GalaxyMass

February 6, 2020

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In [32]: import numpy as np
         import astropy.units as u
         from ReadFile import Read
         import pandas as pd

In [33]: # This function needs to return the total mass of any desired galaxy component
         # Data comes from thre different files: MW000.txt, M31_000.txt, and M33_000.txt
         # Type of particle can be 1,2 or 3.
         # 1=DM, 2=Disk, 3=Bulge

         def ComponentMass(filename, ptype):
             # Inputs:
             #        are the files (galaxy)
             #        and the particle type
             # Returns:
             #        the total mass of each galaxy component (ptype) that we want in unit of 


             #This calls for the data from the ReadFile
             data = np.genfromtxt(filename, dtype= None, names=True, skip_header=3)

             # We create an index of the type of particle we want.
             index = np.where(data['type'] == ptype)

             # From here we extract the mass from the data and index it to the the particle ty
             mass = data['m'][index] * u.M_sun / 100

             # We sum all the partciles for each type and round three decimal places
             massround = np.around(sum(mass), decimals=3)

             return massround


In [45]: # This is the mass of the Milky Way components and the total mass

         # DM mass
         dm_MW = ComponentMass('MW_000.txt', 1)
```

```python
# Disk mass
disk_MW = ComponentMass('MW_000.txt', 2)
# Bulge mass
bulge_MW = ComponentMass('MW_000.txt', 3)
# Total mass
tot_MW = dm_MW + disk_MW + bulge_MW
# Total stellar mass
stel_MW = disk_MW + bulge_MW
# Baryon fraction
fbar_MW = stel_MW / tot_MW
```

In [58]:
```python
# This is the mass of M31 components and the total mass

# DM mass
dm_M31 = ComponentMass('M31_000.txt', 1)
# Disk mass
disk_M31 = ComponentMass('M31_000.txt', 2)
# Bulge mass
bulge_M31 = ComponentMass('M31_000.txt', 3)
# Total mass
tot_M31 = dm_M31 + disk_M31 + bulge_M31
# Total stellar mass
stel_M31 = disk_M31 + bulge_M31
# Baryon fraction
fbar_M31 = stel_M31 / tot_M31
```

In [59]:
```python
# This is the mass of M33 components and the total mass

# DM mass
dm_M33 = ComponentMass('M33_000.txt', 1)
# Disk mass
disk_M33 = ComponentMass('M33_000.txt', 2)
# Bulge mass
bulge_M33 = ComponentMass('M33_000.txt', 3)
# Total mass
tot_M33 = dm_M33 + disk_M33 + bulge_M33
# Total stellar mass
stel_M33 = disk_M33 + bulge_M33
# Baryon fraction
fbar_M33 = stel_M33 / tot_M33
```

In [65]:
```python
totgroup = tot_MW + tot_M31 + tot_M33
fbar_group = (stel_MW + stel_M31 + stel_M33)/ totgroup
```

In [66]:
```python
table = pd.DataFrame()

name = ['MW', 'M31', 'M33', 'Local Group']
diskmass = [disk_MW, disk_M31, disk_M33, '']
bulgemass = [bulge_MW, bulge_M31, bulge_M33, '']
```

```
dmmass = [dm_MW, dm_M31, dm_M33, '']
totmass = [tot_MW, tot_M31, tot_M33, totgroup]
fbar = [fbar_MW, fbar_M31, fbar_M33, fbar_group]

table['Galaxy name'] = name
table['Halo Mass ($10^{12} M_{\odot}$)'] = dmmass
table['Disk Mass ($10^{12} M_{\odot}$)'] = diskmass
table['Bulge Mass ($10^{12} M_{\odot}$)'] = bulgemass
table['Total Mass ($10^{12} M_{\odot}$)'] = totmass
table['Bayron Fraction'] = fbar
```

In [67]:

```
table
```

Out[67]:

```
   Galaxy name Halo Mass ($10^{12} M_{\odot}$)  \
0           MW                     1.975 solMass
1          M31                     1.921 solMass
2          M33                     0.187 solMass
3  Local Group

  Disk Mass ($10^{12} M_{\odot}$) Bulge Mass ($10^{12} M_{\odot}$)  \
0                  0.075 solMass                      0.01 solMass
1                   0.12 solMass                     0.019 solMass
2                  0.009 solMass                                 0
3

  Total Mass ($10^{12} M_{\odot}$)       Bayron Fraction
0                     2.06 solMass   0.04126213592233009
1                     2.06 solMass    0.0674757281553398
2                    0.196 solMass   0.04591836734693877
3                    4.316 solMass  0.053985171455050975
```

1.- The mass of MW and M31 are very similar in this simulation. They are almost identical, so they both dominate the total mass.

2.- The stellar mass of M31 is actually bigger than that of MW. Therefore I would think M31 is more luminous that MW.

3.- The total dark matter of MW is about the same for M31. The ratio MW/M31~1.03. It is a little bit surprising that even though MW has about the same total dark matter, M31 has a stellar mass ~1.6 MW

4.- The baryon fraction for each galaxy is about ~4%-6% with the local group having ~5% of baryon mass vs dark matter. Is is much smaller that the universal baryon fraction. Maybe this ratio is much smaller for this galaxies because they've been expelling material through AGN and SN feedback. Maybe also by interacting with nearby satellite galaxies that might pull material out of them.

In [ ]: