

Sub-millimetre properties of massive star-forming galaxies at $z \sim 2$ in SHADES/SXDF

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Abstract. We study the submillimetre (submm) properties of the following near-infrared (NIR)-selected massive galaxies at high redshifts: BzK -selected star-forming galaxies ($BzKs$), distant red galaxies (DRGs) and extremely red objects (EROs). We used the SCUBA Half Degree Extragalactic Survey (SHADES), the largest uniform submm survey to date. Since $BzKs$ are expected to include obscured star-forming galaxies at $1.4 < z < 2.5$, it is possible that the submm galaxies are a sub-group of $BzKs$. We identified 4 $BzKs$ as submm galaxies within 93 arcmin^2 by using high resolution radio images. This indicates that only $\sim 20\%$ of submm galaxies are $BzKs$. However, this fraction is consistent with the assumption that the most of submm galaxies at $1.4 < z < 2.5$ are $BzKs$, considering the redshift distribution, radio-detection rate and observed K -band magnitudes of submm galaxies. We found no submm detections for EROs which are clearly non- $BzKs$. We identify two submm-bright NIR-selected galaxies, which satisfy all the selection criteria we adopt; i.e. they belong to the BzK -DRG-ERO overlapping population, or ‘extremely red’ $BzKs$. Although these extremely red $BzKs$ are rare (0.25 arcmin^{-2}), about 10% of this population could be submm galaxies. With a stacking analysis, we detected the $850\text{-}\mu\text{m}$ flux of submm-faint $BzKs$ and EROs in our SCUBA maps. While the contribution from $BzKs$ at $z \sim 2$ to submm background is about $10\text{--}15\%$ and similar to that from EROs typically at $z \sim 1$, $BzKs$ have a higher fraction ($\sim 30\%$) of submm flux in resolved sources than EROs and submm sources as a whole do. Therefore, submm flux of $BzKs$ seems to be biased high. From the SED fitting using an evolutionary model of starbursts with radiative transfer, submm-bright $BzKs$ are found to have the stellar mass of $> 5 \times 10^{10} M_{\odot}$ with the luminosity of $> 3 \times 10^{12} L_{\odot}$. From an average SED of submm-faint $BzKs$ having similar $B - z$ and $z - K$ colours to submm-bright ones, we suggest that submm-bright $BzKs$ are more massive than submm-faint ones.

Keywords. infrared: galaxies, submillimeter, galaxies: high-redshift, galaxies: evolution

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