HW3

Wednesday, February 5, 2025 11:19 AM

Galaxy Name	Halo Mass (10^12 Msun)	Disk Mass (10^12 Msun)	Bulge Mass (10^12 Msun)	Total Mass (10^12 Msun)	fbar
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	0.196	0.046
Local Group	0	0	0	4.316	0.054

1. How does the total mass of the MW and M31 compare in this simulation? What galaxy component dominates this total mass?

MW and M31 have approximately the same total mass. In both the Halo Mass dominates over the Disk and Bulge mass, and we know the Halo mass is actually dark matter.

2. How does the stellar mass of the MW and M31 compare? Which galaxy do you expect to be more luminous?

M31 has slightly more mass in its disk and bulge compared to MW. When we say mass we are talking about the visible stars in the system, since M31 has more mass in the stars it can be predicted to be more luminous than MW.

3. How does the total dark matter mass of MW and M31 compare in this simulation (ratio)? Is this surprising, given their difference in stellar mass?

Comparing the fbar ratio of the two,
MW has greater dark matter, lower stellar, with stellar/total ratio of 0.041.
M31 has lower dark matter, higher stellar, with stellar/total ratio of 0.067

No this is not surprising given that their total masses are the same but their dark/stellar matter are different.
I don't have enough information, such as age, structure, chemical makeup, etc. for this to be surprising given the data that is in the table. The ratio matches common sense.

If we are asking why there is dark matter, its probably an evolutionary thing. Either stars form from dark matter pools, or stars turn into dark matter. So if the masses are the same we are looking at similar galaxies in different times of their evolutionary period. Which one is older is hard to say because I don't have more information, and we don't yet know/understand dark matter fully.

4. What is the ratio of stellar mass to total mass for each galaxy (i.e. the Baryon fraction)? In the Universe, Ω_b/Ω_m ~16% of all mass is locked up in baryons (gas & stars) vs. dark matter. How does this ratio compare to the baryon fraction you computed for each galaxy? Given that the total gas mass in the disks of these galaxies is negligible compared to the stellar mass, any ideas for why the universal baryon fraction might differ from that in these galaxies?

See the table for fbar.
16% = 0.16

For the computed table all of my calculates were around 5% not 16%. It's possible that as evolution happens baryons leave their galaxies. Whether its from supernovas, winds, tidals interactions, etc. It's also possible that the universal 16% is looking at all matter everywhere, and baryonic matter is more attracted to pockets of gravity potential wells which forms galaxies.