Genesis of the dusty Universe: modeling submillimetre source counts

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We model the evolution of IR galaxies using a phenomenological approach to match the observed source counts at different IR wavelengths. We introduce a new algorithm for reproducing source counts based on direct integration of probability distributions rather than Monte-Carlo sampling. We construct a simple model for the evolution of the luminosity function and the colour distribution of IR galaxies which utilizes a minimum number of free parameters. Moreover we analyze how each of these parameters is constrained by observational data. The model is based on pure luminosity evolution and adopts the Dale & Helou SED templates. We find that the 850um source counts and their redshift distribution depend strongly on the shape of the luminosity evolution function, but only weakly on the details of the SEDs. We derive the best-fit evolutionary model using the 850um counts and redshift distribution as constraints. Moreover our best-fit shows a flattening of the faint end of the luminosity function towards high redshifts and requires a colour evolution which implies the typical dust temperatures of objects with the same luminosities to decrease with redshift. We compare our best-fit model to observed source counts at shorter and longer wavelengths which indicates our model reproduces the 70um and 1100um source counts remarkably well, but under-produces the counts at intermediate wavelengths. Analysis reveals that the discrepancy arises at low redshifts, indicating that revision of the adopted SED library towards lower dust temperatures (at a fixed infrared luminosity) is required. This modification is equivalent to a population of cold galaxies existing at low redshifts, as also indicated by recent Herschel results, which are underrepresented in IRAS sample. We show that the modified model successfully reproduces the source counts in a wide range of IR and submm wavelengths.

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