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Title

HERSCHEL-ATLAS GALAXY COUNTS AND HIGH-REDSHIFT LUMINOSITY FUNCTIONS: THE FORMATION OF MASSIVE EARLY-TYPE GALAXIES

Source

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Abstract

Exploiting the Herschel Astrophysical Terahertz Large Area Survey Science Demonstration Phase survey data, we have determined the luminosity functions (LFs) at rest-frame wavelengths of 100 and 250 mu m and at several redshifts z greater than or similar to 1, for bright submillimeter galaxies with star formation rates (SFRs) greater than or similar to 100 M(circle dot) yr(-1). We find that the evolution of the comoving LF is strong up to z approximate to 2.5, and slows down at higher redshifts. From the LFs and the information on halo masses inferred from clustering analysis, we derived an average relation between SFR and halo mass (and its scatter). We also infer that the timescale of the main episode of dust-enshrouded star formation in massive halos (M(H) greater than or similar to 3 x 10(12) M(circle dot)) amounts to similar to 7 x 10(8) yr. Given the SFRs, which are in the range of 10(2)-10(3) M(circle dot) yr(-1), this timescale implies final stellar masses of the order of 10(11)-10(12) M(circle dot). The corresponding stellar mass function matches the observed mass function of passively evolving galaxies at z greater than or similar to 1. The comparison of the statistics for submillimeter and UV-selected galaxies suggests that the dust-free, UV bright phase is greater than or similar to 10(2) times shorter than the submillimeter bright phase, implying that the dust must form soon after the onset of star formation. Using a single reference spectral energy distribution (SED; the one of the z approximate to 2.3 galaxy SMM J2135-0102), our simple physical model is able to reproduce not only the LFs at different redshifts >1 but also the counts at wavelengths ranging from 250 mu m to approximate to 1 mm. Owing to the steepness of the counts and their relatively broad frequency range, this result suggests that the dispersion of submillimeter SEDs of z > 1 galaxies around the reference one is rather small.