Rotation Curve of Milky Way
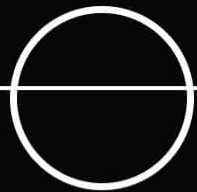
Zachary Cohen,
Dechong Wang, John
Wright
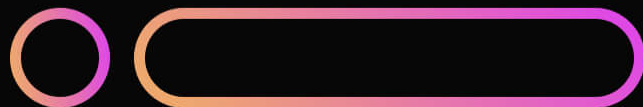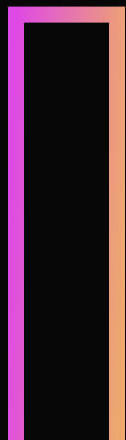
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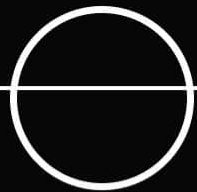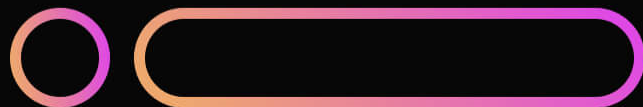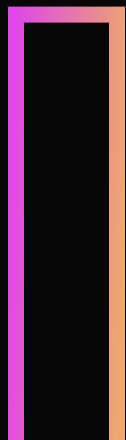
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01

Motivations

Motivations

- Estimate galactic mass distribution

- Understand relationship between mass distribution and rotation curve

- Understand the components of a galaxy

02

Methods

Methods

- Given: rotation curve of galaxy [1]
- Want to infer mass distribution
- Model: velocity is afunction of enclosed mass, which is a function of radius
- How does velocity depend on mass?
- How does mass depend on radius?
- Three components:
- Galactic bulge (always enclosed, constant)
- Galactic disc (thin cylinder, so increases quadratically up to disc radius)
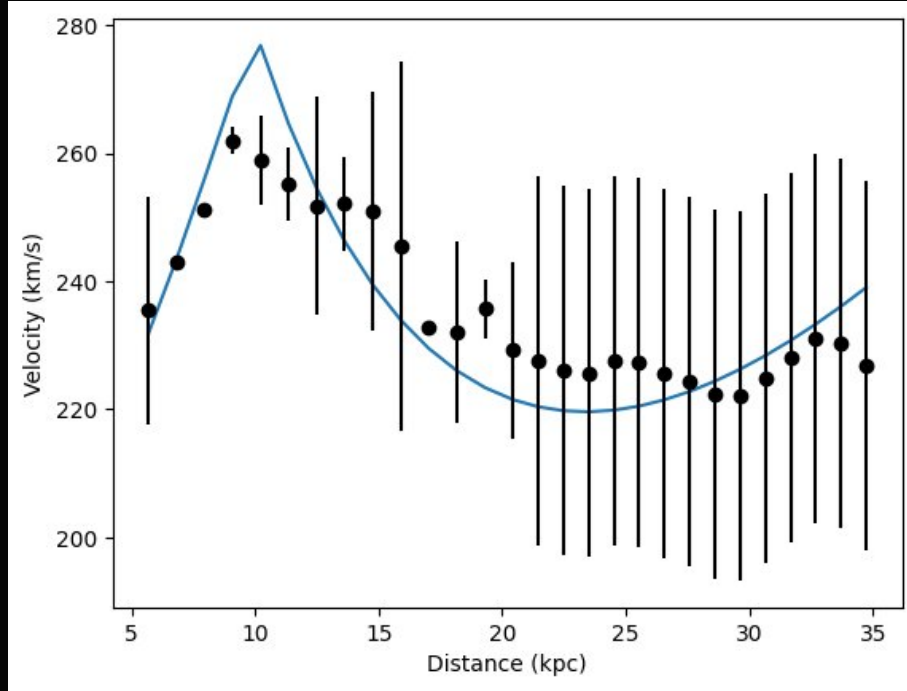- Galactic halo (sphere, increases cubically)
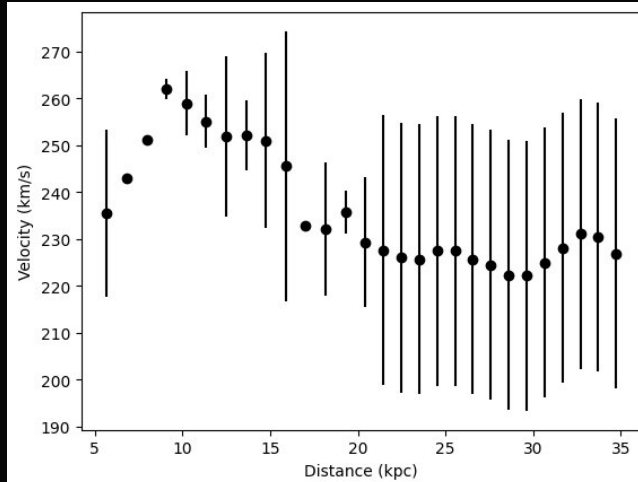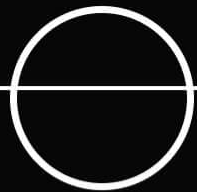

$$v(r) = \sqrt{\frac{m(r)G}{r}}$$

$$\frac{v^2}{G} = m_b \frac{1}{r} + \rho_d \frac{\pi \min(r^2, r_d^2)}{r} + \rho_h \frac{4}{3}\pi r^2$$

$$m(r) = m_b + \rho_d \pi \min(r^2, r_d^2) + \rho_h \frac{4}{3}\pi r^3$$

$$[1.9702122 \times 10^{10}, 1.5506895 \times 10^{11}, 2.9332181 \times 10^{11}] \, M_{\odot}$$

- Estimation: if we rewrite theprevious equations, we get
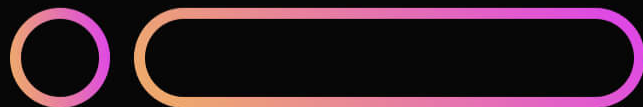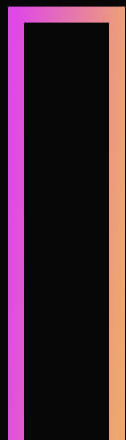- And we can apply standard linear regression to get easy mass estimates

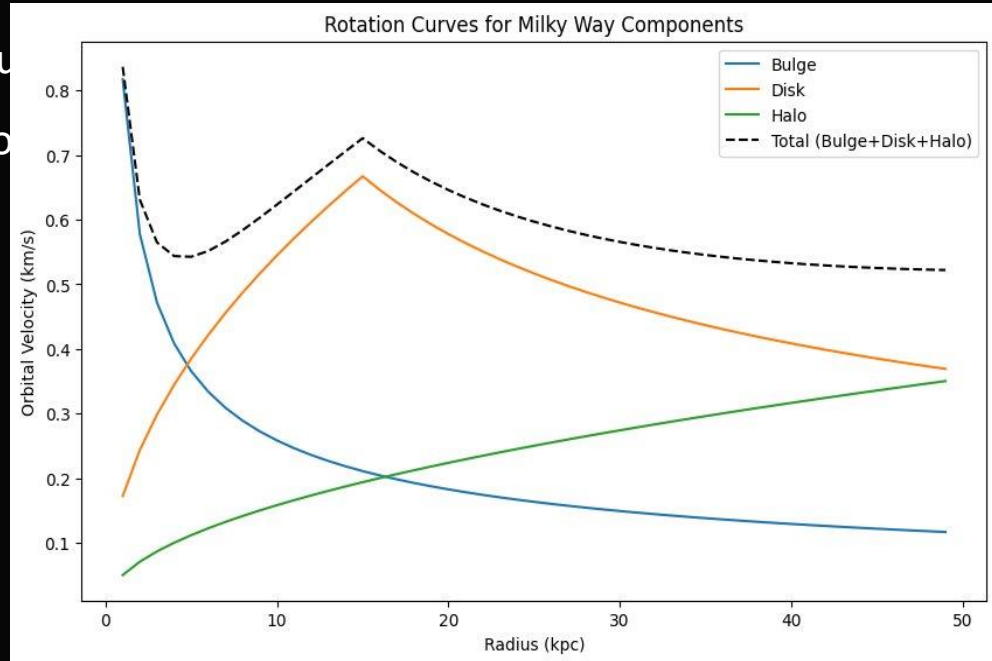$$\frac{v^2}{G} = m_b \frac{1}{r} + \rho_d \frac{\pi \min(r^2, r_d^2)}{r} + \rho_h \frac{4}{3}\pi r^2$$
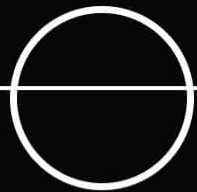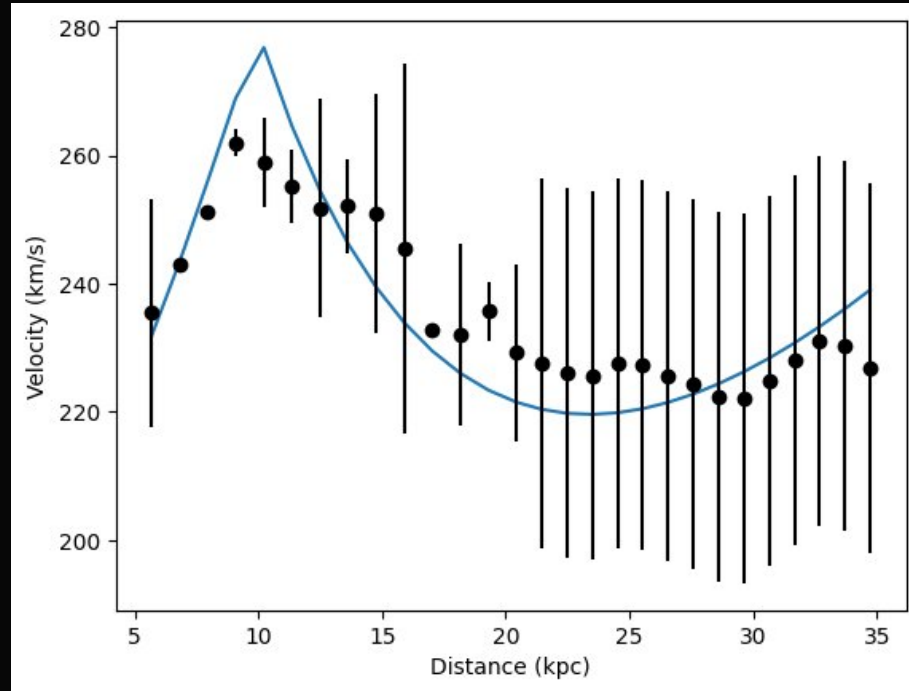
03

Results

Results

- What does this model produ[...]
- Comparison with observatio[...]
- Mass estimates
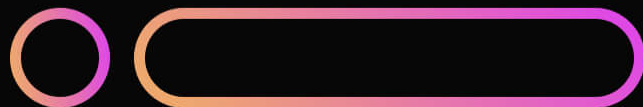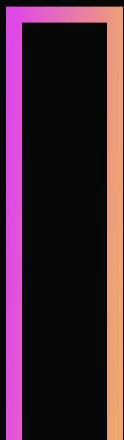- Bulge, disc, halo

Rotation Curves for Milky Way Components
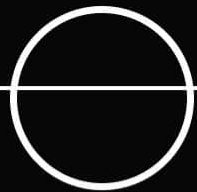
Comparison with observations
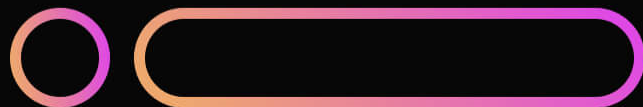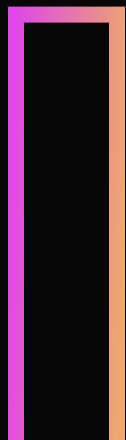
04

Conclusions

Simple model of mass distribution works reasonably well

Mass is distributed along the components of the Milky Way, but there is still unexplained mass present
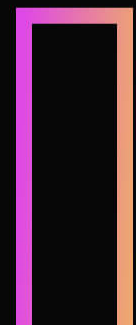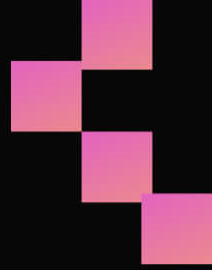
05

References

References

[1] Carignan, Claude, et al. "The extended HI rotation curve and mass distribution of M31." The Astrophysical Journal 641.2 (2006): L109.

THE END

THANKS