Abstract

All measurements of cosmic star formation must assume an initial distribution of stellar masses " the stellar initial mass function (IMF) " in order to extrapolate from the star-formation rate (SFR) measured for typically rare, massive stars (> 8 Msun) to the total SFR across the full stellar mass spectrum. The shape of the stellar IMF in various galaxy populations underpins our understanding of the formation and evolution of galaxies across cosmic time. Classical determinations of the IMF in local galaxies are traditionally made at ultraviolet, optical and near-infrared wavelengths, which cannot be probed in dusty starburst galaxies, for which galaxy evolution models often predict an IMF biased towards massive stars.

The 13C/18O abundance ratio in the cold molecular gas "which can be probed via the rotational transitions of the 13CO and C18O isotopologues" is a very sensitive index of the IMF, with its determination immune to the pernicious effects of dust. We determine this IMF-type index for a sample of four dust-enshrouded starbursts at high redshifts, with ALMA observations, finding unambiguous evidence for a top-heavy stellar IMF in all of them. A globally low 13CO/C18O ratio for all our targets " alongside a well-tested, detailed chemical evolution model benchmarked on the Milky Way data" implies that massive stars dominate starburst events considerably more than in ordinary star-forming spiral galaxies. This can bring these extraordinary starbursts closer to the so-called main sequence of star-forming galaxies, though the latter may not be immune to such IMF changes, depending on their star formation densities.