The First Homogeneous Measurement of the Evolution of the Luminosity Function of Galaxies in the Last 12.6 Billion Years

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Introduction

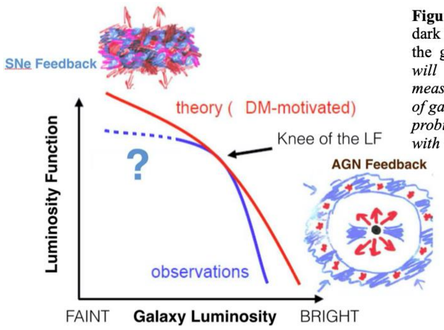
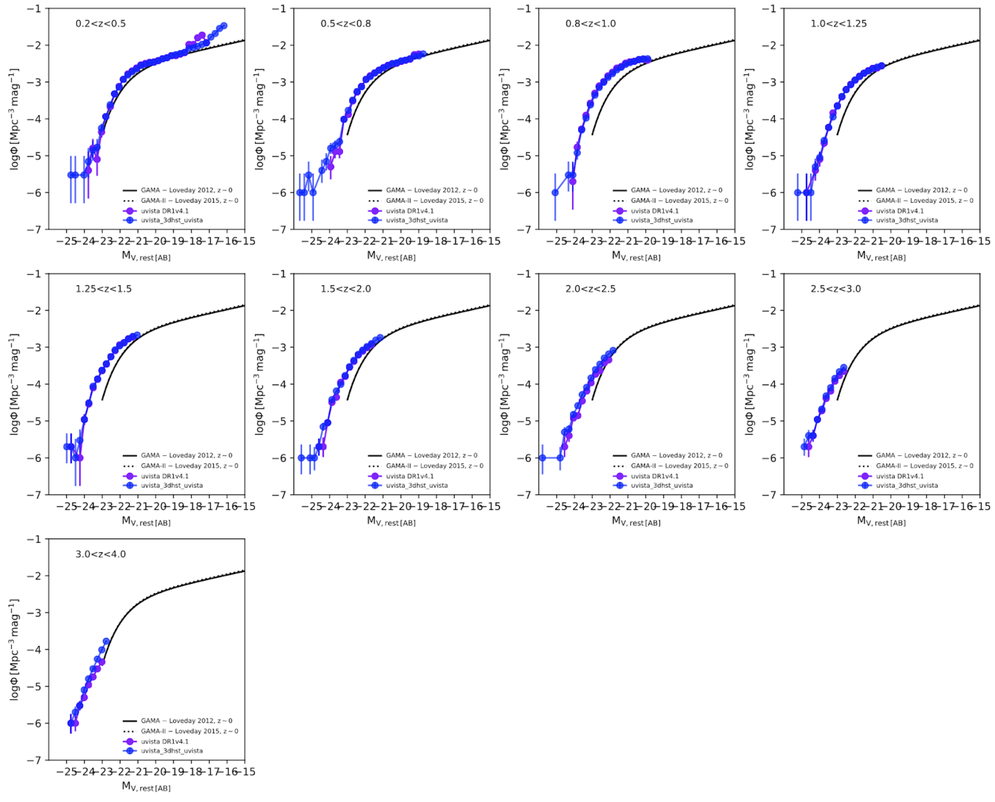


Figure 1: Comparison between the dark matter mass function (in red) and the galaxy LF (in blue). *This project will deliver the first homogeneous measurement of the evolution of the LF of galaxies over 93% of cosmic history, probing both the bright and faint ends with unprecedented statistics.*

Astronomers have inferred when the universe was an infant (380,000 years old), matter was not perfectly homogenously distributed. There were regions that were slightly denser than the average, and others slightly under dense. These perturbances over time caused matter to clump and collect to eventually form the stars and clusters of galaxies we see today.

The mean space density of galaxies per unit luminosity (i.e. Luminosity Function) is one of the most fundamental of all cosmological observables and basic descriptors of a galaxy population. The LF as a function of time provides insights into the physical process that govern the assembly and evolution of galaxies.

Results



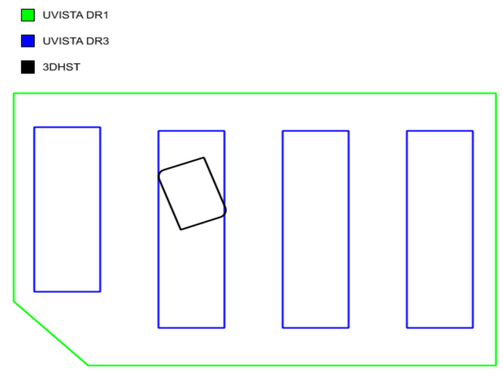
The LF in blue (above) is the combination of all three of the extragalactic surveys overplotted on the single survey DR1. It's clear to see we get more points in the brighter end, Mv<-24, after combining all three surveys, but aren't getting more points on the fainter end than the single survey DR1.

Future Work

The remaining work to do is include the Hubble Frontier Fields in order to capture more of the fainter end of the LF. After this, the figures will be polished and prepared for publication.

Method

Combining the extragalactic surveys, UVISTA DR1/DR3, CANDELS-3DHST, and HFF-DeepSpace, we're able to simultaneously probe the bright and faint end of the Luminosity Function.



The surveys are combined in "wedding cake" layers. After ensuring we don't have double counting in our catalogs, we use the Vmax method to calculate the LF.

$$\phi(M)dM = \frac{\sum_{i=1}^{N_g} N(M - dM/2 \leq M_i \leq M + dM/2)}{V_{max}(M)}$$

After finding the largest distance of an observed galaxy with absolute magnitude Mi and calculating the volume of the sample corresponding to that distance, we get Vmax. This volume for the galaxy is used to calculate the LF of all galaxies with absolute magnitude in the range (M, M+dM).