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Predictably Missing Satellites: Subhalo Abundance in Milky Way-like Halos

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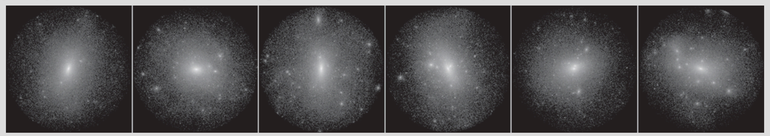
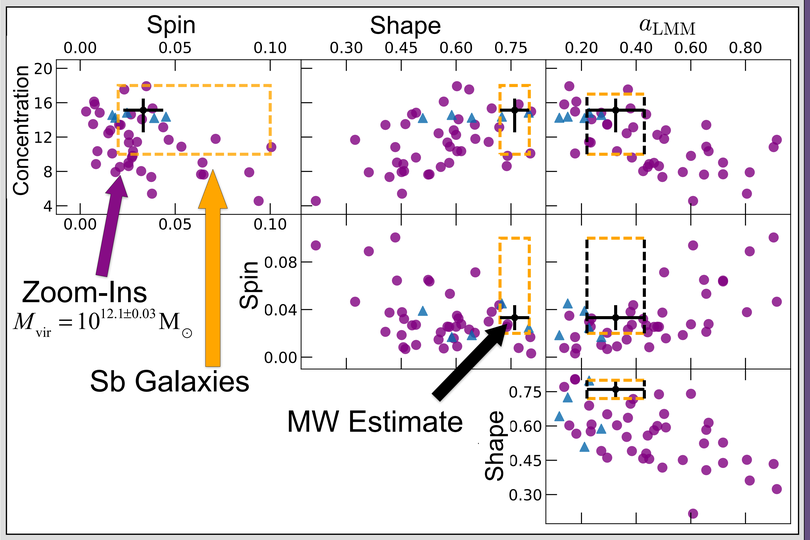
Subhalo abundances depend on a variety of halo properties , but the Milky Way's halo is not average for its mass.

Subhalo abundance depends on a variety of halo properties, especially concentration (cf. Mao et al. 2015).



High Concentration → Low Concentration

Milky Way vs. Simulated Halos

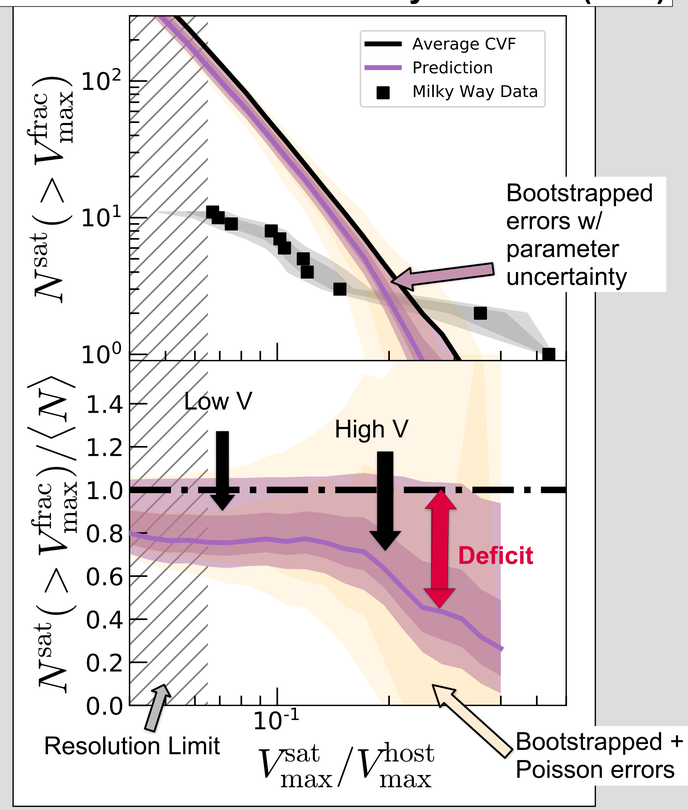


The Milky Way appears unique amongst halos of the same mass (Note: we account for adiabatic contraction).

Results

We have built power-law scaling relation models utilizing combinations of halo properties to predict the number of subhalos above a given velocity, based on simulations of Milky Way-mass halos.

1 Parameter Cumulative Velocity Function (CVF)



In models that incorporate the 1 or 3 most important halo properties, the predicted CVF for the Milky Way lies well below the average for the Milky Way-mass dark matter halos. 1-30% fewer satellitles at low velocities, and 19-52% at high velocities (68% confidence regions).

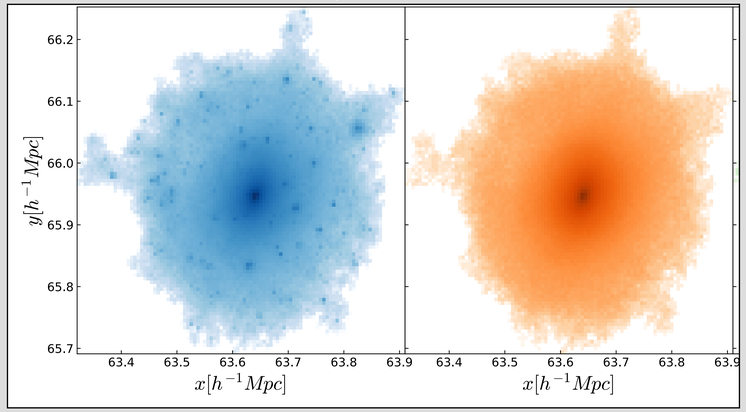
Conclusions

When developing models to explain the MW's satellite population (e.g., to address the missing satellites problem & too-big-to-fail), it is important to assume a host halo like the actual Milky Way's (not an average halo of the same mass).

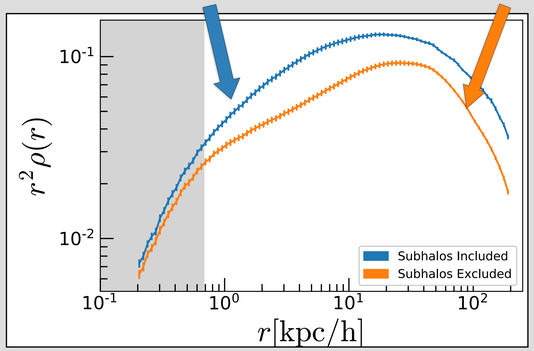
See our paper for details!

Side Note: Density Profiles

We explore density profiles for dark matter halos without their subhalos (mass profiles in simulations generally include all subhalo mass).



With Subhalos | Without Subhalos



We have identified analytic forms which fit the profiles well. Analysis is complete - keep your eyes on the Arxiv.

Sources: Allgood B., Flores R. A., Primack J. R., Kravtsov A. V., Wechsler R. H., Faltenbacher A., Bullock J. S., 2006, MNRAS, 367, 1781; Behroozi P. S., Wechsler R. H., Wu H.-Y., 2013, ApJ, 762, 109; Bullock J. S., Dekel A., Kolatt T. S., Kravtsov A. V., Klypin A. A., Porciani C., Primack J. R., 2001b, ApJ, 555, 240; Bullock J. S., 2010, preprint, p. arXiv:1009.4505 (arXiv:1009.4505); Klypin A., Kravtsov A. V., Valenzuela O., Prada F., 1999, ApJ, 522, 82; Licquia T. C., Newman J. A., Brinchmann J., 2015, ApJ, 809, 96; Licquia T. C., Newman J. A., Bershady M. A., 2016, ApJ, 833, 220; Mao Y.-Y., Williamson M., Wechsler R. H., 2015, ApJ, 810, 21, Moore B., Ghigna S., Governato F., Lake G., Quinn T., Stadel J., Tozzi P., 1999, ApJ, 524, L19; Navarro J. F., Frenk C. S., White S. D. M., 1996, ApJ, 462, 563; Peebles P. J. E., 1980, The large-scale structure of the universe