Homework 3 — pdf portion

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3 Table of Galactic Masses

Galaxy Name	**Halo Mass** ($10^{12} M_\odot$)	**Disk Mass** ($10^{12} M_\odot$)	**Bulge Mass** ($10^{12} M_\odot$)	**Total** ($10^{12} M_\odot$)	$f_{\mathbf{bar}}$
MW	1.975	0.075	0.01	2.06	0.041
M31	1.921	0.12	0.019	2.06	0.067
M33	0.187	0.009	0.0	0.196	0.046

Table 1: This table displays the total masses of the galactic halo, disk stars, and bulge stars in the Milky Way Galaxy (MW), Andromeda Galaxy (M31) and Triangulum Galaxy (M33). In addition, the total mass of each galaxy and the ratio of stellar mass to total mass, also known as the baryon fraction, is included in the fifth and sixth columns respectively. Note that the galactic halo is assumed to be entirely composed of dark matter. All values are in units $10^{12}\, M_\odot$.

4 Questions

1. MW and M31 have masses that differ by $\leq 10^{10} M_\odot$ or 1% of their respective total masses according to this simulation

2. Per Table 1, MW has a total stellar mass of $0.085 \cdot 10^{12} M_\odot$ and M31 has a total stellar mass of $0.139 \cdot 10^{12} M_\odot$, meaning M31 has a greater stellar mass. The relation between stellar mass and luminosity is very intricate and not fully known, but is broadly true that a larger stellar mass corresponds to a larger stellar luminosity. Therefore, we can say that M31 is also more luminous.

3. Per Table 1, MW has a total halo mass of $1.975 \cdot 10^{12} M_\odot$ and M31 has a total stellar mass of $1.921 \cdot 10^{12} M_\odot$, meaning MW has a $\sim 3\%$ greater mass of dark matter. It is not immediately intuitive why M31 has a larger stellar mass but MW has a larger halo mass, and I would suspect the answer to this question lies in the history of mergers both galaxies experienced.

4. The baryon fraction of both galaxies are signficantly lower than the baryon fraction of the universe. I suspect this is due to dissipation of gas and ejected stars throughout the lifetime of the galaxies.