An evolving Milky Way dark matter halo, the influence of the Large Magellanic Cloud.

1 Galaxy Models

In order to model the MW we use a Hernquist profile for the dark matter halo a exponential profile for the disk and a Hernquist profile for the bulge. For the LMC we also use a Hernquist model. In the following subsection we explain in detail how the parameters of this profiles are chosen following the observational evidence from \citep{vandermarel14}.

1.1 MW model

Currently the mass of the MW is estimated in the range $M_{vir} = 1 - 2 \times 10^12 M\odot$. Following \citep{gomez15} take $M_{vir} = 1 \times 10^{12}, 1.5 \times 10^{12}, 2 \times 10^{12}] M_{\odot}$.

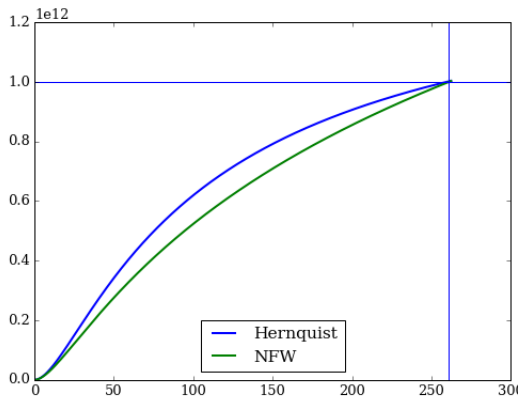
$M_{vir}(10^10 M\odot)$	R_{vir}	r_s	M_disk	10	M_{bulge}	c_bulge	M_H	$M_{H,halo}$	$r_h(MW)$
100	261 /	26.47 /	6.5	3.5	1.0	0.7	146	138.5	53.06
150	299 /	31.27 /	5.5	3.5	1.0	0.7	222	215.5	62.44
200	329 /	35.15 /	5.0	3.5	1.0	0.7	298	293	70

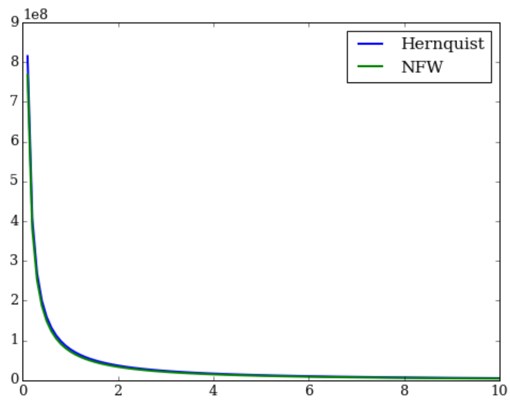
The concentration parameter was derived using the relation from \citep{klypin11}

$$c(M_{vir}) = 9.6\left(\frac{Mvir}{10^12 h^{-1} M\odot}\right)^{-0.075} \tag{1}$$

$c(1E12) = 9.86$, $c(1.5E12) = 9.99$, $c(2E12) = 10.12$.
And the R_{vir} is derived from:

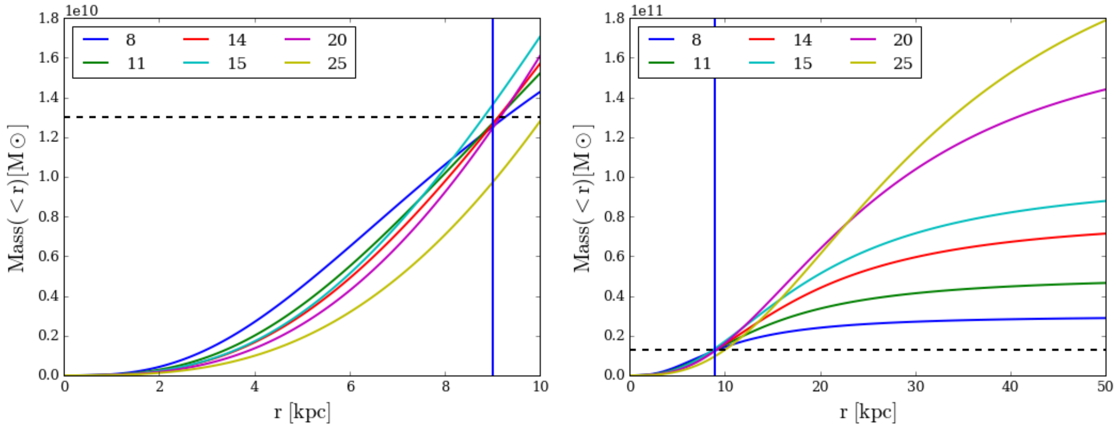
$$R_{vir} = \tag{2}$$



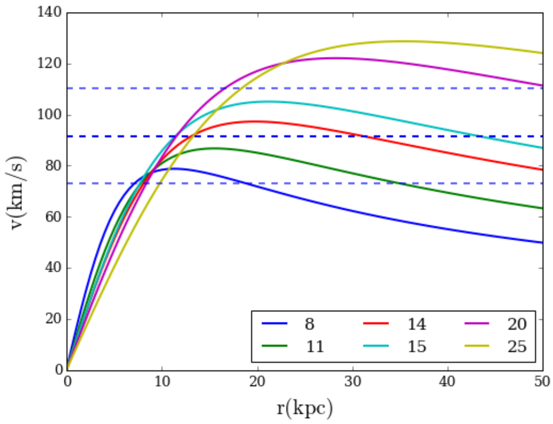


$M_{LMC}(10^10M\odot)$	3	5	8	10	18	25
$r_p(kpc)$	8	11	14	15	20	22.5
$r_h(kpc)$	4.91	8.97	13.75	16.43	25.13	30
$r_h(kpc)$	3.13	6.64	10.81	13.13	20.7	26.02

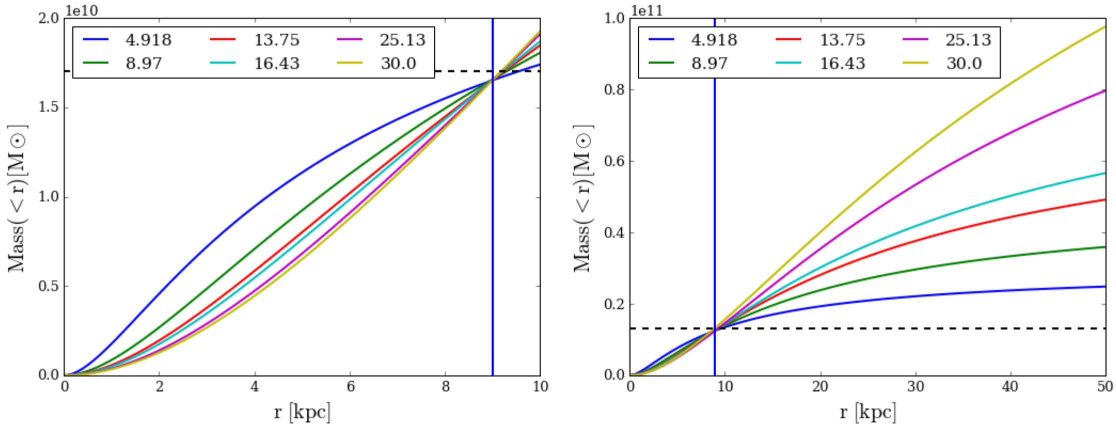
The enclosed mass for the Plummer profile is shown in Fig.??.



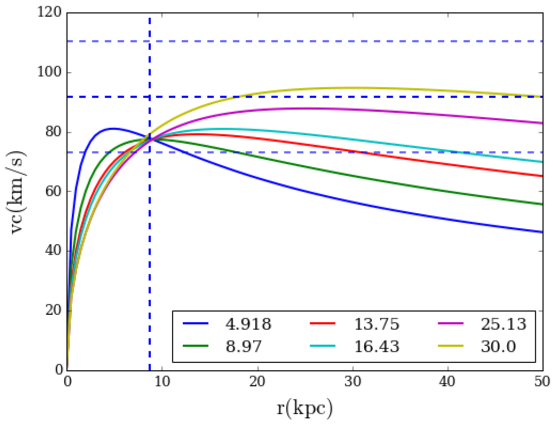
While the rotation curve is shown in ??.



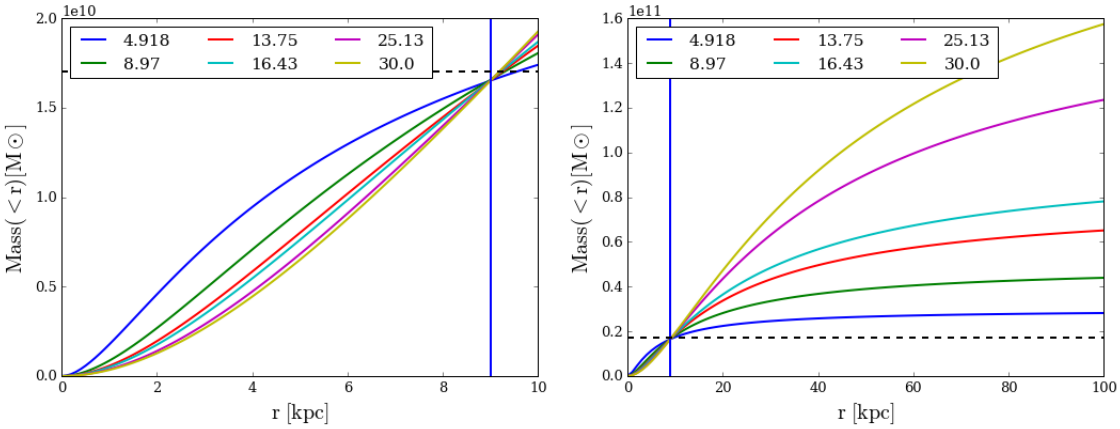
The enclosed mass for the Hernquist profile is shown in Fig.??.



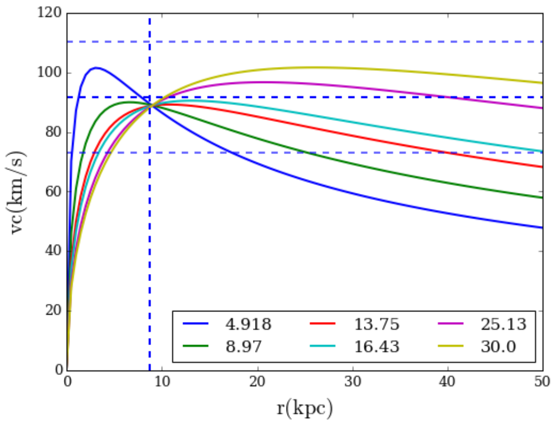
While the rotation curve is shown in ??.



The enclosed mass for the Hernquist profile is shown in Fig.??.



While the rotation curve is shown in ??.



1.3 GalIC modification

In order to compute the Hernquist scale length a and the Hernquist equivalent mass the code do the following:

Input parameters: CC (Halo Concentration Parameter of the NFW profile) and Vvir (Virial Velocity of the NFW halo km/s).
In our case this values are $M_{vir} = 1E12M\odot$ and $CC = c_{vir} = 9.86$
With these parameters we compute the **output parameters:** M_H (Virial mass of the equivalent Hernquist profile) and a.
using:

$$M_{vir} = \frac{V_{vir}^3}{\sqrt(48.6)HG} \tag{3}$$

$$R_{vir} = \frac{V_{vir}}{\sqrt(48.6)H} \tag{4}$$

In the code $H = 3.2407789E - 18h/s$.

Which leads to $M_{vir} = 7E11M\odot/h$ and $R_{vir} = 183.67Kpc/h = 262.38kpc$

With R_{vir} and c_{vir} r_s could be derived:

$$r_s = \frac{R_{vir}}{c_{vir}} = 18.62kpc/h = 26.6kpc \tag{5}$$

To get the Equivalent Hernquist mass we first we have to get the ratio a

$$a = \frac{r_s}{(2f(c_{vir}))^{-1/2} - 1/c_{vir}} = 38.77kpc/h = 55.38kpc \tag{6}$$

Where $f(c_{vir}) = ln(1 + c_{vir}) - c_{vir}/(1 + c_{vir})$
Finally the Hernquist Mass is computed with:

$$M_H = \frac{M_{vir}(a/r_s)^2}{2f(c_{vir})} = 1.02E12M\odot/h = 1.45E12M\odot \tag{7}$$

1.4 Analytic:

For the analytic we derive M_H using the same procedure explained above and we get:

$M_H = 1.46E12M\odot$ and $a = 53.06kpc$.
Where we start from $Rvir = 261kpc$, $r_s = 26.47$ and $M_{vir} = 1E12M\odot$
IC

2 Initial Conditions

2.1 Orbit integration

:

The orbit of the LMC is integrated backwards analiticaly:

The initial condition for all the orbits is the actual position $(X, Y, Z) = (-1, -41, -28)kpc$ and $(vx, vy, vz) = (-57, -226, 221)km/s$

Model	x(kpc)	y(kpc)	z(kpc)	vx(km/s)	vy(km/s)	vz(km/s)
model1	40.8	241.7	-89.68	-17.31	-156.68	-8.76
model2	40.4	243.46	-84.75	-17.45	-161.62	-12.02
model3	39.75	245.96	-77.89	-17.59	-168.41	-16.84
model4	39.28	247.32	-73.32	-17.61	-172.55	-20.25
model5	37.77	251.57	-58.65	-17.69	-187.15	-32.25
model6	36.47	254.04	-47.05	-17.41	-197.12	-42.85