2016.05.11 astro-ph seminar (担当　大橋)

THE CONNECTION BETWEEN THE HOST HALO AND THE SATELLITE GALAXIES OF THE MILKY WAY

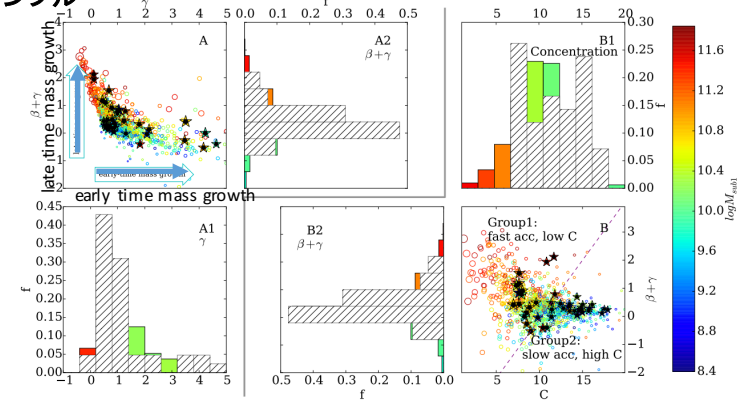
Yu Lu et al. 2016, arXiv 1605.02075

ABSTRACT

Many properties of the Milky Way's dark matter halo, including its mass assembly history, concentration, and subhalo population, remain poorly constrained. We explore the connection between these properties of the Milky Way and its satellite galaxy population, especially the implication of the presence of the Magellanic Clouds for the properties of the Milky Way halo. Using a suite of high-resolution N-body simulations of Milky Way-mass halos, we find that the presence of Magellanic Cloud-like satellites strongly correlates with the assembly history, concentration, and subhalo population of the host halo, such that Milky Way-mass systems with Magellanic Clouds have lower concentration, more rapid recent accretion, and more massive subhalos than typical halos of the same mass. Using a flexible semi-analytic galaxy formation model that is tuned to reproduce the stellar mass function of the classical dwarf galaxies of the Milky Way with Markov-Chain MonteCarlo, we show that adopting host halos with different mass-assembly histories and concentrations can lead to different best-fit models for galaxy-formation physics, especially for the strength of feedback. These biases arise because the presence of the Magellanic Clouds boosts the overall population of high-mass subhalos, thus requiring a different stellar-mass-to-halo-mass ratio to match the data. These biases also lead to significant differences in the mass–metallicity relation, the kinematics of low-mass satellites, and the number counts of small satellites associated with the Magellanic Clouds. Observations of these satellite properties can thus provide useful constraints on the properties of the Milky Way halo.

ー LMC, SMCはMW sizeのhaloのsatelliteとしては異常に重い
ー ミレニアムシミュレーションでは、MW sizeのhaloがMCsをsatelliteとして持つ確率は2.5% (Boylan-Kolchin+11)
ー DMのN体シミュレーションを用いて、MW size haloのassembly historyの違いによるsatelliteの違いを調べた
ー Lu+11のSAMでhalo massからstellar massを算出
ー モンテカルロシミュレーションを用いて、MW size haloのsatelliteのstellar mass function, metallicityなどを調べた

①サンプル



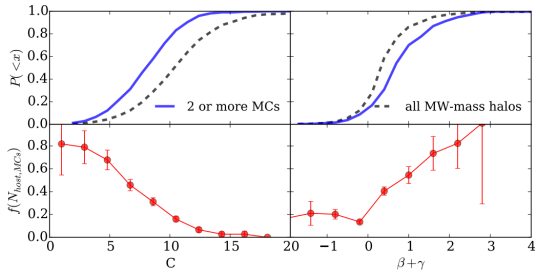
Group 1:
fast-time mass growth, low c
Group 2 :
early-time mass growth, high c

★: MW mass halo

mass accretion history model : $\frac{d \log M}{dz} = -\left(\frac{\beta}{1+z} + \gamma\right)$

concentration parameter : c

②MCs

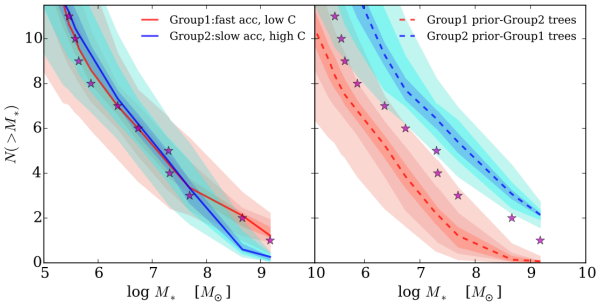


質量の中心集中度cが小さく、haloの質量獲得の時期の遅いhaloで、MCsを持つ可能性が高い

③MCs以外のsatellite

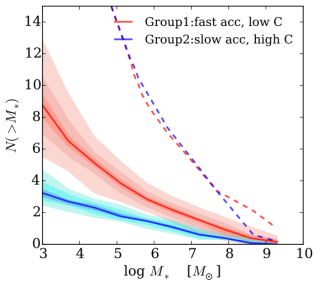
N体シミュレーションで得られた各MW size haloのsatelliteについて、質量が上位11のものを用いてモンテカルロシミュレーション

③-1 satelliteのstellar mass function



ー satelliteのstellar mass functionは観測値と一致
ー Group1(2)のhaloの種にGroup2(1)のmerger treeを適用する?と、観測値と大きくずれてしまう

③-2 LMCのsatellite



ー group 1とgroup2で"LMC"のsatelliteのmassが違うのは、単に"LMC"のmassが違うから
ー LMCのsatelliteが確定していないため、観測との比較はまだできない

結論
・MCsを有するMWは中心集中度が小さく、mass assemblyがの時期が遅いと考えられる

future work
・MWの外縁部(~50kpc)での回転速度の観測→中心集中度を決める
・LMCのsatelliteのmass function決め (Dark Energy Surveyが現在進行中)