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ASTRO 400B HOMEWORK 3

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1. RESULTS

Table 1. Table comparing galaxy component masses of M31, M33, and our Milky Way

Galaxy Name	Halo Mass ($10^{12} M_\odot$)	Disk Mass ($10^{12} M_\odot$)	Bulge Mass ($10^{12} M_\odot$)	Total Mass ($10^{12} M_\odot$)	f_{bar}
Milky Way	1.975	0.075	0.010	2.060	0.041
M31	1.921	0.120	0.019	2.060	0.068
M33	0.187	0.009	0.000	0.196	0.047
Local Group	4.082	0.204	0.029	4.316	0.054

2. QUESTIONS

1. In this simulation the Milky Way and M31 (Andromeda) have the same mass. In both galaxies the Halo (dark matter) is dominates the total mass.

2. M31 has 1.636 times more stellar mass than the Milky Way does, since the stellar mass is what we can see, we would expect M31 to be more luminous.

3. The ratio to Milky Way dark matter mass and M31 dark matter mass is practically 1 (1.028). I might expect dark matter mass to scale with stellar mass, so this is slightly surprising. Especially since the Milky Way is the one with slightly more dark matter mass than Andromeda, while Andromeda has a significantly higher stellar mass both in the disk and bulge.

4. The Baryon fraction of the Local Group is 0.054 or approximately 5.4%. This is significantly smaller than the Baryon fraction of the Universe, with is 16%. Since the gas inside of galaxies is negligible compared to stellar mass, I would venture a guess that there is a significant amount of gas between galaxies which would then add to the Baryon fraction of the universe. In fact, in the Nature paper Wolfe et al. (2013), giant gas clouds are observed within the Local Group that appear to be unrelated to M31 and M33 or our Milky Way. These gas clouds have a total HI mass of $2.6 \pm .02 \times 10^6 M_\odot$, a not insignificant amount. Assuming our Local Group is not unique, that suggests that there are clouds of gas between galaxies that will account for the gap between the Baryon fraction in our local galaxies and the Universe.

REFERENCES

Wolfe, S. A., Pisano, D. J., Lockman, F. J., McGaugh, S. S., & Shaya, E. J.
2013, Nature, 497, 224