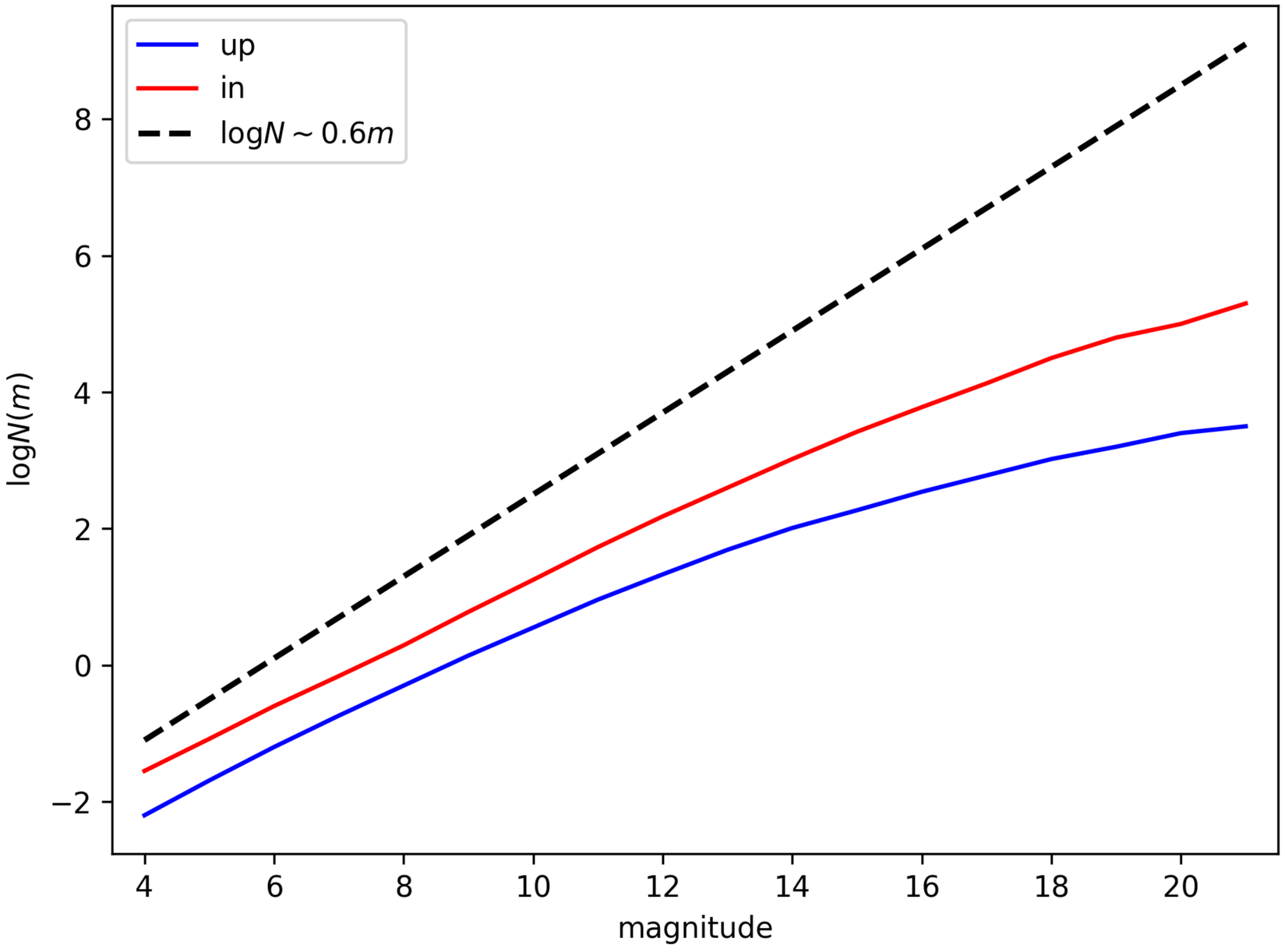
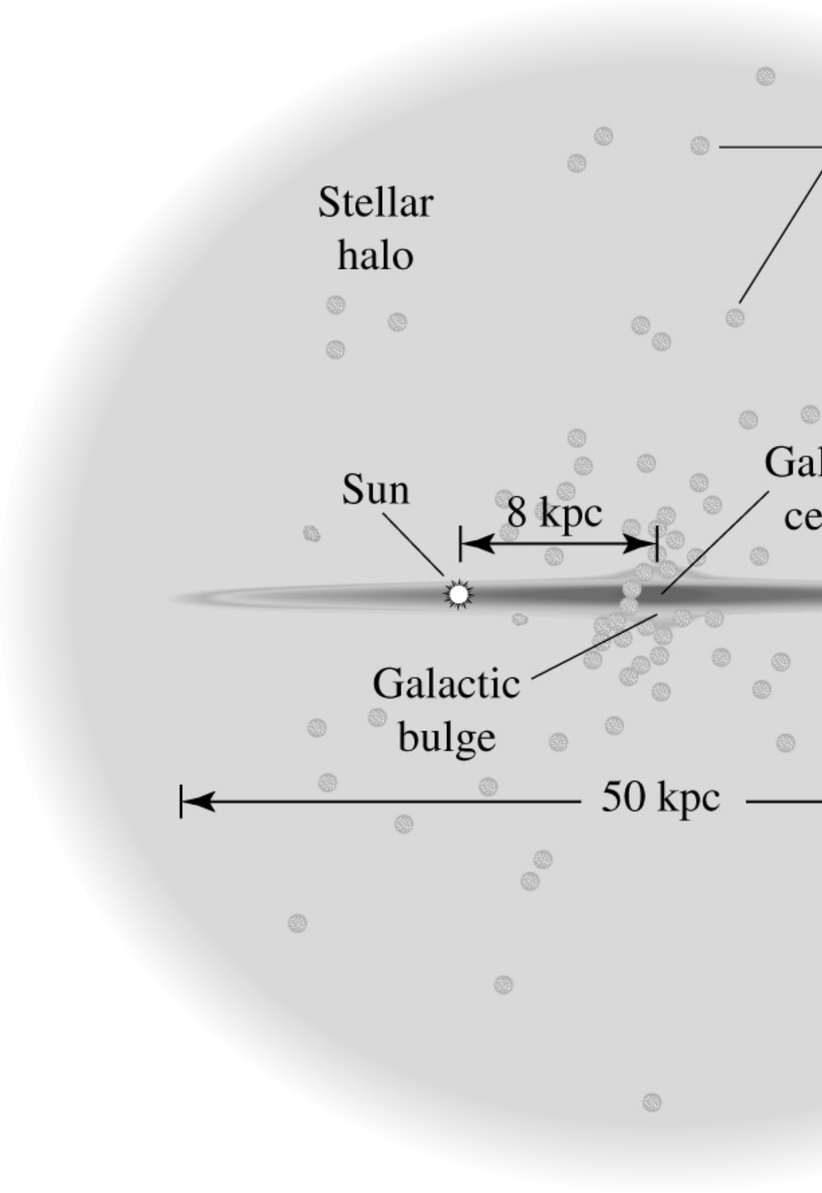
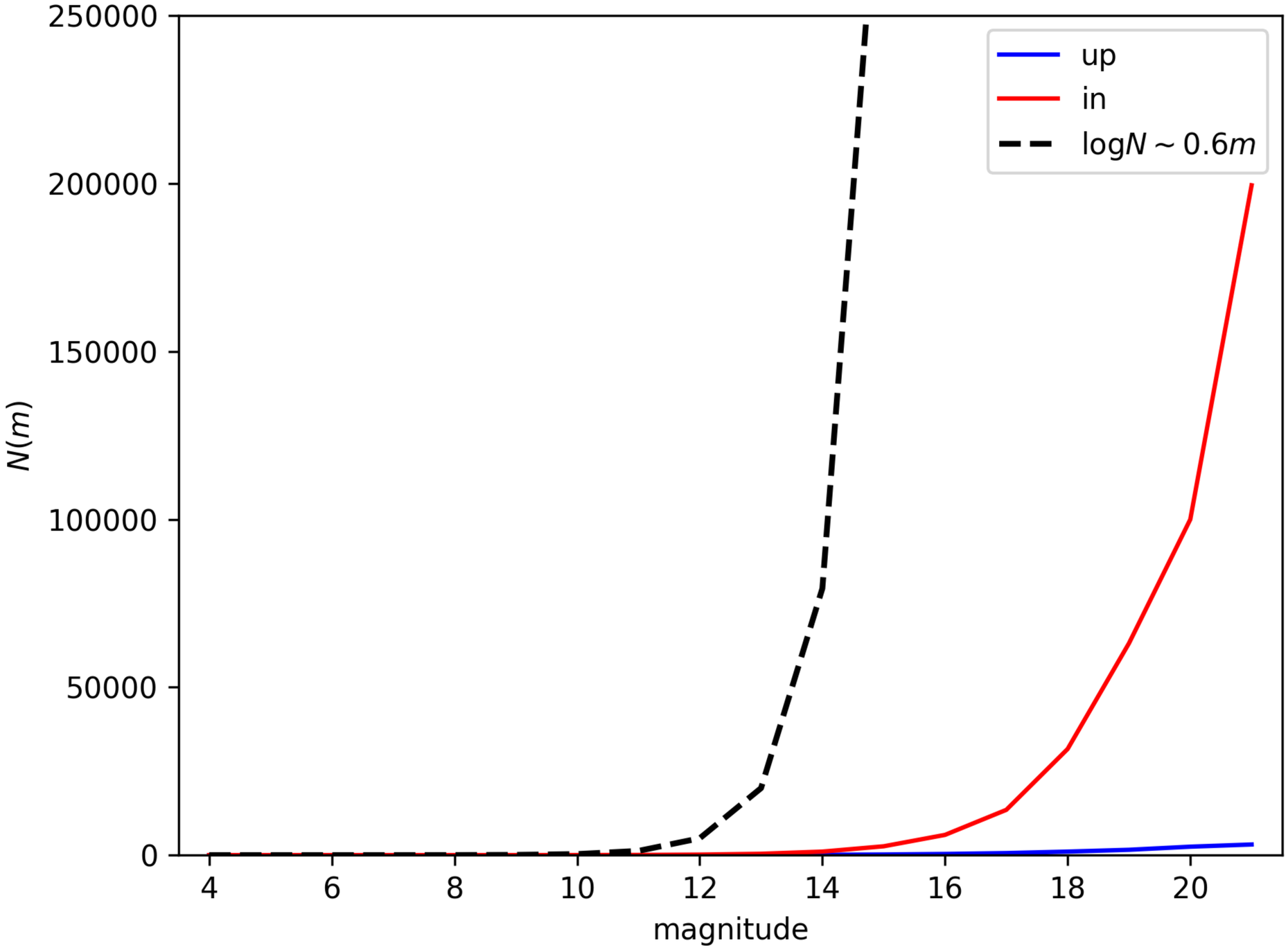
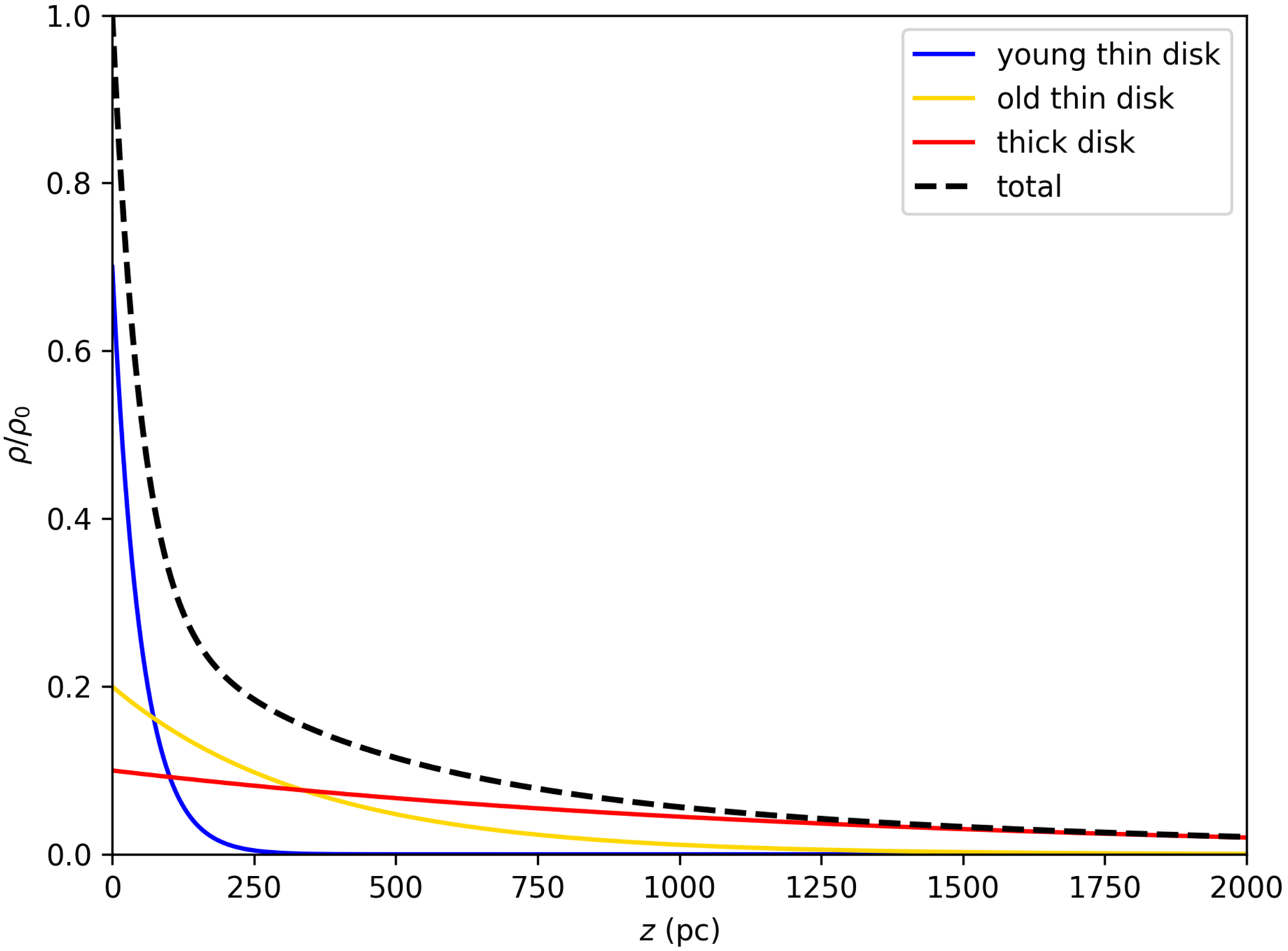
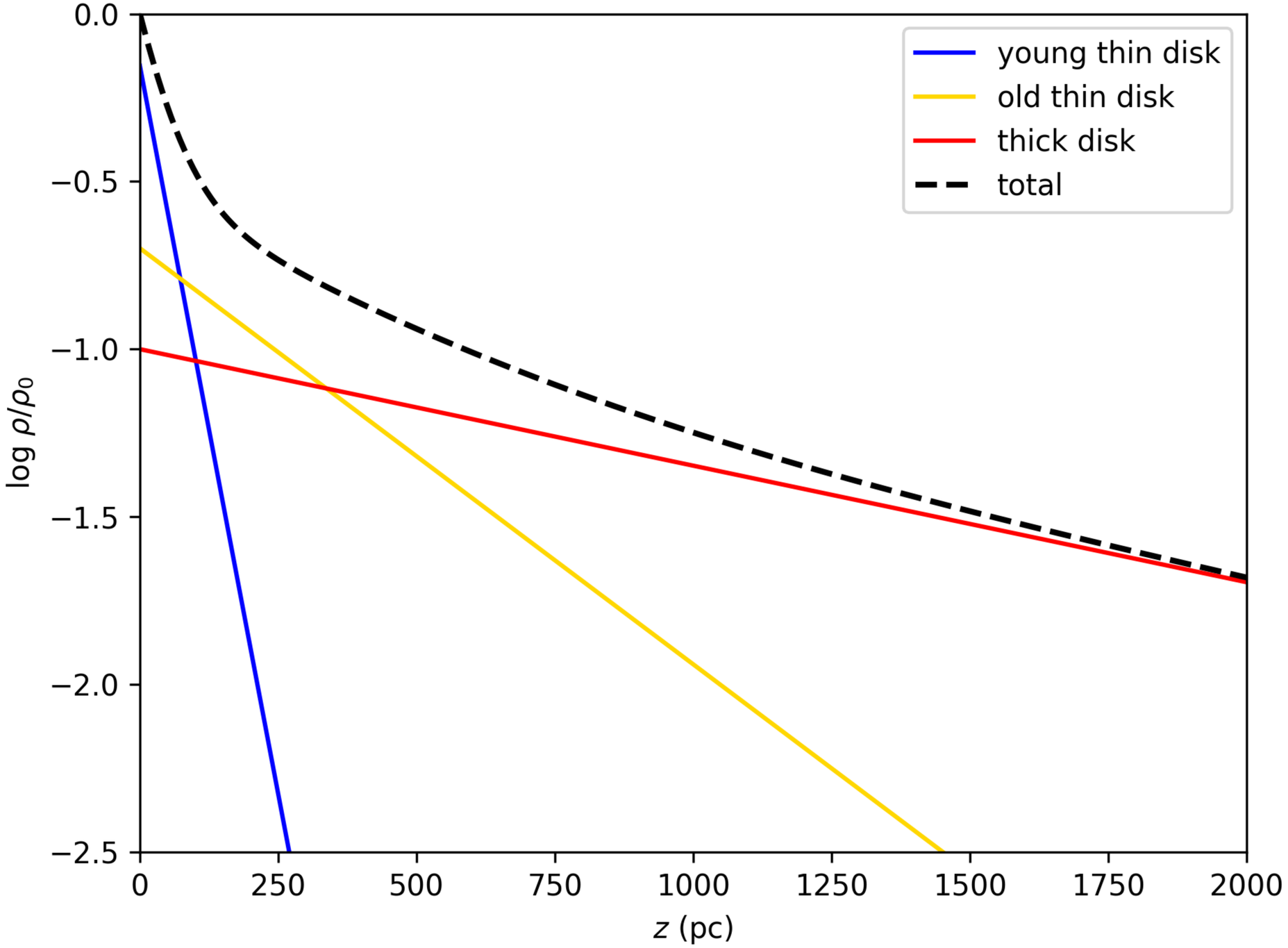
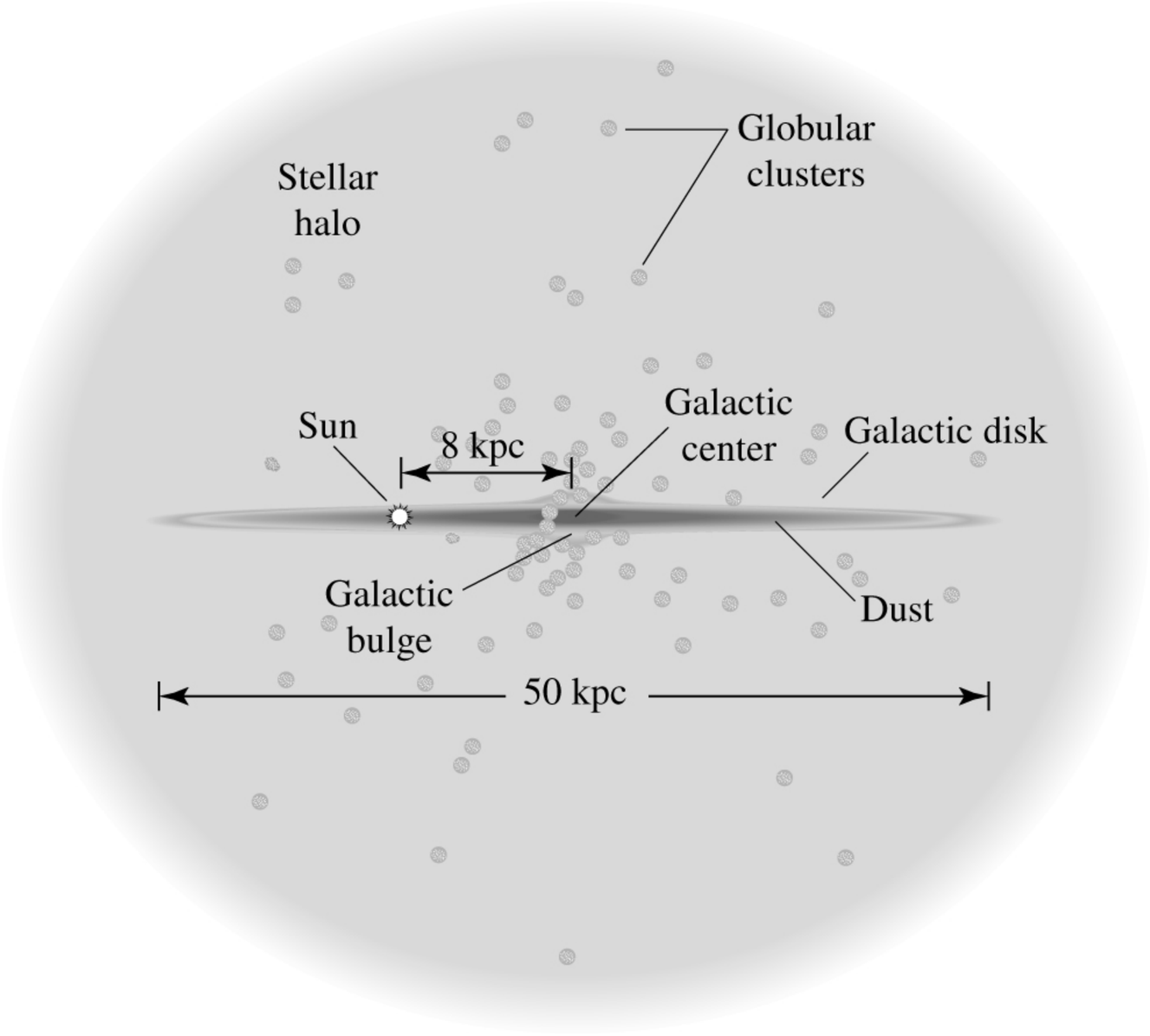

up
in
logN ~ 0.6m
8
6
4
2
0
−2
logN(m)
4
6
8
10
12
14
16
18
20
magnitude


Stellar
halo
Sun
8 kpc
Gal
ce
Galactic
bulge
50 kpc


250000
200000
150000
100000
50000
0
N(m)
4
6
8
10
12
14
16
18
20
magnitude
up
in
logN ~ 0.6m


young thin disk
old thin disk
thick disk
total
1.0
0.8
0.6
0.4
0.2
0.0
ρ/ρ_0
0
250
500
750
1000
1250
1500
1750
2000
z (pc)


young thin disk
old thin disk
thick disk
total
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
log ρ/ρ₀
0
250
500
750
1000
1250
1500
1750
2000
z (pc)



Stellar Halo

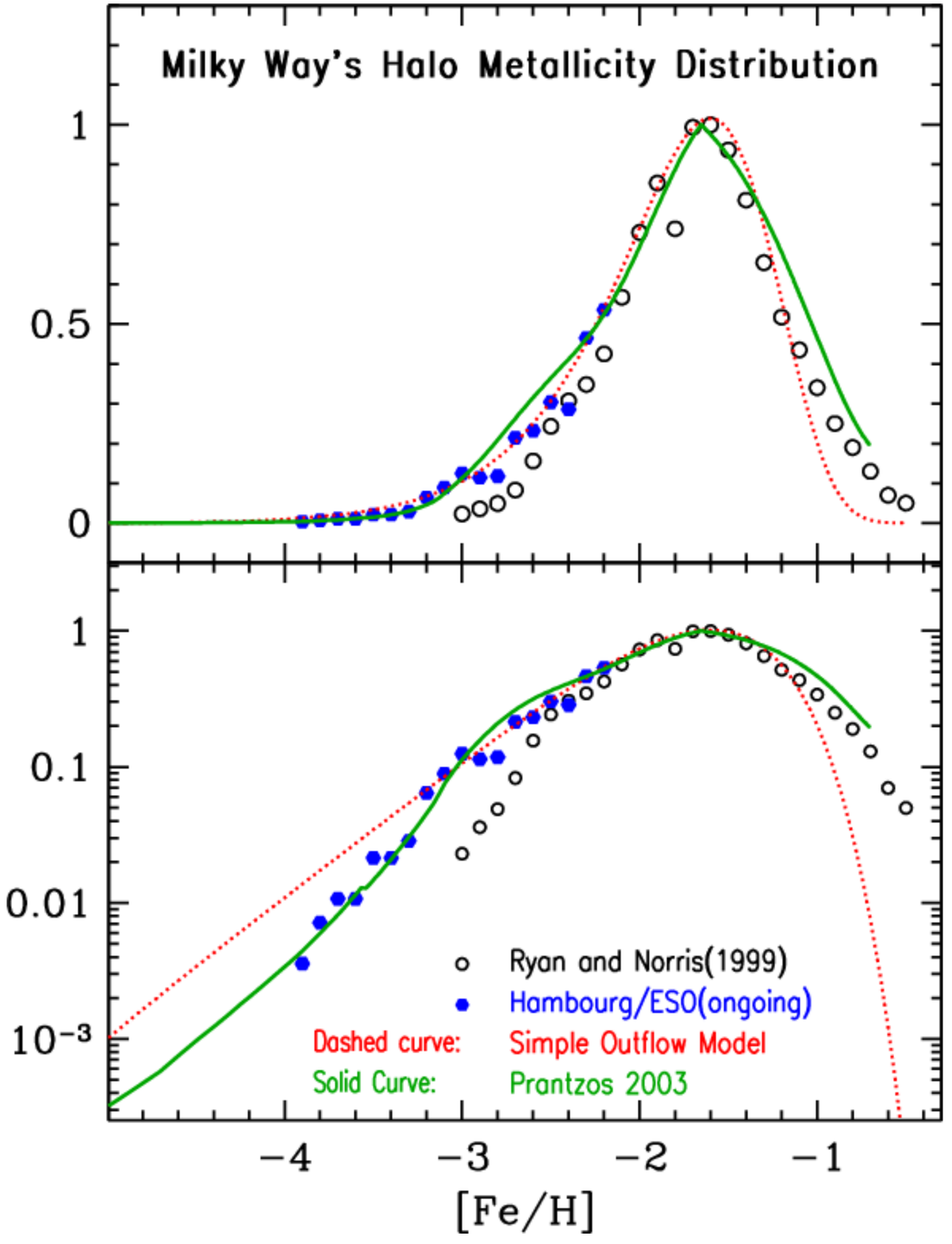
globular clusters & “field” stars

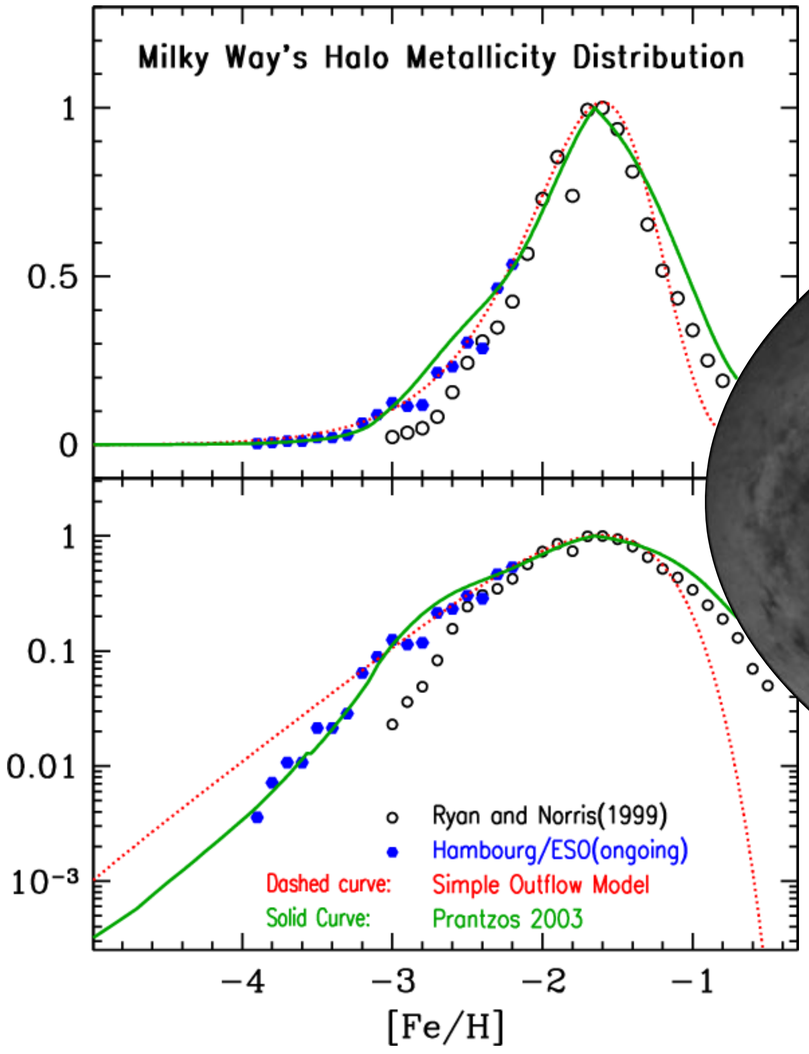
GCs ages: 9-13 Gyr
metallicities: two populations
young, metal-rich; old, MP
distribution: two populations

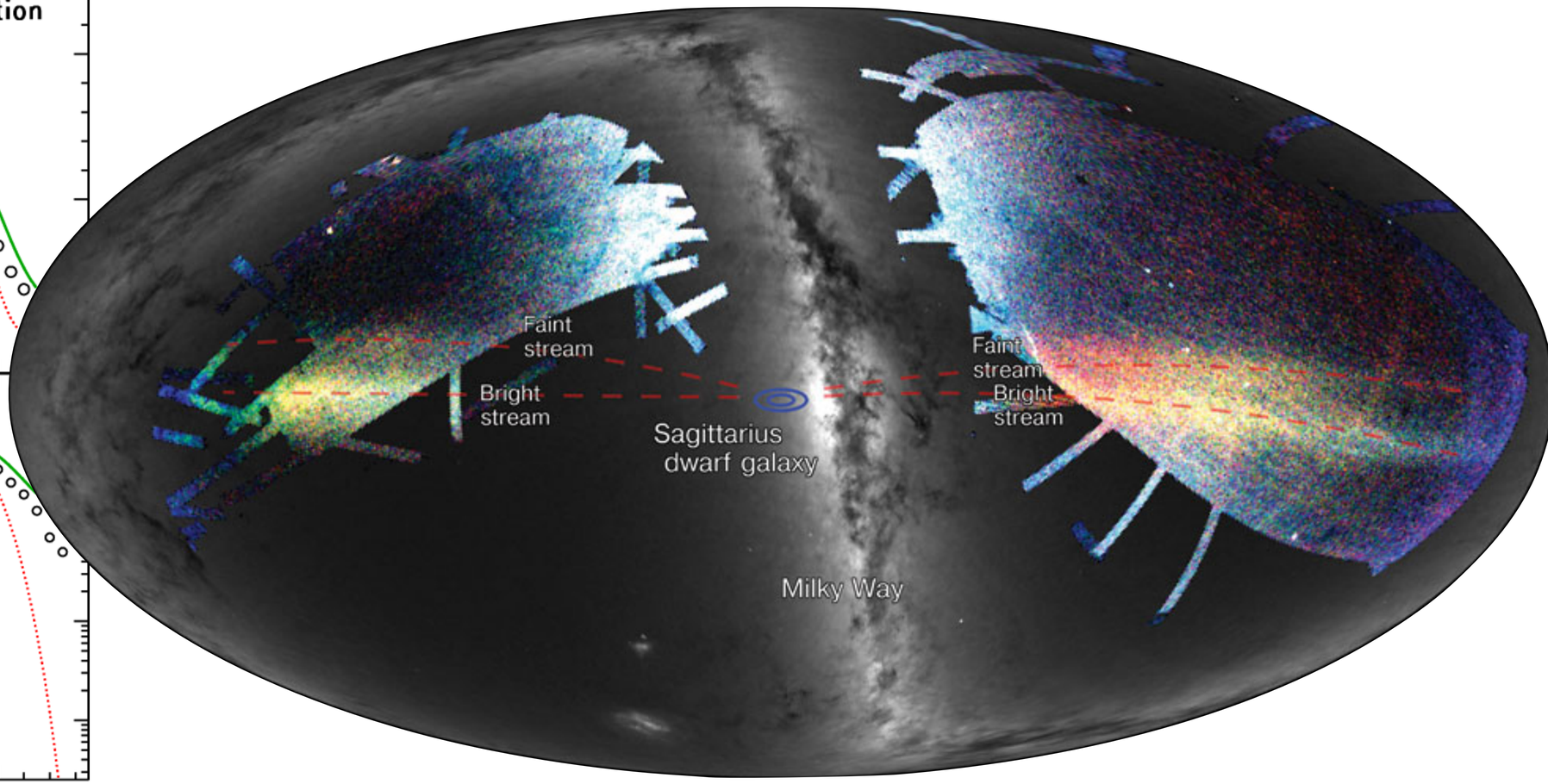
field stars: also very metal-poor
total mass = 10^8 - 10^9 M_{sun}

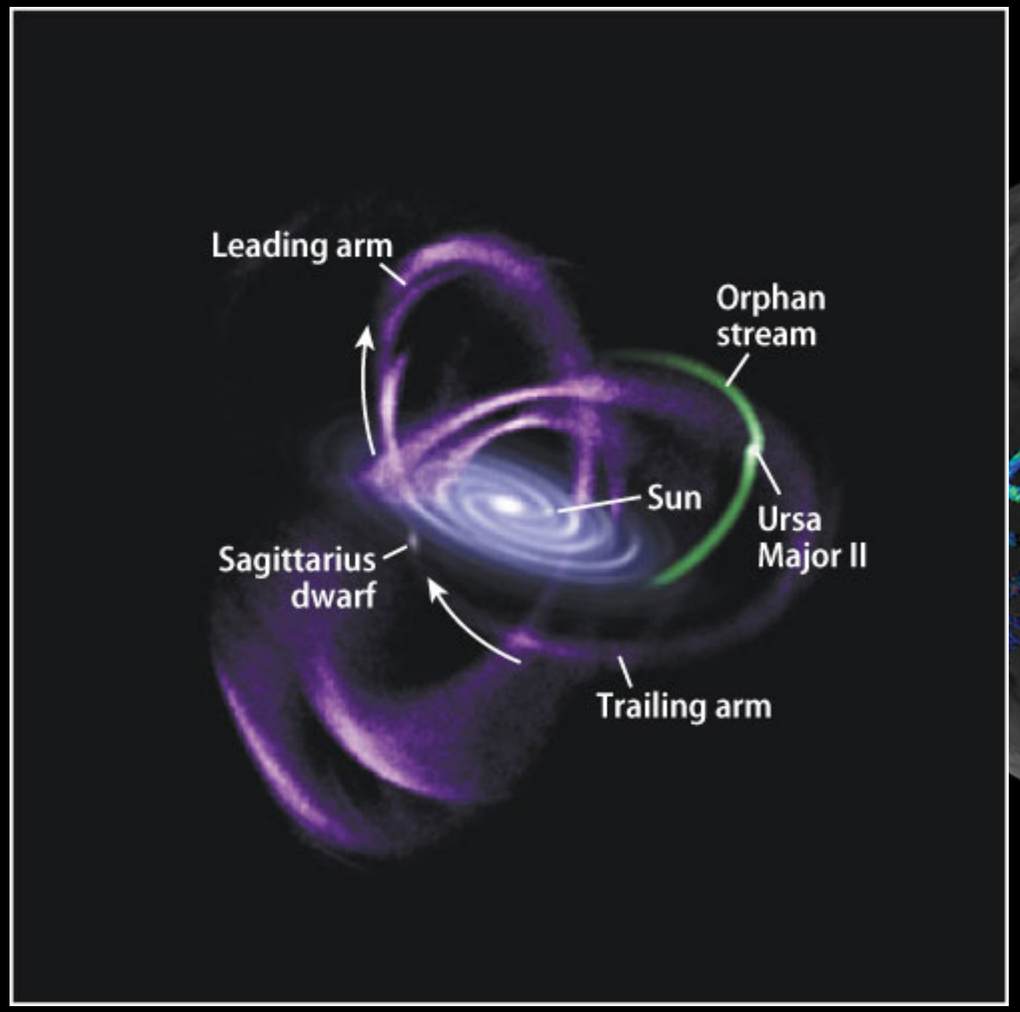
$$n(r) = n_0 r^{-3.5}$$

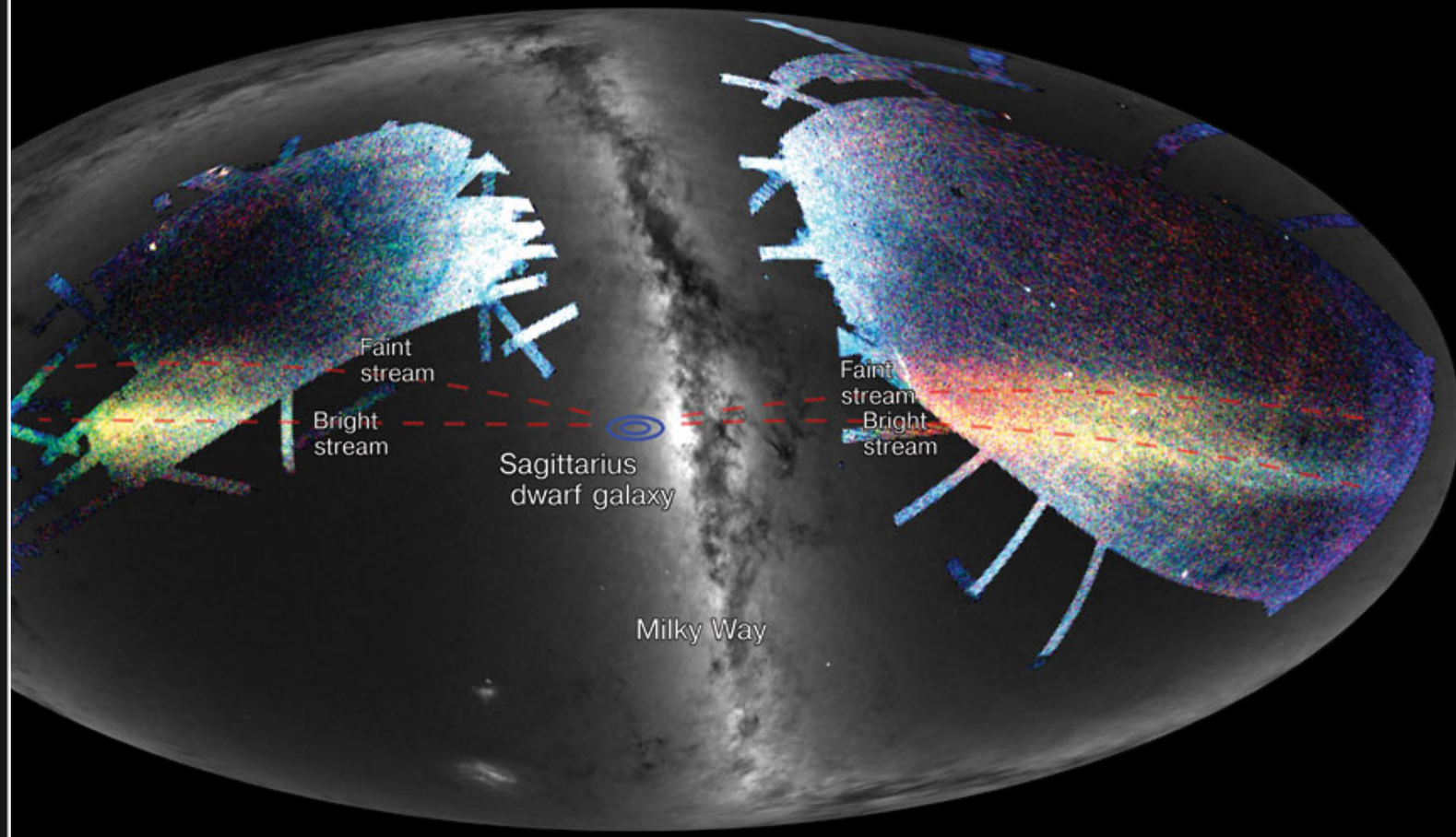
n_0 ~ 0.2% thin disk maximum

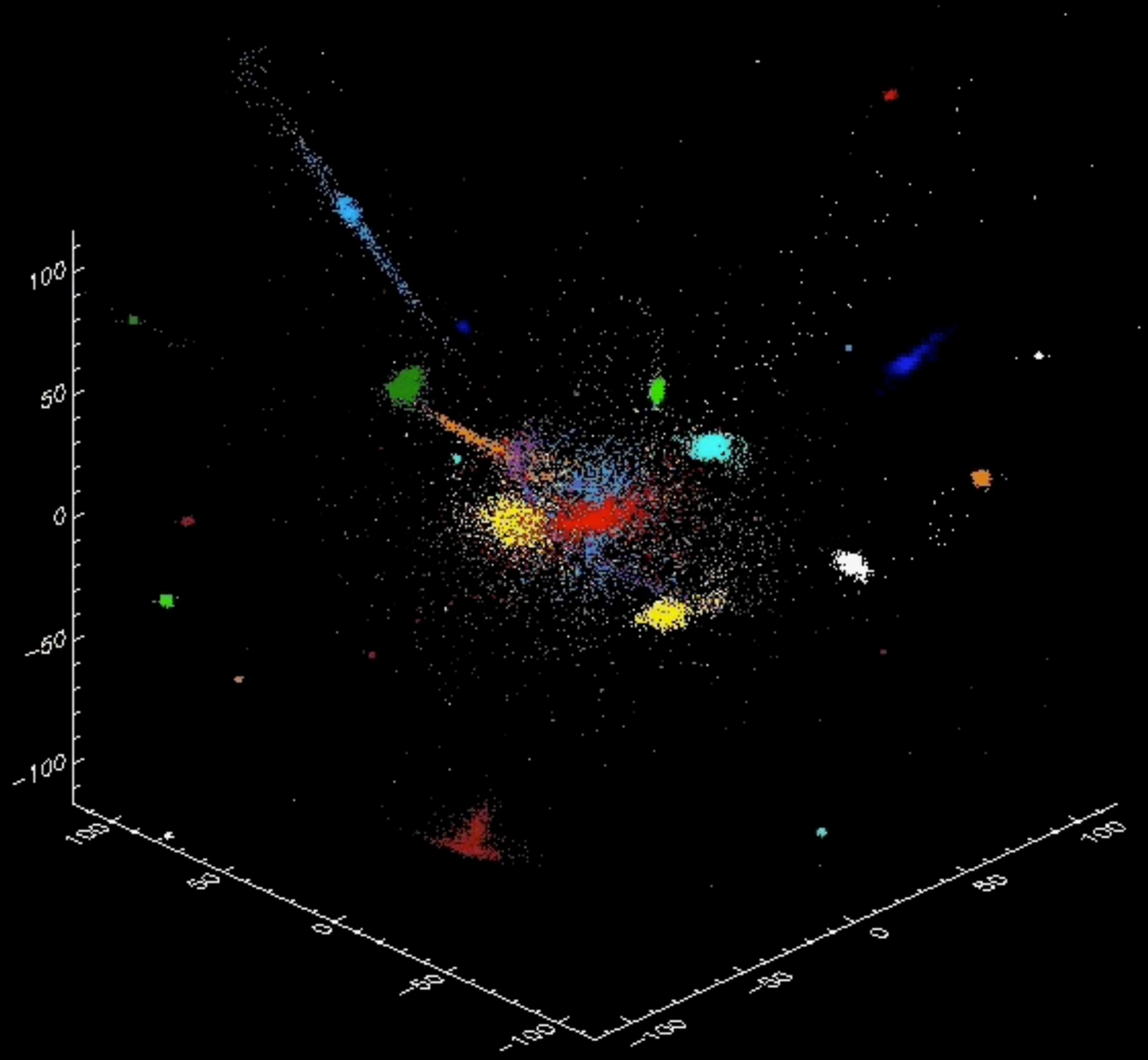

Milky Way's Halo Metallicity Distribution
1
0.5
0
1
0.1
0.01
10^{-3}
Ryan and Norris(1999)
Hambourg/ESO(ongoing)
Dashed curve: Simple Outflow Model
Solid Curve: Prantzos 2003
−4
−3
−2
−1
[Fe/H]

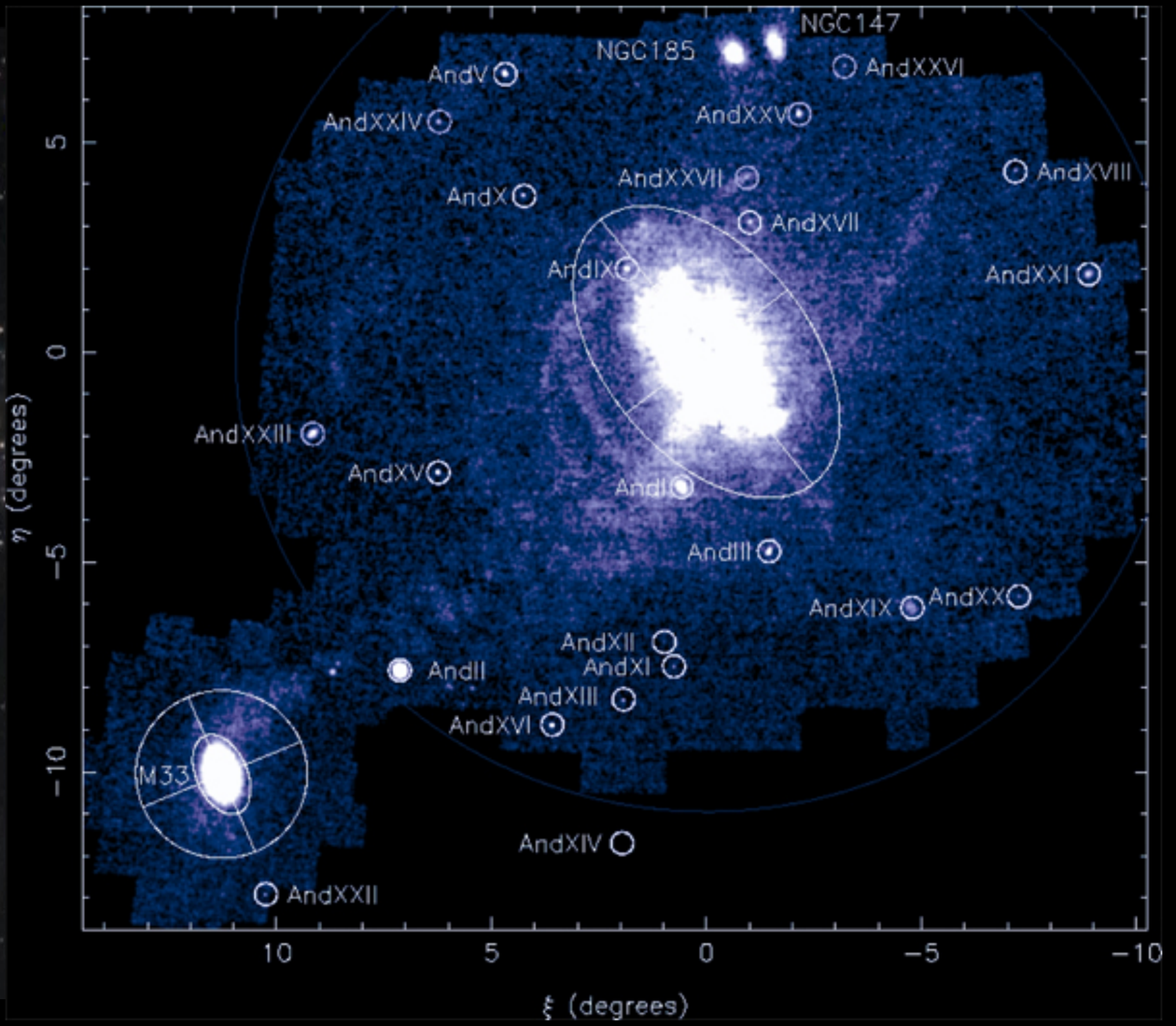

Milky Way's Halo Metallicity Distribution
1
0.5
0
1
0.1
0.01
10^{-3}
−4
−3
−2
−1
[Fe/H]
Ryan and Norris(1999)
Hambourg/ESO(ongoing)
Dashed curve: Simple Outflow Model
Solid Curve: Prantzos 2003


Faint stream
Bright stream
Sagittarius dwarf galaxy
Faint stream
Bright stream
Milky Way


Leading arm
Orphan stream
Sun
Ursa Major II
Sagittarius dwarf
Trailing arm


Faint stream
Bright stream
Sagittarius dwarf galaxy
Faint stream
Bright stream
Milky Way


100
50
0
-50
-100
-100
-50
0
50
100
-100
-50
0
50
100


NGC147
NGC185
AndV
AndXXVI
AndXXIV
AndXXV
AndXXVII
AndXVIII
AndX
AndXVII
AndIX
AndXXI
AndXXIII
AndXV
AndI
AndIII
AndXIX
AndXX
AndXII
AndXI
AndII
AndXIII
AndXVI
M33
AndXIV
AndXXII
5
0
−5
−10
η (degrees)
10
5
0
−5
−10
ξ (degrees)

How do we describe the motion of the Sun?

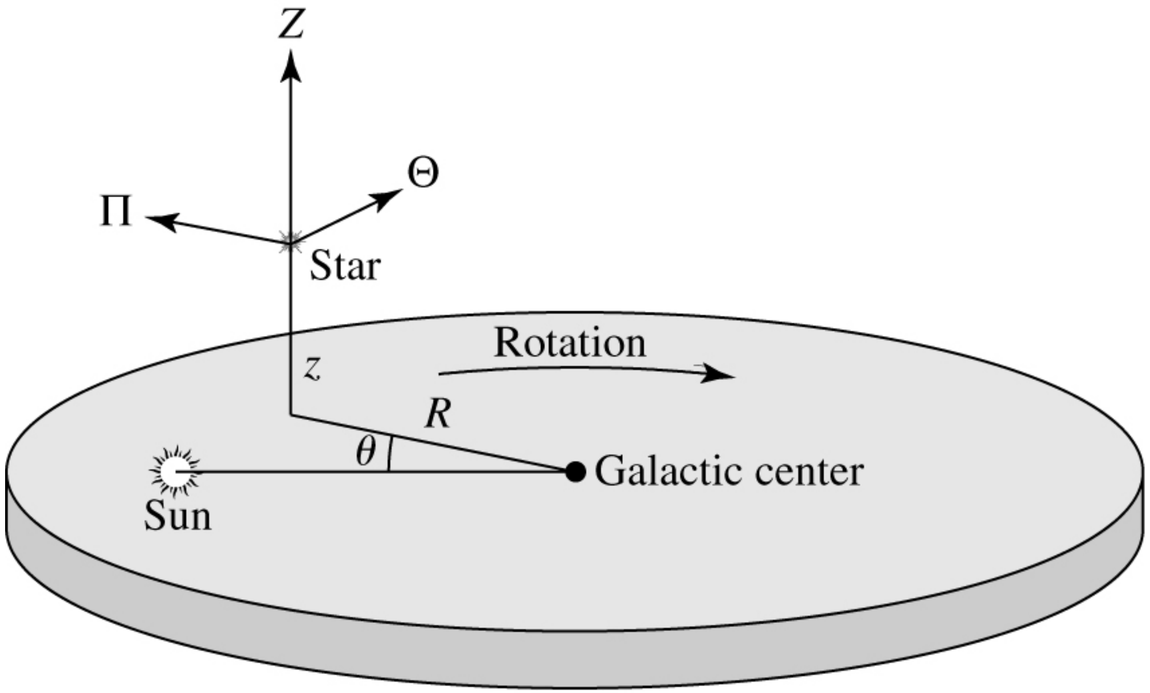
How would we even know the Sun IS moving?

If it is, how fast?

Hint: most stars have a small relative v ~ 30 km/s

metal-poor halo stars have high v ~ 200-250 km/s

The Local Standard of Rest (LSR)



Position coordinates:

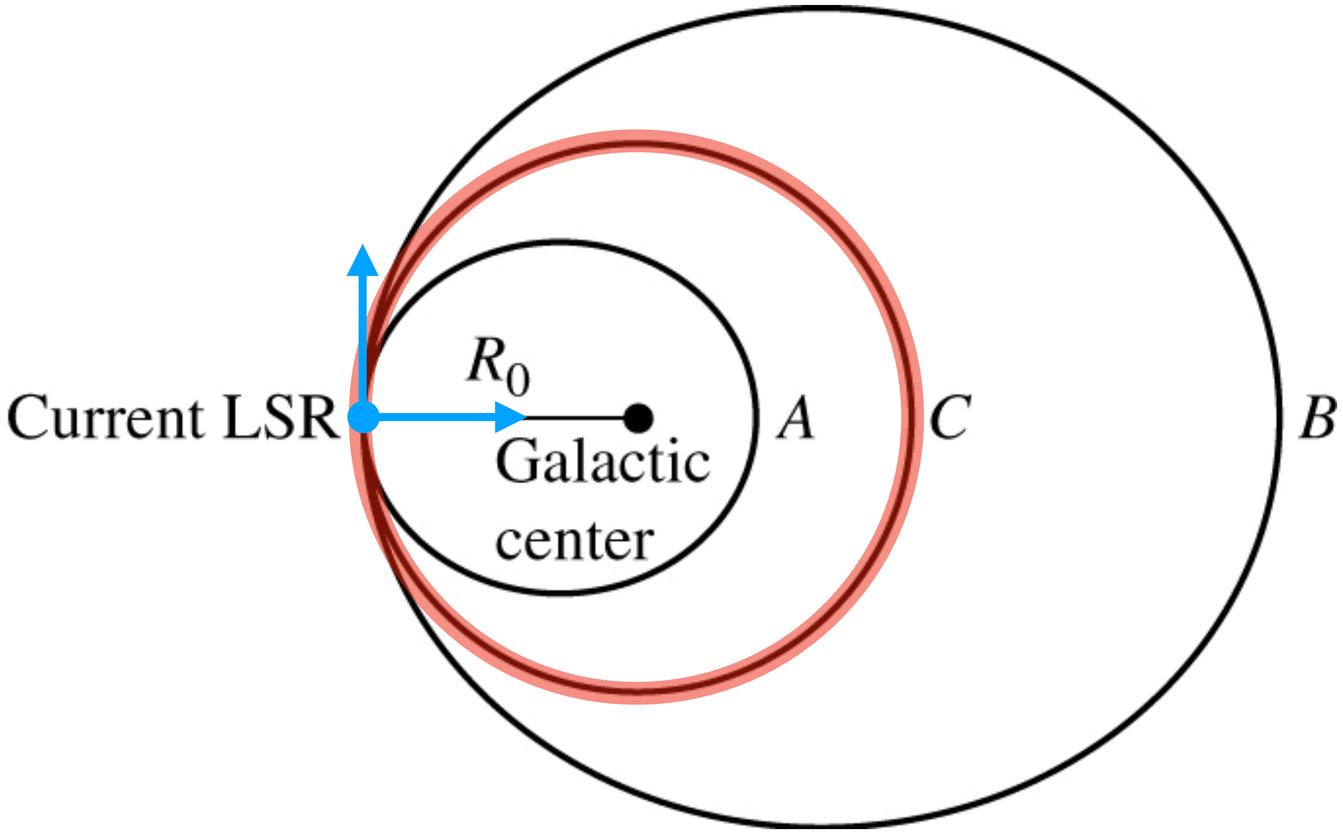
R = radius
θ = angle around Galaxy
z = distance from plane of disk

Velocity coordinates:

Π = radial velocity
Θ = tangential velocity
Z = up/down velocity

$$(\Pi, \Theta, Z) = (0, V_{circ}, 0) \qquad V_{circ} = \sqrt{\frac{GM}{R}}$$

LSR: define a point in space that is moving on a perfectly circular orbit around the Galactic center at the Radius of the Sun



note: the LSR is NOT the Sun's orbit!!

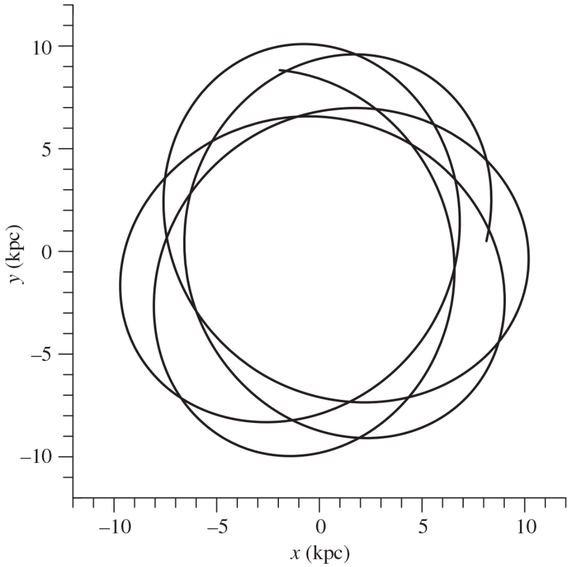
What are (u,v,w) for orbits A,B,C?

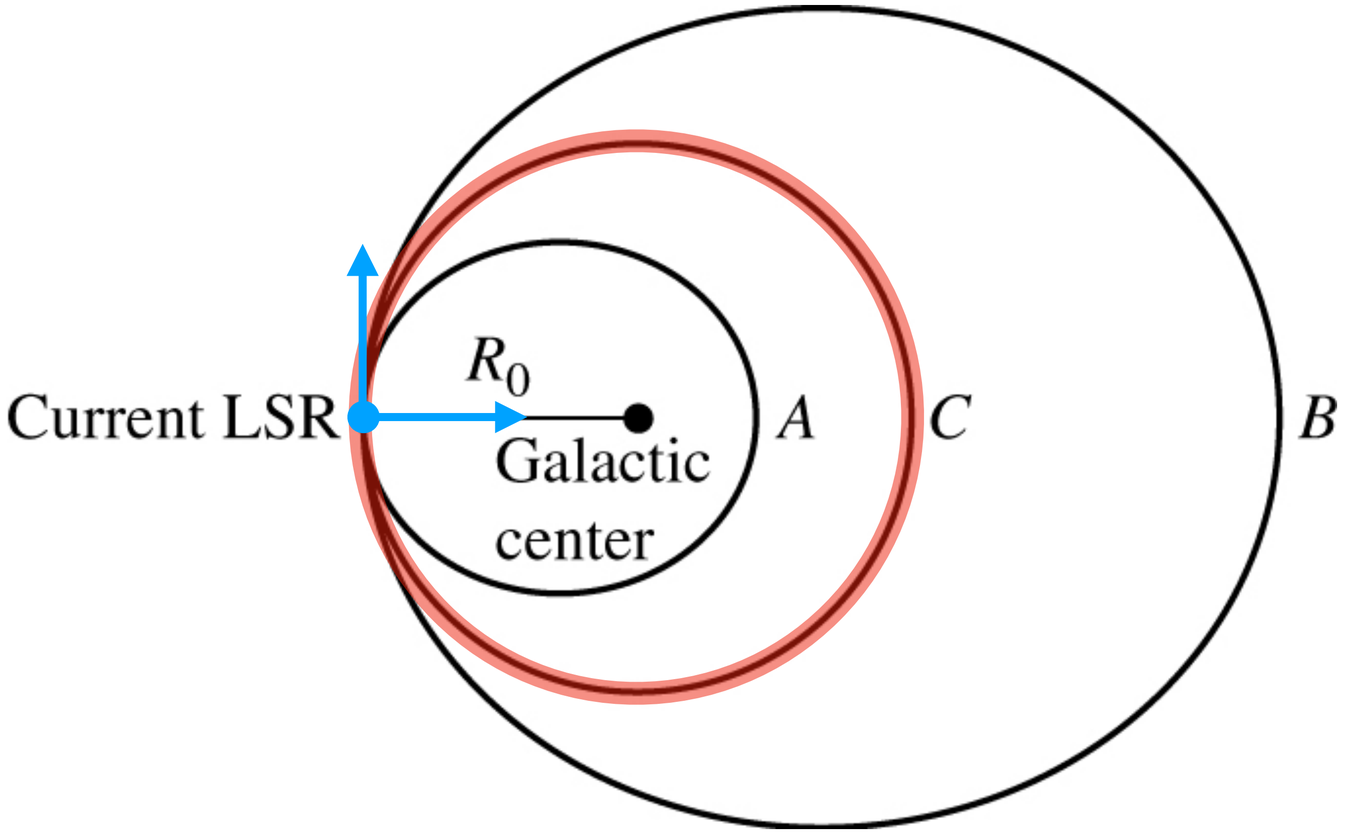
LSR definition

$$(\Pi, \Theta, Z) = (0, V_{circ}, 0)$$

What we really see…

$$(u, v, w) = (\Pi, \Theta - V_{circ}, Z)$$





LSR definition

$$(\Pi, \Theta, Z) = (0, V_{circ}, 0)$$

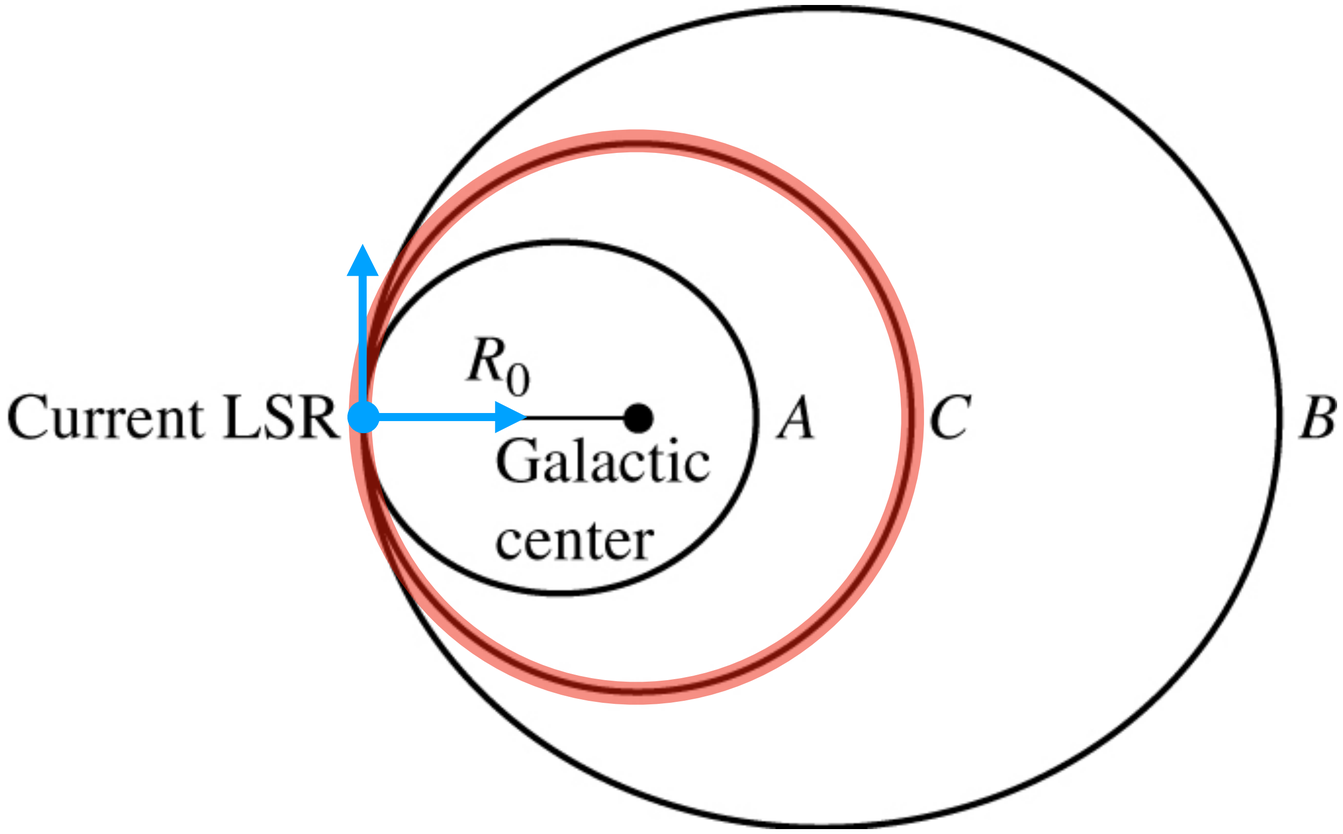
What we really see…

$$(u, v, w) = (\Pi, \Theta - V_{circ}, Z)$$

A: star at apogalacticon, ***v < 0***, “lag”

B: star at perigalacticon, ***v > 0***, “lead”

C: star on circular orbit = LSR, ***v = 0***



LSR definition

$$(\Pi, \Theta, Z) = (0, V_{circ}, 0)$$

What we really see…

$$(u, v, w) = (\Pi, \Theta - V_{circ}, Z)$$

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B: star at perigalacticon, ***v > 0***, “lead”

C: star on circular orbit = LSR, ***v = 0***

Sun : (*u, v, w*) = (-10, 5, 7) km/s

Wait, how do we measure this??