Extinction law in ultraluminous infrared galaxies at z ~ 1

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We analyze the multi-wavelength photometric and spectroscopic data of 12 ultraluminous infrared galaxies (ULIRGs) at z ~ 1 and compare them with models of stars and dust in order to study the extinction law and star formation in young infrared (IR) galaxies. Five extinction curves, namely, the Milky Way (MW), the pseudo MW which is MW-like without the 2175 Angstrom feature, the Calzetti, and two SN dust curves, are applied to the data, by combining with various dust distributions, namely, the uniform dust screen, the clumpy dust screen, the internal dust geometry, and the composite geometry with a combination of dust screen and internal dust. Employing a minimum chi square method, we find that the foreground dust screen geometry, especially combined with the 8 - 40 M_sun SN extinction curve, provides a good approximation to the real dust geometry, whereas internal dust is only significant in 2 galaxies. The SN extinction curves, which are flatter than the others, reproduce the data of 8(67%) galaxies better. Dust masses are estimated to be in excess of ~ 10^8 M_sun. Inferred ages of the galaxies are very young, 8 of which range from 10 to 650 Myr. The SN-origin dust is the most plausible to account for the vast amount of dust masses and the flat slope of the observed extinction law. The inferred dust mass per SN ranges from 0.01 to 0.4 M_sun/SN.

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