Near-IR dark objects: massive galaxies at $z > 4$

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The aim of this work is to explore if there are high redshift massive galaxies that can be unveiled with *Spitzer*+IRAC, but that are missed by the conventional selection techniques that have been applied so far to optical and near-infrared samples. For this purpose, we use the multi-wavelength imaging data available for the GOODS-South field, and we select a flux-limited sample from the IRAC 3.6 μm image. In order to identify the most extreme objects possibly missed by other methods and to complement previously published selections in this field, we confine our study to the galaxies undetected by the optical HST+ACS imaging and close to the detection limit of the K-band image ($K > 23.5$ AB). Our selection unveiled 20 galaxies on which we performed a detailed analysis.

Half of the sample galaxies show a robust photometric solution around $z \sim 4$. Their SED analysis suggests a post-starburst evolutionary status and large stellar masses around $M \sim 10^{11} M_{\odot}$, making these objects an interesting class of candidate progenitors for the most massive spheroids that are observed around $z \sim 2$. We have found that this class of galaxies may provide a substantial contribution to the mass function around $M \sim 10^{11}$ at $z \sim 4$. The remaining half of the sample shows degenerate/bimodal solutions for the photometric redshifts. These can be heavily dust-enshrouded ($A_V \sim 2 - 4$) starbursts at $2 < z < 3$ with bolometric luminosities $L_{IR} > 10^{13} L_{\odot}$, or, alternatively, massive post-starburst galaxies in the redshift interval $4 < z < 9$ and with stellar masses $M > 4 \times 10^{10} M_{\odot}$.