What might WINGS See?

(WFIRST Nearby Galaxies Survey)

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Abstract

Three aims of a WINGS study of stellar halos are: (i) to look at the global properties of the halos (e.g. radial profile and total content); (ii) to find and interpret structures that are signatures of accretion histories (including luminosity functions, merger rates and orbits); (iii) to find features at widest possible separations in constrain the distribution of dark matter. For all of the above purposes, the halos should be observed to the greatest radial extent possible. The extent to which this is possible or interesting will depend on expected densities of the stellar halos as well as contamination by background galaxies at faint magnitudes. This study "observes" the Bullock/Johnston stellar halo models as a guide for expectations.

Methods

- The stellar halo models used are made from superposed N-body simulations of individual satellite disruption events (Bullock & Johnston 2005) with the particles painted with stellar populations (Robertson et al 2005, Font et al 2006). Accretion histories are drawn from LCDM cosmology. Satellite properties are chosen such that any surviving satellites' structures and populations look like Local Group dwarfs
- Mock stellar halo catalogues for our anaylses are generated from the full stellar halo models using Galaxia (Sharma et al 2013). Stars are generated for each halo out to radial separations of 300 Kpc.
- For this poster, all the halos are observed at distance D=4Mpc from one assumed line-of-sight and keeping only stars brighter than apparent magnitude h158=27.12, (slightly less than 1 magnitude brighter than the horizontal branch).
- Our "observed" models each contain of order several million stars.

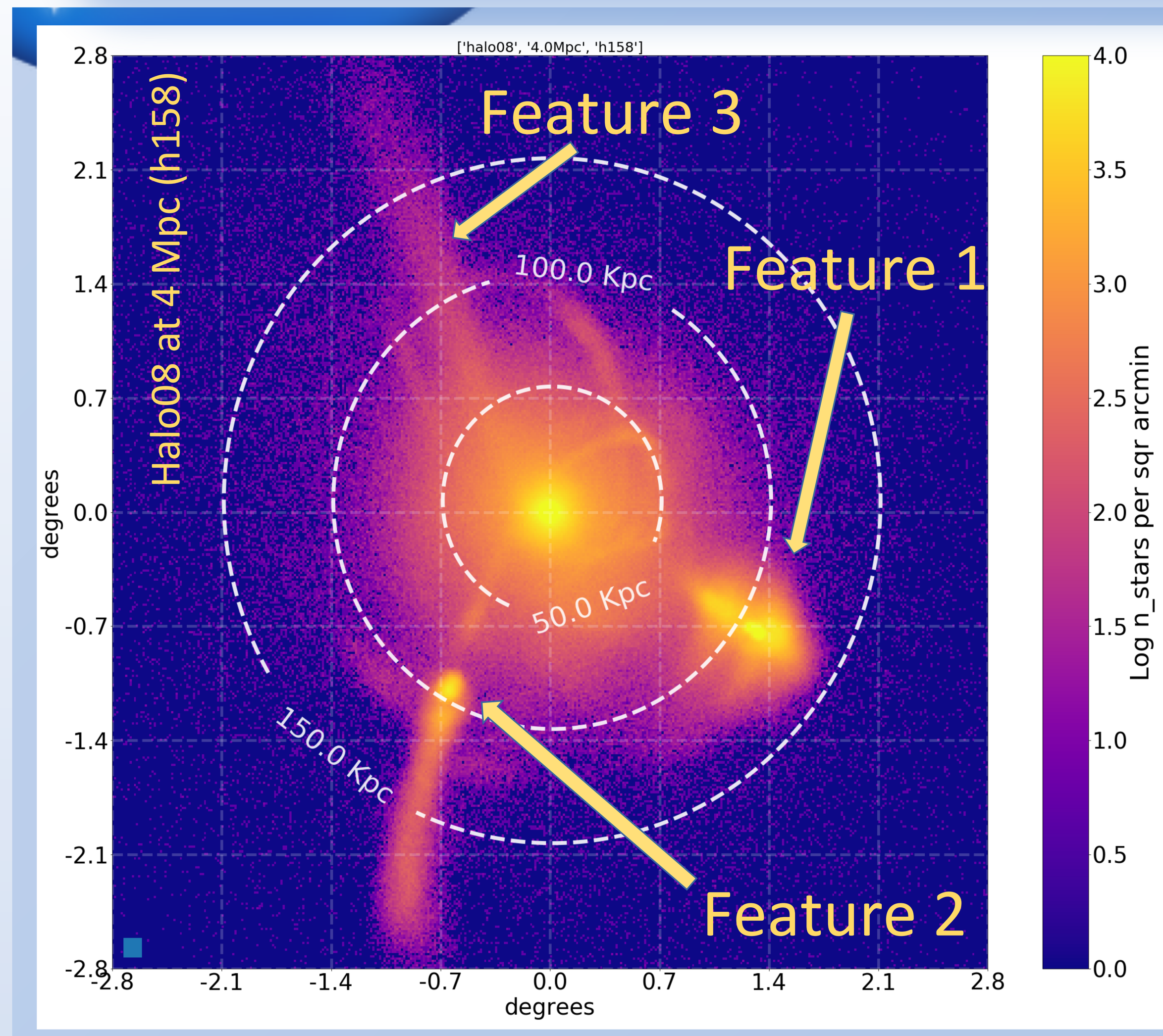

Figure 1:
Projected star count map for Halo 8.

The map is richly structured, in particular at projected separations greater than 50kpc.

Features as dense as 1000/100 stars/ arcmin^2 still exist at separation as large as 100/150 kpc

It will be useful for WFIRST to map stellar halos to large projected separations where distinct features can be identified and interpreted in terms of accretion events.

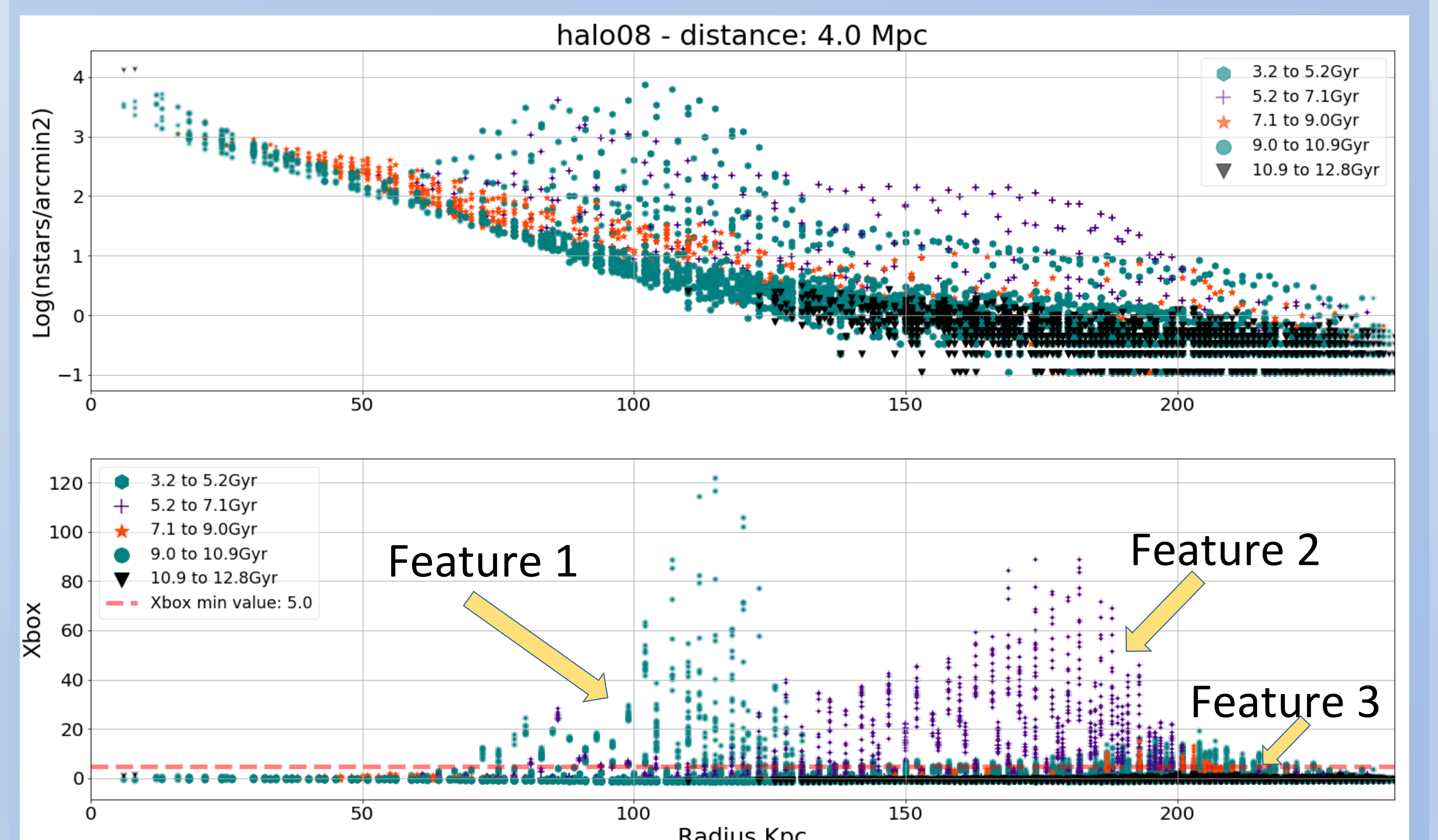

Figure 2 top: Star count values for boxes in Figure 1 color coded by the most common accretion time of stars in each box.
The features highlighted in Figure 1 correspond to more recently accreted objects.
Figure 2 bottom: Xbox= fractional fluctuations around the mean star counts at each radius (calculated for boxes in figure 1 in 10% radial annulus centered on each box).
The largest deviations from the mean are found at larger radii.

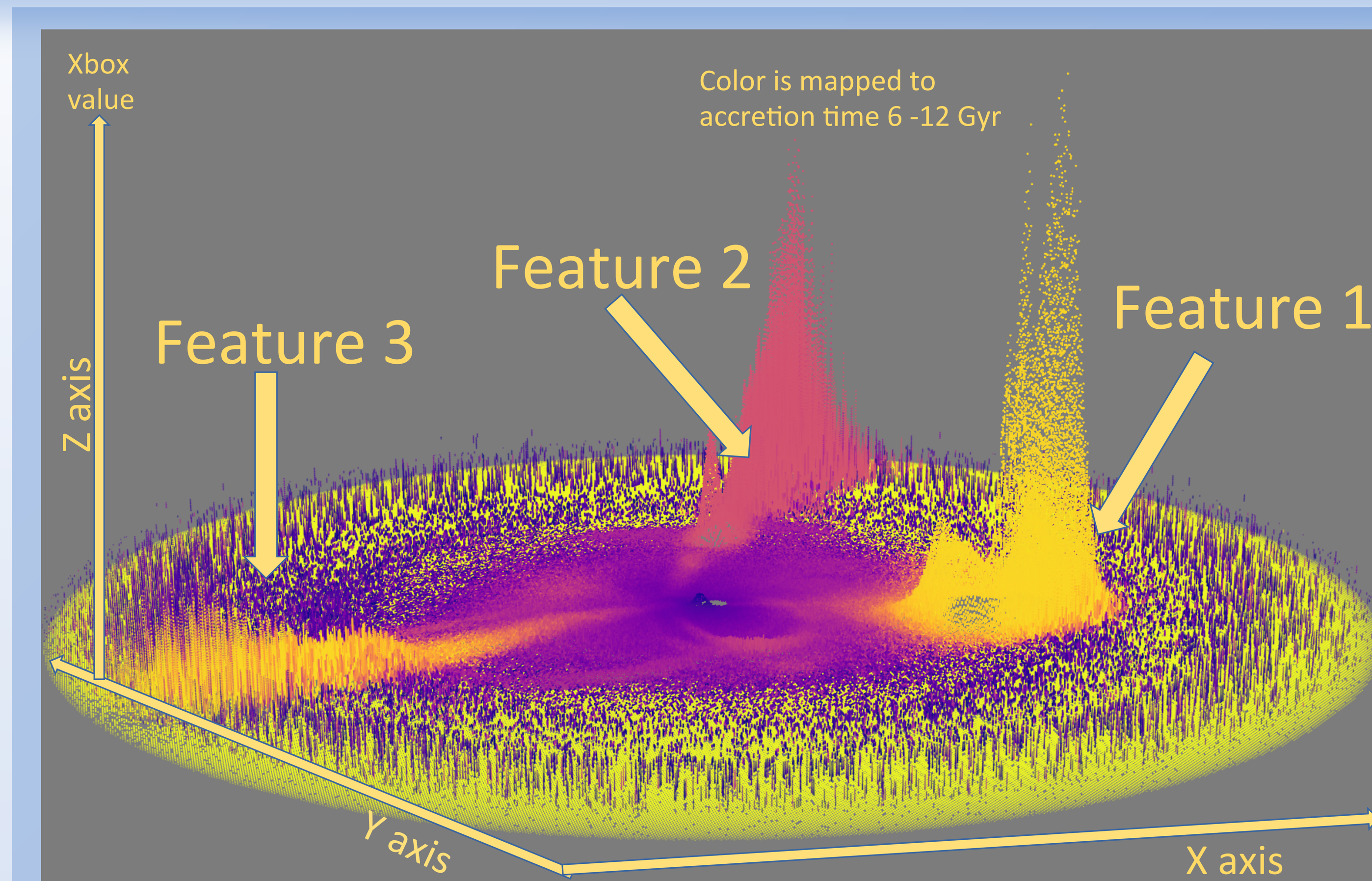

Figure 3:
Map of Xbox (= fractional fluctuations around the mean star counts at each radius).

Adopting a minimum of Xbox=5 cleanly isolated features at large radius.

All three features identified with Xbox > 5 have > 99% of their stars coming from a single satellite

<u>=>Features at large separation will be particularly useful potential probes.</u>

Summary of results for all 11 halos

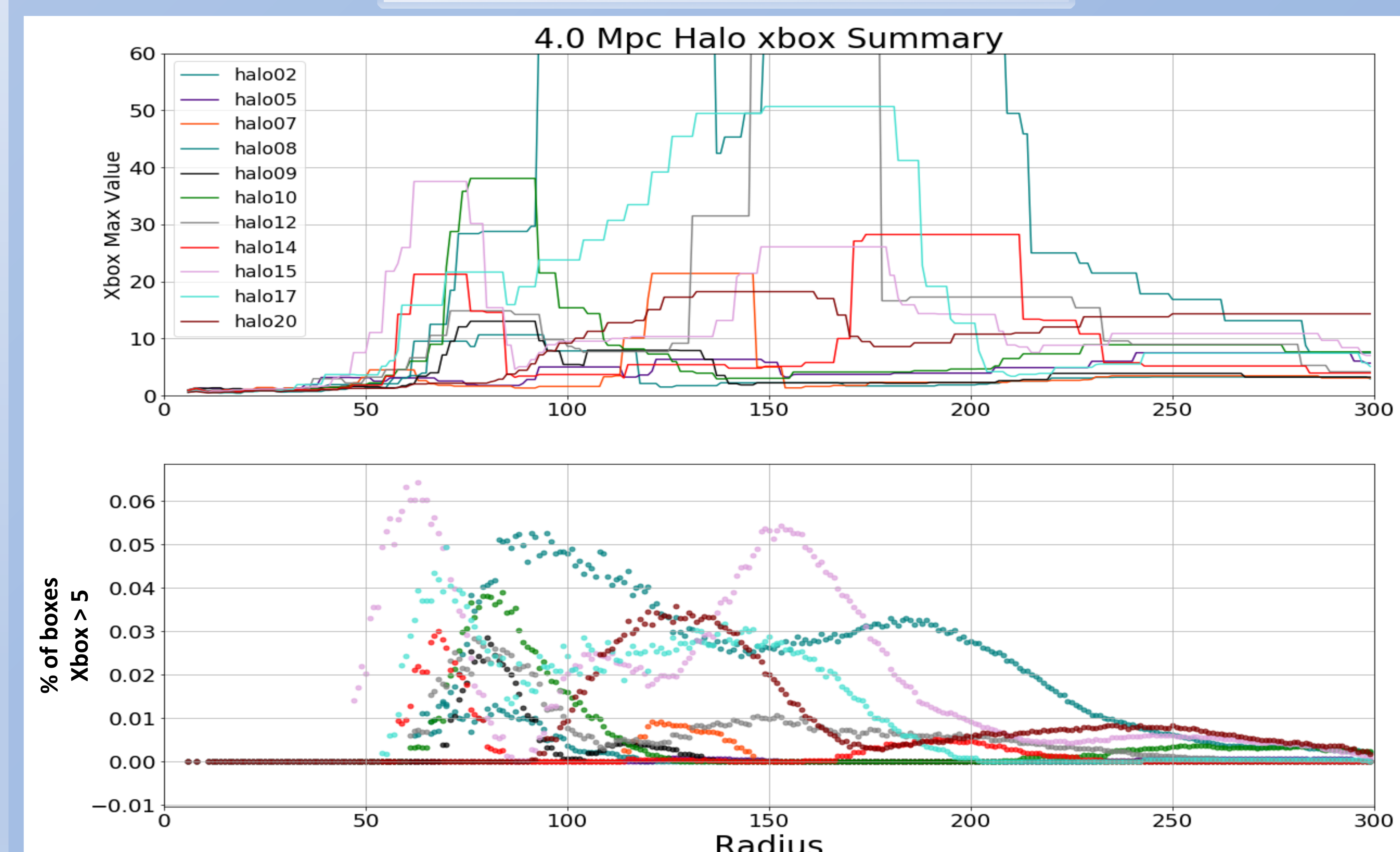

Figure 4 top: Maximum star counts at each radius for all 11 halos.
Figure 4 middle: Maximum Xbox values for all 11 halos.
Figure 4 bottom: Annular filling factor of features with Xbox > 5 at each radius for all 11 halos (calculated for the 10% annulus in radius for each box).
While halo 8 has particularly spectacular results, all 11 halos show interesting and significant structure filling several percent of each annulus at separations out to 150-200kpc

Further work

- Statistical analysis of the frequency, significance and scales of features at different projected separations
- How are these observed properties of individual features related to properties of the satellites that formed them?
- How are their distributions related to accretion histories, luminosity functions and orbit distributions?
- How can WINGS be designed (integration time, angular and radial coverage of each galaxy, number and scales of galaxies observed) to maximize its impact?

Acknowledgements

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