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Author

Dunne L. Gomez HL. da Cunha E. Charlot S. Dye S. Eales S. Maddox SJ. Rowlands K. Smith DJB. Auld R. Baes M. Bonfield DG. Bourne N. Buttiglione S. Cava A. Clements DL. Coppin KEK. Cooray A. Dariush A. de Zotti G. Driver S. Fritz J. Geach J. Hopwood R. Ibar E. Ivison RJ. Jarvis MJ. Kelvin L. Pascale E. Pohlen M. Popescu C. Rigby EE. Robotham A. Rodighiero G. Sansom AE. Serjeant S. Temi P. Thompson M. Tuffs R. van der Werf P. Vlahakis C. Herschel –ATLAS.

Title

Rapid evolution of dust in galaxies over the last 5 billion years

Source

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Abstract

We present the first direct and unbiased measurement of the evolution of the dust mass function of galaxies over the past 5 billion years of cosmic history using data from the Science Demonstration Phase of the Herschel-Astrophysical Terahertz Large Area Survey (Herschel-ATLAS). The sample consists of galaxies selected at 250 m which have reliable counterparts from the Sloan Digital Sky Survey (SDSS) at z < 0.5, and contains 1867 sources. Dust masses are calculated using both a single-temperature grey-body model for the spectral energy distribution and also a model with multiple temperature components. The dust temperature for either model shows no trend with redshift. Splitting the sample into bins of redshift reveals a strong evolution in the dust properties of the most massive galaxies. At z= 0.40.5, massive galaxies had dust masses about five times larger than in the local Universe. At the same time, the dust-to-stellar mass ratio was about three to four times larger, and the optical depth derived from fitting the UV-sub-mm data with an energy balance model was also higher. This increase in the dust content of massive galaxies at high redshift is difficult to explain using standard dust evolution models and requires a rapid gas consumption time-scale together with either a more top-heavy initial mass function (IMF), efficient mantle growth, less dust destruction or combinations of all three. This evolution in dust mass is likely to be associated with a change in overall interstellar medium mass, and points to an enhanced supply of fuel for star formation at earlier cosmic epochs.