THE MASSIVE DARK CORONA OF OUR GALAXY

K.C. FREEMAN
Mount Stromlo and Siding Spring Observatories
The Australian National University
Canberra, AUSTRALIA

Abstract. From their rotation curves, most spiral galaxies appear to have massive dark coronas. The inferred masses of these dark coronas are typically 5 to 10 times the mass of the underlying stellar component. I will review the evidence that our Galaxy also has a dark corona. Our position in the galactic disk makes it difficult to measure the galactic rotation curve beyond about 20 kpc from the galactic center. However it does allow several other indicators of the total galactic mass out to very large distances. It seems clear that the Galaxy does indeed have a massive dark corona. The data indicate that the enclosed mass within radius R increases like $M(R) \approx R(\mathrm{kpc}) \times 10^{10}\ M_\odot$, out to a radius of more than 100 kpc. The total galactic mass is at least $12 \times 10^{11}\ M_\odot$.

1. Summary

A full version of this paper will appear elsewhere (Freeman 1995). Here I present the main conclusions from the individual indicators of the galactic mass distribution.

- The mass of the known luminous components of the Galaxy is in the range (5 to 12) $\times 10^{10}\ M_\odot$.
- From the rotation curve of the Galaxy, $M(20\ \mathrm{kpc}) \approx 22 \times 10^{10}\ M_\odot$, which is already at least double the estimated mass of the visible components.
- The escape velocity at the solar radius, estimated from high velocity stars in the solar neighborhood, indicates that the galactic mass $> 30 \times 10^{10}\ M_\odot$.

C. S. Kochanek and J. N. Hewitt (eds), Astrophysical Applications of Gravitational Lensing, 175–176.

- From the kinematics of distant stars and satellites, $M(50\ \mathrm{kpc}) \approx 40 \times 10^{10}\ M_{\odot}$.
- The timing arguments from the radial velocities and distances of M31 and Leo I give a consistent asymptotic mass estimate M_{total} of at least $120 \times 10^{10}\ M_{\odot}$.

2. Conclusion

The data are consistent with a mass distribution $M(R) \approx R(\mathrm{kpc}) \times 10^{10}\ M_{\odot}$ (corresponding to a flat rotation curve with $V_c \approx 220\ \mathrm{km\ s^{-1}}$), extending out to $R \geq 100$ kpc. The inferred ratio of the mass of the dark corona to the mass of the visible components of the Galaxy is at least 10.

Recently Kochanek (1995) used a Jaffe (1983) model to represent the mass distribution of the Galaxy, and estimated the parameters for this model from the mass indicators taken together. He concludes that the mass within 50 kpc is $(54 \pm 13) \times 10^{10}\ M_{\odot}$, which agrees well with the run of $M(R)$ given here from the mass indicators taken individually.

References

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