High redshift galaxies unveiled by lensing clusters at millimetre wavelengths

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During the cosmic noon epoch ($z \sim 2$–3), the intense star formation activity of high-redshift galaxies enriched their interstellar medium with large amounts of cold dust. As a result, a significant fraction of their UV and optical starlight is absorbed and re-emitted at millimetre wavelengths, making their dust emission observable. Observations at these wavelengths are therefore particularly powerful: deep single-dish surveys allow the detection of dusty star-forming galaxies while simultaneously probing galaxy clusters through the Sunyaev–Zel'dovich (SZ) effect. In this context, the LPSZ project observed a sample of 38 mid-redshift galaxy clusters ($0.5 < z < 0.9$) at 1.2 and 2 mm with the NIKA2 camera on the IRAM 30 m telescope. As a by-product, these observations led to the detection of 260 point-like sources at 1.2 mm, supposedly located at higher redshift. Compared to the expected number counts, we find an excess by a factor of ~ 2 within 45 arcsec of the cluster centres. We quantitatively interpret this excess as the result of strong gravitational lensing induced by these massive foreground clusters with mass between 10^{14} and 10^{15} $M_\odot$. This lensing effect magnifies background galaxies, and can produce multiple images, therefore increasing their observed flux densities. To quantify this lensing contribution and model the expected magnification bias, we constructed simulated galaxy–cluster lensing systems by combining the SIDES simulations with the Lenstool software. This approach enables us to constrain the lensing properties and the evolution of dusty star-forming high redshift galaxies at millimetre wavelengths. We complement this study with interferometric follow-up observations using NOEMA, enabling the study of dust and lensing properties of a sub sample of the detected point-like sources, in order to find the redshift of these galaxies.