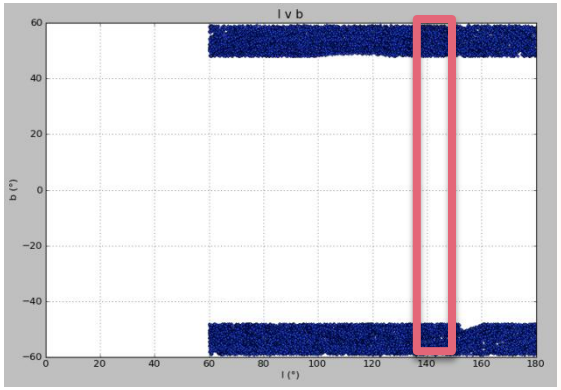


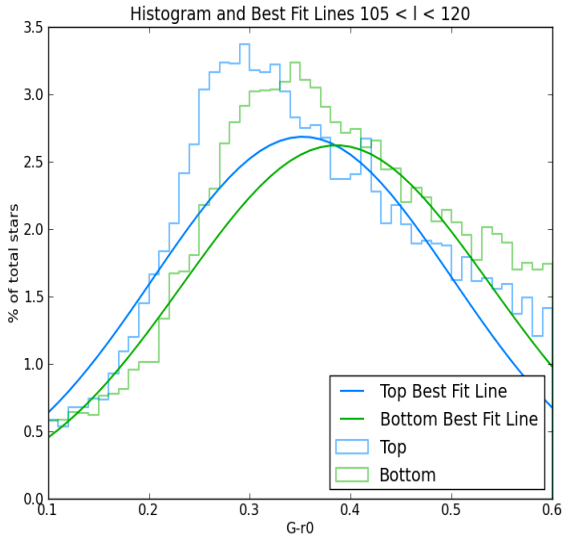



Part 3

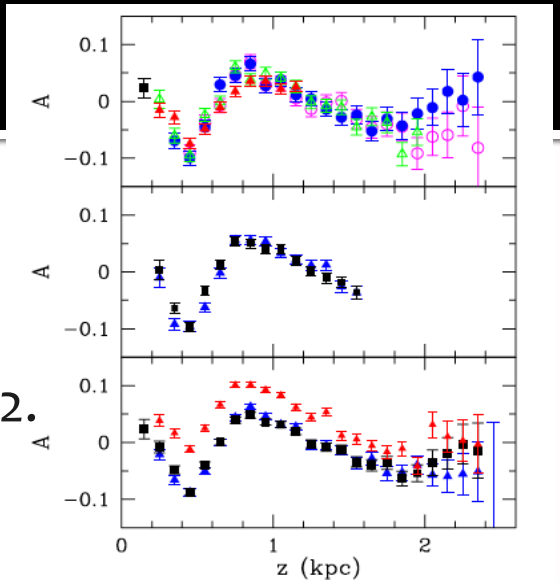
# Conclusions

- South is redder
- How constant
  - North
  - South




| l | North $(G-r)_0$ | South $(G-r)_0$ | Difference |
|---|---|---|---|
| 60-75 | .29 | .32 | .03 |
| 75-90 | .28 | .31 | .03 |
| 90-105 | .29 | .33 | .04 |
| 105-120 | .29 | .345 | .055 |
| 120-135 | .285 | .33 | .045 |
| 135-150 | .30 | .305 | .005 |
| Average | .285 | .323 | .038 |
| Range | .015 | .04 | |

# Acknowledgements





- Widrow, Lawrence M., et al. "Galactoseismology: Discovery of Vertical Waves in the Galactic Disc." *The Astrophysical Journal Letters* 750.2 (2012): 1-5. *The Astrophysical Journal Letters*. Web. 20 July 2012. http://iopscience.iop.org/2041-8205/750/2/L41/pdf2041-8205_750_2_L41.pdf.


- Brian Yanny
- Chris Stoughton
  - and his office
- George and Kristy

- Python
- SDSS III data
- Logger Pro 3.8.5.1

Part 3

# Discussion of Results/Implications

1. Dust
   - Not been properly accounted for
   - Dust makes things seem farther away
     - Hidden dust on the bottom
     - Not comparing equal boxes
2. Different stellar population
   - Could have come from a satellite galaxy
     - w/higher Metallicity/
     - older population
     - Passed through bottom
   - Halo difference (16 kpc)

# Equations

- $M - m = 5 \log (d / 10\ pc)$
- $M^2 = 40.2\ (G\text{-}r)_0 + 3.879$