Dusty Gems: Zooming in on the most intensely star-forming regions in the early Universe found with Planck and Herschel

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Résumé

The brightest, most strongly gravitationally lensed sub-millimeter galaxies on the sky offer a unique opportunity to study individual star-forming regions in high-redshift galaxies on scales of few 10s of pc, small enough that the large-scale galaxy kinematics no longer stabilize the gas (e.g., through rotational "Toomre" support). What is the impact of feedback, turbulence, high gas and stellar mass surface densities on the intense star formation in these galaxies? How are galaxy growth and star formation connected? Is there a distinct 'high-redshift mode' of star formation?

Through a unique synergy of the Planck sub-mm all-sky survey and Herschel/SPIRE photometry, we have collected a small, but exquisite set of the 10 most strongly gravitationally lensed sub-mm galaxies on the sky. Their 350-micron fluxes are all in the sub-Jy and Jy regime, with up to S_350=1070 mJy, several times brighter than the typical "Herschel" and "SPT lenses". All are spectroscopically confirmed. On the example of our first source with sub-arcsec-resolution CO interferometry, Herschel PACS and HIFI spectroscopy, and multi-wavelength optical-to-FIR and sub-mm/mm photometry, I will present early results of our program and outline how these observations will boost our understanding of the most intense star formation in the early Universe. This lens is an exquisite pair of a spatially resolved merger and a well resolved, 4" long giant arc, both at z=2.6. In spite of the intense star formation, the gas in the arc is remarkably quiescent, with a velocity gradient of 100 km/s and multiple line components with widths akin to those in GMCs in the Milky Way and nearby galaxies. I will discuss implications of these
findings for our understanding of star formation in the early Universe.

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